AMATEUR WORK

CONTAINING
ILLUSTRATED ARTICLES DESCRIPTIVE OF ELECTRICAL AND
MECHANICAL APPARATUS, FURNITURE AND OTHER
USEFUL ARTICLES, GAMES, PHOTOGRAPHY
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ETC., ETC.

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AMATEUR WORK

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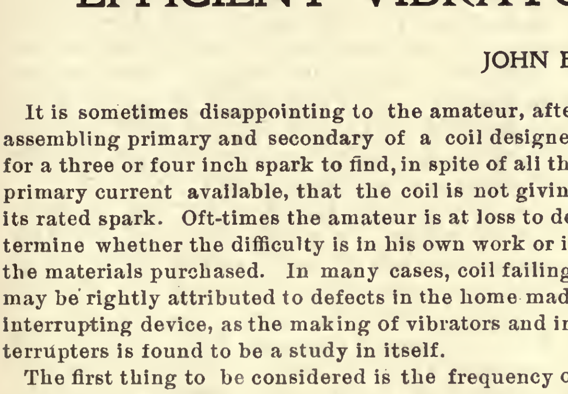
EFFICIENT VIBRATOR FOR SPARK COILS.

JOHN E. ATKINS.

It is sometimes disappointing to the amateur, after assembling primary and secondary of a coil designed for a three or four inch spark to find, in spite of all the primary current available, that the coil is not giving its rated spark. Oft-times the amateur is at loss to determine whether the difficulty is in his own work or in the materials purchased. In many cases, coil failings may be rightly attributed to defects in the home made interrupting device, as the making of vibrators and interrupters is found to be a study in itself.

The first thing to be considered is the frequency of vibration or, in other words, how long shall the spring of the vibrator be, and with a certain length what will be its speed? Any amateur who has experimented with spring metal or even whalebone, understands that with a certain thickness and width of spring metal, the longer the piece in vibration the slower its speed and



vice versa, the shorter the piece the faster it vibrates. Presuming that we have a piece of thin spring-brass in use as a vibrator, consider that the piece vibrates 700 times a minute. Then, with proper platinum contacts, the primary current is interrupted in its progress through the primary winding just 700 times each minute. Now 1-700 of a minute seems a very small period of time to measure, and it is at first difficult to perceive how any good can come from such a brief contact, and in the majority of vibrators using two platinum contact points, this is about the limit for maximum results from a winding, unless the secondary in use is wound for a much greater spark capacity and then underrated, which is, of course, a waste of fine wire. Small coils, such as ¼ to ¾-in. sizes, permit of a much faster vibrator, and on auto coils the speed is often 1000 and higher.

It must be borne in mind that the writer speaks of vibrating interrupters, and not of rotary and other forms involving other principles of interruption.

It will be found by experiment that there is a certain speed of interruption best suited for each coil, and with the assistance of the following description and diagrams the amateur should be able to get one-fourth to one-half more spark capacity out of any home-made coil, than where a core-actuated movement is brought about by a separate or independent electro-magnet in series with the primary winding.

The first requisite is a base-board of ½-in. stock, white-wood or mahogany, size 4 by 7 in. The electro-magnet is of ⅝ in. soft iron, 3 in. long, drilled and tapped at one end for an 8-32 machine screw by which the magnet is attached to the base board. The fiber washers are 1 in. in diameter. This magnet is wound with No. 20 double cotton covered wire. The vibrating spring is of No. 20 gauge steel or spring brass, ½ in. wide and 3½ in. long. The ham er head is of iron, ¾ in. wide and ⅜ in. thick, soldered or pinned to one end of the spring. The other end of the spring has a ⅛ in. hole for affixing to the standard by means of a long machine screw that passes through a hole in the standard through the base board, where it is held securely by a nut. The hammer head is now ¼ in. clear and above the top of the electro-magnet. The standard above mentioned is cut from a piece of ⅜ brass rod.

The contact-screw supports consists of a stout strip of brass rod affixed to two upright rods in a manner similar to the spring support. One platinum point is set into or soldered to the contact-screw. The other platinum point or stud is not soldered to the spring itself, but to a thin spring of brass riveted to the vibrating spring. (See sketch.)

The purpose of this method is to supply means of giving an instantaneous break to the interruption The value of the ascendency spark depends considerably on this quickness of break. In operation, the hammer head is attracted toward the magnet and has travelled nearly a 64th of an inch, and is going very fast when the platinum spring is "kicked" by the stud borne by the vibrating spring, and released from the set-screw contact. This break is far superior to any other simple method and should be adopted for all home vibrators.

In making coil connections, one terminal of the magnet coil goes to the terminal of the primary winding. The other terminal of the primary is connected to the battery. The other side of the battery goes to the vibrator post. The second end of the magnet coil goes to the contact. (See diagram.)

The condenser to be used on this vibrator is connected, one terminal to the contact screw and one to the pillar post. The capacity of this condenser is ascertained by experiment. It is assembled, not by mathematical calculation as to micro-farads, but is built up until the condenser seems to produce the best secondary discharge. Every amateur knows that a condenser is necessary to get a spark, but not every one understands fully its functions. One thing is certain, by a careful adaptation of the condenser, the *best* secondary spark will be obtained when the platinum point spark is *almost* at a minimum. Too much condenser will reduce this contact point sparking to nearly nothing, to the detriment of the secondary results. It will therefore be seen that too much condenser is a harmful possibility; also a poorly constructed condenser is injurious and, furthermore, there never yet has been a coil vibrator of a reliable sort but there is some sparking at the points, and while this sparking in the laboratory is of little consequence, on a power boat or an auto it is a nuisance, and coil manufacturers look more to the efficiency of their vibrator, as regards minimum sparking and consequent non-welding of platinum contacts, than to any other detail of coil construction.

It is the writer's belief that the foregoing interrupter is applicable to almost any battery coil giving three and four inch sparks. The design furnishes excellent opportunity for adjusting the length of the vibrations by merely drilling long slots in the spring and in the base board so that the pillar-post may be brought nearer the magnet.

ACETYLENE GAS ENGINES.

J. K. RUSH.

Until recently it has not been practical to use acetylene for gas engines, owing to the fact that but very few acetylene generators generate acetylene at a temperature low enough to obtain a purity of gas or quantity sufficient to bring about the practical use of acetylene in an engine, but there are some generators producing acetylene of a sufficiently low degree of temperature to bring about a purity of quality and increase of volume of acetylene to such an extent that cooking and heating with acetylene has not only been made practical and profitable to many who are now using acetylene, but its use is now applied very practically to engines, which have been formerly used with gas and gasoline.

Of course, engines used for this purpose are especially constructed, owing to the fact that a much smaller quantity of acetylene is required, when properly mixed with oxygen, to bring about good results in an engine than is used when coal gas is applied.

An engine of this kind may be applied for running various kinds of machinery for factory purposes and the generator used for furnishing acetylene for heat, light and power. The heat may be used in the laboratory, the light for illuminating the entire premises, acetylene as applied to the engine, power for the entire institution—all supplied from one source.

The advent of the acetylene engine in the field of active industry will be a great boon to the trade generally, inasmuch as in many places acetylene generators will be purchased strictly for the sake of obtaining the gas for power purposes.

A country home or estate may now be fitted out with an acetylene plant, whereby the lighting of the buildings, as well as the grounds, is supplied from the machine, acetylene for heating and cooking purposes in the culinary department and hot water heating appliances in the bath room. The acetylene engine can be used for the purpose of forcing water through pipes in the most modern manner possible to conceive of, thus supplying the suburbanite with all the luxuries of city life so far as these particular items are concerned.

It is very interesting indeed to know the various uses to which acetylene is being applied. There is hardly a day at the present time but what some new application is made of this valuable combination of carbon and hydrogen.

We see it in use on all up-to-date automobiles, launches, bicycles and many other similar uses, where the very brightest and best results are desired by way of illumination.

Now, since the acetylene engine has come into the field, it would not be at all surprising to see within the next year at the automobile show, an automobile propelled as well as illuminated with acetylene.

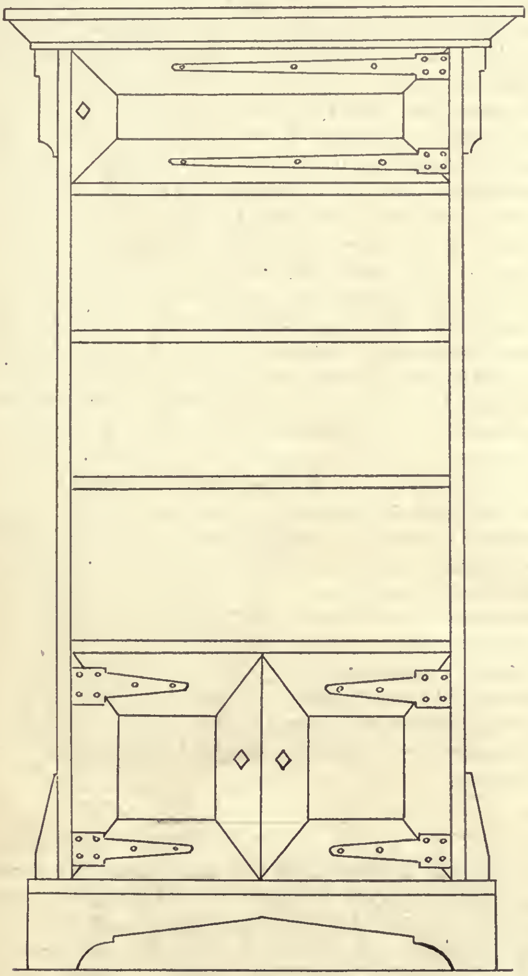
Many theories, which have practically succeeded only in imagination until a year ago, are in actual use today, and acetylene is applied in many and varied ways little thought of two years ago.—"Plumbers' Trade Journal."

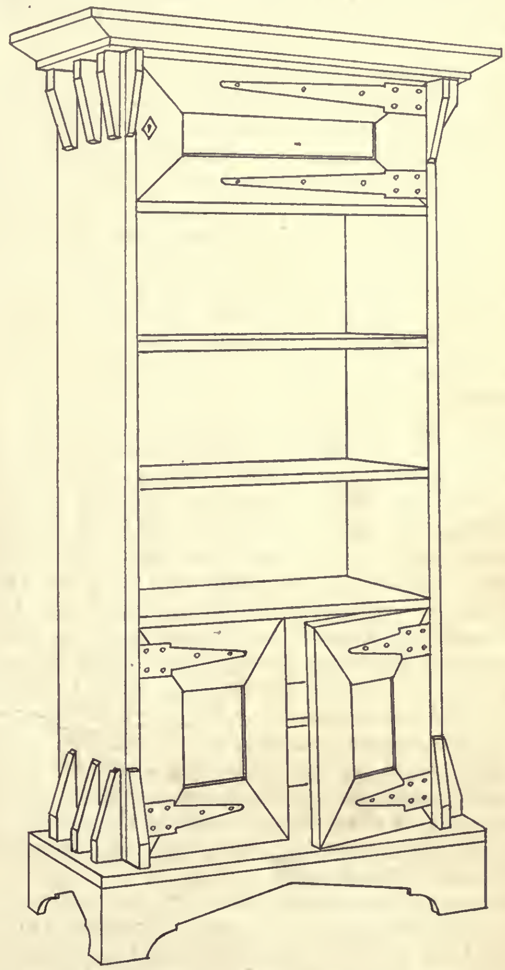
Emery paper and cloth are made by dusting finely ground emery upon paper or cloth coated with thin glue.

A MAGAZINE CABINET.

JOHN F. ADAMS.

About every one, in these days of magazines, regularly receives several magazines, some of which are kept on file, and to which reference is made at frequent intervals. To such readers a stand like the one described will prove of great convenience, the addition of the two cupboards providing room for magazines of less attractive appearance. The design also makes it suitable for both books and magazines, and would be a nice addition to a boy's room, or for a student's room it would contain both books and papers required in study. The stock used througbout is ⅞ or ¾ in. thick, except the panels, which are ½ in. thick.





The two side pieces are 56 in. long and 19 in. wide. The pieces underneath the lower cupboard and above the upper one are 31 in. long and 13 in. wide. A moulding can be added around the top, as shown in the illustration, or it may be omitted, but as it adds to the appearance, should be put on if the maker has the time for it. A piece of 3 in. moulding 6 ft. 3 in. long will be required, as allowance must be made for the mitred corners.

The front piece at the bottom is 31 in. long and 5 in. wide; the two ends are 13 in. long. The corner joints should be mitred. Ornamental openings are cut out as shown in the illustrations. The board between these pieces and the lower cupboard is nailed through with wire nails, and at the back a piece 3 in. wide is nailed under the flatboard to support the weight of the stand which is nailed to the platform just described.

Four pieces 25 in. long and 8½ in. wide are needed for the shelves, the one above the cupboard being 15 in. above the platform, the next shelf 10 in. above; the remaining shelf and the one under the upper cupboard are each 9 in. apart. The front edges of all the shelves are placed flush with the sides, leaving ½ in. at the back for the sheathing. The shelves are nailed in place through the sides. A stronger and more durable way of putting in the shelves, is to cut grooves ½ in. deep in the sides, in which case the shelves should be 25½ in. long.

An additional shelf for the lower cupboard is 25 in. long and 9 in. wide. After putting the frame together and adding the shelves, the back, of matched sheathing, is put on, first attaching with screws strips 1 in. square to the platform board and top board, setting same in ½ in. The sheathing should be 55 in. long and enough pieces are needed to make up the width of 25 in.

The eight ornamental blocks at the bottom are then cut out and nailed and glued in place. They are 7 in. long and 1½ in. wide at the bottom. The eight similar pieces at the top are of the same size, and may be the same in shape. These can be cut out at the mill if patterns are provided with order, and this is recommended to those not having the use of a band saw, as sawing them out by hand means considerable hard work. The spacing is as follows: At the sides the two outside ones are ½ in. from the edge of the sides and the center one midway between these two. Those at the front are added to the sides, glueing them in place as well as nailing.

The upper cupboard is fitted with one, and the lower with two doors. They are all constructed after the same fashion of halved and mitred joints as follows: The rails are cut off to the proper mitre, planed smooth, and the stiles are then marked on the front face to the corresponding mitre. Both rails and stiles are then halved to a good fit, the overlapping parts of the stiles being at the back and not showing at the front. A rabbet is cut all around the inner edges to receive the panel. When finally cut and fitted, the joints are glued up and put between clamps until the glue is dry. The panels are then put in and fastened with small nails or screws. This method of putting in the panels gives a flat surface to the whole back of the door. Another way, if one has a grooving plane, is to cut grooves in the door frame and at the panel in the grooves, using stock for panels somewhat thinner than with the first method.

The dimensions for the doors are as follows: upper door, rails, 25 in. long and 3 in. wide; stiles, 9 in. long and 3 in. wide; panel, 19½ in. long and 3½ in. wide. For the two lower doors, stiles, 15 in. long and 3 in. wide; rails 12½ in. long and 4 in. wide; panel, 7½ in. long and 4 in. wide; panel, 7½ in. long and 7 in. wide. The illustration shows fittings of ornamental hinges, which should be of black iron, if same can be made or purchased, but as such fittings are not to be found on sale in most cities, oxidized brass ones may be substituted, in which case the reader can make them up rom strip brass if not readily purchased. The real hinges are of the ordinary kind, hung in the jamb of the door, the ornaments being separate pieces added after the wood has been fully finished. Nothing has been said about finish, this being the usual dark stain and a wax finish.

ACETYLENE BLOW-PIPE.

An acetylene blowpipe is described in the "Mechanical Engineer," London, due to one Fouche. This tool consists of a flame of acetylene gas blown in the usual way with a blowpipe, but with oxygen gas, so that the resulting temperature is enormous because the flame contains no inert dilutent nitrogen. Such a tool should be of very great service in the workshop, and also in the field. By its aid a broken locomotive frame could be welded. It should be useful at sea for repair work, and in many ways it will prove of service. The apparatus is simple and consists of a supply of the two gases, a suitable water seal, and the blowpipe. A rod of pure iron serves as a soldering-stick or making up supply. It is said that some of the carbon from the flame combines with this pure iron and converts it into mild steel. The superiority of the acetylene-oxygen flame over the oxhydrogen flame lies in the fact that for each cubic metre of oxygen there are theoretically required two cubic metres of hydrogen, but the flame produced is so oxidizing that practically it is necessary to employ a double quantity of hydrogen. Theoretically, two and one-half volumes of oxygen are required for each volume of acetylene, but in practice only 1.7 volumes of oxygen are used. The flame of acetylene is much less diffused, and the heat is therefore better applied, and less is wasted in heating up surrounding metal needlessly. Thus, for the two mixtures, the heat per cubic metre will be: for acetylene 5338, for hydrogen 2473 calories. These and other considerations are said to account for the fact that ten times as much hydrogen as acetylene is required for a given piece of work, or one and a half times as much oxygen.

Sulphite of aluminum is a compound that can successfully be used in making wood fireproof. When strongly heated this compound leaves an infusible and non-conducting residue to cover and protect the cellular structure throughout the wood. It absolutely prevents the propagation not only of flame, but even of a glow because of its non-conducting and unalterable character. Sulphate of aluminum in concentrated solution is far more efficient than an alum solution; in fact, it would seem as if the alkaline sulphate of the alum simply detracted from the power of the aluminum sulphate in the matter of making wood fire resistant.

IMPORTANCE OF TRADE SCHOOLS.

To be educated, in days gone by, meant simply to have one's mind stored with information gleaned from books. To be taught how to make a practical application of knowledge was not considered necessary. Modern thought concerning education is very different from the thought of earlier years. Men have come to realize that to be symmetrically educated one must have mind, body and soul trained and developed.

Among the factors that illustrate the tendency of modern education, the trade school stands out prominently. It endeavors to combine the training of mind with that of hand and so to develop a symmetrically rounded character. At the meeting of the National Education Association held at Asbury Park early in July, Frank A. Vanderlip, vice-president of the National City Bank of New York, gave some excellent thoughts on the importance of trade schools, from which we present the following:

In the group of industrial nations there has come forward in recent years one that has taken a place in the very front rank among industrial competitors. It has reached a pre-eminent position in many special fields of industry, wresting from others the vantage they had long held in serene security. That nation is Germany. By the aid of rapidly developed skill and constantly improved methods, Germany has closed its own markets to the products of the manufactures of other countries. But Germany has done much more than that—it has developed an ability successfully to compete in the neutral markets of the world, until today it shows the greatest capacity in this field of international industrial competition that is displayed by any of the great nations.

In accomplishing this remarkable industrial success Germany has had little aid from nature to make the task an easy one. There has been no wealth of raw materials such as we Americans have had to aid us. There has been no vast homogeneous domestic market such as has been of vital importance in building up our manufactures. Her people have lacked the peculiar inventive ingenuity which in many fields of industry has been the sole basis of our achievements. Her artisans have possessed almost none of the delicate artistic sense which makes French handiwork superior to the obstruction of all tariff walls. Our industries were forced to grapple with English competitors entrenched behind a control and domination of the international markets which for generations have been successfully maintained. But amid this poverty of natural resources, and from among a people not signally gifted either with inventive ability or artistic temperament, there has in a generation emerged an industrial nation which stands forth, if we take into account the disadvantages against which it had to struggle, as a marvel of economic development.

I have had a somewhat unusual opportunity to study the underlying causes of the economic success of Germany, and I am firmly convinced that the explanation of that progress can be encompassed in one single word —the schoolmaster. He is the great cornerstone of Germany's remarkable commercial and industrial success. From the economic point of view the school system of Germany stands unparalleled. The fundamental principle of the German educational system is, in large measure, to train youths to be efficient economic units. In that respect the German system is markedly at variance with the present devolpment of our own educational system. In the German schools the most important aid in the work of successfully training youths into efficient industrial units has come from an auxiliary to the regular school system. It has come from that division of instruction known as the trade schools. The German trade schools have been so designed that they supplement the cultural training of the common school system. They are devised to give instruction which will be practically valuable in every trade—in commercial and industrial calling. They are so arranged that their work supplements both the cultural training of the academic system and the technical routine of the daily task. These schools are the direct auxiliaries of the shops and offices. They have been the most powerful influence in Germany in training to high efficiency the rank and file of the industrial army.

The students in these trade schools, you understand, are youths who have completed the regular compulsory educational course and have gone out into the ranks of active industrial and commercial workers. The hours of instruction are so arranged that they fall outside of the regular hours of labor in shop or office. The curriculum is broadly practical. It includes the science of each particular trade—its mathematics or chemistry, for instance—and its technology. But it does not stop there. Principles of wise business management are taught. The aim is to prepare a student for the practical conduct of a business. He gains knowledge of the production and consumption of markets, and of the causes of price fluctuations. He is put into a position to acquire an insight into concrete business relations and into trade practices and conditions. Are not these aims worthy of our schools? What truer democracy can there be than to have a school system that will point the way to every worker, no matter how humble, by which he may reach a clearer comprehension of the industry in which he is engaged, and with the aid of this knowledge may rise to a position of importance in that industry?

Such an auxiliary system of trade schools will be available for the youth after he has left the direct influence of our present school system. There are in the United States ten million of population between the ages of fifteen and twenty years. Three-quarters of that number are not in attendance at any school. Here is a group of youths, seven and one-half millions in number, from which the students of such trade schools would be drawn.

The present generation of American youth, entering industrial or commercial life, is to encounter a new and in some respects a harder condition of affairs. The industrial life of this country has in a decade undergone changes more significant than has been encompassed before in a period of two generations. No one whose life has been largely in the classroom is likely to have comprehended fully the true significance of the development of the forces of combination—combination in the field of labor as manifested in the growing power of unionism, combination in the demand of capital as manifested in the trusts, concentration in the control of industries, in the subdivision of labor and the aggregate of wealth. The display of the forces of combination, equally significant in the fields of labor and of capital, has brought changed conditions in the problem of human industrial endeavor. The welfare of the people and the position which our country is to maintain among nations, both depend on no single thing more than on the recognition of these changed conditions by our educators. You must provide the educational requisites which these changed conditions make imperative.

The forces of combination—the labor unions and the trusts—are united and working in harmony to accomplish at least one thing. They are united in a tendency to make of a great percentage of our population commercial or industrial automatons. They both tend to sub-divide labor, and thereby limit the opportunity to acquire a comprehension of broad principles. They both tend to circumscribe the field of the apprentice, narrowing his opportunities, forcing him into petty specialization and restricting his free and intelligent development. All this is placing us in grave danger of evolving an industrial race of automatic workers, without diversity of skill, without an understanding of principles, and without a breadth of capacity. There is but one power that can counteract that tendency—that power is the schoolmaster.

These youths, who can gain from their daily work only that narrow routine technical experience which in the main is all that the conditions of modern industry offer, have a right to demand something more. They have a right to demand the opportunity for a practical education. As modern conditions narrow their technical training, those same conditions broaden the opportunity for the man who does acquire knowledge which will give him a grasp of more than a single detail of his business. I believe it is your duty to provide schools which will supplement the routine of the day's work, schools which will give to these youths a comprehension of the relation of the narrow daily task to the broad industry, schools that will supplement such cultural training as our present system has provided with practical knowledge of immediate and valuable application, schools that will counteract the discouragement and monotony of the daily round of toil and create in their stead some enthusiasm for work, build up a love of labor by showing an intellectual side to what was before blank mechanical routine.

OIL IN BOILERS CAUSE OF FAILURE.

That many of the so-called mysterious collapses of furnaces in apparently clean boilers is due to the presence of oil is the contention of an English engineer. He maintains that if the surface of the furnace in a boiler for 200 pounds pressure is kept clean, the temperature of the metal will never reach the point at which the original tensile strength will be appreciably reduced, even under high rates of evaporation. If, however, the surface is simply rubbed over with an extremely thin coating of mineral oil, the temperature immediately rises to over 650° with a moderate evaporation. It, therefore, follows that if a mere coating of oil of inappreciable thickness raises the temperature of the metal beyond the limit of safety, an extremely thin scale or deposit containing a high percentage of oil will inevitably result in dangerous overheating. He accounts for the fact that practically no oil is ever present in the harmless looking deposit found on the crown of collapsed furnaces by the theory that the temperature of the plate has been so high as to drive off the oil by distillation, and maintains that if the deposit were scraped from other parts of the boiler it would never fail on analysis to afford a solution of such accidents as are termed mysterious by those who do not realize the dangerous effect of a slight coating of oil.—"Chicago Tribune."

There is much that is somewhat mysterious about the explosion of nitro powders, gun cotton and other high-grade explosives, but it is agreed by all careful observers that when nitro powder is surrounded by a medium such as air, water or rock, the explosive force is exerted equally in all directions, but manifests itself chiefly in the direction of the least resistance. That is, if a blast is formed in a drill hole the gases formed by the explosion in their efforts to escape, will tear away a portion of the rock surrounding the drill hole. When dynamite is placed on top of a rock it will shatter the rock if it be not too large. If the same amount of powder is placed under the rock and in contact with it, it will also shatter the rock, showing that the explosive force is exerted in an upward as well as in a downward direction. The impression that many have that the explosive force of nitro-glycerine and dynamite is downward only, is erroneous.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

VI. Continued Testing of Lenses.

A few additional directions for testing will probably be of service to the reader.

My mirror was supported on a large board, the lower edge of the mirror resting on a ledge screwed to the board and deep enough to carry the screens as well. Both mirror and testing apparatus should be kept as firm as possible—a heavy tripod about 3 ft. high is convenient for the latter, and the observer can work sitting; while a stout easel forms an efficient support for the mirror. The mirror can also be suspended by a strap from a nail, and rest against the wall; but that plan does not give so much power of adjustment. The mirror may, with advantage, be at a somewhat lower level than the testing apparatus, so that the tube of the latter (which, of course, points to the center of the mirror) is inclined downwards.

While the best place in which to carry on testing is undoubtedly a long cellar or underground passage with a stone floor, excellent results can be got almost anywhere, provided sufficient care is taken: (1) That the temperature of the air is uniform as possible; this, of course, means no fire, and (2) that the floor is as free as possible from tremors. Dr. Common did the testing of his 5 ft. entirely out of doors and found the conditions excellent; and, in my own case, as I had no cellar or stone floor at my disposal, the testing had to be carried out on an upper floor of a "timber-framed" house. By using a combined screen, and keeping perfectly still, and making every one else do so, I succeeded in getting very concordant readings. The least movement of anyone else in the house made the image dance about in a surprising manner.

Having placed the mirror on some firm support, we arrange the testing apparatus so that the distance of the pinhole from the surface of the mirror is approximately equal to the radius of curvature—*i. e.*, twice the focal length—and so that the tube is pointed as accurately as possible to the center of the mirror. The pinhole is removed and the lamp lighted, and all light from the lamp is screened off as far as possible, except that issuing from the ½-in. hole and falling on the mirror, the room being darkened, of course. The lamp ought to be so adjusted in height that the brightest part of the flame is level with the pinhole, or the center of the larger hole, and draughts must be carefully avoided, or the illumination of the mirror will flicker in a disagreeable way.

The mirror is adjusted until the reflection of the flame is thrown back to the tube—this will take some time at first, as the image will be faint; but the difficulty is soon overcome by the use of a large sheet of paper and patience. A cap or disc of white card to fit the end of the tube will prove useful, as the image can be thrown on this, and when the paper cap is removed the light will pass through the tube as required.

The brass plate with the pinhole is now placed in position, and the observer looks through the tube at the mirror. If the head is moved back a few inches the image of the pinhole should be seen through the tube—and the testing apparatus may be moved about until the image of the pinhole is accurately centered.

We may now make a preliminary examination of the image of the pinhole with an eyepiece or, if the eyepieces are not yet procured, with a simple pocket lens. The apparatus must be moved to or from the mirror until the image can be brought into good focus, when, if the curve is fairly regular, the image should be sharp and well-defined. If the grinding and polishing have been carried out as recommended in my previous letter, the figure will probably belong to class A, the

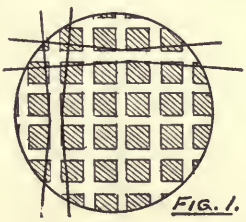


Fig. 1.

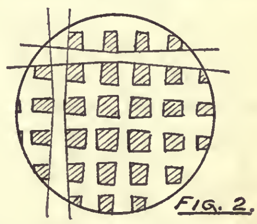


Fig. 2.

oblate spheriod; but if the stroke in polishing is too long, or the pitch too soft, it may tend to B or C. Whatever the appearance inside and outside the focus may be, one thing is essential: the image, both in focus and out of focus, must be absolutely circular and symmetrical. To judge of this the lens must be held accurately at right angles to the axis of the tube or distortion will be introduced, and it is better in every way to use a low power eyepiece which can be screwed into the tube. If one is not at hand a lens may be mounted in a paper cap to fit the tube.

If the image is not quite circular, the surface of the mirror is not a perfect "surface of revolution," and there is nothing for it but regrinding or starting afresh. Unless the curve is the same, whichever way it is taken across the mirror, good definition is quite impossible.

It is well, however, not to be in a hurry to condemn the mirror at the first glance. While I was working at the refiguring of my first 9 in., I used for a short time, to support the mirror, the back of a marble washstand—the mirror was therefore resting against marble which reached about 6 in. up its back. I was dismayed to find on testing, immediately atter polishing, that the image was hopelessly distorted and unsymmetrical. This, however, disappeared in half an hour or so, and the testing was quite satisfactory. The cause of the temporary distortion of the mirror was apparently that the mirror having been polished in a warm room had not had time to take the temperature of the much colder room where the testing was being done, and when the mirror began to cool down, the temperature of part of it in contact with the marble would naturally fall more naturally from being in contact with the upper part.

After examining the mirror roughly with the eyepiece—and it may be mentioned that the eyepiece test is not absolutely to be relied on, as many eyepieces have a certain amount of spherical aberration of their own which tends to make the mirror appear nearer to class A than class C—we may proceed to the screen test. Remove the lenses of the eyepiece and screw its mount into the tube. Then, with the eye a few inches behind the end of the tube, move the head from side to side and note whether the image and diaphragm in the eyepiece move relatively to one another. If they do, move the testing apparatus to or from the mirror until there is no relative motion, and then move it to the left so that the image is just not extinguished by the right-hand edge of the diaphragm. If now the eye is brought close up to the tube and the mirror viewed, it will be seen as it were flooded with light. Depress the left side of the baseboard by a gentle pressure of the hand, and the screen (the right edge of the diaphragm) will be seen to cut off the light from the mirror, the appearance being that described in Chapter IV. Care should be taken, of course, to have the screen exactly at the focus.

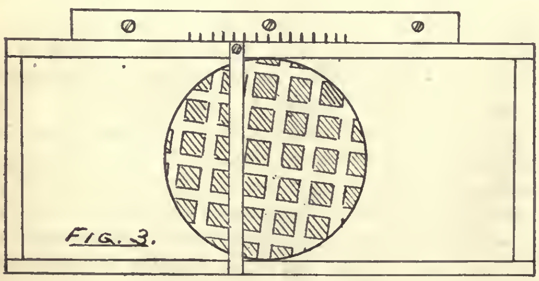


FIG. 3.

The figuring or alteration of the curve from A to B and then through C^1 to C^2 is to be managed. It is evident that we want to flatten the edge of the mirror so as to increase the focus of that part, or to increase the curvature of the center and so to decrease the focus thereof. The latter is the method I adopted, acting on the advice of the same kind expert who enabled me to perfect my first mirror.

It will be seen that if the polisher has its square the same size a'l over, the curve will, at any rate if the pitch is fairly hard and the stroke not excessive, tend to retain its "A" figure, or even, as I found, to show increase of the curvature at the edge as compared with the center, so as to make the A figure more pronounced—*i. e.*, the facets decrease in size uniformly from center to edge, and in consequence the work done by the rouge in abrading the glass in the center of the mirror is more than at the edge, with the result that the curvature in the center tends to increase relatively to that at the edge; or the mirror, in other words, passes from A to B and to C in succession.

Fig. 1 shows the polisher which up to to the present has been used. If now a series of inclined lines are drawn parallel to one another, as in the figure, starting from the edges of the central facet, and the pitch is cut away or trimmed off along those lines, we get a polisher like Fig. 2, which will produce the effect desired. The line along which the pitch is cut must be kept parallel, and a simple way of doing this is to use the instrument shown in Fig. 3. This simply consists of a frame of wood just wide enough to contain the polisher and rather more than twice the length, and deep enough to hold the crosspiece shown, clear of the surface of the polisher. By turning the polisher round on its center the crosspiece can be made to guide the chisel or trimming tool along the line of any inclination.

The amount of graduation should not be very great at first—as when once the figuring is commenced the alteration of figure is somewhat rapid—and it is of the utmost importance to spare no pains in constantly testing the curve as previously described. So long as no attempt is made to figure the mirror, and the facets are consequently of uniform size, the testing may be performed every hour or so; but when once the polisher is graduated, and the focus of the center begins to shorten, testing should be carried out after every twenty minutes' work, or even oftener; towards the end, five minutes' polishing may make all the difference between success and failure.

I ought to mention another method of measuring the focus of the different zones, as it was employed by Dr. Common for his great 5 ft. mirror of 28 ft. focus. He used, I think, 14 zones of different diameters, and each about an inch in breadth, and placed his testing apparatus in a sort of sentry-box 66 ft. away. Instead of using the screen, as above described, he measured the focus directly by focussing the image by means of an eyepiece. Of course the apparatus above described could be used in this way; but after trying the method I abandoned it on account of the great uncertainty about the focus of the central zone. The eye, mine at least, has such great power of accommodation for focus that the tube may be moved a good deal without affecting the sharpness of the image—this is also due to the very sharp angle at which the central rays converge—also many eyepieces have considerable spherical aberration, which is different, of course, for central and marginal zones, and which confuse the readings and adds a fresh source of error comparable with the aberration we wish to measure.

For this reason, when testing finally in the telescope, it is most necessary to use the eyepiece with which most work is to be done. A power of about 300 for a 9 in. mirror, and the eyepiece should be the very best that can be got.

If a low-power e. p. is used in testing in the telescope, the mirror, even if perfect, may show considerable under correction (class C or even B—*i. e.*, elliptic or even spherical), which may quite disappear with the ordinary working power. This matters little in practical telescopic work, as low powers are not usually employed on objects requiring critical definition. My first 9 in. mirror shows signs of under correction with an ordinary Huyghenian of 60 diameters; but an e. p. from my Voightlander prism binoculars, giving a power of 80, shows no signs of error whatever.

It will be seen that I attach considerable importance to the final testing in the telescope. This, I suppose, can be omitted by experts who have had great practice in testing; but I think it is best to have a tube and rough mounting ready as soon as the focal length of mirror is accurately known.

While testing on a star in the telescope it is very important to remember the distinction between the case of incident parallel rays (from a star) and of divergent rays (from a pinhole at the center of curvature). If the reader will look back to Chapter V, he will see that the appearance desired is that of Class B under the pinhole test.

There is no need whatever to silver the mirror when testing in the telescope; the flat should be silvered, but as a 9 in. unsilvered mirror gives enough light to show the companions to Polaris and Rigel, there is ample light from a 1st or 2nd mag. star.

RUSH CHAIR SEATING.

ARTHUR MAETKZER.

The use of rushes for the seating of chairs, settees, etc., is gradually gaining favor in the public taste, and although a large number of people are erroneously of opinion that this class of work is a modern idea, it is, in reality, an old style revived.

Morning-room suites and bedroom chairs are, perhaps, the most favored kinds of furniture upon which rushes are used, although occasional chairs are often found nowadays with this class of seat. The form or pattern of rushing appears to be made up of four sections, each of which, in the case of a square seat, appears to come to a point in the center, and in a rectangular shape, presents a pointed appearance in the two side sections, and a flat edge in the case of the front and back sections, although in reality the whole of the work is one piece, the divisional lines being formed in the process of weaving. The material used is of various kinds, the most common being ordinary rushes, which are greenish brown in color, and are very strong. In the more high class work fancy grasses are often used, these being covered with a fine strand of color, which gives the work the appearance of having been seated with a fancy cord.

Success depends entirely upon the evenness and shape worked up, as the actual weaving is extremely simple. The legs of chairs to be rushed project from ¼ to ½ in. from the level of the seat rails, and it is usual, although not absolutely necessary, to run a bead of polished ½-in. wood from leg to leg on the outside edge of the chair frame, such bead being run over the rush. This course, besides forming a pleasing finish to the outside edge of the seat, precludes the possibility of the rush shifting by constant use. Where the common rushes are used they should be steeped in water before being used as, being brittle, when dry they will not stand the amount of handling necessary unless so treated.

In Fig. 1 we have a diagram of a square seat frame, showing the method of weaving the rushes; and although, for purposes of illustration, the strands are represented as being loose, they are, of course, in actual practice kept close to the framework. Before entering into the details of the weaving, it will be well to mention that whenever the rushes run on the top of

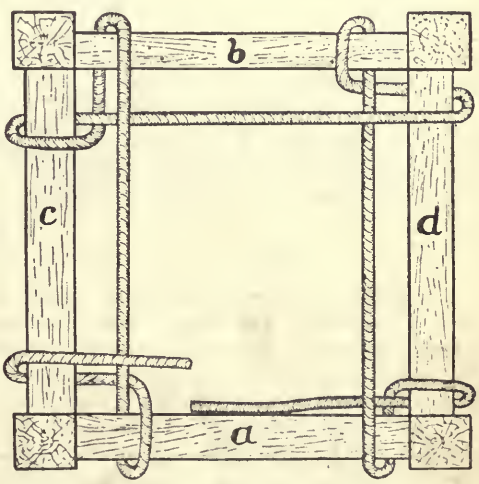


Fig. 1.

the seat they have to be twisted into the form of rope, such twisting being done as the rush is brought to the surface. Although at first this operation may prove somewhat difficult to accomplish, as the worker gains dexterity with his fingers he will find it quite easy.

Where the chair frame has to be repaired or polished, this should be carried out before the rushing is done, but in polished work the final spiriting can be left with advantage until the seat is filled in.

The chair and rushes being ready, a start can now be made in the direction of the weaving, and during the working of the initial stages it will be well to make a careful study of Fig. 1. On the inside of rail *A* fix, by means of short clouts, the free end of a piece of rush; carry same under *D*, close to the leg, and bring up on the top of this rail; at this point the twisting has to be done, but as this process has already been mentioned further reference will not be necessary. Now run the material under rail *A*, bring out on top, and take it right across to the underneath of rail *B*, coming over the rail and thence to under *D*. The rush now comes over *D*, and right across to *C*, where the under-and-over process should be repeated, and the stuff taken round the left-hand side of *B*. From here we run to *A*, and back to *C* again, another long run being taken

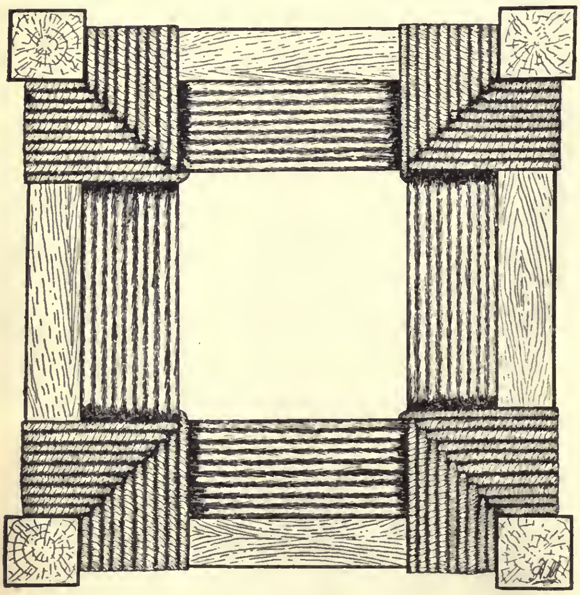


Fig. 2.

to *D*; and the same process is continued from rail to rail until the whole of the seat is filled in. As the seat is covered the long strands are hidden from view, although, of course, part of them form a certain portion of the top surface. In Fig. 2 we give a copy of Fig. 1 with a quantity of rushing done.

In practice it will be found that chair seats are often more or less rectangular in shape, and that when the sides are filled in there is an open gap in the center of the seat, running from back to front which cannot be filled in according to foregoing instructions. At this point, which for convenience, we will presume is where the rush has come over *D* and is returned to the underneath of *A*, Fig. 1, a different form of weaving has to be brought into requisition. Ascertain the center of the long strands, and pass the rush over the rail *A* and right through the center of the seat; run it underneath to rail *B*, bring up to the top, continue to the center and take through to the underneath. Run it over *A* and thence through to the bottom, coming over the back and up to the surface again, continuing this process until the whole of the remaining open portion of the seat is filled in, see Fig.

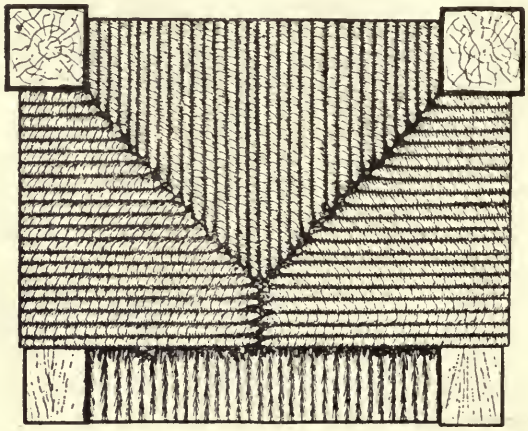


Fig. 3.

2. It will be seen that we have now got the rushes from center of seat to back, and also from center to front. Were the seat composed of rush only, it would not be possible to work up any sort of shape in the sections; and in order to get over this difficulty, a small quantity of flock or, what is better, the "rugging" used by upholsterers, is packed between the layers of rush from time to time as the seat is filled in. In packing the seat up, care should be taken to obtain a good

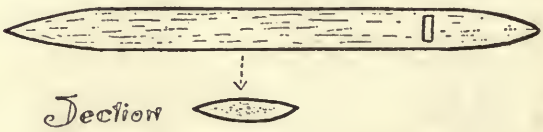


Fig. 4.

"sweep," the highest point being in the center of the sections. Where joints have to be made in the material, they can be made either by tying the ends of the rush together, or by tucking between tightened strands; but if the latter course is adopted care should be taken to ensure their being securely fastened.

Where shaped seats are to be rushed, it will generally be found that they work up without any particular difficulty, and should the back get filled up before the front, work the rush a bit tighter on the back rail. The seats of armchairs and settees, although larger in size than those of standard chairs, are worked up in the same manner, although rather more "swell" can be allowed when inserting the stuffing material.

A very pretty and effective material for rushing is that known as Canary cane, which is imported into this country from Madeira. It is of the fashionable biscuit or yellowish ecru color, and looks remarkably effective in combination with a dark mahogany or ebonized framework. In working this cane, great care should be taken to see that it is made thoroughly pliable by soaking before it is used. Do not use the cane too thick, and see that the surface is not dirtied or damaged in working up. Fine manilla rope is another material which is utilized for rushing seats, and although, correctly speaking, this is not rushing, it forms a very good seat, but has to be thoroughly well packed between the surfaces with rugging, as there is not nearly so much resistance in this material. Where long lengths of stuff are used, it will be found much more convenient to wind it round a stick so as to do away with the pulling of the whole length through every time a turn is made.

There is another pattern of rushing which, although not very largely favored, is sometimes used, the surface of which, being made up of crossed strands of material, presents a chequered appearance. The seat having been freed of the old rush, run a series of fairly loose strands from side to side of the chair seat, taking them first over the top, and then underneath until the whole of the seat is filled in one way. In putting on these first strands it will be necessary to fix them at each end on the outside edge of the seat rails, otherwise they will get mixed up and be difficult to work. Keep the underneath rushes fairly tight, as it will not be necessary to lace these as much as those on top.

The next step is to put in another series of strands running from back to front of seat, and to do this we shall require the services of a wooden needle, which can be made from a piece of boxwood about 7 x ½ x ⅛ in. thick. Fig. 4 shows shape of needle. The second lot of rush will have to be laced as it is put in. Start from the front and, with the aid of the needle, thread the material over four of the loose strands, under the next four, and so on, until the back is reached. Now pull tight and work up to the side framing, and thread the rush through one or two of the under strands when bringing it back to the front from the underneath of seat. Four rows in all of rushing should be run in, and then another four running opposite to the last set; that is to say, where the rushes ran under strands, put them over and *vice versa.* Every time four strands are put in alter the lacing and so continue until the whole of the seat is filled in. Care should be taken in putting in the side-to-side strands that they are left loose enough to admit of lacing, as this process takes up a goodly quantity of rush, and if it is too tight it will break before the seat is finished, owing to over pulling.—"The Woodworker," London.

Two nozzles are used on a water wheel of small diameter where high speed is required. The power of the wheel is thus doubled, though twice the amount of water is required.

HOW TO PAINT A BATH TUB.

Assuming that it is an old metal tub which has never been painted.

First—the tub should be thoroughly cleaned. To do this, wash it with soap and water, or with soda, or with sapolio, in order to get off the grease; then rinse out with clean, hot water wiping dry with dry cloths.

Then roughen up the surface of the tub by going over it with fairly coarse sandpaper, and wipe out the little dust and dirt produced by the sandpaper with a dry cloth.

The tub is now ready to be painted. The first coat should be white lead in oil thinned with turpentine, using a flat bristle brush in putting it on and being careful not to get on too thick a coat. Allow this coat to dry for at least twenty-four hours, when a second coat of this same lead should be applied in the same way and allowed to dry also for at least twenty-four hours.

The tub is now ready for the coat of enamel, using a kind especially made for such purposes. Open the can and stir the enamel thoroughly and apply with a flat bristle brush, carefully and evenly. One coat of this enamel is sufficient, which should now be allowed to dry from four to six days.

When you again commence using the tub do not allow *hot* water to run into it first, as it may soften up the enamel. If the tub has been painted in the past, the old paint should be scraped and sandpapered off before painting.

REMOVING OLD PAINT.

In answer to the question of a reader of its columns as to what will remove old paint and hard oil from any surface, a recent issue of the "Painter's Magazine" contains the following, which may be of interest to some of our own readers: When the surface is to be repainted, in which case a slight raising of the grain of the wood is no objection, the simplest method of preparing the remover is as follows: Dissolve 4 pounds caustic soda 98 per cent, or as many pounds concentrated lye in 1 gallon boiling water and allow to cool. In another vessel mix ½ pound each of starch and china clay in 1 gallon of hot water. Beat this well so as to have no lumps, and when cooled off some add it to the soda or lye solution, stirring well in the meantime, when it forms a thick, smooth paste. Apply this paste with a fiber, not bristle, brush to the surface in a heavy film, and when the paint or varnish is raised wash with warm water. To remove any traces of causticity, give the surface a coat of vinegar and allow to dry before repainting. For removing varnish from wood that is to be refinished in the natural, a mixture of 3½ pints American fusel oil and ½ pint turpentine will lift the varnish without raising the grain or discoloring the wood.

A TABLE LAMP.

JOHN F. ADAMS.

Table lamps, other than those of a very plain character, are relatively expensive when purchased. A very attractive lamp can be made, however, as herein described, at a most moderate cost for materials. The illustration shows the general design; the particular feature, which serves to keep down the cost, while at the same time giving a lamp that will provide abundant light, is the use of an ordinary central-draft, metal lamp, which can be purchased of about any lamp dealer for a dollar or less. Secure one with black iron finish, if possible, as it is more in keeping with the design than a brightly polished metal.

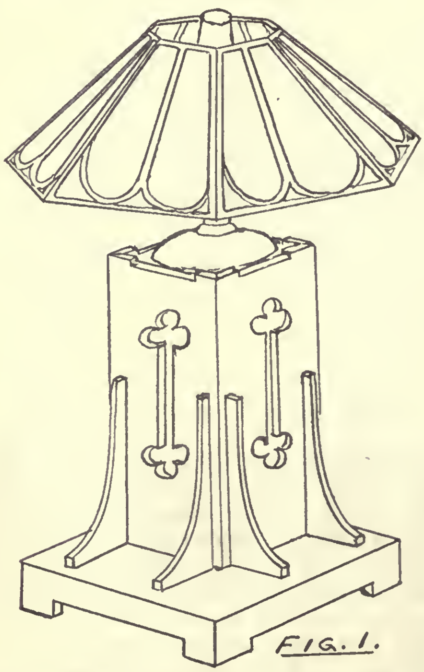


FIG. 1.

As a lamp of this type should preferably stand upon a table of the mission style, the wood and finish of lamp should be similar to table. Where no special kind of finish is required, if made of red gumwood and finished with a dark brown or red filler as preferred, a good effect is obtained. A new and popular combination is the use of birdseye maple, filled and stained to a medium steel-gray, and wax finished. Other woods and finishes will readily suggest themselves for use in particular places.

The pillar is made of four pieces 7 in. wide, 15 in. long and ½ in. thick. The edges of these pieces are beveled to 40° with glue and wire nailed with finish nails. If these joints are well fitted they will be hardly discernable. The eight angle pieces are 10 in. long, 1½ in. wide at the bottom and ½ in. at the top; the front edges being cut to the curve as shown in Fig. 2. The outer edges of these pieces are ½ in. from the corners of the pillar.

The ornamental slots in the sides of the pillar are made by boring three holes at each end and then cutting out with a compass saw, finishing with a chisel and file. The centers of the holes at each end are 8 in. apart; the lower one 4 in. from the top of the platform. The tops of sides of the pillar are also cut out as shown in Fig. 2, the slots being ½ in. deep and 4 in. long. If ½ in. holes are bored at the inner corners of these slots, a good curve is thus obtained; use a sharp bit, however, so that the cut will be a smooth one.

The platform is made of four pieces 12 in. long, 2 in. wide and ½ in. thick. The ends are beveled to 45° and also the upper inner edges so that the top, which is also beveled, will let down into the sides, making all joints inconspicuous. The top is 12 in. square and ½ in. thick, the outer edge beveled to 45° and a hole 5 in. square cut in the center. The openings at the bottom of the

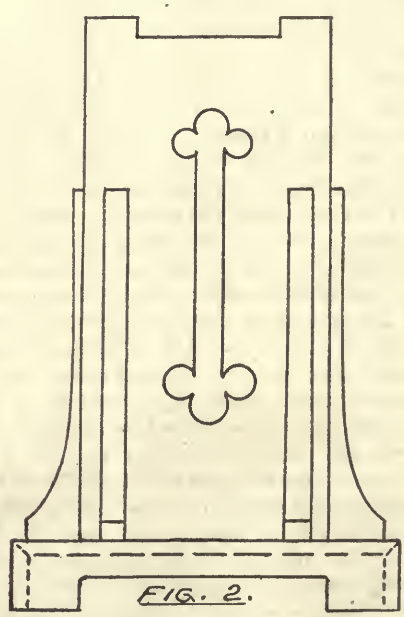


FIG. 2.

side pieces are 7 in. long and 1 in. high, and are to admit the air to the lamp. These openings or those in the sides of the pillar can be omitted but not both of them. When complete, this platform is nailed and glued to the pillar and angle pieces.

The top of the pillar is fitted with a square board in which has been cut a circular hole, of a size to just fit under the shoulder formed by the joint at the center of the oil well of the lamp. Careful measurements should be made of the lamp to be used and the hole cut accordingly, to lines accurately marked with dividers.

After cutting out the opening with a fret or compass saw, fasten in the top of the pillar, from ½ to 1 in. below the bottom line of the slots, according to the shape of lamp used, the object being to conceal as much of the lamp as possible, without having it so low that the burner is shaded by the corners of the pillar.

PAPER FROM CORNSTALKS.

Paper can be made from cornstalks at one-third the cost of making it from wood fiber and rags, is the latest advancement in paper making, says "World's Events." A company has been organized to utilize the waste products of the corn fields, and soon the new writing, wrapping and printing material will be on the market. Samples of the new paper show it to be equal to the fine goods made from linen. One sample resembles Japanese vellum so closely that only an expert can detect the difference. In quality it is just as good.

In producing this fine paper, common ordinary corn stalks, of which 53,000,000 tons rot yearly in the corn fields of the Western States, were used. The cost of manufacturing a ton of this paper ranges from $22 to $25. The manufacturing cost of a ton of rags or pulp runs from $60 to $75. Prof. W. R. Patterson, of the Department of Economics and Statistics of the State University of Iowa, recently made an analysis of the new paper and pronounces it equal to the paper made from rag or wood pulp.

The operation is simple. An improved threshing-machine, used on the farm, separates the stalks from the leaves, husks the ears and delivers the stalks bound in bundles ready for shipment. When received at the paper mill the stalks are depithed. The pith is then rolled into a fine paper. The hard outer covering is macerated and digested and used to make coarse wrapping paper and box board. The company owning the patent on the machinery is negotiating for a large paper mill at Kankakee, Ill., where the tests have been made, and intend to go into the paper-making business on a large scale. The company will utilize every vestige of the corn stalk, as certain portions are used in the manufacture of cellulose, gun-cotton, powder, varnish, lubricants, papier-mache, etc. In fact, every shred of the stalk is put to some use in this mill.

TRANSMISSION OF POWER.

The problem of transmitting 100 h. p. a given distance requires consideration based upon stated conditions, viz., drop in the line, power wasted in the line, pressure, cost of copper employed, relation between cost of copper and power wasted in transmission and attendant data. To transmit 100 h. p. 1 mile with 10 per cent drop, if the engine or turbine shows 100 i. h. p., then the dynamo transforms 95 per cent into electrical energy. When 95 per cent enters the line 90 per cent is delivered at the other end. The power delivered at the distant end of the line is 95 h. p., minus 9.5 h. p., 85.5 h. p. The process is not complete as yet, although the power is now at hand, ready for use. It is necessary to transform it again into mechanical energy. This transformation involves a loss of from 5 to 10 per cent, the balance left being the difference between 85.5—8.55=76.95 at 10 per cent loss in the motor, or the difference between 85.5—4.275=81.225 per cent at 5 per cent loss in the motor. The efficiency of transmission in any case, with 100 h. p. at one end and the loss throughout in dynamo, line and motor of 10 per cent apiece, respectively, will be about 77 per cent. The 100 h. p. is thus reduced to 78 h. p. from the beginning to the end of the system. The actual transmission can be readily accomplished if the cost is not prohibitive, but in instances where this threatens to be the case certain means must be employed to raise the efficiency and reduce the cost of installation.

ELECTRICAL STEEL PROCESS.

Manufacturing steel by a new method has been successfully experimented upon in Melbourne, Australia. New Zealand magnetic iron sand is first separated from its gangue by electro-magnetic separators, this treatment leaving a pure magnetic iron oxide. The sand is then fed from a bin into the furnace, which is entirely novel in its features, being chiefly mechanical and automatic in its operation. The ore drops from the bin into a slowly revolving cylinder placed at such an angle that the ore travels forward continuously in it. As it does so it is heated to a dull red by the waste gases from subsequent operations. From this cylinder the ore drops into a second revolving cylinder, where the fine partitions are subjected to the action of reducing gases, which bring the magnetic oxide of iron to the metallic form, at the same time permitting the particles to retain their individuality. From this second cylinder the reduced ore drops into a smelting bath at the bottom of the revolving cylinders, and the molten steel, or the malleable iron, as the case may be, is tapped from this whenever that operation is necessary. An interesting feature is the use of fuel oil for heating purposes, employed to secure concentration of heat and direct application in the furnace work. It is found that the fuel oil possesses many advantages over producer gases used in existing smelting practice. The work demonstrates that the oil is not only a cheap fuel but is also so thoroughly under control as to insure the best service.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

NOVEMBER, 1905.

We are frequently in receipt of letters from subscribers who, having purchased one or more of the early volumes bound in cloth, desire to exchange the separate copies of subsequent years for bound volumes, and asking what extra charge would be made for such exchange. It is not possible for us to make any arrangement for doing this, upon terms which would be as favorable, mailing expenses included, as the offer we do make; *i. e.*, to send binding covers to those ordering same at substantially cost price, 25 cents.

The binding of our yearly volumes is done by a wholesale binding firm, and in large numbers so that we may obtain them at a cost which enables us to make the low price at which we offer them. This firm does no retail business, and would not bind single volumes at irregular intervals. As a bindery is to be found in about every large town and city, at which binding of this kind can be done at about the same charge that would be made to us, the purchase of the binding covers enables the owner to obtain the binding at about the same expense that would be incurred in mailing the magazines to us, having them bound, and the return postage. The bound volumes thus obtained are uniform in binding, and no risk incurred of loss or damage in transit. We think that this arrangement will be quite acceptable when fully understood, as it is decidedly the most convenient one, and in the majority of cases less in cost than an exchange could be made for.

It is necessary to request that orders for binding covers be sent as soon after the completion of each volume as possible, that the covers may be made at the same time as are those for our regular supply, otherwise the filling of an order may be delayed until another lot of magazines is being bound. If you want the covers, therefore, for volume IV., which was completed with the October number, send your order at an early date.

The number of letters received from readers who are desirous of forming a society devoted to model engineering and kindred subjects, has been large, and the interest shown in the subject has been very encouraging. Many helpful suggestions have been offered, and we are now engaged in formulating a definite plan of organization, the details of which will be announced as soon as possible. The value of such a society seems to be quite generally recognized as providing the means for bringing together those who are interested in such work, and it believed that the mutual help to be received by members would be of the greatest benefit. It was this belief that influenced us to propose the society, and we are much gratified to learn that so many are of the same opinion. Those who have been considering the matter but who have not yet written are invited to do so, that local bodies may be planned whenever a sufficient number have expressed their interest.

The revised premium list not being fully completed has led us to put separate pages in such of the recent numbers as afforded space for same. In this way subscribers can select desirable premiums before receiving the complete list.

FLASH SIGNS; HOW TO MAKE THEM.

T. B. MEYER.

The following, with accompanying diagrams, gives full directions for making an electric flash sign, such as is used extensively at the present time in the larger cities, principally for advertising purposes.

Heretofore electric flash signs have been confined to the more expensive apparatus, such as are seen on the theatres and buildings requiring an expensive flasher and motor to operate the same. The sign here described is used more particularly for window displays though the principle involved may be applied as well to larger signs.

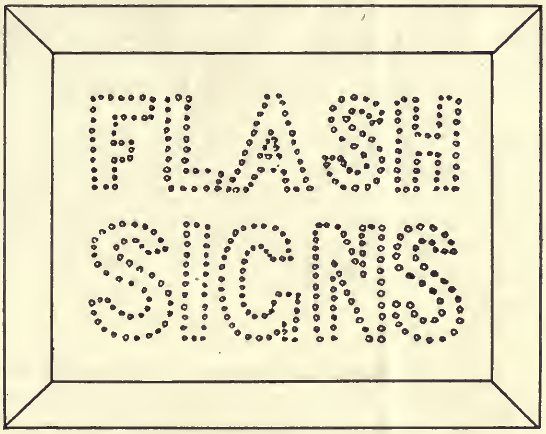


FIG. 1.

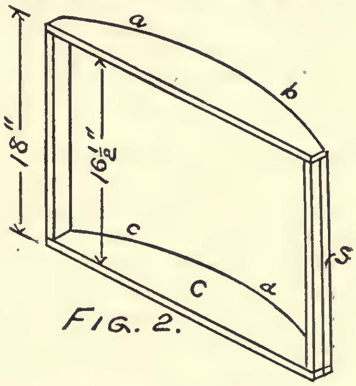


FIG. 2.

FIG. 3.

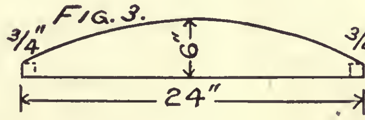
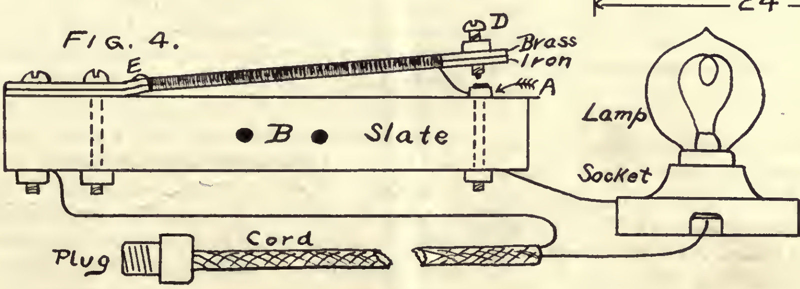


FIG. 4.



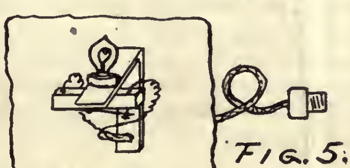
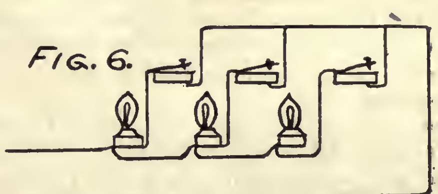


FIG. 5.

FIG. 6.



We will confine our attention to one consisting of an ordinary 1½ in. picture frame moulding, taking an 18 x 24 in. glass or sign. This, allowing for the usual ¼ in. rabbet in picture frame moulding, would make our sign over all 20½ x 26½ in. Such frames may be procured at any picture frame store, to order, for from 30 to 60 cents, depending, of course, on the wood selected and finish of the moulding. A frame may also be made of moulding used for interior finish or dados.

There are two methods by which we may complete the front of our sign: By employing an 18x24 heavy cardboard with the desired lettering painted thereon; white board with black letters will answer, though white letters on black background are to be preferred, or by having the wording painted on glass in stippled white in order to insure transparency, and filled in all around with black. The latter will cost more but makes by far the better appearing sign.

If cardboard is used, a plain glass front must also be used to prevent the cardboard from buckling. The lettering is punched in outline as shown in Fig. 1; the holes being spaced about ¼ in. apart; on the back of cardboard are then pasted various colors of tissue paper, which give a varied color effect from the single plain lamp placed behind.

As a support for this lamp, as well as a reflector and means of keeping out other light, we next build a semi-circular box, as shown at Fig. 2. This consists of two pieces of ⅞ in. soft wood, 24 in. long by ⅞ in. at the ends and 6 in. at the center. Fig. 3. These are fastened together by two strips of wood ⅞ in square 16½ in. long, with ordinary finishing nails. Next, as a backing for the box, fasten a sheet of 20 x 28 tin with carpet tacks to the framework just completed, tacking down well over the curve *ab* and *cd*, Fig. 2, and the sides of the strips *s* at the end of the frame-work. Paint the outside black with thin asphaltum or black paint, and we then have a light-tight box, which may be fitted in to the frame with hinges at bottom to swing open, and a catch hook and screw eye at the top, taking care to allow for the thickness of cardboard and glass.

Our next step is to make an electric thermostat by soldering or riveting together a strip of brass and of soft iron, 1-16 in. thick, ½ in. wide and 4½ in. long. Drill two holes ½ in. apart, at one end, large enough to clear a 6-32 machine screw, and a third at the other end, tapped for a 6-32 machine screw. This is our contact making screw, and should be brass with a 1-8 in. piece of No. 16 or No. 18 platinum or hard silver wire soldered to the end of it. Bend the two-metal pieces slightly at a point 1 in. from the two-hole end.

Then cover between holes with five thicknesses of paraffined paper, shellac down to hold in place, and wind with about 33 ft. of No. 36 single silk covered German silver wire, first soldering end directly to thermostat at *E*, Fig. 4. The winding should be 3 in. in length and clear the holes in the two-metal strip by ¼ in. at either end. Care must be taken that the wire rests only on the waxed paper.

Next fasten this thermostat to an insulating base of slate 4½ in. long by ⅞ in. square, with two 1 6-32 in. round head machine screws, with nuts to match on the under side and place a contact screw with 1-8 in. square of platinum or hard silver soldered on its head in the other end of base, so as to come directly under the contact screw in the thermostat. See Fig. 4. The lower contact screw should also be provided with nuts underneath, and the upper one in thermostat with check nut for adjustment.

Connect, as shown in Fig. 4, the brass strip of thermostat on top, and with right hand end wire under screw head at *A*. The insulating base *B*, Fig. 4, may now be fastened by screws and nuts to the bottom of the box at *C*, Fig. 2, or by two 6-32 machine screws through holes at *B* to a metal angle carrying the lamp and fastened by screws and nuts to the tin back of box. This angle is drilled and tapped 6-32 to take ordinary keyless receptacles and lamp, the latter being placed so as to come near center of back of box. See Fig. 5.

Connections are made as shown in Fig. 4, the cord of from 6 to 10 feet being fitted with the ordinary plug and coming through an insulating porcelain or glass bushing in the tin to the lamp and thermostat. Thermostat should be placed with *B* side down in order to bring the adjusting screw *D* to the front, and if put on the wood bottom of the box should have a piece of thick asbestos cloth under it. The cord *E* should be what is called window cord in preference to the ordinary lamp cord, and may be had for about four cents per foot.

The apparatus being ready, see that the point of adjusting screw *D* comes within 1-16 in. of contact *A*, before turning on the current. The lamp will burn dimly at first, and about 60 to 80 seconds are required before the the thermostat becomes sufficiently warmed up to operate. The period of flashing may be varied by the screw *D*; setting it closer to *A* causes the sign to operate more slowly, while increasing the distance between the two contacts brings about a quicker flashing.

Several thermostats and as many different colored lamps may be placed in one sign, producing a beautiful and ever changing effect. The wiring for three lamps of different colors is shown in Fig. 6. The total cost of material should not be over $4; the sign retails for from $10 to $15.

The official organ of the ministry of commerce and trade in Prussia publishes the following statistics of the trade and technical schools in Prussia at the beginning of 1905: Giving instruction in machine building and other productions of the metal working industries, 19 schools attended by 3055 scholars; architecture and the building trades, 32 schools attended by 5039 scholars; art trades and various high-class crafts, 26 schools and academies attended by 3061 students. Five of the last named schools were State institutions and the other 21 received subventions from the government. These schools had evening and Sunday classes, which were attended by 12,252 students in addition to the number of full course day scholars given. The textile trade schools instructed 1608 males and females, and 237 in the weaving workrooms. There were 1290 technical and 290 commercial finishing schools, with 201,716 and 31,670 scholars respectively, and 428 technical schools, organized and supported by industrial associations or craft guilds, having 28,043 scholars. The State grants subventions to 1237 of the finishing schools.

What is called a heat-proof putty is made by mixing burnt lime with linseed oil and boiling down to the usual consistency of putty and allowing the plastic mass to spread out in a thin layer to dry in a place where it is not reached by the sun. It can be warmed over a lamp or otherwise for use, and on cooling is hard again.

PHOTOGRAPHY.

PHOTOGRAPHING SKIES.

To those who have the faculty of translating color into black and white, the sky is rendered more or less gray, in its monochrome equivalent, and never as white as the paper on which the picture is printed. The color and dependent color value of the blue varies with the direction of the light, the atmosphere and the sun's altitude. Facing the sun the blue is almost effaced; opposite, it is strongest and darkest. It is nearly always lighter at the horizon, but in large towns the effect of dust and vapor may reverse this appearance when the sky is seen over the houses. In Spring, when there is an east wind in this country, the blue has a dryness and opacity that is absent at other periods. In the East there is a depth of blueness that is almost black. All these varying conditions of color, luminosity and gradation have to be represented in black and white by various shades of gray.

BLUE SKY WITH CLOUDS.

The task is somewhat easier where clouds are present. Even in Nature wisps of cirrus and the so-called "mackerel sky" greatly increase the idea of depth and distance. These forms of clouds are really simpler to deal with than the bolder cumulus with their strong shadows and perspective.

RENDERING OF A GRAY SKY.

When we get a gray sky the problem is easier still. It has not the even gradation of the blue sky. The clouds which float across it are usually dark and are not white in the high lights and darker in the shadows than the ground, as is the case with cumulus in a blue sky, and they can be photographed without so much reference to the problems of color. The landscape also is low toned and can be harmonized with less difficulty, most of it being probably lower toned than the sky. There are often instances, however, where the sun shines out brightly after a passing storm, when the landscape, or parts of it, are brilliantly illuminated against a black ground, and are many tones lighter. A good example of this is seen in Francois Millet's April storm effect with rainbow in the Louvre, which has been most effectively reproduced in a photograph. The photograph shows the illuminated portion of the land and woods lighter than the dark sky, as it should be.

THE COLOR VALUE OF BLUE SKY.

It is quite a difficult matter to represent the ethereal blue of the sky by a monochrome process on paper, such as photography, which goes so much beyond mere suggestion. Apart from the technical difficulties of preserving the color value and tones of the landscape objects that meet it, is the task of rendering in some degree the almost unattainable depth and palpitation, as it were, of which we are conscious when looking at it, but which a gray deposit on paper does not at all suggest. We know that a blue sky, as seen opposite the sun, rendered with fairly accurate color relation to the landscape and slight gradation from horizon to zenith, is disappointing in an ordinary platinum print and fails to convey the impression of the original. This is still more marked in the skies of Southern Europe and the East. Have we yet seen Italy, Egypt or India portrayed with the true value of the blue sky in photography? In those countries opposite the sun it may be said with truth to be darker than anything terrestrial save the shadows. Yet if an attempt be made to sun down the sky to the proper value the result will be unnatural, and the landscape appear as if under snow.

PRINTING PROCESS.

The printing process chosen has much influence. One cannot help feeling that the evenly diffused gradation of photography is at fault. The luminousness of the sky is much better shown in mezzotints and etchings than in photographs, where not only are the gradations arbitrary but the surface is broken up. If the photograph deposit be broken up in some way—partly to be achieved by the use of rough paper, by printing through some material, in the case of a plain sky, or by the use of a process such as gum bicarbonate, where a broken up surface can be left by means of a brush—the sky can be kept more nearly approaching its proper value without appearing too opaque.

IMPORTANCE OF CORRECT PRINTING DEPTH.

The depth of printing of a sky, which we have determined upon as correct, cannot be varied without completely changing the character of the picture. Quite a small difference will suffice to spoil the original intention. It is better to err on the side of being too light than too dark. Clouds too heavily printed will seem too near as well as too solid, and lose their vaporous character.—Eustace Calland in the "Practical Photographer."

Films, especially those of a rollable nature, are more difficult to wash than plates. The edges are continually catching in the grooves of the washing tank or else the emulsion surface has a peculiar tendency to rub itself against the sides and bottom of the tank, generally to the detriment of the negative. A satisfactory washing method is as follows: After removing the films from the hypo bath, rinse them quickly in four changes of water, then place them in wash in another tank, changing the water every ten minutes. After the water has been changed eight or nine times, the hypo will be almost entirely eliminated from the films.

THE WIMSHURST MACHINE AND X-RAY WORK.

T. E. ESKIN.

I. The Tubes and Tube Stand.

The questions confronting the beginner in the use of the Wimshurst are so many that perhaps it may be of service to put on record one's experiences, with the hope that they may be useful to others. From the time of Rontgen's great discovery, X-ray work has always been one of my hobbies. At first work was done with a coil giving a 6 in. spark nominally, but really far more. Situated far away from all electric-power stations, the difficulty of getting accumulators charged led to the abandonment of the coil. A friend and myself commenced about two years ago to make experiments with a Wimshurst that had a pair of plates 17 in. diameter, and the results were so good that a larger machine was built. This bad six plates, 18 in. diameter, and gave great satisfaction. This was enlarged to twelve plates, and at the present moment is being rebuilt and further enlarged to twenty plates. Needless to say, the various

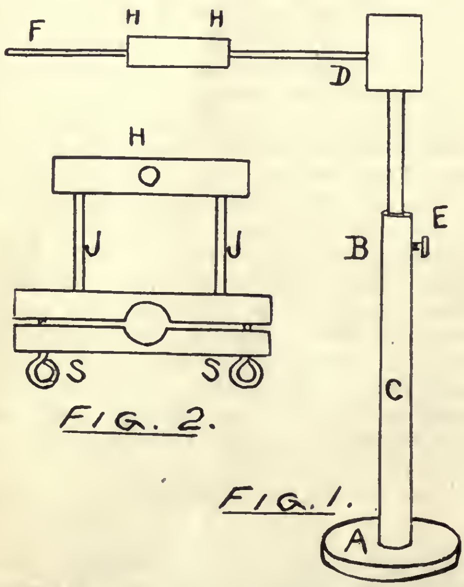


FIG. 2.

FIG. 1.

machines have led to diverse experiences, and misfortunes as well. Perhaps it may be well at the very outset to say that with radiations from an X-ray tube excited by the Wimshurst, I have never yet seen any trouble with dermatitis. There have been cases where exposures have been given for twenty minutes every day for three weeks without the slightest ill effects. The rays which produce the mischief seem closely associated with the hot anticathode, and with a Wimshurst the tube always remains cool. And here perhaps it will be well to say a few words about the kinds of tube.

Of the tubes in use at different times I may mention Brady and Martin's silver medal tube. This is 5½ in. long by 1¼ in. diameter, and is fitted with a double anticathode, the one being a simple wire at the end of the tube, the other placed 1 in. from the end and carrying the platinum reflector. This tube did excellent service with the coil and smaller Wimshurst.

Another good tube was Watson's "Penetrator," which has a concave reflector insulated, while the anticathode is formed by a ring between the reflector and the cathode. This gave very brilliant results, but was badly troubled with small sparks outside the tube, which were very dangerous to its life. Covering it with cotton wool somewhat helped to do away with the danger; but it broke down, the disaster occurring at the end of the exhaust. It was re-exhausted, but after some time it broke down again without any warning, Possibly a larger bulb would have prevented this. I lost it with great regret. Other tubes were from time to time tried, but were usually of too flimsy a construction to stand very long. The tube which is undoubtedly the best for all kinds of work is the bianodic tube, and now no other kind is in use. But with static charges, and under conditions to be described hereafter, the interior glass tube which supports the anticathode carrying the heavy platinum reflector is very liable to fracture. This occurred in two tubes, and led to collapse of the reflector. Messrs. Isenthal & Co. have, at my suggestion, grappled with the difficulty, and as I believe, satisfactoriy. The glass interior tube which carries the reflector is blown into a bulb, which fills the recess and entirely prevents collapse of the anticathode, even if a fracture should occur. The difficulty has thus been got over simply and ingeniously and with great credit to them.

A few words may be said about the working of tubes. In contradistinction to the use with a coil, the tube when used with a Wimshurst does not rapidly run up. During a long run, say twenty minutes, it is quite clear that the penetrating power has increased; but there is none of the sticking and flickering which is so tiresome with a coil, and a tube which once works rarely requires warming or doctoring in any way. Occasionally a new tube requires coaxing at first. Because a new tube will not immediately light up it does not follow that it is too high; a quite low tube will sometimes behave in the same way. It would almost seem as if the molecules of glass had to become accustomed to a certain plane of vibration; sometimes merely wiping it will set it off, at others a careful and judicious warming and, best of all, wrapping it up as far as the cathode in cotton wool. After a time this may be removed and the tube henceforth continue to work well. It may be noted that as a tube does not appreciably run up with the Wimshurst, one which is at all blue will never be got to work satisfactorily.

In close relation to the tube is the subject of the stand for it. It requires to be firm and strong and free from vibration and so constructed that the tube can is easily reversed. The following description of a tube-stand may be useful. *A*, Fig. 1, is a large piece of wood to stand on the floor, carrying an upright post, *AB*, into which *CD* slides, and can be clamped to any height by the clamp *E*. *D* is a small block of wood into which a stout piece of glass rod or tubing ⅜ in. thickness is firmly inserted. On this a piece of glass tubing, *HH* slides freely. This passes through a piece of wood *H* at Fig. 2, which is 10 x 2½ x 1 in. Immediately below is a second piece somewhat smaller, divided into two. Through this the tube passes at *T*, and by the two wooden screws *SS* it is held firmly in its place. The upper and lower pieces of wood are connected by four stout strips of ebonite, 7 in. long, two of which are shown at *J*. The top and bottom of the aperture *T* is padded, and the tube can easily be turned round so that the anticathode can point either up, down or sideways. The carrier *HH* allows it to be moved over the patient to the required spot, while the necessary height is regulated by the clamp at *E*. Should it be necessary to reverse the tube, the connecting wires are unhooked and the carrier *HH* put on the other way, which can be done almost instantty. The stand being on the floor, is much freer from vibration, and the connections are all out of the way. Further, the insulation is perfect and no loss of electricity is sustained, and the tube is out of danger.—" English Mechanic."

CONTINUED IN DECEMBER.

ELECTRIC BATTERIES; THEIR CONSTRUCTION AND USES.

FREDERICK A. DRAPER.

III. Internal and External Resistance—Grouping of Cells.

Before taking up the construction of different types of batteries, it will be well to understand how best to group cells to secure the most efficient service from them, as such information will be of value in helping to determine the kind of cell to use for any particular work. The several factors to be considered in selecting cells are, the relative constancy, the electro-motive force and the ratio between the internal resistance of the cell and the external circuit. The matter of E. M. F. and constancy have already been briefly noted. The internal resistance of a cell, in its relation to the external circuit, is an important matter.

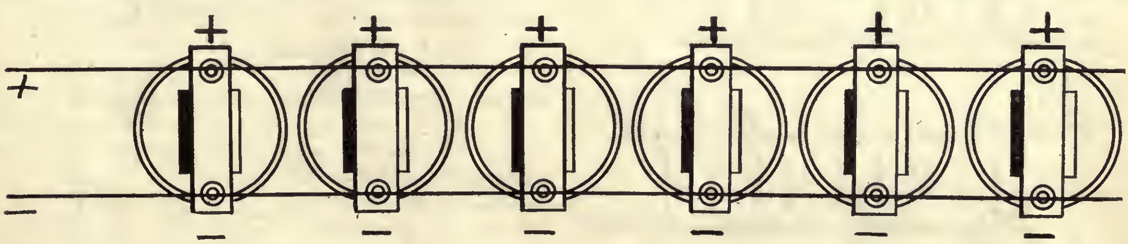


FIG. 1.

By "internal resistance" is meant the resistance to the passage of the current offered by the exciting fluid. In the so-called "dry" cells, the liquid is held by absorbent material, which in a moist state is in contact with the elements. The internal resistance is expressed in formulas as *r*. The external resistance, expressed as *R*, includes the conducting wires, instruments, lamps, etc., through which the current passes from and returning to the cell. The formula which expresses to the relations existing between the E. M. F., and internal resistance of a cell, the resistance in the external circuit, and the current developed is

$$\frac{E}{R + r} = C,$$

in which E is the E. M. F. in volts; R the external resistance, *r* the internal resistance and *C* the current in amperes.

As the elements used in a cell determines the E. M. F. it is evident that the matter of size has no influence upon the difference of potential between the poles or voltage. On the other hand, the size has much to do with the current from a cell, or amperage. This is because the larger the plates the less the proportion ate external resistance. If plates measuring 2 x 2 in in a cell having an E. M. F. of 1 volt and so located that the internal resistance is ½ ohm, are replaced by plates 2 x 4 in., the resistance is reduced one-half, or to ¼ ohm, and the resulting current is doubled. The two examples would figure as follows:

$$1,\ \frac{1}{\frac{1}{2}} = 2;\ \ 2,\ \frac{1}{\frac{1}{4}} = 4.$$

As a substitute for making cells of large and inconvenient size, groups of small cells may be so connected that the current obtainable will be equivalent to that from one or more large ones. This is known as multiple or parallel connection and is illustrated in Fig. 1. Here six cells are so connected that all the elements of one kind (zinc) are on one part of the circuit and the other (carbon) on the other part, the resistance of the

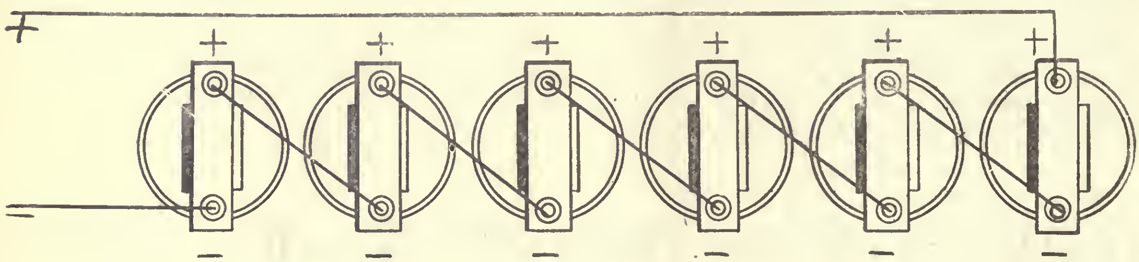


FIG. 2.

connecting wires being negligable. If each of these cells had an E. M. F. of 1.4 volts and an internal resistance of 1 ohm, the formula for the group as above connected would be:

$$\frac{E\,1.4}{O\,1} = 1.4 \times 6 = 8.4 \text{ amperes.}$$

If, however, we desired to increase the E. M. F., the cells would be connected as shown in Fig. 2, known as "series" connection, where the positive pole of one cell is connected to the negative pole of the next, which has the effect of adding the E. M. F. of the cells

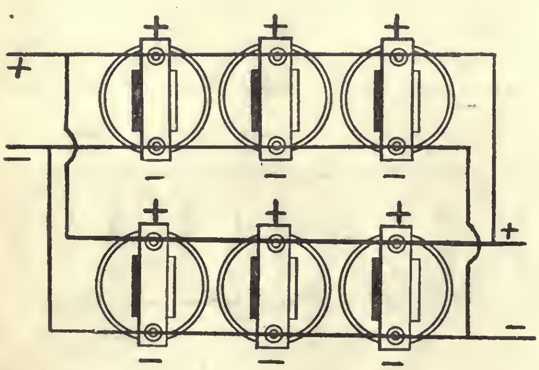


FIG. 3.

so connected. But as the resistance of each cell is interposed to the passage of the current, the amperes remain the same as for one cell. Assuming the E. M. F. and internal resistanee to be the same as for the previous illustration, this is shown as follows: E 1.4×6= 8.4 volts and

$$\frac{E\,1.4 \times 6}{r\,1 \times 6} = 1.4 \text{ amperes.}$$

We have seen how the E. M. F. or current can be altered at will; we will now consider the important bearing this has in relation to the resistance of the external circuit. Assume that an external circuit has a resistance of 1 ohm, that the battery has an E. M. F. of 1.4 volts and an internal resistance of 1 ohm, this would give

$$\frac{E\,1.4}{R1 + r1} = .7 \text{ amperes.}$$

If the external circuit has a resistance of 1000 ohms, one cell would give

$$\frac{E\,1.4}{R1000 + r1} = .001368 \text{ amperes.}$$

With 10 cells the current would be

$$\frac{E\,1.4 \times 10}{R1000 + r10} = .01386 \text{ amperes.}$$

and with 100 cells

$$\frac{E\,1.4 \times 100}{R1000 + r100} = .1273 \text{ amperes.}$$

showing that the current increases at nearly the same rate as does the number of cells. Should the cell be of a type having a high internal resistance, the result of increasing the number of cells in series is found to be quite diffeernt. The type of battery universally used on long distance telegraph work has an internal resistance of about 4 ohms, and has an E. M. F. of about .9 volts per cell. In an external circuit of 1 ohm resistance the current from 1 cell would be

$$\frac{E\,.9}{R1 + r4} = 1.3 \text{ amperes.}$$

and ten cells would give

$$\frac{E\,.9 \times 10}{R1 + r40} = 2.2 \text{ amperes.}$$

From 100 cells we would get

$$\frac{E\,.9 \times 100}{R1 + r400} = .224 \text{ amperes.}$$

showing plainly that with a low external resistance nothing is gained by increasing the number of cells where the internal resistence is high, and also that the excess above a certain number caused a positive loss.

If the resistance in the external circuit be high, as in long telegraph lines, high resistance in a battery is not so objectionable, if other advantages are obtained, as will be seen by the following, assuming an external resistance of 1000 ohms. With one cell we would get

$$\frac{E.9}{R1000 + r4} = .000896 \text{ amperes.}$$

With 10 cells we would get

$$\frac{E.9 \times 10}{R1000 + r40} = .00865 \text{ amperes.}$$

and 100 cells would give

$$\frac{E.9 \times 100}{R1000 + r400} = .0643 \text{ amperes.}$$

The several illustrations here given should enable the reader to calculate the results which any given combination of cells would give, the E. M. F. and external and internal resistance being known. It would be found that the best possible arrangement for circuits of low external resistance to give the maximum of current is where the grouping is such as to make the internal resistance equal to the external resistance. But no arrangment is economical unless the external resistance considerably exceeds the internal. Hence in induction coils, the use of comparatively small wire for the primary winding, when batteries are used for current, the higher resistance of the finer wire retarding the flow of the current.

Another method of grouping cells shown in Fig. 3 partakes in part of the arrangements previously shown and is known as "series-parallel". Combinations of this kind enable both the E. M. F. and current to be increased or varied as desired, the parts connected in series raising the volts, and the joining of these series groups increasing the current. This style of grouping is of value in exciting the coils for sparking gas engines, and other purposes where a strong, snappy current is required for steady work.

"WIRELESS" RECEIVING STATION.

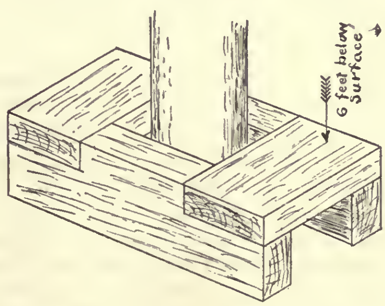
OSCAR N. DAME.

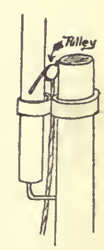
In constructing a receiving outfit, the same aerial and ground is used, and provision is made by a jack-knife switch by which the aerial may be shifted from receiving to sending at will. A synchronizing coil similar to the one described in the October number is also constructed, with three connecting clips for attaching portions of apparatus to the coils. The lower end of this coil is permanently grounded, and the upper end is connected to one side of the coherer. The other side of the coherer goes to the coherer battery, whence continues the circuit through the windings of the relay back to the lower end of the coil where the ground connection is made.

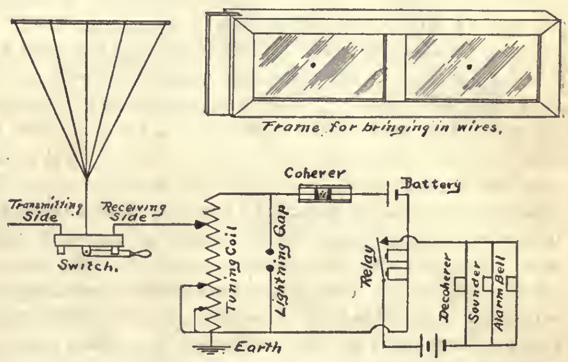
For the protection of the delicate apparatus in use, there is placed in parallel across this circuit, a lightning spark gap, designed to carry foreign discharges direct to ground, should they enter on the aerial. The sounder and decoherer are connected to the relay, as in the sketch here shown.

In selecting a pole for the aerial wire, the locality in which one lives plays an important part. In many sections of the country it is an easy matter to procure straight poles with eight inch butts and four inch tops, 60 feet long, or longer, but in other States the best that can be procured is the shorter Cananian spruce poles, averaging 30 feet in length. These may be procured in all diameters in nearly all cities in the North and East for about $3 each at the yards, and smaller poles for the topmast for about $2. In this way a 50 foot pole may be had for $5, including such small iron work as a blacksmith would provide for stepping the topmast. Such a pole sould be set in the ground fully five feet and braced a few inches below the earth's surface by logs or timber butts placed crossways about the pole and bolted together. This bracing adds greatly to the endurance of the pole in stormy weather.

The question might be asked: "With a certain height of pole, how far may one receive and send?" To this it is difficult to reply with any degree of accuracy, a great deal depending on the apparatus in use. It is absolutely certain that such a pole will suffice for picking up messages from commercial stations located







Frame for bringing in wires.

even twenty miles away, and will, with a 2-inch coil transmit across a township and possibly 10 miles, provided atmospheric conditions were favorable. But it must be fully appreciated that sensitive receiving devices are necessary for this distance, and it is the writer's opinion that no home constructed receiving device will be found available for such a distance as 10 miles unless constructed with great skill and accuracy, while on the other hand, the ordinary glass tubs coherer may be found sufficiently accurate up to 3 or 4 miles.

There are places in this country where the purchase of a Canada tree is out or the question, and in such places recourse may generally be had to saw-mill and lumber yards. Spruce sticks 6 x 6 in. and 30 ft. long make a very creditable mast if tapered on four sides by means of the rip saw at the mill. A top-mast of the spruce 4 x 4 in. and likewise tapered is easily prepared, but both mast and topmast should be made of selected wood free from knots and flaws, for a cut timber is inferior to a natural stick for flagpole purposes owing to its lack of flexibility.

In connecting topmast to mast it is desirable to provide means of lowering the mast during stormy weather, especially if the stick is of small diameter. It is customary to have a ring permanently fastened to the mast at the top, through which the topmast is drawn by means of halyards, the but of the topmast finally being set in position on a pin, as shown in Fig. 2. With ordinary poles of less than 55 ft. height, this may be dispensed with, as the topmast may be easily lifted into place by one man with the aid of a ladder.

Aerial wires should terminate in an insulated knob of glass so as to be readily attached to and drawn up by the halyards. This permits raising and lowering a cage or other device designed to improve the receiving and sending efficiency.

In designing a cage for experimental work it is best to have the cage length just one-fourth the extreme length of the aerial wire. The main wire should be No. 14 or No. 16 bare copper. Iron wire may be used where copper wire is obtainable only at considerable cost.

In bringing aerial wire into the instrument room, it is advisable to provide a better insulation than would be had with a porcelain tube inserted in the wall. The writer has seen a small round hole drilled in the glass pane of the window, for the entering wire. A convenient way to arrange this would be to construct a wooden framework sash of sufficient height to take 4 x 5 or 5 x 7 glass plates (old photo negatives will prove very useful for this purpose), and a hole drilled in one pane for the aerial wire. Should it be desirable to bring the ground wire in through this frame, the second hole should be drilled as far as possible from the first, to insure insulation. As the length of the aerial is measured from the coil to the peak of the wave cage it is desirable to have the wire run direct to the instrument room without any bends and with as few loops as possible. The wire should not be permitted to rest on trees or any part of the building, or on the pole by which it is raised.

A small brass or galvanized iron pulley is fastened by a staple or screw eye to the top, for the halyards. The aerial wire may consist of any of the various forms of cages or fans calculated to assist in sending or receiving, or may be a single wire fitted with a glass or porcelain insulator to which the halyards are made fast.

NEW METHOD OF MINING COAL.

Consul-General Holloway, of Halifax, reports that the Dominion Coal Company, Glace Bay, Nova Scotia, is testing a machine intended to take the place of explosives. It is a hydraulic cartridge, said to be successful in Great Britain. At present coal is blown down with powder after the undercutting is completed. In the use of the cartridge, after the undercutting and shearing are finished, a hole of 3½ inches in diameter is bored in the coal parallel with the roof, wherein the cartridge is inserted. A piston operates at one end and a pump at the other. This forces the water along a tube until it comes in contact with the first piston and pushes it out. The pressure becomes general on all pistons, which commence to penetrate the coal in a downward direction. The pistons are set very close, there being scarcely half an inch between them. As the pressure increases the coal gradually leaves the roof and falls to the floor in the best salable condition. When the powder is used in blowing down coal there is considerable waste through breakage into dust and slack. It is claimed that this element of waste is greatly eliminated by the use of the cartridge, aud 40 per cent more salable coal is produced than by the ordinary methods of mining. The weight of the entire apparatus is 44 pounds. One man can operate it. The amount of water required is from a pint to a quart, according to the pressure needed to bring down the coal. The water is stored in a little, resevoir attached to a pipe, and runs to the bottom of the pump. The machine is supposed to be especially serviceable in long wall and pillar work.

Development of the internal combustion engine for marine purpose means that, in the adoption of the now familiar motor boat, the same ranges of power and action as are obtained by the best reciprocating engines and boilers can be secured at one-sixth of the weight with the new motor. The British Admiralty are so convinced of the advantages of the combustion engine that they have carried out at sea a series of experiments, and there is some talk of utilizing this type of engine in the new torpedo boats which are about to be built.

To doubt and be astonished is to recognize our ignorance, and this is the first step toward acquiring knowledge.—Lord Chesterfield.

ELECTRICAL PROTECTIVE DEVICES.

ARTHUR H. BELL.

Aerial lines of telegraph companies were the first wires requiring lighting and foreign current protection. Long pole lines, stretching far out into the country, rarely escape injury during severe tempests, the heavy potential sweeping into the station, destroying instrument coils, and often shocking the operators and occasionally setting fire to the office. It was found that the oscillating lightning current sought first of all, a ground jump from wire to wire and instrument to instrument.

The first step toward protection, therefore, consisted of a triangular device, similar to the illustration, Fig. 1. The peg seen in the cut is metallic, and may be used to connect one side of the line directly across to the ground; in other words, is grounding that side of the line to which it is pegged. The middle wire of the trio is connected to a large plate of metal or coil of wire buried in moist earth. The two other wires are entering wires, and the lower pair the instrument wire.

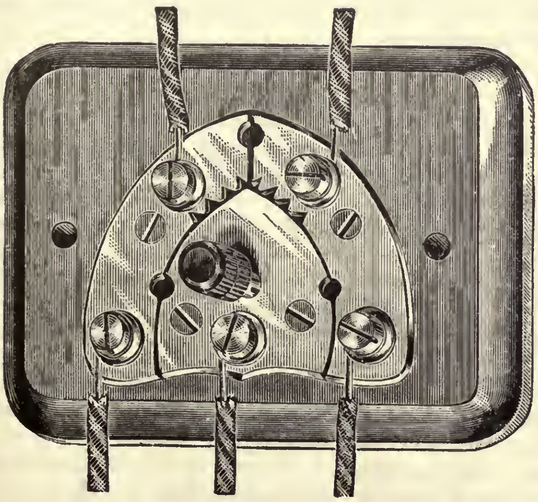


FIG. 1.

Should lightning strike along the line and enter the building, it was presumed that the foreign currents would leap across to the shield-shaped center piece and reach the ground instantly, but experience showed that high potentials often evaded the ground and continued to the instrument table.

Not, however, till the arrival of the telephone, was the serious side of lightning dealt with to any extent. The form of arrester shown in Fig. 1 was also on the first telephone instruments, being placed on top of the bell box at the binding posts. The entering wire is in reality a lead wire, which is drawn to a diameter calculated to melt and part at a certain maximum current. All wire possesses a conductivity proportionate to its area or section, and the thinner the wire the less current it will carry safely. Fuses, therefore, are designed along the lines of Fig. 2, being inserted in a cut in the line wire. It is desirable to use two fuses, one on each wire. In Fig. 2 the lead fuse wire is stuck to a mica strip, with shellac.

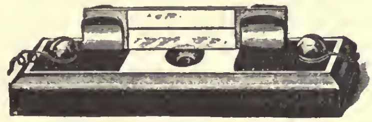


FIG. 2.

It was found, however, that enormous potentials passed through small fuses without "blowing" them, because voltage is not a heating factor like amperage, and provisions had to be made to side-track the heavy voltage before it reached the instrument.

A device known as the carbon block arrestor, came next into use for this purpose. In Fig. 3 the left-hand binding post is connected to the ground wire and is in itself in contact with the left hand of the two carbon blocks. Between this block and the right-hand one which it appears to touch, is a thin wafer of mica, oiled silk or tough paper, insulating one carbon from the other by a space of .0005 in., or so. The right-hand block connects with the fuse and with the instrument. The other end of the fuse goes into the line wire. It will be seen that ordinary currents pass in through the

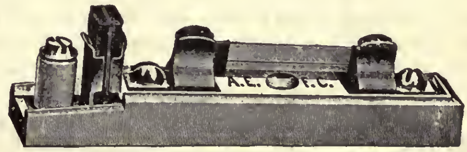


FIG. 3.

fuse to the instrument, and the carbon block operates only when a potential sufficient to leap the carbon gap passes in. The further apart the blocks the greater potential needed to break down the air space. In this way the protector protects from electric light and power circuits the fuse from blowing and the block arcing. It is desirable to place wooden, asbestos lined or porcelain covers over the fuses and the carbons, to protect the premises from fire. Oftentimes the fuses come in glass tubes, and recently the fiber-covered tube has come into popularity.

In telephone practice there are hundreds of devices, designed by the engineers for certain duty. Some are similar to those just described and some are self soldering, that is after blowing, restore themselves to normal condition. The principle involved is the relation of current to time, a certain amount of excessive current passing through insulated resistance wound on a brass spool, heats a metal pin soldered with soft solder in the spool and opens the circuit as long as the excessive current prevails.

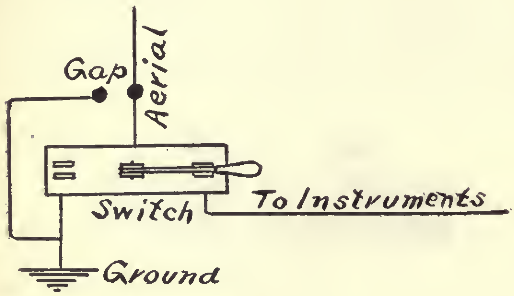


Fig 4.

In wireless telegraphy the aerial wire is elevated to a height of from 50 to 200 feet, and gathers at all times from the atmosphere a certain amount of high tension even on cloudless days. Such tension cannot be readily dispersed, and in most stations the chattering of the sensitive relay shows its action at times to be quite vigorous, in fact it is only recently in actual wireless practice that scientists have appreciated that there are cloudless days when, should it suddenly become dark the atmosphere would be streaked with flashes of heat (?) lightning, as on a Summer's night.

To protect wireless stations it is advisable to connect a spark gap, as in Fig. 4, one side to the aerial wire and the other to the ground whenever there is a tempest, and also throw open the knife switch used for connecting the aerial with instruments. It is most advisable to have a knife switch of the two-way type on the outside of the building, connecting the aerial to the knife blade, the station wire to one post and the ground to the other. Prompt grounding of this aerial insures absolute protection to instruments and the operator.

WHY STEEL CAN BE CUT FASTER THAN IRON.

Arthur H. Corby, before the Sanford Science Students Asso.

With all the tool steels working on steel at high speeds, the continual rubbing of the shaving on the upper surface of the tool wears more or less of a pit on the surface. At the same time, on the extreme point of the tool a small accumulation of portions of the material being cut gathers, being practically welded to the tool. Now, the position of the pit on the upper surface of the tool is situated further back from the cutting edge with a deep cut than with a light one. This is owing to the tenacity of the steel, and is not found to be the case in turning cast iron. The tenacity of the shaving and the action of the tool as a wedge cause the actual point of leverage to be in advance of the extreme edge of the tool. The larger the chip the greater its strength is, and therefore the further back on the tool it slides, making a greater angle between the shaving and the work wherein the front of the tool is more or less clear. The tool splits off the shaving of material like an axe cleaving wood with the grain. After having once entered, the cutting edge of the axe is clear, while the thicker part of the axe, like a wedge, forces the wood apart. In my opinion, the action of the tool in cutting steel is similar, and with the larger cuts the greater part of the work is done well back on the tool, where there is a good body of steel. In a lighter cut the shaving wears a pit right up to the cutting edge, thereby weakening it, and causing it to break down sooner. With cast iron, owing to its brittleness, the action is different, and the work is practically all concentrated on the cutting edge. When the tool first penetrates a piece of iron is broken off for a little distance in advance of teh too; the roughness intervening is removed as the work revolves against the tool, the point of which again penetrates and breaks off a portion, and so the action continues.

A curious fact has recently been brought to light, namely, that a man's mind is so constituted that it cannot work normally in a circular room. The discovery was made in connection with Minot Ledge lighthouse, which is a piece of engineering of the highest order. The tower being circular, space is in great demand and, accordingly, everything is made to conform to the shape. The beds are circular, the tables and benches are half-moons. There have been five well marked cases of insanity in the men who have worked here, and a number of others have been removed before their minds become entirely unbalanced. On being placed in rooms having the ordinary number of angles and corners, the sufferers rapidly improved and the theory has been propounded that the shape of the lighthouse rooms is responsible for the trouble. Experts in mental diseases have made a study of the conditions existing at Minot Ledge, and they say that there is no point on which the eye may rest, so that it travels around and around until the result becomes maddening.

Radium acts upon the chemical constituents of glass porcelain and paper, imparting to them a violet tinge, changes white phosphorus to yellow, oxygen to ozone, affects photograph plates and produces many other curious chemical changes.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

VII. Boring Cylinders on Face-plate.

In the last chapter, the boring of a cylinder that could be clamped to the carriage was considered. It is not always possible, however, to clamp some shapes to the carriage and it becomes necessary to fasten the piece to the face plate and bore with a tool held in the tool-post. This method, of course, introduces considerable overhang, and many problems of proper support for the overhanging end present themselves. We shall consider the case of boring a cylinder on the face plate with an overhang of some 11 inches.

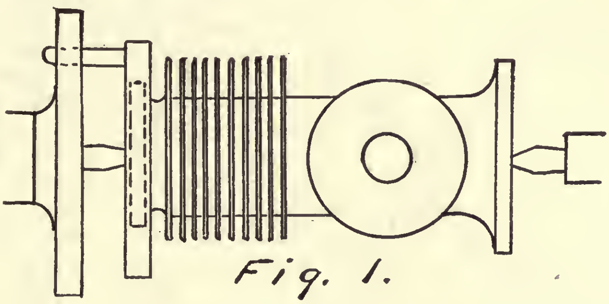
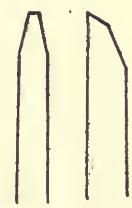


Fig. 1.



Tool

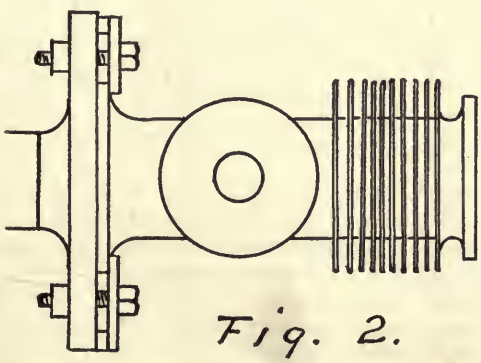
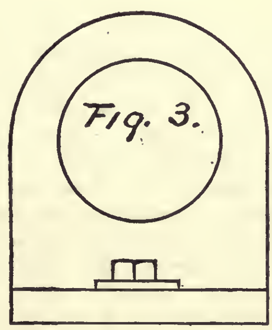


Fig. 2.



One end is first squared by placing on center and facing as shown in Fig. 1. Then the piece having had one true surface upon which it may rest provided, it is turned end for end and the piece clamped against the face plate, as shown in Fig. 2.

This leaves the opposite end unsupported, and when the tool takes hold chattering will commence, owing to the spring. This effect is taken care of by providing a temporary support for the outer end made of a piece of hard wood, Fig. 3, similar in shape to the steady rest and having the aperture lined with a piece of sheet iron or steel to take the wear. When such a rest is provided, a turned section should be made on the overhanging end so that it will run in perfect truth. This may best be done while supported on the centers. Then, when the casting has been firmly clamped to the face plate and the steady rest adjusted, the boring may be done. The center bridges, which are usually cast in castings for facing the ends, are knocked out after the outer end is finished.

The inside of the cylinder is always rough and uneven, so that a very light cut is all that can be taken at first until the tool gets under the scale. Here again enters the problem of proper tool support, because when the tool is working at the extreme inside of the cylinder it has considerable overhang and the pressure of the work is very apt to spring the tool considerably. This may be prevented to a great extent by having a boring tool similar to the one shown in the December, '04 issue of Amateur Work. The bar may be much heavier and will perform the work with far less chattering.

The final or finishing cut is made very fine and the end of the tool should be flat and about 1-16 in. wide, having a feed of less than 1-16 in. per turn. This should give a very smooth finishing cut, but the speed of the cut must not be too high.

It is somewhat difficult to bore a perfectly straight hole with this kind of a tool without several re-cuts; this is not always due to an error in the ways, but many other causes enter into the results which often make it quite troublesome. The spring of the overhanging end is largely responsible for it, which spring gradually decreases as the cut approaches the supported end. A recess in the inner wall, such as a port, will often cause considerable difficulty, but slow feeding and a light cut will usually overcome all such obstacles.

HOW TO MAKE A PANTAGRAPH.

To those who possess but little drawing ability a pantograph will be found of the utmost service for enlarging and transferring copies of designs from paper on to wood, such as is required for fretwork or inlaid work. The use of the apparatus will be understood from an examination of Fig. 1, which shows the appartus complete.

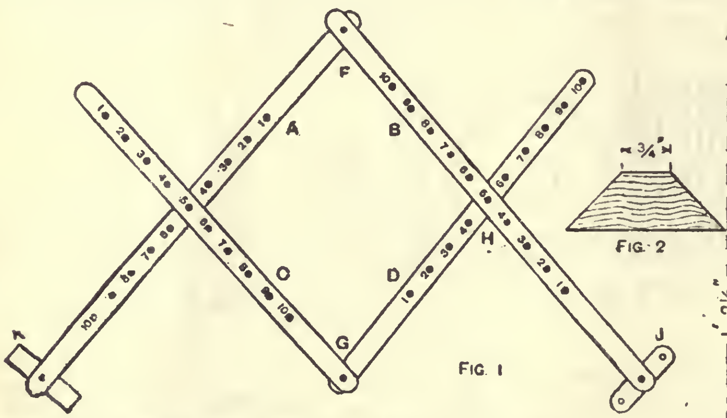


FIG. 1

FIG. 2

FIG 3

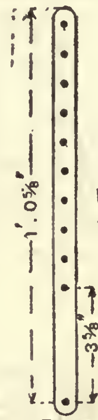


FIG. 4

FIG. 5

This instrument is made almost entirely of wood. It consists of four perforated wooden limbs or rules *A*, *B*, *C* and *D*, and a block *E*. These limbs are arranged in pairs and jointed together at the crossing, the two crossings being jointed together at *F* and *G*. The perforations are made at uniform distances, in accordance with the scale of measurement. The pivoted joints by which the top pairs are connected are constant, while the joints between the two intersecting limbs of each pair may be shifted by inserting the joint pins *H* in different holes in each limb. By thus changing the pins the body may be reproduced in any scale, either larger or smaller than the original, or it may be drawn the same size.

In constructing, first make the block *E* from a piece of wood ½ in. thick, ⅝ in. wide and 2½ in. long to the shape of Fig. 2. Now cut the two limbs or strips *A* and *B*, Fig. 1, both 1 ft. 3½ in. long, similar to Fig 3. At *J* drill a ¼-in. hole for the pencil to fit; at the other end of the limb *B* drill a 1-16 in. hole; these holes must be 1 ft. 2¼ in. apart from center to center. The limb *A* must be similarly drilled with a 1-16 in. hole at each end. Now cut the other two limbs for *C* and *D* 1 ft. ⅝ in. long, and ⅝ in. from the end of each drill a ⅛-in. hole for the tracing point, which can be made with a wire nail 1 in. long. When this is inserted one pair of limbs will be complete; the other pair are coupled in a similar manner. Each limb is ⅝ in. wide and 3-16 in. thick, and shown separate in Figs. 4 and 5; the perforations are shown in the illustration; each hole is ⅞ in. apart. The coupling pins are made from very fine screws. It will be convenient to mark the perforations as shown in Fig. 1.

When a copy is to be made the corresponding numbers on the limbs are put together. In use the end pivot *K* is placed in the block *E*, the pivot *F* sliding on the plane surface of the table according to the impulse given to it, then end hole *J* carrying the pencil, and the coupling of the two limbs *C* and *D* carrying the tracing point *G*. Lines traced by *G* will also be drawn by *J* on a larger scale, corresponding to the adjustment. If the copy is to be reduced, the tracing point is placed at *J* and the pencil at *G*. With the fingers of one hand on the tracing point, move it carefully over the design; at the same time with the other hand apply just sufficient pressure to the pencil to cause it to make its mark as it travels over the paper. All drawings can afterwards be shaded as desired.—"Work," London.

In the casting of brass the pattern should be slightly larger to insure the proper dimensions. The shrinkage allowance on patterns for casting brass is 3-16 inch to the foot in length or diameter of the pattern.

AMERICAN SOCIETY OF MODEL MAKERS.

Organization of the Society Under Way.

The many responses from all sections of the country to the suggestion in the October number regarding the forming of an "American Society of Model Makers" shows the interest to be even greater than was anticipated. Many of the letters would be interesting to our readers, but space will not permit of their being published. They contain suggestions which will be of much value in the work of organizing the society, which, it can now be deffinitely stated, will be given immediate attention. In all probability the society will be incorporated under the special laws of Massachusets, which are very favorable for societies of an educational character.

The membership will, at first, probably be general, but as soon as a sufficient number from any one locality have shown their desire, a local branch will be installed. The replies are already sufficiently numerous to indicate that branches can be successfully established in Boston, New York, Philadelphia, Chicago, San Francisco, and other centers will soon have the required number.

As previously indicated, the general object of the society will be for mutual education and self-help. As suggested by several, this could also include the securing of supplies, the general utilizing of patterns for machines, engines, tools, etc., and the exchange of same. Many other ways in which the society can be helpful will readily occur to readers. It is hoped that the preliminary work of organizing will be completed in time to give details in the December issue. In the meantime, any readers who are interested in such a society but who have not yet advised of their intention of joining, are invited to do so that no time may be lost in organizing branches.

BOOKS RECEIVED.

How to Draw. Leon Barritt. 107 pp. 9 x 12 in. Numerous illustrations. Harper & Bros., New York. Price $2.00

The basic principles of illustration are set forth in this book in a simple, practical way, thus making it an excellent guide for the beginner who wishes to give special attention to the field covered by the book. Instructions for drawing the head, eye, ear, mouth, hand, feet, and the entire human figure are given, with suitable examples. The work then advances to studies from life, including children and animals: also landscape, together with various methods of work, followed by many plates of examples of the work of leading illustrators. The student will find much of value, especially anyone without the guidance of a teacher, for whom the book was especially written.

Foundry Practice. James M. Tate and Melvin O. Stone, M. E. 336 pp. 7¾ x 5 in. 111 illustrations. The H. W. Wilson Co. Minneapolis, Minn. Price $1 50. Supplied by Amateur Work.

In the preparation of this book the author had in mind the special needs of the student and beginner in the work. As both writers are of the staff of the University of Minnesota, they have had ample opportunity to learn what is required for a book of the kind, and have most excellently met that demand. To this end numerous examples are given representative of the different kinds of molding, with suitable illustrations to supplement the text. This should also be a valuable help to pattern-makers, as a working knowledge of foundry practice on the part of those making the patterns would undoubtedly result in a better construction of patterns than is frequently met with.

SCIENCE AND INDUSTRY.

The substitution of oil for water in cooling cylinders of gasoline engines does away with any risk of damage to the engine by freezing and expansion of the water jacket. Small engines can be cooled with oil by replacing the water tank with an ordinary hot-water heat radiator. For engines of medium size a special radiator is used in the form of a vertical boiler containing small tubes open at both ends. The top of the boiler is covered by a cone and short stack into which the exhaust from the engine is conducted to induce a draft through the tubing. The hot oil is fed into the top of the boiler and the cooled oil drawn off at the bottom to circulate back through the jacket of the engine. Large engines require the addition of a small centrifugal pump to keep the oil circulating rapidly. This form of cooler has been successfully applied to engines of over 40 h. p. It cannot freeze, requires no attention, and works well under any climatic conditions. The tank, connections and jackets are sealed air tight, so that no waste of the oil can take place, and the original supply will last as long as the engine.

The fourth jewel screw of almost any of the standard American makes of watches is so small that to the naked eye it looks like a mere speck of metal. It must necessarily be perfect in all respects. When examined under a powerful microscope it is seen that the threads averaged 260 to the inch. It is exactly four one-hundredths of an inch in diameter and over 50,000 could be packed into a lady's thimble with ease. Counting these screws is never attempted, of course, but 100 are weighed on a delicate steelyard and the total number of an output is arrived at by comparing the gross weight with the weight of these. Such tiny screws can only be made in large numbers by machinery, and the operation attending their manufacture is one of the most delicate things in watchmaking.

In boring cylinders it is better to use three cutters than one. With one cutter there is spring to the bar. With two the bar is less well supported than with three. One cutter will cause the hole to be smaller in the middle than at the ends of the cylinder, and the surface of the metal will be rougher in the middle than at the ends of the cylinder.

A boy of 17 is not too young to enter an engineering school, though he could better grasp the requirements of the course were he a year older. It is not the most brilliant or showy student that always makes the best engineer, the chap who has to "dig" and acquire knowledge slowly often developing into the most trustworthy engineer. In its commercial application engineering is the art of making a dollar earn the most interest.

Rocking stones, as they are called, have come into the positions in which they are found usually by one of three methods. Either the stones are practically in situ, and the surrounding rock having been removed by natural decay and disintegration, leaving the stone so peculiarly balanced that it may be readily moved by pressure and caused to rock to and fro; or the rock has fallen from some higher elevation, and some of the stones helping to support it in its new position have disintegrated and disappeared, or the rock has been carried to its present position by ice. All three of these conditions are found, and possibly some others. Some rocking stones weigh many tons.

The young man who, after making up his mind what he wants to do in the world, begins to hunt up obstacles in his path, to magnify them, to brood over them until they become mountains and then to wait for new ones to develop, is not a man to take hold of great enterprises. The man who stops to weigh and consider every possible danger or objections never amounts to anything. He is a small man made for little things. He walks around an obstacle and goes as far as he can easily, but when the going gets hard he stops.

The strong man, the positive, decisive soul who is determined to carry it out, cuts his way to his goal regardless of difficulties. It is the wobbler, the weak-kneed man, the discouraged man, who turns aside, who takes a crooked path to his goal. Men who achieve things, who get things done, do not spend time haggling over perplexities or wondering whether they can overcome them. A penny held close to the eye shuts out the sun. When a man lies down on the ground to see what is ahead of him a rock may hide a mountain. A small man holds petty difficulties so closely in view that great objects beyond are entirely shut out of sight. Great minds keep their minds on the goal. They hold the end so persistently in view and it looks so grand and desirable that the intermediate steps, no matter how perplexing, are of comparatively little importance. The great man asks but one question: "Can the thing be done?" not "How many difficulties will I run across?" If it is within the reach of possibility all hindrances must be pushed aside.

Influenza has been for some time past very prevalent in Germany, says Richard Guenther, Consul-General, Frankfort, Germany, extending to horses, which are in some instances, quarantined. The Frankfort "News" states that in 1890, when influenza was epidemic throughout Europe, many workmen contracted the disease in three watch factories at Madretsch, and a number died. At one factory at Madretsch, however, the disease did not appear. Investigations showed that oil of turpentine was used in the turning of the metals used for watch cases, and the oil becoming warm, evaporated and the workmen inhaled the air laden with it. This seemed to protect them against the disease. Since then oil of turpentine has been always evaporated in that factory upon a stove, and not a case of influenza has ever occurred there. This preventive measure is successfully employed in dwellings, and the inhaling of water vapor with oil of turpentine is said to act favorably on the affected respiratory organs.

As disagreeable experiences are had at the mints from time to time with brittle gold alloys, the subject has again been taken up by chemists. Tests have confirmed the fact that lead, iron and tellurium must be avoided, as they act injuriously upon the properties of gold, even in the smallest quantities.

At the Paris mint the first specific investigations concerning this important question were conducted. In 1868 the director of that mint caused elaborate experiments to be made in order to learn what other metal besides silver and copper could be responsible for a deterioration of gold. Brittle coins were collected and their chemical composition was accurately ascertained. It was found that silver and copper are much less deleterious than lead and iron. In some brittle gold coins only one-fifth of 1 per cent of lead or iron was found, but these quantities were sufficient to impair the malleability of the gold.

When a splinter has been driven into the hand it can be extracted by steam. Fill a wide-mouthed bottle nearly full of hot water, place the injured part over the mouth and press it slightly. The suction thus produced will draw the flesh down, and in a minute or two the steam will extract the splinter, also the inflammation.—"National Magazine."

In hard soldering, or brazing with borax, there are one or two little points which cause trouble. The salt forms large bubbles in contact with the soldering iron and easily scales away from the surface of the parts to be soldered. Then, too, the parts must be cleaned each time before applying the borax. Instead of borax use boric acid and sodium carbonate, of which borax is made, and these troubles disappear. The heat of the iron combines them in such a way as to make an excellent flux—free from the difficulties experienced with borax.

AMATEUR WORK

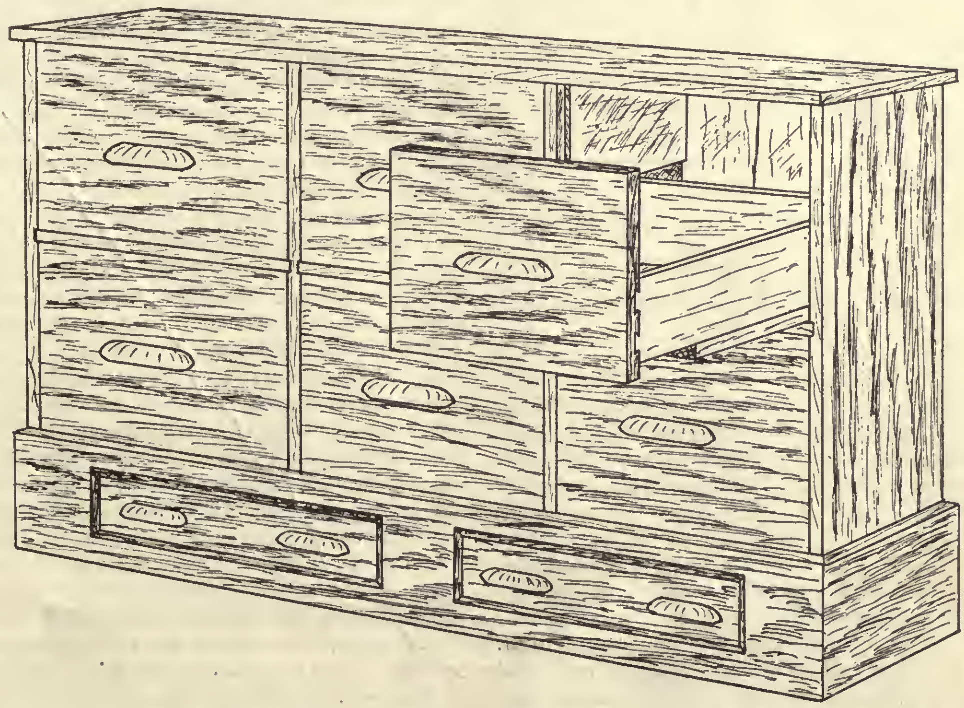
A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V. No. 2. BOSTON, DECEMBER, 1905. One Dollar a Year.

VERTICAL FILING CABINET.

JOHN F. ADAMS.

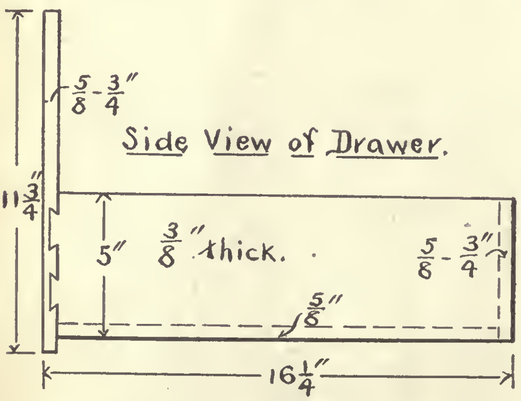
The filing of letters by what is known as the vertical method is rapidly replacing the old method of letter files with firms receiving any considerable number of letters, especially where the larger portion of the correspondence is confined to the same people. Numbers are assigned to regular correspondents and all letters received and copies of answers thereto are kept in the same folder, an alphabetical index with folder numbers enabling the set of letters to be obtained in the time necessary to look at the index and select the proper folder.



Folders are made from sheets of tag-stock, a kind of thin cardboard much resembling that used for postcards and shipping tags. They are cut 18½ x 11½ in. and folded so that one flap measures 9 x 11½ in. and the other 9½ in., the wider one being placed underneath and filed to bring it at the back. These can be purchased of office supply dealers, but are much cheaper, if the tag stock is obtained from a paper house, where the cutting may be done at small expense and the folding done by the purchaser.

The cabinet of drawers in which the correspondence is filed is usually of the sectional type, allowing the addition of sections as may be required by the increase in letters. As transfers of old letters can be made to the regular type of letter files, the cabinet here described is not made after the sectional plan, as the six drawers provide a great enough capacity for the needs of any except large firms who would not be interested in making their own furniture. The lower drawers are used for general correspondence filed alphabetically; the upper ones for firms with special numbers. Oak for a stained finish is the wood most suitable to use, although gumwood will make an excellent appearance.

The two end pieces are 31 in. long, 17 in. wide and ⅞ in. thick. The width of these pieces require glueing up from two pieces of suitable width, using care to match the grain as well as possible at the joints. In the rear inner edges of both ends and top cut ½ in. rabbets to receive the sheathing at the back. Also, on the inner sides of the end pieces and 12 in. from the top ends, cut grooves 3-16 in. deep and ¾ in. wide for receiving the ends of the frame dividing the upper and lower drawers and forming the runs for the upper ones. The top should be attached to the ends with 2 two in. No. 12 wood screws, countersinking the heads, and measures 43 in. long and ⅞ in. thick.



The pieces around the base are 7 in. wide and ⅞ in. thick, the two at the ends being 17⅞ in. long, and the one at the front 43 in. long, these lengths allowing for mitred joints at the corners. If drawers are desired in which to store a supply of folders, the front baseboard is cut as follows:

Draw vertical lines 4 in. from each end and 2 in. each side of the center, connect these with lines 1 in. from the top and 1½ in. from the bottom edge, forming rectangles 16 in. long and 4 in. high. Bore a ¾ in. hole in one corner at each end, and with a compass saw start sawing until a rip saw can be used. The vertical cuts will have to be made entirely with the compass saw. Use care not to saw outside of the lines, and trim up smooth with a chisel and block plane. The fronts of the drawers will have to be made of other pieces, as unless one has a fret saw it is a difficult matter to cut out pieces in this way and have them fit well enough to use as indicated.

The frame forming the runs for the lower drawers is next in order. This measures 39½ in. long and 16½ in. wide. The piece forming the front edge, 3 in. wide, should be of the same wood used for the ends and top; the rest of the frame may be of birch or maple, the back pieces being 3 in. wide and the end pieces 3½ in. wide. The joints are halved, the ends having the cuts on the under side. Two cross pieces 3 in. wide, also with halved joints, are placed with centers 14½ in. from each end. The joints with the front piece should not be cut clear across, but about ½ in. left to conceal the ends of the cross pieces and ends.

Two partitions 24 in. high and 16½ in. wide are now made of wood ⅝ in. thick. If maple or birch be used, glue a 2 in. strip of the wood used for ends to the front edge. It will be necessary to cut grooves ⅛ in. deep and ⅞ in. wide, across the center of each side of these partitions to receive the frames forming the runs for the upper drawers.

These latter frames are 13 1-16 in. wide, 16½ in. deep, and ⅞ in. thick, made with halved joints, the front pieces matching the rest, as before mentioned. Stock 3 in. wide is used, and the frames are firmly attached in place with glue and nails. The joints between these frames and the partitions can be nicely concealed by having the frames only 16 in. deep, setting them in ½ in., cutting into the partitions at the joints ½ in. and putting a strip ⅞ x ½ in. and 39¾ in. long, across the front, using glue and wire finish nails for fastening.

The runs for the two shallow storage drawers are next to be made. Four pieces of birch or any similar wood, 4 3-16 in. wide and 16½ in. long, are then nailed with the front ends flush with the openings, the top edges being attached with 2 in. screws to the frame above. To the under edges of these pieces, attach strips 2 in. wide and 16⅛ in. long, so that they will project towards each other, forming runs for the drawers. Under these place two strips 39½ in. long and of just the width to rest on the floor, and thus give firm support to the runs of the drawers and enabling the latter to be heavily loaded. The two drawers are of ordinary construction, with the exception that around the edges of the front may be placed strips of quarter moulding, and the drawer set in to bring the moulding flush with the front. This recessed effect adds to its appearance. A single drop drawer pull in the center of the drawer will answer. The frame is finished by sheathing up the back with ½ in. matched sheathing, which comes 6 in. wide. Seven strips 25⅛ in. long will be required.

The filing drawers, six in number, are next to be made. The fronts consist of six pieces 12¾ in. long, 11¾ in. wide and ¾ in. thick. As the sides are low it will be necessary to cut down the ends on the front sides for cleats 2 in. wide and ¼ in. thick, which are desirable to prevent warping. Use care to make good joints; the cleats should be glued and held in clamps while the glue is drying. Cut rabbets on the inner lower edge ⅜ x ⅞ in. for the ends of the bottom board. The sides are 16 in. long, 5 in. wide and ⅜ in. thick, the fronts having a ½ in. rabbet to receive them, fastening carefully with 1½ in screws of small gauge, and glue. Dovetail joints would be stronger, and are recommended to those knowing how to cut them. The piece at the back is 12 in. long, 4⅝ in wide and ¾ in. thick, the top edge being nailed flush with the side pieces. The bottom is 16 in. long, 12 in. wide and ⅝ in. thick, the rear end being nailed to the back with nails or screws through the sides and front.

To keep the drawers from tilting forward when opened, owing to the low sides, it will be necessary to attach strips of ⅜ in. stock to the partitions and ends, the lower edges of which will lightly press on the upper edges of the sides of the drawers. These strips should be 15 in. long and about 3 in. wide and fastened with 1 in. wood screws and glue, putting on the glue after locating the position, with two screws, one at each end.

The reader may at first thought reach the conclusion that the work here desribed is of considerable amount and rather difficult, but a careful reading of the directions and study of the illustrations will enable anyone of ordinary skill to make a very serviceable and presentable cabinet, and those having use for one will find the making of it will affect a very considerable saving.

THE METAL WORKING LATHE AND ITS USES.

ROBERT GIBSON GRISWOLD.

VIII. Drilling Accurately on Drill Press.

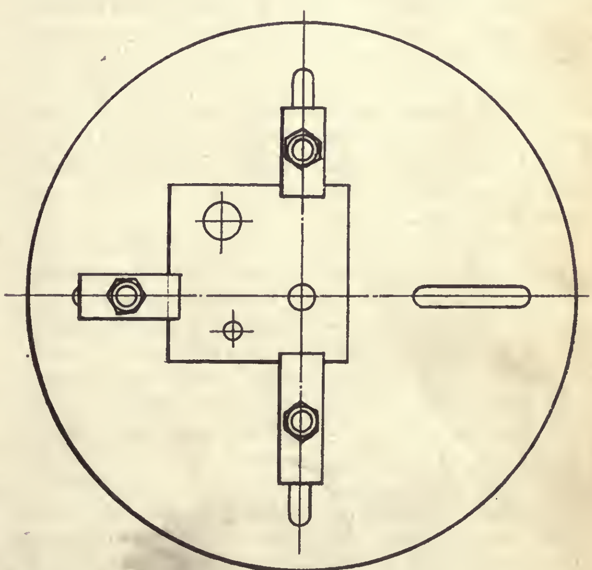
Those who have attempted to drill or bore an accurate hole on a drill press know just what a difficult operation it is. This is due to the fact that, no matter how carefully a hole may have been laid out, to make a twist drill follow a hole true to the mark is next to impossible, owing to the fact that one lip of the drill may cut a little faster than the other, causing it to run. For ordinary work this will do very well when the difference does not exceed a few thousandths of an inch, but if the work is being done it is very essential that the hole be exactly right.

Quite frequently one may see a machine "draw a drill" while starting the hole. When the hole is laid off a smaller concentric circle is drawn inside the first. When the points of the drill enters the material to ascertain depth it is an easy matter to see whether the cone-cup is exactly central with the smaller circle. If it is, the drill is following true, but if not a small groove is cut down the side of the cone on the side farthest from the line, or on the side toward which it is desired to bring the drill to make it coincide with the true center, or the circle denoting the periphery of the hole.

Then when the drill is again started the resistance on this side of the hole is lessened and the drill slips over slightly, cutting more on this side and bringing the hole more nearly in line with the intended center. But the eye is unable to accurately judge when a coincidence between the scribed circle and the edge of the cup occurs, at least within a few thousandths of an inch, and if great accuracy is desired this method cannot be used.

Let as suppose that it is required to drill three holes of different sizes in a die block, as shown in the figure. After finishing the sides of the block until they are truly parallel, coat one (the upper) side with copper upon which the fine marks will show very clearly. This coppering is done in the following manner:

After being sure that the surface is perfectly clean of grease, which may be effected by rubbing it with a rag and chalk, rub it with a rag wet with a solu-



tion of copper sulphate made by dissolving several large crystals of copper sulphate (blue-stone) in a bottle of water to which is added several drops of sulphuric acid. This solution will deposit on the surface of the metal a firm coating of copper upon which the finest lines will appear distinctly.

The holes are then carefully laid off and marked with a very sharp center-pencil. The piece is laid on the face plate and the clamps adjusted, one of the holes being as nearly central as possible, which may be determined by measuring with a pair of hermaphrodite calipers from the periphery of the face-plate. Before the block is adjusted on the face-plate a sheet of writing paper should be placed beneath it which will give greater friction between the block and plate. The clamps are set up just firm enough to hold the block in place and the face-plate screwed onto the spindle.

Then the center indication mentioned in chapter V, of the January, '05, issue is placed in position with the point of the small or short end in the prick punch mark, and the long end point quite near the tail center. The face-plate is now slowly revolved to quarter turn position, which will indicate in which direction the block must be shifted to bring the center exactly in line with the center line of the lathe. A gentle tap with a hammer will move the block very slightly one way or the other until, when the spindle is rapidly revolved, the long end of the indicator shows no movement but remains stationary. The clamps are now set down firmly and the plate revolved to see that the screwing down of the clamps has not shifted the block slightly.

A centering tool, Fig. 24, page 24, November, '04, issue, is now placed in the tool post and a center carefully bored to start the drill. Then a very carefully sharpened drill of the size required, if a very small hole, is put in position with the point in the center just bored, and the pointed rear end placed in a cup center in the tail-stock. If the drill has a center hole drilled in the rear end, so much the better, as it can then be rested against the tail center. The drill is then gripped firmly with a dog or clamp and the work revolved, feeding the drill meanwhile with the tail-stock feed screws.

If the drill has been properly ground, that is, with both lips exactly even and of the same length, the will bore a true hole exactly where desired. This method, however, may be improved on in holes above ⅜ in., as a small boring tool can then be used. A hole slightly under size is first drilled and finished to exact size with the boring tool, which method is the most positive of any for securing a true hole exactly where designed.

The plate is then shifted to a new position and centered and the next hole bored, and so on. With very careful setting these holes may be bored without a greater variation than half-a-thousandth of an inch or less. If the holes are to be reamed they should be left about .01 in. smaller than finished size and then reamed with the reamer resting against the tail center.

What could be better for a Christmas present than the bound volumes of AMATEUR WORK?

BANKER AND CUSTOMER.

It is sometimes said that a banker to whom a customer has paid in moneys for his current account is a trustee of such moneys, but this is a mistake. The true relation between a banker and customer is that of debtor and creditor only, with an obligation on the part of the banker to discharge the debt in a particular manner. So clearly is this the case that if, after paying money into the hands of a cashier to the credit of his account, which is not overdrawn, the customer should suddenly suspect the solvency of the bank, he cannot withdraw it except by check. In the same way, the moment a bank clerk in cashing a check has placed notes or money in the control of the person presenting the check there is actual delivery and possession, and he cannot take them back. Should a customer overdraw his accouut the bank is not bound to offer the sum really due him, but can rightly refuse to honor the check.

When a check is indorsed the indorsee can bring an action against the drawer, just as the indorsee of a bill can sue the acceptor. A check is not an assignment of any portion of a debt due from a banker to his customer, but simply a request with which the banker has promised to comply. Should the latter fail to meet his engagement to pay, all things being in order, the customer can bring an action against him and although no actual loss has been sustained, will be entitled to nominal damages, as the obligation of a banker to honor his customers' checks rests upon a clear and distinct promise or agreement to that effect, which arises from the course of business and the nature of the transaction. There can be an indorsement in blank or a special indorsement of a check. The post-dating of a check drawn to the bearer, or order, in no wise affects its validity, and a person taking it bona fide and for value has a perfectly good title.

Every banker who honestly pays a check drawn upon himself is entitled to charge the sum he so pays to the account of his customer, although the signature of the payee or indorser has been forged. A banker is bound to know the signature of his customer, and therefore, if he pays a check bearing the latter's forged signature he cannot charge the customer's account with the sum so paid. And if the amount payable on check has been fraudulently altered, the banker who pays it can only recover from his customer the sum for which it was originally drawn. But when there is evidence that the great negligence of the drawer clearly afforded opportunity for the alteration of the check, the customer may have to bear the loss himself if there has been no want of care on the part of the banker in cashing the check.—"Scientific Press."

Every amateur mechanic who wishes to keep posted should regularly read AMATEUR WORK.

ELECTRIC BATTERIES; THEIR CONSTRUCTION AND USES.

FREDERICK A. DRAPER.

IV. The Secondary Cell or Accumulator.

The wide variety of batteries described in the catalogues of electrical supply houses are a source of perplexity to the purchaser who is without technical knowledge or experience to guide him in selecting the kind best adapted for the required service. The ideal kind of battery would be one giving a strong, constant current of high voltage without polarizing, and which would permit of continuous or intermittent use without appreciable internal action when not in use and with a long life.

The accumulator, or storage battery, comes the nearest to meeting these requirements, but the use of such a battery necessitates having a charging outfit, or the sending of the cells out to be charged; the latter being the common but rather expensive custom. The construction of an efficient accumulator was described by W. C. Houghton in the June, 1904, number of Amateur Work, to which are referred any readers desiring to construct such a battery. It will be of interest, however, to consider at this time the action which takes place in a cell of this type, so that we can determine how to properly use the same and discover the cause of any trouble which may occur.

An accumulator or, more properly, a secondary cell, is one in which the fluid would not of itself set up any action between it and the other elements of the cell and so liberate energy; but when energy in the form of an electric current is applied to these elements, the fluid, or a certain portion of it, separates into its constituent gases, the electro-positive uniting with or adhering to the negative element, and the electro-negative with the positive element of the cell, thus creating a difference of potential between the two.

If communication be established between these elements by means of a conductor, but not before, these separated gases will reunite, yielding energy which is returned as electricity to an external circuit, but in the opposite direction. The quantity of electrical current returned does not equal, however, that originally used in the separating or charging process, the extent of the loss depending upon the efficiency of the cell and varying from 10 to 35 per cent.

To obtain an efficient cell of adequate capacity, it is evident that the elements should be those having the utmost affinity for the constituent gases of the fluid so that the operation of charging may be expeditiously done, and the output of the cell be great enough to compensate for the energy used in charging. In determining this efficiency the adaptability of the cell must be considered in relation to its uses as well as the relative cost of the elements used for a given capacity.

To more particularly learn the action of accumulators, we will consider the one described by Mr. Houghton, which is of the "lead" class as distinguished from the other or bimetallic class, the former being in much the greater proportion of those in common use, although the new Edison cell is claimed to have such superior efficiency as will cause it in time to replace all others. This remains to be proven, however, although there is undoubtedly great merit in the new cell, and it will have a large sale when placed generally upon the market.

The Plante lead accumulator, as improved by Faure and others, now consists of metallic lead plates in lattice-work form, firmly filled with lead oxide paste, and contained in a vessel nearly filled with sulphuric acid solution, four parts water and one part acid. The charging of this cell causes the water to become decomposed, the oxygen combines with the paste in the positive plate, changing it to peroxide, and the hydrogen uniting with the paste in the negative plate, changing it to spongy lead. Charging is continued until all the paste has been converted, which is indicated by numerous bubbles rising to the surface, and a milky appearance of the fluid, due to the minute bubbles contained therein. This is termed "gasing" and charging should not be continued beyond the point where this condition becomes pronounced as, while no harm is done the battery, it is simply a loss of current to do so. When charging, the current should flow towards the positive plate.

If, after a cell is charged, the external circuit be completed, the current will flow in the direction opposite that used for charging, the lead peroxide of the positive plate will be reconverted to lead oxide and the spongy lead to lead sulphate in the negative plate. If the discharge rate of the cell has been too rapid or too long continued, lead sulphate is liable to be found at the positive plate, which will be indicated by white crystals and is known as "sulphating." It is an extremely difficult matter to remove, as the crystals are tenacious, and bring more or less of the active material with them when taken off. Being non-conductive, the crystals increase the internal resistance and diminish the output of the cell; they are also very liable to form if the cell is nearly discharged, and then left standing for a long time before again charging. If a cell must be left without use, it should first be fully charged and not allowed to remain too long without action.

The normal voltage of a cell is about 2 volts, rising to nearly 2.5 volts just before charging ceases, and dropping during discharge to 1.85 volts, below which sulphating is very liable to occur. Another injurious effect due to too rapid or long a discharge is that known as "buckling," caused by the formation of minute sulphate crystals between the plate and the lead framework or grid, and causing the latter to expand and distort the shape of the plate. Even under normal use, the plates are liable to expand slightly, and should they from these causes, come into contact with each other, a short circuit will be formed which will cause serious trouble.

Cells of this type are rated at the ampere-hour capacity of their discharge within normal limits, the discharge rate depending upon the size of the plates, and the duration of discharge upon the quantity of active material contained in them and exposed to chemical action. With ordinary construction a normal discharge rate is from 2 to 2.5 amperes per square foot of surface of positive plate, and a discharge capacity of from 4 to 5 ampere-hours per pound of plate, both positive and negative, excluding a suitable allowance for lugs, etc.

As the chemical action taking place during charging and discharging should evenly effect all the active material, the value of a low rate of discharge will be evident, as the action will be more even and longer sustained at normal capacity, and yielding, therefore, higher efficiency.

The life of a cell depends upon the uniformity of its use. Properly charged and discharged it will last for from 1000 to 1500 chargings, with three or four renewals of positive plates. The life will diminish to less than half of the above, however, if discharged at an excessive rate, or too low.

A method of charging a small accumulator by means of gravity batteries is described in the January, 1905 number.

BOOKS RECEIVED.

Experiments in Applied Electricity. Arthur J. Rowland and William B. Creagmile. 181 pp., 8 x 5½ in. 59 illustrations. Cloth. Price $1.50. McGraw Publishing Co., New York.

The purpose of the authors was to produce a manual which would meet the needs of students in technical and manual training schools whose courses of study are engineering in character, but with only a limited time for laboratory work. As this is the condition in all but a few of such schools the arrangement and scope of the book will be thoroughly appreciated.

The wide experience of the authors at the Drexel Institute has enabled them to present the several studies of the principles and laws, together with the most suitable experiments illustrating them, in a most practical way, so that the students shall become familiar with the most approved methods of arranging and handling circuits and connections, as well as the apparatus, which too frequently is lost sight of in works of this character. As the apparatus necessary to the experiments can be obtained at moderate cost, the book will be found of much value by instructors and students who are interested in this work.

The 20th Century Bricklayer's and Mason's Assistant. Fred T. Hodgson. 311 pp. 7½ x 5 in. 200 illustrations. Cloth. Price $1.50. Frederick J. Drake & Co., Chicago, Ill.

Whether amateur or professional, no one can read this book without obtaining much valuable information, as it is exceptionally complete in both text and illustrations. To the rural resident, especially, would it be of value, as by its directions the ability to do the many odd jobs of masonry always necessary around a farm could be readily acquired. On the other hand, the apprentice just starting with his trade would be enabled to make greater progress from this additional knowledge of the principles and practice of his trade. As a book for public libraries it is highly commended.

Modern Locomotive Engineering with Questions. Calvin F. Swingle. 630 pp. 6⅝ x 4⅝ in. 265 illustrations and two folding sheets. Flexible leather. Price, $3.00. Frederick J. Drake & Co., Chicago, Ill.

The locomotive of today is a powerful and complicated machine and the training necessary to become a competent engineer requires careful study as well as ample experience. Why the boiler will not steam or why the piston jambs so the lever cannot be thrown, and the hundred and one other things, even to running a hundred miles on a pint of valve oil, as some railroads are today trying to do, cannot be learned with facility or surety, unless the worker is willing to invest in technical books and study them. Those doing this receive their reward in rapid and sure promotion. The book before us is clearly written, has excellent illustrations and well selected test questions at the end of each section, making it an excellent text book for individual study.

Educational Woodwork. A. C. Horth. 160 pp. 168 illustrations. Cloth. Price $1.00 Spon & Chamberlain, New York.

The object of the book is to provide a brief graduated educational course of woodwork, based on a succession ot joints, with a model following each joint, and as far as possible based on it. To the American reader the use of the old wood plane with wedged iron will seem rather out of date, nevertheless the directions for the several exercises are the clearly given, as well much general information of value.

AN EASILY BUILT POWER LAUNCH.

By Courtesy of the Brooks Boat Mfg. Co.

I. Bill of Materials and General Directicns.

The power boat to be described in these chapters will meet the needs of anyone desiring to build a fast, safe boat which shall also be easy of construction by any one without previous experience in boat building. The design of this boat is adapted from the familiar "skip-jack" which sails well. The square sides and nearly flat bottom of this type obviate all steaming of ribs and make the bends of the sheathing very easy to get. About the only objection to this design is, that in a heavy sea the boat will pound and lose headway, but as open boats of this type are not intended for heavy weather this will not be of great importance.

The required materials include:—Of white oak, fir or rock elm: One piece 22 ft. long, 8 in. wide, ⅞ in. thick for keel; one piece 4 ft. long, 16 in. wide, ⅞ in. thick, for transom; one piece 4 ft. long, 7 in. wide, 1⅞ in. thick, for stem and stem-knee; one piece 3 ft. long, 5 in. wide, 2¾ in. thick for deck-beams and floor-timbers; two pieces 14 ft. long, 6 in. wide, ⅝ in. thick, for sides of coaming.

One piece 8 ft. long, 6 in. wide, ⅝ in. thick, for ends of coaming; ninety running feet, 2 in. wide, ⅞ in. thick, for clamps and bilge stringers; one hundred and forty running feet, ⅜ x ¾, for the ribs; forty-five running ft. of ⅞ in. half round for fender-wales; the keel may be spliced, and so made of two shorter pieces, as given on the pattern.

Of pine, cypress, cedar, fir or spruce: Two pieces 20 feet long, 10 in. wide, ⅝ in. thick, for inside bottom plank; two pieces 15 ft. long, 8 in. wide, ⅝ in. thick, for outside bottom plank; two pieces 22 ft. long, 12 in. wide, ⅝ in. thick, for lower side plank; two pieces 22 ft. long 12 in. wide, ⅝ in. thick for upper side plank; two pieces 22 ft. long, 15 in. wide, ⅝ in. thick for middle side plank. The pieces that are 20 and 22 ft. long may each be made of two pieces, spliced. Note that the patterns give these in two pieces, as it is not often possible to get these pieces in this length.

When purchasing the lumber it is not necessary to adhere exactly to the dimensions given in the bill of material, but good judgment should be used in not making any of the parts too light.

For the boat frame we recommend white oak, rock elm or fir in the order named. The first two are good bending timber, and therefore cannot be used for ribs that require a short bend. Southern pine is a very good timber for all parts of a boat excepting for ribs requiring a short bend. It has one objection—that it is very heavy, and for this reason not suited for small, light boats built for speed.

The lumber for the frame should be seasoned. t should be air dried, otherwise it will show checks that detract from the finish and appearance. The lumber for the ribs and coamings that need to be bent should be clear, straight grained and not kiln dried, as this latter method injures its bending qualities.

For planking, pine, cypress, cedar, fir or spruce are most generally used. There are, however, a number of other timbers that may be used, as any light timber that does not split too easily and will withstand the water is suitable.

In selecting planking lumber, avoid knotty stock. A few sound small knots will do no harm and will make a material saving in the cost. For all kinds of planking, wide lumber cuts to best advantage, for the reason that but few of the plank are straight. For example, you could cut only one plank from a board 10 in. wide, while you might cut two plank from a board 12 in. wide. It is a good plan to get your planking lumber all 12 in. wide or wider, and then arrange the patterns on each board so as to cut it to advantage without excessive waste.

For hardware, get three pounds 1¼ in. clout nails for planking sides; three pounds 1⅝ in. clout nails for planking bottom; two pounds 6 penny casing nails, for fastening lower edge of bottom and for ends of floor timbers; a couple of 10-penny casing nails for the forward end of the clamps; one pound of 1¼ in. brads for fastening decks; two dozen 2-in. No. 12 screws, for fastening deckbeams; fifteen dozen 1½ in. No. 12 screws for fastening ribs, floor timbers, etc.; two dozen 1¼ in. No. 12 screws for fastening transoms, cleats, etc.; sixteen ¼ in. tire or carriage bolts, 2½ in. long, for fastening the keel splice; two ¼ in. tire or carriage bolts, 7½ in. long, for fastening the stem to stem-knee; one ¼ in. tire or carriage bolt, 5 in. long, and one 3½ in. long for fastening stem-knee to the keel; four ¼ in. carriage or tire bolts, 4 in. long, for fastening the transom-knee. Sandpaper, putty and paint. If boat is to be used in salt water, use brass bolts and copper nails.

The nails, screws and bolts may be of black iron, galvanized iron or copper nails and brass bolts. For fresh water boats, black iron fastenings are just as good as either of the others, and much cheaper. For salt water, however, you should either use copper nails and brass or bronze screws and bolts, or have all of galvanized iron. Do not mix galvanized iron fastenings with brass or copper in the same boat, as these metals, together with salt water, set up an electrical action that tends to destroy both.

A good putty for filling seams and covering nail heads is made of equal parts of white lead and whiting. The addition of a little Japan drier will cause it to harden quickly.

A good white lead paint is made by mixing equal parts of white lead and zinc, with equal parts of boiled oil and turpentine. For finishing in natural wood, only the best spar varnish should be used.

For tools, a claw hammer, clinch iron, rip saw, smooth plane, block plane, screw driver, one-half inch chisel, three iron clamp-screws of five inch opening, plumb bob and line, two saw horses about 20 inches high, bit stock, No. 4 German bit, ¼ inch bit and a countersink for bitstock will be needed.

Before driving a nail, always first bore a hole with a bit slightly smaller than the nail. In building most boats you will use two kinds of nails—the common or wire nail and the clout nail. This latter is a cut nail with a small point so that it may be driven through and clinched. When boring for a wire nail make the hole about two-thirds the length of the nail. When boring for a clout nail, bore clear through the parts to be fastened. A clinch iron must be held against or opposite all clout nails when they are driven or set, and it should be held against the common nails when possible.

A clinch iron is any piece of metal offering a surface against which the nails will clinch; a common flat iron makes a very good clinch iron. Clout nails should clinch about ⅛ of an inch longer than the parts to be fastened.

Before driving a screw, always first bore for the screw with a bit 1-16 of an inch smaller than the shank of the screw. Always countersink for the head of the screw. For a No. 12 screw use a No. 6 German bit. For a No. 10 screw use a No. 4 German bit.

The bill of materials calls for three kinds of bolts—carriage, tire and drift bolts. A carriage bolt is the common bolt used by all wood workers. It has a round head and a square nut. A washer should always be out under the nut. The tire bolt is the same as the carriage, excepting that it has a round, flat head, the same as a screw. A washer should always be put under the nut. Tire bolts are often substituted for carriage bolts when galvanized or brass bolts are being used, for the reason that they are much cheaper. Drift bolts are seldom called for. They are used to fasten heavy pieces of oak, such as a pipe-log and keel of a launch.

A drift bolt is simply a rod cut off to the length required. In cutting drift bolts the cold chisel will swell or swedge the edges where cut. This would cause the bolt to cut its way into the auger hole and enlarge the hole so that the body of the bolt would not be firmly held by the timber; therefore before driving a drift bolt hammer down the point so that it is slightly smaller than the rest of the bolt, thus causing it to wedge into and not cut its way into the auger hole. Bore holes for all drift bolts with an auger 1-16 of an inch smaller than the bolt. Drift bolts are usually driven through a washer. The driving in of the bolt upsets the end and forms a head that may be hammered down on top of the washer. Wood screws are sometimes substituted for drift bolts. These have a coarse thread nearly the whole length, and a square head so that a wrench may be used to screw them into place.

The construction directions will begin in the next chapter.

Red sealing wax is made of pure bleached lac, to which, when melted, are added Venice turpentine and vermilion. Inferior grades are made of common rosin and red lead. Black and other colors are obtained by adding proper pigments. Sealing wax was known in the seventeenth century.

PHOTOGRAPHY.

PHOTOGRAPHIC POST CARDS.

C. F. POTTER, JR.

The making of photographic post cards is a feature of camera work that does not seem to be receiving as much attention by amateurs in this country, as has been the rule abroad.

I do not believe we appreciate just what the illustrated post card means until we get away from home on a trip of some kind, especially if it takes us to a foreign land.

It is when the camera man gets away from home on an extended trip that he turns to the sensitized post card as the best means of keeping his friends and home folks posted as regards his whereabouts and affording them glimpses of what he and his camera are seeing.

Cards of the developing or "gas-light" variety will be found most convenient for the amateur en tour, and almost any room can, in the evening, be used for this work. The thorough-going amateur will, of course, develop the films as he goes along, and not trust to bringing back the whole lot for development after the trip is ended. The chances for deterioration seem to be greater after the light action has taken place, and one is liable to find the numbers on the black paper neatly printed off on the film, always, of course, in a prominent part of a negative.

The printing of post cards offers no especial features different from ordinary printing, except as regards the use of masks or cut out forms of paper, and the necessity necessity of having a printing-frame of ample size in which to work and get any desired arrangement of mask and negative. I find an 8 x 10 frame with a glass in it, none too large for post card work from 4 x 6 negatives.

The usual form leaves a space for writing, either at the end or bottom or both. The only mask needed for these would be an "L" shaped one, with the long side narrow and the short side wider. Circles and other other forms may be used if desired for sake of variety.

A broad expanse of bare foreground may be included in printing the card, and utilized for the writing space, this, of course, when the negative is larger than the post card dimensions. The usual size is three and three-eighths. Similarly, a blank expanse of sky could form the writing space, though in such a case it would be better to place the card lower down on the negative, leaving out most of the sky and using a mask to secure the writing space at the bottom of card.

It will be apparent to all that the printing of post cards from large negatives, where all of the negative is to be included, can be accomplished as in slide making, or the reverse of bromide enlarging. We might call it bromide reducing.

Our English cousins who go into these things "all over" and who have a larger number of manufacturers catering to their wants than we do here, have a special copying camera for post card reduction from large negatives, fitted with a special card holder on the same principle as a plate holder. They use either the ordinary developing paper cards, or fast bromide cards; the latter being preferable because much quicker.

There are several other processes adapted to post card work and the prepared cards can now be had in a printing-out matte paper and in platinotype, the latter certainly being the method de lux, though perhaps more liable to damage in the mails.

The ordinary government cards can be used and coated with various sensitizing solutions if one cares to attempt this work, but let me warn you against coating them with blue-print solution if you care anything about your reputation. The cards are of cream or yellow tint and no matter how well the blue print is done you cannot get rid of the yellowish high-lights, looking exactly as if the chemicals had not been properly washed out of your print, and the tones don't "jibe" worth a cent.

Kallitype or any of the processes giving brown tones can be used to excellent advantage, and by coating just the space you wish to print upon, with a solid center coating and lightly coated edges, you can get a vignetted effect in the print. The cream tone of the card harmonizes with the brown print, and, indeed you can find no better example of this pleasing combination than the Sepia paper which is also furnished in post card size with the usual inscriptions on the address side.

We can refer readers who wish to coat their own card to Kallitype and other processes, or they may get the Photo-Miniature booklet on that subject, and also on Plain-Paper Printing. A ready prepared sensitizer called "Etchine" is on the market and well known and I can speak very highly of it from personal experience.

Many of our readers will find themselves so located as to make a commercial use of the picture post card craze, as for instance: an acquaintance of mine who lived near a large summer resort and did developing and printing for the visitors. Ordinarily the one print of each subject would be all he would get to do, and he decided to show some of his customers how nice their pictures would look on sepia post cards. Selecting some of their best films in the next batch he developed, he made prints on the cards and found the idea was a winner. Many of the visiting "snap-shot" had not heard of the post cards, but when they saw how nicely they could remember the friends at home without much trouble on their part (the summer resort visitor is not looking for trouble) and at a slight expense, my friend soon found that he had all he could do to supply the demand.

The collecting of picture post cards has become quite a fad, and among photographers there are now several "exchanges" or clubs who exchange cards, limiting their selections to photographic cards of their own make exclusively. Such a club is a branch of the International Photographic Fxchange, a most healthy organization conducted by Mr. F. S. Clute of San Francisco, and a membership in it would bring any of our readers into communication with numerous good workers in this country and abroad. The mission of the post card seems to be that of showing the main points of interest attaching to the place from which they are mailed, rather than reproducing merely artistic or miscellaneous subjects.

A rather recent ruling of the Post Office Department, requires that all the cancelling on a postal card of any kind be done on the address side. This was a measure adopted to prevent the disfiguring of the illustrated cards, and we are sorry to see that some persons have not been content to use the post card privilege for the purposes originally intended, but have overstepped the bounds of propriety in printing pictures on mailing cards that are of such a character as to debar them from the mails. We trust such abuse can be dealt with in a fitting manner and that they will not result in a rescinding of the whole picture post card privilege.

Properly conducted, the exchanging of illustrated cards may be made both interesting and educational to a large degree, and to that end the cards should represent some feature of natural, historical, architectural or other interest peculiar to the place from which they are mailed, or present local types of the people and their modes of living, etc.

Those of our readers who have obtained some insight into the dollars and cents side of the work, will not be slow to recognize the many opportunities afforded in their local fields for the exploitation of the post card idea. A suggestion or two may not be amiss. Your local hotel keeps a supply of stationery for the free use of its guests. Make a better negative of the hotel than the cut they use, print it on the sensitized post card, show it to the proprietor and explain how a half-tone reproduction could be made and cards printed to supplement the office stationery. Tell him how the cards would often be used for short notes, taking the place of paper and envelopes and making a saving in that way for him. How each card mailed would carry with it a fine view of the hotel, advertising it all over the country at the expense of his guests who pay the postage.

Perhaps your town boasts a department store with a writing room for the accommodation of shoppers. Here the same idea might be put into effect and cards illustrated with views of the various interior and exterior features of the building.

In handling such orders you will, of course, first have gotten figures from engraver and printer for getting the cards printed and half-tone "blocks" made from your prints so you will be in a position to quote prices.

If the book and news stores of your city do not already carry a line of post cards illustrating the principal points of interest in and about your locality, you will find a large opening awaiting your endeavors, with a fair promise of ample returns for the work providing you have the knack of selecting the most favorable points of view and making better photographs than "the other fellow."—"Western Camera Notes."

PHOTOGRAPHIC NOTES.

Many amateurs are perplexed when their prints sometimes appear lighter in the center than at the edges; these effects are often caused by pouring the developer on to the center of the plate, instead of flooding the whole surface evenly and quickly with the solution When using rapid-action developers it is most essential to cover the whole of the plate almost simultaneously. To do this, take the dish in the left hand and the measure containing the solution in the right. Then, slightly tilting the dish away from you, run the measure quickly along the edge of the dish, at the same time emptying the solution over the plate.

Never add alum to the fixing solution. Where it is necessary, either for plates or paper, it should be employed either before or after fixing, with sufficient washing between.

"If I had a bright boy whom I wished to see get along in the world and make a lot of money," said an engineer to the "Canadian Manufacturer," "I would enter him in the new profession of automobile engineering. He should begin as a chaffeur—not to be a light headed speed rivaler and law breaker, but that he might learn to operate a machine well; that he might learn how to operate all sorts of machines. Then he should enter a factory and learn how to make them. Possessed of this knowledge I would have him serve a term on the road as salesman, introducing the machines. After that it would be his business to find a good location and set up for himself as dealer and agent. It is the coming business and there will be a lot of money made in it by men who know how."

The silver coinage of the United States contains 900 parts silver and 100 parts copper, while that of Great Britain contains 925 parts silver and 75 parts copper.

THE STEAM TURBINE.

Abstract of a Paper by F. C. Gasche presented before the Steel Works Club of Joliet, Ill.

In contradistinction to the reciprocating engine, the fundamental principle of the steam turbine lies in the fact that the reciprocating engine does work by reason of the static expansive force of the steam acting behind a piston, while in the case of the turbine the work is developed by the kinetic energy of the particles of steam, which are given a high velocity by the pressure to a lower. Steam turbines may be divided into two classes: Reaction turbines of which Hero's is an example; impact turbines, of which Branca's is an example; a combination of the two.

General principles applying to the design of steam turbines are the same as made use of in water turbines. The buckets and guides must have as little skin friction as possible and be so arranged that the steam may strike without sudden shock and have its direction of motion changed without sharp angular deflections.

One great difficulty that presents itself is the tremendous velocity of steam as compared with that of water under ordinary heads. In the reaction or Hero type turbine the peripheral velocity must be equal to that of the jet of steam to give us the ideal condition and in the impact turbine the ideal condition is when the peripheral velocity of the buckets is one-half that of the steam jet.

With high-pressure steam discharging into a vacuum the velocities obtained are from 3000 to 5000 ft. a second. A turbine built on the lines just given would, therefore, have peripheral velocities far beyond the limits of strength of material. As an example, a 19-inch Hero engine would revolve at 75,000 revolutions a minute, and the ends of the arms carrying the steam nozzles would have a velocity of over 40 miles a minute. The great problem confronting the inventors of steam turbines has been to reduce this velocity and at the same time to utilize the maximum amount of the energy of the steam.

Several attempts have been made to improve the simple reaction turbine of Hero and produce one that will run at a slower speed. In 1862 Charles Monson patented a turbine having a succession of simple reaction wheels, each one in a separate chamber and arranged so that steam issuing from a wheel into its chamber passes through the hollow shaft into the next wheel and so on; Fig. 1 gives the idea of this invention. Steam enters the hollow arms in chamber *A* through the hollow shaft, passes out through the orifice at the end into the chamber *A*, whence it is conducted to the hollow arms in the chamber *B* through a second passage in the shaft, and so on to the last chamber.

In 1885 C. A. Parsons secured his first patent for a compound reaction turbine. In all his work the inventor, who was the first to place the steam turbine in large units on a commercial basis, has adhered to the reaction type and is responsible for the successful development of the compound reaction motor. At one time or another Parsons has patented most of the feasible arrangements for the compound turbine, until, at the present time, the Parsons turbine manufactured by the Westinghouse Machine Co., is one of the most successful in the world. Fig. 2 shows the first Parsons turbine patented in 1885. Steam enters at the center *A* and passes to right and left between the series of guide vanes attached to the outer casing and the rotating blades attached to the inner drum which rotates on shaft *BB*. The steam escapes through the exhaust pipe *E*.

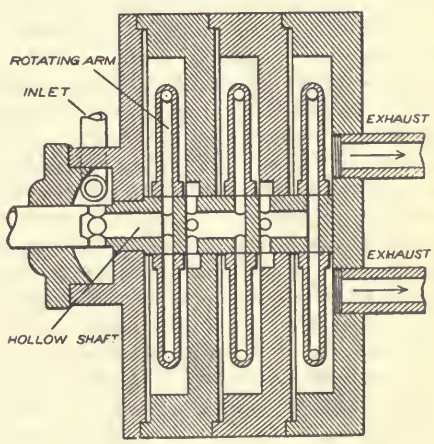


Fig. 1. Monson's Compound Reaction Turbine.

In 1893 DeLaval secured his most important patent relating to the expanding nozzle to be used in combination with an impact type turbine wheel. By the use of this expanding nozzle the energy of the steam under pressure was converted into velocity to impinge against a single row of moving vanes, a steam turbine was produced that for simplicity of construction has no equal.

In 1800 Mr. Curtis designed a steam turbine which was a combination of the DeLaval and the Parsons. A steam nozzle, which is a modified form of the DeLaval, is employed to expand the steam and give it a high velocity before it comes in contact with the blades, but a certain amount of expansion is left to take place in passing through the alternate rows of stationary and rotating vanes as in the Parsons.

Of the DeLaval turbine the unique features are the nozzle and the means by which the wheel is enabled to revolve upon its axis of gravity. DeLaval mounts his wheel nearer the center of a long light shaft capable of being bent and returning to its original form. The shaft is mounted upon bearings of ordinary construction. This flexibility enables the forces set up by the revolving wheel to deflect so as to let the former revolve about its axis of gravity.

In the divergent nozzle the whole expansion of the steam is carried out. The steam at the mouth of the nozzle has the same pressure as the exhaust. In other-words the steam has its energy completely transformed into mass and velocity by the time it comes into contact with the buckets. This brings up another feature of this turbine, and that is that no parts with the exception of the nozzles, are subject to steam pressure.

With 150 pounds steam pressure and 26 in. vacuum the velocity of the steam leaving the nozzle is 3810 feet a second or 43 miles a minute. The nozzles are set at an angle of 20° to the plane of motion of the buckets so that the theoretical velocity of the buckets should be 47 per cent of the velocity of the steam, or 1790 feet a second or 20 miles a minute. It has been found difficult to produce a material for the wheels that with an ample margin of safety would withstand the strain produced by the centrifugal force at this high speed, hence it has been necessary to reduce the speed not to exceed 1350 feet a second.

With the peripheral speed of the buckets set at 1350 feet a second, the diameter of the turbine wheel will determine the number of revolutions a minute which in small machines is as high as 30,000, and in larger machines 10,000 to 20,000 revolutions. To reduce this high speed of rotation within practical limits a pair of helical spur gears are used, giving a reduction of 10 to 1. These form by far the biggest part of the entire outfit. The necessity of using gears to reduce the speed from 10,000 to 30,000 down to 1000 to 3000 revolutions limits the size of the DeLaval turbine to 500 horsepower.

To avoid the use of gears Dr. Riedler and Prof. Stumpf have designed a wheel which is in successful operation in Germany that is essentially the same as the DeLaval except that the diameter of the turbine wheel is made ten times as large, thereby reducing the number of revolutions to one-tenth while keeping the peripheral velocity the same.

With this slower speed is also avoided the necessity for the flexible shaft. These machines have been built up to 2000 horsepower with a wheel 10 feet in diameter and running at 3000 revolutions a minute, and it is proposed to build a 5000 horsepower turbine with a wheel 16½ feet in diameter and running at 1600 revolutions a minute.

In the impact type turbine when using saturated or wet steam, there is considerable wear on the blades owing to the tremendous velocity of the steam, but in the Parsons type turbine this wear is almost entirely avoided on account of the low velocity of the steam which seldom exceeds 400 feet a second as compared with 1350 feet a second in the impact type. Thi- low velocity of the steam is obtained by use of the large number of rows of vanes through which the expansion takes place.

In the 300 horsepower turbine there are 70 rows of vanes so that, in expanding steam from 150 pounds pressure to 26 in. vacuum, the drop in pressure between any two adjacent rows is only 2¼ pounds, which will produce a velocity of about 380 feet in a second, for the steam or proper peripheral velocity of the bucket of 180 feet a second. With this low peripheral velocity there is no trouble in getting the speed of rotation down to 3000 revolutions a minute, or less if desired.

In the Curtis turbine steam is allowed to expand in a nozzle similar to DeLaval's until it has a velocity of 2000 feet per second and this velocity is then reduced by compounding through six rows of moving vanes additional expansion taking place while passing through these rows of vanes as in the Parsons. By this means, the peripheral velocity, which amounts to 1320 feet a second in the DeLaval and 200 feet a second in the Parsons, is brought down to 400 feet a second. The diameter of the turbine wheel is then made four times as great as the Parsons, following the plan of Reidel and Stumpf, which gives a velocity of rotation only one-half that of the Persons.

In spite of the fact that the steam turbine eliminates the two largest sources of loss in the reciprocating engine—initial condensation and friction,—its economy has not come up to the high standard expected on account of leakage past the vanes due to the clearance that is necessary to prevent the revolving vanes striking the stationary ones with difference in expansion of the two when heated, and the unknown losses due to the friction of the steam at high velocity in the expansion nozzle or in passing through the thousands of small passages. The actual steam economy which the builders will guarantee is just about the same as that guaranteed by the makers of the best types of compound engines.

Cost of attendance in favor of the turbine, as one man can care for more of the larger units than can two men where the reciprocating engine is used. Cost of maintenance is bound to be less with the steam turbine on account of its greater simplicity and freedom from a multitude of moving parts. The item of lubricating oil is almost entirely eliminated in the turbine and the only parts subject to wear and breakage are the vanes which are easily replaced.

If the question of space is vital, the steam turbine requires only three-fourths as much floor space as the vertical engine and only two-fifths as much as the horizontal engine. As you can install 4000 horsepower of steam turbines in the same building that would be required for 1000 horsepower of reciprocating engines, and this with only one-half the head room, you have one of the most important considerations in the designing and building of a power station in our large cities, or increasing the output from one already built.

With the steam turbine are avoided all vibration and shock due to the inertia of the reciprocating parts. The weight of the reciprocating parts of a 500-horse-power engine is about 30,000 pounds, with the engine running at 100 revolutions a minute and having a 5-foot stroke, this immense weight must be brought from rest to a speed of 1600 feet a minute and then slowed down again to rest and stopped 200 times every minute; it is evident, therefore, what an advantage the turbine has in the matter of foundation necessary to hold it. As to relative first cost, the question is hard to determine, because it is quite as difficult to compare the costs of the turbine and piston engines as it is to compare the costs of different engines. At the present time, the cost of a turbine and generator installation is about the same as for a piston engine and generator installation of the same capacity.

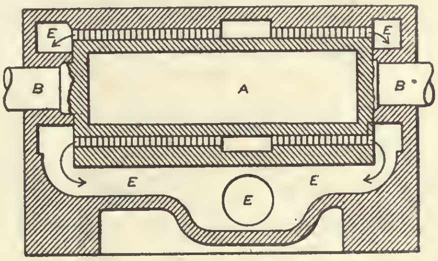


Fig. 2. First Form of Parson's Turbine.

Running of direct connected, alternating-current generators in parallel has come to be a frequent requirement, but frequent as it is, its accomplishment has been anything but an exact science. But no difficulty exists with the steam turbine, as there is no fluctuation of angular velocity, but one direction of motion and no element to detract from an even turning moment. Due to its speed, more flywheel effect is stored up than is present in the piston engine, so that steam turbines easily run together in parallel as hydraulic engines always have done.

It is now quite generally recognized that superheated steam has an advantage, although there is still much to be learned about it. Future investigations, however, in which the turbine will take an important part, will reveal more precisely its economic status, and it may be hoped that before long the net advantages to be derived from different high steam temperatures will be known. The turbine may be used unreservedly with superheat of any feasible temperature. It has no internal rubbing surfaces and there are no glands or packings to become injured; as no cylinder oil is required, there is no opportunity for lubricating troubles; furthermore, there seems to be rather more proportionate benefit from superheat with the turbine than with the piston engine because of diminished skin friction.

In every essential aspect of its commercial utility the steam turbine appears to stand on solid ground. It has its field chiefly in electric lighting and power stations, although in small sizes it has been extensively used for driving blowers, pumps and other devices; its speed, of course, prohibits belt or rope driving, but the direct connected electrical generating unit has been the aim of modern power development.

COST OF CARRYING THE MAIL.

"Harper's Weekly" produces the following information on this subject:

The United States pays the railroads, for carrying mail about $41,000,000 per annum. This sum is further increased to $46,000,000 with rental of mail cars included. In France, the railroads, in return for their grants of right of way, carry the mail free. The only exception is where the government uses a postal car of its own; then the railroad receives about a cent a mile, almost nothing, for hauling government cars. In Switzerland, prior to government ownership, the railroads received nothing; their concession from the government provided that the railroad company should carry the mails free. An exception was made where the company earned less than three and a half per cent dividend per annum. In Germany the railroads haul one mail car free. Where a second or more cars are needed, the government pays the company, if a government car, five pfenning per axle per kilometer, or ten pfenning if the the car belongs to the railroad company. This amounts to from eight to twelve cents a car per mile, representing barely the cost of hauling the cars. In Austria the same regulations prevail as in Germany, except hauling extra cars average from ten to fifteen cents per mile. Italy pays nothing to the railroads for carrying the mails, as it is provided in the concessions made to transportation companies that the government mails must be carried free. Belgiums laws are similar to those of Italy. In England, even with the immense volume of parcels carried by the British government, instead of, as in this country, by express companies, the money received by the railroads for carrying the mails is only about one-ninth of the amount paid by the United States.

Rubber boots are, at best, hot things for Summer wear, yet the farmer must either wear waterproof shoes or go with wet feet much of the time. An exchange gives the following recipe for waterproofing to apply to shoe leather: One pint boiled linseed oil, one half-pound fresh mutton suet, six ounces clean yellow beeswax, four ounces yellow rosin. Melt the ingredients and mix well. Apply when warm, but not hot, and rub into the leather. This recipe is said to be used by New England fishermen with perfect satisfaction. They often stand for hours in water without damp feet.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular ssue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

DECEMBER, 1905.

A Commission of Technical Education was appointed early in the present year by the Governor of Massachusetts to investigate the subject of technical education and report to the next General Court. Without attempting in any way to forestall the report of this commission, it can be stated that at the several hearings which were held, much evidence was given of the value of such schools, but more especially that class of schools which give evening instruction. Some doubt was shown relative to the success of a general system of technical day schools unless such schools were to replace, in part at least, the time given at present by pupils in the regular high schools. The value of the present manual training schools was strongly emphasized, but it was also plainly shown that much still remains to be done in the way of further development before attempting to add educational methods which would be even more expensive in operation than any at the present supported by muncipalities.

It was the general opinion, however, that a system of technical evening schools utilizing as far as possible the equipment of manual training schools, would be of great value to the many young men in the community who have come to realize the, value of such training but who neglected to obtain it during their younger years. Young men as a rule do not appreciate, until too late, the advantages to be obtained by becoming skilled in some trade or craft, and it is not until they have had a few years of business life that they realize their lost opportunities. To this class trade schools with evening sessions would be invaluable and the earnestness which would accompany their studies would make progress rapid and thorough, a condition which does not maintain with those of younger age. To amateurs, also, such schools would be of value, enabling them to perfect themselves in some line of work which, though followed for pleasure, would have many practical advantages.

There is but little doubt that such schools are sure to be instituted in time, and the report of this commission will be awaited with much interest, as it will undoubtedly be the basis for action not only in Massachusetts, but in many other States.

The work of forming the "American Society of Model Makers" is being pushed as rapidly as possible, and we are pleased to state that the number of letters received showing interest in the society is more than large enough to indicate an active and growing society. The membership will at first be general, and local branches started whenever a sufficient number in any one locality have signified their desire for such a branch. The work of organization will undoubtedly be completed so that full particulars can be given in the January number.

THE WIMSHURST MACHINE AND X-RAY WORK.

T. E. ESKIN.

II. Useful Accessories and Methods of Using.

We will now, before we go any further, look at the Wimshurst itself and give some account of the results of small improvements that have been made. First of all we look at the conductors. In the third machine brass was discarded and magnalium was substituted. As far as I am aware, magnalium had never before been used for this purpose. In passing it may be said that magnalium is an alloy of aluminum and mangesium, and strange to say, is lighter than aluminum. It is a better conductor than brass. It takes a high polish, especially I have found with paraffine, and when once polished practically does not tarnish. It is very easily worked and is not expensive. It is a most useful metal.

The conductors consist of two magnalium tubes 1 3-16 in. diameter, and from these magnalium rods project carrying points to collect the electricity from the plates. There are, of course, brass balls at each end of the collectors. The jars consist of four gas jars. These are very convenient, having a length of 10 in., a diameter of 2 in., and a glass bottom of 3 in. They were mounted on sheet ebonite, and after being covered for 2 in. with tinfoil, strips of India rubber were glued over the bottoms and on to the ebonite, thus holding them firm. A wood plug inside covered with tinfoil carries a magnalium rod, which is so screwed into the conductors. The ebonite is mounted on a piece of wood, and this is made to slide in or out. This is of great use, as if anything goes wrong with the belts, the conductors can be instantly removed from the stand, and the belt at fault easily got at.

Next, we may say a word about the brushes. These are generally made fixed, but we prefer two frames movable upon the axis that carries the plates. Although the machine develops the greatest power when the brushes are placed at "five minutes to five," yet when separated so that the frames are at right angles to each other the sparks are more frequent. Sometimes it happens that the machine does not readily sensitise; then moving the frames apart brings it on at once. We have made a simple arrangement by which the frames are maintained in any position. Two small pieces of wood, *AA*, are fixed by screws into the two frames; the two pieces join together at *B* where is a stout pin, which projects into a slot, *SS*. By means of two small nuts placed on each side of the pin at *B*, the frames can be clamped in any position. See Fig I.

The Brushes.—Unless these are always in contact with the plates, there is great loss of power. To insure this the following arrangement has been made: *A* and *B*, Fig 2, are two thin pieces of wood. A band of leather unites them at *C* and forms a hinge. A piece of thin brass wire is rolled round a pen, and thus made into a light spring, which is inserted at *SS*. The brushes are inserted at *D* and *D* through holes drilled in the wood, and connected up by two wires to the frame wire at *C*. By this arrangement the brushes

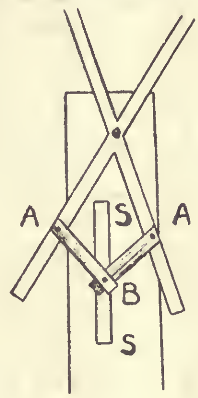


Fig. 1.

are always kept in close contact with the plates. For the single plates a thin piece of wood projects from the frame towards the plate, and on this is mounted a similar spring *S*, Fig. 2, the end of which is straight, and passes through a ring at *L* and, projecting outside carries the brush. It will be obvious that this in like manner is always pressed firmly but lightly against the plate.

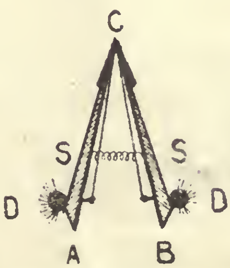


Fig. 2.

A few general hints as to working may be useful. Dust and damp are the two great enemies to effective working. The removal of the first is a comparatively easy matter. A short stick round which a piece of soft rag is wrapped can be held between the plates while they are slowly turned. It is well from time to time also to clean the unsectored sides of the plates. The tinfoil sectors become black with use. We have substituted thin sectors of magnalium well polished; these can easily be cleaned from time to time as required with a little paraffine on a rag. But there is considerable difficulty in mounting them, and so they are liable to leak. We have tried capping them with small half-moon shaped pieces of ebonite, but with very doubtful results. Probably it will be possible to obtain some magnalium foil in time, when the difficulty of mounting will be overcome.

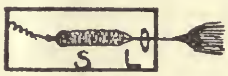


FIG. 3.

Getting the machine damp is a much more serious catastrophe, and at a thousand feet above the sea, with sudden changes of temperature and variable hydroscopic conditions, is almost unavoidable. It occasionally happens, in a sudden change from cold to warmth, that dew is precipitated on every piece of metal or glass in the house. The machine, though always kept covered up when not in use, naturally suffers. It rarely fails to sensitize, but there is no output, and if the room be now darkened a curious state of things is revealed. On each side, half the conductor is receiving positive, and the other half negative electricity. So that although the machine is alive with generated electricity, yet from the positive and negative being thus mixed up the output is nil. The only thing to do now is to go mathematically to work. Don't try moving near the fire, for fear of the plates warping—a disaster which once occurred with a small machine. By the bye, it may be useful to add that the plate thus warped was successfully straightened by placing it between two warmed iron plates from the oven and putting weights upon it. Get warm cloths and go over all the plates. Warm the glass jars and rub them well with a warm cloth. A hot brick placed under the plates is sometimes successful, but the plates should be kept turning. The flame of a spirit-lamp passed rapidly backwards and forwards underneath the rotating plates sometimes answers well. When once it is seen that all the collectors give brushes on one side, and points on the other in the darkened room, there is little probability of there being further trouble. Under the atmospheric conditions we have mentioned the machine is very liable to reverse, and the plates are best kept very slowly turning till the commencement of the work in hand.

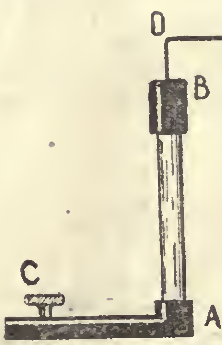


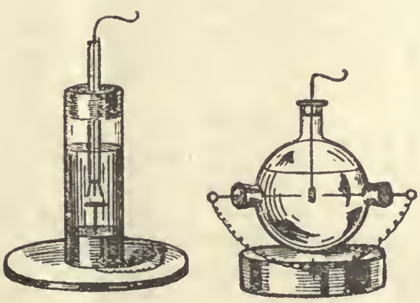
FIG 4.

We now come to the question of spark-gaps, and at the very outset one may say that each tube requires different treatment. Sometimes it has been advised to place the balls as near as possible to the tube. This in highly inconvenient, as they are constantly in the way; and further, one never feels quite sure that the tube is not endangered. An arrangement that was in use for some time and answered well, consisted of two pieces of glass tubing about one foot long. These were fixed into two pieces of wood, which were grooved at the sides and fitted to work on a slide. The balls, which were of course mounted on the glass, could easily be made to approach or recede at pleasure. Finally the following arrangement was made, and gives more satisfaction than any other yet tried: *AB* Fig. 4, is a stout glass pillar 13¼ in. long by 1¼ in. diameter. One end is fixed into a strong piece of wood 7 in. by 4½ in., through this passes a clamp *C* which holds it firmly in any position. The other end of the glass pillar is let into a piece of wood at *B*, and from this a stout magnalium rod *D* springs, which carries the ball. This piece of apparatus is so mounted that the ball is level with the ball of the machine conductor. The wires to the tube can be put on or taken off the rod *D* in a moment, while by releasing *C* the whole can be moved out of the way, or the length of the spark-gap varied on either side as is desired.

As regards the size of the balls, experiment will alone decide. We have balls from ⅝ in. up to 3½ in. in diameter. In the case of some tubes the brilliancy is vastly enhanced by the use of large balls. In the next place, we must say a word about connecting up with the tube. The thickness of the wire does not seem to be of much consequence; only if too thick, it will no longer be flexible. It should be passed through indiarubber tubing; but the connecting-up with the tube requires care. Usually with a bianodic tube a fine spiral of wire connects the two anodes. This is best removed. A fine piece of indiarubber tubing, about 8 in. long, should be taken, and a wire passed through it; at each end there should be a second piece of tubing sufficiently large in diameter to pass over the glass projection which carries each anode. The ends of the wire should now be connected with the two anodes, and the second piece of indiarubber slipped over them. The tighter the indiarubber tubings fit over each other the better, and the outer one may be turned back over the inner till the wire is fixed, and then it can be passed over the anode by turning it straight again. We now take the middle of our tubing, connecting the anodes, and make a small hole, and insert the wire connecting with the spark-gap. The junction of the wires should also be protected with a larger piece of tubing to cover it up. By these means the brush discharge from the end of the tube will be greatly diminished if not entirely done away with. Having now described all the different pieces of apparatus, we come to the actual working of the whole. This falls into two divisions (1) with primary circuit alone, (2) with primary and secondary circuit.

Primary Circuit.—Here the bottom of the jars are unconnected, and the tube is excited by the current directly from the conductors. The current from the Wimshurst is, however, feeble, and the larger the number of plates the better. The output depends on the speed of rotation of the plates. In fact, the brilliancy of tube equals numbers of plates, multiplied by the speed of rotation. The brilliancy is also affected by the spark-gap. If this is too large, the tube shows signs of reversal, particularly if a small-sized one; if too small, the glow is faint. One spark-gap of ½ in., or two of ¼ in. generally work the best.

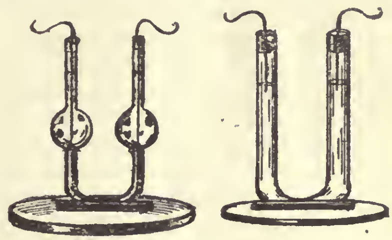
With primary and secondary circuit.—If the bottoms of the jars be joined together, the brilliancy of the tube is, as we should expect, doubled; but as the charge is intermittent, the tube is unsteady and smart sparks occur from time to time which are apt to be disastrous. Leyden jars added still further increase the brilliancy of the tube, but, of course, increase its unsteadiness. For various experiments a large number of jars are



Figs. 5 and 6.

made, and we have two four-pint jars, eight gallon jars, two still larger, and one five-gallon jar. The last is affectionately named "Jumbo," and has a table to himself, and is treated with due respect, since, having been left in the room during one evening's work, though quite away from the machine, he somehow acquired a charge, and when he was touched promptly deposited one of us on the floor. This is said as a word of caution, as it is by no means pleasant to be "knocked into the middle of next week." Experiments with the secondary soon led to some interesting results. Passing the current from the outsides through a large coil of fine wire gave very bright but intermittent flashes. A series of experiments were then made with various forms of resistances, some of which may be described.

Fig. 5 is a glass tube, 6 x 2 in., securely corked and having a small disc of magnalium mounted on a wire carried through the bottom, and outside to a terminal. Through the top passes a piece of glass tubing with a cork at the end, which is pierced with four pins. A copper wire passes down the tube and is connected to the four pins with a drop of mercury. The outer glass tube is filled with oil. The inner tube can be moved up or down till sparks pass freely between the points and the disc. This answers and gives good results.



Figs. 7 and 8.

Fig, 6 is a three-necked retort receiver, also partially filled with oil. Two rods pass through the horizontal corks, and are connected together by wires to a terminal on the stand. The vertical neck has a rod which ends in a magnalium disc. It was thought that as the tube was bianodic the resistance should be as well. It cannot be said that there was any improvement on the original one.

Fig. 7 is a convenient shape and consists of a chloride of calcium tube. The bend is filled with mercury, which extends just up to the bulb. The rest of the tube is filled with oil. The two wire pass through corks at the ends of the tubes, and spark on the mercury. Many other forms and modifications of these were tried with varying results. Generally, the more sparking points there were the better. The principle is the same in all,—viz., a sparking resistance.

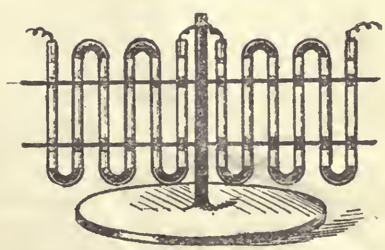


Fig. 9.

Fig. 8 is a resistance of another kind, and gives much superior results. It is a U-tube 8 in. long by ⅜ in., and the liquid used is a solution of copper sulphate. Into this two copper wires plunge. Of course any acid solution will do equally well.

The last form is shown in Fig. 9. This consists of twelve pieces of glass tubing, each 1 ft. long, connected together with indiarubber and containing solution of copper sulphate. The mounting is an upright piece of wood carrying two glass rods, and to these the tubes are fixed. A small coil of fine wire, not shown in the figure, is also interposed, and with the spark-gap properly adjusted, the tube is brilliant and steady, and seldom troubled with sparks. The resistance in the secondary act as a balance to the resistance of the primary, which is made up of the tube and the spark-gaps. If the spark-gap is too small the secondary cannot pass, and the tube is as if running from the primary only, and if too large there are sparks at the tube instead of current in the secondary. When the two circuits are properly balanced the brilliancy of the tube is most extraordinary, and the larger the diameter of the tube the better the result. One word of caution—don't leave a resistance coupled up at one end only, otherwise it will blow up with an alarming explosion and scatter the liquid contents in all directions. The results of our experiments are communicated in hopes that they will be useful to others.

HOTHOUSE CULTIVATION OF FRUITS.

Consul-General Roosevelt, writing from Brussels, tells of the development of the hothouse-grape industry and the extension of hothouse cultivation to other fruits and vegetables. He reports:

About forty years ago the cultivation of grapes under glass was practiced on a small scale at Hoeylaert, a village near Brussels, more as an experimental venture than as a business enterprise. From the beginning the experiment was accompanied by success, and from its small origin this method of cultivation rapidly developed until it now ranks as one of the most flourishing and lucrative industries in this district. Today there are no less than 10,000 hothouses in the immediate vicinity of Brussels.

The hothouses are usually from 65 to 82 feet in length, and about 26 feet in width. Heat is distributed through clay pipes.

The principal varieties of grapes are: Frankenthal, a blue, medium-size grape of fine flavor and very juicy; Big Colman, an immense purple grape of attractive appearance, somewhat too solid and lacking in juice, and the Black Alicante and Queen Victoria, both acceptable as to quality and flavor. These grapes are sold on Belgian retail markets all the year round, at prices varying with the seasons from 15 cents to $1 per pound. In the last few years the cultivation of peaches in connection with grapes, has also become quite profitable, and though still practiced on a limited scale, has produced excellent results, the yield being first class in every respect.

The cultivation of strawberries, tomatoes, spinach, lettuce, asparagus and chicory under glass is also carried on in this district by syndicates, which regulate production as well as prices. Grapes grown in this consular district are exported largely to England, Germany, Russia and Denmark, and occasionally in small quantities to the United States.

TIME DISTRIBUTION BY TELEPHONE.

The Observatory of the Bureau of Longitudes of Paris, says the "Electrical Review," is adopting a new method of time distribution by telephone. It is intended to be used in regulating chronometers and clocks throughout the city, in watchmaking and scientific establishments, and no doubt it will be of considerable value. At the Observatory a standard clock has a michrophone placed inside of the case, which receives the shock caused by the clockwork. The microphone is connected to the city telephone circuit, and thus a subscriber can receive the time regulation in order to adjust his chronometers or clocks. This can easily be done by counting the beats, and the exact time corresponding to the first beat is given by the voice through the telephone. It will be noted that the microphone is operated simply by the mechanical shock, and there is no direct electrical connection attached to the clock. Even the slightest electric contact made by the clock might have an effect upon its movement and thus put it out of order, especially in the case of a standard clock which has to be regulated within one one-thousandth of a second. With the use of the microphone, no such errors could be introduced. The method could also be used for astronomical work between two observatories, which by noting the beat could be made to work together by means of a single clock.

At Klagenfurt, in Austro-Hungary, the electric process of pipe-thawing is used somewhat extensively by the inhabitants. The winters in this region are very severe and the pipes are often frozen. The Hubner-Messimer electric firm adopted a system which has proven very successful says the "Electrical Review." A fifty-ampere transformer is installed in a convenient place near the electric lines and it is connected by two fuses to an ammeter which measures the current consumed and a rheostat. The wires from the secondary of the transformer are run to two points on the pipe which is to be thawed out. A pipe 150 feet long and half an inch in diameter can be thawed in three hours using a current of 50 amperes and 110 volts.

An interesting source of power is found at St. Pierre, S. D., where the city has decided to put in an incandescent electric light plant to be driven by waste water from the artesian wells. Tests have shown that water, coming under pressure, will develop more than enough power to operate such a plant.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

VII. Continued Testing of Lenses.

Before passing on to describe the tube and mounting I employed, I must say something as to the procedure in case of over-correction. If the polisher is made as I suggest, and the pitch is not too soft, over-correction, *i. e.*, class C^3, is not likely to occur until the final figuring is in progress; but when the polisher is graduated, a few minutes polishing makes a great difference to the figure, and it is only too easy to overdo the deepening of the center, and so get the hyperboloid. In such a case it is sufficient to make a new polisher of uniform squares and polish with short strokes. The pitch may also be a little harder with advantage. I found, in working my first 9 in. mirror, that it was quite impossible, with uniform facets, to advance beyond the oblate spheriod, class A, and it was not until I graduated the polisher that I could even get a spherical figure, much less anything like a paraboloid. The mirror, however, was very light, being only 1 in. thick. In the case of the second 9 in. mirror, which is 2½ in. thick, the same thing occurred, the figure showing no signs of altering beyond class A until the polisher was graduated. I think, therefore, that the method I have indicated is fairly safe.

The Tube.—I describe the one made for my second 9 in. mirror, as that used for the first, though fairly satisfactory, proved rather liable to warp and split. My tube is built up of ½ in. mahogany screwed to four corner-pieces of teak 1½ in. square, which extends the whole length. This gives a very stiff tube, which, at the same time, is not too heavy to be removed from its stand and carried indoors, or, at least, under shelter. The tube is 10 in. inside measurement, though I think 10½ in. would be better. The length, of course, depends on the focal length of the mirror; in my case it was 73 in. If the tube is made about 3 in. longer than this focal length it will about do.

Drawings of the tube will show, I think, how it was all fitted up. Fig. 1 is partly a section, partly a view, of the left side of the tube. Fig. 2, a view of the front and Fig. 3 of the mirror end.

AA are the corner pieces of 1½ in. teak, to which are screwed *BB*, the sides of the tube of ½ in. mahogany, an opening being left at *C* to enable the mirror to be covered by a hinged lid.

M is the speculum, supported by two small brass pieces *D*, on the backing *E*, which is circular, and

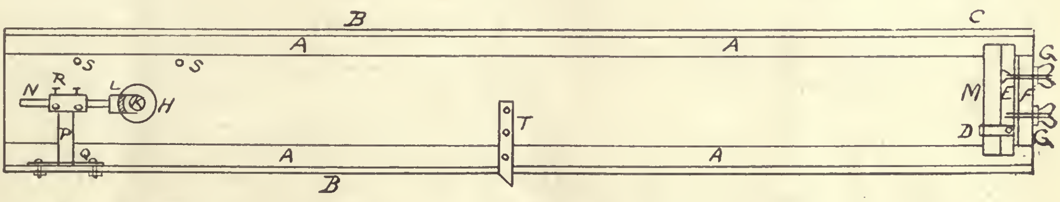


Fig. 1.

In case of pronounced over-correction, *i. e.*, when the curve is distinctly B,—I think it is best to regrind with, say, one-minute emery, or Dr. Blacklock's method might be adopted. He made a doubly graduated polisher, the central squares being reduced in size as well as those at the margin; while on a zone about half-way between center and margin the facets were kept the same size as before. I have not tried this method, so cannot speak from experience; but I think I should be rather afraid of rings making their appearance on the mirror. In making my second 9 in. mirror I obtained very slight over-correction at the finish; but a new polisher of hard pitch and uniform squares corrected this in ten minutes or so.

One more word about testing. It is very necessary to have behind the mirror, which is transparent, being unsilvered, a uniformly dark surface; otherwise false lights and shadows will show, and confuse the tests. I used black paper; but anything fairly dark will do.

made of 1 in. teak, covered with two thicknesses of cloth.

F is the end piece of the tube; also of 1 in. teak to which the long corner pieces *A* are screwed. The mirror is adjusted by three long brass bolts *G*, the heads of which are sunk flush with the front of *E*. These have adjusting nuts outside, while the mirror board *E* is pressed forward by a central pad of india-rubber, shown to the right of the letter *E* in the figure. This keeps the screw just taut without bending the board *E*; the bolts *G* pass through board and end of tube quite loosely.

H is a hole 2½ in. or so in diameter, the position of which on the side of the tube is decided by the focal length, and by the distance outside the tube at which we desire the image to be formed. If, for example, we want the image 5 in. outside the tube, then the distance from center of tube to image=5+5=10½, and the center of *H* must be (focal length—10½ in.) from the surface of M. Through the hole can be seen the flat mirror K. This is 1½ in. in minor axis—1¾ would be better—and is supported on a cylinder of teak L, cut off at 45°, to which it is clipped y copper strips. This block L is held at the end of a in. brass rod about 8 in. long, which passes quite lo ely through a short brass tube O, 3 in. by in. the rod N being held at two points by means of six screws, R. This gives almost unlimited power of adjustment in any direction. The tube O is held on a pillar of iron P, 1 in. broad by ¼ in. thick, which is securely fixed to a plate Q, 6 x 3 x ¼ in., which is secured to the side of the tube by four small bolts. I am aware that this is not the orthodox way of mounting the flat mirror; but, after trying the ordinary way in which three springs are employed, I have adopted the method shown, as it is far easier to make, to fit, and to adjust, besides being absolutely firm. As regards the definition, or rather the loss of definition, produced by the pillar P, I have not found anything to complain of after careful comparative trials.

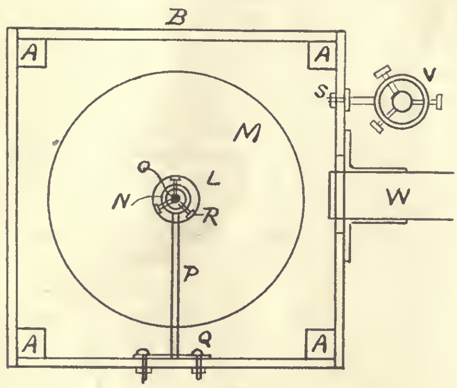


FIG. 2.

At the sides of the tube are pointed pieces TT, 9 x 1 x ½ in., which take its weight when on the stand. SS are ½ in. holes drilled in the side of the tube to take the fittings for carrying the finder. These are shown in Fig. 2.

I have made no provision for covering either of the mirrors, as I found that if care is taken to prevent violent changes of temperature the silver film is little affected by time. So long as the whole tube is kept clear of dust and protected from direct impact of rain, the mirrors do not dew over, and I have found the films on them last well over a year without renewal. The silvering process I have adopted is so quick and simple that resilvering is virtually no trouble. A cover for the end of the tube, which is stowed in a vertical position in a porch or under an open shed, is all I have been using.

The fittings to carry the eyepiece I have not drawn. Almost anything will do in the way of rackwork, such as the front of an old magic lantern, or the mount of an old portrait or other photographic lens. A visit to an optician will most likely furnish what is needful for a few shillings. Even rackwork is not absolutely essential, and I have found that a simple sliding tube about 5 or 6 in. long (Fig 2, W) with a screw thread to take the standard eyepiece screw, and sliding in another tube about 2 in. long, with a flange by which it can be fixed over the hole H (which need not be of any particular size) is practically quite sufficient. If the tube is made to slide easily, and kept lubricated with vaseline and protected from blows, which would dent it, focussing is just as easy as rackwork after a little practice. This tube is of course also used in the testing apparatus before mentioned. It will also be convenient to have a disc of brass with a hole about 1-16 in. in diameter in the center, to screw into the end of the tube in place of an eyepiece for the purpose of adjustment, as will be described later.

For merely testing the mirror on a star, a stout board, not less than 1½ in. thick, to which the flat mounting, etc., can be attached, would be sufficient, but as I said before, I recommend that tube and mounting be made as soon as the focal length is accurately known—certainly as soon as the polish is coming up. In this way we may take advantage of any fine weather that may occur for testing on a star and after all, the image of a star is the "final court of appeal" as regards the perfection, or otherwise, of the mirror.

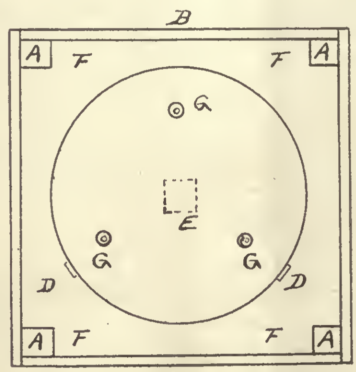


FIG. 3.

For purposes of testing, the mounting may be very simple. I have found that an ordinary kitchen chair balanced on its hind legs and carrying the tube across the back and seat, makes an efficient temporary mounting if steadied in some way by cords, struts, etc., or the telescope may have its mirror end on the ground and the front end on a trestle; in fact, a number of ways in which the telescope can be kept pointing to the Pole Star will occur to the reader, and the Pole Star is the best for the purpose on account of its brightness and its very slow motion in the field of view.

The finder is carried on two iron rings with stems passing through the holes S and secured by nuts inside. Each ring, as shown in Fig. 2 at V, has three screws, similar, but larger than those used for securing the flat, and with this arrangement adjustment is easy and quick. A finder with cross wires complete, may be picked up second-hand, or an ordinary cheap telescope, such as is sold for $1.25 or so, can be utilized. If the second or third lenses, counting from the object-glass, be removed, the telescope becomes an inverting one of lower power, and if the small tube containing the two lenses nearest to the eye be drawn out, a diaphragm will be found be placed across this, and secured, as nearly as possible at right angles and crossing in the center, by means of seccotine, an efficient finder will be provided—not that a properly constructed telescope with the necessary adjustments is not better. In any case, the provision of an efficient finder will be a great help in the testing.

In my next I will describe the method of adjusting mirrors and finder, and the mounting I have employed.

DIRECTED WIRELESS TELEGRAPHY.

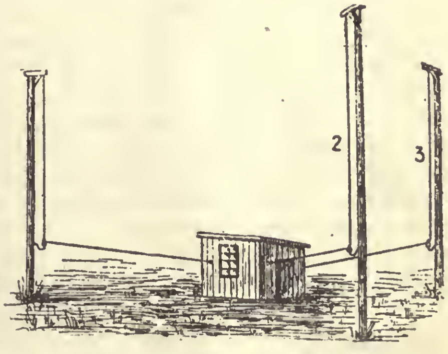
Early in July some experiments were conducted at Strasburg by Dr. Ferdinand Braun with a system of directed wireless telegraphy which he has invented. The results seem to him very promising, for he was able at will to direct the waves so as to actuate the receiver at the receiving station or not. Dr. Braun in several German journals discusses his experiments and points out the probable usefulness of his developments.

Since electric waves are governed by the same laws as light waves, it should be possible to throw a beam in one direction by means of a parabolic reflector, but the practical difficulties in the way seem to be insuperable. It occurred to Dr. Braun, however, that he could construct a system of sending wires which could be made to intensify the wave in one direction and interfere with it in another. If two sending wires are tuned to exactly the same pitch and are operated by the same exciting apparatus, but are so arranged that one of them will be set in vibration a small fraction of a second later than the other, it should be possible to obtain interference. The difficulties encountered in doing this are those of tuning two oscillators to the same pitch, and of producing the desired difference in phase.

New methods had to be devised for measuring these exceedingly small time differences. This has been done, but the method is not described. Extended laboratory experiments resulted in the development of means of tuning the wires and for producing the difference in phase sought without throwing the two wires out of tune. In this work Dr. Braun was assisted by Dr. Papalexi, of the Strasburg Institute, and Dr. Mandelstam, who co-operated with him.

The laboratory results agreeing satisfactorily with the theory, it remained to test the system on a practical scale. Fortunately a suitable place for carrying out this work on a larger scale was available in the large drill ground at Strasburg, known as the Polygon which was courteously tendered to the experimenters by the military authorities. The investigations were carried out on a small scale as compared with wireless telegraph transmission systems, since it was desirable to obtain quantitative, and not merely qualitative, results. It was intended to measure the difference in intensity of the waves sent out in different directions, and for this purpose a relatively short transmission was advantageous.

The sending station consisted of three wooden masts arranged at the corners of an equilateral triangle. Upon each of these masts was stretched a wire or antenna, from the lower point, of which a connecting wire was carried to wooden building placed at the center of the triangle, in which are mounted the various sending devices. A sketch of the arrangement is given in the accompanying figure. By means of the apparatus contained in the building it was possible o set the wires on posts 1 and 2 into synchronous vibration, and to set up a vibration of the wire on post 3 of the same pitch, but which lagged or led in phase the vibrations of the other two. Assuming the vibration of wire 3 to be slightly lagging, interference between it and that of wires 1 and 2 would take place in the direction from 3 over the house at right angles



Receiving Station.

to the plane containing posts 1 and 2. This amounts to throwing an electrical shadow in that direction. If, on the other hand, the vibrations of wire 3 were made to lead those of 1 and 2 by a proper amount, an amplified wave would be sent out in the same direction, and a shadow thrown backward from wire 3 and, at the same time, interference on the sides would take place. In carrying out this work it was necessary to obtain great accuracy in timing the vibrations of the three wires. The time differences was about one ten-millionth part of a second. Dr. Braun cencludes from his work that it is possible to adjust the time difference to within a two-hundred-millionth part of a second. This amounts to an accuracy of one second in six years.

This system of three masts is only a simple arrangement, for more sending wires might be used with an augmented effect; but for the work in hand the simplicity of the system presented some important advantages. It should be noted that transmission is not limited to one direction only with three masts, for it can be sent in the reverse direction by reversing the phase relations. By alternating the function of wire 3 with that of wires 1 and 2 it is possible to transmit messages at will in six directions. The simple addition of a commutating switch in the sending station enables this change in direction to be made easily and at will. It was found that the receiving apparatus at a particular position responded without fail when this commutating switch was in one pesition, and yet showed no signs when the position of the switch was changed. The distance of the sending station was in these researches 1.3 kilometers.

The results of the experiments were completely in accord with the laboratory investigation and with theory. In other words, it is possible by means of this arrangement to direct a wireless message through a fairly narrow angle. Dispersion takes place and is not small, but there is a decided electrical shadow in the reverse direction, and there is, in fact, a wide angle in which no effect can be measured.

If the receiving station had been equipped for transmitting messages also, it would have had three or more antennæ, and there is no doubt that these wires could be used in an analagous way for increasing the effect at that point.

The use of more than three wires would enable the transmission to be sent out through a still smaller angle with a less degree of dispersion; but it would complicate the system somewhat. The system as it is, with the three wires, is considerably more complicated than that having but a single wire, and the question is raised whether a parabolic reflector consisting of a number of wires properly arranged might not be employed with but a single oscillating wire at the focus. This is shown to be impracticable, since to be of any value with waves of the length of 120 meters, which is comparatively short, and therefore relatively favorable for this purpose—the sending wire should be about thirty meters from the reflector, and the latter should have an opening of 120 meters at the focus. Moreover, this reflector should be extended many hundred meters at the sides in order to prevent dispersion. A reflecting wire placed at this distance from the sending wire occupies a very small angle, and hence would be almost useless as a reflector.

It was found that the three wires, as used in the interference system, had no effect whatever as a reflector. Although there is no fundamental reason why this difficulty should not be overcome, there is the other objection that the parabolic reflector should be about a kilometer long to give results comparable with those obtained with the three-wire system described.

The Strasburg tests, in Dr. Braun's opinion, demonstrate that a directed system of wireless telegraphy is practicable. Five wires might be substituted, which would increase the action in one direction and give rise to less dispersion, but the three-wire system gives results as favorable as could be expected.—"Electrical Review."

The following is a simple method of removing what is commonly called damps from a well which may be of interest, says James I. Bennett, in the "Engineer." I had charge of a plant where we had a deep well, which was dug down 75 feet, then drilled some 200 feet further. The water end of the pump was down in the dug part of the well where the drilled hole commenced. The steam end was above ground and a rod connecting the two was stayed to a timber set vertically in the well. It was necessary to go down into the well every time the pump was packed. For some reason or other it was impossible to get a lantern to burn at a depth greater than 3 feet below the surface. I tried everything I could think of, but it was no use. Finally I tried the plan of forcing air to the bottom of the well by attaching a 2-inch hose to the fan of a small portable forge and lowering one end of the hose to the bottom of the well. I found that I had mastered the difficulty and always felt safe when down in the well, with some one at the fan forcing fresh air to the bottom.

German papers state that the "Great Grocery Exhibition," an association of large dealers in groceries in England, has now for the fifth time offered a prize for a safety lamp using mineral oil. A lamp is wanted which shall not cost more than 50 cents and which, regardless of any ignorance or carelessness, must not be more dangerous than a common candle. The problem seems to be hard to solve, as a prize has already been offered four times heretofore. Many lamps have, of course, been received for competition, but so far none has satisfied the judges. That such a lamp would be of great value is apparent from the fact that during last year no less than 256 fires, about 5 each week, in the London district were due to petroleum lamps.

Silver can be rolled into sheets 1-1000 of an inch in thickness, and silver foil is made so thin that it will transmit light.

INEXPENSIVE WIRELESS RELAY.

ARTHUR H. BELL.

Amateurs desiring a sensitive relay for their wireless receiver at moderate cost, have been unable to find anything in the open market cheaper than the 150 ohm telegraph relay of general commercial use.

This relay costs in the vicinity of $7 and is not exactly suitable for use in the coherer circuit because of its sluggishness. Polarized telegraph relays of high resistance winding are not carried in stock by supply houses, and the cost of a special one, built to order. would be over $15. Thus it is that the amateur, searching the apparatus field for a satisfactory combination of electro magnet and permanent magnet with which to make a relay, happens across a very common telephone part—the polarized bell or polarized ringer, as it is often styled.

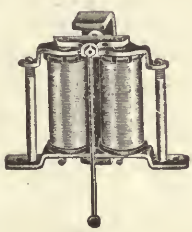


Fig. 1.

As will be seen by the illustration, Fig. 1, the polarized ringer has two electro-magnet coils, wound with very fine wire. The resistance of the wire often reaches 1000 ohms to the coil, making 2000 ohms to to the pair. In fact, there are standards of resistance for these windings, namely, 80, 500, 1000, 1500, 2500 ohms per set. The purpose of these ringers is patent to all who have read previous articles in this magazine on telephone systems, and as all reliable telephone instruments are equipped with them, every reader will have an opportunity to observe their operation in actual telephone usage.

For our purpose, however, the value of a ringer in the telephone field will not be considered. Any manufacturer of coils and telephone parts can supply these either with or without the two gongs, for less than $4, the price depending upon the resistance and quality of the winding and the general finish of the parts.

It will be noted that there is an armature pivoted over the pole pieces of the magnets, and a permanent steel magnet with one pole fastened to the yoke of the electro-magnets and the other pole an inch above the armature. Because of this permanent magnet the ringer is polarized and the armature kept in stress and acting very inert when the coils are energized. For example, a dry cell of battery connected to the coil terminals will cause the armature to tilt in a direction according to the direction the current is sent through the windings.

Here, therefore, is a simple polarized relay, readily adaptable to wireless service by connecting the coil wires to the binding posts for the coherer circuit, and placing a contact point on the bell hammer rod and a contact post on the baseboard with which to make contact when the armature swings over. The connections are exactly as with the familiar telegraph relay.

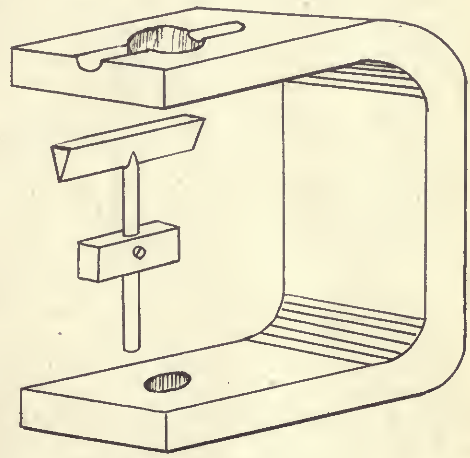


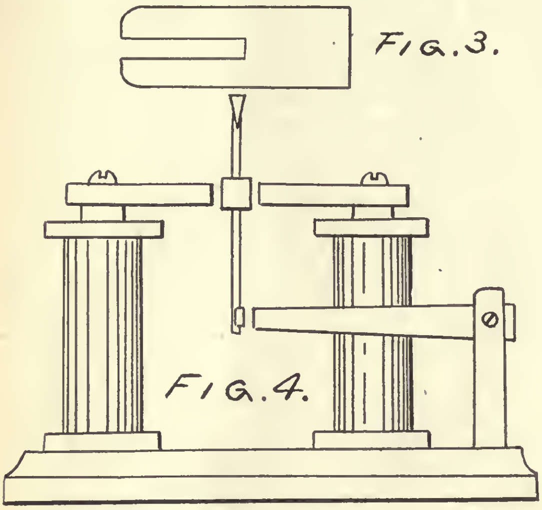
FIG. 2.

It must be understood, however, that the pivots of these $4 ringers were not calculated for the exceedingly sensitive work of wireless telegraphy, and all the parts of the ringer are not adaptable to our purpose. The bell coils and the yoke bar to which they are fastened should be kept intact. The armature and hammer and the pivot supports should be removed. The steel magnet is neither long enough nor high enough above the coils. It will be found useful some day for experimental purposes and should not be thrown away.

Another magnet of steel (Jessops) out of $\frac{1}{2}$ x $\frac{3}{4}$ stock should be forged into horse-shoe shape, with poles the same distance apart as on the magnet removed. A hole should be drilled at each end, one for fastening to the coil yoke, and the other to support a set of bearings for the armature. The piece should then be magnetized. Fig. 2 shows the general shape of this magnet.

In selecting style of bearings the knife edge is undoubtedly the easiest to make, and fully as efficient as ordinary jewels. The sketch in Fig. 2 will illustrate how the bearings of this relay are formed on the top of the magnet, which is polished with a fine file, a niche cut with the same and smoothed on an oil stone. The armature and the supporting rod must be of soft and very thin, light pieces of iron.

Out of the bell armature which was removed, must be fashioned two pieces, as in Fig. 3, to be adjustably fastened with machine screws to the poles of the electro magnets. In use these pole pieces are just far enough apart for the armature to swing in between.



The maker may use his own judgment as to the best method of connecting a contact point to this armature, the facilities for doing this being different in each individual case, but one way in which this can be done is to solder a point of platinum to the lower end of the pivoted pendulum, which contact strikes against another contact spring attached to a wooden or metal pillar post, which is affixed to the base-board near the magnet coils. (See Fig. 4.) It will be noted in Fig. 4 that when the armature swings over and a contact is made, that a complete circuit is made through the sounder.

A TROUSERS STRETCHER.

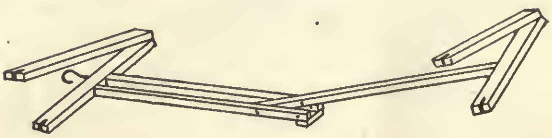
WILLIAM C. KENDALL.

The writer has tried many different patterns of trousers stretchers, but for convenience in applying or removing, as well as simplicity of manufacture, has found nothing which compares with that to be described. It has been used with marked approval of parents, that is, the fathers, as an exercise in woodworking for pupils in a manual training school, and may, for that reason be found of interest by both instructors and pupils in similar schools.

To use this stretcher the trousers are fastened near the top in the wide clamp, and near the bottom of the legs in the other clamp, the arm carrying the latter being raised several inches wheh applying. The stretcher is then turned over and the arms pressed down into line and the fastening pin put in place, thus holding the trousers at a firm tension. A hook on the wide clamp is for hanging on a clothes hook. Care must be taken not to leave snap matches in the fob pocket, otherwise the result may be surprising and disastrous.

The clamping ends are made from strips 1½ x ⅝ in.; the long clamps are 15 in. long, the short ones are 10 in. long. The arms are 22 in. long, 1¼ in. wide and ⅝ in. thick, and are mortised to the clamps. The section with two arms has the outer ends of these arms fastened together with a piece 3⅝ in. long, two brass screws in each end being used.

The single arm passes between the two arms of the other section a distance of 8 in., a pin joint being placed 1 in. from the end of the single arm and 7 in. from the end of the double ones. This is made by boring a 3-16 in. hole through all three arms and then driving in a piece of round brass rod 4½ in. in length. Holes are also bored through all three arms 1½ in. from the ends of the double arms, these holes being a loose fit for a brass pin 3-16 in. diameter and 4½ in. long.



This pin is to be removable and a very satisfactory head for the same can be made from the round screw nut found on dry cells, the pin being filed down to a drive fit, or threaded, if the latter can be done conveniently. A brass screw hook is put through the fixed arm of the wide clamp.

The clamps are held together upon the trousers by brass bolts with thumb nuts. These bolts are slipped into slots cut in the free ends of the clamps. As the bolts are liable to be lost, a better way is to use thumb screws and put pins through, the slots being made to allow free turning. It will probably be necessary to file the heads flat, as they flare out somewhat where they join the screw portion. Brass hinges with three screws in each leaf are used for the clamps, and are so attached as to leave about ⅛ in. space between each arm of the clamps.

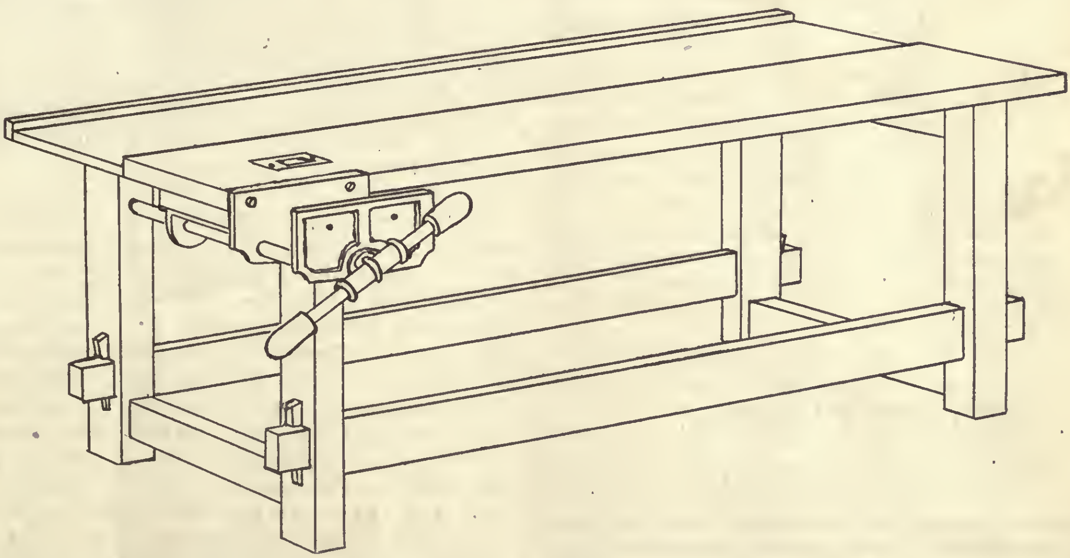
Mahogany is the wood usually selected for making the clamps, and with the brass trimmings makes an attractive appearance, but any light, strong wood will serve. Oak is rather too heavy.

For leather belts castor oil not only stops slipping, but gives the belt twice as long a life.

A WORK BENCH.

JOHN F. ADAMS.

A good work bench is a great aid in turning out work, greater accuracy being secured as well as greater rapidity, yet how many, especially amateurs, are to be found working at some makeshift contrivance of old boards, not because they cannot afford the amount required for stock for making a bench, but rather that they have never realized the value of one in their work. To readers of this class let me say, let no time be lost in ordering the necessary stock and making a bench according to these directions, as I am sure that the increased facilities afforded by such a bench will be sufficiently appreciated to win the thanks of those acting upon this suggestion.



If funds be limited, spruce can be used and will make a strong bench, but care must be used not to mar it by heavy pounding or cutting with metal tools. Maple will increase the cost, but is a fine wood to wear under heavy duty, although no bench should be used as an anvil or to stop cuts with a chisel or bit. The illustration shows a bench fitted with a quick acting vise, a fixture well worth having if one can afford the $5 necessary to secure it. Where economy is necessary an ordinary carpenter's vise can be substituted, the iron screw for the same costing about 60 cents.

The lumber bill is as follows; 1 plank 6 ft. long, 12 in. wide and 1⅞ in. thick; 1 board 6 ft. long, 12 in wide and ⅞ in. thick; 1 strip 6 ft. long, 1⅞ in. wide and ⅞ in. thick, for the top. For legs, 4 pieces 3 x 4 in. stock 32 in. long which, planed on all sides, will be ⅛ in. less each way. For the long braces 2 pieces 2 x 4 in. stock, 5 ft. 6 in. long, and for the short braces, top and bottom, 4 pieces 2 x 4 in. stock. 18 in. long.

Tenons are cut on the short braces 2⅜ in. long and 3 x 1½ in. Mortises are cut in the posts for same to bring the top ones flush with the top of the posts, and the top edges of the lower ones 7 in. from the floor. The tenons on the long braces are 4 in. long and 3 x 1½ in., the mortises for same in the posts being located to clear those for the cross braces by 1 in. After these are fitted, mark out and cut holes in the tenons to receive wedges 5 in. long, ½ in. thick and ⅞-⅝ in. wide. The object of using wedges is to give increased rigidity. All joints should be laid out with a marking gauge and carefully cut to exact fits. Poor joints mean a rickety bench.

When the frame work for the legs is completed, the front (2 in.) plank is attached by large wood or small lag screws put up through the top braces, boring 1 in. holes 3 in. deep and then continuing with a gimlet bit of the size to give a snug fit to the screws. Use three screws at each end. This plank projects forward 2 in. beyond the front of the posts. Next, attach the ⅞ in. board in the same way, using care that the two pieces are closed up to leave no crack between them.

Another way of fastening the frame is to use 3 in. angle irons, eight being necessary. The strip at the back is then attached by wood screws, the top edge of this piece to be the same height as that of the front plank, so that work placed across the two will lie level.

If preferred a wide board with racks along the top for tools may be substituted, but the writer prefers to keep his tools in cabinets where dust and moisture will not injure them. A bench stop is also to be fitted to the left end of the bench about 6 in. from the end of the bench and 3 in. from the front edge. Get the kind with hand nut for adjusting to height, instead of the kind requiring the use of a screwdriver.

Another very useful attachment not shown in the illustration is an arrangement for planing boards of various widths and lengths. A board about 22 in. long, 8 in. wide and 11-16 in. thick will be needed. Also 4 strips 4 ft. long and ½ in. square. Two of these are fastened to the edges of the front brace at the right end, leaving a ¾ in. space between for the board above mentioned. The remaining two are fastened to the under side of the front plank directly over those below, thus forming channels in which the board slips freely. The board is slipped in from the left end after boring ¾ in. holes at distances from the top of the bench varying by 1 in., but in 4 vertical lines, so that the holes will not be too near together. A plug is placed in the appropriate hole, upon which the work is rested.

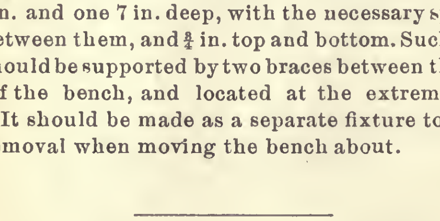
Another valuable feature is a cabinet of drawers for tools, there being ample room for one with drawers 36 in. long and 12 in. wide; having two drawers 3 in. deep, one 4 in. and one 7 in. deep, with the necessary space of ¾ in. between them, and ¾ in. top and bottom. Such a cabinet should be supported by two braces between the long ones of the bench, and located at the extreme right end. It should be made as a separate fixture to facilitate removal when moving the bench about.

A TOOL GRINDER.

RAY L. SOUTHWORTH.

A device that has proved to be very useful and practical, also a formidable rival of the grindstone or emery wheel when these are not available, is shown in the drawing.

An emery stone, preferably a coarse one, is mounted on a movable piece, and a tool holder may hold the tool upon the stone, as the latter is moved to and fro,



or the tool or piece to be ground may be held by the hands. A spring or weight may be attached to give the necessary pressure when a tool-holder is employed.

Referring to the drawing, we see that the device consists of an emery oil stone *A*, mounted upon a piece of hardwood *C* by glue, and sliding between two narrow pieces of maple or other hardwood *D*, obtained by sawing a piece through the middle. By using a piece of matched flooring, split in the center, the necessary tongues and grooves are obtained without having to make them. The pieces *DD* are screwed to another piece, which forms the base. To move the mounted stone to and fro an arm *E* extends from *C* to a wheel *G*, having a screw or metal pin holding *E*. Upon the shaft with *G* is a grooved pulley of wood upon which a belt may run, or the pulley may be placed outside the outer bearing and a crank handle attached to it.

JUST GOOD ENOUGH TO DISCHARGE.

I chanced to be in one of the largest wholesale houses of this city not very long ago and heard the manager talking with one of his lieutenants about giving a certain young man employment. The manager asked about the young man's character and habits, and inquired what kind of work he had been doing in the past. After acquainting himself with these points he finally said: "Well, I don't want any more of these kind of men who are just good enough to discharge. I have several of that kind now and I don't know what to do with them. I either want a man who does his work so well that I feel he is deserving of promotion, or else I want him to do it so poorly that I can find grounds for discharging him." It struck me that there was a good lesson for young men who are afraid they are doing more work than they are getting paid for, and who are constantly satisfying their minds with the thought that they are doing their work as well as some one else they know of. Simply because an employer does not find fault with the work his clerks are doing is by no means a sign that he is satisfied. It is just as the manager mentioned above said, it frequently happens that a clerk will do his work in such a way that it cannot exactly be criticised severely, but at the same time he may not show the interest in his work and the abilitp to take the initiative that is desirable in a man who is to hold a responsible position. The clerk who does nothing but what he is told to do should not be surprised if he does not advance very rapidly, even though he may do that work well.—"Omaha Exhibit."

Seidlitz powders are prepared in two parts, each contained in a separate envelope. The alkaline powder, which occupies the blue paper, consists of two drams of Rochelle salts (tartrate of soda and potash) and 40 grains of bicarbonate of soda, and the acid part occupies the white paper, and consists of 35 grains of tartaric acid.

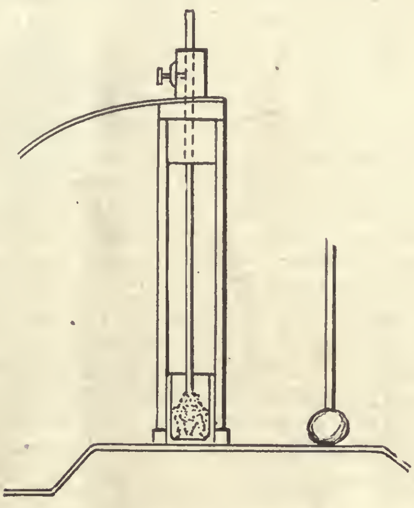
NEW SYSTEM OF WIRELESS TELEGRAPHY.

OSCAR N. DAME.

Passengers on the Sound Line Steamers plying between New York City and local ports in conjunction with the N. Y., N. H. & Hartford R. R., have become familiar with a new wireless installation which appeals especially to enthusiasts on the subject because of its apparently practical nature. This system is known as the Massie system, being the invention of Walter W. Massie, of Providence, R. I.

Knowing that AMATEURR WORK readers are interested in wireless apparatus, a description of these instruments as viewed in operation by the writer is here given.

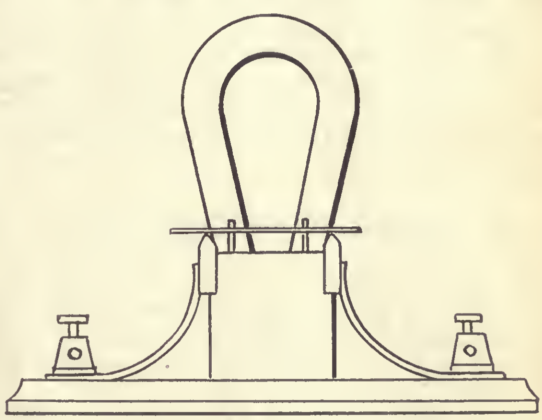
It would seem that the sending end, that is, the induction coil, is of the same type as those used in other systems. The secondary discharge is figured as 50,000 volts. This voltage charges a set of glass plate condensers, which may be adjusted to any desired capacity, and with the disruption of the spark gap, a powerful oscillation is set up in the aerial wires, and such transmission is estimated suitable for 250 miles.



In his coherer, the inventor has certainly accomplished more than his contemporaries, inasmuch as he has developed with simple materials a coherer that responds to feeble waves quickly and positively, and what is more, is subject to immediate decohering without undue tapping. The majority of coherers require blows of considerable force and beside the likelihood of cracking the glass, these violent knocks tend to injure the sensitivity.

This coherer consists of a small glass tube a few inches in length, having a metal cup or plug in the lower end and a brass collar and set screw at the top. A steel spring supported by one end on the baseboard is affixed to the bottom plug. The ccherer contains a certain amount of fine silver fillings at the bottom, and on top of this a pinch of soft iron filings. It will be understood that the iron filings are subject to magnetic influence, and the silver ones are not.

Set into an adjustable collar at the top is a fine pointed steel needle, permanently magnetized, the point of which engages a few of the top layers of fillings in such a manner as to crowd them up from the other filings. Thus there is direct connection through the coherer of extremely high resistance. It might be said that the magnetic filings are cohered to the nee-



dle at all times, the direct point of variation being where the two kinds of filings meet. When the oscillating current enters the coherer, the magnetic and non-magnetic filings cohere, greatly lessening the resistance of the circuit and operating a relay as in other systems of wireless receiving.

Decohering is brought about by a tapper which strikes gently against the free end of the spring supporting the coherer. This style of coherer is adaptable to a signal bell outfit and also to a Morse register.

In regular receiving this system employs a detector of the microphone type, which consists of two knife-edge blocks of carbon on which rests a polished steel needle. The oscillating waves vary the resistance of contact so that dots and dashes sound as buzzes in a telephone receiver connected with battery across from carbon to carbon. This method is not new, but has been improved by the addition of a small steel magnet which rests on the baseboard near the steel needle in a position calculated to exert a certain magnetic force upon the needle and hold it upon the carbon blocks so that it can neither vibrate or roll or otherwise impair the efficiency of the dots and dash readings.

This magnet is very effective and the sensitivity of the instrument may be regulated by drawing the magnet nearer or further away from the needle in order to meet specific conditions of receiving.

It is said that the resistance normally of the oscilliphone, as the detector is styled, is approximately 40,000 ohms, and after cohesion with the carbon blocks is established by the oscillating current, it drops to about 700 ohms. It would seem, therefore, that this great variation should prove very effectual in long distance work, and the operator informs the writer that shore stations have found this device accurate for fully 150 miles and that it is in daily use between Block Island and Point Judith, and Nantucket Shoals light ship, and also from the railroad shore station at Wilson Point to the Sound steamers of the company.

It would seem, therefore, that these very workable instruments, all of which are covered by patents, would prove very profitable for wireless enthusiasts to study. A sketch of the oscillator, and also of the coherer, is shown, to more fully explain the text. In the oscillator, the two upright pegs behind the steel needle are placed there to keep the needle from rolling upon the magnet. They are short pieces of smooth rod inserted in the insulated block supporting the two carbons and not electrically connected with anything.

CORRESPONDENCE.

No. 115. PLAINFIELD, N. J., OCT. 24, '05.

Will you please tell me if granulated carbon could be used in the coherer (wireless) instead of nickel or other metal filings, thereby eliminating the decoherer? If not, why?

Is it very essential that the particles in the coherer be in a vacuum? W. A. G.

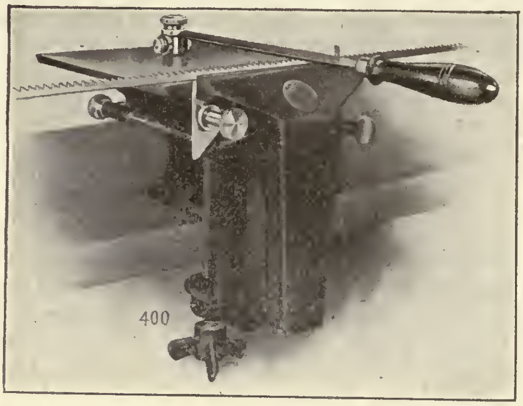
Granulated carbon could be used in a Marconi type coherer in connection with a telephone receiver instead of the relay, but the results would not warrant its use except on a short distance experimental station.

The silver filings in a coherer measure an indefinite number of ohms until the wave crosses the filings chamber, when the resistance drops to a few hundred ohms.

This great variation admits of the use of a sensitive relay, and the supplementary sounder and Morse recorder, while in carbon-granules, as has been shown in the telephone transmitter button, there is a variation in the resistance, but not to a sufficient extent for wireless receiving purposes.

TRADE NOTES.

The accompanying illustration shows a new device made by the New Britain Machine Company, New Britain, Conn., for the hand filing of band saws. It consists of a specially designed automatically-closing vise and of a roller guide which is attached to the end of the file. It is claimed by many that a band saw properly hand-filed cuts better than a machine-filed saw. Hand filing is an art that can only be acquired by constant practice and long experience. The greatest difficulty in hand filing is to give to all the teeth the same shape and to hold the file in a vertical position. The New Britain band saw filer obviates the



above difficulty, inasmuch as the file is guided mechanically in the horizontal direction and is also prevented from turning by means of the roller guide which is attashed to the end of the file. The file, by means of this guide, can be set to any angle and thus the contour of the saw teeth can be maintained uniform throughout the saw. The vise is fitted with a spring which regulates the pressure of its jaws on the saw. When filing, the tension of the jaws on the saw is ample to hold it firmly and to prevent it from chattering, and yet it allows the saw to feed along by a slight pressure of the file from left to right, as a pressure in this direction tends to release the jaws enough to allow the saw to slip, and when the pressure is removed the saw is firmly held, as above noted. This free feeding feature is regulated by a stop pin at the right of the fixed jaw which prevents the over-running of the file when sharpening or feeding. By moving the lever shown at the right of the vise the saw can be easily released when desired.

German papers state that it is a well-known fact that the presence of very small quantities of foreign substances is likely to change the qualities of metals and their alloys materially. Gold is no exception to this rule. Admixture with foreign substances often makes it brittle, while otherwise it is the most malleable and ductile among the metals. Even if alloyed with pure copper, gold shows these undesirable qualities, and such an alloy cannot be used for the manufacture of jewelry, for the coining of metals, or for other industrial purposes.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V. No. 3. BOSTON, JANUARY, 1906. One Dollar a Year.

BURGLAR ALARM FOR SAFES.

FREDERICK A. DRAPER.

The numerous and daring robberies repeatedly chronicled in the daily papers, where stores, banks and post offices have been entered, the safe blown open and contents taken, would seem sufficient in the way of warning to influence those having valuable property to protect it, especially when this can be done with comparatively little expense and trouble. That is, it can be protected to the extent that an alarm can be given of an attempted robbery, either on the premises or at a point at a distance, such as a fire or lighting station, or other place where men are on duty both d[illegible] night. The fact that a safe or other depository is protected in this way is generally sufficient to prevent any attempt at robbery, and an "ounce of prevention is worth a pound of cure."

The device by which an alarm is given in the event of interference from any cause is here described. It comprises two electrical circuits of differing strengths, working through relays located at the point where an alarm is to be given. Any decrease in the stronger [illegible]ing n[illegible]t, or increase in the weaker one will cause either [illegible] the other of the relays to make contact and

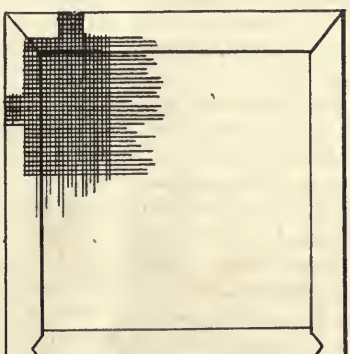


FIG. 2.

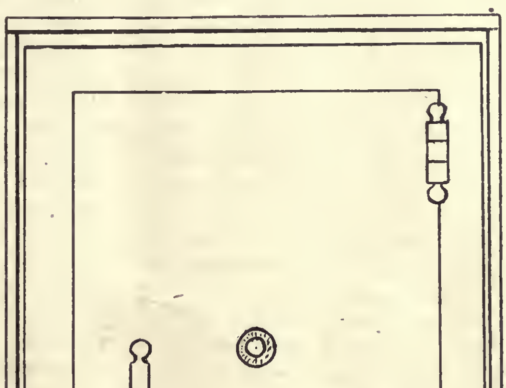


FIG. 1.

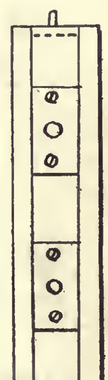


FIG. 3.

close a local circuit and ring a bell until a drop has been replaced or the battery run out. Another arrangement of two circuits is with one circuit closed and the other open, but the latter is not so efficient as the former. With the first system any break in the stronger circuit or "ground" between the two will operate on the relay, therefore the wires cannot be cut, crossed, or circuits diverted from the point protected without operating the relay. In fact, with this system a safe is not necessary, except as a protection against fire, or to retard robbers until those hearing the alarm can arrive and learn the cause.

Assuming that it is a safe which is to be protected, it is necessary to build a box of peculiar construction large enough to entirely surround the safe without touching it. In making this box, the principal object to be looked after is that no "grounds" are made by tacks, nails or screws between the wiring of the two circuits in the walls of the box. They are composed of two layers of wire screening, insulated from each other and held by a wooden frame. The screening can be obtained of any hardware-dealer.

Each side of the box is made in a separate section, all to be joined about the safe as shown in Fig. 1. The framing of a side is shown in Fig. 2, each frame being made of three thicknesses: a center one ⅜ in. thick, and two outside ones ¼ in. thick, all about 2½ to 3 in. wide, according to the size of the box; no great strength, only stiffness, being required. Only general dimensions will be given, as the requirements will differ so greatly with each case. It is advisable to make drawings of each part with dimensions before beginning construction so that contacts may be correctly located.

The sides, front and back all rest upon the floor section, with outer edges flush. The front and back lap the sides, the side on which are the hinges of the safe door, coming only to the front line of the safe to permit of swinging the door wide open, that side of the front section having a projecting piece to fill in. The top, bottom and sides project beyond the safe far enough to clear projecting, parts like the knob, by at least ½ to ⅝ in. The top and bottom also lap the front, which is removed to one side during the hours when the safe is open.

The construction of one section, a side, will be described. As before mentioned, the frame work is made in three thicknesses. A plain, rectangular frame is made with mitred corners and center brace of stock ⅜ in. thick, as shown in Fig. 2: all joints should be glued. This frame is then covered on each side with the screening, the kind ordinarily used for screen doors will answer. Where joints are made on the front edge with contact plates it will be necessary to remove the paint covering the wire with a blow torch or potash. The covers of screening should be large enough to extend, where connected to the contact plates, and with corresponding projections on the bottom sections, a trifle less than ¼ in. beyond the sides of the wooden frame. At the corners it is cut away for about 2 in. each way to a little less than the frame.

After tacking the screening to the frame both sides are covered with heavy paper, which is laid on with a strong paste or thin liquid glue. The layers of paper are to insulate the wire coverings from each other.

The screening is put on with galvanized iron tacks, on a line marked with gauge or pencil and located to clear the tacks to be put in on the other side by about ⅜ in. long, so that by no possibility can a point come through and "ground" one side with the other. The frame is now turned over, the open spaces are partly filled with straw board, excelsior or other non-conducting substance, so that in the event of moving things about and the box becoming indented, the two surfaces would not come in contact to form a "ground." This done, the screening for this side is then tacked on. A test for "grounds" can be made with a common bell and battery, one lead placed on one wire and one on the other. If the bell rings, or the hammer even vibrates, there is a "ground" which must be located and removed before proceeding further. This trouble is not likely to occur if care is used in driving the tacks.

The double screen frames are now covered on the outside with cartridge paper or other attractive covering and after nailing the sections together the outside frames are added. These are made of ¼ in. stock with mitred corners or halved joints as preferred and for the sides are the same size as the inner frame. They are fastened to the part already made with ½ in. wood screws, countersinking the heads. Use plenty of screws of small gauge, covering with putty when all is completed. The projecting edges of wire are then soldered to the contact plates, to be described later, four or more being placed on the front edge, as shown in Figs. 4 and 5. The edges, other than the front, are simply soldered together, using care that no stray wires or drops of solder cause a "ground." The joints between sections are carefully nailed.

The contact plates are shown in Fig. 6 and will have to be made up, as they are not commonly on sale of the size and shape needed. Obtain some strip brass ⅝ in. wide and about ⅛ in. thick, cut into 32 pieces 2 in. long. Drill holes in the center of one-half of them of tapping size for ¼ in. rod, and cut threads with tap. Also drill holes in the center of the other half a trifle over ¼ in. diameter, say 9-32 in. Holes are also drilled at each end of all the pieces and countersunk to receive the screws for fastening. Get some ¼ in. brass rod from which 16 studs are made to fit into the ¼ in. threaded holes. These studs should clear the plate about ⅜ in., the best way to make them being to cut the thread with a ¼ in. die, put on the plate and head over on the under side as with riveting, and then cut off the rod with a hack saw, finishing with a file.

The top, front and back sections are constructed in the same way, with wire projecting at several places with which to connect one section with another, except the front one, on which are put the contact plates as described. These are located on the inner side, four to each edge, two being connected to the inner screening and two to the outer screening, alternating them. The plates with the studs are put on the front section. The screening is soldered to the bottom of the plates before they are screwed down. These plates are put on the framework, or the sheathing with which the inner side of the front section is covered. On the hinge side of this section, a board wide enough to reach the side section is nailed, the contact plates being put on the edge of this board and the wire screening connections carried down to the under side of the plates.

FIG. 4.

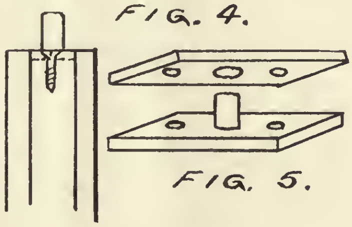


FIG. 5.

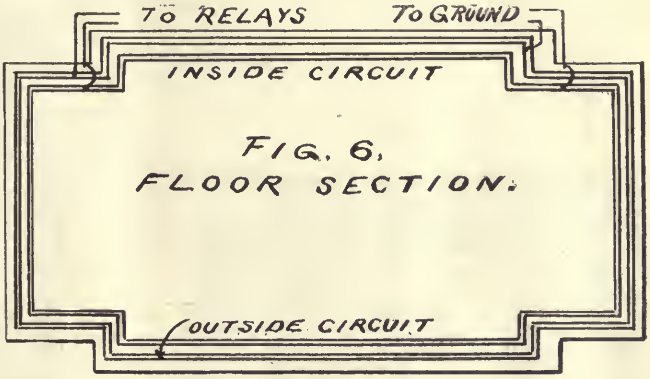


FIG. 6. FLOOR SECTION.

The front of the top section will also require that the front two inches be a plain board, hinged to the rest of the top, so that it may be lifted off from the top of the front section, otherwise the studs would prevent the front from being put in place. To electrically connect this hinged piece and the rest of the top, use four ordinary burglar alarm door springs which are set into the hinged piece and make contact with flat pieces on the edge of the top. These door springs are connected with the contact plates by insulated wire, all joints being soldered.

The floor section will have to be shaped to fit between the feet of the safe, and the two covers of wire can be dispensed with. Make a solid frame of matched boards with 2 in. cleats at the ends, the boards at front and back to be loose until placed in position. Brass angles are then to be located at the edges to make contact with the other sections resting thereon, and these angles connected electrically as shown in Fig. 7, which also shows the leads to the line wire, grounds and day loop.

Another way of finishing the outside of the box, after all wiring has been done and connections made and tested, would be to sheath it all over with thin matched sheathing, which would be more durable than the wall papering mentioned, but much care must be taken to avoid short circuits.

The electrical connections, instruments and operation will be described in the next number.

A SIMPLE PASTE.

A simple paste, easily made and that will keep a year, is made as follows: Buy at the druggist's an ounce of the best gum tragacanth. Pick clean and put in a wide mouthed glass or white ware vessel that will hold a quart. Pour on a pint and a half of clear, cold soft water. Cover the jar and let stand until the next day. The gum tragacanth will then be swollen and nearly to the top of the jar. Stir it down to the bottom with a stick and add two or three drops of the oil of wintergreen or sassafras. I prefer the former. This will prevent the paste from becoming sour or mouldy. Stir it several times during the day, but afterward do not stir it at all, leaving it to form a smooth white mass, like very thick jelly. Cover closely and set away for use, or you may take out as much as will fill one of the jelly tumblers with a cover, and keep it on your desk, handy for use. I have made this paste for several years and never lost any. I have kept it two or more years, and it has always been sweet and never mouldy. It does not turn yellow in scrapbooks, and is the best all around paste I have ever used. The gum will cost you 5 cents, and 5 cents worth of the oil of wintergreen is enough to last several years.

When melting babbit metal, care must be taken not to overheat it, or the more easily melted constituents will partly evaporate, leaving the alloy in bad condition. Melt a small portion first and gradually add to it until all is melted. Then skim off the top and the metal is ready to pour. Before pouring the metal wrap a sheet of smooth, thin writing paper around the shaft or other journal to be babbited, and secure it by winding a string spiral, in turns, ½ in. apart. Then put in the bearing and pour the metal. The paper prevents the cold iron from too quickly chilling the babbit and gives it a smooth surface, while the grooves made by the string make good oil conduits. If this is properly done, the journals will fit the bearing nicely and will not require scraping.

PHOTOGRAPHING ELECTRICAL DISCHARGES.

BY A HOBIEST.

Like most of the human race, I have hobbies, and one of them is photography. In this most interesting pursuit I delight in attempting unusual subjects, overlooked by the eagle eye (or less) of my fellows. I suppose that the reader gathers from this that I dabble in the outskirts and leave the more serious phases for those better qualified to handle them, and this I will not dispute, at the same time I find much of beauty in some of the unexplored corners.

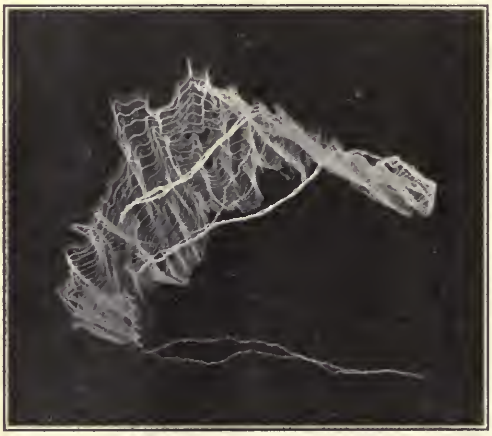


Fig. 1. Discharge of 1,000,000 volt transformer. flame 10 feet long.—By Percival E. Fansler.

In my profession as an electrical engineer, I have often marvelled at the strange outbreaks of this wonderful form of energy and have often wished that it were possible to record on a photographic plate, the brilliant manifestations of power accompanying high potential discharges. Recently, taking advantage of an exceptional opportunity, I made careful photographic study of phenomena produced by

Fig. 2. Discharge of 50-inch Induction Coil. Sparks 48 inches long.—By Percival E. Fansler.

appartus second to none in the world, and the pictures accompanying this article are typical, representing several distinct types of discharges. Before taking up the pictures in detail I might say that an electrical discharge results when two bodies, at a difference of potential or at a difference of electrical pressure, are separated by a medium, the dielectric strength of which is too low to withstand the strain imposed upon it. In other words, if we have a water pipe, closed at the end with a wooden plug, and if the pressure of the water is increased, a point is reached where the plug is forced from its seat, and the pressure is released.

This is precisely what happens when the secondary terminals of a transformer are brought into too close proximity; the difference of electric pressure existing between them is so great that the air gives way and we have an electric discharge or spark, the character of which varies with the conditions. An appreciation of the figures to be given may be gained from the statement that the pressure between the wires of an ordinary electric light circuit is 110 volts, and that it takes about 25,000 volts to jump an air gap of 1 inch. Fig. 1 is the discharge of a 1,000,000

Fig. 3. Flaming Discharge of 250,000 volt Transformer.—By Percival E. Fansler.

volt transformer, the highest pressure transformer, by three-fold, ever built. It was designed by the electricial engineering department of Purdue University, and will be used in research work. Over 100 h. p. was required to create the discharge shown, for which the terminals were separated five feet.

The photograph was made in the open air and the wind blew the flame out to the length of nearly ten feet. The terminals consisted of two brass rods held vertically on long glass arms, the lower ends 5 feet apart, the under about 6. On closing the switch a brilliant discharge occurred between lower ends of the rods, disappearing instantly, to be followed by others at intervals or 1-120 second, each a little higher than the preceding, owing to the fact that the heated path had a tendency to rise. This accounts for the ribbon effect, each individual discharge with its accompanying heat band being clearly defined. The exact exposure may be calculated by counting the number of discharges and figuring 120 to the second; in fact, this is an excellent although impracticable way of calibrating shutters.

Fig. 2 is from a similar but smaller transformer of the same type, operating in still air, and producing a more unbroken impression.

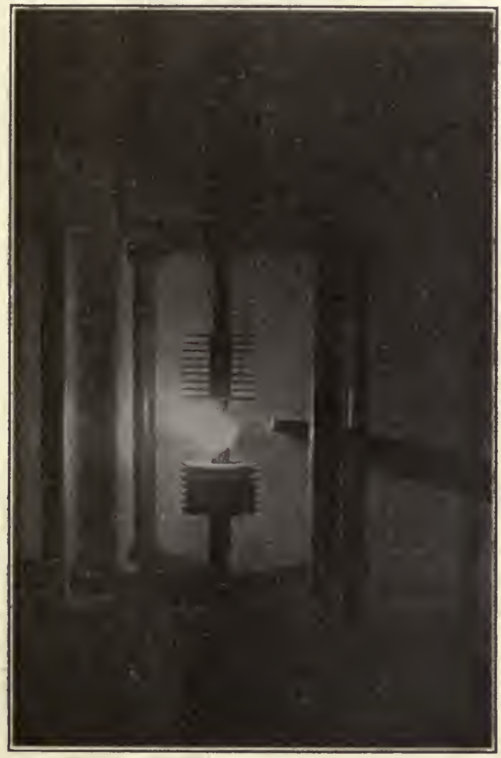


FIG. 4. SPARK GAP OF DE FOREST WIRELESS TRANSMITTING STATION.—By Percival E. Fansler.

Fig. 3 is the discharge of the largest induction coil in the world, one capable of giving a spark 60 in. long, or 18 in. longer than the classic Spottswoodie coil. This spark differs from the first two in that it is of a much higher frequency; that is, as many as 2000 distinct discharges may occur in a second.

The last picture, Fig. 4, is the spark produced in a DeForest wireless telegraph station, and was taken when messages were being transmitted from St. Louis to Chicago, a distance of 460 miles.

The discharge, unlike the others, was through but a short distance the terminals of the 60,000 volt transformer being separated but an inch, yet 20 h. p. was dissipated in the rupture and the copper flanges and air blast shown indicate the amount of heat generated and dissipated. This is, to me, a wonderful picture, lacking, it must be admitted, in composition, and with other faults, and yet it vividly portrays the utilization of a vast amount of energy for the needs of man, and in a most fascinating and spectacular way.—"Photographic Times."

TINY WORKING MODEL ENGINE.

A tiny working model of a triple expansion engine, made by Robert Bunge of New York, is perhaps the finest piece of skilled work of its kind that has ever been brought to the attention of our contemporary, the the "Scientific American." The engine measures 3½ in. across the bedplate, and stands 3½ in. from the bottom of the bedplate to the top of the cylinder covers. Every part is perfect. It is even equipped with the link reversing motion. With a steam pressure of 100 lb., 7200 revolutions per minute are made, turning a screw 2½ in. in diameter by 7 in. pitch. The high-pressure cylinder is 5-16 in. in diameter, the intermediate cylinder 8-16 in., and the low-pressure cylinder 10-16 in. The valves are of the regular piston type for cylinders, and measure 5-32 in., 7-32 in. and 9-32 in. in diameter. The shaft, the crank and the crank-pins are all turned from one piece of steel, which in itself is rather a neat piece of work. The eccentrics are split and are exact miniature duplicates of those used on engines actually in service. The nuts used in the construction of the model are for the most part a fraction less than 1-16 in. in diameter, and yet each is perfectly hexagonal. The studs are a little less than 1-32 inch in diameter and are threaded at both ends, one end screwing into the machine and the other receiving the nuts. The crossheads are made of steel, and are fitted with brass shoes that can be taken off whenever wear occurs. The steam pipe is ⅛ in. in diameter, and the exhaust is 3-16 in. in diameter. The maker may well claim for this model that it is the smallest triple-expansion engine in the world.

MUST HAVE EYES TO FIND WAY.

In China many hundred of people live their entire lives on boats. Among them there is a strange idea that a boat must have an eye painted on its bow in order to see its way through the water. An Englishman traveling in China sat in the front of a small boat with his feet hanging over the painted eye. The owner became very much excited and begged the traveler not to cover the eye of the boat, as it must see its way. When the first railroad was built through China the native workers wanted to paint an eye on the front of the locomotive. They regarded it dangerous to have so fierce an appearing thing tearing its way through the country without an eye to guide its course.

BOOKS RECEIVED.

Dies; Their Construction and Use for the Modern Working of Sheet Metals. By Joseph V. Woodworth. 384 pp. 9 x 5½ inches. 505 illustrations. Price $3.00. The Norman W. Henley Pub. Co., New York.

The use of the power press for the cheap and rapid production of sheet metal parts has progressed at such a pace during the last few years that a comprehensive book upon the above subject is at once of the greatest value to every mechanic engaged in work calling for use of dies. Competition is now so keen in manufacturing work of this kind that the most approved of modern methods are necessary to those who would attain or maintain supremacy, consequently this book upon the construction and use of dies is of great value. In writing it the author aimed to give practical men a complete presentation of all parts of the work, the fixtures and devices in use, from the simplest to the most intricate, together with numerous examples of work fully illustrated in the different stages of production. These are described in such a clear manner that all grades of metal working mechanics will be able to understand how to design, construct and use them, and all who may be in any way interested in the manufac ture of sheet metal parts may learn the best tools and processes to use.

While this subject is rather advanced for manual training schools, the book is one which would be very useful for reference and supplementary reading by those expecting to take up mechanical work upon graduating, and should be added to the list of every public library having funds for purchasing it.

American Tool Making and Interchangable Manufacturing. By Joseph V. Woodworth. 535 pp., 9 x 5½ inches. 601 illustrations. The Norman W. Henley Pub. Co., New York.

To the machinist who expects to attain to position above that of the ordinary workman, a knowledge of tool making, as applied to interchangable manufacturing, is pretty nearly an absolute necessity. To such a one, as well as the manufacturer, this book will be of great value. The supremacy accorded the machinery made in this country is to quite an extent due to the fact that the feature for interchangable parts governs whenever it has been possible to have it. This is now so generally demanded as to make it necessary that tools be manufactured by processes which will produce this result. The author of this book fully recognized this, and arranged the text and illustrations to give accurate and concise descriptions of the fundamental principles, methods and processes by which the greatest accuracy and highest efficiency could be obtained in the production of repetition parts at a minimum of cost. He also describes and illustrates a large number of special tools, together with their construction and use, as far as space would permit. All of which is done in a clear, practical way, which can easily be understood by the reader. The manufacturer, the practical machinist, the technical instructor and intelligent apprentice will alike find this an indispensible text-book, the careful study of which will be of the greatest profit.

The Standard Electrical Dictionary. By T. O'Conor Sloane. 682 pp., 7 x 5 inches. Price $3.00. The Norman W. Henley Co., New York.

The practical electrician and student will both find this dictionary a handy book of reference. While as compact as the subject will permit, yet the system of indexing and the use of synonyms following a subject enable the reader to quickly follow up any particular line upon which information is desired. As the present is the tenth edition, the usefulness of the book needs no further evidence.

Pattern Making and Foundry Practice. By L. H. Hand. 145 pp. 6½ x 4¼ inches. 104 illustrations. Flexible leather. Price $1.50. Frederick S. Drake & Co., Chicago, Ill.

The author of this book, a practical pattern maker familiar with all branches of the subject, has condensed into the limits of a pocket manual numerous examples and a great deal of information upon this important subject. In particular, several examples of railway car parts and some structural shapes are noted. The practical experience of the author is in evidence throughout the book.

The Electro-Plater's Hand Book. By James H. Weston. 278 pp. 6½ x 4¼ inches. 50 illustrations. Flexible cloth. Frederick S. Drake & Co., Chicago.

This book has been written to meet the requirements of platers desiring a practical and yet non-technical work on electro-plating. Platers of practical experience have been freely consulted in its preparation, thus giving to the contents a wider range of adaptability than is frequently the case with handbooks of this kind. The directions for the various operations are clearly given and suitably illustrated.

To fit boys to become apprentices in the shops of the Pennsylvania R. R., the board of education of Altoona has adopted a special course of instruction in the high school of that city. The plan is indorsed by the Pennsylvania officials, who co-operated with the school authorities in preparing the new course of instruction.

Russia is the fortunate country which produces about ninety per cent of the world's platinum. The remainder comes mainly from Columbia, South America.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

VIII. Mounting and Adjustment of Lenses.

As it will be necessary, in order to finally test the performance of the mirror in the telescope, to get it into good adjustment, I will briefly describe how this is done.

It is necessary, in order that the definiteness of a star may be as good as possible, that the image should be axiel— *i. e.*, should lie on a straight line joining the center of curvature to the center of the mirror. Of course, the image is actually formed at one side of the tube and outside it; but this image is merely the reflection of an image formed in the axis of the tube. The first thing is to get the center of the flat exactly level with, and central in, the e. p. tube. The disc of brass before mentioned, with the 1-16 in. hole in it, is screwed into the eyepiece tube—or a fairly high-power eyepiece with lenses removed may be used—to keep the eye central. On looking through this at the flat, the latter will appear circular; the end of the eyepiece tube will appear as a larger circle; and the two must be made exactly concentric, the six screws on the flat mounting being loosened and the brass rod supporting the flat moved until this is so. (Fig. 1.)

The center of the flat being placed exactly opposite the center of the e. p. tube, the reflection of the speculum will be seen as a circle somewhat smaller than the circle presented by the flat itself. The flat is now gently moved by means of the adjusting screws until the image of the mirror is exactly central in the flat. This is shown in Fig. 2, where *F* is the flat, *M* the speculum, and *T* the end of the e. p. tube.

The adjustment of the speculum may now be considered. The eye being kept at the aperture in the brass cap, the flat will be seen as a very much smaller circle reflected in the speculum, as in Fig. 3, where it is shown out of adjustment. This small image has to be got exactly central with the other circles seen, and here a little method is of great assistance. If the screws at the back of the speculum are arranged as I advised in No. V, a good deal of time will be saved by always working as follows: The top screw is always turned by itself, turning it, or rather the nut, to the right; move the image of the flat downwards, in a direction at right angles to the axis of the tube. Turning to the left, of course has the opposite effect.

The two lower screws are always turned simultaneously, but in opposite directions. Turning them outward moves the image of the flat to the left, or up the tube and away from the speculum: turning them inwards moves the image to the right or down the tube. Thus in Fig. 3 the top screw would be turned to the right until the image *k* of the flat is level with the center of the circles *k*, and then the two lower screws would be turned inwards until the image is central, *k*. Some such rule as this will be found to save much time, as one is always certain what the effect of moving any screw will be; but if the screws push instead of pulling, as in my tube, the rule will be exactly reversed.

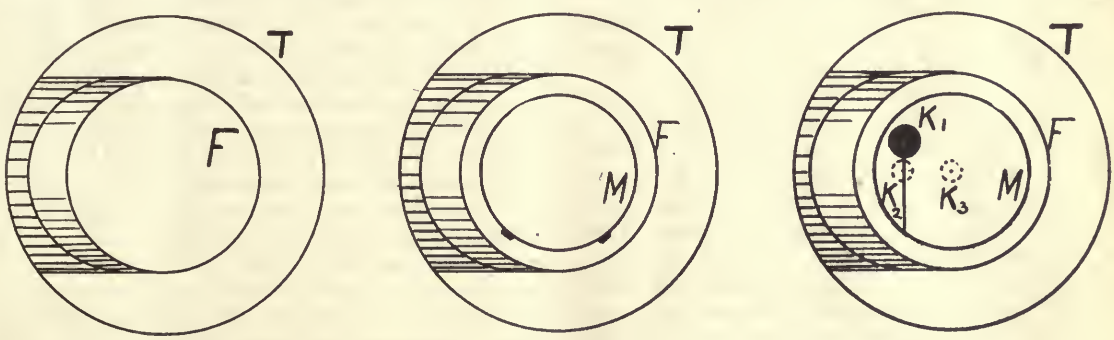


FIG. 1. FIG. 2. FIG. 3.

When all the circles are perfectly concentric, the mirrors are in adjustment, and any false light at one side of the image of the star will, if not due to the speculum, be due to the e. p. not being properly made, or the end of the e. p. tube not being cut off at right angles, or to the screw-thread by which the e. p. is held not being properly cut. To see where the fault lies, the e. p. tube may be rotated. If the fault is in the e. p., the wing, or irregularity of whatever sort, will also rotate round the image; but if it does not the fault lies in the speculum—less probably in the flat.

To adjust the finder, direct the telescope to a distant object or, though less conveniently, to the moon, and apply a low power. A little patience and care in moving the tube will soon get some object in the center of the field of view. The finder is then adjusted by means of its supporting screws until the object in question comes on or, as I prefer, just above the intersection of the cross wires, these wires being placed so as to make an angle of 45° with the vertical. A higher power may be now applied, and the adjustment repeated; but even the preliminary adjustment will serve to get the Pole Star well into the field of the lowest power, and it can then be readily brought to the center and a higher power applied. As I said previously, it is well to use the eyepiece with which most work is likely to be done in the case of a 9 in., this will be 250 to 300. Once a star is in the centre of the field of view, the finder can be finally adjusted, and it must be remembered that finder must be readjusted every time the adjustments of the mirrors are altered in any way.

My own plan is to carry out the adjustment of the mirrors when required, which is seldom, by day, pointing the telescope to the sky; the finder is then adjusted by means of a house on a hill two miles off, and I am certain of being able to pick up a star with the lowest power; the final adjustment of the finder is then easy at the commencement of observations, the system I have adopted of mounting the finder greatly facilitating the work.

The appearance of a star in the telescope I have already described; but I may say a few more words on the subject. The image, when carefully focussed, should be a very minute, perfectly round disc, with one or two fine rings round it, and without any trace of wings or flare—except that when the mirror is silvered and a bright star observed, a faint band of light, due to the flat support, will be seen extending across the field of view in the direction of the axis of the telescope. This is a defraction effect and cannot be altogether avoided; but it is of very little importance, and practically not noticeable with any but bright stars, while, with planets, I have never seen it. In the ordinary way of supporting the flat, by three springs, six of these rays are produced.

If the flat justifies its name and really is a plane mirror, the image of a star should be perfectly round —that is, assuming the speculum to be a good surface of revolution—whatever its size may be. But, if the flat is defective, the disc of the star will be a cross in focus, and if the focus is very slightly disturbed one way or the other, it will become an ellipse, the major axis being directed either along or across the main tube. If the flat gives this appearance it should be rejected, as no critical definition can be looked for—and the defect is by no means uncommon. One flat I tried, though the work of a professional optician, was utterly defective in this way, and the telescope was quite useless until I obtained another, which at once removed all trace of the defect. This defect, of an oval disc, may be due to the speculum, as in the case of Dr. Common's first 5 ft. mirror, where it was due to some molecular stain in the glass of the speculum; but any such defect would be at once recognized in the testing at the center of the curvature.

It must be remembered that any and every night is not good enough for perfect definition; and it is only when the atmosphere is at rest and free from currents of irregularly heated air, that these very delicate tests can be applied; but if a good night can be got, the defects, if any, in the mirrors, will be obvious.

METHOD OF MAKING FINE WIRE.

A new method of forming very fine wires by an electrolytic treatment has been recently brought out at Paris by H. Abraham, a well-known physicist. The process consists in diminishing the section of a wire by using it as a soluble anode in an electrolytic cell. The resistance of the wire is taken at intervals and this gives an idea of the rate at which the section is diminished. The action is thus controlled and the current is cut off when the proper point has been reached. However, in order to obtain a regular section of the wire by this process, we must observe certain precautions. In the first place, the bath must be very dilute and have a high resistance so as to give a uniform distribution of current over all the length of the wire. This also allows some latitude in placing the two electrodes and they need not be given an exactly defined position. The best solution seems to be distilled water containing a few thousandths by weight of copper sulphate, or for silver wires, nitrate of silver can be used. Second, the operation should be carried out very slowly, so that the salt which forms around the wire will have time to diffuse in the bath. If this point is not observed the bath becomes conducting to great extent when the current is high and the wire is broken. The current density to be used here is on the order of 0.01 ampere per square centimeter surface of the wire. It is well to cut down the current density as the section of the wire diminishes. The experiment can be made very conveniently in a porcelain dish such as is used in photography. Here the wire can be seen readily. It is suspended by the ends from glass hooks and is soldered at the ends to two metal rods which lie outside the bath so as to avoid local circuits. "Electrical Review."

In the petrified forests of Arizona there are trunks of trees three to four feet in diameter and over 100 feet in length, entirely changed to quartz. According to Dana, the trees now silicified in Arizona appear originally to have flourished on the shores of an inland lake into which they fell and became water logged; then they were buried beneath volcanic material of a highly silicious character, which underwent alteration through the action of water, setting free more silica than the water could hold in solution. As this change took place only particle by particle, the minutest cells of the wood are preserved and may be seen through the microscope.

CASTING IN PLASTER MOLDS.

ALBERT T. SALT.

The fact that plaster of Paris is capable of reproducing the most minute design upon a pattern has caused it to be used for casting metals when the most exact impression of the pattern is desired. There is no substance known which will do this in the manner that plaster of Paris will do it.

The best results are obtained by the use of a mixture of asbestos and plaster of Paris. The asbestos acts in the same manner as the hair which is put into mortar and holds the plaster sufficiently to prevent its cracking when the hot metal strikes it. It will read ly be seen why asbestos is adapted to the work. Its fibrous nature acts admirably for holding the plaster together, and as there is no question about its ability to withstand the heat, asbestos is used with the accompanying good results.

It will readily be appreciated that the more plaster of Paris that can be used for making the mold the more delicate the impression will be. Hence it is desirable to use just as little asbestos as possible. Experience has shown that the lower the melting point of the metal which is to be cast the less quantity of asbestos that is required. For the very lowest melting metals very little or really none is required. For the very lowest melting metals very little or really none is required, although with the lead and antimony alloys a little asbestos mixed with the plaster gives more uniform results. For gold, silver, bronze or german-silver, the following proportions of asbestos and plaster of Paris should be used:

FOR GOLD, SILVER, BRONZE OR BRASS.

Plaster of Paris	1 part.
Asbestos	1 part.

FOR GERMAN-SILVER OR OTHER NICKEL ALLOYS.

Plaster of Paris	1 part.
Asbestos	2 parts.

The kind of asbestos to use is the short fiber and not the long, stringy kind that is used for packing, board or similar materials. This long fiber asbestos interferes with the impression as the fibers are apt to get between the pattern and the plaster. By the use of the short fiber, however, this difficulty is avoided and the impression is so nearly like that of the plaster alone that it can scarcely be distinguished. The proper kind of asbestos has an appearance similar to freshly fallen snow, while that of the long and unsuitable variety has an appearance of curled hair. These points should be borne in mind when an asbestos is selected for plaster casting. There is no difficulty in obtaining the right kind of asbestos from the manufacturer of asbestos goods. To say that short fiber asbestos is desired is usually all that is required. It should be ascertained, however, that the asbestos is free from sticks or other foreign matter, as these are apt to interfere with the impression of the pattern.

As for the plaster of Paris to use, it may be said that this occurs in commerce in two kinds: Ordinary plaster of Paris used for the manufacture of walls, stucco work, center pieces, or similar work, and dental plaster. This latter is excellent and is in a very finely divided condition and free from foreign matter, but is quite expensive when compared with the other kind. For ordinary work, however, the common grade of plaster of Paris is perfectly suitable and is that which is usually employed. It will be found that it is filled with lumps, sticks, paper, or other foreign matter, but these substances may be removed by riddling. When such a purification has been done, the plaster is excellent.

Let us take for an example of an article which is to be cast in plaster, a bronze medal which has been struck with great care from a steel die. In plaster every detail may be exactly reproduced so that, with a little trimming of " fins," one would actually believe that it had been struck with a die. It is necessary for the plaster molder to have the detail reproduced but it is possible for him to do so if he understands his business. It must be carefully borne in mind, however, that all the requirements of draught, gating, pouring, etc., which are necessary in sand casting are likewise necessary for casting in plaster. The method is practically the same, and unless a pattern will draw out of a sand mold it cannot be used for plaster. The same rule applies to pouring a gating, for the result is the same in either case. It will be taken for granted, therefore, that the reader of this article understands the art of sand molding. Unless he does it is feared that he will not be able to make a good job with plaster.

Taking for an example of plaster of Paris molding, the bronze die-struck medal, let us proceed to reproduce this in plaster. The first thing to do is to see that the medal is clean and free from dirt which would interfere with the molding. After this has been done, the surface is given a light coat of olive oil by means of a brush and tuft of cotton. This is done to prevent the plaster from adhering and to allow it to be removed after the plaster has set, without tearing taking place. A light film of oil is all that is required and too much will prevent an accurate impression from being taken.

For a bench, a marble slab is excellent, for the reason that it is flat, water does not rust or warp it, and the plaster may be easily removed from it. It is advisable to rub it over with a light coat of oil before beginning the work, as the plaster will then leave it equally well as it will the pattern. Now place the medal upon the marble slab and place four pieces of wood around it in order to hold the plaster when it is poured in. These pieces of wood should be thick enough to stand by themselves.

The regular ⅞-in. pine is perfectly suitable. The width of these pieces will depend upon the pattern and it should be sufficient to leave plenty of thickness of plaster outside of the pattern. If this is not done the mold is much more apt to crack. It is unnecessary to state that the edges of the pieces of wood should be straight and smooth, so that they will lie flat upon the marble slab and also adjoin one another with a tight joint. This is necessary on account of the semi-liquid nature of the plaster, which will tend to run out if the joints are not fairly tight. When all done, this arrangement is a simple box-like appliance for holding the plaster.

The wood strips are now held down by some lead weights or other suitable methods. The nowel, which this really is, is now ready for the plaster of Paris. The asbestos is mixed with water to the consistency of cream and kept in this form. It never becomes hard, so that it may be kept indefinitely in this form. If it is preserved in such a manner, the air gradually works out of it and there is less danger of bubbles forming upon the pattern where the plaster of Paris with which it is mixed, sets. How much plaster to use for the mold will have to be left to the judgment of the operator, and he will have to be sure that he has plenty. Like many other things, this part is a matter of experience, but is not at all difficult to learn.

For the mixing of the plaster and the asbestos with the necessary amount of water an enamelled kettle or pan is quite suitable. It does not rust like a tin pan. Fill it partly full of water and sift in the plaster of Paris until it just shows above the top of the water. Now add about one-half as much of the cream asbestos as there is of plaster mixture. This proportion is taken if it is desired to cast gold, silver, or bronze. If german-silver is to be cast, an equal amount of each is taken. After the asbestos has been added, the whole is stirred and the pan or kettle which contains it is brought near the mold.

Dip a medium stiff brush in the plaster mixture and "dab" the pattern all over so that all parts of the surface are covered with the plaster. This will ensure a perfect impression being made, and also free the pattern from air bubble. This will usually take from two to three minutes. When the plaster begins to set on the pattern, or medal, which we have used pour on the rest of the plaster mixture so that the wood frame used for the flask is filled to the top. Now wash out the pan before the mixture has set hard. If this is not done it will be difficult to remove it and a dirty pan will be had for the next operation.

As this setting is hardening, another flask may be prepared. This setting, however, usually takes place in a few minutes to a sufficient degree to allow the top to be scraped off with a steel scraper so that it is flat. This operation should be done when it is just barely set, as the plaster is then quite soft and the scraping is an easy operation. The weights may now be removed and, when the plaster has sufficiently set to allow it, the strips may be removed. If the strips of wood are varnished with shellac the removal is much facilitated and the plaster does not adhere as tightly as it does to the unvarnished wood.

Now turn the mold over so that the face side is up. This will bring the pattern, or medal, into view. If the plaster has run under it a little trimming, so as to leave the face uncovered will render everything in satisfactory shape. Now cut four conical holes in the corners of this mold so that when the cope has been cast, there will be four pins to serve as guides in closing the two parts. These will answer the same purpose as pins on a regular molders' flask. The conical holes may be made with a knife or any suitable tool. They should be deep enough to prevent any abrasion taking place when the mold is being closed. The depth, of course, depends upon the depth of the pattern, but any molder knows that a flask pin must be suited to the pattern, and so it is in this case.

Now soak this plaster mold in water until it will take up no more. This operation is necessary for the prevention of the other side or cope from adhering when it is set. Usually fifteen or twenty minutes are necessary for the complete soaking of this mold, and care should be taken that it is thoroughly soaked, otherwise the two halves will not pull apart as they should. While the soaking is going on, a third side may be prepared.

When the soaking is completed, the plaster mold is put back down upon the marble slab and wood strips placed around it as before. In this instance, however, the strips must be twice the width of those used before so as to allow the cope to be cast of the same thickness. As the strips which were used before were one and one-half inches in width, they must be three inches in this case. The surplus water should be removed from the pattern and, if necessary a little more oil rubbed in it. The pattern should not be removed at all until both sides have been cast and the mold parted.

The operation of mixing the plaster and asbestos is carried out in the same manner as before; but, in this instance, the operator can probably gauge the quantity which is required with more exactness than in the other case. The experience which has been gained with the other side will give an idea of how much to use. Dab the pattern with the brush as before and then, when the plaster which has been put on begins to set, pour on the remainder. It is usually advisable to let the plaster rise a little way above the wood strips, as it can then be shaved down to a flat surface with exactness. When this side has set sufficiently, the top may be scraped off as before. The whole mold is now cast, and when set so that the mold will allow it, the strips may be removed and the mold allowed to set hard. Give it plenty of time to do this or difficulty will be experienced in getting the cope and nowel apart. Five or ten minutes will usually suffice for this and when it has been ascertained that the mold is hard enough to stand the opening operation, the halves may be pried apart by some hardwood wedges. These are inserted between the halves or at the joint. A table knife is also handy. The halves are simply pried open like a book.

If everything has been done properly, there will be produced a perfect mold and with the detail of the pattern exactly reproduced. It is better to cut the gate before the pattern has been removed, and this may be done in the same manner as in sand. Vents should be provided at the top of the casting, as there is no opportunity for the air to escape unless this is done. When the gate has been cut the pattern may be removed by means of a draw-nail or sharp pointed tool. Where to pry it out must be carefully considered, as a blemish will usually result where it is done. There are but few patterns, however, where there is not some spot which is better adapted for such a purpose than others, and this position should be used.

The backs of the cope and nowel may now be scraped so that they will be flat. This will allow an even pressure to be exerted when the halves are clamped together. The mold is now ready for drying. It will be seen that all of the water which the plaster has taken up must be driven off before the casting can take place. This is accomplished in an oven heated by gas. The heat which is best is one which is not extreme but gradual. The large excess of water should be driven off slowly and at the last a higher heat may be used. When all the water has been driven out of the mold, it will be found to be very light. As the plaster absorbs so much water, the drying is necessarily a slow operation, but it should not be hastened at all, otherwise the mold is liable to crack or blister. Take plenty of time if good results are desired. In drying, the mold should be set upon its face or back, as there is then more surface exposed for the drying and the mold is not apt to warp.

The mold, when dried, is ready for casting. The pins which have been cast on it serve to guide the cope into place, and when it has been done a hot iron plate is placed on the top and bottom and the mold clamped together. The plaster mold is also used when hot, as this insures the metal running in better shape and also obviates the absorption of moisture which a cold mold would be liable to do. The mold is now ready for casting and is usually poured on end as the castings, which are made in plaster molds, are generally thin and require the pressure of a gatehead to insure a sharp impression.

One of the requisites for successful plaster casting is the drying of the mold. As there is so much water in the mold, it dries very slowly and there is always a temptation to hasten it as much as possible. This should be avoided, as a mold which is dried quickly will warp and crack when it is being clamped.—"The Brass World."

The use of chemically treated carbons is increasing in many of the leading cities of Europe. In this case the carbons are either impregnated with a solution of certain salts, or they are cored and the salts in a solid form are placed in the inside of the carbon. The Bremer carbon is one of the most successful of these systems, and it gives a very brilliant and at the same time agreeable light which has a mellow hue and is not as trying to the eye as the ordinary arc light. In this case the carbon is treated with a fluoride of calcium solution. Besides the advantage as to the quality of the light, it is claimed that the Bremer carbon shows the highest efficiency has yet been obtained for an arc lamp, or 0.1 watt per candle-power. This form of lamp is generally used with a tight globe. It runs on ninety volts in some of the standard lamps. The light which it gives is of a yellowish color.

Steam is produced as follows: Water, although a continuous mass, is made up of a multitude of drops. Each drop of water is an elastic shell containing a certain amount of oxygen (air.) If one will take a clean kettle and place it on an ordinary fire he will notice that as soon as the water begins to get warm at the bottom little bubbles begin to form. This is caused by the expansion of the air in the water. The expansion continues until 212° Fahr. (boiling point) is reached, when the bubble bursts, the heated and expanded air passes through the water to the top, and in such passage picks up more or less of the water and becomes vaporous, when you get an expanded vapor caused by the passage of heated and expanded air through the water. In this state it has less friction than the air when expanded. In English we call it steam; the Frenchman says vapeur; the German says dampf, hot, moist air. We say a steam carriage, the German says ein dampf wagon.

New York City is about to try the experiment of making its own electric light. The high charges of private companies have had something to do with the new departure, and an interesting experiment in the use of city garbage as fuel has helped. It has been discovered that the street-cleaning department was paying to have material carried out to sea and dumped when that same material, burned under proper conditions, would furnish power for a large part, if not all of the city's public lighting. If this can be done on a large scale, material which has been a source of expense will become a means of considerable profit.

AN EASILY BUILT POWER LAUNCH.

By Courtesy of the Brooks Boat Mfg. Co.

II. Construction of Moulds and Frame.

Construction will begin with the keel. Mark out with pattern, marking lines across the keel at the places where the moulds come, being careful to get them exactly in place.

If the keel has been made in two pieces it is spliced by putting a butt block on the top side as shown in Fig. 2. This butt block is of oak of the same thickness and width of the keel, and about 12 in. long. It is fastened in place with sixteen ¼ in. tire or carriage bolts, 2½ in. long; or the splice may be fastened with the same number of 1½ in. screws.

The stem and stern keel are cut to shape from the patterns and the two parts are bolted together with carriage or tire bolts, as shown in Fig. 3. Before putting in these bolts, file the heads. Cut the rabbet in the stem ⅝ in. deep, and make the outer edge of the stem ¾ in. thick. Fasten the stem-knee to the keel with two tire or carriage bolts, as shown in Fig. 3.

Cut the transom to shape from pattern and cut transom-knee out of oak 1⅞ in. thick. Fasten the transom to the transom-knee with two bolts, and fasten the transom-knee with two bolts. Fasten the end of the keel to the transom with four 1½ in. wire nails.

The moulds are temporary forms, used to get the shape of the boat; therefore any rough lumber may be used to make them, it being only necessary that their outer edge be exactly the shape of the patterns. The moulds may be made of 4 or 6 in. strips and fastened together as shown in Fig. 5, the corners being cut out to allow of the clamp and bilge stringer laying in so as to be flush with the outside of the mould. There are six moulds in this boat. The patterns only give half of each; that is, the pattern only gives one side of the mould, to the center-line, as shown in Fig. 9. You can, however, get all the measurements for the moulds from the patterns, and when the moulds are finished, you can prove them correct by trying the patterns on one side and then turn the pattern over and try it on the other side of each mould.

To set up the frame, set the keel on two horses, as shown in Fig. 1, letting the middle sag down five inches below the ends. Get this accurately by stretching a string over the keel from end to end of the keel and then springing down the keel until it measures 5 in. from the string to the keel, in the middle. Block the keel in this position. Set the moulds on their stations. Then fasten and brace the stem moulds and transom.

There is only one stop-water in this boat, located between the end of the keel and the stem, as shown in Fig. 3.

The clamps are sprung in place in the notches at the top of the moulds. The forward ends of the clamps are beveled and brought together against the back of the stem, as shown in Fig. 8. The two ends of the clamps are fastened together with three 1½ in. No. 12 screws, two of them from one side and one from the other, as shown in Fig. 8. The ends of the clamps are fastened to the stem with two ten penny casing nails, slanted down through the clamps into the stem, as shown.

The after-end of the clamps end against the transom, where they are fastened to cleats. These are 2 in. wide and 1 in. thick, and are nailed to the inside of the transom, 1⅝ in. from the outer edge as shown in Fig. 9. These cleats may be fastened to the transom with eight or ten 1½ screws. The ends of the clamps are flush with the top of the transom, but are ⅝ of an inch from the outer edge of it. This is so that, when the ribs are put in they will come flush with the edge of the transom. The clamps may be temporarily held in place at each mould with a small screw.

On account of the length of your material you will probably have to put each clamp in with two pieces. When this is done the splice is made by putting a butt block, 12 in. long and the same size of the clamp on the outside over the splice, fastening it to the clamp with 1½ in. No. 12 screws.

The bilge-stringers fit into the bottom corners of the moulds, the same as they did into the clamps at the top. The forward end of the bilge stringers are beveled off and fastened to the side of the stem-knee with two 1½ inch screws, as shown in Fig. 10.

The after end of the bilge stringers butt against the transom, and are fastened to the bottom of the cleat the same as the clamps, and when necessary they are spliced in the same way. The end of the bilge stringers come flush with the bottom of the transom, but are ⅝ of an inch, or the thickness of the ribs, inside the outer edge of the transom.

The term ash in chemistry refers to the fixed residue obtained by burning any part of an organized substance in air. Ash usually contains the following metallic and non metallic elements: Potassium, sodium, calcium, barium, iron, manganese, aluminum, copper, zinc. Non-metals: Chlorine, bromine, iodine, phosphorus, sulphur, silicon, carbon.

"The more a man talks the less he has to say."

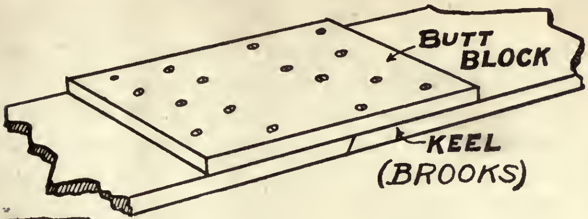


FIG. 2.

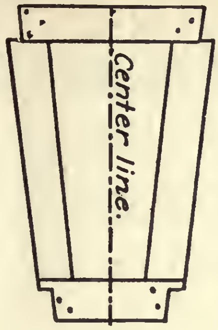


FIG. 5.

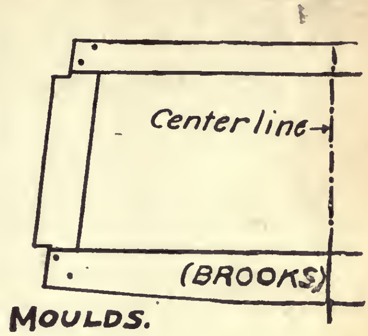


FIG. 6.

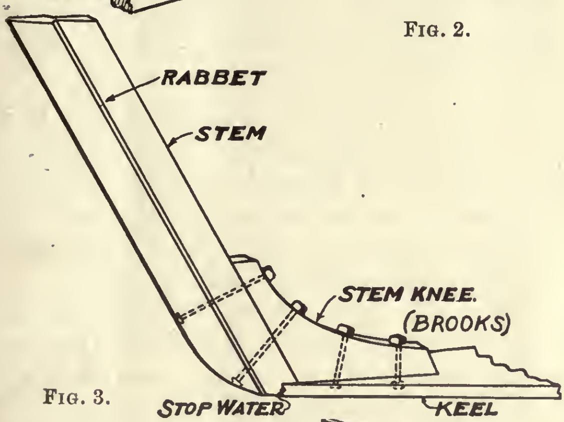


FIG. 3.

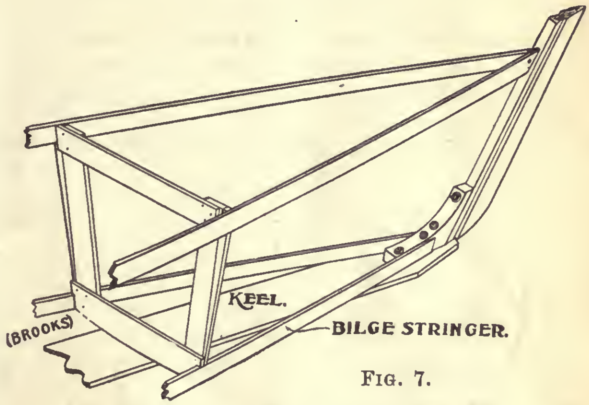


FIG. 7.

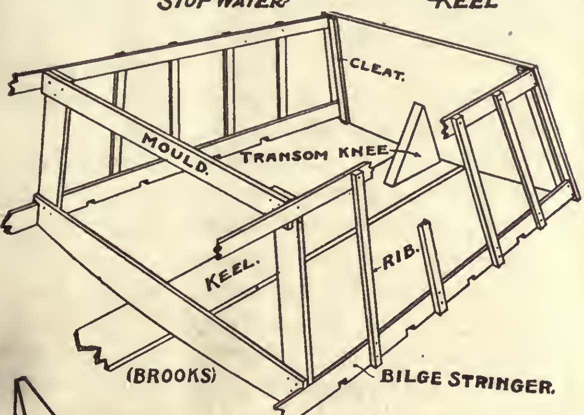


FIG. 4.

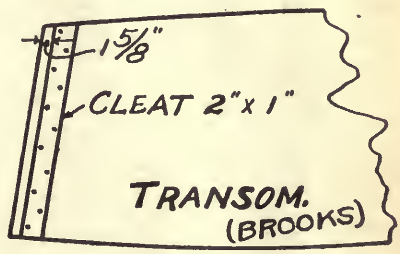


FIG. 9.

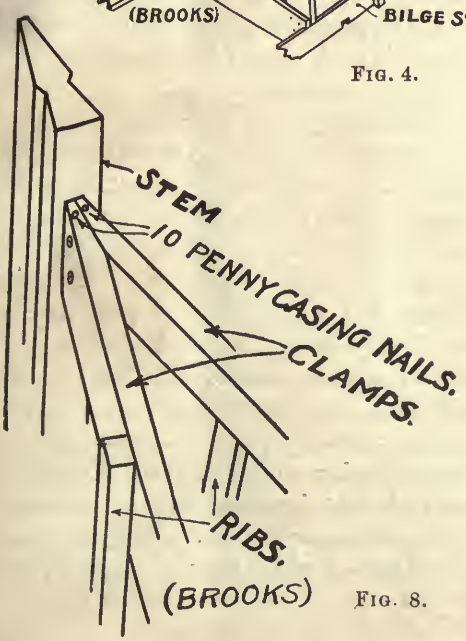


FIG. 8.

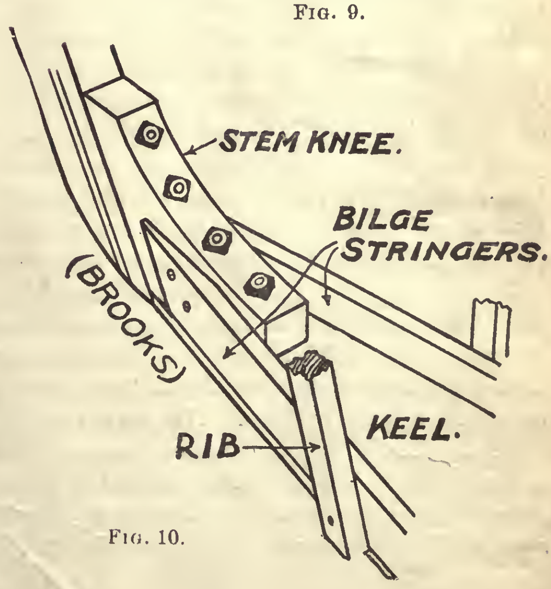


FIG. 10.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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TO ADVERTISERS.

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Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

JANUARY, 1906.

The rapid increase in our subscription list during the past few months is very gratifying to the publishers of this magazine. The wide territory from which subscriptions have been received enables us to say that the "Sun never sets on Amateur Work."

Australia, New Zealand, Philippines, Hawaii, Alaska, many countries in South America and Europe gives to our circulation an international character.

This may prove of decided value to tne "Society of Model Makers" when organized, enabling the members by correspondence to obtain information about work in all sections of the globe. As our readers undoubtedly have kindred interests, those contemplating a foreign trip will be given the names of subscribers in the countries they contemplate visiting, and we feel confident that acquaintances formed in this way will be pleasant and profitable to both visitor and visited.

The organizing of the "Society of Model Engineers" is progressing as rapidly as circumstances will permit, much correspondence being necessary in the drafting of the articles of incorporation, constitution and by-laws. We have received a large number of letters from readers expressing a desire on the part of the writers to become members, and we have no question of the very successful results which will follow when the Society is in active operation. Many writers have suggested that the Society procure designs and parts for model engines, tools, etc., and one of the first things to be taken up will be the offering of prizes for the best designs and descriptions for various models. Readers having any particular wants in this line, are invited to express them by letter, that those of greatest interest may receive first consideration.

The mention of the proposed "Society of Model Makers" has occasioned this question from a few readers—"Of what value is model making?" The answer has been the subject of a number of articles in this column, but its importance is great enough to warrant further attention.

The making and use of well designed and constructed working models, is probably the best possible method of learning the construction and operation of the machine of which they are a reproduction on a small scale, short of actual work upon those of full size. As circumstances prevent the great majority of readers from complying with the latter condition, the model alone remains as a subject for work and study, hence its great utility as a means of instruction, combined generally with the additional advantage of being the source of much enjoyment.

The practical side lies in the fact that knowledge acquired in this way may, at some future time be of the utmost value in fitting one to occupy a more responsible position in industrial life, but even if such direct benefits should not follow, many advantages not so evident are quite probable. The ability to grasp mechanical conditions may enable one to appreciate the merits or the faults of an invention or industrial enterprise to the end that a profitable venture is begun or an unprofitable one avoided.

The amateur mechanic or electrician of ability and experience is not the one who puts time or money into Keeley motors, non-refillable bottles, or gold-from-sea-water delusions, but, on the contrary, it is the class who have given no time to model making and study, and are consequently without the education to be derived therefrom who, because of that ignorance cannot discover the false note accompanying such enterprises, and rush into investments which can never prove profitable, and many times lose the savings of years.

A CORNER CUPBOARD.

CHARLES R. BLAISDELL.

Those of us bachelors, young or old, who are obliged to make one room serve the purposes of a suite, may find the corner cupboard here described of assistance in providing additional storage for wearing apparel of various kinds; hats on the shelf, clothing on the hooks and rubbers on the floor. It requires but little in the way of lumber, and if measurements are made before ordering all the sawing can be done at the lumber mill, leaving the work of putting together to consist of driving a few nails and screws.

It should not be higher than the picture moulding of a room, which in many houses is below the frieze of the wall paper. If this moulding is at the top of the wall, as it is in many houses of recent construction, the height may be about 7½ ft. The width will depend upon the size of the room and the space available, but most rooms have a corner allowing a cupboard at least 4 ft. wide or, more properly, front measure in this case.

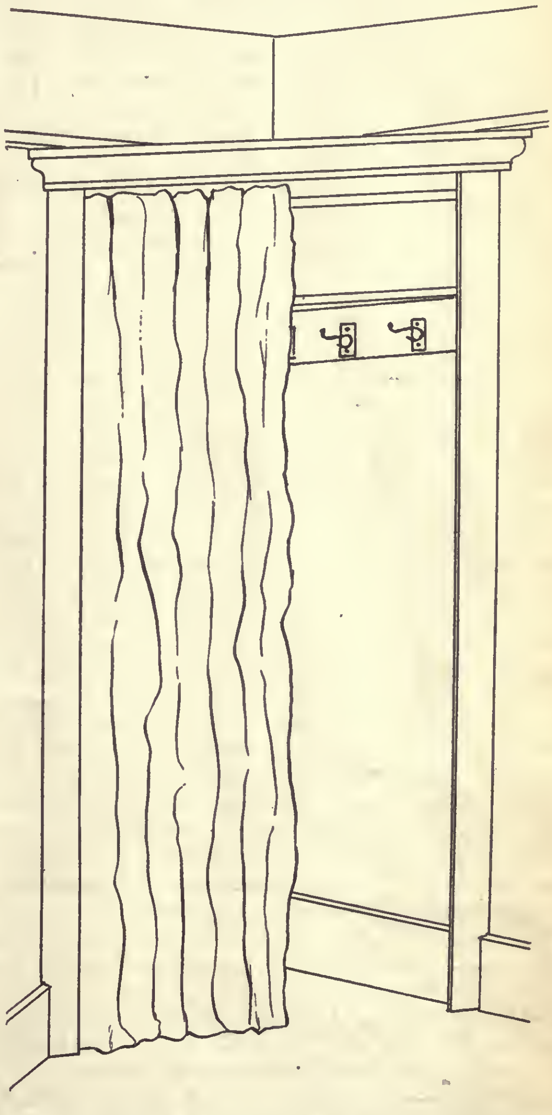
The wood used should be that like the room in which it is to be placed, or similar to it. Cypress can be used in a room finished in white wood, chestnut or ash, and is a good wood for the purpose. The necessary pieces are: A strip of moulding at the top; three pieces 3½ in. wide, one at each side and one at the back; two pieces 3 ft. long and 5 in. wide to support the shelves, and a piece 5 ft. long and 12 in. wide for the shelf. The latter piece is sawed into two pieces, the cut being at 45° angle, to give one piece 4 ft. long, the other 2 ft. long on the longest edges, the other ends being also cut off to the same angle.

The method of attaching the pieces permits of their being easily taken apart in case of a move, a matter not infrequent with those who board. The moulding is attached to the two side strips by 1½ in. screws, the heads being on the inside.

The two supports for the shelf are fastened together at the ends in the corner with two 3 in. angle irons and ½ in. screws. The outer ends are attached to the side pieces in the same way, after first bringing the angles to the increased angle at which these pieces meet. A block of wood can be screwed to the side pieces under the ends of the shelf supports to help carry the weight should it be thought desirable, although it will hardly be necessary.

It will be noted in the drawing that the lower ends of the side strips are cut out to fit over the baseboard of the room. These ends are also fastened by angle irons to the baseboard. If there should be any objection to putting screws into the baseboard, two strips 3 in. wide are run from the side strips and fastened the same as were those under the shelf.

The remaining long strip is now cut out to a halved joint and fastened with screws to one of the supports for the shelf, and the lower end to the baseboard or to one of the strips just mentioned. It will be necessary



to keep it all rigid by fastening with angle irons to the wall somewhere, preferably just above the shelves. The shelves are not fastened or at most, by two screws at each end. A curtain pole and portiere complete the outfit, after having put on the clothes hooks.

THE PROBLEM OF THE GAS TURBINE.

Abstracts from an address by A. Dougal Clark, Prest. of the Junior Institute of Engineers, London.

The wonderful success obtained by your distinguished Past-President, the Hon. C. A. Parsons, and his many able followers with the steam turbine in its various forms, has naturally attracted the attention of engineers to the apparently analogous problem of the internal combustion turbine. Accordingly, much mathematical and engineering ability has been recently devoted to the subject so far, I am sorry to say, without concrete result. In this subject, as yet, the dreams of the theorist obstinately decline to realize themselves in tangible iron and steel.

I have not been able to find any gas-turbine in a state of effective rotation doing useful work, though I have noted many statements in the Press to the effect that some wonderful German, French or Italian gas-turbine had worked, or was about to work in such manner as to relegate the ordinary cylinder and piston gas-engine to the museum with which many engineers used to threaten the steam-engine. One gas-turbine only has really rotated within my own direct knowledge. It was designed by Mr. F. W. Lanchester of Birmingham, to operate with exhaust gases from one of the petrol engines used in his well-known motor-cars. He assured me a few days ago that it really rotated at a high speed, and made a loud shrieking noise, but only gave, he said, a total brake horse power equal to that capable of being evolved by two bluebottle flies. This power he did not consider satisfactory.

Speaking seriously, it does seem remarkable that so much interest should be taken by so many able men without any sort of result in practice. Why is this? I propose tonight to answer the question in so far as I can. It appears to me that most of those who have written on gas-turbines and have even designed and patented them, have given too little weight to certain differences between the steam and internal combustion engine problem. Many, indeed, have assumed that the solution of the gas-turbine problem is the easier of the two, and that few difficulties exist which have not already been met and conquered by Mr. Parsons in the steam turbine.

Many distinguished men have been of this opinion; and even Mr. Parsons himself, so early as his first turbine patent, appears to have been of the opinion that the hot gas or internal combustion turbine presented practically the same problem as the steam-turbine. In his specification Mr. Parsons clearly intended to apply his invention to the gas-turbine as well as the steam-turbine; and he outlined the fundamental idea of nearly all subsequent proposals of gas-turbines. Many other inventors have followed him; but I may only mention two well-known names—those of Ferranti and Stodola. Both have proposed turbines similar to his, with more or less elaboration, as well as other modifications intended to overcome certain difficulties.

In most of the recent discussions upon gas-turbine problems, it has been recognized that the temperatures possible to the cylinder gas-engine are impossible for the gas turbine. It has been fully proved by many investigators, including myself, that the temperature quite common in ordinary gas-engine practice ranges as high as 2000° C., though in the best practice, for most economical results, 1500° C., or 1600 C. appears to be an upper limit. With these temperatures a first-class modern gas-engine of about 40 h. p. will give an indicated efficiency of 35 per cent. At the same time the negative work of the cycle is so low that the mechanical efficiency of the engine may be as high as 86 per cent, or even more. If one realizes what the temperature of 2000° C. means, it becomes very evident that no turbine constructed either on the lines of Parsons or Laval could possibly be made to work with continuous supply of such gases; as 2000° C. is considerably above the melting-point of platinum. It is much higher than the temperature at which cast-iron flows from the blast furnace or, indeed, the temperature of the interior of the blast furnace. Any blades of iron, steel, or, in fact, of any other material, even fire-brick itself, becomes fluid or semi-fluid at the temperature. It is obviously hopeless, therefore, to attempt in the gas-turbine temperatures which are quite feasible in the cylinder-engine. This fact as I have said, is accordingly said, by those who take a favorable view of the gas-turbine, that it is necessary to supply the turbine with gases at a much lower temperature. Mr. Neilson fixes the temperature of 700° C. as one which steel turbine blades would probably stand without too rapid deterioration. I fear that on this point I must differ from him, because in my experience, oxidation of steel and even iron, is a fairly rapid process at this temperature. Nothing new has been proposed as to the thermo-dynamic cycle of the gas-turbine; so that all reasoning upon efficiencies depends upon the deductions already made from internal combustion engine practice.

Seeing the impossibility of consuming a turbine with materials to stand a high temperature, many have proposed to convert high temperature into kinetic energy, so that instead of having work stored up in the gas in the form of heat, the heat shall disappear and the energy of the heat be transformed into motion of the gaseous particles at a high velocity. Such proposals, then, include the compressing of a gaseous mixture to (say) 50 or 60 lbs. above atmosphere; the igniting of that mixture within a combustion chamber at constant pressure; and the expansion of the mixture through an expanding jet of the Laval type so as to drop the temperature and obtain its equivalent in kinetic energy or velocity of the gaseous particles. The rapidly moving particles at the relatively low pressure and temperature are then allowed to impinge upon rapidly rotating blades of sickle co-figuration; and they are supposed to give up their energy of motion to the blades, and so expend work upon the turbine. This appears to be the most feasible of all the gas-turbine proposals, so I will proceed to examine it little more minutely.

Success by this cycle of operations requires (1) A rotary or turbine compressor of high relative efficiency· (2) An expanding nozzle which shall insure that free expansion is quantitatively equivalent to adiabatic expansion behind a piston. (3) A rotating turbine of such construction as to secure a very high efficiency of kinetic energy of the moving gas into effective work available at the turbine shaft.

Assuming air to be the working fluid, and the specific heat to be constant through the temperature range, it is easy to calculate the efficiency of the Joule or Brayton cycle, that these operations in effect represent. It would be useless to attempt to work a turbine at a pressure so low as to be relatively inefficient compared with the gas-engine, so I have chosen a Joule cycle of (say) 48 per cent ideal efficiency, which in a cylinder gas-engine would probably give in practice about 30 per cent, indicated efficiency. For the ideal efficiency the pressure of compression would require to be 141 lbs. per square inch absolute. To give power with a reasonably small pump, I shall assume a maximum temperature of 1700° C.—that is, assuming a perfect compressor and a perfect nozzle expander, the temperture would only fall from 1700° C. to 750 C. Plainly, this temperature would be too high for a Laval disc with blades. In order to get a reasonable temperature in the combustion chamber, no higher than 1000° C.; and this would bring down the temperature after complete expansion to about 500° C., which, no doubt, steel turbine blades can be expected to stand for some considerable time.

With these assumptions, however, the gas-turbine would not be very economical as compared with cylinder engines, even assuming all difficulties overcome. The theoretical and practical difficulties, however, are very serious indeed. To begin with the question of an efficient air-compressor, I am not aware of any turbine compressor capable of compressing up to 140 pounds, absolute from atmosphere from anything like 60 per cent. efficiency. Before success could be attained, this efficiency of compression, so far as the diagram is concerned, should be at least 90 per cent in order to allow for unavoidable mechanical and other losses in the subsequent processes. It has, it is true, been proposed to substitute cylinder compressors operated from the turbine, instead of turbine compressors; but this, it appears to me, would be equivalent to abandoning at once all the advantages of the turbine principle. If reciprocating cylinders are to be used for compressing, there is no objection to using them also for expanding. No gas turbine with cylinder compressors could, in my view, succeed.

Assuming, however, even 90 per cent efficiency from a turbine compressor, and assuming that we have a compressed gaseous mixture burning freely in the combustion chamber at the desired pressure and temperature, we have yet to face the problem of the expanding nozzle. It is always assumed that, with the use of an expanding nozzle, temperature drop can be as certainly attained as with an expanding piston in a cylinder. This, it seems to me, has by no means been proved.

You will all recollect Dr. Soule's famous experiment with two vessels immersed in water and connected together by a pipe having a stop-cock upon it. Air was compressed into one of the vessels, the water round the vessels stirred and equilibrium obtained, while the other vessel was rendered as vacuous as possible, and it was then found that, when the water was stirred again no disturbance of the equilibrium ensued. This, of course, meant that though heat was lost in the one vessel — giving velocity to the gases —it was gained in the other by the impact of the gases against the walls.

Joule modified this experiment by placing the two air-vessels in separate water containers. He then found that the temperature of the one dropped, due to expansion, but temperature of the other rose as much as the first dropped. Apply this experiment to reasoning on the behavior of the flame in an expanding nozzle. Assume the two vessels to be connected by a Laval nozzle, and assume that while in the nozzle the gases experienced the full temperature fall due to adiabatic expansion. Immediately, however, on contact with the walls of the second vessel, the velocity of the particles would be stopped, and the temperature would be restored to a point somewhat above the original temperature—that is, the mass of expanding flame in the pressure vessel would gain heat by the amount the first vessel lost. This is the result of the final process. It will be easily recognized that to obtain sufficient temperature drop in an expanding nozzle, necessitates the practical absence of turbulent motion of every kind—that is, to expand adiabetically, the jet must be so constructed that there is an absolutely smooth flow from high pressure to low, and no impact or loss of velocity from any cause whatever. So far as I understand expanding jets, no adiabatic expansion so perfect as this has ever been obtained.

Assume, however, that the efficiency of expansion in such a jet is (say) 90° per cent. We now come to the question of the efficiency of conversion by the turbine blades. In many calculations from diagrams, it is assumed that the efficiency of conversion of motion into work is practicaly perfect. This, however, is by no means the case in present turbines. Even the steam-turbine, high as its efficiency is, compared with the reciprocating engine, has no very high efficiency of conversion in any of the forms of turbines that are at present on the market. That is, if we assume a mass of gas to exist in a compressed state in a reservoir, and we choose to expand this mass of gas in two ways—for the sake of comparison, (1) behind a piston, and (2) by means of a Laval jet and turbine—we shall find that the efficiency of conversion of the turbine, when once high velocity is attained, does not exceed 80 per cent. In this respect the efficiency of conversion of rotating turbine blades is inferior to that of a moving piston in a cylinder. The reason of this is obvious. It is impossible to so arrange the impact of a rapidly moving gas with a turbine blade or blades in such a manner as to entirely avoid any turbulent motion.

The impact, for example, of swiftly moving gases on a fixed surface ultimately results entirely in turbulent motion, which restores to the gas or to the blade struck all the heat which has disappeared in temperature fall due to adiabetic expansion. What is true of a fixed blade is to some extent also true of the moving turbine blades. A certain proportion of the energy existing in the gas in the form of motion is inevitably lost when this gas comes into contact with any solid surfaces. So much is this the fact, that in designing steam-turbine blades for any type of turbine, the shape of the blades, the shape of the space between the blades—both moving and fixed blades, or fixed jet and moving blades—is of the first importance; and it has only been found by experiment that certain shapes of blades and passages have a much higher efficiency of conversion than other shapes.

In this respect, too, the turbine principle is inferior to the cylinder and piston. In a cylinder, with gases expanding behind the piston, the efficiency of expansion may be considered to be 100 per cent, and even an efficiency of compression in many gas engines is also the same order. I do not here refer, of course, to heat losses due to conduction, or anything of that kind, but to efficiency of adiobatic compression or expansion.

Although the efficiency of expansion is relatively low for gases in steam-turbines, yet the turbine offers a great advantage in total work obtained from steam. This is due to the fact that the turbine avoids initial condensation; and, further, it permits of the utilization of a very long range of expansion at the low-pressure end, which is not available in the case of steam-engines. By saving, therefore, in minimizing initial condensation, and in obtaining added work from pressures wasted in the ordinary steam-engine, the Parsons steam-turbine more than compensates for any inefficiency of expansion as compared with the cylinder engine.

It is well known, however, in turbines of practically all constructions, including that of Mr. Parsons, that the efficiency of the steam-turbines is not so great as that at the low-pressure end. This is partly due to the difficulty of adjusting the velocity of the blades to suit the necessarily varying velocities at different points of the flow of the steam. This, however, is a small difficulty with the steam-turbine, but a very considerable one with the gas-turbine. Compared with cylinder expansion, I cannot see how it is possible with present knowledge to obtain an efficiency of conversion in a gas-turbine greater than 80 per cent. This is partly due to the high velocity of the issuing hot gases.

To produce an efficient gas-turbine, therefore, on the favorite cycle so much discussed recently, it is necessary first to have, as I have said, a very efficient compressor, a very efficient conversion when the moving gases strike the turbine blades. Using the numbers I have suggested, of 90 per cent efficiency of nozzle expansion, and 80 per cent efficiency of conversion in the turbine, we have a cycle having negative work equal to 0.4 of work in compression, we shall require 0.445 of work put into the compression. On expanding in the nozzle, we shall obtain 0.9 only of the total energy of flame gates in the shape of kinetic energy; and of that 0.9 we shall only get 0.8 returned in the shape of available work by the turbine part. That is, we shall get a total work from the turbine of 0.72; and deducting the negative work, $0.72-0.445=0.275$. That is, from a cycle which should give us 0.6 in work, we shall only get 0.275 or about 22 per cent.

The practical efficiency of an engine of this kind will only be 22 per cent, even assuming the high efficiencies of compression and jet expansion which I have mentioned. In my view, no such efficiencies of compression or jet expansion are at present known; and accordingly there appears no likelihood of the production of any gas-turbine which can rival the reciprocating gas-engine in efficiency and in economy. To produce such a turbine requires the solution of three problems: (1) An efficient turbine compressor, comparable in efficiency with cylinder compression. (2) An efficient nozzle expander with a higher efficiency than 90 per cent. (3) An efficiency of conversion of kinetic energy of the moving gases into work delivered at the turbine spindle of greater than 80 per cent. Either these problems must be satisfactorily solved, or else new materials discovered which will stand temperatures which at present melt firebrick. The outlook, I fear is not hopeful.

From what I have said, you will see that my view of the future of the gas-turbine is not favorable. But, notwithstanding, the subject is so fascinating that many inventors and scientific men will doubtless continue to investigate the problem; and possibly new solutions may be discovered which are not dreamed of today. I am the last man in the world to deprecate daring in any practical and scientific work; but I would advise the junior engineers—members of our Institution—to avoid the subject, except as a scientific study. I fear there is little hope for a young man to make a position and a business success of any internal combustion turbine, so far as present knowledge carries us.

PHOTOGRAPHY.

WATERTONE SEPIA PRINTING PAPER.

JAMES THOMPSON.

Sepia watertone papers, simple to work and cheap withal, are not a novelty, and to some it may seem superflous for me to instruct the amateur worker as to a manner in which he may prepare such a printing media for himself. The papers on the market are, it must be confessed, most convenient for the multitude, coming, as such do, all nicely coated and cut to convenient sizes.

Some individuals there be too indolent to do anything for themselves, and from such the dealer will always reap a harvest, high cost being no bar to the customer's purchasing. Some there are are, on the other hand, who buy the good thing only when it is cheap, and to such the sepia watertone paper wili appeal, for it is both good and reasonable in price; but in addition to the people enumerated there are many workers desirous of results removed from the common, and by sensitizing their own printing media, these individuals can be suited as regards quality and texture. Many are thus found printing pictures on specially selected papers, leaving around the image, printed space, a generous margin, which imparts to their work much of the charm pertaining to the etching or engraving. In some notable examples the result has much of the refinement and quiet elegance of the wash drawing, looking anything but photographic.

For those who sigh for such effects, and to meet the demands of those who aspire to print on note paper, postal cards, menu cards and textile fabrics, such as cotton, linen, silk and the like, as well as parchment and various suitable brands of leather, I submit a formula giving fine sepia tones and requiring nothing more than plain water for development and weak hypo as a fixative. In fact, the manipulation is precisely the same as that advised for the Eastman sepia paper, and barring the hypo, is the identical procedure essential in the production of the blue print.

A rather close grained paper is in order, for when porous the elimination of the unreduced salts is difficult, even with a prolonged washing. Where "velvety" effects are desired, a generous application of size is imperative, and where keeping qualities are in view, linen paper must be employed. With the cheaper wood pulp stock one must in time expect deterioration, and the development of that sickly yellowness so noticeable in the cheap book.

Do not begrudge the price. The best paper is essential; high class bond or ledger stock, for example, being admirable for the purpose, providing there is a generous application of size to give softness to the image. Arrowroot size is among the best and may be prepared in the proportion of two grains of the powder to the ounce of water. Beat up with a little cold water in a bowl, adding balance of water hot. Bring to a boil, when the cloudiness will disappear and the size be ready for use. During the past few years I have worked out more than a dozen sepia formulas. Some are slightly better than others, and among the best is the one I am about to submit.

SALTING SOLUTION.

Citrate of Iron and Ammonia	40	Grs.
Ferric Oxalate Merck's	15	"
Oxalic Acid	15	"
Oxalate of Potassium	30	"
Citric Acid	5	"
Gum Arabic	10	"
Distilled Water	1½	Oz.

Mix in order given in a dark bottle, letting stand at least 12 hours before using. Apply with a flexible pad or wad of absorbent cotton, drying by the fire so as to keep the solution on the surface. When thoroughly dry coat with the silver solution, which should be prepared as follows:

SILVER SOLUTION.

Nitrate of Silver	55	Grs.
Citric Acid	25	"
Distilled Water	1	Oz.

When the chemicals are dissolved, this will be ready for use, and like the salting solution it should be protected from light by keeping in a cool, dark place.

Coat with the silver solution and immediately dry by artificial heat. The best and most vigorous prints result from a thin, even coating of the salting solution, for when the latter is in excess the image is apt to have a muddy, bronzed appearance. The best results I have had by using rather small sheets of paper and applying the solution quickly with a wad of absorbent cotton, drying immediately by the fire. This procedure is most essential when the rough surface or more porous papers are used. When the paper is hard and smooth one may get better results by allowing the surface to become nearly dry before hastening with artificial heat.

Under print rather than over. Half tones should not be visible at all. Wash away the unaffected salts in clear water, from one to three minutes being sufficient. Then transfer to the cleaning bath, one and a half grains of common salt and hypo to each oz. of water used. In this the print will rapidly darken, and in from 1 to 3 minutes, or when at its best, remove and wash for 20 or 30 minutes.

When the printing has been deep, longer fixing can do no harm, provided there is no bleaching of the half tones. Long fixing alters the color, usually having a darkening effect, and my own preference is for the colors obtained by short fixing as being more satisfactory in tone.

The formula here submitted is about right for the average pictorial negative, one rather thin but full of detail and fine gradation. For dense negatives a dilution of solution containing the iron will be necessary, while on the other hand strong, vigorous prints may be obtained from these negatives by using but an ounce of water, instead of an ounce and a quarter, as per formula. If still more contrast is required, add from four to eight drops of a five per cent solution of bichromate of potassium.

I would remark that success of the process demands the keeping of solution on the surface of the paper, for when too much sunk into the meshes the results are apt to be poor. This is more than likely to be the case when soft papers are used, therefore the importance of rapid drying. Experience can alone determine best conditions and quality of paper to employ, but for the novice the ledger paper or bond stock may be with confidence recommended, where the surface is slightly spontaneously dried, and is then completed by artificial heat.

It is a most pleasing variation where the solutions are with a wad of cotton applied with studied carelessness to the spot where the image is to be. In such a procedure, when the sun has done its work we have a picture that has all the appearance of hand-brush work in sepia water color. This is more likely to be the case where the outlines are not too abrupt, and experience can alone determine how this can best be effected.

As before mentioned, printing of this character can be done on postal cards, note paper, envelopes, menu cards, etc., the results depending greatly on the quality of the paper used, as well as the sizing on same. Pure linen paper and arrowroot size will produce the most satisfactory results, but where pictures are for temporary purposes, or when simply experimenting, cheaper papers, such as may be obtained from the stationers all the way from 20 cents a pound will answer well enough.

Concerning postal cards, there is small use in attempting to print pictures on those issued by the government, the paper they are made from being so deplorably bad. Where postals made from good stock cannot be obtained at the stationers, pictures may be printed on good paper and the regular postal card employed on which to mount them, the entire writing surface of the card being covered. By passing a hot iron over the card perfect adhesion and flatness will be assured.

Where printing on cloth is attempted it will be best to wash out the stiffness, as the size that gives body to so many textile fabrics contains chemicals that will impair the photographic image. Size well with a good solution of arrowroot or in lieu of that, plain starch. Sensitize and paste on a stiff piece of paper cut to the dimensions of your printing frame. In this way there will be no difficulty in keeping in register when examining from time to time to note progress of printing.

With the formula here exploited a few minutes in the sun will be sufficient with ordinary negatives, the printing capacity of the process being quite rapid. On this account it will be well with more than usually thin negatives to print under one or more sheets of tissue. It is good a plan to follow at all times when printing in direct sunlight, the image thus being more likely to be permanent and always sharper and more decided regardless of other benefits.

Doubtless it may occur to some that if the two solutions were combined in one, the process would be ever so much simplified. Well, it is possible to combine the sensitizer with the salting solutisn, making good pictures thereby, but the results are not quite identical. Separate, the solutions keep better, and in my opinion the results are more uniform. Where the two are combined there is a heavy sediment so each time the coating is attempted the solution must be well shaken to thoroughly insure mixing of ingredients. However, for the benefit of labor savers, I submit a formula that will do the business in one application, and do it reasonably well.

SENSITIZER NO. 2.

Citrate of Iron and Ammonia	20	Grs.
Ferric Oxalate	18	"
Oxalate of Potassium	20	"
Gum Arabic	10	"
Silver Nitrate	50	"
Citric Acid	25	"
Distilled Water	1	Oz.

Mix the silver and citric acid in half of the water and the balance of ingredients in the remainder, combining the two after dissolving and shaking thoroughly. If found to be too strong, giving excessive contrasts, dilute with water, and when mixing a new lot, reduce the quantity of citrate and oxalate of iron, say two grains of each. It should always be borne in mind that prints dry out much darker than appearances while in the wash water would indicate. The following is suggested for strong negatives:

SENSITIZER FOR STRONG NEGATITES.

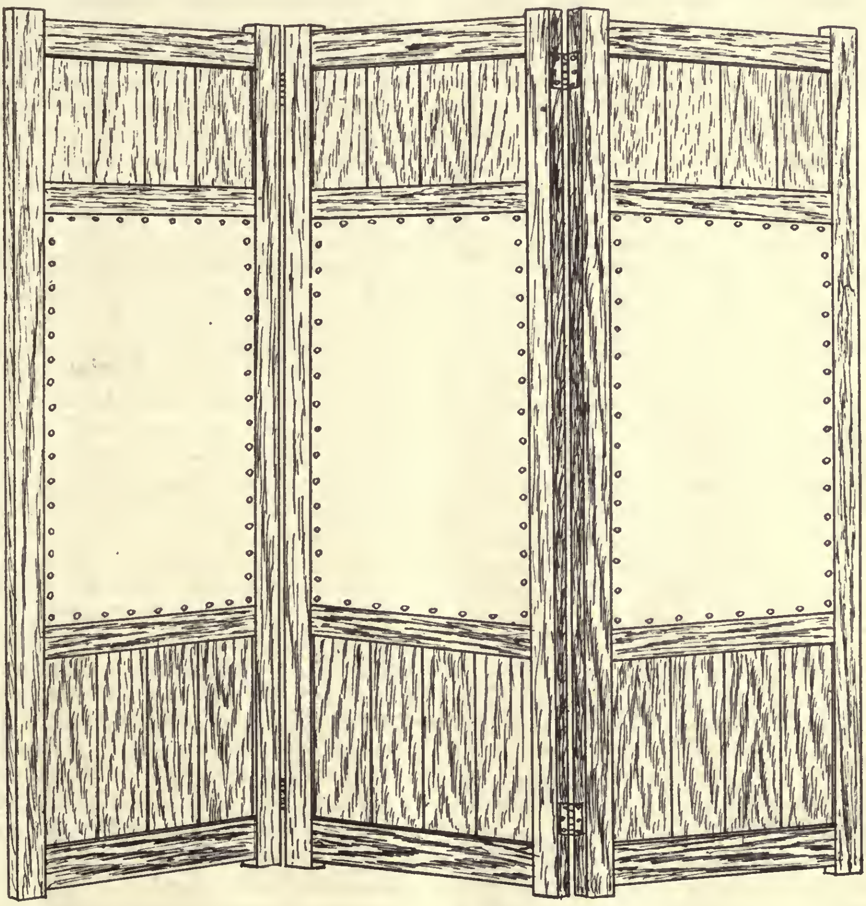
Citrate of IronAmmonia	17	Grs.
Ferric Oxalate	17	"
Oxalate of Potassium	18	"
Gum Arabic	10	"
Silver Nitrate	50	"
Citric Acid	23	"
Water (Distilled)	1	Oz.

The pictures from these formulas are of a warm sepia, without a trace of fog, and all detail in the negative should appear in the print even in the highest lights—"Western Camera Notes."

A SUBSTANTIAL SCREEN.

JOHN F. ADAMS.

Now is the season of drafts made manifest by sundry colds, unless measures are taken to guard against them by means of screens; the one here described being quite attractive and yet not difficult to make by any one of ordinary skill with woodworking tools. As will be noted from the illustration, there are panels of wood at both top and bottom of each section, the center covered with leather, real or imitation, cloth, cretonne or burlap, or ornamental wall paper laid on cloth. Exposed nails with large heads are used only when they would be in harmony with the covering.



The materials required for construction include:— Six pieces 6 ft. long, 2½ in. wide and 1¼ in. thick; six pieces 20 in. long, 2½ in. wide and 1¼ in. thick; six pieces 18 in. long, 2 in. wide and 1¼ in. thick, 30 ft. of stock 4½ in. wide and either ⅜ or ½ in. thick, the thinner wood being desirable because of less weight. Also 25 ft. of 1 x 1 in. strips for making the frame upon which to tack the coverings to the center panels. It is quite probable that the stock for the wood panels will have to be got out special if the width mentioned is used, but by using stock 3 in. wide, and having five strips in each panel, matched stock ½ in. thick can be used and this is a dimension commonly carried by dealers in interior finish.

If matched stock is not to be had, use strips ⅜ in. thick, and before gluing up bevel each edge slightly with a plane to form shallow V shaped channels at each joint. Use care not to have them very deep as but little surface for gluing is to be had at most. The upper panels measure 13 in. high and 18 in. wide; the lower ones are 16 in. high. The pieces surrounding the panels are all grooved to a depth of a trifle over ¼ in. the width of groove depending on the thickness of the panels.

The upper and lower cross pieces, 20 in. long, have tenons 1½ in. long on each end, the edges being ⅜ in. from the ends of the side pieces. The cross pieces under the upper and above the lower panels have tenons ½ in. long and of width to fit the grooves for the panels, the grooves being cut long enough to allow for same. They are spaced 12 and 15 in. respectively from upper and lower cross pieces, making the height of the center panels 32½ in. The inner cross pieces are glued to side pieces only; the others are both glued and pinned with 3-16 in. dowel pins.

The 1-in. strips are glued to the inner edges of the center panel, allowing ¼ in. on either edge, provided the covering is put on with large headed nails. If burlap or other cloth is used without nails, a frame is made of the strips, with a center piece to prevent bending and the cloth is tacked to the outer edges with upholstery tacks, the size of the frame being such as to allow a tight fit after the cloth is on. It is held in position with 1½ in. wire nails of small gauge and small heads, holes being bored with an awl put through both cloth and the strips, and the cloth smoothed over the holes, thus concealing the nails.

The sections are hinged together with iron hinges, or green bronzed ones, if a green stain is used on the wood. The most suitable woods to use are: Oak, if stained to match the other furniture of the rooms in which it is to be used, or red gum-wood with mahogany stain or mahogany with natural or dark finish. White wood can be used, but as much of the attractiveness of the screen depends upon the markings of the grain of the wood, this wood is not very suitable. A novel and extremely artistic combination is bird's-eye maple and a gray stain with wax finish, but this cannot be used unless the room is decorated in a style to harmonise.

ARTIFICIAL DIAMOODS.

Consul-General Guenther of Frankfort, writes concerning the most recent efforts for the production of artificial diamonds, as follows:

Crystallized carbon, as chemistry has taught for a long time, occurs in nature in two entirely different forms—as diamond and as graphite. Anyone who can afford to do so can burn a diamond in oxygen and become convinced that nothing remains except pure carbonic acid. The only compensation, except this knowledge, for the costliness of the experiment is the brilliant light colors under which the diamond, so to speak, gives up its life.

When the nature of the diamond was first discovered many chemists were full of hope that they would succeed in producing artificial diamonds of considerable size from carbon. This, however, has not been accomplished thus far, and today it is assumed that the formation of large diamonds, principally found in South Africa has been under conditions which have not been possible to produce in the laboratory. From time to time artificial diamonds have been made from carbon under great pressure, but these experiments were always more expensive than the value of the diamonds obtained and, besides, were very dangerous. In one instance the laboratory of the experimenter was completely destroyed.

The French chemist, Moissau, has shown a new method for producing artificial diamonds by the employment of molten iron as a solvent for carbon, and using the electric stove, invented by himself, for producing a degree of heat hitherto not reached. Through the intense heat of this electric stove and by sudden cooling of the molten metal, the carbon is separated in the form of very small diamond crystals. The London "Lancet" reports a further step in advance in the production of crystalized carbon through experiments of Dr. Burton of Cambridge. This scientist has proved that the diamond is a denser form of crystal than graphite, and that a lesser pressure is sufficient for producing artificial diamonds than had been employed heretofore. Doctor Burton in his experiments used a molten alloy of lead and some metallic calcium, which can also hold a small quantity of carbon in solution.

If the calcium is separated from the molten mass, some of the carbon crystallizes. The separation of calcium can, for instance, be accomplished through steam. If the introduction of steam is made during full red heat, then small graphite crystals are found in the resulting crust of lime; if the steam is introduced during a low red heat, no graphite is formed, but a number of microscopical crystals are formed, the properties of which are entirely identical with those of natural diamonds. These experiments, which may be continued, strengthen the belief that it may be possible some day to produce in the laboratory of the chemist diamonds of sufficient size and perfection to compete with natural diamonds.

These experiments furnish a new theory with reference to the probable origin of the diamonds, which may not have been under an excessively high temperature, but from a peculiar crystallization from a yet unknown solvent, perhaps under high pressure. The artificial diamonds obtained by Dr. Burton are pronounced to be the finest so far observed, because they possess an unusually high power of refraction.

Sir William Brookes, in a lecture recently delivered at Kimberley before the British Association, called attention to a peculiarity of diamonds, namely, that they are especially transparent for X-rays, while imitation diamonds hardly let these rays pass through them, and he declared that this furnished an excellent means of distinguishing genuine diamonds from imitation diamonds.

"It is an easy thing to criticise; in fact, any fool may criticise, but it takes a wise man to tell one how to make it better."

A VILLIAGE TELEPHONE EXCHANGE.

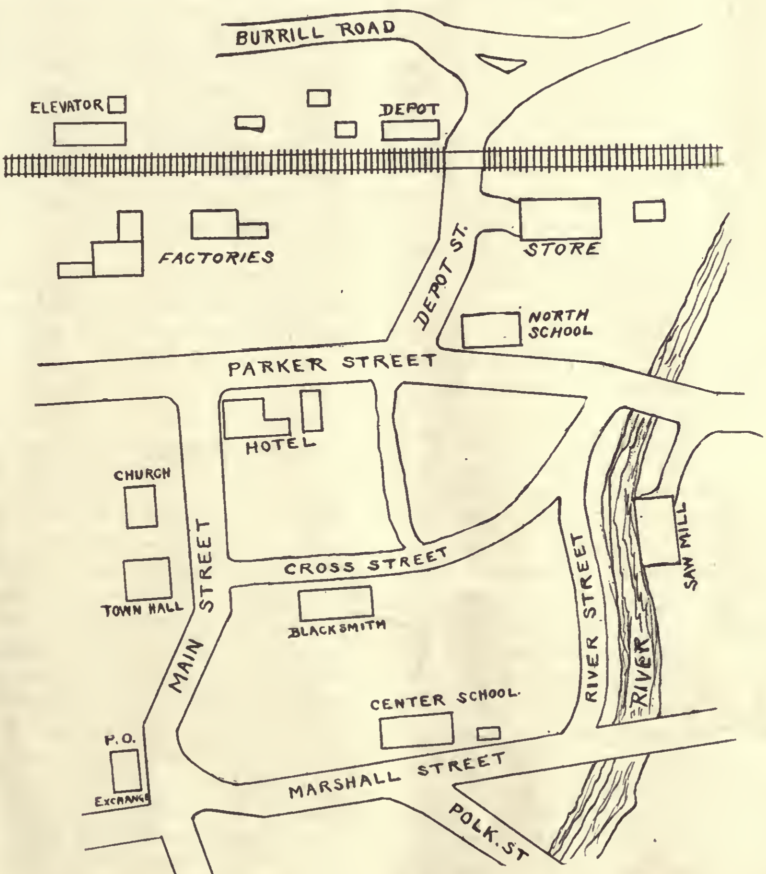
LAWRENCE V. STEVENS.

I. General Prospectus of the Exchange.

In previous numbers of this magazine have appeared details of telephone instrument construction calculated to give the amateur a clear and concise idea of the apparatus and theories upon which they operate.

It is now the intention of the writer to enter the domain of exchange construction, treating of the mutual exchange in which telephone service in established between 25 or 30 residences, stores and factories of a small agricultural or manufacturing community, the lines centralizing in a manually operated switch board located at the general store of the community.

There are three phases of this telephone proposition, namely the financial, the constructive and the maintaining problems, and of each the writer is disposed to treat in a connected series of articles dealing with each phase in proper order. Throughout the country, especially in the Middle and Southern States, this exchange proposition furnishes an exceptional opportunity for an active association of local capital and labor, the plant being self-sustaining from the start with favorable prospects of regular dividends after the first year of service.



It is to be understood that this exchange proposition deals entirely with one community and not with the general network of toll and long distance lines covering the territory. In years to come, connections may be made with other towns and other companies, a fixed charge being made for "trunking" between exchanges, but this feature is a matter which will adjust itself with the development of the plant and requires no consideration at this time.

An ideal way to describe the establishment of this exchange is to enter at once upon the proposition in an imaginary community of 200 residents, where the inhabitants are enterprising and willing to co-operate in furthering the interests of a local enterprise.

Jefferson is the township's name and the location is in a State of the Middle West. The principal pursuit is farming; that is, poultry raising and fruit growing, although there are several general stores, a blacksmith and carriagesmith and two new factories near the railroad devoted to manufacture of woodenware and hardware specialties, also an elevator and hotel.

There are no large cities near Jefferson, and the town itself covers an expansive area. The annual increase in population averages 40. An outline map of the township is here given for future reference during construction, and it will be seen that many the houses are quite far apart and it may be presumed that isolation is quite complete in the winter time. The stores seem to be centered in the heart of each settlement, and the Post Office is kept in the largest general store at the Centre.

Into this community come the canvassers of the large and rival telephone companies of the West, but their propositions met with little favor from the inhabitants, principally because of the high rates quoted and also because the town, being self-sustaining, has but little use for telephone connection with such outer points.

The Jefferson Telephone Company, as a new home industry, possess a field of its own. It purposes to furnish day service between the hours of 7 A. M. and 8.30 P. M. at a rate of $1.50 per month for unlimited number of calls, 5 cents a call for subscribers listed under the limited rate, a charge of 10 cents per call for a message taken over the wire at the central office and delivered by messenger to a non-subscriber, and 15 cents a call for messages sent from the central office to pay station to any subscriber of the exchange. It is to be expected that most of the subscribers will take the unlimited service, thereby dispensing with charge accounts and considerable bookkeeping, but it will be found that there are citizens who want the service, but would not use more than a dozen calls per month, so to provide for this class of customers, accounts are to be kept at the special rate of 5 cents per call.

In the contract which the company makes with the citizens, all apparatus for the first 25 stations is to be purchased by joint and equal contributions by the subscribers, said apparatus to be furnished to future subscribers at a retail price; which, of course, is an inducement to get connected while the construction proceedings are under way. The company retains the sole right to provide the instruments to be used upon its lines; a very wise move at the outset, because uniformity in apparatus means successful transmission and a minimum of complaints.

Criticism may be made of the policy of charging a low rate for service and also charging for the instruments, when in some communities there is a fixed sum for the yearly rental or quarterly rental as the case may be, and the apparatus furnished free. It has been found that a monthly rental is more practicable than a quarterly, because the charge of $1.50 per month is more easily collected, and in case a delinquent subscriber does not settle within a month the service may be cut off at the pole without unpleasant argument at the subscriber's house, the wiring instruments remaining on the subscriber's premises as a silent reminder of the unpaid debt and a strong continual and unfailing argument in favor of re-establishment of the service. It will be found that once installed, the telephone will never be ordered disconnected except for a good cause, such as poor service, and under proper management there will be no poor service.

To this end, while the Jefferson Telephone Company depends entirely upon the good will and financial assistance of the first 25 subscribers, it will be found advisable to choose one of the number to manage the enterprise, and that the manager be given full power to manage and maintain the affairs of the company absolutely during his term of office, the other 24 subscibers keeping entirely aloof from all controversies and disagreements arising between the company and the public.

In the next article will be described the central exchange, the personnel of the first 25 subscribers and the arrangements for new business, with a general statement of first costs of equipment.

MARKING STEEL TOOLS.

Marking steel tools is sometimes done by an etching process, carried out as follows: A rubber stamp making white letters on a black ground is required. Then an ink to use with this stamp is made with resin, ½ lb.; lard oil, 1 tablespoonful; lampblack, 2 tablespoonfuls; turpentine, 2 tablespoonfuls. Melt the resin and stir in the other ingredients in the order given. When the ink is cold it should be like the ordinary printer's ink. Spread a little of the ink over the pad, ink the rubber stamp as usual, and press it on the clean steel—on a saw blade, for instance. With a strip of soft putty make a border round the stamped design as close up to the lettering as possible, so that no portion of the steel inside the ring of putty is exposed except the lettering. Pour the etching mixture into the putty ring composed of 1 oz. of nitric acid, 1 oz. of muriatic acid, and 12 oz. of water. Allow it to rest for only a minute, draw off the acid with a glass or rubber syringe and soak up the last trace of acid with a moist sponge. Take off the putty and wipe off the design with potash solution first, and then with turpentine.

A BAROMETER IN THE HOME.

H. M. CHADWICK.

The barometer, always an ornamental instrument, is easily discovered to be interesting and instructive also, if one takes the readings and records them rightly.

This can be done by means of the accompanying chart, which is arranged to cover a period of one week. The writer takes two readings daily, one in the morning just before starting for work, and one in the evening upon his return. This method is tolerably satisfactory, although of course one at midnight would give completer record.

The chart should be drawn to a full size scale in black ink on transparent paper or tracing-cloth; it should then then be put into a printing-frame with an unexposed negative, and printed onto the negative by exposure to lamplight. Care must be taken to get a negative and not a positive image on the plate. To do this place the face or ink side of the paper against the film. Develop the plate in the ordinary way, and print as many copies of the chart on blue print paper as may be desired.

The holder for the chart is made as shown in the cut and is to be fastened to the wall beside the barometer. The top moulding is removable to permit the changing of the charts each week.

Although the barometer is an instrument for recording the atmospheric pressure, its office is often misunderstood. Many people, seeing the words rain, change, fair, and so forth, on the dial, think that it is primarily a weather prophet. It does incidentally prophesy the weather, however, and the following rules are subscribed as being generally applicable:

"Generally the rising of the mercury indicates the approach of fair weather; the falling of it shows the approach of foul weather. In sultry weather the fall of the mercury indicates coming thunder. In winter the rise of the mercury indicates thaw, and its fall indicates snow. Whatever change of the weather suddenly follows a change in the barometer may be expected to last but a short time. Thus, if fair weather follow immediately the rise of the mercury, there will be very little of it; and in the same way, if foul weather follow the fall of the mercury it will last but a short time.

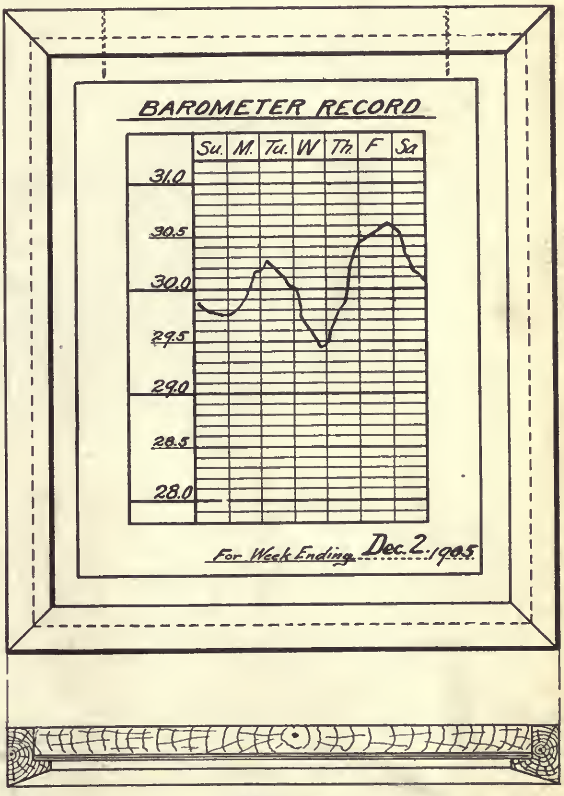
If fair weather continues for several days, during which the mercury continually falls, a long succession of foul weather will probably ensue; if foul weather continues for several days, while the mercury continually rises, a long succession of fair weather will probably succeed.

A fluctuating and unsettled state of the mercurial column indicates changeable weather."

These rules were given to the public in a lecture by Professor Lardner in 1846, and in his opinion they should be printed and sold with every barometer.

Prof. Lardner says: "It would be right, however, to express the rules only with that degree of probability which observation of past phenomena has justified. There is no rule respecting these effects which will hold good with perfect certainty in every case."

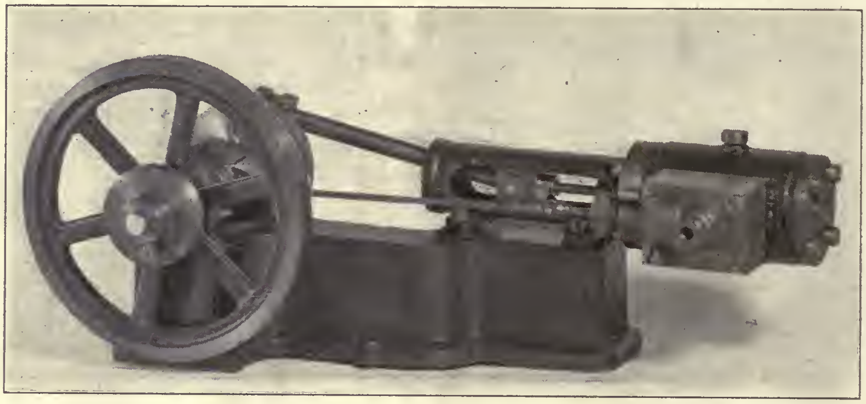
The terms rain, change, etc., are very misleading, as with a change of altitude the mercury assumes a different height, or in the aneroid, the hand moves along the scale without regard to the weather conditions.



An instrument which is often called a barometer but which, properly speaking, is not, is the "little old man and little old woman" so common on our mantle shelves. This taking invention is really a hygrometer, since it indicates the degree of moisture in the air, and nothing else. The old man is popularly supposed to come out in stormy weather, and the old lady to appear with the sun; but on fine days with a humid atmosphere, the man is always out. The couple are interesting to watch, especially when they are observed in connection with the barometer. They should be placed out of doors in a sheltered spot where they may be seen from within, as under a porch near a window. This open air exposure is necessary, in winter at least, for the hot, dry air that comes from the furnaces of most of our dwellings causes the old lady to remain out for weeks at a time, if kept indoors.

MODEL STEAM ENGINE.

The illustration shows a model horizontal steam engine, obtained in England by Mr. F. S. Parsell of New York, together with several others, one of which has already been described in these columns. It is a very faithful reproduction of its larger prototype, is finely made, and runs very smoothly with either steam or compressed air, the latter being frequently used for exhibition purposes on short runs.



The following are some of the principal dimensions: 7 in. long and 3 in. high. Diameter of fly-wheel 2¾ in. Bore ⅝ in; stroke 1¼ in. It is fitted with D valve, has oil-cups on main bearings, and with the exception of the polished portions is painted an attractive shade of brown. All castings are of brass, which is the one particular in which it differs in appearance from a large engine. If a sufficient number of requests are received, castings and parts of this design will be prepared, as it in every way suitable for working up by members of the "American Society of Model Engineers." Instead of using brass, however, a non-corosive white alloy would secure a more representative appearance, and the slight addition to the expense would be more than offset by the correct color of the finished parts. If you think you would like a set of castings, express your wish by letter at an early date. This does not mean that you should send a binding order, but simply to enable an estimate of the probable number of sets needed upon which to obtain an estimate of cost from the foundry.

POISONOUS EFFECTS OF WHITE LEAD.

Consul-General Mason of Paris, furnishes a report on the agitation that has been in progress for some time in France against the use of white lead in preparing paint for industrial purposes. The consul general writes:

After many years of more or less desultory agitation and discussion the protest against the use of white lead as a material for industrial painting has assumed in this country the form and proportions of a definite and insistent measure of reform. There was held recently in the great hall of the Trocadero in Paris a meeting of scientists, philanthropists, contractors, master and journeymen painters to the number of nearly 2000, the purpose of which was to put into definite form some of the facts and statistics which show the extent and danger of lead poisoning among painters and workmen in the white lead factories, and the effects of such exposure upon the health of the workingmen and their children.

The president of the assemblage, Prof. Dieulafoy, was assisted by some of the most eminent scientists and physicians of France, among whom were Dr. Brouardel, Profs. Richelot, Chantemesse and Vidal, and a large number of practising physicians from Paris and the Departments. Among the vast assemblage were delegates from the syndicate of industrial painters in Paris, Lille, Bourges, Bourdeaux, Nantes and other cities, so that the proceedings assumed a distinctly national and representative character.

In his opening address Prof. Dieulafoy stated that it was a matter of common knowledge and experience among physicians whose practice is among people of the working class, that journeymen painters who use whitelead for interior or exterior work on buildings, as well as the workmen employed in white lead factories, are often afflicted with a long train of diseases resulting from saturnine poisoning. Among these meladies were cited saturnine colic, an intensely painful form of abdominal cramp; muscular and articular rheumatism, ending in muscular atrophy and paralysis; saturnine anemia and gout, which reduce the individual to a state of complete incapacity for labor, and finally saturnine nephritis, which disorganizes the kidneys and leads to uremia and its various epileptic, apoplectic and delirious complications.

This formidable arraignment was taken up and continued by Dr. Mosney, physician in chief at the Hospital St. Antoine, whose practice has brought him into contact with a great many cases of saturnine disease. Dr. Mosney read a letter frem Prof. Bertillion, the eminent crimonologist, who confirmed from his own experience and observation the now generally acknowledged assertion that the manufacture and use for painting of white lead constitutes two of the most unwholesome and dangerous occupations known to modern industry.

The poison attacks the system both through the lungs by inhalation in the form of fine particles of dust, and through the digestive organs when taken into the stomach with food or drink that has been cotaminated by the touch of soiled hands or exposure in an atmosphere poisoned with the dust or fumes of lead. The arraignment having been completed and driven home by statistics and scientific testimony from which there could be no reasonable appeal, the meeting took up the question of a practical remedy. This was declared to be simply the abolition by law of the manufacture and use of white lead as a painting material and its replacement by zinc white, a substitute which is superior in whiteness, equally durable, harmless to human health, and only about 1 per cent more expensive to produce.

CORRESPONDENCE.

No. 116. NEWPORT, R. I., DEC. 12, 1902.

I have read in the columns of AMATEUR WORK several articles about spark coils and interrupters. I take the liberty to ask a little advice about them. I wound up a secondary coil containing one pound of No. 36 silk covered wire run through paraffine, and the primary had two layers of No. 16 wire. The secondary was tested with a magneto, and it was found to be all right. I made an interrupter like the sketch shown below (plain lever, not shown) and the best spark I could get was about 1-16 of an inch on ten dry cells in series-multiple. Both points on the vibrator were pure platinum.

I also have a small secondary winding, rated at ⅜ in. spark, but it will not work. The condenser is variable up to 14 M. F.

I have made an interrupter like the one in the November issue of AMATEUR WORK, and it works very fast, but will not excite the secondary on the large coil. If you could suggest any method of breaking the circuit so that I could work these coils, I would be glad to have it. I can get a ½ in. spark out of a small coil by making and breaking with a file. My large coil is very near the dimensions given in the October number. F. E. M.

In all probability your large coil has broken down inside and is short circuiting between layers. It would be advisable to rewind your No. 36 wire on a lathe or other revolving device in ½ in. sections instead of in layers, as with layers a paper insulation is required between the layers of wire. Have diameter of each disc two inches, with a 1⅛ in. hole. Separate sections 1-16 in. from each other by pasteboard discs. Put four layers of cotton cloth over the primary before placing the two windings together. Wax the cloth with hot paraffine.

The most satisfactory spark results are to be had from coils wound in sections with the proper amount of condenser, say 30 sheets of foil, size 4 x 5 in., and a vibrator 2½ in. swing. You should easily get a ½ in. spark on six dry cells arranged in series, provided the primary is well wound with d. c. c. wire, 3 layers, and the core is of soft iron wire, 2 inches longer than the secondary.

The vibrator described in the July 05 issue, (Page 223, Fig. 1) in the article, "Interruption of Primary Currents," is a very efficient one.

No. 117. ALLERTON, MASS., DEC. 5, 1905.

Please give specifications for a simple coherer for experimental use. G. T. W.

The simplest coherer would be a glass tube about 1-16 in. bore and 4 in. long, with plugs turned from brass 1-16 in. rod. The ends of the rod should be brightened by rubbing in mercury. For filings use a silver coin, after heating them to cherry red in the fire. Separate the electrodes, 1-16 in. Fill the chamber less than one-half full.

No. 118. COLUMBUS, OHIO, NOV. 30, 1905.

Will a spark coil giving 1 in. spark in one section of the country vary in results when operated with same battery and interrupter in another section?

Is it possible to communicate by wireless even when the tops of the two aerial wires on the poles are not within visual distance of each other? T. B. M.

Makers of coils prepare for climatic influence on coils by winding to give more than the rated spark. Coils which in the East give a 6 inch spark have been known to give out 7 inches in Denver and other Western cities. This is perhaps due to the lower atmospheric pressure, which enables the energy to penetrate to greater distance.

Have your poles extend in the air as far as possible above trolley and arc lights, and there will be very little other interference.

SCIENCE AND INDUSTRY.

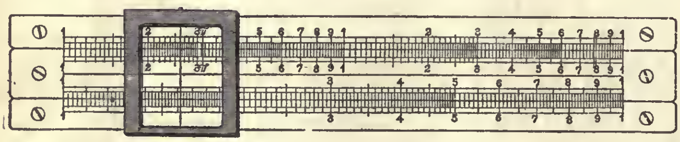
A respiratory apparatus for firemen, invented by Mr. Charles E. Chapin, a draughtsman who lives in Berkeley, Cal., consists of a hood lined with oiled silk to cover the head and an air cylinder which is strapped on the back. The cylinder is divided into three chambers, carrying enough air under a pressure that can be regulated to last an hour. The air is conducted by a rubber tube to the head piece, the exhaled air passing out through a valve before the mouth. The fireman can get enough air to fill his lungs comfortably, but cannot expend the supply in a short time, as he might be tempted to do if he became frightened. The main supply of air comes from the outer cylinders, the middle one being smaller and to be drawn upon only after the two others are exhausted. The apparatus can be adjusted on the bank in half a minute, and, as it weighs only 23 pounds, it does not impede the fireman in his work.

Attracted by the peculiar glitter of a boulder while hunting moonstones at Arcadia Beach, Philip J. Boyle. a California diver, is something like $1500 in pocket. Upon examination the boulder proved to be a mass of gold quartz weighing 278 pounds. It contains upward of five pounds of gold. The boulder is oval in shape and its surface has been worn smooth by the action of the waves.

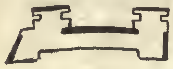
TRADE NOTES.

The Gunter scale, for decades a valuable aid to engineers, surveyors, navigators, etc., has recently been entirely superseded by the "Mannheim" Slide Rule. This has nowadays proved itself to be indispensable in every office and to everybody whose business involves calculation.

Multiplication, division, involution, evolution and arithmetical, algebraical and trigonometrical functions can be performed on this rule mechanically with the greatest ease and rapidity and without mental strain.



Kolesch's "Precision" calculating rule embodies a great improvement over other similar rules. It is made of the very best well seasoned built up mahogany stock with white celluloid facings. The graduations are all engine divided, clearly and accurately cut, and being on a white background are very legible. This is one great advantage of these rules over lithographed rules which are on the market, and which will wear off in a short time so that graduations and figures are illegible and indistinguishable.



The main improvement, however, is the construction of the stock or body of the rule. The rules formerly constructed with celluloid facings on the inside of the groove only are always liable, under changes of temperature, climate or humidity, to expand, contract or warp, as shown in illustrations below.

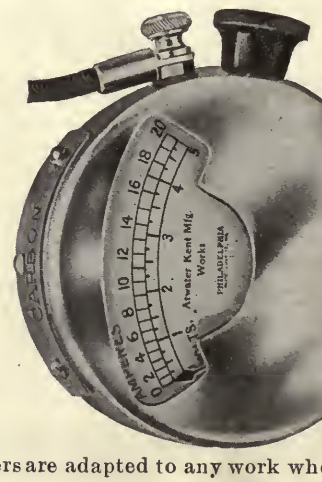
In the Kolesch "Precision" slide rule this drawback is entirely overcome by mounting the two faces of the backbone with celluloid, as shown in figure below, making the body unaffectable by changes of temperature or humidity.

The ends of the celluloid facings on these rules are secured to the wood by German silver screws, which

secure absolute adherence to the celluloid facings to the body of the rule. (See cuts above.) In order to meet every demand, these rules are manufactured five, eight, twenty inches long.

Messrs. Kolesch & Co., 128 Fulton St., New York, gladly furnish any information and descriptive prices of "Precision" slide rules, also particulars of circular calculators.

The Atwater Kent Mfg. Works, 42 North Sixth Street, Philadelphia, Pa., manufacturers of ignition specialties, have introduced a new feature in their Automatic Volt Ammeters for 1906, which are now ready for the market. This is a "Dead Beat" needle, which, on account of its quickness in coming to rest insures a quick and accurate reading.



Their meters are adapted to any work where primary batteries are used. Every meter is guaranteed absolutely accurate, hand calibrated to standardized appartus and thoroughly tested. A neat, hand-sewed leather case is furnished with each instrument. Price, 0-5 volts, 0-20 amperes, $5; 0-10 volts, 0-20 amperes, $7. Their voltmeters, which are the same in appearance as the Automatic Volt-Ammeters, but without button attachment, also have this excellent feature of the "Dead Beat" needle. Price, 0-6 volt, $5; 0-10 volt, $6. Price of ammeter, 0-10 amperes, $5; 0-25 amperes, $6; 0-30 amperes, $7. Meters with special reading up to 30 volts and 30 amperes, are made to order. These are very convenient and fully meet the requirements of automobile and gasoline engine users.

AMATEUR WORK

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Vol. V. No. 4. BOSTON, FEBRUARY, 1906. One Dollar a Year.

BURGLAR ALARM FOR SAFES.

FREDERICK A. DRAPER.

II. Electrical Instruments and Circuits.

As mentioned in the previous chapter, the electrical arrangement consists of two closed circuits of sufficiently different strength so that short circuits or breaks, whether intentional or otherwise, will operate either one or the other or both relays. This is accomplished by inserting resistance coils in the circuit. These are shown in the illustration of circuits as R^1, which may be 50 ohms, and R^2, which may be 150 ohms resistance.

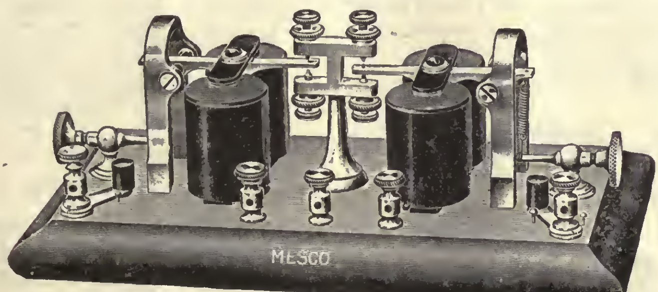


Fig. 6.

To further illustrate the subject, assume that arrangements are made with a near-by fire station for placing the alarm instruments therein, and from which the response to an alarm will be made. Such an arrangement is a good one, as even in small towns two or three men are always present, except when called away by a fire, and at such times so many people are passing on the main streets that a robbery requiring the use of explosives would hardly be attempted. The reason for having the alarm station located where there are always several men present is to prevent robberies such as one occurring in a large Massachusetts town near Boston. In the case mentioned, a band of seven or eight robbers captured singly the two night police officers, locked them up in the town jail, and then blew open the safe of a bank and disappeared with the contents, amounting to several hundreds of dollars.

An alarm station with only one attendant, unless securely protected, could be similarly "captured" and the whole system made useless. Where only one attendant is possible, however, he should be located in a room where he cannot be reached without being alarmed in time to be ready for emergencies and have an opportunity to give a signal over a telephone line which cannot be cut, or otherwise bring ample assistance to the premises being guarded. He should also make a thorough test of all parts of the alarm system early every evening, and again on that part necessary to signal others before retiring.

At the alarm station are located the batteries, relays, resistance coils, signal bell and continuous ringing alarm bell. At the protected premises there is a signal bell and strap key for sending and receiving signals at the opening and closing hours. These also permit of signals during the daytime, if desired, by arranging the circuits so they may be closed by a switch.

The installing of the alarm station will first be described. A double balance relay, Fig. 6, is necessary. The circuits pass through both sets of coils. One side is adjusted at the highest tension so that any reduction of current will release the armature. The other side is adjusted just beyond where the strength of the current will pull down the armature, so that any increase in current will move it.

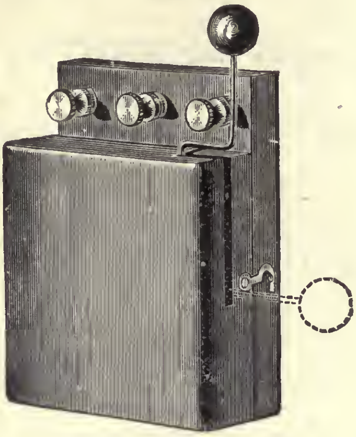


Fig. 7.

From the open sides of the relay, wires are run to an automatic drop, Fig. 7. which operates whenever either armature of the relay is thrown, and causes a bell to ring continuously until the drop is replaced or the battery runs down. The continuous ringing feature is necessary to assure that the alarm will be noticed and receive attention. A short ring might escape notice because of other noises, or the temporary absence of attendants.

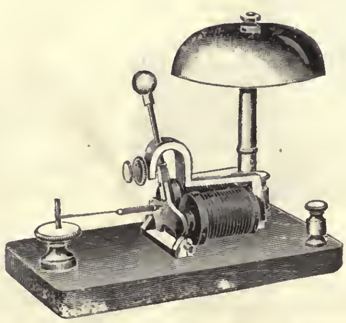


Fig. 8.

The line circuits through the relay are also connected to a ground which may be a near-by iron or water drain pipe, or a direct wire. If a water or drain pipe is used, it must be examined to learn that no telephone or other wires are grounded thereon, as other circuits on the ground might cause the relay to operate and thus cause false alarms. A direct wire ground should have the earth end buried several feet in moist soil, and is best arranged by turning that end into a spiral of several turns, or soldering to a copper plate 10 or 12 in. square.

The batteries for the line are of the ordinary gravity type, two to four cells being necessary. They are connected in series and located between the ground and the relays with zinc pole on the relay side, although a reverse arrangement may work best in some places.

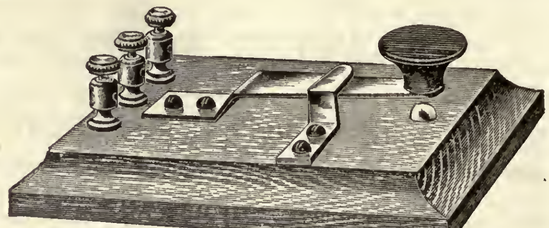


Fig. 9.

A signal bell, Fig. 8, and strap key, Fig. 9, are also connected into the line by a shunt around relay, which is thrown out during the open hours by the switch fitted to same. If daytime signals are not needed, these may be omitted and the "O. K." signals given through relay and drop, which would also serve as tests for the line on one side of the relay. The wiring arrangement of the alarm station for the arrangement described would be shown as in Fig. 10.

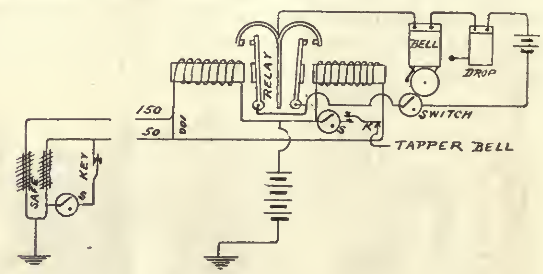


Fig. 10.

At the premises to be guarded, a signal bell and strap key are also installed in the same circuit as that at the alarm station, provided answering "O. K." signals are desired. If such signals are not thought necessary, the signal bell here is omitted, the key being necessary, however, to advise the alarm station when opening and closing hours arrive. The circuits at this end must also be connected to ground as previously described. The bell and key require a circuit in shunt with the safe cover. If the line wires are run outside of buildings, lightning arresters should be used where the lines enter buildings. The type used for telegraph lines is suitable.

After the work of fitting up the frame, installing instruments, etc., is completed and the battery reaches its full strength, the relay is adjusted and the circuits tested. If these directions have been carefully followed, the system should be found to work satisfactorily, and if the alarm station has vigilant attendants any attempt at robbery will give sufficient warning to prevent its being successful.

SHARPENING A SCRAPER.

FRANK G. ODEL.

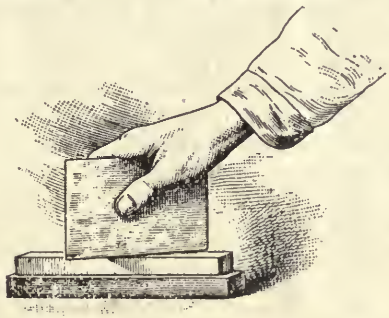
The following directions for sharpening a scraper will be of interest to the many readers interested in woodworking.

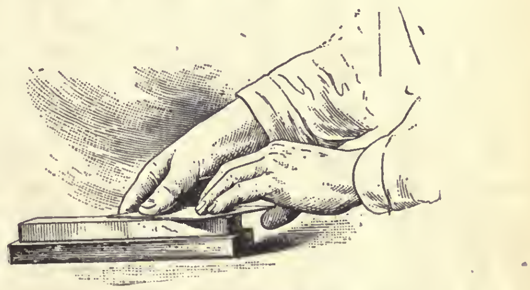
I presume that every reader understands that the cutting edge of the scraper is formed by turning over a "burr" or wire edge, which does the cutting when applied to the wood. This burr is made by rubbing against the edge of the scraper with a tool called a burnisher, which may be made of any piece of steel of convenient form but which must be harder than the scraper. A common method is to grind a file down until a perfectly smooth surface is secured with the corners slightly rounded and the tool set in a convenient handle. A simpler and much better method is to grind a smooth point on a discarded nail set and mount it in a handle, like the burnisher illustrated. Do not forget to put a point on it and make it sharp.

Whether you file or grind your scraper will depend largely on the temper of your steel and your own disposition. In either case you will have to whet the edge smooth on an oil stone before a satisfactory cutting edge can be obtained. Now don't forget that to have a scraper cut well it must have an edge as smooth as any other edged tool used for fine work, and this edge can only be obtained on the oil stone.

If you are using the common cabinet scraper and the class of work will permit, the square edge will be desirable, inasmuch as you can secure eight cutting edges and avoid frequent sharpening.

Let us suppose that we have ground or filed a straight and smooth edge on our scraper, then put it on the oil stone. After you have rubbed down a pretty smooth edge turn the scraper flatwise on the stone and take off the wire edge.


POSITION OF SCRAPER ON OILSTONE.


SCRAPER LAID FLAT ON OILSTONE.


TURNING THE EDGE.


POINTING OUT THE EDGE.


RUBBING OUT THE BURR.

Whether the edge of your scraper should be square or beveled will depend on the class of work you have to do. If it is fine bench work on very hard wood and you wish the finest possible finish, use a square edge and turn the burr on your scraper for a light shaving. If you are on a floor or other work where fast cutting is required and plenty of sandpaper will follow, use a beveled edge and have plenty of steel back of the edge to hold it firm.

Repeat these operations with every cutting face of your scraper until you have a corner as smooth and sharp as you would put on a smooth plane. Having reached this point we are ready for the burnisher.

Now set your scraper firmly on the bench and hold it in position with your sinister hand while the dexter one grips the burnisher, and with a stout upward pull against the corner turn the edge. Better protect that sinister hand with a bunch of shavings or something else, for the edge is likely to cut your hand if the oilstone has done its duty.

You will now find that there is a little hooked edge turned over on your scraper if you have made a hard and steady pull with the burnisher. To make sure that this edge will be perfectly smooth, turn the scraper down on the bench at an angle and " point out the edge."

Here is where that sharp point comes handy on the burnisher. Incidentally, it is useful for starting screws, marking keyholes, in fitting locks, etc., but indispensable as a sharpener for the scraper. Be careful to put the point exactly in the angle where the little burr turns over the edge of the scraper and ever so lightly and carefully draw it along the whole length of the angle to smooth up the cutting edge of the burr, then more lightly than at first turn the edge again with a single stroke of the burnisher.

If you have been happy in following these poor instructions you will now have an edge which will cut a shaving as fine as silk and as fast as you can pull the tool. Presently it will get dull. This will be largely caused by the gathering of fine particles of dust in the angle of the burr if your wood be free from sand or grit, so take your burnisher and carefully "point out" again and turn the edge lightly afterward. You will be surprised, if not familiar with this method, to see how long the tool holds its edge without sharpening, but don't forget that everything depends on the oil stone to begin with.

After this operation has been repeated two or three times, the scraper will really become dull and the pointing out process fail to work. Then turn the tool flat down on the bench and with the burnisher rub the edge smooth.

A few brisk strokes of the burnisher will turn back the burr and the edge will be observed to be more or less full of imperfections. Is not too badly worn and and the steel be of good temper, you may return to the oil stone and again smooth up the edge and repeat the processes of turning. pointing out and finally turning the cutting edge.—" Carpentery and Building."

MAKING FIRE IN LUZON.

For making fire in the Philippine Islands there is a curious contrivance used by some few of the natives of Northern Luzon. It consists of a hardwood tube of about one centimeter bore and 6 centimeters in length, and a piston of slightly less diameter and length. The tube is c.osed at one end by an air-tight plug or, instead, the wood forming the tube is not bored through its entire length. The inside of the tube is smooth and highly polished. The piston has a handle and resembles the piston of a boy's popgun. The end of the piston is made to fit the tube air-tight by a wrapping of waxed thread, and directly in the end a shallow cavity is cut. Lint scraped from weather-beaten timber and well dried is used for tinder. A small bit of this lint is placed in the cavity at the end of the piston, the latter is inserted ½ in. in the open end of the tube, and then driven quickly home with a smart stroke of the palm. Upon withdrawing the piston the lint is found ignited, the sudden compression of air generating the necessary heat.

TO TELL IRON OR STEEL PIPES.

Iron and steel pipes can be distinguished, the one from the other, very often by means of their appearance. Iron pipe is rough, and the scale on it is heavy, whereas the scale on steel pipe is light and has the appearance of small blisters or bubbles, underneath which the surface is smooth and somewhat white. Steel pipe seldom breaks when flattened, but if a fracture does occur, it will be noticed that the grain is very fine. Iron pipe, when subjected to this test, breaks easily and shows a coarse fracture, due to the long fibre of the material. The impression prevails with many that steel pipe is so exceptionally hard that it is threaded with difficulty and that the threads are easily broken off. In realty, steel pipe is soft and tough; threads made in it do not break, but they tear off, to avoid which it is necessary that the cutting die shall be sharp so as to cut above the center. Dies suitable for steel pipe can also be used on iron pipe, but blunt dies that work succesfully on iron pipe will tear the threads on steel pipe, owing to the softness of the metal.

CASTOR OIL AS A LUBRICANT.

Castor oil as a lubricant is in extensive use in some countries. In Australia, which imported 769,362 gal in 1898, its chief use is officially stated to be as lamp oil, and the decline in imports in 1902 to less than 500,059 gal. is attributed to the substitution of petroleum for the castor oil. It may also be noted that in the Cape of Good Hope, where it is probably largely used for the same purpose, 307,728 gal. were imported in 1902. To a limited extent this oil is used in the United States. As is well known, the mechanical function of lubricating oils is to form a coating or cushion between rotary surfaces, thus keeping them free from contact and preventing loss of power through friction. To this purpose castor oil, being heavy bodied, viscuous and non-drying, is in most cases well adapted. It is the heaviest of fatty oils, having a density of 0.96 and is particularly adapted to the oiling of fast-moving machinery because the heat generated keeps it in a liquid state.

ADJUSTABLE TOOL HOLDER FOR GRINDING.

WM. C. HENDERSON.

The device about to be described was originally designed and made for the purpose of grinding gouges used for wood-turning. Such gouges, when newly purchased, are not generally fully ground and sharpened, and when a considerable number of tools are to be ground, a great deal of time is required to produce an evenly ground edge, unless some form of holder is used which will obviate the necessity of light grinding and frequent examinations. This holder permits of manual training will find that with this holder grinding may be done by pupils after they have been given a little instruction.

The perspective view, Fig. 1, shows the general arrangement, with turning gouge in the holder, preparatory to grinding. It will be noted that the tool to be ground is held in a V-shaped trough, which is supported by an adjustable arrangement by which the tool can be held at angle against the wheel. A rear

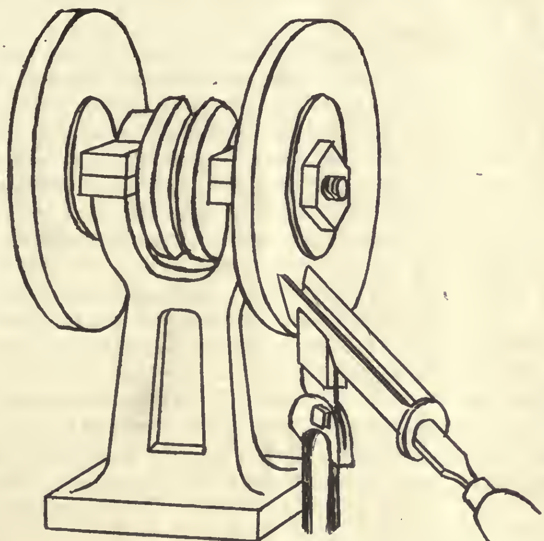


FIG. 1.

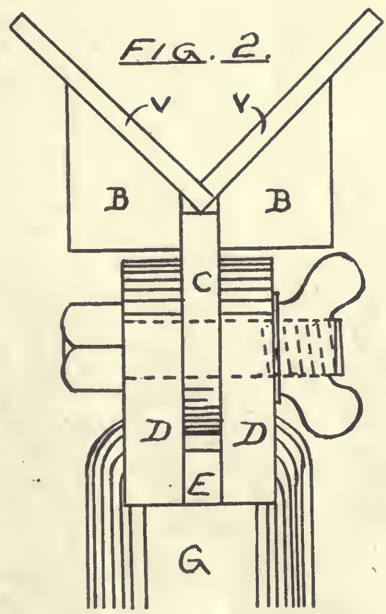


FIG. 2.

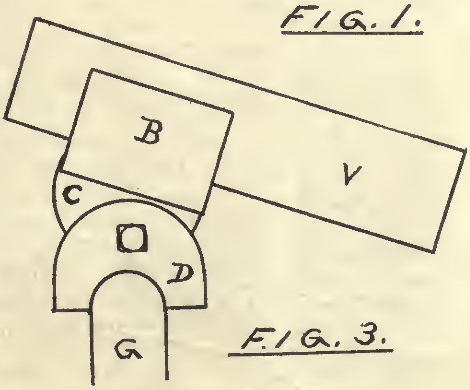


FIG. 3.

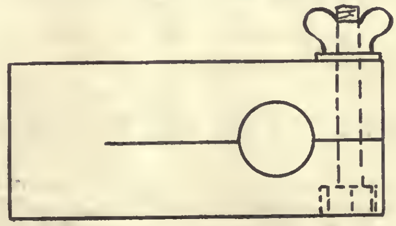


FIG. 4.

adjustments to secure any commonly used angle; and when once set will ensure an evenly ground tool, even if the work be done by an inexperienced grinder. Of course this holder does not lessen the care which must be taken to avoid drawing the temper of the tool by too heavy pressure, but this danger is somewhat lessened, as the tool can be secured so that only a light pressure can be given. For these reasons, teachers of view, Fig. 2, and side view, Fig. 3, show more clearly how this is accomplished.

The two pieces forming the V-trough are made of wood strips 6 in. long, $1\frac{1}{2}$ and $1\frac{1}{4}$ in. wide and $\frac{1}{4}$ in. thick. They are nailed together at right angles. Two pieces *B* and the piece *C* are then cut out with the grain of the wood of *C* running up and down, and of *B* parallel with that of the V-trough. The two pieces

B are cut from wood ⅝ in. thick and 1¼ in. wide and 3 in. long, the upper edges being beveled to an accurate fit to the V and secured thereto by glue and nails. This is not done, however, until the piece *C* has been cut out and the two pieces *B* fastened thereto. This piece is ⅞ in. thick, 3 in. wide and 3½ in. long, the lower edge being cut to a semi-circle.

Two pieces *D* ½ in. thick are cut to the same size and shape as *C* and spaced by the piece *E* which is 3 in. long, and 1 in. wide and a little over ½ in. thick. These three pieces are glued and nailed together. In the end of a piece of 1½ in. oak curtain pole cut a slot 1½ in. deep to fit over the pieces *D* and *E*, and securely fasten thereto with glue and wood screws. This pole is made long enough to give the necessary adjustment to height, as determined by the type of grinder in use. If mounted on a bench, a hole is bored through the same, and a jamb-block fastened to the under side. This is a plain piece of 2 x 3 in. maple or spruce, having a 1½ in. hole near the end, and a slot cut through for about 4 in. An ordinary bolt with butterfly nut and washers, serves to tighten the pole, which passes through the hole, in any desired position.

If the holder is desired for use in a lathe, the dimensions here given may be reduced a little, the jamb-block fastened to the under side to the bed by a bolt and strap on to ways.

When grinding gouges, a block of thin wood is fitted over the gouge with a drive fit, located so that it will touch the lower end to the V-trough. The grinding can then be done with the knowledge that the gouge cannot be ground more in one place than another, hence it will have that even bevel and rounding edge so desirable for turning.

The most suitable wood from which to make the holder is maple or birch, and when completed should be given a liberal coating of equal parts of linseed oil and turpentine; then two coats of shellac. This will prevent any warping and enable the holder to be easily kept clean.

TO REMOVE STAINS FROM MARBLE.

To remove stains from marble, mix quicklime with strong lye to the consistency of thick cream, and brush this on the marble. Leave for twelve hours and then wash off. If this is of no avail, mix 4 oz. of soft soap with 4 oz. of whiting, 1 oz. of soda (sodium hydrate) and ½ oz. of copper sulphate in powder, and boil the whole together for fifteen minutes. Rub this mixture, while still hot, over the marble, using a bit of flannel on a stick for the purpose. Leave for twenty-four hours, then wash off and polish the marble. Oil stains may be removed by applying a paste of common clay and benzine. Iron rust and iron ink stains are treated with: Butter of antimony, 1 part; oxalic acid, 2 parts; soft water (rain water), 32 parts. Dissolve and add whiting or flour to the consistence of a thick paste. Apply evenly with a brush and leave for a few days. If the stains are still visible, repeat the operation. To restore the polish after any of these operations, use a bit of old felt hat wrapped around a bit of wood, and with it, hot water and emery powder, rubbing the marble until an even surface is obtained. The emery powder should be in graded sizes, using the coarse first and finishing with the finest flour of emery, changing the felt with each change of powder. The flour will leave a comparatively fine gloss on the surface, which should be heightened by putty powder and fine, clean cotton rags, finishing with silk. No water should be used toward the last.

The Bonis electric sweeper, cleaner, and ventilator is a portable arrangement, consisting of an aspirator with 1-16 h. p. motor and suction attachment, and separator or dust filter. The brushes, which are attached to a hollow pole like a broom handle, or moved by hand, are bell-shaped, and have bristles arranged around the outer rim in such a manner that the air can pass freely through them. The suction produced in the center of the brush by the motor draws into the receptacle the dust, dirt, fluff, etc., removed in the sweeping. India-rubber brushes are used for fragile objects, furniture, etc. The air being loaded with dust is caused to pass through a separator provided with a number of cells for retaining the dust, after which the filtered air is passed through a canvas bag out into the open. The receiving chamber can be made metal and provided with a disinfecting fluid, thus deodorizing all substances as they enter. The mechanical part of the apparatus, provided with motor and exhauster, can be used as a ventilator.

The operation of producing liquid air is briefly as follows: Air is compressed to 1200 lbs. to 2000 lbs to the square inch; passed into receptacles where it is purified by separating the moisture, oil, etc., and passed thence into expansion chambers and through coils of pipe of considerable length. During the process it becomes intensely cold, reaching finally 312° below zero, at which point it becomes liquid. It is drawn off into insulated vessels, where it is kept for days, gradually lessening in quantity until it is entirely evaported.

The dust of meteorites that undergo complete combustion on contact with the earth's atmosphere has been traced on the earth's surface as for instance, in the inland ice of Greenland in the shape of particles of magnetic iron with cobalt. This same character of dust has also been found at a number of places in northern regions, and it is known as cosmic dust.

A CHEAP NINE-INCH REFLECTOR.

M. A. AINSLEY.

Mounting—Silvering the Mirror.

In deciding on the mounting to be adopted for the 9 in. telescope, I was guided principally by consideration of expense and of the possibility, or otherwise, of getting the work done. Not having any workshop, I was unable to do the work myself and had to rely on the ability and intelligence of the local blacksmith and carpenter. The result is a mounting which is rough and might be much improved; but it has proved efficient and steady and most convenient in use. It is not, however, so well suited to the longer focus of the second mirror, or indeed to any focus of more than 6 ft. The mounting has proved especially convenient for sweeping up comets, nebulæ or planets in daylight, on account of the ease of motion in any direction. I do not propose to give drawings of it, as any of my readers who are building a telescope will probably modify the arrangement to suit their own preference; but the accompanying view will show how the whole thing was arranged.

It will be seen from the photo that the slow and rapid motion in altitude is obtained by means of a windlass and a wire cord passing over two pulleys. There being three lines of wire, the motion of the telescope is reduced in this proportion. This arrangement was found to allow of very rapid motion in altitude when required; or the motion could be made slow enough to keep a star central in the field of view with a power of 480. I used bronze picture wire, which worked well, but was liable to fray. I think the steel wire used for Bowden brakes would be better; but it should be galvanized or well greased. The larger the pulleys are, the better the arrangement will work; those shown in photo are undoubtedly too small. The pulleys used for the weights of an old-fashioned grandfather's clock are very suitable.

It will be seen that the telescope is carried on two points of iron on one side of a square platform of teak 2 in. thick. This is bolted to a 6 in. plate of iron which is, in its turn, carried on a vertical 2 in. shaft about 20 in. long. The bearings for the vertical shaft are two iron plates at the ends of a stout wooden tube about 5 in. square, which, in my case, is supported vertically on an iron framework. A stout wooden tripod would be just as good; but it should be made as heavy as possible to avoid all danger of capsizing in a wind. At the sides of the square platform will be seen two long teak beams which carry the bearings for a ½ in. iron axle with a handle at one end. This forms the elevating windlass; while the lower pulley is screwed to a crosspiece underneath the axle of the windlass.

The points on which the tube is supported are fixed so as to be half the diameter of the tube above the c. g. thereof. This insures that the mirror end always has a tendency to fall, and keeps the wire taut; the friction of the windlass prevents the tube moving, and this is adjusted by screwing down the caps of the bearings. It will be found that with foci up to 6 ft. the handle comes conveniently for the left hand; with longer foci it would probably be better to put the windlass on the lower side of the tube itself.

Quick motion in azimuth presents no difficulty, the telescope turning easily about the vertical axis; but the slow motion gave some trouble, as I was unable to go to the expense of tangent screws, universal joints, etc. The arrangement finally adopted has proved efficient, but requires a little practice to work.

A hole is bored in the near side of the teak square, and the end *A*, Fig. 2, of a long screw is inserted, there being a hinge, to enable the screw to lie in any direction. On the screw works a brass wheel about 5 in. diameter, which bears against the end of a galvanized iron gas pipe about 3 ft. long. The lower end of the gas pipe bears on the ground. For quick motion the gas pipe is raised off the ground; when the object is in the finder is placed somewhat to the left of the center of the field of view, and the gaspipe allowed to rest on the ground, the brass wheel being then turned the telescope is pushed slowly round until the object is central in the field, when it is followed by turning the brass wheel. It will be seen that the slow motion only acts one way—*i. e.*, it only turns the telescope to the right. This is undoubtedly a defect; but as nine objects out of ten, including sun, moon and planets, have their apparent motion in that direction, little inconvenience is caused after one is accustomed to the working. Anyone with mechanical skill and ingenuity will doubtless be able to improve on the arrangement. If the focus is longer than 6 ft. it will perhaps be found difficult to reach the wheel with the right hand; but there is no reason why the pipe should not be made longer, and a post fitted to the teak square to raise the wheel higher.

On commencing the work the gaspipe is turned so as to come under the end of the tube. The tube is then placed on the mounting, the point supporting it falling into two shallow holes in the platform; the mirror end is then allowed to rest on the pipe and the windlass unwound, and the wire and pulley hooked on; and on finishing, the windlass is wound nearly home, the wire unhooked and the tube carried indoors.

Of course the dimensions and details of the mounting can be altered at will to suit varying conditions. Though rough, the mounting has proved very efficient and steady in my hands, though I do not claim that it is by any means perfect.

Silvering.—A great number of processes have been published, and all are good; but I strongly recommend a trial of the formalin process. When once mastered it is so quick and convenient that its slight uncertainty may be put up with. Experiments may be made on small pieces of glass until the right proportions of the various ingredients are determined. The chemicals required are: 10 per cent solution of nitrate of silver, 10 per cent solution of strong liquid ammonia; commercial formalin (40 per cent formaldehyde). The above must be made with distilled water. Saturated solution of potassium bichromate, to which strong sulphuric acid has been added in the proportion of about one oz. to the pint; a small quantity of absolute alcohol; 2 gal., or more, of distilled water.

Apparatus.—A deep porcelain vessel, about ½ in. larger all round than the mirror and preferably with a flat bottom. A 4 oz. measure, and one of ½ oz. graduated in minims. Two or three large glass or porcelain jugs to hold about a quart. Cotton wool.

I will describe the silvering of the 9 in. mirror:

First clean the mirror all over, back and sides as well, with a litle alcohol and rub with cotton wool; then rub well with the bichromate solution and let it soak in the same for ten minutes or so. Repeat the cleaning with bichromate until, when wetted, the film of water adheres to every part of the surface. Too much care cannot be taken over this, as unless the mirror is quite clean, the silvering is likely to be a failure. Rinse the mirror well under the tap and finally with distilled water. Place it in the silvering vessel face up. Pour out, for a 9 in. mirror, a pint of distilled water into the silvering vessel which, with all measures, jugs, etc., must have been previously cleaned with bichromate solution and distilled water. This will cover the mirror to the depth of, perhaps, ½ of an inch.

Then measure out 320 minims, or 5 dr. 20 min., of formalin and add to the water. Rock the silvering vessel well so that the formalin and water are properly mixed.

Then take 2 oz. of the 10 per cent nitrate solution and slowly add the ammonia solution. A dense brown precipitate is at once formed; as the ammonia is added this will gradually disappear and the addition of ammonia must be stopped just before the solution clears. If any excess of ammonia is allowed to get in a little more nitrate of silver must be added, so that the solution is slightly clouded. The measure should be well rocked during the addition of the ammonia, and great care taken not to have any excess. The slight cloudiness left does no harm but an excess of ammonia means almost certain failure. The ammoniated solution is now poured into a jug and a pint of distilled water added. This is poured rapidly into the silvering vessel, and over the mirror, and the vessel well and vigorously rocked.

The action is extremely rapid. In a very few seconds the solution begins to turn pink, and a black deposit appears on the mirror—the solution darkens to brown and then black and the mirror will, if all is well, be covered completely with a deposit of silver before the solution has lost its transparency. The rocking is continued until the action has ceased, when the solution will become transparent, but filled with black coagulated particles. The mirror is then lifted out—no fear need be entertained of staining the fingers at this point—and rinsed, first with distilled water and then under the tap for a few minutes. The film should be nearly, if not quite, opaque to the light from the window, although if the film is a little thin it will still perform well. The mirror is placed on its edge on a pad of blotting paper and leaning against some support in a place as far as possible free from dust. It must be allowed to become absolutely dry before any attempt is made to polish.

To polish the film, prepare two pads of the finest chamois leather by tying up a handful of cotton wool in a piece of leather about 8 in. square. See that these are quite dry; they may be warmed in front of a fire with advantage.

When the film is quite dry it is rubbed all over with one of the pads, in small circular strokes, with little pressure, until any bloom on deposit has disappeared. The film is usually fairly brilliant on leaving the solution; but to get the best possible polish it is, as a rule, necessary to use a little rouge. The other pad, therefore, is dipped in a little of the finest rouge and well rubbed on a glass plate. It is then used to polish the mirror in a similar manner, being rubbed all over it with circular strokes and slight pressure. If it is found that the film is rubbed away, it is a sign that it was left rather too long in the silvering solution—the exact moment at which it should be taken out being a matter of experience.

The quantities given above are for a 6 in. mirror 1½ in. thick, in a vessel ½ in. larger all round than the mirror. The quantity required varies, of course, with the size of the mirror, but should be sufficient to cover the mirror to a depth of at least ½ inch. Each ounce of the solution contains 24 minims of the nitrate solution, or about 2-2 grains of nitrate, and 8 minims of formalin.

The quantity of formalin given can only be taken as approximate. It varies with the temperature and with the particular sample of formalin employed. It is always a good plan to make a few experiments on small pieces of glass, or even on the inside of a test tube or measure. Too much formalin causes the action to be too quick, and the silver coagulates in the solution before it has had time to deposit on the mirror; too little formalin causes the action to be too slow or to fail altogether.

The temperature of the silvering bath should not be less than 65° or 70°, and may be even higher with advantage. I have got good film with the temperature as low as 48° F.; but it is not easy.

There is no difficulty in silvering the mirror face down if it is thought better, the mirror being supported by pitch on a cross-piece of wood; but I got perfectly satisfactory results by the method given above. It is an advantage to divide the solution into two parts, as above; if the solution is mixed in a jug and then poured on, the action begins so rapidly that an uneven film often results.

Considerable economy of solution may be effected by making the mirror serve as its own silvering dish. For this purpose the edge thereof should be fairly smooth. A band of stout brown paper 3 or 4 inches wide and long enough to go two or three times around the mirror, is dipped in melted paraffine and stretched around the edge of the mirror while still hot, and tied or strapped tightly. In this way a dish 1½ to 2 in. deep is formed, the bottom of which is the mirror itself, and in this way I have obtained a good film with only 6 oz. of solution. The silver film, once in use, should be left alone as much as possible, all that is necessary generally being to dust the surface lightly with cotton wool from time to time. Any violent changes of temperature, which would produce dewing, should be avoided as much as possible, and the telescope, when not in use, kept in a porch or shed, but not indoors, where the temperature is higher than outside. The silvering process given above, when once mastered, is so quick and handy that it is virtually no trouble.

Eyepieces.—Three at least will be required, and they can be obtained second-hand for about $2.50 or so. The most convenient power to start with are about 7, 15, and 30 to the inch of aperture, giving 63, 135, 270 on the 9 in. When experience is gained a fourth of about 55 to the inch will be useful for double stars and faint details on planets; and if a still higher power is required the field lens of this may be removed, the eyelenses alone giving 75 to the inch, or 675 on the 9 in.; it will seldom or never be advisable or necessary to go so high. For general work it will probably be found that about 30 to the inch (270) is the most useful. If the focal length of the mirror is stated when buying, the optician will supply the correct powers. Eyepieces by Zeiss and Steinheil are listed at $3 or so, with their focal lengths in millimetres marked on them. One millimetre =.04 in. nearly, and the magnifying power is equal to

$$\frac{\text{Focal length of mirror}}{\text{Focal length of eyepiece}}$$

A Zollner star spectroscope to fit the 135 power will give good views of the spectra of stars down to the 3d or 4th magnitude. This merely requires fitting like a cap on to the flange of the previously focussed eyepiece.

For observation of the sun I recommend the method of projection on a sheet of paper or a card with a low eyepiece. If the expense of a diagonal solar reflector is allowable, the sun may be examined directly, with a dark glass cap, but under no circumstances should any attempt be made to examine the sun directly without some such aid. The heat concentrated by a 9 in. mirror or, indeed, by any size over 2½ in. or 3 in. is enough to instantly melt or crack any dark glass on the eyepiece, unless, indeed, the mirror is used unsilvered. If it is wished to examine the sun directly and no "solar diagonal" is at hand, the aperture should be reduced to 2½ in., or at the most 3 in., by an "eccentric" stop, so that one side of the mirror only is used. This should not be placed in contact with the mirror, but a few inches away.

A cap with a very light neutral-tinted glass to fit the lowest power eyepiece is very useful for observing the moon. Of course, if caps, spectroscopes, etc., will fit all the eyepieces, so much the better; and all the eyepieces should, of course, be fitted with the standard screw.

A dew-cap, or short cylinder of tin or paper, blackened inside, to fit over the object-glass of the finder is most useful, and saves a lot of trouble due to dewing of the object-glass.

Before concluding, there is one piece of apparatus I should like to mention—the Barlow lens. This is an achromatic concave lens which, placed in front of the eyepiece at a few inches distance, at the same time enlarges the image and throws it further out from the main tube. It is almost a necessity if a solar diagonal reflector is to be used. A very efficient substitute is an ordinary concave eyeglass of about 10 in. (negative) focus, which may be mounted in a wood or brass cylinder and placed inside the eyepiece tube. I used this plan for a considerable time for all purposes, as the concave lens has the effect, in my case, at least, of improving greatly the performance of an under-corrected mirror. Of course, with high powers a certain amount of color is introduced into the image, but much less than might be thought, while with low powers, for example, the prismatic effect was quite unnoticeable at or near the center of the field. I merely give this as a hint. A good mirror requires no such help.

I have now made as clear as I can how I was able to provide myself with a telescope which has proved of good quality at a very small cost. Throughout the articles I have recommended nothing that I have not myself tried and found successful; and even if the method I have adopted is imperfect, I think I may claim that it will for a given (small) sum of money provide a very much better instrument than could possibly be bought for the same sum. The cost of the 9 in. reflector I have described is, roughly, about $95, and I doubt if even a first-class 3 in. refractor could be bought secondhand for that sum. As from time to time queries are asked with regard to non-achromatic telescopes, perhaps I may conclude with a word of advice to the authors of those queries and others. It is this:

Do not attempt to make anything of the sort. Any non-achromatic telescope will be most unsatisfactory and not worth the trouble of fitting up. Make a reflector. If you are frightened at the details and difficulties of the work, get two 4 in. or 4½ in. discs ¾ or ½ in. thick. Grind the mirror to a good long focus—5 or 6 ft. Never mind the testing of the curve, and polish on fine cloth instead of pitch, if you are afraid of pitch. Get a bit of plate glass 1 in. in diameter to serve as a flat. Get an eyepiece giving about a hundred diameters, and mount the whole thing roughly on a post. You will not have a first-class instrument, but it will be as easy to make as a non-achromatic refractor, quite as cheap and immeasurably superior. This to the beginner who does not want to go to the trouble of testing, etc.; but there is no doubt whatever that he will sooner or later take up the work seriously and turn out a good instrument.

I trust that these articles may have been of some use to some beginner or other; and I must apologize for having taken so long to complete them.

WIRELESS TELEGRAPH IN ALASKA.

Gen. Greeley, chief signal officer of the army, speaking of wireless telegraph work in Alaska between St. Michael and Nome, says: "This is the only long distance wireless telegraph system in the world, I think, that is regularly operated as a part of the telegraph system handling commercial business. On Aug. 6, 1904, it completed a year of uninterrupted service over its course of 107 miles. It has handled daily and uninterruptedly the entire telegraphic business of Nome and the Seward peninsula, which, together with the official business, averaged several thousand words daily.

More than a million words were sent during the year, many thousand being commercial code words in which no error has ever been traced to this section. In a single hour there have been transmitted over this section 2000 words without an error or repetition. Capt. Wildman was retained at Nome throughout an arctic winter to insure continuity of operation and the successful training of the enlisted force. During the year there were 134,630 messages besides considerable free official business. It was deemed proper to relieve the isolation of Alaskan life by furnishing daily the approved news bulletin to each military post and station, and by granting a strictly limited use of the line to intercommunication on social subjects between the different military stations."

SAVED BY WIRELESS TELEGRAPH.

The story of a 29 hours' struggle to keep from sinking at sea, during which time the vessel's hull once disappeared partly under water, and in which wireless telegraphy finally brought rescue, was reported by the oil tank steamer, City of Everett, upon her arrival at New York Oct. 19. This steamer came from Port Arthur, Texas, with the barge, Standard Oil Co. No. 94, in tow.

On October 9, in a heavy storm, the pounding of the the seas broke the steamer's hawser pipe plate, carrying away the turret door and allowing the sea to rush through the opening. The water filled the fore-peak, causing the steamer to settle by the head to a depth or five feet. Water covered the entire forward portion of the hull up to the mainmast. Oil was pumped hurriedly out of one tank, No. 3, both to lighten the steamer, thus raising her half sunken hull, and also to quiet the heavy seas. The steamer, however, became unmanageable.

By wireless telegraph the steamer Capt. A. F. Lucas was informed of the oil steamer's plight, and came to her assistance. For 29 hours the A. F. Lucas stood alongside, until the flooded compartment was pumped out and repaired sufficiently to allow the City of Everett to proceed on her voyage.

Kinetic energy is the power stored in a moving object which keeps it in motion. By way of illustration, conceive a railway train rushing along a straight, level stretch of track, the train being driven to its power limit. If the source of power, say the steam pressure, is now suddenly removed by closing the throttle, the train will continue to run or "coast," for a long distance, due to its kinetic energy, gradually reducing in speed until the energy is exhausted and the train stops.

Renew your subscription before you forget it.

PHOTOGRAPHY.

FLASHLIGHT PHOTOGRAPHY FOR AMATEURS.

HARRY L. SHEPERD, B. S.

In an exchange notice which I read a few days ago, I noted that a member had for exchange flashlights, 3x6 in size, of groups. The subjects for exchange did not appeal to me very forcibly, in the first place, and in the second, I wondered if this enthusiast's work was of the "soot and chalk" variety which we so often see in this class of work, due to using too little flash powder, and increasing the injury by developing in too strong a developer. Don't spoil a good thing by using too little powder. My test is this: Use the Pyro. developer recommended by the makers of the plates I am using, and diluting that developer with an equal bulk of water. I want the high lights to show in 30 or 35 seconds after I pour on the developer. If they do not show in that time, then I consider I have used too little powder. It is the shadow that I aim at. Give them a chance. Well, now, you say, that is all right; but the high lights in my case don't don't show in less than a minute with full strength developer, and my negatives lookall right. Well, I will not dispute the point, but give my test a trial and submit a print from your negative and my negative, as I will call it, to some one versed in flashlight work, and get their opinion. Again, don't develop too far. Here you no doubt notice that in the example cited I have worked backwards. This a guide for you, as it was for me when I first really appreciated the benefit of flashlight powders. After a few trials you will know the correct amount of powder for any particular case. Again, in the example above, I speak of the Seed plate. As you perhaps know, some brands of plates are coated with an emulsion contained in a quite hard gelatine which does not absorb or allow the developer to penetrate as rapidly as a softer gelatine would. So my remarks as to the time the high lights should appear applies in my case more particularly to the Seed plate, though the Cramer, also, I found about the same as the Seed.

Portraiture appeals to many amateurs who do not have a chance to work by daylight. Well, on my part I think most amateurs will get as good, if not better results by using the flashlight.

Don't for a moment think that you can just set your camera up, tell your "victim" to look pleasant, while you fumble around in the dark to find a match to light the fuse attached to the flash powder and produce something that will make you famous. Rather go about the matter in this way: Study the series of articles in this magazine on portraiture by Mr. Raynor (the window method), and get a general idea of how the light ought to fall on the face, where to place the camera, the background, the reflector, etc. Then substitute for the light coming in the window your flash powder.

When I say substitute, I mean, have the same general arrangement of your apparatus. The light should in most cases fall on the face at an angle of 45°. So, you see, you will need a stand which can be raised or lowered. I use a stand made of wood. The base is 2 ft. square of two 1-in. boards nailed together. At one corner I nailed an upright 7 ft. high and in sections 3x1 in. Brace this well. A movable block holds an ideal flashgun. This block I can bolt to any height I wish. The flashgun should point directly at the subject, and behind it should be tacked a piece of white cardboard about 1½ ft. square to reflect the light. Hang a piece of white cheese cloth in front of the flash, which will soften the lighting to a wonderful extent. Keep the background well back, 4 ft. at least, if you wish to avoid shadows. Again don't place the white reflector, on the shadow side of the face, too far to the rear, as that will reflect too much light to the back of the head.

At Stop U. S. No. 8, with the flash at 5 to 6 feet from my subject, I use 30 grains of Luxo powder. Now right here let me tell you that in using flash pistols and the like, to be very careful. Flash powder is dangerous, and especially when used in conjunction with any affair whose purpose is to set it off at the instant required. Sometimes a jar will release the trigger and that is the time you will get burned. I have seen some bad accidents due to the careless handling of flash pistols. So be careful. Keep the pistol away from your face.

Now in portraiture have lots of artificial light so that you can see what you are doing. A couple of gas burners are not too much, but keep them back of the camera. In this way the subject will hardly notice extra light from the flash, closed eyes will be the exception, not to mention the dilated pupils of the eyes.

Now have your subject look in the required direction, then shift the stand, holding your flash gun till the light will strike in the right direction. Stand on a chair and look along the barrel of the flashgun to see that it is just right. Place a heavy weight on the base of the stand to keep it firm. Attach a cord to the trigger of the flashgun. Pass it around a nail in the wall, a hook, a doorknob, in fact anything in a line with the gun, so that by pulling the cord, when you are seated behind your camera, with your eyes on a level with the lens, you will release the trigger and so set off the flash.

Now suppose you are all ready. Set your shutter at "bulb" or "time" exposure. Hold the bulb in your left hand, the cord attached to the trigger of the gun in your right hand. Keep your eyes on a line with the lens, then talk to your subject. Tell stories or lies, anything to get the "right expression," and when you get it squeeze the bulb and pull the cord, and there you are.

In using a kodak it is best to open the shutter and make the exposure by raising and lowering a black cloth thrown over the front of the kodak.

Suppose you have opened the shutter and the subject moves, or a "cast-iron expression" turns up; well, close the shutter and try again. An exposure of 15 or 20 seconds by gaslight will not affect the sensitive plate.

In using a single lens of long focus, the camera may be 8 to 15 feet from the subject. In this case it is not necessary to have the flash as far back as the camera If the flash is suitably protected and the lens well protected, you may have the flash 5 feet and the camera 20 feet from the subject.

Be careful of reflections, as in the case of mirrors and the glass in picture frames, or else you are liable to get "freak" pictures.

In flashing over 60 grains of flash powder, lay it in a train, because if it is piled up the force of the explosion will blow a good deal of it away. About 60 grains of flash powder is the maximum amount that can be burnt efficiently in a pile; double the quantity will not produce twice the light unless you spread it out.

I have a lot of other points to tell you on other phases of the flashlight work in the picturing of birds, animals, etc., but will have to defer it till some other time.

I hope some of the "hard facts" I have stated above will prove useful to some whose efforts have not so far been crowned with success.—"Western Camera Notes."

A HALL CLOTHES RACK.

JOHN F. ADAMS.

The clothes rack here described is suitable for small halls where space is limited, and whatever arrangement is provided for holding the outer garments of visitors must of necessity be compact and with the greatest possible capacity. The illustration shows a mirror, which will be appreciated by the ladies—and the gentlemen also; a small holder for umbrellas and a receptacle for rubbers, which is high enough to afford a low seat when putting them on. The frames for the umbrella holder are attached to the side most suitable for the location of the rack. The lower frame is made of a size to receive a small iron roasting pan, which is painted a color to match the wood and also to prevent rusting. It is easily removed to clean or empty water draining from wet umbrellas.

The rack requires two pieces 69 in. long and 1¾ in. square, two pieces 13½ in. long, 6 in. wide and ¾ in. thick. Mortises are cut in the centers of the upright pieces ½ in. deep and wide to receive the ends of the cross pieces, the top edges of the latter being located 2 in. and 33½ in. from the tops of the uprights. Rabbets are cut ¼ in. wide on the uprights and crosspieces and deep enough to permit of a mirror 13 x 36 in. being put in so the front will be ¼ in. from the front edges of the cross pieces.

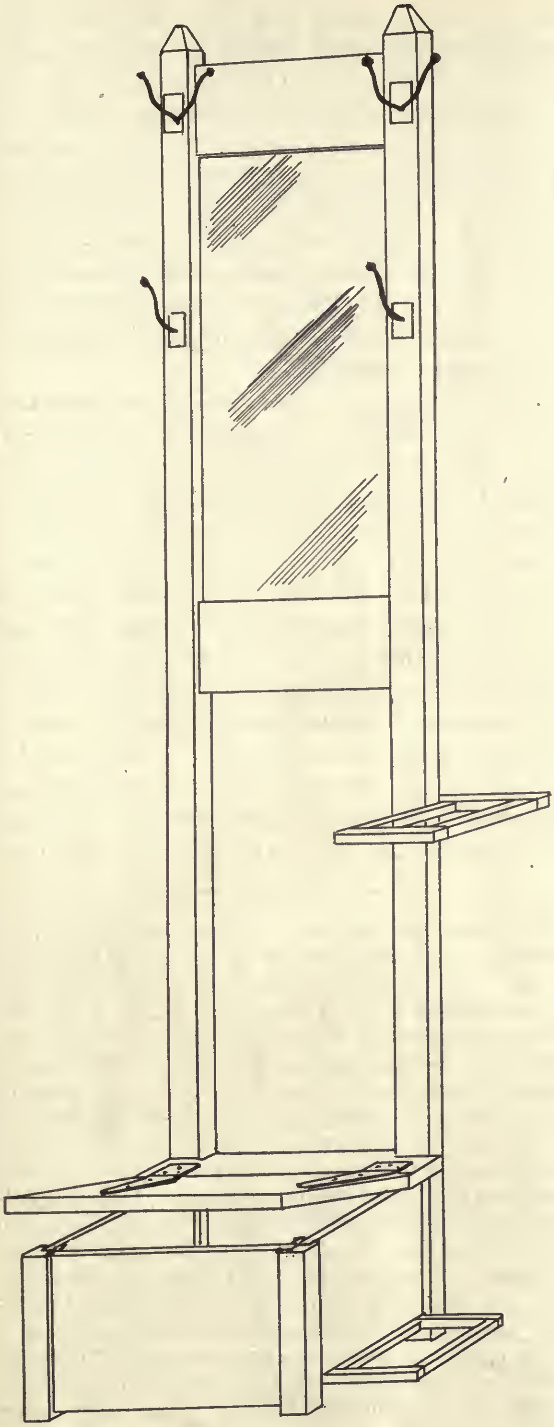
At the lower ends of the uprights cut grooves 8¼ in. long, ¾ in. wide and ½ id. deep to receive the ends of the side pieces and back of the box. Two front posts 8½ in. long and 1¾ in. square are made, and grooves are cut for side and front pieces as at the back. The front and back are 13½ in. long, 7 in. wide and ¾ in. thick. The bottom is 13¼ in. long and 7¼ in. wide and is fastened by nailing through.

The top consists of two pieces 17 in. long and ¾ in. thick; the front one 8½ in. wide, which is hinged to the back, which is 2½ in. wide and nailed to the top of the sides and back. The corners will have to be cut out to fit around the two upright pieces so that the rear edge will be flush with the back edges of the uprights. It is also desirable to fit cleats to the ends of the hinged cover to prevent warping. If that is done, the cleats should be 1½ in. wide and ⅜ in. thick and fastened by both glue and ⅝ in. wood screws.

The two frames for the umbrella holder are made from strips 1 x ¾ in., the upper one measuring 6 x 8 in. outside, and the lower one somewhat longer. Inside of each corner put small angle irons for strength. If two large wooden curtain rings can be secured they will be more ornamental, and having no corners will be less liable to break.

The mirror is held in place by strips ⅜ in. wide, and a backing of a single piece ¼ in. thick is desirable. A piece of thick manilla paper is put between the mirror and the backing and another sheet pasted on the outside, covering all cracks to keep out dust and moisture. The latter, condensing on the back of a mirror from changes of weather is what causes a mirror to become creased and spotted.

The woods most suitable for this rack are oak or mahogany, and as but little stock is required, the cost if mahogany is used, will not be large.



CARE OF THE LATHE.

The cleaning and lubricating of a lathe is considered in an article in the "Bazaar" by H. J. S. Cassal, who says with regard to cleaning, that the balls should frequently be taken out of the ball thrust bearing and freed from the little flakes of hard metal which they wear from grooves and which are ground up from pieces working through. Similarly, the grooves themselves should be scraped with a file to get rid of the flakes. The saddle should frequently be cleaned underneath, as well as in the grooves at the edge of the bed. The slides of the rest and the inside of the box in which the screws run should be cleaned at least once a week, and if the lathe is much used the bearings should be flushed out with paraffine until the oil runs through perfectly clean, at least once in a fortnight, whilst the bottom mechanism should occasionally be looked to and cleared of shavings and dirt. For lubricating, two kinds of oil should be used. The head should never have anything but the best sewing-machine, or other good fast-running oil put on. For the balls, the lower mechanism and the slides, etc., a thicker oil should be used—sperm, or one of the thick bicycle oils which are now sold everywhere.

Almost any animal or mineral oil will do for the rest of the lathe. It is well to assure oneself that the oil used has not vaseline as a base, and is not thinned down with paraffine, both of which substances have a deterioriating effect upon bearings and rubbing surfaces, especially if any grit be present. Another thing which should be cleaned now and again and which is frequently left uncleaned for years because it is difficult to get at, is the divided nut of the screw-cutting gear, which accumulates a lot of dirt. The bed should be kept well oiled, not forgetting the tongues of the poppet, nor the far end of the bed, which is usually left dry, so that the saddle when run right back is sliding on a dry surface.

A good mixture which will prevent the rusting of machinery, says an English publication, is made by dissolving one ounce of camphor in one pound of melted lard. After the impurities have been skimmed, black lead should be added to give the whole an iron color. After cleaning the machinery carefully and smearing it with the mixture, it can be left indefinitely, or if wiped off after 24 hours it will obviate rust for some time. When removed, the metal should be polished with a soft cloth.

Repeated successful experiments in various parts of the United States have abundantly proven that a weak solution of copper sulphate will clear water polluted with algæ and other organic substances. When applied in proper amount water is usually clear within four days from the time of application.

"A man who hasn't much to do is always telling some other fellow how he did it."

AMATEUR WORK.

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TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

FEBRUARY, 1906.

The formation of the "American Society of Model Engineers" is about completed. The constitution and by-laws are in press, and copies of same will be mailed to all who have written us expressing a desire to become members. It will be noted that the government of the society is entirely within the control of the members, which ensures freedom from any action in the interests of any particular person or idea.

It is the opinion of the founders that the annual dues, which for a time will be $1.00 per annum, be used for prizes for the best designs of machines, tools, instruments, etc., and the obtaining of patterns and castings of same for members of the society desiring them. It is also expectedthat when the society reaches a size and membership which will permit, that annual exhibitions be held at which the work of members will be shown, and suitable prizes awarded. Also, that a bureau of information and supplies be established, for furnishing members with materials at cost. The value of membership in the society will be evident from what has been mentioned. Those who have not yet expressed their desire to become members should write at once.

In a communication recently received from a subscriber, we noted the statement that the articles published during the past year on general engineering and educational topics were of no particular interest to this reader, and that the space taken for these articles "had reduced the quantity of reading devoted to constructive work." As the same opinion may be held by other readers, we call attention to the fact that the size of type now used throughout the whole magazine is smaller than that formerly used, which permits of about one-third more reading matter in the same number of pages. The space thus gained by the use of smaller type has been used for the general articles above mentioned.

As to the value of these articles we think that the larger number of readers find them of interest. They are carefully selected, and are published for the purpose of keeping readers informed of the progress of engineering development, so far as this may be done by articles not too technical in character. By reading articles of this kind, a better perspective is obtained, so that the relative effect of new work in specific lines can be the better estimated. This result cannot be otherwise than beneficial to all readers, whether they appreciate it at the time or later, and for that reason we feel that the best interests of our readers will be served by continuing to publish a limited number of articles of a general character.

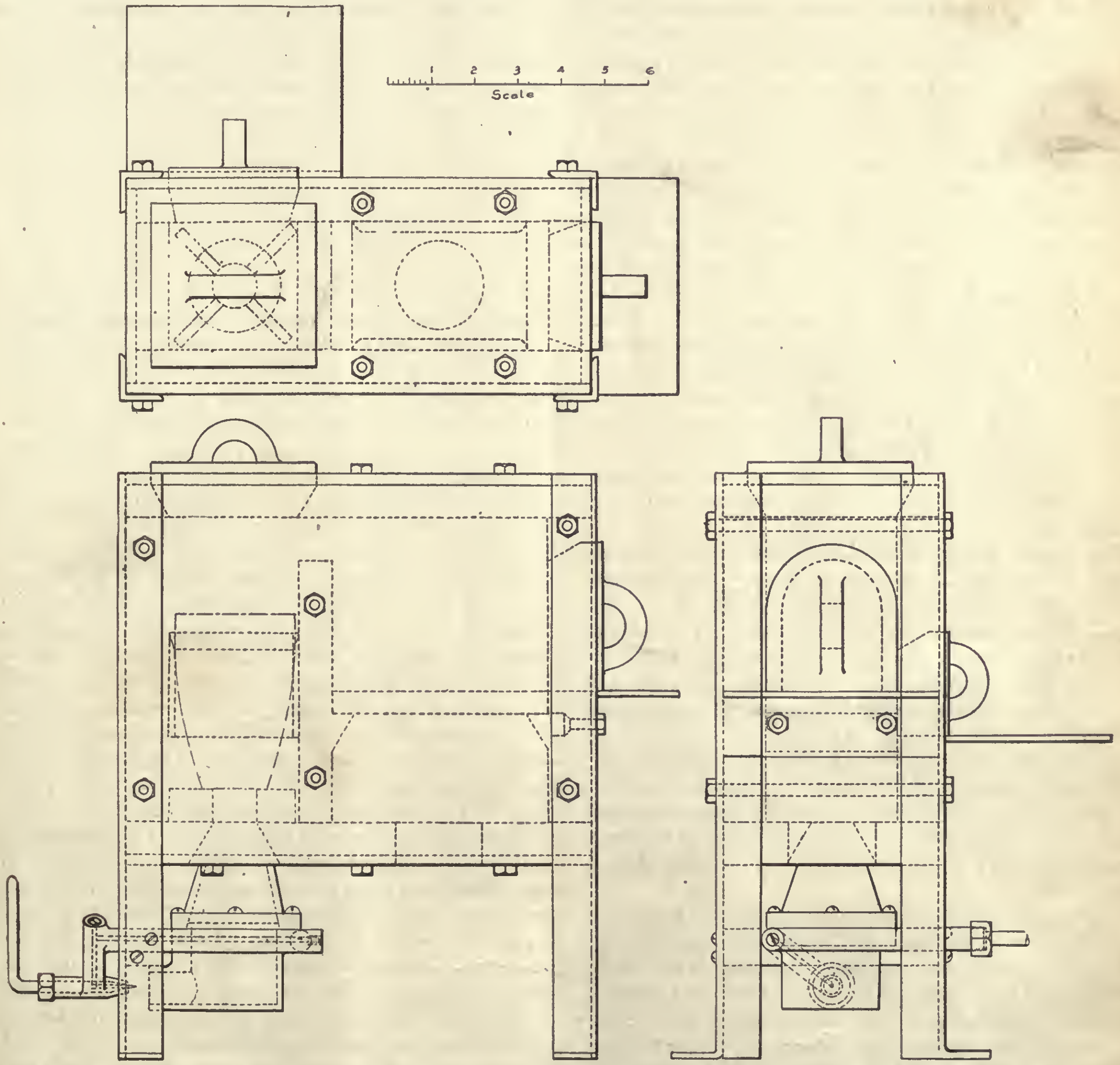
The people who earn a precarious livelihood by gathering amber on the shores of the Baltic sea work only in the roughest weather, says the "Mining World." When the wind blows in from the sea, as it often does with terrific violence, the bowlders are tossed and tumbled at the bottom, and great quantities of sea weeds are washed up on the beach. This is the harvest of the waders, for hidden in the roots and branches of the seaweed, lumps of the precious gum may be found. In other parts of the coast divers go crawling on the bottom of the sea for the lumps of amber hidden in seaweed and rocks. It is believed that amber is the gum exuded from the trees, of which not a vestige remains. The finds are very variable. The largest piece known, weighing 18 pounds, is in the Royal Museum in Berlin. The usual finds range from lumps as big as a man's head to particles like grains of sand. The larger pieces are found jammed in rocks or in tangles of marine vegetation. Divers work from four to five hours a day in all seasons, except when the sea is blocked with ice. The work is so arduous that they are bathed in perspiration even in the coldest weather. For all their ginding toil the Samland natives are happy in their way and increase and multiply as in more favored regions of the earth.

A COMBINED SMELTING, HEATING, TEMPERING AND ANNEALING FURNACE.

ROBERT GIBSON GRISWOLD.

Small tools, dies, etc., can hardly be satisfactorily handled in the flame of a blast lamp or in an open fire, as great risks are run which may result in the burning of the piece or, if hardening be the process in hand, insufficient or irregular heating may be the result. Furthermore the direct heat of a blast lamp is so intense that the thin portions of a tool such as a die may become overheated long before the heat has penetrated to the interior of the heavier portions. Such uneven heating often leads to very unsatisfactory hardening and soft spots may result in the very portions of the work that should be hard.

Such conditions are more easily controlled in a furnace and a small combination type is described and illustrated herewith. As is plainly shown, it is divided into two compartments—one directly over the burner and the other separated from this by a vertical bridge-wall, over the top of which the heated gases pass into the longer chamber for the uniform heating of die-blocks, cutters, etc. The smaller chamber, situated directly over the burner is used for melting metals in a crucible, which may be introduced through a trap in the top. Being directly over the flame and surrounded by it, the crucible becomes



intensely heated and such metals as lead, tin, zinc, copper and brass may be readily melted.

A small door in the side permits the introduction of small rods and soldering irons for heating. In the large chamber is a false floor upon which larger pieces, such as die-blocks, may be laid for heating. As the gases play over this floor, heating it to a red heat, any piece laid upon it will soon become evenly heated throughout, as the heat is allowed to "soak" into the work. This "soaking" is seldom given the time it requires, but much of the resulting success in the proper hardening of a piece depends on the length of time given for the heat to penetrate into the center of the work. In this type of furnace the heating of the work is done very gradually as the heated gases only play over the piece and the fierce blast cannot reach it.

The walls are made of firebrick, lined on the outside with ¼ in. asbestos board. This firebrick is made by moulding a paste of 3 parts fire-clay and 2 parts Portland cement into wooden moulds of the shape and size required. Strips ¾ in. in height are tacked to a smooth plank so that the inside dimensions correspond with those scaled from the drawing. In order that the pieces may be firmly bound together, ¼ in. rods, threaded at each end, are let into the cement while moist, the ends protruding on either side sufficiently to pass through the adjoining walls. Holes for these ends to pass through are also made at the time of moulding the sides, as are also the door openings. In fact, all work must be done while the material is plastic, as it is almost impossible to drill or cut it when hard.

Washers are placed beneath the nuts on the asbestos board, and the top cover may be wired on for greater security. The supports for the furnace are of 1 x 1 x ⅛ in. angle iron with a toe bent outwards to receive a screw at the lower end. Two shelves of 1-16 or ⅛ in. iron are attached as shown. These form supports for the hot doors when the latter are removed and also as rests for soldering irons, or bars.

Surrounding the hole over the burner are four supporting lugs upon which a crucible may rest so that the flame will reach all sides. These lugs are moulded on as a part of the bottom. The other hole in the bottom of the larger chamber permits the escape of the hot gases.

The burner is of the blast lamp type and produces an intense heat. It is of cast iron and supported between the legs of the furnace. The details are sufficiently clear to render a lengthy description unnecessary. The gasoline is led around the upper part of the burner through a small hole drilled through the legs until they intersect at the corners. These holes are tapped and provided with screws where shown, so as to form a tight passage around the burner. A needle valve controls the admission of gas to the burner, and in the passing of the gas into the burner carries with it sufficient air for combustion. A cast iron plate, liberally perforated with 1-16 in. holes, is placed across the inside of the burner at the joint, and the upper one securely holds it in place. The ignition of the gas occurs at this plate and a solid blue flame passes up through the hole in the bottom of the furnace.

The gasoline must be fed to this burner under pressure, which may be secured by feeding the gasoline from an elevated tank or, better still, from an air-tight reservoir fitted with a pump such as is used for inflating bicycle tires.

The burner must be thoroughly heated before it will operate and this is done by burning a small quantity of gasoline or alcohol in a cup beneath the burner. When heated, and while in operation, the gasoline in passing around the burner is vaporized and passes through the needle valve as a gas. The flame is very easily regulated by turning the needle valve handle one way or the other.

CHIPPING CASTINGS.

The well nigh lost art of chipping castings is described in an article of the "Mechanical World," which states that in the large modern shop of today there are but few apprentices who can do a creditable piece of chipping with a hammer and chisel. This is perhaps not to be regretted, as a chipped and filed surface is not to be compared with the work of the planing or the milling machine, and it is indeed a triumph for the machine man of today that the work is practically finished when it leaves his machine. The consequences of this is that surfaces which used to be cast to nearly the finished size and dressed up with hammer and chisel are now machined, and the need for skilful chipping and filing is gone. The tendency of today is to limit the work of the fitter to the fitting in of keys and the scraping of surfaces and journals, each man performing, as nearly as can be arranged, the same operation on one particular piece of work. This, of course, greatly reduces the cost of manufacture, as the men, through doing the same thing constantly, become very expert, and working under a piecework or premium system, are able to make a very good rate of pay; but the apprentice has not the same chance to learn as he had, even though he spends his time of apprenticeship with different squads of workmen and has every chance given him. Thus there are many points to be learned when doing a piece of work from start to finish, which are not noticed when one starts work on a job that is already partly finished. An apprentice who has been trained in a shop of this kind feels very awkward when he goes to a small shop and has to use a hammer and chisel frequently; or, being sent to an outside job where there is a lot of chipping to be done which it would not pay to shift to a machine, he does not very well know the best way to start work or have his chisels properly ground.

AN EASILY BUILT POWER LAUNCH.

By Courtesy of the Brooks Boat Mfg. Co.

III. Planking—Deck—Installing Engine.

The ribs and side timbers are the up and down pieces on the outside, that extend from the bottom of the bilge stringer to the top of the clamp, as shown in Fig. 1. They are spaced 9 in. from center to center of each, and are fastened with two 1¼ in. No. 12 screws at each end of each piece. The last two or three ribs on each end are not placed straight up and down, but are swung so as to equally divide the extra space caused by the angle of the stem and transom. These ribs are simply straight pieces and are sawed off flush with the top of the clamp and the bottom of the bilge stringers.

There is one floor timber half way between each of the ribs or side timbers. The floor timbers are fastened on top of the keel in the middle, with two 1½ in. screws to each. The ends of the floor timbers are mortised into the lower edge of the bilge stringers and are fastened with one six penny casing nail at each end, up through the floor timber into the bilge stringer.

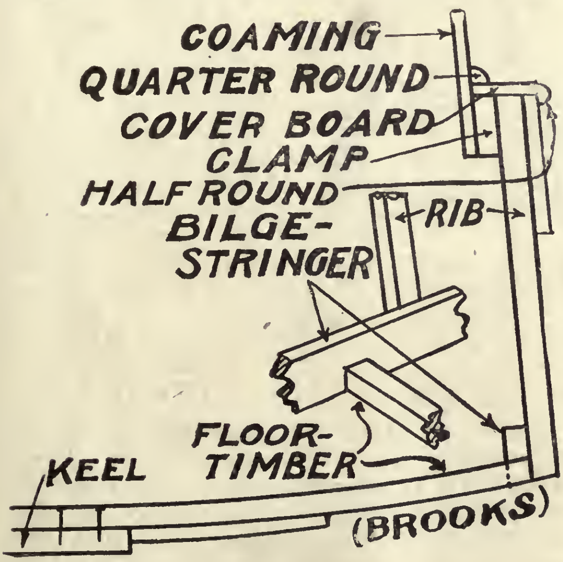


Fig. 11.

Where the floor timbers lay on top of the keel they are slightly flattened with the plane, so as to lay flat on the keel.

In planking, first get out and put on the the top streak. After cutting out one side, use it for a pattern to get out the plank for the opposite side. Apply the plank up to place on the stem, and you can tell just how much to trim out the rabbet to let the plank in flush. Fasten the plank to the stem with three or four 1½ in. clout nails, and to each rib, with three 1½ in. clout nails. Where the plank butt or splice, they are fastened by putting a butt block of oak, 8 inches long and the width of the plank, by ⅝ of an inch thick, on the inside. Fasten the plank to the butt block with one dozen nails. This butt block is the same as is shown in Fig. 2. Next, put on No. 2 plank, making the seam between each of the plank tight on the inside, and a little open, ⅛ of an inch on the outside for calking. After the top streaks of planking are on, turn the boat over and, commencing with the bottom plank next to keel, put it on, using 1⅝ clout nails to fasten the bottom plank to the floor timbers.

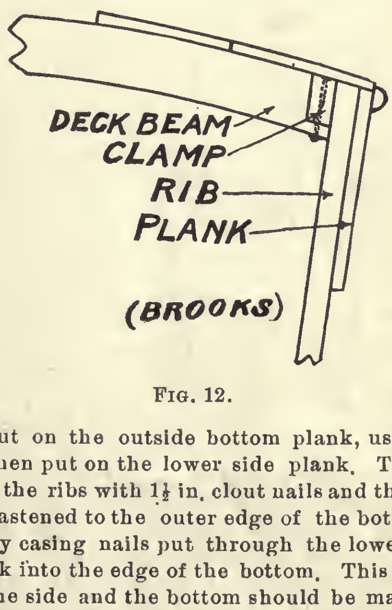


Fig. 12.

Next, put on the outside bottom plank, using same nails; then put on the lower side plank. This is fastened to the ribs with 1½ in. clout nails and the bottom edge is fastened to the outer edge of the bottom with six penny casing nails put through the lower edge of the plank into the edge of the bottom. This seam between the side and the bottom should be made tight, as it is not to be calked. The casing nails from the side into the bottom are spaced close together, from 1½ to 3 in. apart.

After the boat has been planked, turn it over and put in the deck beams. Saw out seven beams for the forward end from the pattern that shows the greatest crown. Saw out four beams from the after end from the pattern that has the least crown. The deck beams are placed one between each rib, and are fastened to the clamp by mortising out one-half the width of the beam from the bottom of the beam itself. This will let the beam in with its top flush with the top of the clamps, as shown in Fig. 12. The ends of every deck beam are fastened to the clamp with one 2 in. screw.

The decks may be either canvas covered or of natural wood finish. The canvas covered deck is less work to make and is more durable, as the sun and rain will not affect it. A fine varnished deck, finished in natural wood, should not be put on unless the boat is to be well cared for and properly housed.

When the deck is to be canvas covered, it may be made of the waste lumber left from the planking. Cut into strips and lay it on as shown in Fig. 13. It is best not to cut the ends of the deck to shape until after it is fastened in place, then you can easily trim the whole off even with the outside of the boat and the inside of the coaming plate. Round off the sharp edge of the deck on the outside to an oval shape. Set in all nails. Plane and sandpaper the deck smooth. Putty all nail heads and open seams.

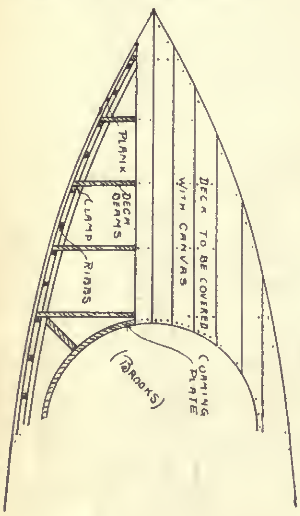


FIG. 13.

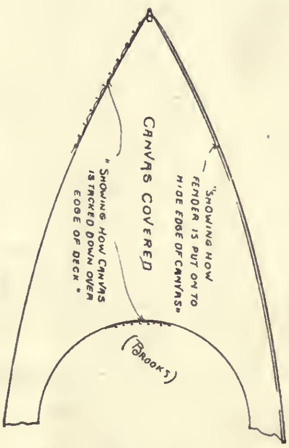


FIG 14.

The canvas should be 7 or 8 oz. duck. The deck is given a thick coat of paste and the canvas laid on while it is wet. The paste is made by mixing rye flour with cold water and then scalding it until it thickens. Lay on the canvas and smooth out all wrinkles. Bring the edge of the canvas over the ouside edge and tack it to the top of the sheer-streak with 2-oz. tacks. On the inside the canvas will have to be slit and folded under the coaming plate to which it is tacked. In this way the coaming will cover the inner edge and the fender-wale will cover the outer edge of the canvas, as shown in Fig. 14. Where the strips of canvas join, it may be either stitched together on a sewing machine before it is put on, or each strip tacked as it is laid. When the seams are tacked, use 2 oz. tacks close together—say ¼ of an in. apart. The canvas deck should be given three coats of paint and be repainted whenever it shows wear.

When the decks are to be finished in natural wood, first let some pieces, two or three in. wide by ⅜ thick, into the top of the deck beams, as shown in Fig. 15. These are to support the ends of the strips that make the deck, and of course should be so located that the inner edge of the covering-board and the ends of the deck will both rest on these pieces which are mortised into the deck beams.

The covering boards (marked cover board in Fig. 16) are first put on. These are shaped by laying the material on top and marking in from below. The covering boards are the full width from the outside of sheer-streak to the inside of the coaming-plate, alongside of the cock-pit. They may be narrowed up where they enclose the deck at the ends, as shown in Fig. 16.

The decks may be laid of any fancy wood, either in alternate strips of a dark and a light color, or all of the same.

When laid in this way the decks will have to be calked. A good way to calk the deck is to use a heavy piece of cotton twine. Lay it in the seams and tap it snugly down with a putty knife. The seams should then be payed off with varnish or wood filler and then puttied.

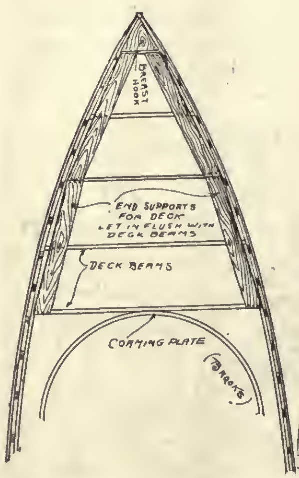


FIG. 15.

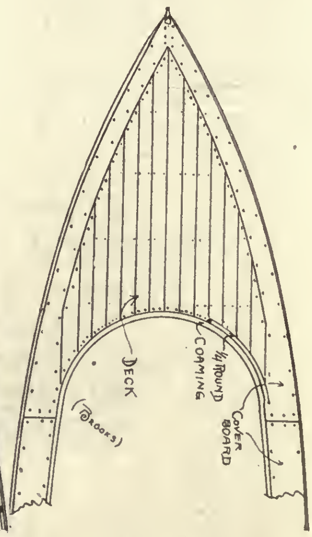


FIG. 16.

The two side pieces that form the coaming are cut out, fitted in place, and fastened to the clamp as shown in Fig. 11, using 1¼ in. screws 12 in. apart. The end pieces of the coaming are simply gotten out straight and fitted across the end. When put in these end pieces should be about 9 in. wide. After they are fastened, they may be scribed to conform to the height of the coaming and the crown of the deck. The corners of the coaming are reinforced by fitting a piece of quarter-round in each, on the inside.

The fender-wale is a half-round strip that is put on the outside, with its top edge flush with the top edge of the boat. It is fastened in place with 6-penny casing nails. See Fig. 12.

The engine bed is usually made of two pieces of oak, 2 in. thick. These run fore and aft and are notched over the floor timbers. The top of the bed timbers are dressed down to conform with the angle of the shaft. The size of these timbers and their distance apart will, of course, vary with different engines. The bed timbers are fastened to the bottom with 1¾ in. screws, put up through the bottom into the bed timbers.

The shafting is cut out of 3 in. oak, and is fastened in place on the keel at the location shown on the keel pattern. The shaft log is fitted down onto the keel. The floor timbers are cut out to allow the shafting-log to go down on the keel. Fit the shaft-log to the keel and fasten it in place with 1½ in. screws, up through the bottom into the shaft-log. Before putting in the shaft-log, fit a piece of canvas, laid in white lead paint, between it and the keel, and when putting in the screws, be careful not to get any of them in the way of the shaft hole.

Fig. 17 shows a simple method of making a guide for holding auger so as to bore shaft log straight. Two guides are fastened, one on each side of stern post, with a notched cross-piece connecting them. The notch in cross-piece will, of course, be in line of shaft hole. The shaft hole should be bored with a ship auger, which must be removed every few turns to clean out shavings. Sometimes a small hole is first bored out and then burned out to desired size with a red hot iron. Should the auger run too far out of line, stop boring and start again from other end of pipe log, then when the holes intersect they may be straighened by burning. If for any good reason it is desired to bore a hole over where a hole has already been started, first plug the original boring.

It is a good plan for the amateur to bore the shaft log before it is set up in the frame. The auger guide may be used same as described, then when the frame is set up the stern-post may be bored true by passing the auger through the shaft log and boring from the inside.

Another way of making the hole in shaft log is to make the log in two pieces by dividing it lengthwise in the center, and the hole may then be worked out with a mallet and chisel, half of the hole in each piece. When so made the log should be bolted together, with a piece of canvas laid in white lead paint between the parts.

The rudder port is a piece of gas pipe that is threaded into the fashion-piece and extends to the top of the deck; or when the tiller is under the deck, the upper end of the rudder port ends just below the tiller. The diameter of the interior of the rudder port should be ½ in. larger than the diameter of the rudder post.

The shoe is a flat piece of iron that holds the lower end of the rudder and is bolted directly to the keel. The shoe should clear the propeller wheel an inch, and when the shoe will not give this clearance straight out from the keel, it may be bent or an extension wedge-shaped skeg may be used to lower it. The end of the shoe should be turned over and a bent key put into the end of the rudder post to prevent its unshipping.

The location of the rudder port and the end of the shoe should be far enough back from the stern post to allow an inch or more clearance between the rudder and the propeller wheel. The rudder post should stand parallel to the stern post.

Cut the rudder out to shape and rivet it to the rudder post. The post may be in two pieces, or the post may be in one piece and the rudder blade in two sheets fastened together with the post riveted between.

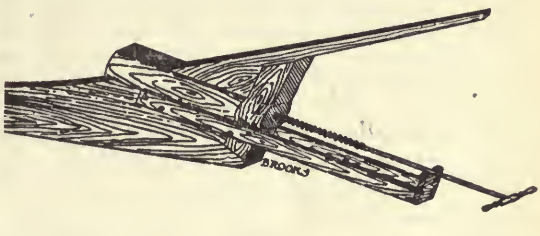


Fig. 17.

The upper end of the rudder post is forged square to fit the tiller. On small launches the tiller is usually connected with cotton rope. This runs through blocks and fair leaders around the coaming. When the tiller is on deck, four cheek halyard blocks are used at the four corners of the coaming, and common brass eyelets for fair leadors alongside the coaming. When the tiller is below deck, a common block without becket should be used at the four corners. This block should be fastened by a staple to the clamp to allow it to swing freely. When the steering wheel is used it will of course be fastened to the forward end of the coaming.

The seats in this boat had best be put athwartships, the same as a row boat, they may be located to suit owner's taste. The seats should be made of ⅞ in. lumber and be from 12 to 14 in. wide. The sides on the inside may be paneled up, or finished with narrow strips, or left as it is and painted.

To finish the outside of the boat, set in all nails and plane and sand paper smooth; then give a priming coat of paint, putty all nails heads; then give two or three coats of paint.

There are about 70 generally recognized elements; 13 of the 70 are non-metallic, these being sulphur, phosphorus, fluorin, chlorin, iodine, bromine, silicon, boron, carbon, nitrogen, hydrogen, oxygen and selenium. The remainder are deemed to be metals and there are thus 67 known metals, the greater part of which are, because of their rarity, of no commercial value.

"Keep a man busy and he will enjoy life and make others enjoy it with him; but let him loaf, and he is a nuisance to himself and all he comes in contact with."

CEMENT MORTAR AND CONCRETE.

PHILIP L. WORMELEY, JR.

I. Cement and Cement Mortar.

The term "hydraulic cement" is applied to one of most useful materials of engineering construction and one which in recent years has become widely extended in its field of application. Hydraulic cement posseses the property of hardening or setting under water, in which respect it differs from lime, which does not harden except in the presence of air. Thus it is evident that all places where air is excluded, such as foundations, thick walls, etc., cement mortar should be used instead of lime.

Only two classes of cement will be discussed here—Portland and natural. The difference between these is due partly to the method of manufacture and partly to the condition and relative proportions of the materials employed, which are, generally speaking, limestone and clay. In the manufacture of Portland cement the separate materials are mixed in such proportions as have been found by experience to give the best results. The mixing is done by grinding the materials together in mills, after which the mixture is burned at a very high temperature in kilns, and the resulting clinker ground to an impalpable powder is known as Portland cement.

In the case of natural cement, the materials used have been already mixed by nature in approximately the correct proportions, being found in the form of a rock which is generally classed as a clay limestone, or a limey deposit technically called calcarous clay. This material is burned at a much lower temperature than Portland cement. When the manufacturer has each ingredient absolutely under control and can adjust proportions to suit all conditions, it is reasonable to expect that a better and more uniform product will result than when the materials are found already mixed.

Portland cement is far more extensively employed than natural cement on account of its superior strength, although the latter is frequently used in cases where great strength is of little importance. The superior strength and durability of cement as compared with lime, together with the low price at which it may now be procured, have caused the former to replace the latter in engineering construction to a great extent.

In storing cement, care must be exercised to insure its being kept dry. When no house or shed is available for the purpose, a rough platform may be erected clear of the ground, on which the cement may be placed and so covered as to exclude water. When properly protected, it often improves with age. Cement is shipped in barrels or bags, the size and weight of which is usually as follows:

Bulk and weight of cement in ordinary barrels and bags.

Kind of Cement.	Quan. Cu. ft.	Wt. (net) Pounds.	Quan. Cu. ft.	Wt. (net) Pounds.
Portland	3½	380	⅞	95
Natural	3½	300	⅞	75

Western natural cement usually weighs about 265 pounds per barrel net.

CEMENT MORTAR.

Cement mortar is an intimate mixture of cement and sand mixed with sufficient water to produce a plastic mass. The amount of water will vary according to the proportion and condition of the sand, and had best be determined independently in each case. Sand is used both for the sake of economy and to avoid cracks due to shrinkage of cement in setting. Where great strength is required, there should be at least sufficient cement to fill the voids or air spaces in the sand, and a slight excess is preferable in order to compensate for any uneven distribution in the mixing. Common proportions for Portland cement mortar are 3 parts sand to 1 of cement, and for natural cement mortar, 2 parts sand to 1 of cement. Unless otherwise stated, materials for mortar or concrete are considered to be proportioned by volume, the cement being lightly shaken in the measure used.

A "lean" mortar is one having only a small proportion of cement, while a "rich" mixture is one with a large proportion of cement. "Neat" cement is pure cement, or that with no admixture of sand. The term "aggregate" is used to designate the coarse materials entering into concrete — usually gravel or crushed rock. The proportion in which the three elements enter into the mixture is usually expressed by three figures separated by dashes—as, for instance, 1–3–5—meaning 1 part cement, 3 parts sand, and 5 parts aggregate.

In the great majority of cases cement mortar is subjected only to compression, and for this reason it would seem natural, in testing it, to determine its compressive strength. The tensile strength of cement mortar, however, is usually determined, and from this its resistance to compression may be assumed to be from eight to twelve times greater. A direct determination of the compressive strength is a less simple operation, for which reason the tensile test is in most cases accepted as indicating the strength of the cement.

In mixing cement mortar it is best to use a platform of convenient size or a shallow box. First, deposit the requisite amount of sand in a uniform layer, and on top of this spread the cement. These should be mixed dry with shovels or hoes, until the whole mass exhibits a uniform color. Next, form a crater of the dry mixture, and into this pour nearly the entire quantity of water required for the batch. Work the dry material from the outside toward the center until all the water is taken up, then turn rapidly with shovels, adding water at the same time by sprinkling until the desired consistency is attained. It is frequently specified that the mortar shall be turned a certain number of times, but a better practice for securing a uniform mixture is to watch the operation and judge by the eye when the mixing has been carried far enough. In brick masonry the mistake is frequently made of mixing the mortar very wet and relying upon the bricks to absorb the excess of water. It is better, however, to wet the bricks thoroughly and use a stiff mortar.

The term "grout" is applied to mortar mixed with an excess of water, which gives it about the consistency of cream. This material is often used to fill the voids in stone masonry, and in brick work the inner portions of walls are frequently laid dry and grouted. The practice in either case is to be condemned, except where the conditions are unusual, as cement used in this way will never develop its full strength.

L. C. Sabin finds that in a Portland cement mortar containing three parts sand to one of cement, 10 per cent of the cement may be replaced by lime in the form of paste without diminishing the strength of the mortar, and at the same time rendering it more plastic. In the case of natural cement mortar, lime may be added to the extent of 20 to 25 per cent of the cement with good results. The increased plasticity due to the addition of lime much facilitates the operation of laying bricks, and has caused lime and cement mortar to become largely used.

In plastering with cement, a few precautions must be observed to insure good and permanent results. The surface to receive the plaster should be rough, perfectly clean and well saturated with water. A mortar very rich in cement is rather a drawback than otherwise on account of shrinkage cracks, which frequently appear. The mortar, consisting of two or three parts sand to one of cement, should be mixed with as little water as possible and well worked to produce plasticity. It is essential that the plaster be kept moist until it has thoroughly hardened.

MATERIALS FOR MAKING CONCRETE.

In securing sand for mixing mortar or concrete, if it is possible to select from several varieties, that sand should be chosen which is composed of sharp, angular grains, varying in size from coarse to fine. Such sand is, however, not always obtainable, nor is it essential for good work. Any coarse-grained sand which is fairly clean will answer the purpose. If gravel, sticks, or leaves be present they should be removed by screening. The voids in sand vary from 30 to 40 per cent, according to the variation in size of grains. A sand with different-sized grains is to be preferred, because less cement is required to fill the voids. By mixing coarse and fine sand it is possible to reduce the voids considerably.

It is customary to use the terms "river sand," "sea sand," or "pit sand," according to the source of supply. River sand as a rule has rounded grains, but unless it contains an excess of clay or other impurities, it is suitable for general purposes. When river sand is of a light color and fine-grained it answers well for plastering.

Sea sand may contain the salts found in the ocean. The tendency of these salts to attract moisture makes it advisible to wash sea sand before using it for plastering or other work which is to be kept perfectly dry.

Pit sand for the most part will be found to have sharp, angular grains, which make it excellent for mortar or concrete work. Where clay occurs in pockets it is necessary either to remove it, or else see that it is thoroughly mixed with sand. The presence of clay in excess frequently makes it necessary to wash pit sand before it is suitable for use.

The results of tests made in the laboratory would indicate that the presence of clay, even in considerable amounts, is a decided benefit to "lean" mortars, whereas it does not appreciably affect the strength of a rich mixture.

It is important that gravel for use in concrete should be clean, in order that the cement may properly adhere to it, and form a strong and compact mass. As with sand, it is well to have the pieces vary in size, thereby reducing the voids to be filled with mortar. The voids in general range from 35 to 40 per cent.

The best stone for concrete work consists of angular pieces, varying in size and having a clean, rough surface. Some form of strong and durable rock is to be preferred, such as limestone, trap, or granite. The total output of the crusher should be used below a maximum size, depending upon the nature of the work in hand. All material under one-eighth inch will act as so much sand and should be considered as such in proportioning the mixture. Precautions must be taken to insure a uniform distribution of the smaller pieces of stone, otherwise the concrete will have an excess of fine material in some parts and a deficiency in others.

Less than 8 per cent of clay will probably not seriously impair the strength of the concrete, provided the stones are not coated with it, and may prove a benefit in the lean mixtures. The voids in crushed stone depend upon the shape and variation in size of pieces, rarely falling below 40 per cent, unless much fine material is present, and in some cases reaching 50 per cent. A mixture of stone and gravel in equal parts makes an excellent aggregate for concrete.

It would appear from tests that crushed stone makes a somewhat stronger concrete than gravel, but the latter is very extensively used with uniformly good results. This superiority of stone over gravel for concrete work is attributed to the fact that the angular pieces of stone interlock more thoroughly than do the rounded pebbles, and offer a rougher surface to the cement. A point in favor of gravel concrete is that it requires less tamping to produce a compact mass than in the case of crushed stone. Then, too, the proportion of voids in stone being usuall y greater than in gravel, a proportionately greater amount of mortar is required to fill the voids, which means a slight increase in the cost of concrete.

Cinder concrete is frequently used in connection with expanded metal and other forms of reinforcement for floor construction, and for this purpose it is well adapted on account of light weight. Its porosity makes it a poor conductor of heat and permits the driving of nails. Only hard and thoroughly burned cinders should be used, and the concrete must be mixed quite soft so as to require but little tamping and to avoid crushing the cinders. Cinder concrete is much weaker, both in tension and compression, than stone or gravel concrete, and for this reason admits only of light reinforcement.

BOOKS RECEIVED.

Practical Pattern Making. F. W. Barroows. 326 pp. 7 x 5 in. 148 Illustrations. Cloth. Price $2.00, The Norman W. Henley Pub. Co., New York.

It requires the reading of but a few pages to disclose the fact that the writer is a practical mechanic, is well posted as to the best methods of using the tools and materials for pattern making, and knows what is good practice in design and construction. The occasional sarcastic flings at other equally competent workers and writers in this field is rather likely to give the reader an unfavorable impression of what is really an excellent book. The examples of different kinds of pattern work are well selected, the advantages of a given method of construction plainly stated, accompanied by considerable general information. A system for marking and recording patterns is given which would be of much value if adopted by shops having any considerable number of patterns to store, and which are liable to be wanted at frequent intervals.

Gas, Gasoline and Oil Engines, Including Producer Gas Plants. Gardner D. Hiscox, M. E. 442 pp. 9 x 5½ in. 351 Illustrations. Cloth. Price $2.50 net. The Norman W. Henley Pub. Co., New York.

The rapid development of gas engines during the past few years has necessitated the re-writing of this book, of which this is the 15th edition. Being much enlarged, and the revision so comprehensive, required new plates, and the result reflects much credit upon both author and publisher. The engineer or operator, and especially the repair man, must of necessity be familiar with the design and construction of the leading types of engines, and unless exceptionally situated, would find it difficult to acquire this knowledge as easily as he can by a study of this book.

The general theory and design are comprehensively treated in the first eight chapters; the several parts are taken up in the following seven chapters; particular types, including automobile, measurement of power and testing take the next five chapters; marine and bicycle motors the two following; kerosene, oil and distallate motors follow, concluding with a lengthy chapter devoted to producer gas and its production. A list of patents granted since 1875, and the names os builders of all types in the United States and Canada complete the book, making it very comprehensive and of the greatest value to anyone desirous of taking up the study of internal combustion engines.

An Elementary Text Book of Theoretical Mechanics. George A. Merrill. B. S. 267 pp. 8 x 5½ in. 168 Illustrations. Half leather. Price $1.50 American Book Co. New York.

The time is coming when Mechanics will not be taught in the upper classes as a part of the course in Physics, but as this will in many schools require a radical readjustment of the curricula, it will remain for those schools fortunate in having progressive directors to lead the way, prove the desirability of such separation of studies, and the advantages to the pupil. This book has been written in accord with this idea, and provides an excellent course for pupils of upper classes expecting to later take a technical college course. No knowledge of calculus is required. A sufficient number of examples are given to thoroughly illustrate each topic.

In 1867 John O'Reilly, a trader in South Africa, stopped for the night at the house of a farmer. He noticed that the farmer's children were playing with some pebbles they had found in the river. O'Reilly took one of the pebbles to Cape Town where an authority called it a diamond of 22½ carets and paid him $3000 for the stone. The farmer at whose house O'Reilly stayed remembered that he had seen an enormous stone in the hands of a Kaffir witch doctor, and from the Kaffir he traded his entire live stock for the stone and a few days after sold it at Cape Town for $56,000. This diamond was afterwards known as the famous "Star of South Africa." It weighed 84½ carets in the rough and was a stone of unsurpassed brilliancy. This was the beginning of the South African diamond mining, for less than a few months 15,000 persons were prospecting.

The total value of all diamonds mined and sold to date is placed by an authority at $1,100,000,000, and of this vast sum that one-third of the amount represents the purchases of citizens of the United States.

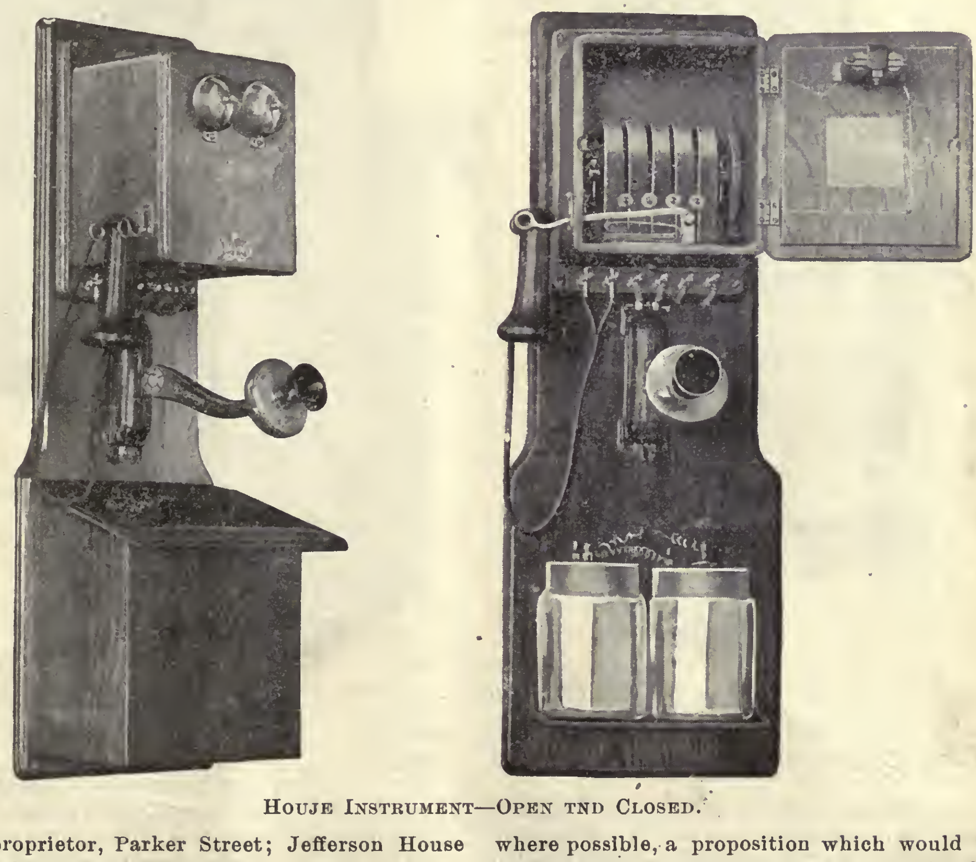
A VILLAGE TELEPHONE EXCHANGE.

LAWRENCE V. STEVENS.

II. House Instruments and Switchboard.

In canvassing the town for subscribers the manager has secured 19 signatures, and eight more citizens have signified their willingness to subscribe as soon as operations are begun. The list is as follows:

John Sherman, Depot Street; John Dennett, Supt. of Schools, Depot Street; Ezra Robbins, elevator owner, Burrill Road; Hyde Bros., chair factory off Depot Street; Chas. C. Hyde, residence cor. Parker and Depot Streets; Ellis, Towne & Co., general store, Depot Street; Acme Furniture Co., off Depot Street; Arthur Field, farmer, Parker Street; Phippen Bros., milk farm, Parker Street; Jefferson House, Richard Watson, proprietor, Parker Street; Jefferson House stables, Parker Street; Selectmen of Jefferson, Town Hall, Main Street; Archibald Cross, blacksmith, Cross Street; Dennett Bros., saw mill, River Street; Alex. Harper, retired, Cross Street, cor. River; Cole estate, general store and P. O., Main Street; Marshall poultry farm, Marshall Street, between Center School and River Street; Oscar Turner, residence, Polk Street; Dr. E. B. Plummer, Polk Street, cor. Marshall.



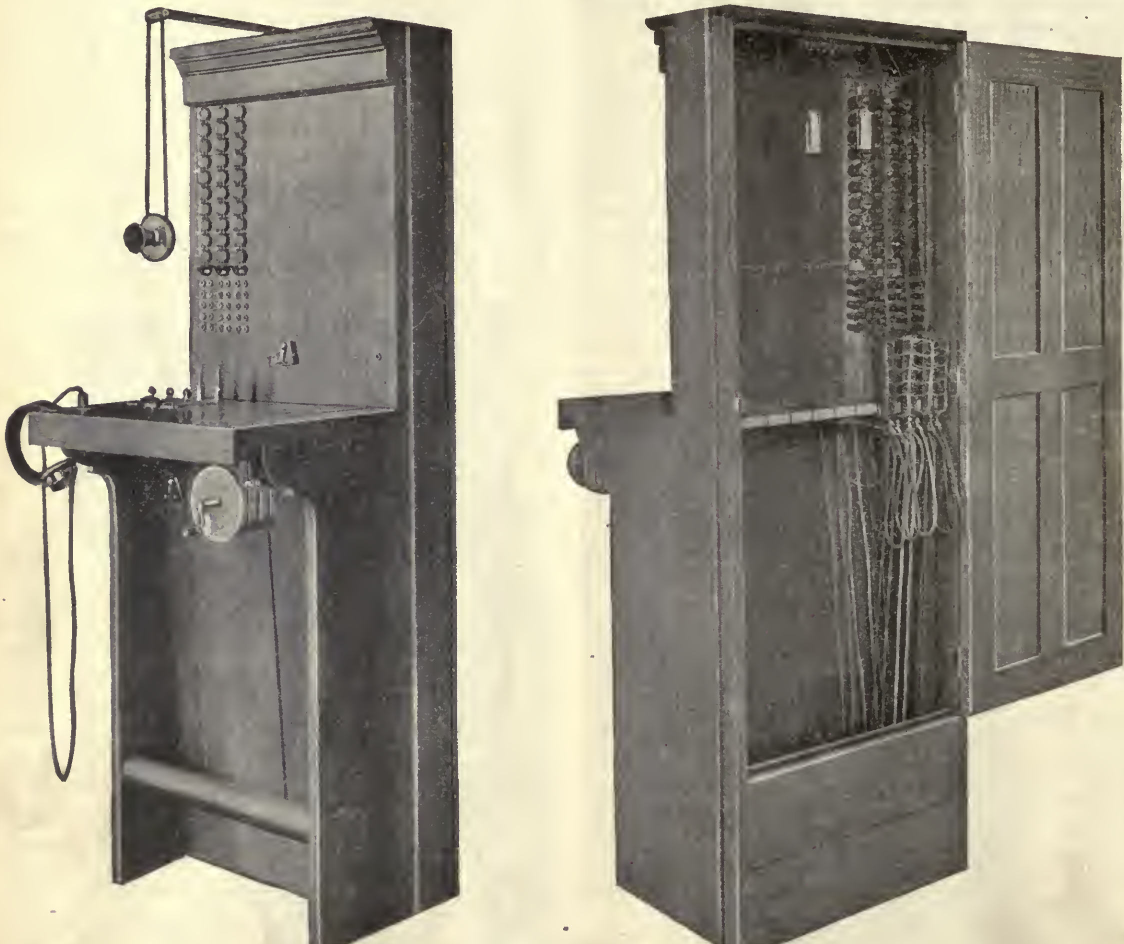
HOUJE INSTRUMENT—OPEN TND CLOSED.

AMATEUR WORK readers will be better able to follow the trend of these articles if each name and address is checked off on the map given in last month's issue as these locations will be referred to many times during the progress of the work.

It will be observed that the town has been pretty well covered, and that wires will have to be placed on every street in town, but in certain cases over private ground to save wire expense.

As the purpose of the company is to supply telephone service at a minimum of expense and labor, it is decided to utilize all substantial trees on the highways, where possible, a proposition which would not meet with approval in many larger communities, but quite worthy of introduction in Jefferson, where the trees furnish an unusual opportunity for such practice. As to line construction, it is deemed advisable to secure the services of one able telephone construction employe to supervise the undertaking, and thus lessen the possibilities of error. It is an easy matter to secure the services of such an expert through the medium of the supply house furnishing the stock of instruments and fixtures, and such procedure will always be found cheapest in the end, even though the wages paid for expert help seem somewhat high. One capable foreman can direct the work of a dozen inexperienced hands in stringing wire, setting poles, and the the like, the gang of men thereby accomplishing more in two days than they could in a week if alone and unaided.

In the selection of equipment for the central office and the sub-stations, the merits of several makes of apparatus have been carefully looked into, in several cases it being difficult to discriminate between them, but in view of the fact that one system provides means of signalling between parties on the same party line, without operating the drop signal at central, a purchase of twenty complete sets of subscribers' instruments of the wall type, and a 50 line switchboard



Switch Board—Front and Rear Views.

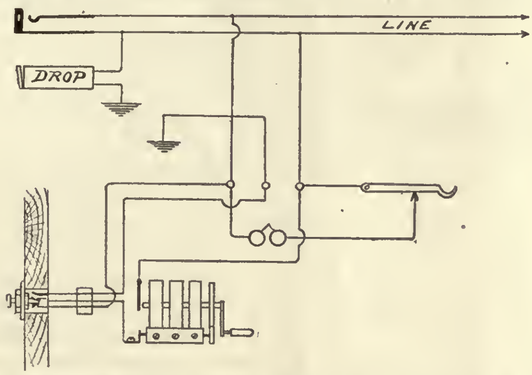
Such poles as are required at street corners may be cut in the nearest timber section, from which they can be purchased.

The Jefferson central office is at the general store at the center. Provision is made for the switch-board in a corner near the Post Office section and book-keeping desk, where it is convenient for the clerks to answer the calls. This matter of having the calls answered by several, appears to a certain extent primitive and unbusinesslike, but the calls will be few and far between at first. Should the business increase sufficiently, a permanent operator may be stationed at the switchboard, at least during the busiest part of the day.

equipped for this service, is assumed to have been made.

The subscribers' instruments are of the type known as 5-bar, 1600 ohm bridging, with a push button installed on each set, so that in turning the generator the ringing current may be sent grounded or metallic upon the line. When ringing central, the push button is pushed while ringing, which rings through one side of the ground, thereby calling central without ringing any of the bells on the line, and in ringing various calls on the line the button is left normal, the subscriber turning the generator as usual. This feature eliminates a portion of the ringing on each line and also permits parties desirous of transacting much business together to locate on the same party line.

A sketch of this circuit may not be out of place, as the engraving of the instrument shown in this article does not illustrate the push-button feature, which is at



the left on the bell box. Apparatus of this type is set up by special arrangements with the factory.

The price of each subscriber's outfit is $11.25 net in quantities of 25. The instrument is similar to the conventional Bell type of wall set, with transmitter fitted to an extending arm, generator above and batteries in the box below. The metal work is nickel and black enamel. The woodwork is oak or mahogany, as preferred. In the cut of the instrument wet batteries are shown. It is the general opinion of telephone men of today that the dry battery answers all the requirements, and in the Jefferson installation, where maintainance expense must be cut to a minimum, the wet type of cell will be replaced with the dry.

A VARIABLE RESISTANCE SET.

WARREN S. PRESTON.

In wireless telegraph experiments there is occasional need of a variable resistance to be introduced in the different circuits, especially in the coherer and relay circuit, where it is necessary to balance the amount of current flowing through the coherer so that the relay will not be energized until the filing structure in the coherer chamber is broken down by the in-coming wave. In building such a piece of apparatus it is advisable to provide for other uses besides wireless telegraphy, so that the outfit may be of general use in the laboratory.

The first detail of construction is a box-like base, the top for the switches and sliding resistance, and the inside for the fixed resistance coils. This is made of mahogany or other well seasoned stock, size 10 x 12 in. and ½ in. thick. The sides should be 2 in. deep. A bottom is not necessary, but may be provided. The general design of this base is given in the illustration.

In winding resistance coils, it is customary to wind two wires at one time joining the two wires at one end, thereby making a non-inductive circuit. In a small resistance it has been the writer's experience that this provision is hardly necessary, and in the lower resistances of this set this theory will be disregarded.

It is a very simple matter to estimate from an authentic table of wire resistance the approximate number of inches of any gauge of wire necessary to give a desired resistance, and the finer the wire used for the purpose, the greater the latitude in cutting to measure without affecting the resistance. In these days of improved wire-drawing machinery, wire of all gauges is drawn exactly true and even, but it is not feasible to figure entirely by these gauge tables, because no two manufacturers use the same metallic formula for their wire stock, consequently 36 inches of one maker's No. 36 wire might measure one whole ohm more resistance than another's.

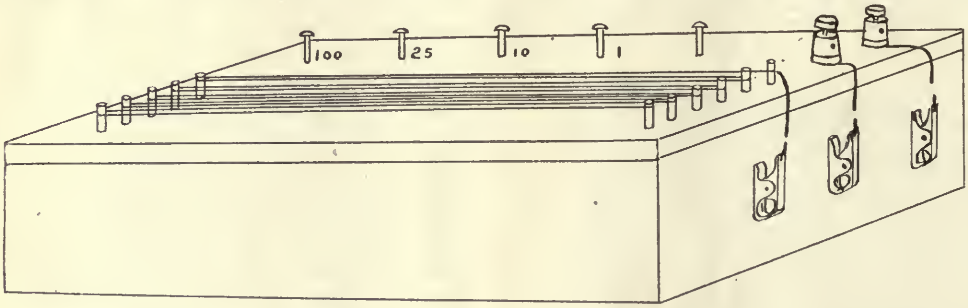
It will therefore be necessary to provide for this variance by using one brand of No. 36 single cotton covered wire for the whole instrument. The American wire gauge tables give the resistance of this gauge as 414 ohms per thousand feet or 2.4217 feet to the ohm.

As few amateurs are provided with instruments at home for measuring 2.48 feet of this wire to this scale, the amateur should visit or correspond with some school, college or private laboratory in regard to this, giving them an unstretched sample of the wire to test. In about 20 different brands of No. 36 magnet wire tested by the writer, very little variance was noted in the length of wire giving one ohm, but of course in 100 feet a decided difference was noted.

One interesting detail in this connection, is the relation of wire gauge to resistance. For example, a wire 3 sizes larger than another will have twice the sectional area and one-half the resistance for equal lengths. Reference to any table will prove this. A No. 36 wire contains 25 circular mills sectional area and measures 414 ohms to the 1000 feet while No. 33 is 50 circular mills and measures 206.99 ohms to the 1000 feet.

Our first resistance coil will be one ohm, and one of the simplest forms to wind upon is the ordinary thread spool. The exact length should be found by measuring with an accurate resistance test set, but 2.42 feet will prove very close. This wire should be wound neatly upon the spool with two inches free at each end for soldering connections. The next resistance will be 10 ohms and will consist of 24.22 feet of wire. The third resistance will be 25 ohms and consist of 60.55 feet of wire. The fourth resistance will be 160 ohms and consist of 242.17 feet wire.

These 4 coils are mounted in the base box with wood screws placed in the holes in the spools. Two binding posts are placed at one side of the base board, and a connection clip and connection cord attached to each, as in sketch. Five pins or heavy brads are driven through the base board a half inch or so, leaving about one-quarter of an inch exposed at the top. To the bottom of each pin is soldered wires from each coil in this fashion: Commencing at the right, the outer end of the 1 ohm coil is soldered to one brad. The other end is joined with the first end on the 10 ohm coil and both soldered to pin or brad No. 2. The other end of the 10 ohm coil is joined to the first end of the 25 ohm coil and both joined to the brad No. 3, etc., etc. The last terminal is soldered to a final brad. It will be seen that by means of the clip arrangement any one or all of these coils may be introduced in a circuit by just clipping on to the brads. The combined resistance is 136 ohms.



Provision may now be made for a single wire resistance of No. 36 bare German silver wire, the resistance of which per foot must be ascertained from the manufacturer, as this wire is drawn to all percentages and hardly any two brands will measure the same.

Thirty feet of this wire is fastened by one end to a pin driven into the base board and is then tightly strung back and forth across the base board around wooden pegs made of ½ in. dowelling set into the base board, as in sketch. The extreme end of the wire is soldered to another flexible cord and clip, with this wire resistance the exact resistance of which per inch has been ascertained, and the coils, any combination of resistances may be connected up to balance the coherer circuit, thereby adding greatly to the efficiency of the apparatus.

A SIMPLE RELAY.

OSCAR N. DAME.

Among my possessions was a bell ringer coil, about 3 in. long, with outside diameter of one inch and core diameter ⅜ of an inch. Originally the coil, or electromagnet, as it may be better called, had been a part of a 1000 ohm telephone bell, making the resistance of this single winding just 500 ohms. At one end the core was drilled and tapped for an 8-32 machine screw. It was a very simple matter to likewise drill into the other end and tap for a similar screw. This being done, two pieces of soft steel rod, 1 inch long, ¾ wide and ⅛ thick were formed by drilling and filing into the shape as shown in Fig. 1. A third piece of similar stock was next fashioned into an armature, as in Fig. 2, with small holes drilled at each end near the bottom, into which pieces of polished steel wire were with about ¼ in. projecting. These wire tips

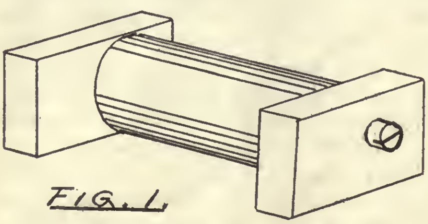


FIG. 1.

FIG. 2.

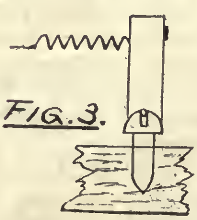


FIG. 3.

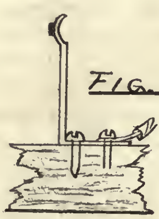
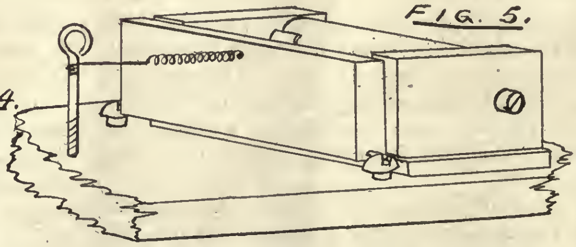


FIG. 4.

FIG. 5.



fitted freely into the slots in the heads of two heavy brass wood screws which were very appropriate for the purpose, as they could be set into a base board without difficulty.

Exactly in the middle, and close to the top edge of this armature, was affixed a small silver tip or contact point soldered to a strip of stout brass, shaped like Fig. 4 and inserted between the armature and the coil, half way between the two magnet poles. In assembling these parts a brass peg was driven into the baseboard, to which was fastened, by a silk thread, a small closed spring of the type generally used on relays, to keep the armature clear of the magnets when the relay is not energized.

The sounder circuit was completed by soldering a wire to one of the wood screws supporting the armature, and a second wire to the contact strip between the pole pieces. The two terminals of the magnet itself were brought to binding posts at one end of the baseboard.

In testing with this relay it was found to be fully as sensitive as many of the two coil type which the writer has tried in wire telegraphy, and the apparent sensitivity of the device seems to warrant its use in such simple wireless experiments as the amateur might care to indulge in at small cost. In fact, the actual cost of the entire outfit was but a few pennies, not counting, of course, the bell ringer coil, which would have cost approximately $1.25 at the supply house. Even with this expense, the results make the building worth while. Following the design here given, the amateur could construct his own magnet out of ⅜ stock and wind on as little or as much wire as he chooses, according to the uses to which the relay will be put. Altogether it is the simplest practical relay the writer has ever used.

CORRESPONDENCE.

No 119. FREDERICKTON, N. B., DEC. 6, '05.

I would like very much to have you answer the following questions:

Is there any process for restoring the transparency to old tracing cloth that has become semi-opaque by being kept in a damp place, without interfering with the tracing in India ink already on its surface?

Is there any cheap method of photo-engraving for amateurs? Can you tell me how it is done or give me the name of some book on the subject? G. S. M.

Inquiries at several large drafting rooms fail to give any process for restoring the transparency of tracing cloth which has become opaque with age. This trouble seems to be inherent with the cloth, whether stored in a dry or damp place, and does not affect the printing qualities, other than to make it somewhat slower.

Photo engraving requires quite an elaborate outfit as well as considerable experience and skill. The process is not one which can be taken up to good advantage by amateurs. For books upon the subject apply to Spon & Chamberlain, 125 Liberty Street, New York.

No. 120 WHEELING, W. VA., DEC. 7, '05.

What is a time-lock, as used on large vault doors, and is one easily made?

How can I quickly magnetize some hard steel rods? G. W. H.

A time lock is a clockwork device placed on a vault or large safe door for protective purposes. Contrary to the general opinion, with a time lock it is not necessary to open a safe at a certain moment only, but the clock is set to permit the opening of the door at so many hours and minutes after the time the door is closed, and not before, and at that time the mechanism operates, but if the custodian of the vault does not wish to open the doors at that moment, he may do so at a later period. As time locks involve considerable intricate gearing, home manufacture, except on an experimental basis, is not advisable.

Wind 6 layers of 100 turns each of No. 20 cotton covered magnet wire on a mailing tube into which a rod will readily slip. The current from two or three dry or wet batteries should permanently magnetize the rods if the circuit is kept closed for 10 minutes.

No. 121. HAGARSTOWN, PA., DEC 12, '05.

Will you kindly answer the following questions:

Why will an induction coil not work on an alternating current if the voltage is lowered to that of direct current suitable for the coil, and the vibrator is fastened against the end of the core so that it will not move?

What size spark should a coil give which is 1 in. diameter, 8 in. long, the primary having two layers No. 14 wire, and the secondary 2¼ pounds No. 24 wire? H. B. M., JR.

An induction coil properly constructed for a direct current with vibrator, should operate on an alternating current if the vibrator is secured as stated. Care should be taken to make sure that the current is not in excess of the capacity of the primary winding, otherwise it will be very likely to burn out. One difficulty in using an alternating current taken from a lighting circuit is that the frequency is so high that, unless a coil is constructed especially for use on such a circuit, the reversals of current are too rapid to permit the secondary being fully influenced by the current in the primary winding.

A coil with the dimensions and windings mentioned will give only a small spark, even if a condenser be used, owing to the large size of wire in the secondary winding. See specifications for coils in the October, '05, number.

No. 122. MINNEAPOLIS, MINN., DEC. 10, '05.

In the November, '05, number is an article on rush chair seating. I am interested in that work, but am handicapped on account of the lack of material. I endeavored to secure the rushes in this city, but no one carried them. If you can inform me where such rushes are to be obtained you will greatly oblige.

E. J. P.

The rush seating of chairs is no longer a common pursuit, having been superseded by cane seats which are more quickly and cheaply made. For this reason rushes are not now obtainable of dealers, but must be prepared by the users during the season before they get brown and brittle, as the twisting into rope requires that they be strong and flexible. An article on this subject will be published if obtainable.

No. 123. OMAHA, NEB., DEC. 13, '05

Referring to the article on "Induction Coils" in the Oct. '05, number, will you please give me the gauge of the primary and secondary wire in Brown & Sharpe gauge for a 1½ in. spark coil. As I understand the above mentioned article, the gauges specified therein are English gauges and vary from the American.

W. H. H.

The B. & S. gauge No. 32 is nearly identical with the English gauge No. 36, but if No. 36 American gauge be used, a superior coil will result than if the equivalent gauge to the English is taken. The gauge used for the primary winding depends upon the source from which the current is taken. If dry cells are used, the primary should have three layers of No. 14 or 16 gauge. If a storage battery, two layers of No. 12 gauge will answer.

No. 124. ROBINSON, ILL., JAN. 21, '06.

I would like to know if ordinary cast iron would do for the field castings of an 8 light dynamo of the Edison type.

S. M., JR.

The efficiency of the field castings of a dynamo is dependent upon the metal used. A hard cast iron is the lowest, soft gray cast iron next, then annealed iron; wrought iron and steel being the best. The dimensions of the fields are determined from the grade of metal used, and specifications calculated for steel would not answer for a metal having less permeability as cast iron.

The specifications which you have should state what metal the designer intended should be used in the fields.

No. 125. ATHOL, MASS, DEC. 26, '05.

Will you please inform me how to fill a barometer tube so as to avoid having small air bubbles in the mercury?

How far apart should the balls be of a spark coil rated as one inch spark?

Where can the filings for a wireless coherer be procured, and how are they mixed?

H. P.

In filling a barometer tube so as to avoid air bubbles, hold it at a low angle, put in the mercury with a small syringe such as are used to fill fountain pens, letting the mercury out slowly. As the tube becomes filled, raise the open end until at the last it is held vertical. Even then air bubbles are likely to be found in the mercury. These are removed by placing the closed end of the tube on the toe of the shoe and shaking the tube up and down rapidly but not too violently. This will slowly work the bubbles to the top.

The balls of a spark coil rated as one inch, should pass a spark at a distance of one inch, but it will probably not be a very fat spark at that distance. When using coils for sending "wireless" messages, no matter what their rated spark capacity, they are separated only about ⅛ in., a fat intense spark being what is desired.

Filings can easily be made from nickel and silver coins by filing them over a sheet of white paper with a quite coarse file, free from oil. The coins must also be cleaned before filing, and the filings must not be touched by the hands. Any dust is blown off by a bellows or fan, but not by the breath.

No. 126. WESTMOUNT, P. Q., DEC. 24, '05.

In the July, '04, number is given a diagram for wiring a call bell telephone having an induction coil. I have wired a couple of 'phones after that diagram, but they do not work properly. The signalling part works O. K., but the talking part does not, when the instruments are connected. There seems to be a "short", somewhere. May I trouble you to let me know wherein the trouble may be, outside of bad connections?

F. H. T.

The trouble lies in the wiring diagram, which was correctly given in the March, '03, number. This has been mentioned several times in these columns, but was probably overlooked. A change in one wire is all that is necessary to make the difference between success and failure.

"Liquid chalk" is a handy thing to have on the bench where there is much work to lay out on castings or sheet iron. The "liquid chalk" is a mixture of chalk, glue and water. Take a pint can and powder enough chalk to fill two-thirds of it; add clean hot water until the can is almost full, and then add about two tablespoonfuls of liquid glue and mix thoroughly while it is hot. This is much more handy than solid as it can be put on with a brush in the same way as paint. It will not rub off in handling, and gives a nice surface to work on. The chalk must be powdered very fine or it will be rough when dry.

The use of ore of magnetic sand found on the north shore of the Gulf of St. Lawrence will be attempted, this having been made possible by a method of removing the titanium, and concentrating the sand, until it assays 80 per cent. metallic ore. However, the magnetic sand cannot be conveniently used as ore until a successful method of briquetting it has been discovered.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V. No. 5. BOSTON, MARCH, 1906. One Dollar a Year.

EXPERIMENTAL APPARATUS

FOR CURRENTS OF HIGH FREQUENCY AND TENSION.

OSCAR F. DAME.

The ordinary induction cell under certain adjustments gives a flaming spark, which we might call high frequency in comparison with the normal output, when we adjust the vibrator at its highest speed and keep the battery amperage unchangeable. Such a spark does not pass in a straight line from one terminal to the other, but assumes a caterpillar shape, carrying with it much more heat than the ordinary discharge, particularly when we close up the gap to one-quarter of its maximum distance.

Should we bridge a small Leyden jar across the secondary terminals, we would note a decided change in the character of the spark, it now being a blue-white instead of a flaming yellow, and decidedly noisy. Such a spark has greatly increased in frequency, and is alternating in character. The experiments are of great interest, in that they permit of the construction of apparatus similar to that built and operated by Tesla in his most original experiments some years ago. His experiments have been very numerous, and to possess

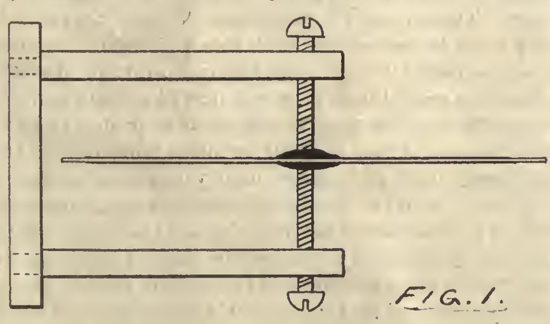


FIG. 1.

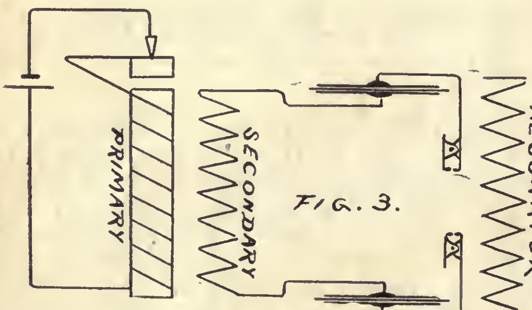
all the apparatus necessary for them would involve a considerable outlay, but it is possible for any one possessing an induction coil giving over 1-in. spark, to produce these alternating currents of high-frequency at very small expense, using such materials as may be found in nearly every home workshop.

The first requisites are two glass condensers or capacities. These may be in the form of Leyden jars or glass plate condensers. Leyden jars are easy to make but not always neat in appearance when home-made, as tinfoil cannot be applied evenly to glass cylinders without considerable trouble. The writer found it possible to construct condensers out of large panes of sheet glass, extra thin, of a size about 18 by 24 in. Each side is coated with tinfoil to within 2 in. of the

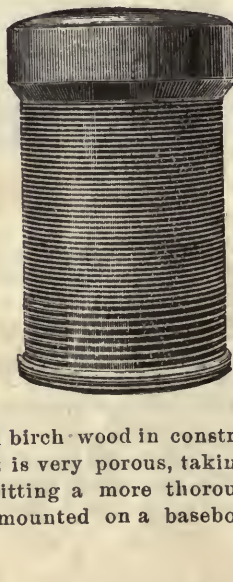
FIG. 2.

edges on both sides. If it is not possible to secure large sheets of tinfoil, smaller pieces overlapping one another to make perfect contact may be used. The pieces of glass are carefully shellacked on both sides, particularly at the edges, but with the exception of a central spot on each side exactly 2 in. in diameter. The glass is then mounted on a wooden baseboard, between two supports made of dry wood or rubber, and with adjustable plates, which also serve as contact plates and terminals. There is no particular method of designing this support, but a simple way is to employ two long machine screws for adjusters. These may be tightened with a screw-driver, as required. A side view of one of these condensers is shown in Fig. 1.

In connecting wlth the induction coil it is necessary to use 3/4 in. balls on the spark gap and separate same between 1/4 and 3/8 in. Placing the two plate condensers upon the table, two feet apart, the outer terminals are connected by metal chains to the spark gap knobs above referred to. To the inside terminals, thereby completing a circuit through the condensers, will be connected a "resonator" which is probably a new device to many AMATEUR WORK readers, but which will be found available in all high frequency and wireless telegraph experiments. A resonater is a solenoid or spiral of heavy wire of low resistance, the turns of



which are fully 1/4 of an inch apart. The resonator here required should be of No. 12 bare copper wire, wound in 40 turns about a cylinder of dry wood 6 in. in diameter. As the wire is to be wound in open spiral it will be advisable to have the cylinder at least 18 in. high, and a fair estimate of wire length is 70 feet. This wire is tacked to the wood at the two ends, and the entire resonator placed in a pan and basted with boiling paraffine until the wood is well filled with the wax. Any wax that may stick to the outside of the wire readily falls off.



The writer used birch wood in constructing his resonator, because it is very porous, taking up plenty of wax and so permitting a more thorough insulation. This cylinder is mounted on a baseboard for convenience in handling. The two connecting wires are in reality light brass chains with suspender clips fastened to the ends. In this way, any part of the wire may be used for the resonance. In fact, it requires some experiment to ascertain just how much of the spiral is to be included in the condenser circuit to give the proper frequency. This resonator when used with a coil ordinarily giving from one to three inches spark, will deliver a volume of radience of surprising intensity, permitting the performance of the most curious and instructive experiments. In the dark we may observe all around it a very intense electro-static field, and it is possible by simply holding in the hand such objects as incandeseent lamp bulbs and Geissler tubes to render same luminous. The larger the coil in use he better the results. The effects shown in the illustration were from a 4-in. coil, but similar and just as brilliant results of a lesser magnitude were obtained from a 1½ in. coil working on six dry cells. A diagram of all connections is shown in Fig. 3.

A spontaneously moving stone ball in a cemetery at Marion, Ohio, is attracting a great deal of attention It is 36 in. in diameter and rests upon a heavy pedestal. This ball is slowly turning upon its base, revolving about a horizontal axis in a direction from north to south, presumably by the action of the sun's rays. The monument was erected a number of years ago, but its movement was not known until the spring of 1904, since which time it has been watched and measured repeatedly, and it is established beyond question that the stone is turning continually. The ball was never securely fastened to the base, but an unpolished part of it was set in a socket, and the friction of the two rough surfaces was relied upon to prevent any displacement. At the present time, however, the rough spot is nearly half way to the top on the north side, and has moved more than 5 in. since August 1 last year. There is very little chance for the perpetration of a hoax in connection with this interesting phenomenon, as the ball weighs 4200 pounds and would require extensive machinery to move it. The State geologist suggests that the rotary movement is probably due to two causes. First, the ball becomes more heated than the heavy base and consequently expands more, giving rise to a slight creeping. The ensuing contraction might not be sufficient to take up the displacement caused by the heat in the earlier part of the day. Secondly, the circumference of the sphere may be regardas lengthening out on one side and giving rise to a pulling stress between the ball and the base upon which it rests.

"If you are a good workman you will not be a good kicker. The two do not fit."

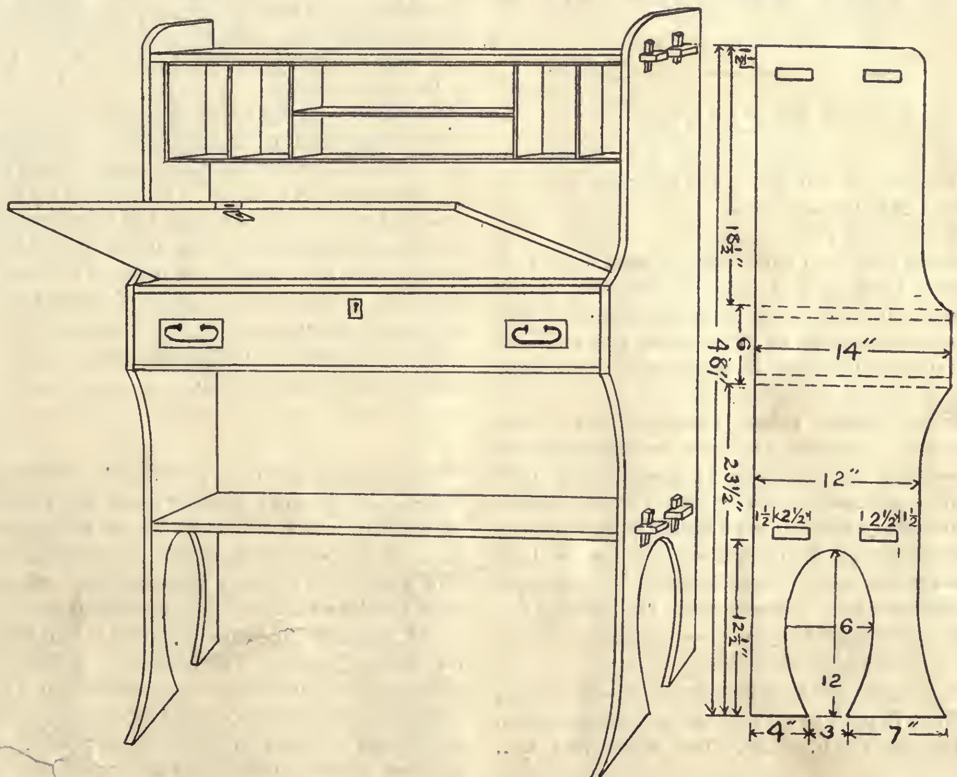
AN OCCASIONAL DESK.

JOHN F. ADAMS.

The desk here described will probably interest pupils in manual training schools who are looking about for some article of furniture which they can make and show to friends as evidence of the skill they have acquired. Let us hope that those who attempt this design will take enough time and care with the work so that their friends will find it an easy matter to give their approbation. As the design is not a difficult one it should be easily within the capacity of any second year pupil of a manual training high school. Oak or mahogany are the most suitable woods to use.

pins, after fitting to the holes in the sides and marking the exact positions of the holes. The pins are 3 in. long, ¾ in. wide, ⅞ in. thick at top, ⅝ in. thick at the bottom ends. On the under side of the back edge of the top, cut a rabbet ½ in. wide and deep for the backing.

The shelf over the drawer is 29 in. long and 13½ in. wide. Grooves about ¼. in deep are cut in the sides to receive the ends of this shelf, leaving about 1 in. at the front without the groove. The ways for the drawer consist of a frame of strips 2½ in. wide, with



The general dimensions are: 48 in. high, 34 in. wide and 14 in. deep. If the shelves are made without the extensions for the pins, the width is 30 in. The dimensions and shape of the sides are clearly shown in the illustration. The extra width at the center and bottom can be obtained by gluing strips 2 in. wide onto a board 12 in. wide, using care to match the grain at the joints. The outer sides are spaced 30 in. apart.

The top and lower shelf are 34 in. long and 12 in. wide. The ends are cut out to form lugs 2¾ in. long and 2½ in. wide, the outer edges of each lug being 1½ n. from the edges. Holes are cut in these lugs for

halved joints. Grooves are also cut in the sides for this frame, which is the same size as the shelf above.

The drop lid is 28½ in. long and 16 in. wide and will have to be glued up from two pieces, the grain of which should be nicely matched, as it is the most conspicuous part of the desk. Cleats 2 in. wide and ⅝ in. thick will have to be fitted to the ends on the inner side, to prevent warping.

The pigeon holes at the top are made up separately from the desk and put in place with screws. Maple ½ in. thick and 10 in. wide is used throughout. The top and bottom pieces are 28 in. long, and the two end pieces 6¼ in. long, the four division pieces 5⅝ in. long, and the shelf at the center 11 in. long. Small wood screws ⅝ in. long should be used throughout for fastening together, except the center shelf, which is put in with wire finish brads ⅞ in. long. The two pieces at the ends of this shelf should be put on before they are fastened in.

The back is sheathed with matched sheathing ½ in. thick which should be well seasoned to prevent opening up cracks.

The drawer is 28½ in. long, 13 in. wide and 4½ in. deep. The construction of a drawer has been so frequently described in these articles that it will not be repeated here.

The lid is attached to the shelf with brass hinges recessed into both lid and shelf. A lock is also fitted to the top edge, the tongue plate being fitted to the under side of the top shelf. A lock and drop handles are also fitted to the drawer.

BOOKS RECEIVED.

Forge Practice. John Lord Bacon. 257 pp. 7¼x 4¾ inches. 272 illustrations. Cloth, $1.50. John Wiley & Sons, New York.

The increased attention now being given to this subject in manual training and technical schools, makes the publication of this book most opportune. It is the outgrowth of a series of notes given the students at Lewis Institute, Chicago, in connection with shop work of the character described.

It requires but a most casual examination to show that the author is well fitted for the task in hand and has presented the several parts of his subject in an exceptionally clear and attractive way. While intended as an elementary work, it is sufficiently complete so that anyone mastering the contents will be as well educated as the better run of forge hands. The amateur desirous of acquainting himself with the subject can find no better book for the purpose, as the exercises are of a most practical kind.

Machine Construction and Drawing. Frank Castle, M. I. M. E. 275 pp. 9½ x 7 inches. 266 illustrations. Oblong flexible cloth, $1.25. The Macmillan Co., New York.

This is the most complete book upon this subject, and at low cost, which has been brought to our attention. To the student, working alone it is especially suitable, as it contains a large amount of supplementary information regarding the proportions of parts and the methods for obtaining them which would be very useful to the draftsman. An unusually large number and great variety of machine and engine details are illustrated, which though of English design, are of a general character making them suitable for teachers in need of studies for class work, or for advanced students doing special work. Every teacher of mechanical drawing will find it a most useful book, as will also anyone wishing to take up the study without a teacher.

Electric Wiring, Diagrams and Switchboards. Newton Harrison, E. E. 272 pp., 7½ x 5 inches. 105 illustrations. Cloth, $1.50. The N. W. Henley Pub. Co., New York.

The intention of the author was to present this subject in language suited to the general reader, so far as a technical subject of this kind will allow of such treatment. Simple methods are given for working out wiring circuits; the principles of switchboard design are also suitably presented. The working lineman and the amateur who desires a working knowledge of these subjects will find the book of great assistance toward that end.

Electrician's Handy Book. T. O'Conor Sloane, A. M., E. M., Ph. D. 761 pp. 6¼ x 4½. 556 illustrations. Flexible leather. $3.50. The N. W. Henley Pub. Co., New York.

The immense field now embraced by the term "Electrical Engineering" makes it necessary that the working electrician have at hand every facility in the way of reference book which it is possible to obtain. This is also true of the teacher, and of the student whose means will permit of the purchase of books of this kind. The mention of the number of pages and illustrations contained in this book indicates its comprehensive character, and as the price is most moderate it will undoubtedly meet with the cordial reception which its merit deserves.

For making fire in the Philippine Islands, there is a curious contrivance used by some few of the natives of Northern Luzon. It consists of a hardwood tube of about 1 centimeter bore and 6 centimeters in length, and a piston of slightly less diameter and length. The tube is closed at one end by an air-tight plug or, instead, the wood forming the tube is not bored through its entire length. The inside of the tube is smooth and highly polished. The piston has a handle, and resembles the piston of a boy's popgun. The end of the piston is made to fit the tube airtight by a wrapping of waxed thread, and directly in the end of it a shallow cavity is cut. Lint scraped from weather-beaten timber and well dried is used for tinder. A small bit of this lint is placed in the cavity at the end of the piston, the latter is inserted in. in the open end of the tube, and then driven quickly home with a smart stroke of the palm. Upon withdrawing the piston the lint is found ignited, the sudden compression of air generating the necessary heat.

"The better workman a man is, the better the world looks to him."

A HAND DRILL PRESS.

HERBERT O. BACON.

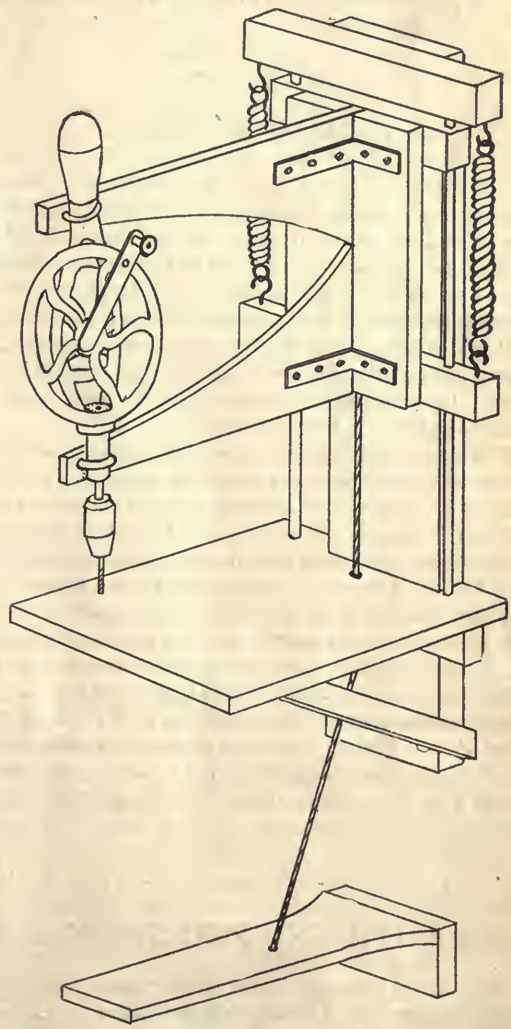
The frequent breaking of small twist drills when used in a hand drill upon metal, led me to make the holder for the hand drill with foot-power feed, which is here described, and the use of which greatly reduced the breaking of drills, and afforded other advantages quite evident to any one familiar with work on a drill press. In this device the drill moves, the table is stationary, which permits of placing the work at any angle in relation to the drill and fastening the same when necessary to guard against any movement.

The exact dimensions of the different parts will depend upon the size and shape of the hand drill, but the different makes vary but little, and therefore the specifications given will be suitable for most kinds. The principal points to be seen to are: That the hand drill is securely fastened to the frame and that the frame is strongly constructed without side play, as it is the latter that causes the drills to break.

The general make-up is shown in the illustration. Obtain a piece of spruce plank 3 ft. long, 6 in. wide and 2 in. thick, which will plane up to 1¾ in. thick. Also four feet of 2 x 3 in. spruce, which will plane to 1¾ x 2¾ in. and from which cut three pieces, 12 in. long and one piece 10 in. long. One of the 12-in. pieces is put across the top of the plank, one forms the lower carrier of the sliding frame, and the third piece supports the table. The 10-in. piece is for the upper carrier of the frame.

To the carriers of the sliding frame nail two strips about 6½ in. long, 3 in. wide and ⅜ in. thick, between which are fastened the two arms for holding the hand drill. The arms are cut out to the shape shown, and of dimentions suitable for the hand drill to be used, and are securely fastened with screws to one of the vertical pieces just mentioned, and then to the carriers. The other vertical piece is then put in place, and two angle irons put on to prevent side play. The outer ends of the arms are then recessed to fit the hand drill, which is held in place by two clips. (Sleigh clips can be obtained of any carriage supply dealer or repair shop.) These clips have flat iron centers with threaded ends. They are bent to an U-shape to fit around the hand drill, holes being bored in the arms to receive the threaded ends, and the nuts are then tightened up, holding the hand drill firmly in place.

The hand drill frame slides upon two rods, which may be of brass tubing or drawn steel shafting ⅝ in. diameter and 18 in. long, or 1-in. hickory dowel rods may be used. Holes are bored part way into the upper cross piece and the piece under the shelf, and clear through the two cross pieces on the drill frame. Care must be taken that these holes are accurately spaced and in line, especially in the sliding frame, to avoid friction or bends in the rods, which would prevent the frame from sliding easily. After boring the holes, those in the frame should be smoothed up with a round file, to give an easy fit to the rods. When properly fitted the table, a piece of



oak 15 x 12 x ⅞ in., is attached with screws to the support, the holes for the rods put through this board, and the parts assembled; the table is then secured in place. Braces are fastened on either side of the back plank and to the front of the table.

Two screen-door springs are then attached to the under piece of the frame and top cross piece, as shown in the illustration, using heavy screw-eyes for fastening. The springs should have tension enough to hold the frame at the top of the rods, and yet allow it to be brought down easily when the pressure of the foot is applied to the lever underneath.

The treadle needs no description, being simply two boards, jointed with a strong T hinge on the under side. A piece of sash cord is attached to the center of the lower cross piece of the frame; carried through a hole in the table, on the under side of which is an ordinary window pulley, to the treadle, in which a hole is bored, the cord being knotted underneath. Graphite is a good lubricant for the rods, as it prevents wear of the cross pieces.

A BLOW SYRINGE.

A discarded bicycle pump was utilized to make a blow syringe which has been extremely useful about the house, especially in removing dust from the piano, and a description is given with the hope that it will be found of value by other readers of AMATEUR WORK. The shape makes it much more convenient than the bellows commonly used, and the cost, even if a new pump has to be purchased, is much less then for a bellows. In printing offices it would be serviceable for cleaning the dust from the case.

The casting at the lower end of the pump is entirely removed, which is easily done by unscrewing it from the tube. The top of a cheap zinc oil can is then cut off at the proper place to make a good fit for the end of the pump and soldered to the narrow collar that will be found thereon. In cutting off the top of the oil can, leave about ½ in. extra metal to form into a shoulder to fit inside the collar, making the work of soldering an easy matter. Ordinary soft solder may be used with rosin as a flux. The oil nozzle should be removed while soldering to the tube to avoid bending it. It may also be found necessary to file off a small part of the outer end of the nozzle, if a small one is used, to allow a larger volume of air to pass when using the pump.

FAITH AND PERSISTANCE.

In that very human little story "Mrs. Wiggs of the Cabbage Patch," appears this sentence: "Leaders of great enterprises must, of necessity, turn deaf ears to words of discouragement." Which is to say that every great enterprise depends upon the hope, belief, enthusiasm and persistence of some one man.

The world owes its victories to the men who have turned a deaf ear to the pessimists, obstacle hunters, and trouble scientists.

The way to succeed is to prepare for success, and this centering of your thought and time and energy in one direction is the mental macadam that the road of life needs to make the going easier.

Hope awakens the ambition, expectancy stimulates and sharpens the senses, and belief fires the will. Business, like religion, is founded on belief. Every new cult starts in the conviction of some one man. He tells others, and they believe it because he does, and the first thing you know we have a white marble edifice and a million converts.

So that when a man starts out with a proposition that he believes in—whether it is religion, rails or raisins—if he'll just close his ears to the "discouragers," and look for "encouragers," it won't be long before he'll have enough followers to rear his temple or steel plant or raisin factory, as the case may be, with buyers waiting at the front door clamoring for back orders.

Paper making from furze may, if successful, open up a large class of new paper-making materials and possibly prove the solution to the serious problem caused by the rapid exhaustion of the timber districts in the effort to meet the demand for wood pulp, the now universally used material. It has been ascertained that the furze, suitably treated, produces a very white and solid pulp by the following treatment: 1000 kilogrammes of the green plant, cut up as fine as possible, are mixed with caustic soda lye of 30° B. and raised to a temperature of 170° in an autoclave, under pressure. After a boiling of five or six hours, the pulp is washed with water, acidulated with sulphuric acid in suitable quantity, bleached with chloride of lime and washed thoroughly, when it is in a suitable state for employment in the manufacture of paper.

The flowing of solid concrete is an accomplished fact. Compression tests recently carried out by Prof. H. Woolson, of Columbia University, on cylindrical test pieces of concrete seventeen days old and 12 in. by 4 in. diameter, showed that the material flowed under a load of 120,000 lb. to 150,000 lb. The concrete was contained in steel tubes. Two test pieces were compressed by more than 3 in., and the diameter correspondingly increased. It was supposed that this excessive distortion had completely disintegrated the concrete and left in a powdered mass, but when the steel tube was sawn apart and removed, the concrete was found to have taken the exact shape of the distorted tube and was solid and perfect.

Phosphor bronze is an alloy of phosphor, tin and copper, containing usually 5.053 to 0.76 per cent phosphorus and four to ten per cent tin, balance copper. It is as tough as wrought iron, more ductile than copper and is capable of withstanding great wear.

CEMENT MORTAR AND CONCRETE.

PHILIP L. WORMELEY, JR.

II. Methods of Mixing Mortar.

Cement concrete is the product resulting from an intimate mixture of cement mortar with an aggregate of crushed stone, gravel or similar material. The aggregate is crushed or screened to the proper size as determined from the character of the work. In foundation work, stone or gravel 3 inches in size may be used to advantage, whereas in the case of molded articles of small sectional area, such as fence posts, hollow building blocks, etc., it is best to use only such material as will pass a one-half inch screen. An ideal concrete, from the standpoint of strength and economy, would be that in which all voids in the aggregate were completely filled with sand, and all voids in the sand completely filled with cement, without any excess. Under these conditions there would be a thoroughly compact mass and no waste of materials.

It is a simple matter to determine the voids in sand and also in the aggregate, but in mixing concrete the proportions vary a great deal, depending in each case upon the nature ot the work and the strength desired. For example, in the construction of beams and floor panels, where maximum strength with minimum weight is desired, a rich concrete is used, whereas in massive foundation work, in which bulk or weight is the controlling factor, economy would point to a lean mixture.

When good stone or gravel is used, the strength of the concrete depends upon the strength of the mortar employed in the mixing and upon the proportion of mortar to aggregate. For a given mortar the concrete will be strongest when only enough mortar is used to fill the voids in the aggregate, less strength being obtained by using either a greater or less proportion. In practice it is usual to add a slight excess of mortar over that required to fill the voids in the aggregate.

It is more accurate to measure cement by weight, unless the unit employed be the barrel or sack, because when taken from the original package and measured bulk there is a chance of error due to the amount of shaking the cement receives. As it is less convenient, however, to weigh the cement it is more common to measure it by volume, but for the reason stated this should be done with care.

For an accurate determination of the best and most economical proportions where maximum strength is required, it is well to proceed in the following way: First, proportion the cement and sand so that the cement paste will be 10 per cent in excess of the voids in sand; next determine the voids in the aggregate and allow sufficient mortar to fill all voids, with an excess of 10 per cent.

To determine roughly the voids in crushed stone or gravel, prepare a water-tight box of convenient size and fill with the material to be tested; shake well and smooth off even with the top. Into this pour water until it rises flush with the surface. This volume of water added, divided by the volume of the box, measured in the same units, represents the proportion of voids. The proportion of voids in sand may be more accurately determined by subtracting the weight of a cubic foot of quartz and dividing the difference by 165.

For general use the following mixtures are recommended:

1 cement, 2 sand, 4 aggregate for very strong and impervious work.

1 cement, 2½ sand, 5 aggregate, for work requiring moderate strength.

1 cement, 3 sand, 6 aggregate, for work where strength is of minor importance.

In the case of gravel containing sand or crushed stone from which the small particles have not been removed by screening, the amount of such sand or fine stone should be determined and due allowance made for it in proportioning the mortar.

When mixing an aggregate containing small particles with mortar, the same conditions obtain as if these particles had been screened from the aggregate and added to the sand used in making the mortar, and in reality we have a mortar containing a larger proportion of sand than was present before the aggregate was incorporated. It is evident, then, that in such cases the quality or richness of the mortar should depend upon the proportion of fine material in the aggregate.

For example, suppose that 1 cubic foot of gravel contains 0.1 cubic foot of sand, and that the voids in gravel with sand screened out measure 40 per cent.

For general purposes this would suggest a 1-2-5 mixture, but since each cubic foot contains 0.1 cubic foot of sand, 5 cubic feet of gravel will contain 0.5 cubic foot sand, and the proportions should be changed to 1 part cement, 1½ parts sand, 5 parts gravel.

It has been demonstrated that concrete can be mixed by machinery as well, if not better, than by hand. Moreover, if large quantities of concrete are required, a mechanical mixer introduces marked economy in the cost of construction. None of the various forms of mechanical mixers will be described here, since concrete in small quantities is more economically mixed by hand.

MIXING BY HAND.

In mixing concrete by hand a platform is constructed as near the work as is practicable, the sand and aggregate being dumped in piles at the side. If the work is to be continuous, this platform should be of sufficient size to accommodate two batches, so that one batch can be mixed as the other is being deposited. The cement must be kept under cover and well protected from moisture. A convenient way of measuring the materials is by means of bottomless boxes or frames made to hold the exact quantities needed for a batch.

A very common and satisfactory method of mixing concrete is as follows: First measure the sand and cement required for a batch and mix these into mortar, as previously described. Spread out this mortar in a thin layer and on the top of it spread the aggregate, which has been previously measured and well wetted. The mixing is done by turning with shovels three or more times, as may be found necessary to produce a thoroughly uniform mixture, water being added if necessary to give the proper consistency. The mixers, two or four in number, according to the size of the batch, face other and shovel to right and left, forming two piles, after which the material is turned back into a pile at the center. By giving the shovel a slight twist, the material is scattered in leaving it and the mixing is much increased.

A dry mixture, from which water can be brought to the surface only by vigorous tamping, is probably the strongest, but for for the sake of economy and to insure a dense concrete well filling the molds, a moderately soft mixture is recommended for ordinary purposes. Where the pieces to be molded are thin, and where small reinforcing metal rods are placed close together or near the surface, a rather wet mixture may be necessary to insure the molds being well filled.

In the manufacture of such articles as pipe, fence posts, and hollow blocks, a rather large proportion of quick-setting cement is used, the object being to reduce the weight and consequent freight charges by means of a strong mixture, as well as to make the concrete impervious to water. The use of a quick-setting cement permits the molds to be removed sooner than would be possible with a slow-setting cement, thus reducing the number of molds necessary for a given output. Quick-setting cements are not recommended for such purposes, however, as they are usually inferior to those which set slowly.

In coloring cement work the best results are obtained by the use of mineral pigments. The coloring matter, in proportions depending upon the desired shade, should be thoroughly mixed with the dry cement before making the mortar. By preparing small specimens of the mortar and noting the color after drying, the proper proportions may be determined.

For gray or black, use lampblack.

For yellow or buff, use yellow ocher.

For brown, use umber.

For red, use venetian red.

For blue, use ultramarine.

DEPOSITING CONCRETE.

Concrete should be deposited in layers of from 4 to 8 inches and thoroughly tamped before it begins to harden. The tamping required will depend upon the consistency of the mixture. If mixed very dry it must be vigorously rammed to produce a dense mass, but as the proportion of water increases less tamping will be found necessary. Concrete should not be dumped in place from a height of more than 4 feet, unless it is again mixed at the bottom. A wooden incline may be used for greater heights. Rammers for ordinary concrete work should weigh from 20 to 30 pounds and have a face not exceeding 6 inches square. A smaller face than this is often desirable, but a larger one will be less effective in consolidating the mass.

In cramped situations special forms must be employed to suit the particular conditions. When a thickness of more than one layer is required, as in foundation work, two or more layers may be worked at the same time, each layer slightly in advance of the one next above it and all being allowed to set together. At the end of a day there is usually left a layer partially completed which must be finished the next day. This layer should not be beveled off, but the last batch of concrete should be tamped behind a vertical board forming a step.

To avoid introducing a plane of weakness where fresh concrete is deposited upon that which has already set, certain precautions have to be observed. The surface of the old work should be clean and wet before fresh material is put on, a thin coating of neat cement grout being sometimes employed to insure a good bond. The surface of concrete to receive an additional layer must not be finished off smoothly, but should offer a rough surface to bond with the next layer. This may be done by roughing the surface while soft with pick or shovel, or the concrete may be so rammed as to present a rough and uneven surface. Wooden blocks or scantling are sometimes embedded several inches in the work and removed before the concrete hardens, thus forming holes or grooves to be filled by the next layer.

As stated before, it is important that concrete be tamped in place before it begins to harden, and for this reason it is proper to mix only so much at a time as is required for immediate use. The retempering of concrete which has begun to set is a point over which there is much controversy. From tests made in the laboratory it would appear that such concrete suffers but little loss of strength if thoroughly mixed with sufficient water to restore normal consistency.

The time required for concrete to set depends upon the character of the cement, upon the amount and temperature of the water used in mixing, and upon the temperature of the air. Concrete mixed dry sets more quickly than if mixed wet, and the time required for setting decreases as the temperature of the water rises. Warm air also hastens the setting.

Portland cement concrete is well adapted for work exposed to sea water, but when used for this purpose it should be mixed with fresh water. The concrete must be practically impervious, at least on the surface, and to accomplish this the materials should be carefully proportioned and thoroughly mixed. It is also of great importance that the concrete be well compacted by tamping, particularly on exposed surfaces.

Although it is advisable under ordinary circumstances to discontinue cement work in freezing weather, Portland cement may be used without serious difficulty by taking a few simple precautions. As little water as possible should be used in mixing, to hasten the setting of the cement. To prevent freezing, hot water is frequently used in mixing mortar or concrete, and with the same object in view, salt is added in amount depending upon the degree of cold. A common practice is to add 1 pound of salt to 18 gallons of water, with the addition of 1 ounce of salt for each degree below 32° F. Either of the above methods will give good results, but it should be remembered that the addition of salt often produces efflorescence. It seems to be a fairly well established fact that concrete deposited in freezing weather will ultimately develop full strength, showing no injury due to the low temperature.

TO FACE CONCRETE.

A coating of mortar one-half inch in thickness is frequently placed next the form to prevent the stone or gravel from showing and give a smooth and impervious surface. If in preparing this mortar finely crushed stone is used instead of sand, the work will more nearly resemble natural stone. A common method employed in facing concrete is to provide a thin sheet of metal of convenient length and about 8 or 10 inches wide. To this pieces of angle iron are riveted, so that when placed next to the mold a narrow space is formed in which the cement mortar is placed after the concrete has been deposited behind it, Fig. 1. The metal plate is then withdrawn and the concrete well tamped. The concrete and facing mortar must be put in at the same time so that they will set together. If the concrete is fairly rich, a smooth surface can usually be produced without a facing of mortar by working a spade up and down between the concrete and inner face of the mold, thus forcing the larger pieces of the aggregate back from the surface.

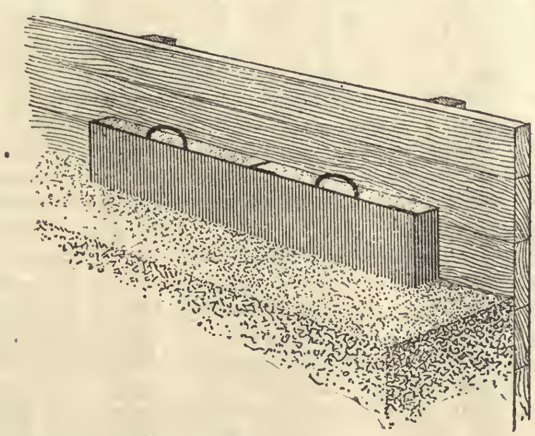


FIG. 1.

WOOD FOR FORMS.

Lumber used in making forms for concrete should be dressed on one side and both edges. The expansion and distortion of the wood due to the absorption of water from the concrete frequently make it difficult to produce an even surface on the work, and unless the forms are accurately fitted together more or less water will find its way out through the cracks, carrying some of the cement with it. A method sometimes adopted to minimize the effect of expansion is to bevel one edge of each board, allowing the edge to crush against the square edge of the adjacent board when expansion takes place.

In the case of a wooden core or inside mold, expansion must always be taken into consideration, for if neglected it may cause cracks or complete rupture of the concrete. Sharp edges in concrete are easily chipped and should be avoided by placing triangular strips in the corners of the molds. To prevent cement from sticking to the forms they may be given a coating of soft soap or be lined with paper. This greatly facilitates their removal and enables them to be used again with but little scraping. A wire brush answers best for cleaning the forms.

A sensitive galvanometer for use with a potentiometer in a position where there is much vibration is not easily found. The D'Arsonval suspension galvanometer is useless in such a place, and the ordinary small pivot galvanometer may not be sensitive enough for the work. A device recently tried with success was to remove the mirror and table from a student's microscope, and put an extension on so that the lenses could be brought over a pivot galvanometer. With this arrangement, which is always ready for use regardless of ordinary vibration, the potentiometer can be used for measurements to two-thousandths of one volt.

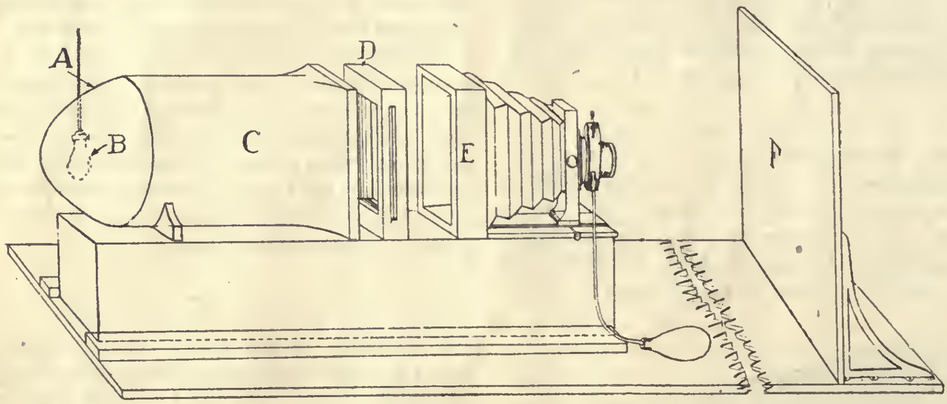
Aluminum paper, ordinary cellulose coated with powdered aluminum, is now being made in Germany as a substitute for tinfoil. It is used as a wrapper for food, and is said to possess the right qualities for preserving food. The paper itself is a kind of artificial parchment, prepared by treating ordinary paper with sulphuric acid. The sheets are spread out and evenly coated on one side with a solution of resin in alcohol or ether; then the powdered aluminum is applied, and the paper is finally pressed.

PHOTOGRAPHY.

A SIMPLE ENLARGING APPARATUS.

E. STANLEY THOMAS.

I propose to describe a simple form of enlarging apparatus that I have had in use for a number of months and which I believe will interest the readers of this magazine. The diagram will explain its construction quite clearly, I believe. *A* is an ordinary aluminum reflector, six inches in diameter; *B* is an ordinary incandescent electric light of sixteen candle power; *C*, a tin tube twenty inches in length, round at one end with a flange to receive the reflector as nearly light tight as possible and at the other end made square to fit closely over the edge of frame *D*, which is an inch wide. This frame carried the negative in two sets of grooves, one at the top and one at bottom These grooves are wide enough to hold two thicknesses of glass so that one can use a film negative between two clean glasses. The front of this frame or the side next to the light, is fitted with pegs so that it takes its place against the frame of the camera just the same as the camera back which is removed for the purpose. The grooves in this frame are fitted with flat springs so that a single negative glass will be held firmly in place.



The camera is represented by *E*, and the easel upon which the paper is pinned is indicated by *F*. At the upper side of the tube near the light are a few small holes and in connection with some at the other end through on the under side, ventilation is secured. It is well to loosely drape a focussing cloth around the place where the reflector joins the tube, and again where the tube joins the camera so that there will be no leakage of light to strike the paper either at the join or through these holes.

The whole thing is placed on a table and joined up, the negative inserted and the focus secured on a piece of white card pinned to the easel. A trial strip of paper is exposed to get the time, and once found it is marked on the envelope of the negative for future reference. I generally stop down to U. S. 32, and the exposure is then from twenty to thirty-five for an 8 x 10 enlargement, and from forty-five to seventy-five minutes for a 16 x 20. I append a few notes from my negative envelopes:

No. 211 Very dense, enlarged to 8x10; U. S. 16; 35 minutes.

No. 147. Rather dense, enlarged to 16 x 20; U. S. 32; 65 minutes.

No. 279. Average negative, enlarged to 16x20; U. S. 32; 45 minutes.

No. 301. Very dense, enlarged to 8 x 10; U. S. 32; 60 minutes.

No. 419. Fair negative, enlarged to 8 x 10; U. S. 16; 23 minutes.

My densest negative requires ninety minutes with U. S. 16 to obtain a 16 x 20 enlargement. I use Eastman's C (soft) platino bromide, as I find it best for this form of light. When I mark the exposure time on the negative envelope the size of the stop as well as the size of the enlargement is also indicated so that there will be no need to experiment when wishing to make an enlargement from the same plate at a later date. The camera I use is a 4 x 5 instrument fitted with a No. 2 Plastigmat of 6¼ in. focus.

I have made some very satisfactory enlargements with this simple piece of apparatus and would recommend others to try one on the same lines. It is not hard to construct, and the cost is very moderate indeed. The convenience of being able to get all ready and then turn out the lights in the room and work without the discomfort of a dark room is made very simple by turning on an 8 candle-power ruby lamp lamp which hangs conveniently near. Fitting the lens with a cap glazed with ruby glass, even though it be a rough affair whittled out of wood and pasted over with black paper, would allow one to pin up the paper before making the exposure, and it would also serve as a ruby light in developing the paper by opening the lens to the largest stop. In developing by such a light one could simply swing the camera and its tin tube around so that the light from the lens falls where it is wanted. If the negative is a very dense one, remove it and then there will be nothing but the sheet of ground glass to obstruct the light before it passes through the ruby cap on the lens.

While this apparatus is not the most advisable where a large amount of work is contemplated, on account of the length of exposure required, it will be found entirely satisfactory to the average worker who makes but few enlargements from time to time. In fact, the length of exposure is an advantage, permitting, as it does, perfect control by shading or otherwise dodging the print during exposure.

PHOTOGRAPHIC NOTES.

There is a little trick in the mounting of prints that is well worth adopting. That is to say, it may be of advantage to those who mount their prints when dry. In my immediate household there are three aspiring amateurs, and among the lot there is owned about everything that is intended to make the following of photography easy. Long ago—five or six years, to be precise, one member bought a print roller, and for a time we could none of us do anything without it. But those days are gone and the roller is packed away somewhere with a lot of other outlawed truck, lanterns, etc., now voted of no earthly use. One of us happens to be in a place that does mounting and printing for professionals, and was surprised to see with what ease and celerity the prints were fixed on the cards. The operator despised the use of a roller and did the work excellently well with—what do you suppose?—a silver half dollar.

With this or a similar coin the print can be quickly rubbed into contact in every part much better, in my humble opinion, than is possible with the most expensive print roller. The abraded edges of the coin insures that every portion should be rendered in contact and all superfluous paste pushed outward to the edges. A smaller coin will answer in a pinch ; in my own case I keep for the purpose an English penny, and one would be surprised to see how the image on it has worn down by a few years of use. For the past four years not one of us has used the roller and find that the coin serves every need in mounting. I have never seen this idea exploited, and assure the reader that it is something that will pay to investigate.

A tiny working model of a triple-expansion engine, made by Robert Bunge of New York, is perhaps the finest piece of skilled work of its kind that has yet been brought to the attention of our contemporary, the "Scientific American." The engine measures 3½ in. across the bedplate, and stands 3½ in. from the bottom of the bedplate to the top of the cylinder covers. Every part is perfect. It is even equipped with the link reversing motion. With a steam pressure of 100 pounds, 7260 revolutions per minute are made, turning a screw 2¼ in. in diameter by 7 in. pitch. The high pressure cylinder is 5-16 in. in diameter, the intermediate cylinder 8-16 in., and the low pressure cylinder 10-16 in. The valves are of the regular piston type for all cylinders, and measure 5-32, 7-32 and 9-32 in. in diameter. The shaft, the crank and the crank-pins are all turned from one piece of steel, which in itself is rather a neat piece of work. The eccentrics are split, and are exact miniature duplicates of those used on engines actually in service. The nuts used in the construction of the model are for the most part a fraction less than 1-16 in. in diameter. The studs are a little less than 1-32 in. in diameter, and are threaded at both ends, one end screwing into the machine, and the other receiving the nuts. The crossheads are made of steel and are fitted with brass shoes that can be taken off whenever wear occurs. The steam pipe is ⅛ in. in diameter, and the exhaust is 3-16 in. In diameter. The maker may well claim for this model that it is the smallest triple-expansion engine in the world.

In cleaning a fountain pen it is a great mistake for those experienced in such matters to attempt to take all the elements apart, owing to the difficulty experienced in putting them back in their correct relative positions. It is also a difficult matter to cleanse the minute passages thoroughly and free them from foreign matter which will get there, and which becomes hardened and obstructs the flow of ink and air. The simple device now explained is most effective in its action. It consists of one of the little pipette tubes supplied with fountain pens, fitted into and passed through a cork slightly tapered. This is placed in the water-supply tap, with the result that a fine jet of water is produced, issuing from the point at a pressure so great that if the point section of the pen be unscrewed and the jet allowed to play into the passages, all impurities will quickly disappear and the pen be thoroughly cleansed.

INSTALLING GASOLINE ENGINES.

It is the usual thing for the average purchaser of a gasoline engine to hunt up some corner in which to put his engine so as to be out of the way. Now this is one of the biggest and most expensive mistakes one can make, for as soon as some small screw gets loose in the far corner, the engine, salesman and manufacturer are consigned to a warm place, simply because the present owner has not left enough room to make any small adjustment necessary in every engine and and piece of machinery; therefore it pays always to install the engine in a light, dry place, easy of access and with sufficient space all round it to handily reach all parts and give plenty of room for turning the flywheels in starting. Whenever possible, place the engine on the ground floor. If placed on an upper floor the necessary provision should be made to avoid vibration from the engine; if installed in the basement place it in the best light.

Without a good foundation an engine may be expected to give more or less trouble from vibration as it is subjected to forces, suddenly and repeatedly exerted, which produce violent reactions on the foundations. Care should be taken to excavate down to good soil and to line the bottom with a substantial thickness of concrete in order to form a single mass of artificial stone. The foundations then may be built up of either concrete, brick or stone. Anchor plates should be extended to the bottom of the masonry and fastened so as to prevent turning while screwing up the nuts. Place gas pipes or tubes with an inside diameter twice the diameter of the bolts around them, while the foundation is being built; this allows the bolts to be adjusted, and any variations between the tubes may be filled with thin cement after the engine is set.

The top of the foundation should be finished perfectly flat and level with a dressing of cement, and after this is thoroughly dry the engine may be placed in position. When bolting down the engine, it is better to draw each nut down a little at a time until all are tight and thus avoid straining the engine crank. After the nuts are drawn tight, if the crank turns unreasonably hard without loosening the main bearing caps, it may indicate an uneven foundation, causing a strain in the engine bed casting.

When setting up large engines, especial care must be taken to avoid straining the bed castings. Foundations hung from an upper floor, or built upon it, should be placed as close to the wall as possible. For the smaller sizes of engines it is a good plan to lay wooden beams on the top of the foundations and then to place the engine on the top of them so that when the frame is bolted down it beds itself into the timber. The timber cap often saves an annoying vibration when it can be overcome in no other way.

All the connections should be as short and as free from turns as possible, and no mistake can be made by having plenty of unions, so as to disconnect with ease. The gasoline tank should be set as near to the engine as is convenient, and with the top of the tank preferably not more than a foot or two below the base of the engine. In cases where the gasoline tank must be set from forty to fifty feet away, it is necessary to place a check valve in the suction pipe near the tank; both suction and overflow pipes must have a gradual rise all the way from the tank to the pump and should be as straight as possible to avoid the air traps, which prevent a steady flow of gasoline. It is most essential to clean thoroughly all pipes and fittings before putting together, by hammering lightly to loosen any scale and washing out with gasoline, as solid matter of this nature may be responsible for some of the simple but hard to get at troubles common to gasoline engines.

Shellac is best for joints in gasoline piping, but when this cannot be obtained, common laundry soap will answer the purpose just about as well. In some cases it will be found advisable to use gravity feed instead of a pump, and the foregoing remarks are applicable with the exception of the tank, which must be so arranged that its lowest point is slightly above the generator valve.

The exhaust pipe must be of full size, free from turns and short as possible, the shorter the better, and the more economically the engine will run. It will be found advisable to place the muffler as close as possible, setting it carefully so as to avoid any strain on the valve casting. Keep both muffler and exhaust piping away from combustible material, and never turn the exhaust into any chimney or flue.

There are two general methods of supplying the water, the first being that of the cooling tank, commonly used with small engines. For convenience in piping the tank should be slightly elevated, and both pipes, having as few bends as possible, should slope from the tank to the engine, a valve being placed in the bottom pipe near the tank. By using a circulating pump, fitted to the engine or shaft, water may be used from an underground cistern or tank.

The other method is to use a continuous stream of cooling water from the city water-works or other source. When city water is used it is a good plan to have a break and funnel inserted in the drain pipe so that the current of water flowing through the cylinder jacket may be seen. For making joints in water pipes either thick lead or graphite may be used with almost equal success. It may be well to place particular emphasis on the fact that it will pay to get into the habit of always shutting off the water at the tank and draining the cylinder every time the engine is stopped—not necessary to do it in summer, but absolutely necessary in winter—as a fair percentage of gasoline users know to their cost. "The Canadian Thresherman."

INFLUENCE OF THE EARTH IN WIRELESS TELEGRAPHY.

A good deal of interest has been shown recently in the statement that grounding a wireless telegraph station impairs considerably the efficiency of the station. The London "Electrician" in its issue of December 29, gives an abstract of a recent German paper by Herr J. S. Sachs, detailing the author's experiments to arrive at some definite conclusions in this matter. The work was suggested by Prof. Drude, and the system employed was due to the latter. It consisted of a primary circuit containing a spark-gap and a secondary circuit with its ends connected, respectively, to an air wire and a balancing capacity. The primary was a single turn of thick wire interrupter with a spark-gap. Its condenser was made of lead-foil fastened to a glass plate. The secondary was inside the primary and possessed ten well insulated wires wound in a single layer on an ebonite ring 8.7 centimeters in diameter.

The air wire consisted of a brass tube three metres long and 1.4 centimetres in diameter. The balancing capacity was a metal plate. The coils were designed to resonance, and the wave-length was computed to be thirty-one metres. The receiver differed from the sender only in having a constantan-iron thermo-couple in the position of the sender's spark-gap. The experiments were generally carried out in the open court in front of the Physical Institute of Giessen. The distances betweeu sender and receiver varied from twenty-five to fifty metres. Readings were taken by galvanometers placed inside the institute building, to which wires were run from thermo-couple. In order to make allowance for the variableness of the energy radiated from the sender a coil called a standard coil, not in resonance with the sender, was kept in a fixed position relative to the sender's winding and was provided with a thermo-junction similar to that in the receiver. This junction was also connected to a galvanometer.

The mode of experimenting was to pass a current through the induction coil for the same period in each observation of a set. The deflections of the galvanometers connected with the two thermo-couples, divided the one by the other, gave the figures which were used in drawing conclusions.

In this manner were investigated the effect of varying the relative positions of the various parts of the sending apparatus, and the effect of symmetry of the two ends. Another series of experiments was performed to contrast the behavior of the receiver when sender and receiver were wholly insulated, with its behavior when the balan ing plates at both ends of the thirty-metre stretch were connected to a plate buried one metre in the gronnd. When insulated the balancing-plates were one metre above the ground. It was found that the readings of the galvanometer were about twice as great when the whole apparatus was insulated as when the apparatus was earthed.

In order to examine the influence of the earth on the propagation of waves the author used the principle that this influence must alter with alteration of the apparatus above the ground. In dry, frosty weather, with air wires vertical and balancing-plates horizontal the maximum efficiency occurred when the apparatus was three metres above the ground. The effect at this height was more than four times the effect when the plates were only ten centimetres above the ground. On the other hand, in wet, cloudy weather, the maximum occurred at about one metre elevation, the effect at this height being about two and one-half times the effect at the height of ten centimetres. In both cases the maximum value was maintained with slight change, on further raising the apparatus to four or five times above the ground.

Experiments conducted to show the effect of distance on transmission gave values obeying the inverse square law. The distances varied between twelve and twenty-four metres.

The author's conclusions are stated thus: The earth's surface is, for waves of thirty-one metres, a strong absorbing and a weak reflecting medium. The connection to the earth of sender or receiver is greatly prejudicial to transmission. Insulating it is decidedly favorable. It is desirable to install the apparatus as high above the earth as possible. The integral effect at the receiver varies inversely as the square of the distance of transmission.—"Electrical Review."

The waste heat from a boiler furnace that escapes through the chimney is considerable, and to some extent unavoidable, for if all the heat were utilized, the chimney would not draw, since it is the heat in the chimney which first produces the draught in the furnace necessary for burning the fuel. Nevertheless, too much heat escapes by the chimney in most cases. A method recently patented professes to rectify this defect by bringing the flue containing the products of combustion to the place where the steam is applied before it passes into the chimney. The air, steam or hot-water and feed-pipes are passed through this flue, so that the heat contained in the gases of combustion prevents radiation from the pipe in question and contributes to the heating of the air, water and steam.

Polished aluminum has a slightly bluish tint like tin, but this can be improved. In polishing aluminum the grease is removed with pumice stone, and then is used an emery paste mixed with tallow, forming cakes which are rubbed on the polishing brushes. Finally, red polishing stuff, moistened with oil of turpentine, is used.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

MARCH, 1906.

Wireless telegraphy has occupied a prominent place during the last few years in the public and trade press. In its early days most extravagant claims were made as to its field of operation, but these have gradually given place to more moderate statements, as actual experience has shown the limitations of this method of communication. Even at this time it is too early to definitely state what future developments may bring about, and those most familiar with the subject have adopted a waiting attitude, suspending judgment until some points are more definitely determined or new inventions superseded the imperfect devices at present in use. This much has been definitely settled; that this system of communication is entirely practical within certain limitations, and of sufficient usefulness so that inventors will continue to give it the attention needed to work out efficient devices. The financial aspects are another matter, however, and not until the numerous disputes regarding the invention of certain important devices have been settled will promotors' claims be accepted by the investing public. The small investor will probably find it to his best interest to let those assume the risks who have money, the loss of which will not be ruinous.

It would seem hardly necessary to call the attention of readers of this magazine to the benefits to be derived from following a hobby of some kind, as the mere fact that they are readers is evidence of some such pursuit. The many friends of these readers, however, may not have been made alive to the advantages which accompany the study and work in some special line, and it is these friends we desire to reach and make acquainted with this magazine.

We hope, therefore, that the magazine will be shown to all friends of readers who would be interested in it, as we are very desirous of largely increasing the circulation during the present year. This will, in turn, enable us to increase the size of the magazine, which we shall do as soon as the conditions will permit. The large number of subscriptions received during the past few months are encouraging evidence that our efforts are being appreciated and we again extend our thanks to the many who have so kindly aided us in this way. Keep up and increase the good work and we will try and show our appreciation through the columns of the magazine.

The "American Society of Model Engineers," is nearly ready to begin operations. Many of the officers for the first year have been selected and the work planned for the same period. Many additional letters have been received expressing interest, so that the number now enrolled is over 300. This is very encouraging, and once active operations are begun, the number will increase rapidly.

Do not forget to enclose stamp with inquiries for which a direct answer is desired.

Have you the new premium list? If not, send a postal, as it contains many new and useful tools.

"I never saw an ignorant man that didn't say that 'book larnin" was useless, and condemn all colleges, and then go out and work for a dollar and a half a day, while the educated man makes from five up."

READING COVERS AND PORTFOLIOS.

G. W.

The materials required are "bookbinders' mill-board," some tape or narrow ribbon, various sheets of paper and some ordinary wheat-flour paste. The tools are a T-square, a straight, flat ruler, a sharp-pointed knife, a pair of scissors and a paste-brush. For covering one can use leather or cheaper substitutes, such as buckram and printed cretonnes or linens. Buckram is the best for the joints of the portfolios, and as a complete covering, if it is required to decorate when finished by the pen or brush. It is hard, with a smooth texture, and possesses the great advantage of not stretching or shrinking to any appreciable extent when paste is applied to it. Indeed, this latter attribute is so important that a word of warning may come in here—to test any other material before using it, and to discard it if it stretches or shrinks when wetted.

To begin with the practical construction: First make some thick wheat-flour paste. For this the flour should be mixed slowly, with cautious additions of a few drops of cold water until it is as smooth as cream. Then add quickly some boiling water in which a teaspoonful of powdered alum has been previously dissolved. Stir it constantly as the water is being added, and then pour back the whole into a saucepan and keep stirring it over a fire until it thickens to the required consistency.

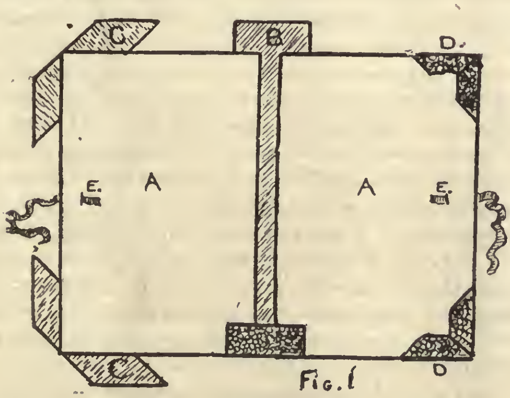


Fig. 1

The result is a firm, adhesive substance that, owing to the presence of the alum, will keep several days. Corrosive sublimate, a far more powerful antiseptic, is such a deadly poison that it cannot be recommended; a few drops of oil of cloves, however, will assist in its preservation and impart a fragrant odor to the paste.

It is necessary to have a firm, pointed steel blade—an ordinary penknife will do, but a shoemakers' knife is better; also a flat ruler, with a metal edge if possible, and some smooth boards for pressing the finished work, with a few bricks or other weights, unless a regular napkin press be available.

As the first stage of the process is somewhat "messy," it is best to make a good batch of "carcasses" in useful sizes, and keep them ready for after decoration when needed. Having decided upon the size, first, with the assistance of a T-square, mark your lines at true right angles upon the cardboard. Then, laying the piece flat upon a wooden board or, better still, upon a piece of glass, place the metal edge of your ruler to the pencilled line. Now, pressing very firmly upon the rule with the left hand, run a sharp-pointed knife lightly down upon the edge of the ruler; repeat the cut, using more pressure again and again, until the severance is made. The process needs boldness and care, or a slice of one of the fingers of the left hand may easily be detached with the cardboard if the knife should slip.

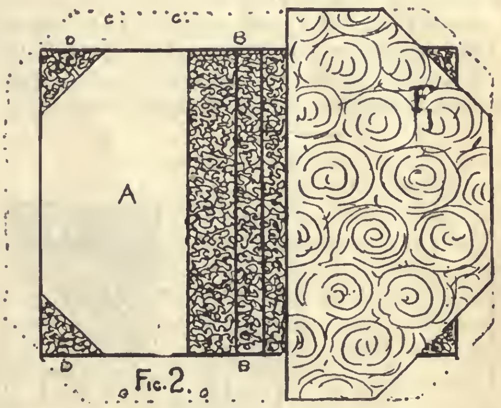


Fig. 2.

We will suppose a reading cover for a single number of a magazine is the subject of the first trial. For this two boards 9 x 11½ will be needed. This size is a quarter of an inch larger than the page each way. Next cut the pieces of paper for lining the inside of the covers the exact size or the page, 8¾ x 11. Then cut off a piece of the fabric, whether it be bookbinder's muslin, the "buckram" specially recommended, or ordinary stiff linen, such as that used for rolling window blinds, 14 x 3, and another of the same material, 10 x 3. Now paste these strips very thoroughly, allowing each to remain a few seconds before going over it again with the paste-brush.

Lay the first with its moistened side uppermost upon a flat surface. Place your two pieces of cardboard (*AA* Fig. 1) parallel upon this strip, *B* Fig. 1, remembering (and this is very important) that the width you allow between them will represent the holding qualities of the finished portfolio. For a single number let them be not over a quarter of an inch apart, parallel with each other and with the edges of the strip; see also that they leave equal portions of the strip top and bottom for turning over. Now turn over these pieces and lay the strip 10 x 3 (which should be at hand ready pasted) to meet the turned over ends of the first strip, and thus complete the inside of the hinge. Lay a sheet of paper right over the strip and rub it with firm pressure to make the pasted material adhere smoothly; turn it over and rub down the other side in the same way. If properly done, the result is a rough portfolio, the complete foundation for all the after decoration, whatever it may be. To strengthen the corners, pieces of the same material used for the back strip may be applied, *CC*, Fig. 1. These turn over as shown in *DD*, Fig. 2, or covered over entirely, they improve both the finish and the lasting quality of the portfolios. They are not needed, however on small portfolios, as, unless skilfully applied, they are apt to produce a clumsy appearance. Their proportionate size in *CC*, Fig. 1 has been purposely exaggerated to explain their shape.

Having proceeded so far, if you intend to finish the work in the ordinary common style, paper of any variety, whether plain or previously decorated, should be the shape *F* in Fig. 2, and pasted on as there shown. It will be seen that the paper covers some of the material used for the back and corners; so, in planning out your materials, allowance must be made for this

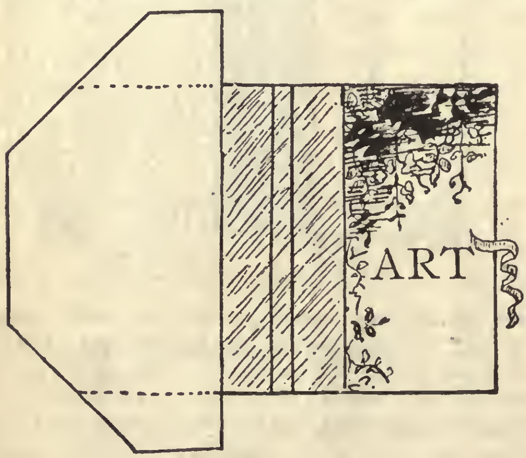


Fig. 3.

necessary overlapping. A quarter of an inch is sufficient, but it is better to allow too much than to find by too great economy you have spoiled the whole.

When the whole portfolio is to be covered (with a patterned silk or linen, or a plain material for decorating) it is called "whole binding," and a shape shown by the dotted lines *GG*, upon Fig. 2, will be required. For another style, known as "Roxburgh," or "quarter-binding," shown in Fig. 3, the material used for the sides covers the corners, but yet allows the back strips to show; in this instance the back piece is arranged to be much wider than for the so-called "half-binding" of Fig. 1.

It is often impossible to mount thin silk directly upon cardboard; indeed, it should never be attempted without a previous covering of white paper, if the silk be white, or a suitable color to match in other cases. If a sheet of paper be pasted and the silk laid smoothly on and dried under pressure, it may then be used as easily as ordinary paper. This, however, sometimes stains the silk. The best plan is to cut the paper to the exact size required, to gum the silk to it, using a very thick mucilage at the edges only. This, when dry, may be cut to a straight edge—otherwise always a difficult task—and applied as readily as if it were a firm fabric. Finally, paper slightly smaller each way than the cover, should be neatly pasted on the insides.

Fig. 4.

How strings to tie the portfolio should be affixed is shown in Fig. 1, although they are really not applied until the stage shown in Fig. 2; but it was easier to explain the manner of their insertion in that diagram. After the outer covering is pasted on, but before the inner lining sheet is fixed to each cover, a slit should be cut with a sharp-pointed knife right through the cardboard. Through this the ribbon should be passed and its loose end pasted down. The lining paper may be trusted to secure it finally. When wide ribbons are used as decorative features of the cover, Fig. 4, they are passed through in the same way. This needs some care, but can be accomplished with a little patience. Where the fabric is too rough in texture to permit lettering by ink or paint, it is best to embroider the title required on the ribbon. Paint it thereon in opaque water-colors after it is fixed in place.

When a portfolio is intended to preserve a book, such as a paper-covered novel, and not to be used at will for a variety of volumes, a preparatory stitching of the volume to be encased is desirable.

But if the cover is to be used for blotting-paper, for a railway time-table, or the successive numbers of a periodical, it is best to arrange strings of elastic at the back to tie the contents in place. If some narrow ribbon be passed from the inside through the back piece about half an inch from the top and from the bottom and tied in the middle of the open pamphlet or magazine, the contents are easily removed and replaced at pleasure.—Arts and Crafts, London.

EASILY MADE WEATHER INDICATORS.

N. SHARPE.

The primary factor in all kinds of weather is the moisture which is always present in varying quantity in the atmosphere. The second factor—the pressure of the air—depends upon the first. The average weight of the atmosphere is 14.7 lb. per square inch. The weight increases as the atmosphere becomes drier. This is easily tested by weighing a flask filled with dry air, and comparing the result with that obtained when the same flask is filled with a mixture of steam and air. The introduction of moisture will be found to reduce the weight. So it is with the atmosphere. When the weather is clear and the sky bright, there is very little water vapor mingled with the air; but when the sky is covered with clouds and wet weather is approaching, the air is laden with water particles, and is therefore lighter than usual.

It is here purposed to show the application of the above principle to the making of several kinds of weather indicators. The susceptibility of catgut to moisture is well known. This substance possesses the power of shortening its length and twisting when exposed to damp; and this twisting motion can be utilized in making a simple weather indicator that will provide amusement as well as information. It takes the form of a quaint little house with two doors, in one of which stands a woman and in the other a man. The latter comes outside when bad weather is threatened, and the woman retires, the reverse taking place when the weather is fine.

This effect is produced by means of a short piece of catgut suspended from the roof by one end and attached at the other to the moving framework below. The two figures are glued to the ends of a short wooden bar, in the center of which an upright piece is secured. The lower end of the catgut is then attached to the upright. Damp air causes the catgut to twist in one direction, while dry air causes it to twist in the other, thus turning the framework on a pivot, and changing the position of the figures. The figures are arranged according to the direction of this twist, which must be tested by experiment.

The property of catgut in altering its length when exposed to damp is utilized in another form of weather indicator, made as follows: Take a baseboard about 1 ft. square and 1 in. thick, and fit to the back of it two hanging plates. Mark two lines across the face of the board, one at each end, and about 1½ in. from the edge. These lines must be drawn so that they will be horizontal when the baseboard is hung in position. At a distance of 1½ in. from the side edge, measuring along the top line, insert a screw-eye, such as is used for picture hanging, having a ring about ½ in. in diameter. Mark a dot 1½ in. from the screw-eye, and four more along the remainder of the line, leaving 1½ in. space between them. Now, measuring from the side edge as before, mark a dot on the bottom line 2¼ in. from the edge, and finish off the line with four more dots 1½ in. apart.

Now get ten little brass pulleys, about ⅝ in. in diameter (these are used in venetian blind work, and can be obtained at a hardware store), and the same number of button-headed screws, about 1 in. long, with shanks an easy running fit for the holes in the pulleys. Then insert a button-headed screw carrying a pulley at each dot in the top line—five in all. Screw a pulley the same number in the lower line, where the position of the pulleys falls between that of the pulleys in the top line. About 9 ft. of 1-16 in. catgut, as used for suspending clock weights, will be required. Tie one end securely to the screw-eye in the top row, and take a turn under the first pulley of the bottom row; then up and over the top row of the first pulley, and so on. If the pulleys have been properly spaced, as directed, a free length of catgut will hang from the last pulley of the top row.

A lead pointer must now be made. Take a piece of heavy sheet lead and bend it double; place a piece of wire in the fold and close up with a hammer. From this cut a fairly long triangle, leaving the wired doubled edge for the base; the two remaining sides should be equal and should come to a point. Remove the wire from the bend and in its place pass through the free end of the catgut, which should be so tied as to bring the point of the weight about halfway down the board, the surplus catgut being cut off.

All that now remains to be done is to paste on the scale, which should reach from the last pulley of the top row to the bottom of the board. After fitting together it is advisable to take off the pulleys, etc., and give the board, including the scale, a coat of varnish. It would also be an improvement if the edges of the board were chamfered. When dry, reassemble the parts, taking care not to screw in the button heads so far as to cause the pulleys to jam.

The action of the indicator is very simple. Moisture in the air causes the gut to contract, which is at once indicated by the rising of the lead pointer, a sure sign of wet weather. In fine, dry weather the gut lengthens, and the slack is drawn down by the pointer.

The two indicators described, however, rely for their action upon the moisture of the air, and are not affected by atmospheric pressure. Another variety now to be described is more truly barometric and will, if properly read, indicate wind as well as rain. The general principle of this class of indicator depends on the fact that the volume of air enclosed in an elastic vessel varies in proportion to the pressure of the outer air.

An instrument of this kind can be made from an old electric incandescent bath. Get a burnt-out lamp of fair size, and have at hand a fine-cut file and a basin of water. Holding the bulb so that the pointed end is under the water in the basin, file away the point, still keeping it under water. Very soon a jet of water will be seen rising into the globe. When this occurs, stop filing, but on no account lift the point out of the water. Hold the lamp steady until it contains enough water to weigh it down below the surface. Leave it there for about half an hour; then take it out, dry it, and hang it up, point downwards, by a string tied round under the cap. Wet weather will bring a drop of water of varying size to the outside of the point; in dry weather the glass will be quite dry. The cause of this action is that the gas which is always present in an old lamp bulb expands and contracts according to the atmospheric pressure. This expansion and contracton reacts upon the water, and the drop is exuded and withdrawn as the weather is wet or dry.

Another instrument of the same class is made from a tall, narrow bottle, a length of glass fine-bore tubing, some colored liquid, a cork to fit the bottle, and a strip of cardboard. After thoroughly cleaning the bottle, fit the cork, and when this has been adjusted, bore a hole centrally through the cork of a size to enable the tubing to fit tight. The tube, upon the fineness of whose bore depends the delicacy of the reading, should be about twice the length of the bottle. Bend the tube U-shape, by heating in a lamp or gas flame, so that the limbs are about 1 in. apart, and one limb about 2 in. longer than the other. Cut a piece of pasteboard to the same length as the short limb, and about 1½ in. broad. Draw two lines centrally down the length, about 1½ in. apart, and graduate a scale between them, from about 1 in. from the bottom to the same distance from the top.

Now push the long limb of the tube through the hole in the cork until the short limb is almost touching the under side; then secure the scale to the tube with a few stitches of white thread passing through the pasteboard and round the tube. This done, pour a colored liquid into the tube till it reaches about halfway up the scale in each limb. Now push the cork firmly into place in the neck of the bottle, with the tube and scale inside. Melt some sealing-wax and carefully spread it all over the surface of the cork and round the edge, as well as round the tube, to make it air-tight. On the approach of bad weather the colored liquid will rise in the long limb, because the air pressure outside will be slightly weaker than normal. For fine weather the liquid will sink in the long limb, the air being heavier. The action is explained by the fact that the bottle contains a fairly large volume of air, whose volume will vary more or less perceptibly with the variation of the atmospheric pressure.—"Work," London.

Renew your subscription before you forget it.

WANTED—LEVEL HEADED MEN.

You may be smart, shrewd, cunning, long-headed, you may be a good scholar, very clever—even brilliant —but are you sound? That is the question everybody who has any dealings with you will ask. Are you substantial, solid? Have you a level head?

Everywhere we see men who are very brilliant out of work, plenty of sharp men who wonder why they do not get responsible positions. But people are afraid of these one-sided, poorly balanced men. Nobody feels safe in their hands. People want to feel that a man in a responsible position can keep a clear brain and level head no matter what comes, that he cannot be shaken from his center no matter how much influence is brought to bear upon him. They want to be sure that he is self-centered, that he is sound to the very core. Most people overestimate the value of education, of brilliance, sharpness, shrewdness, which they think can be substituted for a level head and sound judgment.

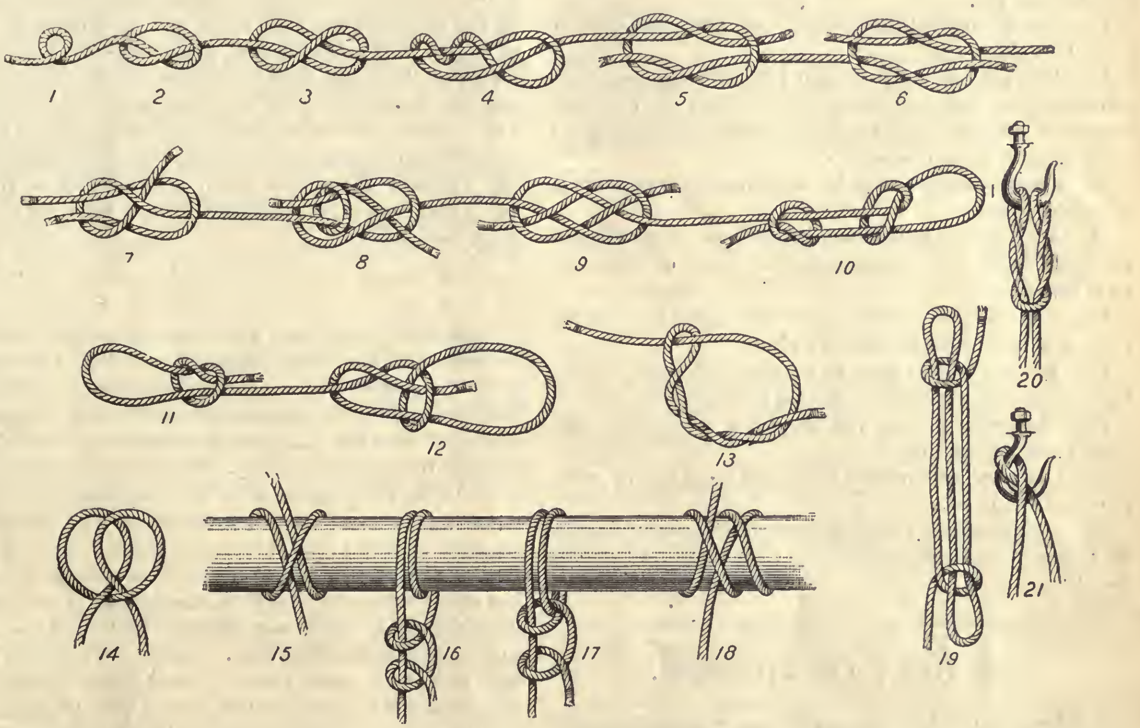
The great prizes of life do not fall to the most brilliant, to the cleverest, to the most long-headed or to the best educated, but to the most level-headed men, to the men of sound judgment. When a man is wanted for a responsible position, his shrewdness is not considered so important as his sound judgment. Reliability is what is wanted. Can a man stand without being tripped; and if he is thrown can he land upon his feet? Can he be depended upon, relied upon under all circumstances to do the right thing, the sensible thing? Has the man a level head? Has he good horse sense? Is he liable to go off on a tangent or to "go off half-cocked?" Is he "faddy"? Has he "wheels in his head?" Does he lose his temper easily, or can he control himself? If he can keep a level head under all circumstances, if he cannot be thrown off his balance and is honest, he is the man wanted.

The freezing system of tunneling is to be adopted in the construction of the new tube railroad for Paris at the point where the track will pass beneath the Orleans trunk railway. For various reasons, the ordinary shield system will not be suitable. The earth is to be frozen to a temperature of 30° below zero, so that the excavators can cut the tunnel without incurring any danger of collapse before the metal lining has been placed in position. The workmen, however, will experience some inconvenience while working at such a low temperature, but it is thought that this method offers the only solution of the problem.

Vast quantities of chalk are annually made into tooth powders. It is the base of most of the dentrifices. Mixed with the chalk as detergents are charcoal, cuttlefish bone and pumice. Bleaching salts and various acids also constitute parts of some dentrifices and constitute a grave danger to the teeth.

SCAFFOLD KNOTS AND HITCHES.

There is a great lack of knowledge among workmen generally with regard to the tying of rope for scaffolding, and when it is considered that during the erection of a building the workman lives, as it were, on the scaffold, sometimes poised in midair and in other dangerous positions where life and limb is jeopardized, it is most essential that the scaffold should be trustworthy and safe, and one of the factors of safety is the correct lashing and tying of the rope, with the manipulation of which the workman should be perfectly familiar.



As a chain is no stronger than its weakest link, so stability of the scaffold is dependent to a great extent upon the security of its knots; hence the importance of knowing the best one to use for the purpose required. Although scaffolds are generally erected by qualified men, yet there are occasions when the workman requires some adjustment or addition to the scaffold for a special purpose. He has then to undertake the alteration himself, and his knowledge of tying knots can be applied.

The knowledge one possesses in tying knots is not confined to the one vocation of scaffolding, but is useful in all departments of everyday life. A great number of knots have been devised for various purposes. The few here illustrated are those chiefly used in the erection of pole scaffolding and comprise nearly all that are necessary. The tying of these knots should be practiced by the uninitiated, for the process is inexpensive, as the back of a chair may be utilized, a small piece or or two of sash cord, with a little persistence, being all that is required to make perfect.

A very good proof that the lesson has been learned thoroughly is to tie each of these knots in the dark. The principles of a good knot are its facility in tying, its freedom from slipping and its being easily untied, says a writer in an English exchange. All knots will jam more or less when subject to a strain. In the diagrams here given the knots are shown open before being drawn taut in order to show the position of the parts. The names usually given and their uses are as follows:

1. Bight of a rope.

2. Overhand, or thumb knot, to prevent a rope running through the sheave of a block.

3. Figure of eight knot, used as No. 2.

4. Stevedore knot; is useful when the rope passes through an eye. It is easily untied after being strained.

5. Square or reef knot; this is the most useful knot for joining two ropes of the same size. However tight it jams it is easily "upset" and undone.

6. Granny, or thief, knot; this should not be used, as it will jam tight but not slip (as erroneously supposed), will not "upset," and consequently is difficult.

to undo.

7. Single sheet bend, or weavers' knot; used principally for joining two ropes of unequal sizes more securely than a reef knot.

8. Double sheet bend; more secure than No. 7.

9. Carrick bend, for fastening the four guys to a derrick.

10. Flemish loop.

11. Slip knot.

12. Bowline, for making a loop that will not slip. After being strained this knot is easily untled. Commence by making a bight in the rope, then put the end through the bight and under the standing part, pass the end again through the bight and pull taut. This knot should be tied with facility by every one handling ropes.

13. Timber hitch; the greater the strain the tighter it will hold.

14. Clove hitch, consisting of two half hitches; used chiefly to tie ledgers to standards. This is the most usetul of all the knots used in scaffolding on account of its simplicity and security.

15. Clove hitch, as No. 14, showing its application around a pole.

16. Round turn and two half hitches for securing a rope to a ledger, or for fastening the guys of derricks, shear legs, etc.

17. Fisherman's bend; used when a thick rope, such as a fall, is made fast to a ring.

18. Rolling hitch; used in a variety of ways, chiefly in making fast one rope to another that is held taut.

19. Sheepshank, for shortening a rope when the ends are inaccessible.

29. Catspaw, an endless loop, and used where great power is required.

21. Blackwaller; easily applied, but requires watching; has a tendency to slip.—"Carpentry and Building."

THE HEAT OF THE SUN.

The heat of the sun never penetrates more than 100 feet below the earth's surface, and at which depth the thermometer remains at 52° F. throughout the year, whether in the Arctic or tropical zones, says the "Mining World." Downward from 100 feet, every 66 feet means a gain of 1° of heat, and at 10,000 feet it is estimated water would boil. At a distance of 30 miles all rocks in the crust would melt. It is improbable that the same rate of temperature increase continues to the earth's center, because that would give a heat vastly beyond conception. We know that in the borings of mines heat increases with depth.

The large number of hot lakes and geyser springs, numerous volcanoes in various parts of the world, are certain indications that a vast amount of heat still lies beneath the earth's surface. Not long ago supposition was that the interior of the earth was a vast ocean of molten rock, surrounded by a cold crust, but later knowledge of physical laws has led to the belief that the earth is more rigid than a globe of steel of similar size. If the earth was a globe of molten material surrounded by a thin crust, it would be continually pulled out of shape by the attraction of the moon, and great tidal waves would be created on the surface by the surging molten mass within. While the interior of the earth is rigid, an exceedingly high temperature nevertheless prevails, and it continues in a solid state only by intense pressure.

If it were possible to strip off the cold exterior crust, the solid and heated interior would instantly become molten. It is most probable that there are local pools and reservoirs of molten materials in and under the crust. Whenever there is a local disturbance caused by the shrinkage of the crust and a release of pressure, we may suppose that pools of liquid rock are formed. Through fissures in the earth's crust such molten masses have in the past ages been forced up and spread over the surface. The lava beds of Arizona, New Mexico and other western points, the Palisades of the Hudson River, the Giant's Causeway in Ireland and numerous other occurrences, are remnants of ancient lava flows.

Laminated poles and pole tips are coming into increased use, and this, says "Power," is a feature of modern dynamo and alternator construction. For traction dynamos this construction is found to be of advantage, because the magnetism more quickly responds to changes of load. It is obviously of little avail to fit the engine with an elaborate cut-off and governing gear if the magnetism of the dynamo is sluggish. In the case of alternators, and to a certain extent of dynamos, lamination is of advantage is reducing eddy currents. Further, the designer is dealing with material which can be depended on to come up to a certain magnetic value. Unfortunately this is not the case with cast steel or cast iron. When the complete pole is laminated, the block is often cast into the yoke. This method, though cheap, is not so good as bolting on the poles, because the plates must be affected by the heat and can be insulated only with oxide. The molten metal would destroy paper or japan. For dynamos, pole shoes are usual, so as not to have the air-gap area too concentrated. The shoe also acts as a support to the magnetic coil.

The largest raindrops are about one-fifth of an inch in diameter. Their size has been determined by allowing rain to fall into a thick layer of flour, each drop forming a pellet of dough, and these pellets are compared with dough pellets obtained, it is said, from drops of known size delivered upon the flour by artificial means.

CARE AND MANAGEMENT OF BELTS.

W. A. DOW.

The object of this article is to bring before the readers of this paper a lesson on the care of belts and the placing of pulleys, adjustments and tightness.

In placing a belt around two pulleys, no rule can be given which will account for the stretch in the belt, since the stretch of a belt is variable in different belts of the same length. A belt should be cut slightly shorter than the measured length around the pulleys and it is evident that the length of a belt cannot be obtained exactly by calculation. In practice, to obtain the necessary length of a belt which is to pass around two pulleys already on their places upon the shaft, it is usual to pass a tape measure around the pulleys, the stretch of the line or tape being allowed for the stretch of the belt.

If the length of a belt for pulleys not in position is required, it may be obtained as follows: Suppose Fig. 1 represents the condition where the diameter of the large wheel is 36 in. and the diameter of the small wheel 18 in. and the distance between centers is 50 in.; then, $\sqrt{50^2 + 9^2} = \sqrt{2581} = 50.79$ in., the length of the belt on each side tangent to pulleys. This must be multiplied by 2 to get the length of both sides, to which must be added the half circumference of both the larger and smaller pulleys, or $50.79 \times 2 = 101.58$ in.; half circumference of larger pulley $= 18 \times 3.1416 = 56.54$; half circumference of smaller pulley $= 9 \times 3.1416 = 28.27$; therefore $101.58 + 56.54 + 23.27 = 186.33$ in. is the length of belt required.

Fig. 1

The rule, therefore, is: Square the distance between center of pulleys and square the difference in radii of the two pulleys, add together and extract the square root. Multiply this root by 2 and add half the circumference of each pulley. The result will be the length of the belt. This will give a belt a little too long, but allows for a small amount to be cut out of the belt to give the necessary tension. Another rule is as follows: Add the diameters of the two pulleys, divide the result by 2, multiply the quotient by 3¼ and add twice the distance between the center of the shafts. The result will be the length of belt required.

The grain side of the belt should be placed next to the pulley, for with the grain side out there is a tendency to stretch and crack; this occurs especially when small pulleys are used, whereas if the grain side was next to the pulley the tendency would be to compress it and prevent either cracking or tearing. Very little of the belt's strength is lost by wearing away its weak side.

When two pulleys are placed one above the other, the upper pulley will have a grip due to the tension and weight of the belt, whereas if placed horizontally, the weight of the belt will fall equally on both pulleys and for this reason vertical belts of large size require greater tension on the pulleys to transmit the same power than belts placed horizontally.

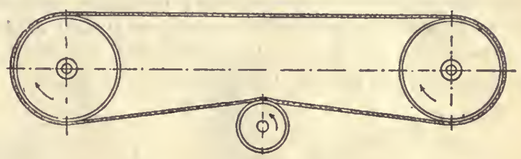


Fig. 2

As soon as motion is transmitted by a belt from one pulley to another, one side of the belt is under greater tension than the other. The side of the belt to be the most strained is the drive side, which is the side that approaches the driving pulley. The slack side is always that which recedes from the pulley. In some cases the sag of the belt is so great that the arc of contact on the drive pulley is not sufficient to prevent slipping of the belt. When this occurs, which is usually when the slack side is the lower side of the belt, an idle pulley is placed between the two main pulleys, as shown in Fig. 2.

As will be noticed, this pulley takes up the sag of the belt and allows a longer arc of contact to be made on the drive pulley. When the direction of rotation of the driven pulley is required to be reversed from that of the driving pulley, the belt must be crossed, as shown in Fig. 3. It is evident that cross belts have a greater arc of contact and a greater transmitting power than open belts and the slip is less, but the life of the belt is shortened on account of the two sides of the belt being in constant use.

When a belt connects two pulleys whose planes of rotation are at an angle one to the other, it is necessary to have the center line of the belt approach the pulley in the plane of the pulley's revolution irrespective of the line of motion of the belt when receding from the pulley, as shown in Fig. 4. This figure represents what is known as a quarter-twist belt. *A* and *B* are the two pulleys whose planes of revolutions are at right angles, the belt traveling as denoted by the arrows. The center line of the belt is in the plane of rotation of *A* on the side on which it advances to *A*. Now, if the position of the pulleys is changed, the same rule applies. It is evident, therefore, that the belt motion must occur in the one direction only and shafts at any angle one to another may have motion

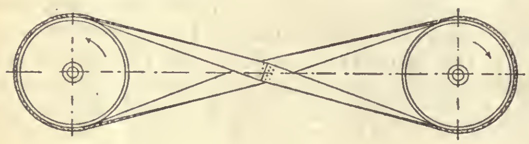


Fig. 3

communicated from one to the other by a similar belt connection, providing a line at right angles to the axis of one forms also a right angle with the axis of the other.

The axes of shafts may be set at any angle to the plane of rotation, provided that the axle line of pulley *A* at right angles to the imaginary line *C*, which is at right angles to the axis of the shaft of pulley *A*, and the side of the driving pulley which delivers the belt is in line with the center line of the driven pulley.

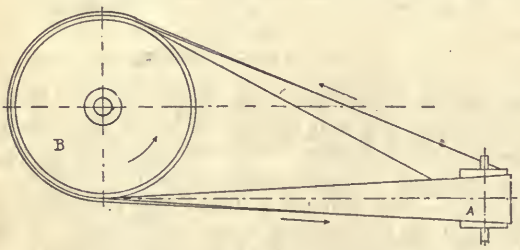


Fig. 4.

It sometimes occurs that these provisions cannot be carried out, and in those cases pulleys to guide the direction of the motion of the belts must be employed. Thus, in Fig. 5, an arrangement of guide or mule pulleys is shown which are placed at the intersection of the middle planes of pulleys *A* and *B*. The dotted

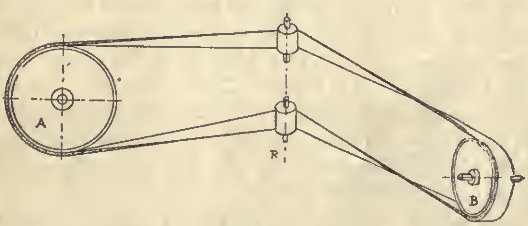


Fig 5

line TR shows the intersection of the two planes. The axes of the mule pulleys are made to coincide with this line, in which case the belts will have the suitable directions and can be run in both directions.

An arrangement of guide pulleys by which two pulleys not in the same plane are connected, is shown in Fig. 6. As will be noticed, the arc of contact of the smaller pulley *A* is increased by the use of the two idlers *C* and *D*, and the belt may be run in either direction. From the foregoing it can be seen that belts can run in any direction, providing pulleys are placed in proper positions.

It often happens when new belts are required, the width necessary to transmit a certain horse power must be known. This can be determined by the following formula:

$$W = \frac{800\,H}{S}$$

where W = width of belt in inches, H = horse-power to be transmitted and S = speed of belt in feet per minute. If the width is given and it is required to find the number of horse-power the belt is capable of transmitting, the formula becomes

$$H = \frac{WS}{800}$$

Suppose, for example, a belt is 8 in. wide and its speed is 2000 ft. per minute, then $H = (8 \times 2000) \div 800 = 20$ horse power. This rule is used when both pulleys are of the same diameter. When two pulleys are used of different diameters, multiply the length of the belt in contact on the smaller pulley by 360 and divide the product by the circumference of the pulley. The

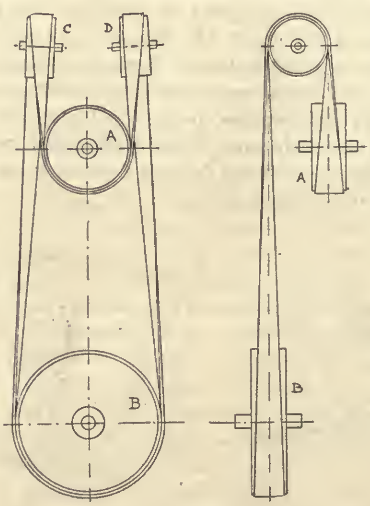


Fig. 6

quotient will be the arc of contact. After the arc of contact is found, subtract it from 180 and multiply the remainder by 3. This last result is to be added to 800 and the sum used when computing the power of the belt. The following article shows how the arc of contact is used when computing the power of the belt. Suppose the small pulley to be 24 in. in diameter and the length of contact 30 in., then $(30 \times 360 \div (24 \div 3.1416) = 143$ degrees. Then $(180 - 143) \times 3 = 111$ and $800 + 111 = 911$, which is the sum to be used in the horse-power formula. Suppose under those conditions an 8-in. belt is used which runs 2500 ft. per minute, then according to the formula (2500 × 8) ÷ 911 = 21.9 horse-power.

In all the above cases, a single belt was implied in the calculations. When a double belt is used it will transmit 1½ times the power of a single belt, and in order to find the width of a double belt, multiply the width of a single belt by ⅔. For instance, if it requires a single belt 15 in. in diameter to transmit a certain horse-power, it will only require a ⅔ × 15 = 10-inch double belt to do the same work.—"The Practical Engineer."

A KNIFE CLEANING MACHINE.

C. B.

The knife-cleaning machine illustrated at Fig. 1 is a strong and serviceable article, and can be made without the aid of any expensive tools. Fig. 2 is an elevation of the machine. The baseboard *A*, the central upright *B*, and the crank *C*, which carries the handle *D*, are made from 1-in. stuff, while the two wooden discs *E* and the uprights *F*, which carry the spindle *G* are of ¾-in. stuff. The pieces are in single thickness; but to prevent warping it is advisable to make the baseboard and the wooden discs of two thicknesses, with the grain crosswise, glued and screwed together. The baseboard having been planed up to 1 ft. x 7 in, the uprights *p* shou d be cut out; these are 3 in. wide where the spindle enters, increasing to 4 in. at the bottom with an extra 1 in. to be recessed in the baseboard. The center of the spindle is to be 5½ in. from the baseboard.

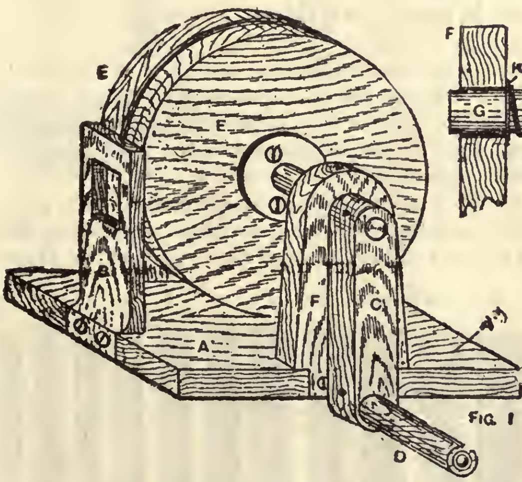
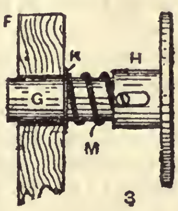


FIG. 1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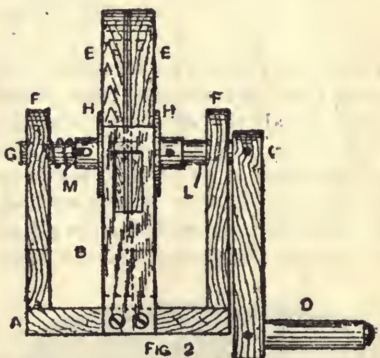


FIG. 2

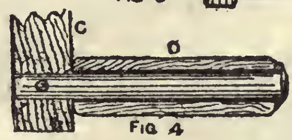


FIG. 4

These uprights must be quite vertical and are secured to the baseboard with two screws each. The ho es o receive the brass tube bushes which form the bearings of the spindle are next marked out and bored. These holes should be perfectly in line with each other and should be made a driving fit for the tubular bushes, which must be nicely smoothed inside. The spindle *G* may be of brass or iron, 8½ in. in length and about ½ in. in diameter. To this is fitted the two flanges *H*, (ceiling plates, as used in gas fitting, will answer very well); they should be a good fit on the spindle, as any looseness will cause the discs to which they are attached to run out of truth.

The wooden discs, 10 in. in diameter, should next be marked out with compasses and cut with a pad saw as close to the lines as possible, and afterwards smoothed round with a rasp or rough file. Turning them on the lathe, if one is available, would of course make a better job. From the center strike out circles slightly larger than the greatest diameter of the flanges and screw the latter on central. The holes to fit the spindle are continued through the discs, which are then mounted on the spindle to see if they run true. The disc to the right should push on and is held by a set screw.

The other disc is made a sliding fit, the fixing in this case being by means of a ¼-in. headless screw, tapped into the spindle, working in a slot cut in the cylindrical part of the flange, shown in enlarged detail at Fig. 3. The disc can th n ve pulled away a short istance from the other to allow of the introduction of the cleaning medium. A strong spring *M* is coiled round the spindle to keep the discs close together; a washer *K* being interposed between the spring and the upright. If the discs do not run true on the spindle a true line can be marked on the periphery by holding a pencil or a knife edge against it while the spindle is revolved, the surface then being planed true to the line. When true, the disc should be covered with hard felt, attached with glue.

The crank *C*, Figs. 1 and 2, which is 8 in. long by 1½ in. wide, is bored at one end to fit tight on the spindle and at the other to take a ½-in. rod on which the handle *D* is fitted, the centers of the holes being 6½ in. apart. The handle, a sectional view of which is given at Fig. 4, can be made from a piece of stout broom-handle, which should be lined with brass tube to fit over the ½-in. rod. At one end of the rod a rivet head is formed, then a washer is slipped on and then the handle.

The other end is forced into the hole in the crank. A ⅛-in. pin put through this and another through the spindle, securely holds the parts together. A washer is inserted between the crank and the upright to prevent them from rubbing together. Side play of the spindle is prevented in one direction by the crank of the handle, and in other directions by a piece of brass tube, similar to the spindle bushes, cut the correct length, and slipped on the spindle *L*, Fig. 2, when putting the machines together.

The central upright *B*, Figs 1 and 2, which is 2 in. wide, is next fitted to just clear the discs, the thickness being reduced to ½ in. after it leaves the baseboard. See Fig. 1. The opening in the upper part is 1 x 2 in., the top edge being level with the center of the spindle. The knife to be cleaned is passed through this opening between the discs.

Screw holes for clamping-down purposes are made to suit the table or bench on which the machine is to be used; when fixed, the edge of the baseboard should be flush with the edge of this table, so as to allow of the proper working of the handle.—"Work," London.

A VILLAGE TELEPHONE EXCHANGE.

LAWRENCE V. STEVENS.

III. Running Line Wires—Fuse Board.

In installing the switchboard at the central office in the general store, the experts from the supply house will attend to all the details of wiring and testing out the circuits in the board. Lines representing the full capacity of the board are brought out in pairs to a connecting strip of maple wood, fastened to the wall at the point of entrance for all outside wires. A cross frame of oak fastened to the roof of the store

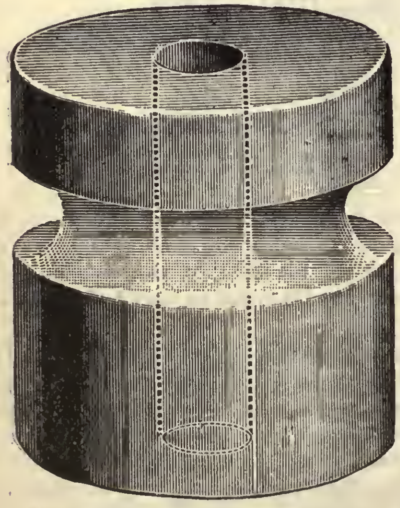
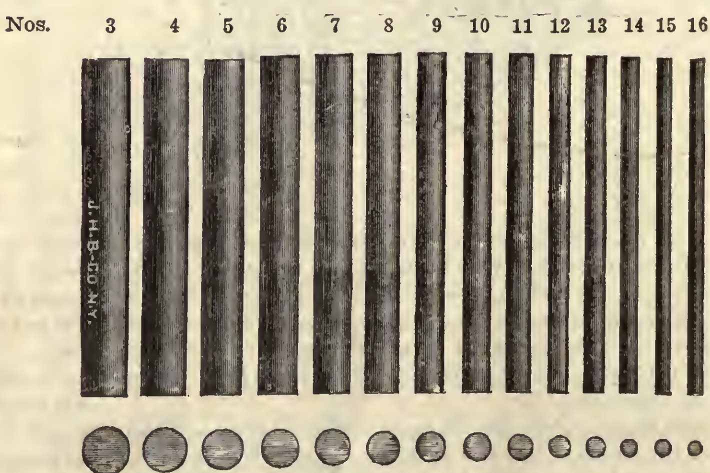


Fig. 1.

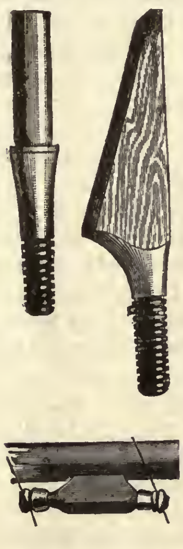
will answer for the terminal for all outside lines. On this frame the galvanized line wires are fast to insulators, Fig. 1, and the ends of each wire soldered to well insulated copper wire, No. 14 gauge, of the brand often spoken of as Okonite or Kerite wire. This rubber-covered wire enters the building through one duct or hole cut in the wall and hooded over to prevent the entrance of rain or snow.

The insulated wires are connected in proper position upon a fuse frame, which is supplied by the company furnishing the apparatus, and which is illustrated in



Wire Gauges.

Fig. This frame serves to protect the switchboard should wires become charged with electricity from lightning or a cross with high potential circuits. Each wire is fused with standard mica fuses, which blow at any excess of current over one ampere. Also as an extra preventative each wire fuse terminal is connected to one block of the carbon arrestor, the opposite end of which is grounded. The blocks being separated a small fraction of an inch by a thin slip of silk cloth or mica, do not interfere with the path of the ordinary



BRACKETS.

current through the fuse, but should oscillating currents of high arching power reach the fuse, the discharge is carried through the grounded carbon to earth, thus saving the switchboard from harm. The circuit of this device is plainly shown in Fig. 3. All con-

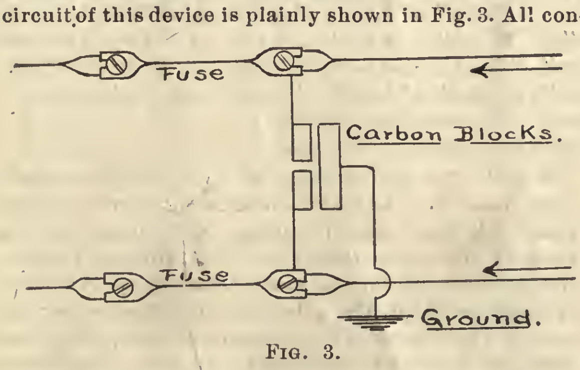


FIG. 3.

nections made on strips are soldered, with the exception of the fuses which are fastened securely under screw heads and washers.

We will assume that the first line constructed is that of Hyde Bros., whose chair factory we find located at the railroad. As Mr. Chas. C. Hyde, the head of the concern, will also require a telephone, provision is made for connecting an instrument at his house to this line, so that communication may be established between factory and residence without calling central,

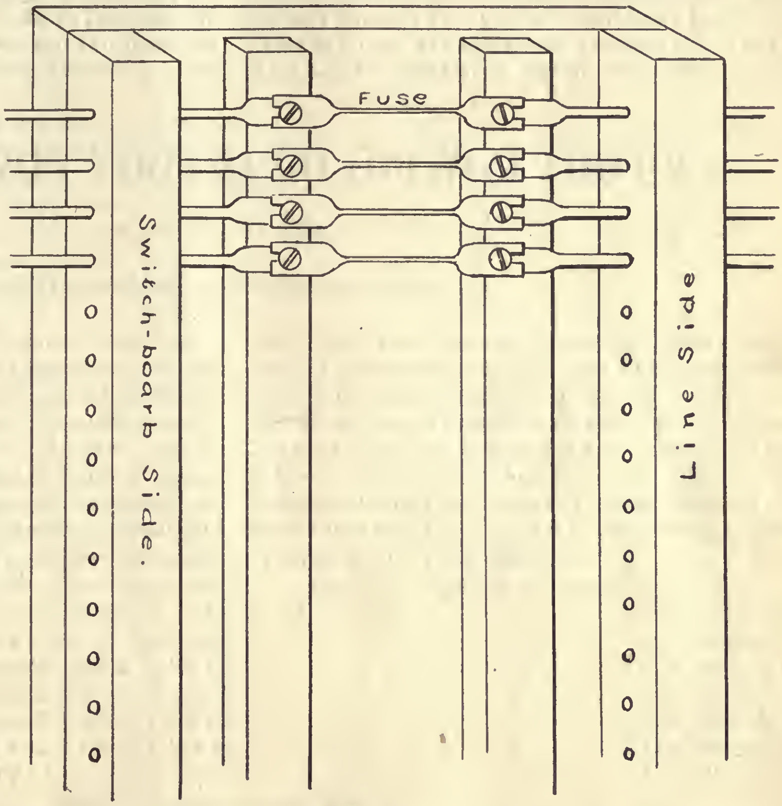
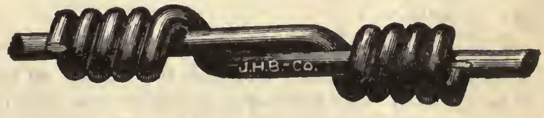


FIG. 2.

by ringing upon the line as provided for in the system of ringing suggested for this exchange.

In selecting a line wire the different advantages of both galvanized steel and bare copper wire are to be looked into as regards first cost, maintenance and expense of handling, and it will probably be advisable to procure No. 12 gauge best galvanized iron wire, such



SPLICE.

as is listed at seven cents per pound, subject to discount in mile bundles. It is estimated that one mile of this wire will weigh 164 pounds, and bundles are usually in ½ mile coils. Glass insulators of a size suitable for properly running this wire through trees are of the type shown in Fig. 1, the price being 3 cents each by the hundred.

There are two ways of placing the two wires in the trees; first, by fastening separate insulators as far apart as possible in the trees, or else more uniformly, by means of a duplex bracket, which consists of a short, stout stick, a foot in length, bearing an insulator like Fig. 1 at each end. Such a bracket has the disadvantage of damage to both wires should the bracket split and fall away from the tree. In running the line to Hyde Bros., separate insulators are used, fastening same to either side of the main trunk of the trees where possible, in preference to swinging on less substantial branches.

The experienced lineman sent by the supply house will direct all the details of erecting this first line, to the point of entrance at the factory and the residence of Mr. Hyde, at which places the subscribers may feel confident of their ability to commence the work of installing the interior wires and instruments.

A 9-FOOT ROWING OR 12-FOOT POWER TENDER.

CARL H. CLARK.

I. Lines and Moulds—Tables of Offsets.

The two boats described in the present series of articles are designed to be of the canvas covered variety. This method of construction is very simple and easily carried out, thus being well adapted to amateur builders; at the same time it makes a very light boat and one which will not shrink and leak upon being out of water for some time. The small, 9 ft. boat is designed especially for rowing, as for use as a yacht tender, and noted, the frames or mould lines, 1, 2, 3, etc., which appear as straight lines on profile and top view, are curved in the end view or body plan. The water lines which are straight in body plan and profile are curved in the deck plan. The water lines are spaced 3 in. apart in the 9 ft. boat, and 4 in. in the 13 ft. The first step will be to lay off the lines and get them ready for use, the proceedure being the same on both boats.

TABLE NO. 1. OFF-SETS FOR 12-FOOT POWER TENDER.

Numbers of Moulds.	Stem	1	2	3	4	5	S
Height of gunwale	2′ 8 7-8″	2′ 5″	2′ 2 3-4″	2′ 1 1-4″	2′ 1″	2′ 1 5-8″	2′ 4 1-4″
Half breadth ,,		1′ 7 1-2″	2′ 3″	2′ 5 1-2″	2′ 4 3-4″	2′ 1″	1′ 8 1-4″
Half breadth w. l. 5		1′ 5 1-2″	2′ 2 3-8″	2′ 5 1-4″	2′ 4 3-4″	2′ 1 1-4″	1′ 8 1-2″
Half breadth w. l. 4		1′ 4 1-8″	2′ 1 5-8″	2′ 4 7-8″	2′ 4 1-4″	2′ 0 1-2″	1′ 5 1-2″
Half breadth w. l. 3		1′ 2 1-4″	1′ 11 7-8″	2′ 3 3-4″	2′ 3 1-8″	1′ 10″	5 1-4″
Half breadth w. l. 2		11 5 8″	1′ 8 3-4″	2′ 1 1-4″	2′ 0 1-2″	1′ 3 5-8″	
Half breadth w. l. 1		7 3-8″	1′ 3″	1′ 6 1-2″	1′ 4″		

Water lines are spaced 4″ apaat.

TABLE NO. 2. OFFSETS FOR 9-FOOT TENDER.

Number of Moulds.	Stem	1	2	3	4	5	S
Height of gunwale	2′ 0 3-4″	1′ 9 3-4″	1′ 8″	1′ 7″	1′ 6 3-4″	1′ 7 1-4″	1′ 9 1-8″
Half breadth ,,		1′ 2 5-8″	1′ 8 1-4″	1′ 10″	1′ 9 1-2″	1′ 6 7-8″	1′ 3 1-8″
Half breadth w. l. 5		1′ 1 1-4″	1′ 7 3-4″	1′ 10″	1′ 9 1-2″	I′ 6 7-8″	1′ 3 1-4″
Half breadth w. l. 4		1′ 0 1-8″	1′ 7 1-8″	1′ 9 5-8″	1′ 9 1-4″	1′ 6 1-4″	1′ 1 1-4″
Half breadth w. l. 3.		10 3-4″	1′ 5 3-4″	1′ 8 3-4″	1′ 8 3-8″	1′ 4 1-2″	3 7-8″
Half breadth w. l. 2		8 5-8″	1′ 3 1-2″	1′ 6 3-4″	1′ 6 3-8″	11 5-8″	
Half breadth w. l. 1		5 1-2″	10 1-4″	1′ 2 3-4″	1′ 0		

Water lines are spaced 3″ apart.

being light is especially adapted for lifting on board when desired. She will carry three persons very comfortably, and four without trouble. The 12 ft. boat is fitted either for a power tender, using a 1½ h. p. motor, and will be described as such, although with the addition of a centerboard and sail plate she makes a comfortable and able sailing tender. For rowing alone she is rather wide and bulky.

The lines of both boats are shown in Fig. 1, those of both being practically the same except for size. These lines are the same as would be furnished to a boat builder, consisting of sheer plan top view, and end view showing shape of moulds or timbers. As will be

A full size reproduction of the profile or sheer plan must first be made on brown paper for reference. A base line is drawn as shown, passing through the top of the keel. The following description of the work for the small boat will apply equally to the large one by the substitution of the proper figures. The length, 9 ft., is laid off along the base line and a vertical line drawn at each end. From table 4 it will be seen that the distance of No. 1 mould from the stem is 1 ft 9 in., which is to be laid off from one end vertical. The spacings of the other moulds, 1 ft. 6 in., are laid off in turn; this should leave 1 ft. 3 in. from No. 5 mould to the stern, as in the last line of table 4. Verticals are drawn at these points, care being taken to have them exactly at right angles with the base line.

The water lines Nos. 1, 2, 3, 4, 5, are now drawn 3 in. apart on the 9 ft. boat, and 4 in. apart on the 12 ft. The outline of the stem is gotten from table 3 by measuring forward from No. 1 mould on each waterline the distance given; thus, on waterline 5, 1 ft. 9 in. is laid off toward the bow, on waterline 4, 1 ft. 8½ in.; on No. 3, 1 ft. 7½ in., and so on, giving the outline cf the stem as in Fig. 1, on the inner line. As wili be noted, this curve runs into the vertical already drawn and extends up to the height of the gunwale. For striking in this

TABLE NO. 3. OUTLINE OF STEM.

Distance from No. 1 mould to stem on each w. l.

	9-FOOT TEND R.	12-FOOT TENDER.
Gunwale	9"	2' 4"
Water line 5	1' 9"	2' 4"
,, ,, 4	1' 8 1-2"	2' 3 1-2"
,, ,, 3	1' 7 1-	2' 2 1-8'
,, ,, 2	1' 5 7-8"	1' 11 3-4"
,, ,, 1	1' 2 1-4"	1' 7"

and other curves a small batten of oak or other pliable wood is used about ⅛ in. thick and ½ in. wide, held in place by brads or small awls stuck down either side of it. The sheer or gunwale line should now be struck in from measurements given in the offset table thus: From table 2 the height of gunwale on stem is 2 ft., 0¾ in., which is measured up on the stem above the base line, the distance 1 ft. 8 in. is laid up on No. 2; 1 ft. 7 in. on No. 3, and so on. For striking in this curve a stiffer batten should be used, about 1 x 1½ in. of pine or spruce held in place as before.

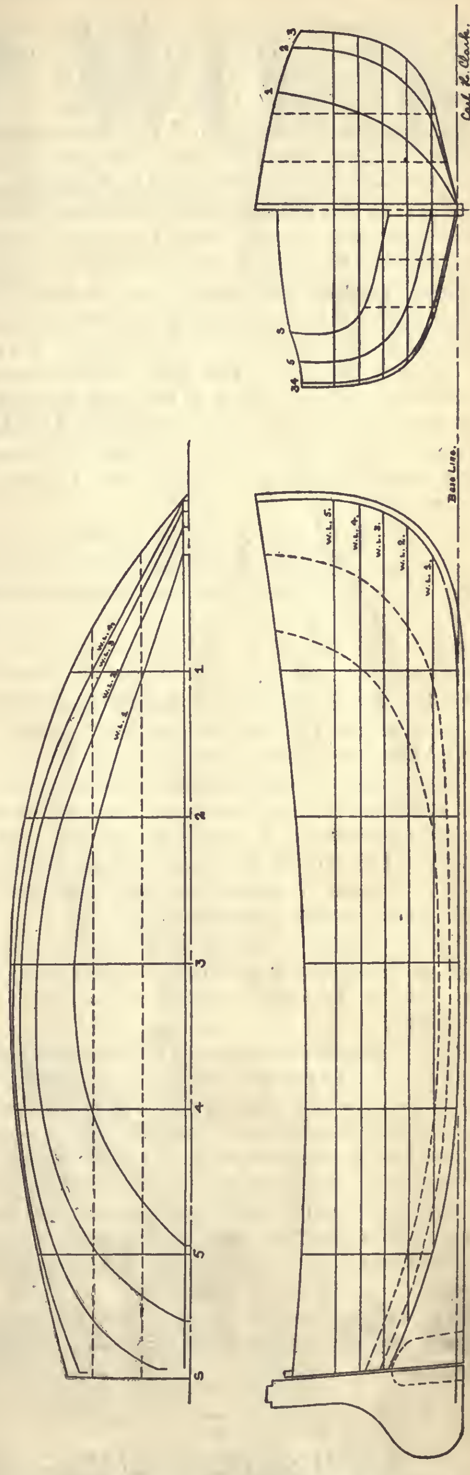
TABLE NO. 4. SPACING OF MOULDS.

	9-FOOT TENDER.	12-FOOT TENDER.
Stem farward of No. 1 mould	1' 9"	2' 4"
Spacing of moulds 2, 3, 4 and 5	1' 6"	2'
Stern aft No. 5 mould	1' 3"	1' 8"

The after side of the stern is not vertical but rakes aft slightly,—1¾ in. and 2¼ in. respectively in the two boats; this distance being measured on the base line of the after side of the stern post drawn from this point to the intersection of the vertical and the gunwale.

The line of the upper curve of the deadwood is next located; it extends only on Nos. 4, 5 and S and is obtained by measuring up from the base line the proper distance on these sections; thus from table 5; ¼ in. is to be measured up on mould No. 4.; 3½ in. on mould Mo. 5, and 8¼ on the stern. This curve is drawn in, making a fair, smooth joint with the base line as shown. The profile should now appear like that in Fig. 1, with the exception of the dotted section lines and the keel.

The shapes of the cross-section or moulds are next to be laid off using table No. 2. Although in the drawing



the shapes of the several moulds are shown together for convenience, for use they should each be drawn on a separate sheet of brown paper. It will be necessary to lay off only on one side of each mould. A center line and base line are drawn and the five waterlines 3 in. apart and parallel with the base line. Now, taking mould No. 3 as a sample, at the height of gunwale, 1 ft. 7 in., a line should be drawn parallel to the base line; having now the base line, five waterlines and the gunwale height line, the several half breadths from the table are to be laid off. The half breadth of gunwale, 1 ft. 10 in., is laid off from the center line on the line through the gunwale height; the half breadth on water line 5, 1 ft. 10 in., is laid out from the center line on water line 5; on waterline No. 4, 1 ft. 9⅝ in., is measured out; on waterline 3, 1 ft. 8⅞ in., and so on down to the base line, where the half breadth is ⅞ in., or half the width of the keel. The other moulds are laid out in the same manner. It will be noted, however, that moulds No. 3, 4 and S do not extend down to the base but stop above it at the height given by table 5, the half breadths at this point being the same as that of the keel, ⅞ in.

TABLE NO. 5. DEADWOOD.

Heights above base line.

	9-FOOT TENDER.	12-FOOT TENDER.
Height on mould No. 4	0 1-4″	0 3-8″
,, ,, ,, ,, 5	3 1-8″	4 1-4″
,, ,, ,, ,, S	8 1-4″	11″

The patterns of the moulds having been drawn it is necessary to take off from the outline the thickness of the planking, the lines having been drawn to the outside of the plank. This thickness is ¼ in. in the small boat, and 5-16 full in the larger one. This simply means the drawing of a curve parallel with and inside of the outline already drawn, a distance equal to the plank thickness. It should be noted that Nos. 3, 4, 5 moulds are practically straight from the keel to the first waterline, which should be carefully followed in laying out to avoid any possibility of roundness or barrel shape on the bottom which would tend to make her cranky.

It will be necessary to make a set of wooden moulds or forms, of the exact shape of the paper patterns. Directions for making moulds have several times been printed in previous issues. They should be made of ⅞ in. stock and be accurate to shape and both sides alike. The moulds should be strongly put together, as there is likely to be a considerable strain upon them and any springing will alter the shape of the boat. Great care must be taken that the moulds are of the correct width across the top as given by table 2.

This completes the preliminary work and the directions for starting the actual construction will now follow.

CORRESPONDENCE.

No. 127. So. Orange, N. J., Jan. 31, '06.

In an article recently published in Amateur Work on induction coils by Mr. Graves he says a coil should be wound in sections. Does he mean cross sections or length sections? Also, in winding, do you wind from the right side to the left and then from the left back again?

Can you also tell me what size coil I will need for a wireless outfit to send messages about two miles?

T. G. C., Jr.

By "sections" Mr. Graves means thin sections of pan-cake form, the number and thickness depending upon the size of the coil. These are wound to proper diameter between discs of cardboard which have been previously soaked in paraffine wax. The process will be fully described in an article now in preparation to be published at an early date. The windings and connections between sections must be such as will send the current around the core and primary in the same direction. As it is more convenient, as well as less liable to short rircuits, to connect the inside and outside terminals of adjacent sections together; every other section should be wound in the same direction, the inside terminal of one should be connected to the outside terminal of the next, the sections and separating discs being liberally coated with paraffine.

No. 128. San Francisco, Cal., Feb. 12, '06.

Will you kindly tell me how to avoid the spark at break between two sliding contacts without the use of a condenser?

I have two magnets each wound with 400 turns of No. 30 B. & S. gauge wire, connected in the usual form and use three dry cells for an electric clock making contact every minute, but the sparking oxidizes the contacts and makes trouble. The condenser, consisting of 100 4 x 6 sheets of foil, also limits the spark to a degree. T. W. H.

The spark at the breaking of the contact points is caused by the "extra current" or induced discharge of the magnet windings. Some form of condenser must be used to prevent it. It may also be well to introduce about 30 ohms of fine insulated German silver magnet wire in series with the condenser. The added resistance will lessen the amperage of the condenser discharge and greatly reduce the tendency to spark. If this does not fully cure the trouble, we would suggest that you make a condenser of tin foil, separated by thin, strong paper and then roll in tubular form. Wrap fine twine about the package to hold it in shape, and immerse in paraffine wax.

Electrical traction on Swiss railroads is a new thing; but it seems only natural that Switzerland, so rich in "white coal," begins to utilize its wealth of water, and supersedes, by the power derived from it, the enormous quantity of coal imported from Germany, France, Belgium and England. This new trial of electrical power on such an important new line will be watched with keen interest. If successful, the new mode of traction will certainly be employed all over the country.

AMATEUR WORK

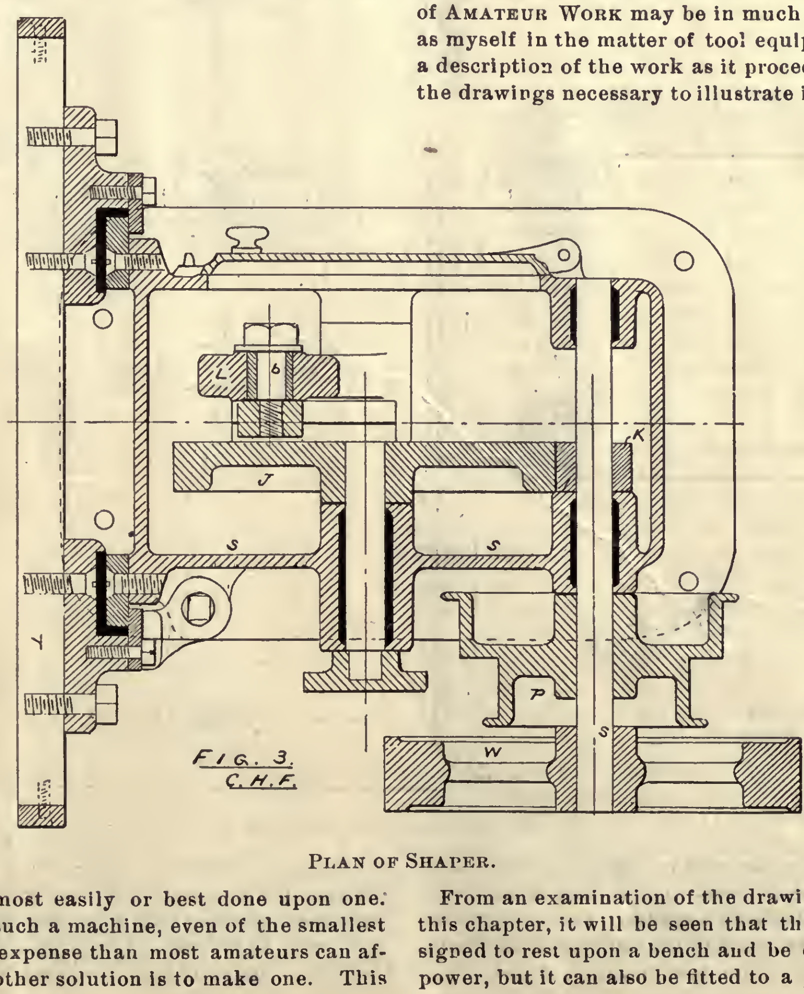
A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V. No. 6. BOSTON, APRIL, 1906. One Dollar a Year.

A BENCH SHAPER.

CHARLES H. FARNHAM.

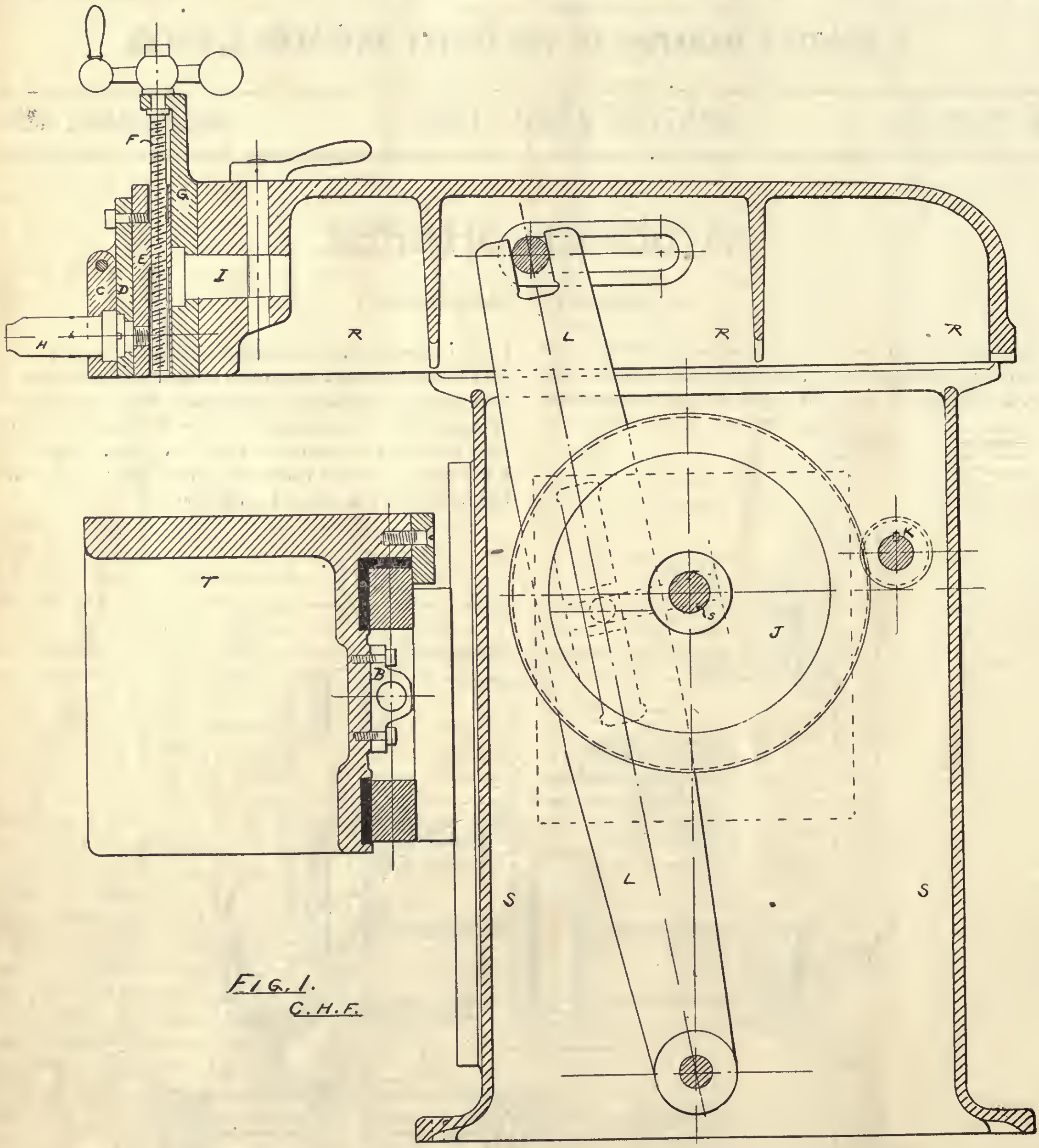
The amateur mechanic who wishes to do much of anything in metal working, generally has more or less work which calls for the use of a shaper, or at least which could be most easily or best done upon one. The purchase of such a machine, even of the smallest size, means more expense than most amateurs can afford, so the only other solution is to make one. This I have attempted to do, and am making very satisfactory although slow progress, as the time available for this work is not large. Believing that other readers of AMATEUR WORK may be in much the same position as myself in the matter of tool equipment, I will give a description of the work as it proceeds, together with the drawings necessary to illustrate it.



PLAN OF SHAPER.

From an examination of the drawings accompanying this chapter, it will be seen that this machine is designed to rest upon a bench and be driven by hand or power, but it can also be fitted to a pedestal for foot-power drive. An object kept constantly in mind when designing was the dispensing wherever possible with machine work which could not be done upon a 10 inch screw cutting lathe. All the bearings for traverse motions, therefore, are babbitted, and the gibs or similar bearing surfaces are made from flat dram steel, with the exception of that on the ram, which will have to be done outside on a planer. This will not be an expensive matter, nor will the cutting of the teeth in the large gear *J*. The pinion for this gear is a stock size, and can be obtained at small cost at any large gear cutting place.

The travel of the ram is about 7 in.; the traverse feed about 8 in., and the drop of the table will allow of about 8 in. under the tool. This capacity, while not large, is ample for most needs of the amateur. The traverse feed of the table is not shown in the illustrations given at this time, but may be automatic or by hand as desired. The screw for this feed works through a box bolted to the back of the table, the



SIDE SECTIONAL VIEW OF SHAPER.

ends bearings on the stand being located after the box is in position by placing the table at one end and then at the other. As the vertical feed is generally small, this will be in hand feed only.

The ways for the vertical feed are made from flat bar steel, fastened to the stand with screws, the heads being countersunk. The outer edges of the ways project so as to give bearings for the gibs of the table which are made in the same way. The space between the faces of the ways on the stand and the table are babbitted, as shown by the heavy black places in the drawings which represent babbit metal.

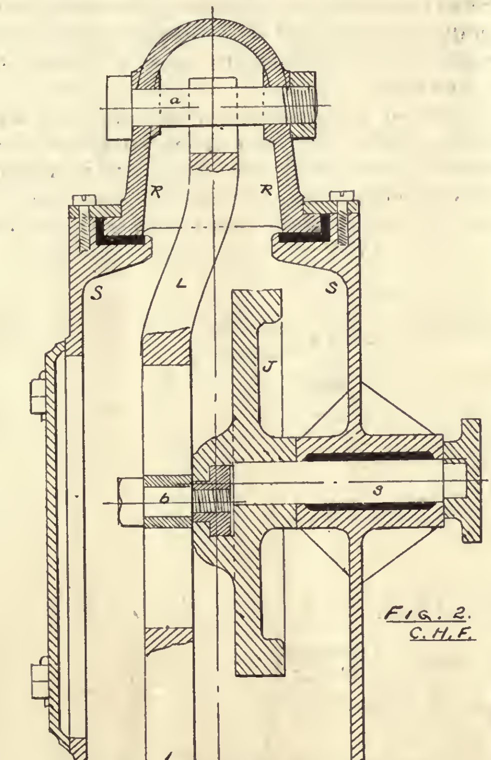


FIG. 2.
C. H. F.

FRONT SECTIONAL VIEW OF SHAPER.

The table has holes cored in it so that slots can be cut by the machine itself, when assembled, and of course the facing off of the table will be done in the same way. Most of the finishing of the tool holder will be done upon the lathe, although I may make a temporary holder, and with that make one nicely finished on the shaper.

The stroke of the ram can be adjusted by the stud *b*, Fig. 2, access to which is had through the door in the side of the stand. The lever *L* gives a quick, positive motion to the ram, and the wearing parts, if kept well oiled, will last a long time.

The bearings for the driving shaft and also for the stud *s* are also babbitted, but the bearings for the shaft *c* at the foot of the lever *L* are drilled. The lever *L* is made from a piece of flat bar steel, and will be described in detail with the other parts as the work proceeds. Additional drawings with dimensions will be given when needed, so that anyone desiring to make the machine can follow the work with no difficulty. When the patterns are completed and castings obtained therefrom so that the cost can be determined, I will be pleased to get sets of castings for anyone desiring to make up a machine, but at present writing cannot give an estimate close enough to warrant quoting prices. The subsequent parts of the description may also be more or less irregular, owing to the reasons before stated.

MICA MINING IN INDIA.

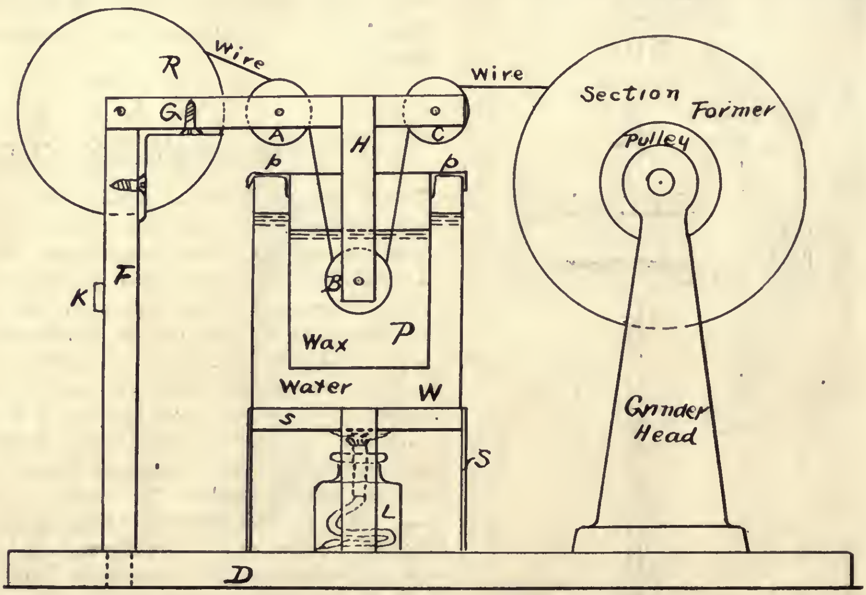
Mica mining in India is done by coolies, both men and women, whose wages average three annas, 4 cents, a day for the men, and 6 pice, 2 cents, for the women. The former act as miners, and the latter take the place of trammers and pumps in a civilized mine, standing or sitting in double line on ladders and in the passages, and passing earthern pitchers full of water and baskets containing excavated matter from one to another. In this way it may require as many as seventy women to remove the water from a mine not 35 ft. in perpendicular depth, though of course the actual line is considerably longer. The shafts are usually built on an incline, and sometimes have a diameter of 15 ft. to 20 ft ; but most are just big enough to allow several pairs or miners to get in and wield their hammers in a cramped position. The tools used consist of a drill, a chisel and a hammer, the drill and chisel being used alternatively, and the miners working in pairs, one to hold and one to drive. As explosives are not used, it does not pay to carry the operation into the hard rock except where it is very rich, and in this case the ancient fire breaking method is employed. Some of the larger mines run to a depth of 100 ft., and a few even to 150 ft. In these cases small vertical ventilating shafts, about 2 ft. in diameter, are put down to ventiate the inclines, and serve as means for raising the excavated material, for which purpose they are provided with small wooden lifts, called lathes.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

I. Apparatus Needed—Waxing Can.

The amateur electrician, and especially the one interested in wireless telegraphy, soon reaches a point in his work when the desire becomes pressing for a spark coil of more than toy proportions and capacity. To experiment with X-ray tubes or send wireless messages several miles requires a coil giving substantial spark of several inches in length. A description of how such coils can be made will be given in this series of articles, and the reader is assured that anyone using proper care and following these directions need have no apprehension that the result will be other than satisfactory, and the expert can produce results.



It is assumed that those working from these directions are fully informed as to the principles of coil construction, and have also determined the capacity and dimensions of the coils to be made, and desire only the information necessary to enable them to do the work so that the results will be equal to those desired.

As perfect insulation is one of the most important if not *the* most important, feature necessary to the proper and continuous working of a coil, the way this is secured will first be considered. Paraffine wax is one of the best substances yet discovered for insulating purposes, is easily applied and remains effective except in the hottest climates. A mixture of 4 parts paraffine, 1 part beeswax and 1 part resin is excellent; the proportion of beeswax being increased if the coil is to be used outdoors in cold or moist weather. Shellac varnish has the disadvantage of being extremely difficult to remove if for any reason the winding has to be undone and rewound. But whatever substance is used, it is quite necessary that all spaces be filled to saturation, and this includes the cotton or silk covering of the wire.

The method and utensils for applying the wax to the wire used in the secondary winding will now be described. While silk covered wire is preferable to cotton covered, as the covering is thinner and therefore allows more turns of wire to be wound within the inductive influence of the primary, the additional cost inclines many to use the cotton covered. Both kinds of the fine gauge used, (No. 34 for wireless and No. 36 for X-ray) come coiled upon spools, which have holes through the center permitting them to be mounted upon rods when winding.

Our apparatus requires, therefore, a holder for the spool of wire, a receptacle *P* for the paraffine wax, which is kept warm by a water bath *W*, a lamp *L* and stand *S* for heating the water, a rigging *F*, *G*, *H*, running the wire from the spool into the wax and out again and thence to the section winder. The latter device will be described in the next chapter, and is simply mentioned at this time so that in getting out the board upon which the parts are to be mounted, the proper size may be provided. A thick, flat board *D* about 24 x 15 in. should be obtained for this purpose. If the winder is to be run by the treadle wheel of a sewing machine, and such an arrangement is a very good one, some way of clamping the board to the machine table must be provided, or what is better, a table made of the same height as the machine with some device for fastening securely together.

By having a table, the work of getting the parts together for an evening's winding, and removing them afterwards, is greatly simplified, as the only adjustments necessary before beginning operations is to secure the table to the machine and connect the belt.

By referring to the sketch the arrangement will be quickly learned. The heating utensils for the wax require a tin can for the wax, *L*, which is supported by projections *P* at the top in a larger can *W* holding the water. This can should have a wire handle for convenience in handling. It is also supported above the lamp by a stand *S*, which can be made from a cover by cutting out a large round hole and then soldering on four legs made from strips cut from another can. As a suggestion as to sizes, the can for the wax may be the size used for canned peas or corn and the can for the water the size used for tomatoes, or a 2-lb. coffee can.

On the can for the wax solder three lugs *p*, made from tin strips, the outer ends being turned over about ¼ in. and forming a loose fit over the edge of the water can. These are to prevent the wax can from shifting about.

The lamp *L* is a simple alcohol lamp made from a short bottle with a wide mouth, like a vaseline bottle a short piece of quill from a hen feather for the wick tube and a cork. Bore a hole in the cork, forming a tight fit for the quill. The wick can be made by twisting up several strands of soft cotton twine. Use grain alcohol. By first heating up the water and wax on a stove, the small lamp will supply sufficient heat to keep the wax fluid.

The frame for holding the spool containing the wire is made from two upright pieces *G* at the top and two pieces *H* descending therefrom which at the lower end holds the wheel *B* over which the wire runs in its passage through the wax. The principal requirement is that it shall be firm and the shafts fairly even so the spools *A*, *B*, *C*, will run evenly. A cross piece *K* connecting the two uprights is also a help. The three wheels for grinding the wire through the wax were made from small spools, those termed "twist" spools, in which V-shaped grooves were cut with a sharp knife and smoothed up with a file. The shafts upon which they were mounted were made by cutting off wire building nails of about ⅛ in. diameter. By consulting the drawing no difficulty should be experienced in constructing the parts mentioned and getting them into working order. Be sure and allow sufficient room between the top of the cans and under side of the frame so that the cans may be lifted from the stand, which is necessary in order to clear the lower guide wheel and frame. The winder will be described in the next chapter. In anticipation of it readers who are without a turning lathe should obtain a polishing head; one costing from 75 cents to $1.00 will answer.

A VILLAGE TELEPHONE EXCHANGE.

LAWRENCE V. STEVENS.

IV. Running Lines—Passing Partitions.

The construction of telephone lines, particularly in Jefferson, must not be considered as the mere fastening of wires to almost any kind of pole or tree simply because it was previously stated that for the sake of economy trees would be used where possible in place of regualation poles.

Wires must be placed where they will not interfere with highway traffic, or be likely to fall to the ground should upper limbs break off and strike them. The cost of such poles as will be required for street corners, etc., will be about as follows: Thirty-five foot poles $3 each; 30 ft. poles, $2.50; 25 ft. poles, $2; these prices are for Western grown chestnut stock. Great care must be taken that line wires do not chafe against tree trunks, which would ground the wires on stormy days and interfere with ringing "central," as the system selected, it will be recalled, uses a ground button for this purpose. Wires passing over roofs should be drawn tightly so that the sag will not bring them in contact with the ridge-pole. Where there is any likelihood of striking, a glass insulator must be provided, and the wires securely fastened thereto.

When the line wire is brought to the point of entrance of a building, two heavy glass insulators must be placed and the wires fastened with extra strong tie wire, and soldered to the bare ends of heavy rubber covered or okonite No. 18 wire which serve as entering leads to the house. The entering wires must be at at least 6 in. apart. After the entering wires are brought through the outer wall into the room or cellar as the case may be, they are connected to a pair of protectors which, in general design, are similar to the lightning arrestor mentioned in a previous chapter, inasmuch as they are fused against strong foreign currents, and also provided with carbon grounding blocks for the same purpose. These protectors are sometimes made of wood, but the more modern types are of porcelain and cost at wholesale 16 cents per set. The ground wire for these protectors must be of heavy rubber covered or okonite wire gauge No. 16, and the ground connection must either be made upon a water pipe or by means of a coil of wire or plate buried in moist earth, in which latter case the ground wire would pass out of the building by a third hole at least one foot from the other two. The absolute importance of proper installation of this protector should be impressed upon the workman. Lightning which strikes upon the wires at distant points is often the direct cause of fires in factories and dwellings a mile distant, where protectors were not provided or were neglected by the owner, carbons being poorly installed or the ground wire improperly grounded or broken unintentionally after being correctly installed.

The location of the instrument upon the wall having been decided upon, instrument wires must now be placed between that point and the protectors. Upon dry walls wire which is styled "paired brown okonite" may be used, and this in preference to the ordinary waxed annunciator, as it has better insulating qualities, lasts longer, and is less liable to corrosion. This wire is tacked to the woodwork with ordinary short staples or double pointed tacks, great care being taken not to place a tack over two wires or allow a tack to cut into the adjoining wire while driving it. The instrument wire should be neatly taped where it passes through walls and floors, and where iron work is passed the wires should be protected by much heavier taping or by circular loom, which is a specially prepared tubing used generally for the purpose. There is no objection to using tape, if generously and properly applied. Only enough tacks should be used to secure the wires to the walls. Too many tacks increase the probability of crosses and grounds.

In placing the instrument upon the walls the transmitter arm should be perfectly horizontal, and the transmitter at proper height for the users' lips, as continually tipping the transmitter up or down greatly affects the transmission. The ground wire from the instrument may be connected to the same ground as was used for the protector ground, but must not be connected to the protector wire before it reaches the ground connection.

In wiring cellars and damp places, a better grade of insulated wire must be used, also porcelain knobs used to keep the wires clear of moisture. It is customary in many installations to have the entering wires brought into the cellar and the protectors placed on one of the beams near the point of entrance. The instrument wires then start at the protectors and pass along the beams to the room where the instrument is, if on the first floor, and brought up through a small hole bored for the purpose. In many respects this is the best way to install, as the protectors are easy of access yet out of sight.

In the next chapter will be given a list of telephone troubles which occur in general telephone practice and which are easily cleared by the subscriber. Principally among these are the difficulties attending rundown batteries after long use and the methods of testing for same; the testing of grounds which may swing in after storms, and the maintenance of the central switchboard and the station instruments.

COAL FOR JEWELRY.

Coal as an ornament in jewelry is being used in Japan. According to the "Horological Journal," only the hardest and most perfect of the bits are used, and the workers in coal from whom the jewellers obtain their supply make a practice of saving for them certain pieces, often not more than two or three of the required quality being found each day. Of course, this black diamond jewelry is very inexpensive, but at the same time it is pretty and a novelty as well. A very general use made of these pieces of coal is for ornamental settings in the heads of sticks and umbrellas; they are used in combination with silver or brass rims, and sometimes shells and tiny pieces of brass are worked into the general design with an effect that is distinctly Japanese. Ornamental corkscrews with pieces of coal set into the handle are novelties that serve as souvenirs of Japan, and necklaces, rings, trinkets and chains are also manufactured with settings of black diamonds. A curious trinket purchased by a recent traveller in Japan was a link chain cut out of solid black coal, each link being perfectly formed. Although the tools used are of the rudest construction, the process of attaching these bits of coal is not a difficult one as done by the Japanese. After grinding out the base to the necessary size it is covered with a coating of an elastic cement, also a Japanese product, and the piece of coal is inserted. When the composition hardens, the coal is very firmly held in place.

For grinding high-speed steel, nothing is quite so good as a well-selected wet sandstone, the tools being ground upon it by hand pressure. Mr. Gledhill states that where emery wheels are used it is advisable to grind the tool to shape before hardening; this grinding may be done mechanically. By so doing the tools require but little hand grinding after hardening, and only slight frictional heating occurs, so that the temper is not drawn in any way, or the cutting efficiency of the tool impaired. When the tools are ground on a wet emery wheel and undue pressure applied, the heat generated by the great friction between the tool and the emery wheel causes the steel to become hot, and the water playing on the steel while in this heated condition, tends to produce cracking.

"A fellow that is always kicking hasn't time to do anything else."

A 9-FOOT ROWING OR 12-FOOT POWER TENDER.

CARL H. CLARK

II. Setting up Frame—Planking.

As a boat of the present type is of rather light construction, it is necessary to make some kind of framework to hold the several parts in place while they are being fitted and fastened together. The boat, after completion, is, however, very strong and rigid.

As will be seen, the backbone of the frame consists of a wide board A, Figs. 2 & 3, to which the moulds, stem and stern board are fastened. The present explanation refers to the 9-foot boat. Returning to the original sheer plan as laid down on the paper, a line is drawn parallel to the line of the underbody and at a distance of 5/8 in. inside of it, this 5/8 in. being the total thickness of the keel, the line of the underbody being shown by *a* Fig. 2, and the inside line just drawn by *b*. This line *b* gives the shape to which the lower edge of the board A is to be shaped to fit inside of the keel. This board should be about 10 in. wide, 7/8 in. thick, planed on both sides and without wind. It should be carefully fitted to the line *b*. A series of notches, as in Fig. 2, are cut in the lower edge; these are 2 in. long and ½ in. deep and are located one at each mould and two between, making them spaced 6 in. apart. They are for the purpose of passing the frames through before the forms are taken out. At the after end the board *A* is cut off at the proper length and angle to fit inside of the stern board, and the corner brace *C* is nailed on to give better fastening. The stern board being ¾ in. thick, the after edge of the brace *C* should be ¾ in. inside of and parallel to the line of the after end of stern. At the forward end it is cut back about 1½ in. inside the line of the stem so as to fit inside of the stem and admit of the latter being fastened to it.

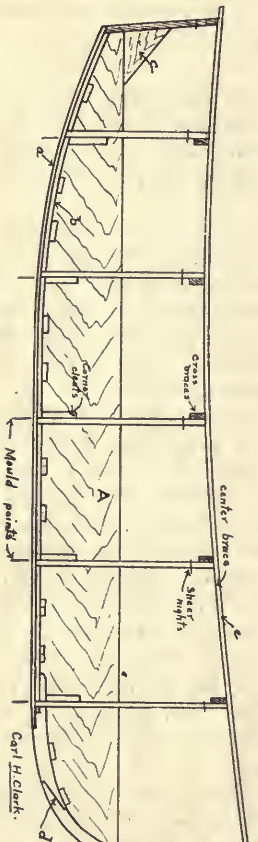
The stem is of oak and may be either cut from a natural crook or bent to shape. It extends a few inches aft of No. 1 mould and is 2 in. thick and 1½ in. wide; this means that a 2-in. thick plank or knee will be required. If sawed out of a plank a natural crook knee should be obtained, as cutting from an ordinary plank will give a cross grain which has little strength. It will probably be impossible to obtain such a crook in one piece, so a joint or splice can be made as shown at *d* Fig. 2. The contour of the stem should be shaped accurately to the lines as laid down.

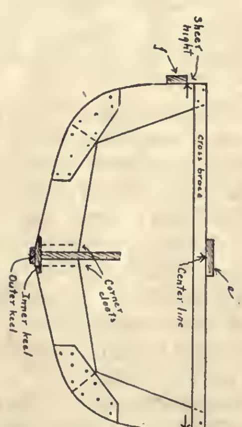
If desired the stem may be bent to shape from a straight piece; to do this a form of the inside curve of the stem must be made and fastened solidly down to the floor. The stock in this case should be unseasoned, and then bent around the form and held in place by blocks of wood nailed to the floor and wedges driven in between them and the stem. It should be left in place for some time after it appears to be dry, as there must be no possibility of its straightening out. Even then it should have a brace nailed across the ends to hold them exactly in place. The stem should in either case be left a few inches long at the upper end.

When the stem is done, it and the board *A* should be laid in place on floor, exactly to the proper lines, and a line drawn on the board around the inside face of the stem; the board is then cut out to the line to let in the stem, which should be fastened to the board in exactly the right position. This is for the purpose of holding it steady during building.

The inside keel is of oak, 3½ in. wide 3/8 in. thick, a piece about 7 ft. 6 in. long being required. It is bent around and fastened to the board *A*, being, of course, placed so that the center lines of the two agree. The best way to fasten this keel piece to the board will be by small cleats fastened in the corner between the two. It must not be fastened through, as then it could not be released after the outer keel piece is in place. It should, however, be fastened with brass screws to the lower end of the stem, which, as shown in Fig. 2, is cut out to receive it; the overlap should not be less than 6 in. The outer keel piece is of oak also, ¼in. thick and 1½ in. wide, and about 7 ft. 6in. long. It is bent around outside of the inner keel, care being taken to have it in the middle of the latter. It is fastened to it with 5/8in. brass flat-head screws. At the forward end it is in turn let into the stem, extending 2 in. or more forward of the inner keel to allow fastening it directly to the stem. Care must be taken that these keel pieces lie evenly and smoothly on the board *A*, as any deviation will cause the boat to be unfair.

The stern board is of either oak or mahogany gotten out to shape in the same manner as the moulds. The after side only must be cut to size as, owing to the tapering of the boat at the stern, the forward side will be larger and bevel towards the after side. About 3/8 in. should be allowed for this bevel, which need be only approximate at present. The upper edge of the stern board should be left about 3 in. higher than necessary and trimmed off after completion. The center line should be drawn on the stern board for use in setting up. As will be noted in Fig. 2, the sternboard sets on top of the outer keel piece, and extends down past the inner keel, which is cut short enough to butt against it. The sternboard must be carefully adjusted so that its center line and that of the stem are in line. This may be done by sighting past the stem at the center line on the sternboard, or a line may be stretched from the center of the sternboard to the center of the stem and this line sighted by the edge of the board A. When it is adjusted it may be fastened by a screw driven up through the outer keel, and by about three





screws driven temporarily into the end of the board A and the brace C.

The moulds having been made as before described, they should be fitted to the sides of the board *A* as shown in Fig. 3. The moulds are sawed at the center line, a piece just the thickness of the board *A* being taken out; they are then to be fitted to the sides of the board. As shown in Fig. 3, they are cut out around the inner keel piece; but must not be cut too low, as the keel piece will be leveled slightly as shown in Fig. 3. The moulds are then to be fastened to the sides of the board *A* with corner cleats as shown. In setting these moulds, Nos. 1, 2 and 3 are set with their after faces on the mould points, while Nos. 4 and 5 have their forward faces on the mould points; this is in order to allow them to be bevelled off to the proper angle and yet retain the proper shape. As before suggested, the moulds should be left about 3 in. above the sheer mark. The crossbar at the top should also have the middle point marked on it and also the sheer heights. The moulds should be adjusted so that they are square horizontally with the center board, and also vertical, and that the middle points marked on the cross braces are all in line between the center of the stem and the center of the stern; when this is accomplished a piece of board about 3½ in. wide is nailed along across all the braces as shown at *e*, Fig. 2. A piece of thin board should also be bent around and fastened to all the moulds and to stem and stern as *f*, Fig. 2.

With the fastenings thus described the form should be so stiff that it can be lifted about and turned over with no possibility of springing out of shape. It may thus be worked upon either side up as may be most convenient.

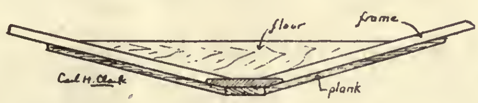
The next step will be to bevel off the edges of the moulds so that the plank will lie evenly upon them. A limber batten should be provided slightly longer than the boat; it is bent around the moulds and the corners of the latter are planed off until the edges all bear evenly against it. The sternboard is treated in the same manner. The stem is also bevelled off, leaving, however, a flat place on the forward face about ⅝ in. wide for the stem band. The underside of the inner keel piece is also bevelled to the angle of the moulds to allow the plank to lie evenly. Where the outer keel joins the stem, the former should be tapered off gradually to the taper of the stem. In all this work care must be taken to put no fastenings where they cannot be gotten at from the inside, as the forms remain in place until the boat is nearly complete and any blind fastenings will cause much trouble.

As before stated the size and description applies to the 9 ft. boat, the corresponding sizes for the 12 ft. boat are as follows:—

The board *A* should be about 12 in. wide and ⅞ in. thick; fitted to a line 1 in. inside of line *a*. The notches should be 2 in. x ⅝ in., one at each mould and three between, making the spacing 6 in. as before. The sternboard is 1 in. thick. The stem is 2¼ in. thick and 2 in. wide. The inside keel is ⅝ in. thick and 4 in. wide. The outer keel is ⅝ in. thick and 2 in. wide.

The planks are ¼ in. thick, of either pine, cedar, spruce or cypress. It should be in lengths of about 10 feet to enable each plank to consist of only one length. The stock in any case should be straight grained, free from knots and well seasoned. The planking in a boat of this type is far easier to fit than in the case of a boat which is to be calked, as the plank is not only lighter, but the seams do not require to be as close and well fitted. The top streak should be of oak about $\frac{5}{8}$ in. thick, as the canvas cover only extends to the lower edge of the top streak, leaving the natural wood above.

It will be a good idea to fit the top streak first, as this will hold the whole structure more rigid. To obtain the amount of curvature in the plank, the board from which it is cut will require to be considerably wider than the finished plank. The board is bent around the moulds as near as possible in place, and held by clamps or some other means; the sheer heights of all the moulds and stem and stern are then marked upon it, ribbands already then being removed. It is



then taken down and a curve drawn through the points with the batten. This is the line to which the upper edge of the plank must be cut to fit the sheer. The width of the plank amidships should be about 4 in. and taper to about 3 in. at the ends. The curve of the lower edge also being lined in by the battens, both edges of the plank are planed carefully, and the plank should then require very little fitting; the plank for one side may be used as a pattern for that of the other side. These two top strakes should then be fastened into place. At the ends they should be allowed to run across the stem and stern board. At the bow and stern the plank is to be fastened with brass screws, permanently, while only temporary fastenings of very slim screws should be used in fastening to the moulds, as they must be removed later. In fastening a plank, it should be fastened at one end and wrapped around into place, fastening to each mould successively. Care must be taken that there is no fullness or straight places between the moulds. Holes made for fastening to the moulds should be as few and as small as possible, as the fastenings are to be drawn and others put in their places.

The garboard strake or plank next to the keel is next fitted; this strake will have a considerable amount of spilling or curvature at the ends. This curve can best be obtained by fitting a spare piece of stock for a pattern so as to not risk spoiling a good board. At the after end it will taper to a point, landing at about No. 5 mould, and should be fastened permanently to the inner keel with brass screws or copper nails.

In fitting the plank they should be about 4 in. wide amidships, tapering towards the ends. It is not necessary in this type of construction to give the planks as much spilling as in the ordinary method, but they may be run around nearly straight, and a few wedge shaped planks fitted on the bilge to fill up the space thus left.

The planks should be left at least $2\frac{1}{2}$ in. wide at the ends to give sufficient fastening. About three or four strakes should be put on the bottom; the boat should then be turned up and the same number put on the top sides under the top streak. This should be continued until the space on stem and stern board is all used, leaving a wedge-shaped space on the bilge. The planks are fastened on to the stem and stern board with about $\frac{7}{8}$ in. copper nails, and to the moulds temporarily with either small nails or screws. The space on the bilge is filled up with parallel pieces tapered at the ends to fit between the planks already fitted. The seams need need not be as close as for a calked boat, but should be as close as convenient in order that the canvas may not press into the seams. While fitting the plank they should be allowed to run beyond the stem and sternboard, but should not be trimmed off square and even. It will probably not be possible to put in enough temporary fastenings to hold the edges entirely even, but this will not matter, as they can be drawn down when the frames are fastened in place.

The frames are of oak, preferably, and are $1\frac{1}{2}$ in. × $\frac{5}{8}$ in. bent in flatwise and should be long enough to extend from gunwale to gunwale in one piece. The stock should not be too dry, as it does not steam well and becomes brittle. The frames should be sawed to size and planed; two of the corners should be rounded for finish. A steam box should be fitted up as described in previous articles. The frames should be steamed until thoroughly saturated and pliable; the end is pushed through the notch in the board *A* and the frame pulled through and bent into place; being thin the frames should bend very easily. For fastening the frame to the plank $\frac{3}{4}$ in. copper nails are used, driven from the outside and clinched on the inside of the frame. The fastening should be done immediately after the frame has been bent into place and while they are still hot. The frame is first fastened to the keel and pressed down into the angle at keel, and then the planks are fastened successively, enough nails being used to hold both frame and plank flat and square. Every third frame should not extend across the keel, but should be fitted against it, to allow the fitting of a floor timber on top. Amidships the frames should be run as nearly parallel as possible, but at the ends it may be found necessary to cant them somewhat on account of the bevel of the sides. There is, of course, a frame yet to be fitted later in the place of each mould. A floor timber is now to be fitted on the frames just mentioned; it is of half-inch stock shaped as shown in Fig. 4, about $2\frac{1}{2}$ in. deep above the keel and lying on the top of the frames to which they are fastened by nails and screws. The floors serve to retain the angle of the bottom and also to rest the bottom boards upon.

The moulds should now be removed one at a time and frames bent in their places, and lastly the board

A is removed. The boat should not change shape when these parts are taken out and should be stiff and rigid.

A gunwale should be worked around on the inside of the frames just even with the top of the top streak; it is ⅝ in. thick and 1½ in. wide, running from stem to stern. It is fastened by copper rivets through the tops of the frames and top streak. At the ends a piece of frame is put in between the gunwale and the top streak to keep it parallel. The frames are then trimmed off flush with the gunwale.

For the 12-foot boat the corresponding sizes of planks are:—The top streak should be scant ⅝ in. thick and about 5 in. wide amidships; the remainder of the plank should be scant ⅜ in. thick. The frames are 1¾ in. x ½ in. The fastenings of frames to plank should be 1 in. copper nails of small diameter. The floor timbers should be fitted on every other frame and should be ¾ in. thick and 3 in. deep above the keel. The gunwales are ¾ in. thick and 1½ in. wide.

It must be borne in mind that the 12-foot boat is not only larger but has the additional racking and strain caused by the engine, and it must be built correspondingly stronger and heavier.

When the work is thus far completed the outside surface should be perfectly smooth and even. All nail heads should be set in flush and all seams and edges finished down smooth with sandpaper. The boat is then ready for the cover.

HACK-SAW ATTACHMENT FOR LATHE.

G. T.

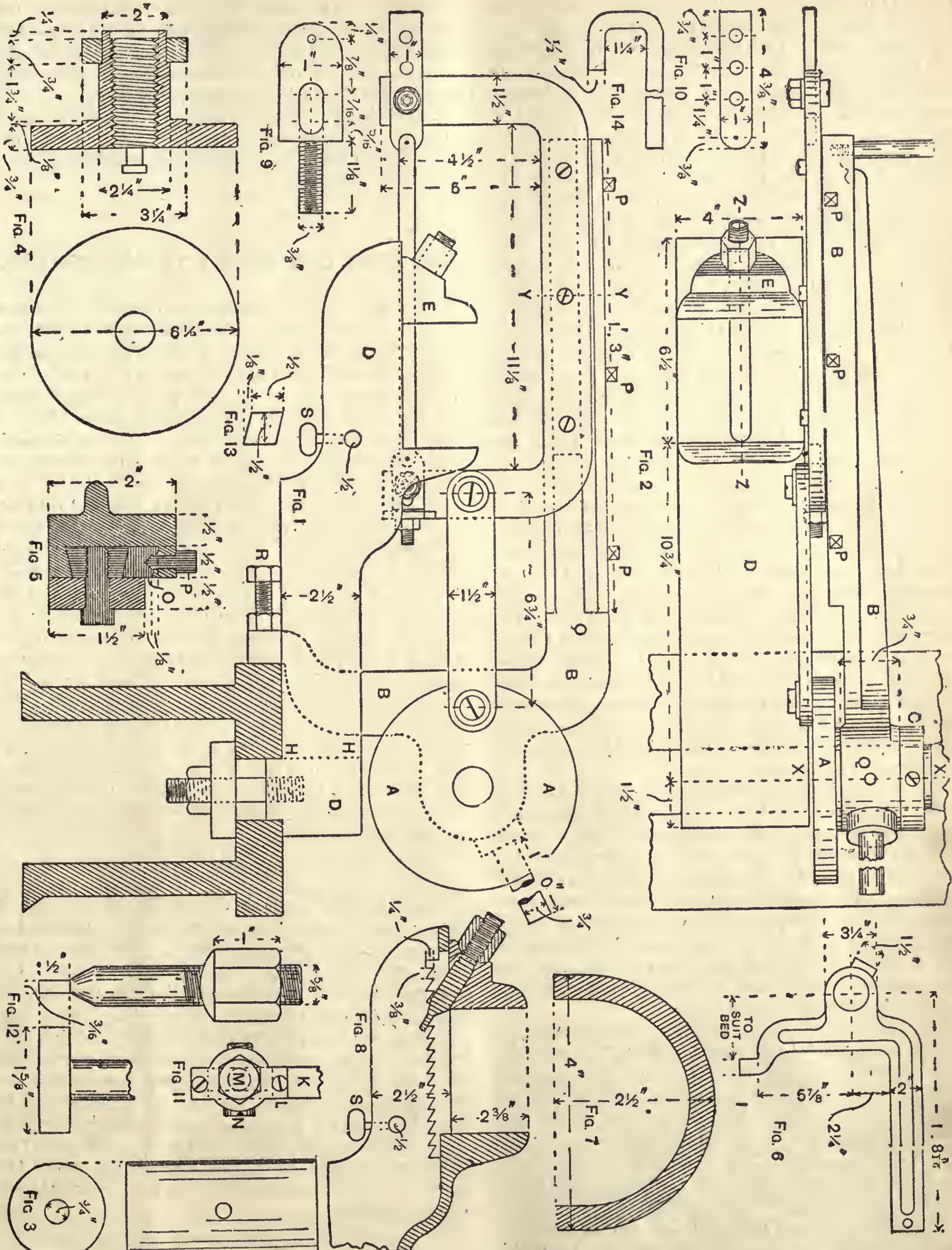
The hack-saw attachment shown in elevation and plan as Figs. 1 and 2 can be removed and replaced as quickly and easily as a face plate and T-rest, and is of a size to suit a 6 in. center lathe; but the dimensions may be altered to suit any other size of lathe if necessary.

The first thing to do is to get out the patterns and send them to the foundry. In all, six iron castings will be required, these being for the driving plate *A*, the saw frame guide *B*, the collar *C*, the vice *D*, the movable jaw *E* and the counterweight (Fig. 3), which is 6 in. long and 3 in. in diameter. Patterns for the driving plate and collar should be made to the dimensions given in Fig. 4, where the separate collar is shown on the left; this illustration being a section on the line *X X* (Fig. 2), with the saw-frame guide omitted. The guide pattern should be made to the dimensions given in Figs. 1, 5 and 6. Attention must be paid to the circular-bearing part of the casting, which is continued along the lines in the form of a rib. Fig. 5 is a section on the line *Y Y* (Fig. 1). The boss at the back of this casting carries a ¾-in. iron rod, on which the counterweight is clamped.

The vice is a hollow casting as far as the dotted line *H H* (Fig. 1), the remainder being solid, to enable a ¾-in. bolt to be tapped in for the purpose of clamping the vice to the lathe bed. This end of the casting is half-round, as shown in section at Fig. 7, and continues so until it nears the vice jaws, when it merges into a flat top with vertical sides. The fixed jaw is solid, and is added to the pattern after the body is built up. On the flat top of this casting is a ⅝ in. slot, which extends from the fixed jaw to within ¾ in. of the extremity, this slot being either cast in or cut out afterwards, whichever method is more convenient. Beneath the flat top and on the edges of the ⅝ in. slot are two racks of teeth ¼ in. deep, ⅝ in. apart, and ½ in. wide, into which fits the tail of the bolt that tightens the loose jaw on to the work. Fig. 8, which is a section on the line *Z Z* (Fig. 2), shows the method of tightening the work. The hole in the loose jaw of the vice, through which the ⅝-in. bolt passes, should be elongated into a taper slot at the bottom. The counterweight casting is merely a cylinder with a ¾ in. clearing hole through the center of its length.

The saw frame itself is a forging from 1½ in. x ½ in. iron, 11⅛ in. between the legs, and 5 in. from the extremities to the top (inside measurement). The two pieces to which the saw blade is attached (shown separately at Figs. 9 and 10) are made and fitted to the frame in such a position as to bring the cutting edge of the saw 4½ in. below the lower surface of the frame. The forward piece (Fig. 10) is made of 1 in. x ⅜ in. iron, and is drilled in three places to accommodate 8-in., 9 in., and 10 in. saws, with a pin at the end on which the blade fits; this is recessed flush in the frame and secured with a ⅜ in. screw and nut. The tail piece (Fig. 9) is made of the same iron, and also has a pin at one end for the saw blade, the other end being fashioned into a ⅜ in. screw for pulling the blade up taut by means of a nut bearing on a ¼ in. plate let into the frame for that purpose. Details of this fitting are given at Fig. 11, where *K* is the saw frame, *L* the steel plate, and *M* the tension screw; *N* is a ⅜-in. screw which locks the fitting together after the proper degree of tightness has been attained, the slot to accommodate this screw being shown in Fig. 9.

Attached centrally to the top of the frame at the back by means of three ⅜-in. screws is a 10 in. piece of 1 in. by ½ in. iron or steel, preferably steel, undercut to slide to and fro in the saw-frame guide (see Fig. 5). A ½ in. hole is also drilled and tapped centrally on the back leg of the frame, 2¼ in. below the under side of the top, and with a suitably screwed stud carries one end of the connecting link, the other end being attached to the driving plate. This link is made from



HACK-SAW ATTACHMENT FOR LATHE.

⅝-in. x 1½-in. iron, and is drilled with two ⅝-in. clearing holes, centers of which are 6⅝ in. apart.

A ⅝-in. bolt should next be forged out to the shape and dimensions given at Fig. 12, and a nut made to suit it; this nut should be at least 1 in. in length, otherwise it will soon strip, and must be rounded at the bottom. A ⅝-in. iron rod is then cut 1 ft. 1 in. long, and screwed for 1 in., and is afterward tapped into the boss on the saw-frame guide, to carry the counterweight, which is secured with a set screw. The guide casting should next be taken in hand, and the circular part bored to a diameter of 2¼ in. This should be done on the face plate, but as it requires a large lathe, it will probably have to be bored with a cutter bar against the poppet head. After boring, clean down the sides until the coating is 1⅝ in. thick. Great care must be taken to ensure that the bore is parallel and square with the casting. The casting should be planed in the sliding part to take the piece of steel on the back of the saw frame, and the slip piece *O* (Figs. 1 and 5), the dimensions of which are given in Fig. 13. The slip, which is 1 ft. 3 in. long, is held in position by three small screws *P* (Figs. 1, 2, and 5), and is used to adjust the saw for wear and tear. When planing out this slide, see that the 2¼-in. diameter hole is absolutely vertical; this will correct any slight error in the angle of the bore. A hole for lubricating purposes is made at *Q* (Fig. 2), and the boss drilled and tapped ⅝ in. to take the iron rod. The lower end of this casting is drilled and tapped ½ in. to take the set screw and nut *R* (Fig. 1), which can be adjusted to bear against the bed of the lathe and thus arrest the downward progress of the saw at any desired place. A 2½-in. peg is tapped into this casting at the foremost part, to take additional weights when the saw becomes blunt.

The driving plate is screwed out to fit the mandrel, and, if possible, turned on the lathe it will eventually be used upon to the dimensions given at Fig. 4. Care must be taken to make this casting fit nicely in the bored part of the saw-frame guide; when the collar is tightened up against the shoulder, there should be no shake in either direction. While the plate is on the lathe, turn in a line 2¼ in. from the center, and on this line drill and tap a ½-in. hole to carry, with a suitably screwed stud, the connecting link, the other end of which is screwed to the saw frame.

The vice is now planed up to fit in the lathe bed, and a ⅝-in. bolt tapped in to clamp it firmly in position, after which it can be cleaned up at the other end and the ⅝-in. shot filed out, if necessary, to allow the bolt (Fig. 12) to pass easily. This ½-in. hole in the vice (see Figs. 1 and 8) is drilled 1½ in. below the flat top, and slightly forward of the fixed jaw, to allow the ½-in. iron gauge (Fig. 14) to slide through, this being fixed in position by the small thumbscrew *S* (Figs. 1 and 8). The loose jaw is then machined up, and the bearing for the ⅝-in. nut cleaned out with a circular cutter to correspond with the rounded end of the nut (see Fig. 8); thus when the nut is tightened up the bolt takes a position more approaching the perpendicular than it could do if the hole fitted the bolt all the way, while if the nut had a flat bottom it could only set down on the casting in the one position.

This completes the instruction, and everything is now ready for working. To give the best results, the lathe should make sixty revolutions per minute. —"Work," London.

DRY POWDER FIRE EXTINGUISHERS.

Dry powder fire extinguishers were much advertised at one time, but in a presidential address recently delivered before the American society of Mechanical Engineers, Mr. John R. Freeman said that the chief reason why these long tin tubes of powder have become popular is that they can be manufactured for about 10 cents each, and that they retail as high as $3 each. They are nearly all composed of common bicarbonate of soda, frequently disguised by the admixture of a cheap coloring matter, like venetian red, and prevented from caking by the addition of starch. Samples of everything of this kind that Mr. Freeman could find were purchased in the ordinary channels of trade by different parties, and the respective groups of samples were analyzed by three different chemists in order to fortify Mr. Freeman against the possibility of wronging anyone through a mistake in the analyses, and had samples sealed up and retained for further analyses should anyone question his figures. Mr. Freeman had tests made of several of them and found them of doubtful value on even the smallest fires, and worthless for a fire in free ventilation. Generally considered, he would recommend throwing them into the rubbish heap. Pails of water are, in his opinion, far more reliable.

Consul Keene of Geneva, reports that the opening of the Simplon tunnel, which was fixed for April 1, has been postponed to May by action of the Swiss authorities. The consul says: The official opening of the new international line through the Simplon Tunnel, after having been advertised for April 1, 1906, is now reported as being postponed until May 1. After having been for a considerable time under discussion, the mode of traction between Brigue and Domo d'Ossola, about 22 miles, is reported to be electrical, in accordance with a decision recently made by the Federal department of Swiss railroads. The first two electrical engines, when delivered at the end of the year, will first be tried on the Italian electrical lines of the Valteline.

"It is the hit dog that yelps."

A SMALL LIGHTING PLANT.

HOW ONE YOUNG MAN MADE A START IN BUSINESS.

The question has been asked—what is the minimum size of town that will support a lighting plant? That there are thousands of small villages or hamlets all over the country where an enterprising man could make a living by operating a small lighting plant is shown by the history of the Burton, O., central station, says the "Electrical World." Burton is a pretty little village of 700 population located in the hilly district of the Western Reserve, about 30 miles from Cleveland. This is a dairy farming country, the town is an old one, there is little or no manufacturing, and the people are fairly prosperous.

The history of the plant dates back nearly ten years when Mr. Earl C. Bliss left the village to enter the electrical engineering course at the Case School in Cleveland. After two years he was obliged to leave school and go to work. He spent about a year in the machine shop of a prominent engineering concern, and during that time he saved about $125. With this capital he went back to his home and made a proposition to the village fathers to light the town. With considerable scepticism they gave him the franchise and a contract for one arc lamp in the center of the public square. His first investment was for an old traction combined engine and boiler, a small second-hand generator, some wire and a few lamps. His plant he set up in the basement of an old building in the heart of the town. Gradually he secured new business and improved his plant. At present his outfit consists of a 50-h. p. boiler, a 50-h. p. engine, one 20-kw, one 15-kw and one 7½-kw generator, all belted and generating direct current at 125 volts.

Mr. Bliss did all his own work of setting up the machinery, wiring the building, built his own switchboard, equipping it with instruments, built a boiler feed-pump, heater, etc. He operates the entire business without assistance, fires the boiler, strings the wires, wires buildings, trims and repairs lamps, keeps the books and collects the bills. Once a year for ten days he hires a substitute to run the plant while he takes a vacation, but the balance of the year he is on duty about 14 hours a day. He now owns the building where the plant is located, has paid for all of his outfit and has a home nearly paid for, all out of his earnings of the plant. Of course, with some assistance he might have time to engage in other business, but he prefers to devote his entire time to keeping his system in first class condition and improving his business.

At present the load consists of two arc lamps at $60 per year, 54 incandescent lamps at $6 per year and four commercial arcs at $60. All the stores, the town hall, several churches and about 50 residences are illuminated by incandescents. Formerly all lights were on a flat rate, but the first of this year Mr. Bliss adopted a meter rate of 15 cents per kw-hour for residences and 10 cents for churches and places of business. This has cut out considerable waste and increased his income proportionately. The announcement of the change in policy was made on the back of a handsome calendar at the first of the year and circulated to all townspeople, attracting considerable attention. He uses an electrolyte meter, a simple and inexpensive device, which has proven very satisfactory. Meters are installed on payment of $10 which is returned when the meter is returned in good condition. If used less than one year, $1 is deducted from the refund.

A use for white mice is mentioned in a paper read before the Chemical, Metallurgical, and Mining Society of South Africa by Messrs. Macaulay and Irvine, who suggest that the law should provide that a supply of white mice should be kept at all collieries. It is well known that these animals are peculiarly susceptible to poisoning by CO (carbon monoxide), their susceptibility being so great that they can be employed as a reliable test for dangerous quantities of the gas. The respirating exchange in a mouse is twenty times as rapid as in a man, and consequently the mouse exhibits symptoms of blood saturation much more rapidly. Dr. Haldane proved that with 0.4 per cent CO in the air, a mouse gave symptoms of illness—a staggering gait—in 1½ minutes, and that it becomes unconscious in three minutes, whereas he himself did not feel discomfort for half an hour. This gives a sufficient interval to allow a miner to escape. Dr. Haldene says that air must be regarded as dangerous the moment the test mouse becomes incapable of motion. The law should therefore provide that whenever there is a suspicion of an accumulation of CO in collieries or metalliferous mines these animals should be used as a test.

The Quebec cantilever bridge, now being built over the St. Lawrence River, is to beat all the bridges in the world in having a single span of 1800 ft. The Williamsburg suspension bridge over the East River has a span of 1600 ft., only 5 ft. greater than that of the Brooklyn bridge; and aside from suspension bridges, of which these are the greatest, there is the Forth railway bridge, with two spans of 1710 ft. each. This new bridge at Quebec is the only one over the St. Lawrence River below Monreal, 130 nautical miles distant.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

Subscription rates for the United States, Canada, Mexico, Cuba, Porto Rico, $1.00 per year.

Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

APRIL, 1906.

The recent revival of electrical treatment in medical practice, and new discoveries and inventions resulting from the more scientific methods followed in investigating this class of phenomena, will undoubtedly be productive of most beneficial results to those suffering from diseases which yield to this kind of treatment. Experimental work with static and electro-magnetic machines, induction coils and the adjuncts connected therewith are to be commended to those interested in electrical work, not only for the pleasure and instruction directly attending such work, but also for the practical value of the information resulting therefrom. Anyone who will thoroughly study the construction and uses of such apparatus, and become competent to act as assistant to doctors giving medical treatment, make radiographs, etc., will find his services in constant demand in any of the larger cities of the country, and at most remunerative terms, and even if the studies are not carried to this length the knowledge gained will be of sufficient value in many vocations to make it well worth the effort.

The formation of the "American Society of Model Engineers" has already been productive of useful results in the way of designs for tools particularly useful to the amateur. The shaper shown in this issue by Mr. Charles H. Farnum, and a bench planer to be presented at an early date, are the result of interest in the society and several other equally useful tools are promised by others. It was the expectation, in organizing the society, that such information would be forthcoming, and we are extremely gratified that it should follow so soon. A slight delay in the preparation of the literature has been caused by sickness, but this will be sent to those who have requested it at an early date. It is possible that an exhibition of models could be arranged in connection with the "Food Fair" to be held in Boston in October next, provided a sufficient number of readers having them would advise us that the same would be sent. If such an exhibit is desired, write and tell us so, and advise what can be sent. In this connection, we would announce that a design for a working model of a steam locomotive has been offered, and a description of it will be published if a sufficient number of readers request it, but as such a model is not an easy one to make unless one has a fairly complete tool outfit, we await information as to the number likely to be interested before going further with it.

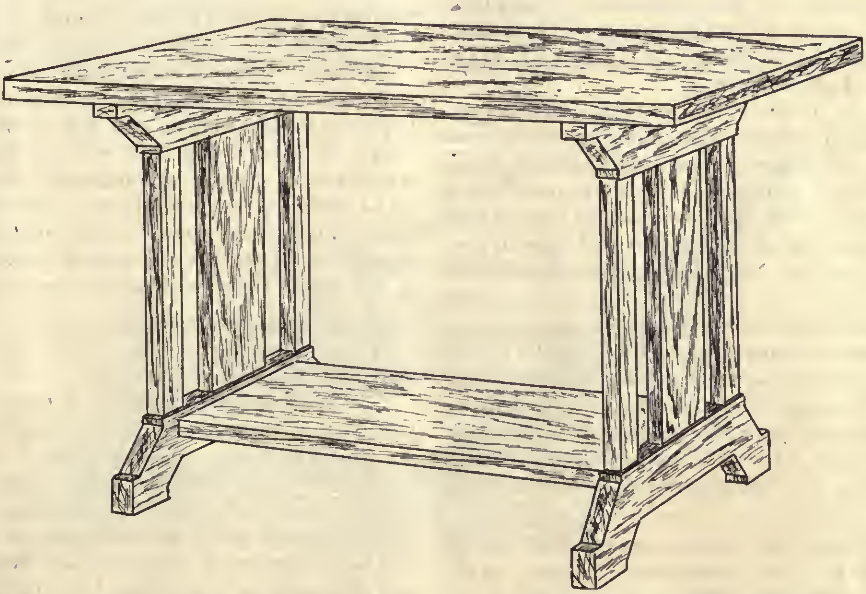
The value of glass may far exceed that of gold. A contemporary draws attention to its enormously increased value when made up into microscope objectives. The front lens of a micro-objective, costing $5 does not weigh more than about 0.0018 gramme, which weight of gold is worth about one cent, and so the value of a kilogramme of such lenses would be about $3,000,000. The cost of the raw material for making this weight of glass is from five cents, and thus, when worked up into the shape of a lens, the glass has been increased in value about fifty million times. Such disparity between the cost of the raw material and the manufactured article is probably a record in industrial technics.

"Don't tell a man all you know the first time you see him or he will be sorry to see you again."

A LIBRARY TABLE.

JOHN F. ADAMS.

The library table here described has a substantial, dignified appearance which makes it well suited for the service for which it was designed, and at the same time the simple construction permits of it being made by any one who can use woodworking tools with ordinary skill. The illustration shows a plain wood top, but a covering of Spanish leather fastened with large headed nails to match the leather, adds much to the appearance—and also the cost.



The top is 48 x 30 x 1½ in. and will have to be glued up from two or three pieces. The stock should be dressed down at the mill on a jointer from 2-in. stock, to take out all wind, and should be thoroughly seasoned. The grain should be carefully matched at the joints, and the latter should be even throughout their length.

The ends are made as follows: The top pieces are 28 in. long, 3¾ in. wide and 1¾ in. thick. The ends are cut out to the shape shown in the illustration, which is first marked out to the following dimensions: One inch from the upper edge mark horizontal lines 1 in. long; on the lower edge 3½ in. from the ends mark vertical lines ½ in. long; connect the ends of these lines with a line at 45°, and saw out to shape. As the shoulders make sawing by hand rather difficult, holes can be bored along the angle and the cutting done with a chisel.

For the bottom of each end will be needed one piece 28 in. long, 3¾ in. wide and 1¾ in. thick, and one piece 11½ in. long. The latter piece is cut into two pieces, each with one edge 7½ in. long, which is the upper edge. In the long piece make a cut ½ in. deep on the upper edge 3¾ in. from the end; then make a 45° cut from the lower corner to the end of the first cut. The two short pieces are then glued to the ends of the latter piece. The gluing up should not be done until after the mortises are cut for the vertical pieces.

The vertical pieces are all 10 in. long and 1½ in. thick; the two outer pieces are 2 in. wide, and the center piece 20 in. wide, the spaces between being 3 in. wide. The lengths given allow for tenons ⅞ in. long on each end, which should be cut to give a ¼ in. shoulder all around, and the mortises of a size to match.

The shelf across the foot is 31 in. long, 10 in. wide and 1½ in. thick, the length allowing for tenons ½ in. long at each end. A wide shoulder can be given these tenons, so that they are ⅝ in. thick and 6 in. wide, making the work of cutting the mortises for them as little as possible. Two screws are put through each end to hold the shelf in place, the heads being deeply countersunk and covered with buttons glued in.

The two wide pieces at the ends are shown plainly in the illustration. If desired they may be ornamented by holes cut at the center with an expansive bit. Scribe with the dividers a circle 4½ in. in diameter, mark four points in the circumference and use these points as centers to bore holes 3 in. diameter. The points where the circles join are smoothed up with a file. A little more elaborate figure can be made in the same way. Draw a light center line and mark 11½ in. from each end. On these points scribe circles 4½ in. diameter, and mark off three points in the circumference at the two sides, using these as centers to bore 3 in. holes. On each side of the center line mark off 1 in. and draw lines connecting the two sets of holes and then cut out with a compass saw.

As the stock used for this table is rather heavy, mahogany would be the most suitable wood to use, and would make the best appearance, but red gumwood finished with a dark red stain would look well and be much less expensive to make.

BOOKS RECEIVED.

PRACTICAL LESSONS IN ARCHITECTURAL DRAWING. William B. Tuthill, A. M., 61 pp., 11½ x 7½ inches. 33 full-page plates; 33 illustrations. Cloth. $2.50. W. T. Comstock, New York.

The student in architectural drawing who desires the maximum of instruction and examples clearly presented in one convenient volume will find all these conditions fulfilled in this book. It requires but a most casual examination to show that the author had a thorough knowledge of the subject and how to present the same so that the student would be able to profit fully thereby.

The examples include an exceptionally large amount of detail, so that the student who will diligently study them and the text will not tail to make excellent progress. The following selections from the several chapters will more clearly show the scope of the book:—A small frame cottage, a frame house, a brick building, a stone building, the specifications, color, building laws, etc.

A MANUAL OF CARPENTRY AND JOINERY. J. W. Riley. 500 pp. 7½ x 5 in. 923 illustrations. Cloth, $2.00. The Macmillan Co., New York.

The author in writing this book had in mind the special needs of carpenters and joiners desirous of studying the scientific principles of their work, yet at the same time giving ample attention to the simplest types of construction, with numerous details of the work.

The book is, therefore, vastly more complete in its treatment of the subject than any single volume which has hitherto been brought to our attention. The large number of excellent illustrations shows how exhaustively the author has presented the many details of this kind of work. As a textbook for schools it should serve admirably, and as a guide for those who are without opportunity for class instruction it should be invaluable. The rural resident who would attempt building operations should surely have a copy at hand.

PRACTICAL GAS AND OIL ENGINE HANDBOOK. L. Elliott Brookes. 160 pp. 6½ x 4½. 43 illustrations. Flexible cloth, $1.00. Frederick J. Drake & Co., Chicago, Ill.

The tremendous increase in the use of internal combustion engines for power in boats, automobiles, on the farm, in factories and shops, and other places, many times in the hands of those totally unacquainted with engine operation, has developed a large demand for books giving infoımation regarding the construction and use of this form of power. In this book an alphabetical arrangement of topics has been selected. and for reference work this makes a very handy arrangement, but the novice will find it rather difficult to assemble the separate portions of information so as to get a proper idea of relations and operations of an engine. Aside from this, which will be no objection to those having a slight knowledge of the subject, the text is clear and the illustrations, especially those relating to governors, are excellent.

TURNING FOR BEGINNERS. James Lukin, B. A. 128 pp. 7¾ inches. 130 illustrations. Cloth. 60 cents. Guilbert Pitman, London, Eng.

The author had primarily in view the needs of the beginner in lathe work, and has treated the subject in an elemental way and with a fullness of detail which makes it an excellent guide for those taking up lathe work. A large number of well selected examples, especially in wood turning, make it an excellent desk book for teachers in manual training schools. It is well worth the moderate sum needed to secure it.

MODERN DYNAMOS AND BATTERIES. S. R. Bottone. 172 pp. 7½ x 4¾ inches. Cloth. $1.00. Guilbert Pitman, London, Eng.

It was many years ago when we first read a book by this author, and the eagerness with which its pages were read is fresh in memory today. Since then many books have come from his pen, all intended to supply information needed by the electrical student. The special feature which has characterized these books is the large amount of constructional work which is described enabling the reader to build the instruments needed for his studies and experiments. This book, the second in a set covering "Electrical Engineering for Students" is in line with its predecessors, and contains chapters relating to different types of batteries, measuring instruments and dynamos.

The fizzing of cooling water for the jackets of internal combustion engines may be guarded against, it is said, by the using of a 20 per cent solution of glycerine. Its advantages over the usual brine of calcium solutions is that no deposit forms on the hot cylinder walls when the engine is in use.

Sulphuric acid is said to have been discovered by Basil Valentine, a monk of Erfurt, in Saxony, in the fifteenth century. He obtained the acid by distilling copperas in a retort at a red heat, the acid dropping from it in an oily liquid, whence the name of vitriol.

CEMENT MORTAR AND CONCRETE.

PHILIP L. WORMELEY, JR.

III. Construction of Sidewalks—Cellar Floors.

A useful and comparatively simple application of concrete is in the construction of sidewalks, for which purpose it has been used with marked success for a number of years.

The ground is excavated to subgrade and well consolidated by ramming to prepare it for the subfoundation of stone, gravel or cinders. The depth of excavation will depend upon the climate and nature of the ground, being deeper in localities where heavy frosts occur or where the ground is soft than in climates where there are no frosts. In the former case the excavation should be carried to a depth of 12 in., whereas in the latter from 4 to 6 in. will be sufficient. No roots of trees should be left above subgrade.

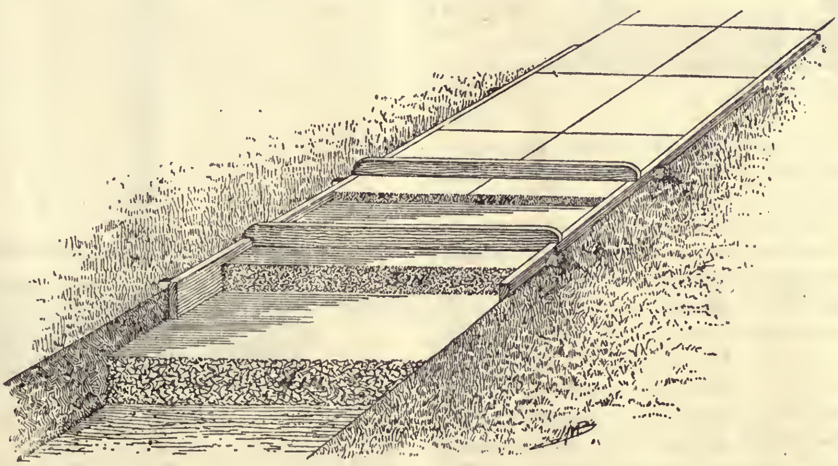


FIG. 2.

The subfoundation consists of a layer of loose material, such as broken stone, gravel or cinders, spread over the subgrade and well tamped to secure a firm base for the main foundation of concrete which is placed on top. It is most important that the subfoundation be well drained to prevent the accumulation of water, which, upon freezing, would lift and crack the walk. For this purpose it is well to provide drain tile at suitable points to carry off any water which may collect under the concrete. An average thickness for subfoundation is 4 to 6 in., although in warm climates, if the ground is firm and well drained, the subfoundation may be only 2 to 3 in. thick or omitted altogether.

The foundation consists of a layer of concrete deposited on the subfoundation and carrying a surface layer or wearing coat of cement mortar. If the ground is firm and the subfoundation well rammed in place and properly drained, great strength will not be required of the concrete, which may, in such cases, be mixed in about the proportions 1–3–6, and a depth of only 3 to 4 in. will be required. Portland cement should be used and stone or gravel under 1 in. in size, the concrete being mixed of medium consistency, so that moisture will show on the surface without excessive tamping.

To give a neat appearance to the finished walk a top dressing of cement mortar is spread over the concrete, well worked in, and brought to a perfectly smooth surface with straightedge and float. This mortar should be mixed in the proportion 1 part cement to 2 parts sand, sharp coarse sand or screenings below ¼ in. of some hard, tough rock being used. The practice of making the concrete of natural cement and the wearing surface of Portland is not to be commended, owing to a tendency of the two to separate.

A cord stretched between stakes will serve as a guide in excavating, after which the bottom of the trench is well consolidated by ramming, any loose material below subgrade being replaced by sand or gravel. The material to form the subgrade is then spread over the bottom of the trench to the desired thickness and thoroughly compacted. Next, stakes are driven along the sides of the walk, spaced 4 to 6 ft. apart, and their tops made even with the finished surface of the walk, which should have a transverse slope of ¼ in. to the foot for drainage. Wooden strips at least 1½ in. thick and of suitable depth are nailed to these stakes to serve as a mold for the concrete. By carefully adjusting these strips to the exact height of the stakes they may be used as guides for the straightedge in leveling off the concrete and wearing surface. The subfoundation is well sprinkled to receive the concrete, which is deposited in the usual manner, well tamped behind a board set vertically across the trench, and leveled off with a straightedge as shown in Fig. 2, leaving ½ to 1 in. for the wearing surface. ⅜ in. sand joints are provided at intervals of 6 to 8 ft. to prevent expansion cracks, or, in case of settlement, to confine the cracks to these joints. This is done either by depositing the concrete in sections, or by dividing it into such sections with a spade when soft and filling the joints with sand. The location of each joint is marked on the wooden frame for future reference.

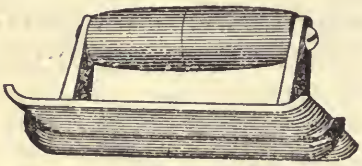


FIG. 3.

Care must be exercised to prevent sand or any other material from being dropped on the concrete, and thus preventing a proper union with the wearing surface. No section should be left partially completed to be finished with the next batch or left until the following day. Any concrete left after the completion of a section should be mixed with the next batch.

It is of the utmost importance to follow up closely the concrete work with the top dressing in order that the two may set together. This top dressing should be worked well over the concrete with a trowel, and leveled with a straightedge (Fig.2) to secure an even surface. Upon the thoroughness of this operation often depends the success or failure of the walk, since a good bond between the wearing surface and concrete

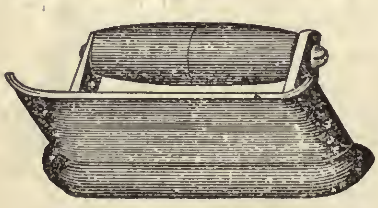


FIG. 4.

base is absolutely essential. The mortar should be mixed rather stiff. As soon as the film of water begins to leave the surface, a wooden float is used, followed up by a plasterer's trowel, the operation being similar to that of plastering a wall. The floating, though necessary to give a smooth surface, will, if continued too long, bring a thin layer of neat cement to the surface and probably cause the walk to crack.

The surface is now divided into sections by cutting entirely through, exactly over the joints in the concrete. This is done with a trowel guided by a straightedge, after which the edges are rounded off with a special tool called a jointer, having a thin shallow tongue (Fig. 3). These sections may be subdivided in any manner desired for the sake of appearance.

A special tool called an edger (Fig. 4), is run around the outside of the walk next to the mold, giving it a neat rounded edge. A toothed roller (Fig. 5) having small projections on its face is frequently used to produce slight indentations on the surface, adding somewhat to the appearance of the walk. The completed work must be protected from the sun and kept moist by sprinkling for several days. In freezing weather the same precautions should be taken as in other classes of concrete work.

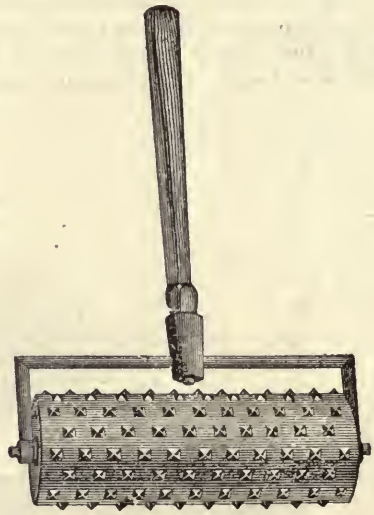


FIG. 5.

Basement floors in dwelling houses as a rule require only a moderate degree of strength, although in cases of very wet basements, where water pressure from beneath has to be resisted, greater strength is required than would otherwise be necessary. The subfoundation should be well drained, sometimes requiring the use of tile for carrying off the water. The rules given for constructing concrete sidewalks apply equally well to basement floors. The thickness of the concrete foundation is usually from 3 to 5 in., according to strength desired, and for average work a 1–3–6 mixture is sufficiently rich. Expansion joints are frequently omitted, since the temperature variation is less than in outside work, but since this omission not infrequently gives rise to unsightly cracks, their use is recommended. It will usually be sufficient to divide a room of moderate size into four equal sections, separated by ½ in. sand joints. The floor should be given a slight slope toward the center or one corner, with provision at the lowest point for carrying off any water that may accumulate.

Concrete stable floors and driveways are constructed in the same general way as basement floors and sidewalks, but with a thicker foundation, on account of the greater strength required. The foundation may well be 6 in. thick, with a 1-in. wearing surface. An objection sometimes raised against concrete driveways is that they become slippery when wet; but this fault

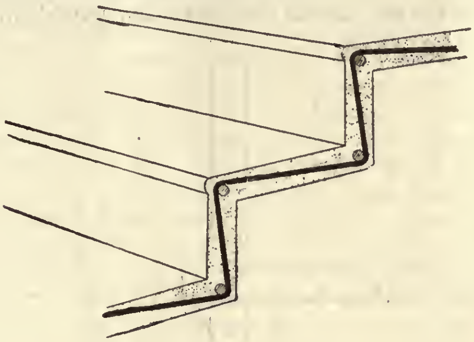


FIG. 9.

is in a great measure overcome by dividing the wearing surface into small squares about 4 in. on the side, by means of triangular grooves ⅜ in. deep. This gives a very neat appearance and furnishes a good foothold for horses.

Concrete may be advantageously used in the construction of steps, particularly in damp places, such as areaways and cellars of houses; and in the open, where the ground is terraced, concrete steps and walks can be made exceedingly attractive. Where the ground is firm it may be cut away as nearly as possible in the form of steps, with each step left 2 or 3 in. below its finished level. The steps are formed, beginning at the top, by depositing the concrete behind vertical boards so placed as to give the necessary thickness to the risers and projecting high enough to serve as a guide in leveling off the tread. Such steps may be reinforced where greater strength is desired or where there is danger of cracking, due to settlement of the ground.

Where the nature of the ground will not admit of its being cut away in the form of steps, the risers are moulded between two vertical forms. The front one may be smooth board, but the other should be a piece of thin sheet metal, which is more easily removed after the earth has been tamped in behind it. A simple method of reinforcing steps is to place a ½ in. steel rod in each corner, and thread these with ¼ in. rods bent to the shape of the steps, as shown in Fig. 6, the latter being placed about 2 ft. apart. For this class of work a rich Portland cement concrete is recommended, with the use of stone or gravel under ½ in. in size. Steps may be given a ½ in. wearing surface of cement mortar mixed in the proportion 1 part cement to 2 parts sand. This system, as well as many others, is well adapted for stairways in houses.

SPECULUM GRINDING AND POLISHING.

J. R. STEPHENS.

In 1878 and 1879 I did considerable work in grinding and polishing glass mirrors of 12 in. aperture, and 8 ft. solar focus. The methods used were essentially those of Dr. Draper, with whom I had correspondence at the time. The apparatus used by me, however, differed materially from Dr. Draper's machine. I will first quote the general method (date 1864) from Dr. Draper, and then give a description of my apparatus.

"The method of producing reflecting surfaces next to be spoken of is, however, that which has finally been adopted as the best of all, being capable of forming mirrors which are as perfect as can be, and yet only requiring a short time. It is the correction of a surface by local retouches. In the account published by M. Foucault, it appears that he is, in France, the inventor of this improvement.

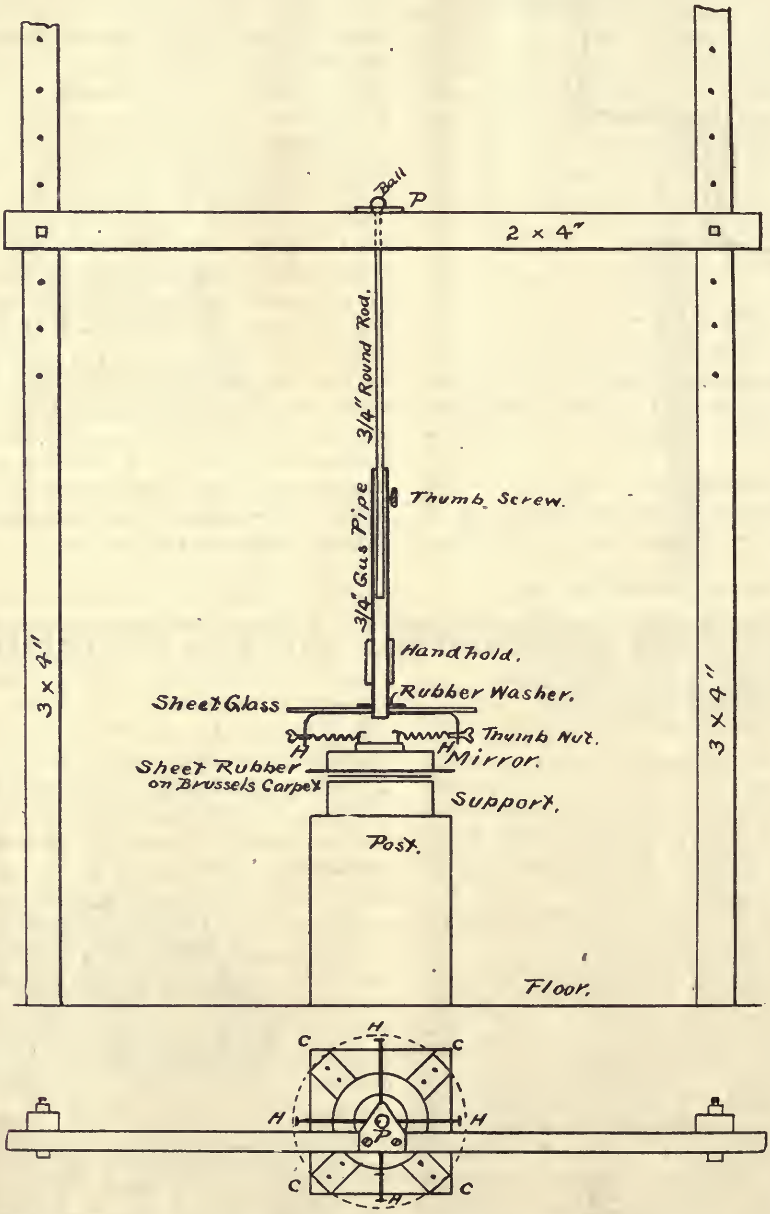
"The mode of practicing the retouches is as follows (for 15½ in. mirror 150 in. solar focus):—

"Several disks of wood, varying from 8 in. to ½ in. in diameter, are to be provided, and covered with pitch or rosin, of the usual hardness, in squares on one side. On the other, a low cylindrical handle is to be fixed. The mirror, having been fined with the succession of emeries before described, is laid face upward on several folds of blanket, arranged upon a circular table screwed to an isolated post, which permits the operator to move completely round it.

"An ordinary barrel has generally supplied the place of the post, the head serving for the circular table, and the rim preventing the mirror sliding off. The other end is fastened to the floor by four cleats.

"The large polisher (8 in.) is first moved over the surface in straight strokes upon every chord, and a moderate pressure is exerted. As soon as the mirror is at all brightened, perhaps in five minutes, the operation is to be suspended, and an examination at the center of curvature made. By carefully turning round the best diameter for support is to be found, and marked with a rat-tail file on the edge, and then the curve of the mirror ascertained. If it is nearly spherical, as will be the case if the grinding has been conducted with care and irregular heating avoided, it is to be replaced on the blanketed support, and the previous action kept up until a fine polish, free from dots like stippling is attained. This stage should occupy three or four hours. Another examination should reveal the same appearance as the preceding. It is next necessary to lengthen the radius of curvature or the edge zones, or, what is much better, shorten that of the center, so as to convert the section curve into a parabola. This is accomplished by straight strokes across every diameter of the face—at first with a 4 in., then with a 6 in., and finally with an 8 in. polisher. Examinations must, however, be made every five or ten minutes, to determine how much lateral departure from a direct diametrical stroke is necessary to render the curve uniform out to the edge. Care must be taken always to warm the polisher, either in front of a fire or over a spirit lamp before using it.

"Perhaps the most striking feature in this operation is, that the mirror presents continually a curve of revolution, and is not diversified with undulations like a ruffle. By walking steadily round the support on the top of which the mirror is placed, there seems to be no tendency for such irregularities to arise. If the correction for spherical aberration should have proceeded too far, and the mirror become hyperbolic, the sphere can be recovered by working a succession of polishers of increasing size on the zone intermediate between the center and edge, causing their centers to pass along every chord that can be described tangent to the zone.



"A most perfect and rapid control can thus be exercised over a surface, and a uniform result very quickly attained. It becomes a pleasant and interesting occupation to produce a mirror. But two effects have presented themselves in this operation which unfortunately bar the way to the very best results. In the first place, the edge parts of such mirrors for more than half an inch all round bend backward, and become of too great focal length, and the rays from these parts cannot be united with the rest forming the image. In the second place, the surface when critically examined by the second test, is found to have a delicate wavy or fleecy appearance not seen in machine polishing. Although the variations from the true curve implied by these latter greatly exaggerated imperfections are exceedingly small, and do not prevent a thermometer bulb in the sunshine appearing like a disk surrounded by rings of interference; yet they must divert some undulations from their proper direction, or else they would not be visible. All kinds of strokes have been tried—straight, sweeping, circular, hypocycloidal, &c.—without effecting their removal. M. Foucault, who used a paper polisher, also encountered them. Eventually they were imputed to the unequal pressure of the hand, and, in consequence, a machine to overcome the two above mentioned faults of manual correction was constructed." Here Dr. Draper proceeds to describe his machine.

The apparatus constructed by the writer was also intended to obviate the unequal pressure of the hand, but at the same time retaining the "feel" of the polisher. This consists (see figure) of two uprights spiked to floor and ceiling. They should be planed on all four sides and set exactly plumb. Against them a horizontal bar is bolted, conveniently spaced bolt-holes in the uprights providing for raising and lowering the bar. The middle of this bar supports an iron plate P, ½ in. thick. Through the overhanging part of P, and well clear of the bar, a 1 in. round hole is drilled, which is then countersunk nearly all the way through the plate, the cup-shaped depression being made spherical to receive a smooth iron ball 1⅝ in. diameter, which by a ground fit is thus uniformly supported, while revolving in any direction. The top of this ball may be squared to give wrench hold. Through one diameter of the ball, a hole is drilled into which is firmly screwed the end of a ⅝ in. round iron rod several feet long, the upper end of which has, for this purpose, been turned or drawn down to ½ in. and threaded, thus forming a short neck under the ball.

The ⅝ in. rod, at its lower end slips loosely inside a ¾ in. gaspipe (internal diam. 13-16 in.) 3 ft. long. When set at the right length the thumb-screw shown, clamps rod and pipe. Through the lower end of the ¾ in. pipe two ⅜ in. round rods are passed at right angles and firmly secured. The outside 3 in. at both ends of each rod is turned down at right angles, flattened at the tips and drilled with small horizontal holes, H H H H near the extreme ends.

Some care should be taken that H H H H lie in a plane at right angles to the pipe, and form a square of which the pipe is the center, each hole being, say, 10 in. from this center. Through H H H H threaded hooks are loosely passed, the hooks being on the inside, and each threaded outside carrying a thumb nut. These hooks are connected with four short hooks screwed into the top of the polisher (near to and at a uniform distance from its edge and 90° apart) by four helical springs or rubber bands all of the same length and stiffness. Each connection may be made part link or light chain and part spring, to allow for varying sizes of polishers.

The top of the ⅜ in. cross-rods may be used to support a sheet of ordinary window-glass, 2 ft. in diameter, with 1½ in. hole bored or ground in the center. The space between the pipe and the glass is covered by a cloth washer, weighted with an iron washer to keep it in close contact with the glass. The object of this is to protect the face of the mirror from dirt. The movements of the polisher may be watched through the glass. For the same reason the bottom of the pipe is plugged.

Vertically under the center of the hole in P the center of a square optician's post is located. It may be made of several pieces of seasoned wood, surfaced on all four sides, well glued, and spiked together. It must be firmly fastened to the floor, and the upper surface, which should be the end grain, must be carefully dressed plane and level. The whole is then thoroughly painted. This supports a cylinder of wood about 3 in. high, and of the same diameter as the mirror, carefully turned and faced on both ends. This, too, should be well painted. The center is to be plumbed under the center of the round hold in P, and the surface levelled.

This supports two thicknesses of new Brussels carpet cut to the diameter of the mirror. They are covered with a projecting sheet of rubber, or thin oilcloth, to prevent soiling the carpet with drip. Every care must be taken to prevent the drip from working in between the mirror and the cloth, particularly at irregular intervals around the outside, for this would be fatal to the production of a good surface towards the edge. Indeed, with this method of polishing it might be advisable to make the wooden support somewhat smaller than the mirror. This would conduce to cleanliness, and also give the edge a chance to yield a little when long strokes are used.

On the cloth rests the carefully centered mirror, closely, but not tightly, held in place by four adjustable wooden clips, C, C, C, C. These clips also serve to support, when used, the outside wooden or metal hoop indicated by the dotted circle in the plan, the use of which is to guide the eye in making long strokes, and also to prevent a careless overstroke. The mirror should be of good homogeneous glass, not rolled, about ⅛ in. diameter in thickness; it should be ground approximately circular, with the back mechanically flat. The face should be rough-ground to closely approximate the desired focus, and so that the edge will caliper to the same thickness all around. If desired the rough-grinding may be done with this apparatus by taking off the hooks and springs, and connecting the pins in the back of a heavy lead-grinder, of half the diameter of the mirror, directly with the cross-arms. This may be done with wire or stout twine.

The fine-grinding should certainly be done with the apparatus full-rigged. The tool for fine-grinding the 12 in. mirrors (8 ft. solar focus) was of the best, close-grained cast iron, 6¼ in. diameter and ⅝ in. thick, finished size. Both faces and the edge were well cut away in order to get rid of the skin. One face was closely turned and scraped to templet, then put in a planer and grooved in squares in the usual manner with a round nosed tool. The edges and corners of the squares were rounded with a file to prevent crumbling and scratching.

Polishers may be made of the same material and in the same way, but without the grooving. They should be thinner and ribbed on the back along two diameters at right angles to each other, into which are screwed the holding-hooks for the springs. If, however, the polishers be of wood, the spring holding-hooks on the back should be made of two strips of flat iron, turned up and over 180° at the ends. These should be screwed to the back of the polisher and at right angles to each other. This precaution is to transmit the tension of the springs across the polisher without straining it locally. If desired, polishers may be weighted, also the grinder. In using this arrangement, Dr. Draper's directions for hand-polishing were generally followed.

If the springs are slack, the weight of the polisher governs entirely. By shortening the length of the adjustable swinging-bar, and increasing the tension on the springs, the tendency is to lift towards the edge of the mirror, provided the length of the bar is materially less than the radius cf curvature of the mirror. This setting has a tendency, with straight diametrical strokes, to parabolise a spherical mirror, at the same time forming a good edge. The spherical figure may, however, be maintained or restored by making the strokes with longer bar, and with less tension on springs along chords tangent to the intermediate zones, occasionally zig-zagging from one side of the mirror to the other, all the while walking steadily around the post, and turning the polisher by twisting the pipe at the hand hole.

The mirror is occasionally turned a little within the clips with gloved hands, and also the polisher (90° at a time) within the springs. This to insure a uniform effect.

A number of variations in adjustments, not above indicated, may be used for special purposes; but they are hardly necessary. It is to be noted, however, that, with properly-designed hooks, raising H H H H, with reference to the polisher, reduces its pressure on the mirror, and vice versa. Full-sized fine grinders and polishers of any form may be used quite as well as smaller ones, and do their work more quickly.

All sorts of strokes may be used, but straight ones usually suffice. The whole system is flexible, elastic, and under complete control. In short, it is much like a fiddle—it may be tuned up to suit.

CONCLUDED IN THE MAY NUMBER.

The "Amerika's" supplies for a trans-Atlantic journey lasting seven-one-half days, carrying 4000 persons, crew included, include the following: 32,000 pounds of beef, mutton, lamb, veal and pork—all fresh provisions; 7500 pounds of game and poultry; 3500 pounds fresh and 250 pounds smoked fish; 7500 pounds fruit; 12,000 pounds assorted fruit; 80 cases of oranges; 36,000 eggs; 12,000 pounds fresh bread; and about $450 worth of fresh vegetables. For the outward and the return trip there would also be required 9000 pounds canned meats; 3600 pounds of salted meat; 4850 pounds ham, sausages, smoked meat and tongue; 800 pounds bacon; 5000 pounds butter; 1500 pounds cooking butter; 3600 pounds cheese; 40,000 pounds of flour; 15,000 pounds of rice, etc.; 4000 cans vegetables; 4100 pounds coffee; 300 pounds tea; 3500 pounds sugar; 3000 quarts of milk and cream; 4000 pounds sauerksaut: and 20 tons herrings. There would be required to quench the thirst 15,000 quarts of beer in kegs and 1200 bottles of beer; 960 quarts and 1300 pint bottles of Bordeaux and Burgundy wines; 1680 quart and 1400 pint bottles of Rhine, Moselle and Saar wines; 3500 quart and 6000 pint bottles mineral waters; and 950 bottles of liquors and spirits. The above is an extract from an interesting article by Julius P. Meyer in "Cassier's Magazine," on the new Hamburg American liner.

Hints to users of incandescent lamps are as follows: Don't buy lamps that are not plainly marked with a well known maker's name, and remember that cheap lamps generally waste current. Don't use a 16-c. p. when an 8-c. p. is sufficient, particularly when wiring your premises; remember current costs more than switches. Don't leave lamps alight that you can do without. Don't forget to regularly clean your lamps with a damp cloth, holding them by the glass and not by the cap, and when the down-stairs lamps get dull, put them upstairs and bring the others down; they have not been burning so long. Don't burn your lamps until they get black in the face from old age. You will get more light from a new 8 c. p. lamp than from a blackened 16-c. p., and only use half the current. Don't forget current costs more than lamps. Don't forget to periodically look through all your lamps in daylight at a sheet of white paper, scrap the "niggers" and send the doubtful ones to the electric light works to be tested.

PHOTOGRAPHY.

THE CAMERA CLUB.

H. P. ELLSAN.

In travelling about the country, one cannot fail to be impressed with the lack of merit in the methods and work of the many camera clubs or photographic societies that are to be found in nearly all the cities. Very often I have been shown the rooms of some photographic club. Nice rooms, with good appurtenences for developing, etc., but when I ask a few questions, I invariably receive the same reply. I might say, "This is a nice room; how often do you meet?" The answer usually is, "Why, we are supposed to meet once a month, but usually there are so few here that we can't hold the meeting." "Well," I would say, "what do you plan to do when you do meet?" The answer usually is, "Why, we elect officers, discuss matters of interest, and collect fees."

That's just it. Officers, fees, new members, new business, old business, general discussion, and every one goes home, thoroughly decided never to attend another meeting. Is there any way to remedy this difficulty—a lack of interest on the part of men in the camera club? I think I may say that the method I propose if carried out will be found practical and interesting to members of any club for the purpose of personal benefit in photographic work.

1.—Officers. You will say you have just scorned officers, and yet you put them at the top of your list. Very true; I do hate to see the election of officers the drawing card for meeting after meeting, but we must start with them. We must have a small executive committee, one of whose members shall be virtually president of the club, another secretary, another treasurer. Their chief duty will be however, to arrange for each meeting, as we shall see later.

2.—Meetings. There should be regular monthly meetings on some convenient night, and it should be understood that anyone becoming a member of the society is expected to make a reasonable effort to attend each meeting.

3.—The activity. This is the important feature of the regime. The executive committee should choose a subject for discussion for each month, one of true photographic interest, and appoint some member of the club to prepare to discuss it or obtain the services of some outside authority on the subject.

In case the club be composed of persons having time and inclination to work out new processes it might be well to have a double subject for each meeting; the one practical, the other theoretical. The practical subject, let us say, has been chosen. It is "Gum-bichromate processes." The theoretical, let us say, is "The action of light on the sensitive film. Both of these subjects are treated in one evening. During the month members will be expected to do work along the line of the practical subject. They will prepare in this case, let us say, three or more prints, adopting one of the processes which they have heard discussed in the meeting. They will take those prints to the next meeting, and will benefit thereby the fellow workers and obtain help from them.

There are countless subjects, both practical and theoretical, which may be treated in this way, and a vast library to be drawn from to work up a lecture. Further, there are in every town many men who are by experience capable of giving valuable talks on special branches of work, and in many cases these men will be found very willing to give the club the benefit of their research.

In closing let me say to clubs that whether you adopt my suggestions literally or not, at least observe these maxims. Make the election of officers and other business of less importance. Do not have general discussion of the broad field "Photography." Confine your attention at each meeting to some special topic, preparation having been made beforehand so that an intelligent lecture may be given. Pay less attention to the number in your club; five is enough. Energy is what counts, not numbers. With this I close, with the sincere hope that some people may follow at least in part the suggestions I have made, and that they may be aided thereby to bring the club to some degree of excellence.—"Western Camera Notes."

HOME MADE RUBY GLASS.

Dissolve a little eosine in ordinary negative varnish, and also a like amount of aurantia in another portion of the varnish. Flow one side of two sheets of glass, one with one varnish and the other with the remainder. When dry bind the two with their varnished surfaces together and you will have an excellent substitute for the expensive and often hard to obtain ruby glass. A pair of glasses so produced is as near safe as one can hope to secure, and passes a very pleasing and comfortable light by which to work. Continued use will result in a slight fading of the color but they are so easily prepared and the fading is so slow, except where sunlight is used as an illuminant, that this is a very slight drawback.

EBONIZING WOOD.

PROCESSES FOR STAINING BOTH HARD AND SOFT WOODS.

Ebony or "lignum vitæ," as it is known to botanists, is a wood that is so intractable as to be worked with great difficulty. Therefore, the following processes of "ebonizing" various kinds of wood, and imparting to them a black color, should be of interest. Success in some cases will depend on the nature of the wood being ebonized. For example, woods that are rich in tannin, such as oak, beech, etc.. will readily become blacked when brought into contact with salts of iron, because this mineral chemically reacts on the tannin and converts it into tannate of iron, which is black, or greyish black, while on soft woods that are free from tannin, salts of iron will only produce a silvery grey, but logwood, Brazil wood and aniline hydrochlorate will impart a rich deep black color to woods free from tannin. It will therefore be best for the reader to experiment on a few small pieces of the woods he intends to ebonize, so as to find out which particular process will yield the deepest and richest black. When this information has been obtained, he can proceed to ebonize all the wood he wants to.

As the process employed usually consists of steeping the wood in the ebonizing solution, or of an application of it to the surface of the wood by means of a sponge or brush, it will be best to cut the wood into the desired pattern before ebonizing it, because the ebonizing solutions seldom penetrate the surface very deeply; consequently cut-out edges will show white or a different shade of black to that which the surface does. Besides, some of the ebonizing solutions require to be applied to the wood very hot, or even require the wood to be boiled in the fluid, with the result that the wood becomes more or less softened and liable to warp, and such warping would spoil the accuracy of cutting, whereas if the cut pattern be at all warped after ebonizing, it is easily rendered flat again by laying it between boards with heavy weights on top until the wood is dry and level.

EBONIZING PROCESS FOR SOFT WOODS.

No. 1.—Dissolve 1¼ oz. of sulphate of iron crystals in 1 quart of water and then add 2 oz. of logwood chips and boil the fluid for one hour; then strain the fluid and apply it to the wood with a sponge, or else steep the wood in the fluid for a few minutes; then remove the wood, allow it to dry by exposure to the air, not before a fire, and repeat the application of the fluid, or the steeping in it until the wood is black enough. To increase the deepness of the black tone, the wood may be wetted with iron liquor, after the first application of the logwood solution and before the second and third application. This iron liquor is prepared by dissolving 2 oz. of steel filings, clean and free from grease, by boiling them in ½ pint of strong vinegar or acetic acid, and straining or filtering the fluid. When the wood is stained deep enough and is dry, sandpaper it until a smooth surface is obtained, then lay on the surface a slight coating of olive oil, and then mix a little French polish and drop black and rub over the surface of a polishing pad such as French polishers use.

Such a pad is made by taking a quantity of tow or cotton wool, rolling it into a ball, and then covering the ball with a piece of clean linen rag; cotton fabric will not do, as the fiber is too short, and works up fluffy under the rubbing. To use the polish, pour a little of it into a plate and then mix a little powdered drop black to disguise the brown color of the polish. The blade of a knife is the best thing to rub up the polish and drop black, being careful that there is no lump of the black left uncrushed or unmixed with the polish.

Now take the polishing pad between the thumb and forefinger, moisten its surface with a little olive oil, dip the oiled surtace on the polish, but not too much, put one spot of olive oil on top of the layer of polish and proceed to rub the pad over the wood. The rubbing is usually done in a series of intertwining circles, but the outline of the pattern will determine how best to rub the pad over the wood. When you find the polishing pad becoming sticky, apply a little more polish and oil to the pad. Any polish that has found its way into the cut-out pattern of the wood should be removed by means of a piece of wood covered with a piece of fine linen.

If it is desired to bring up a very highly polished surface, a little methylated finish should be rubbed over the polished surface before the polish has become quite dry. Instead of bringing up a polish with French polish, the wood may be varnished with a coat of quick-drying varnish, and if required to present a dull gloss, the varnished surface, when dry, may be rubbed with a pad dipped in finely powdered pumice stone, and then raw linseed oil rubbed over the pumiced surface until it is uniformly smooth. Instead of French polishing or varnishing, a very good smoothly finished surface is imparted to the wood by wax polishing, which is much simpler and quicker. The process is carried out as follows:

No. 2;—Put 1 oz. of beeswax, ½ oz. of Japan wax and ½ oz. of yellow wax (ceresin) into a small saucepan, and gently heat them until melted; then remove the saucepan from the fire and add sufficient oil of turpentine to render the mixture of a soft, unctuous consistence when cold. The actual amount of turpentine required will depend on the quality of the waxes used. Pure beeswax and a high-class ceresin will require more oil of turpentine than the inferior qualities. If the compound sets too solid at first, it should be remelted at a gentle heat, because the turpentine that is in the compound will render it very inflammable at anything like a high temperature, because the turpentine vapors that are given off when hot easily ignite when they reach a naked flame. Allow the melted wax to cool slightly, and add more turpentine and allow to cool until congealed; repeat the melting and addition of turpentine if still too solid and stiff until the mass is of a soft greasy consistence. By means of a few grains of any of the aniline colors which are soluble in oils and fats, known as oil dyes, the wax compound can be colored to match any kind of wood.

To use the wax polish, just lightly rub the surface of the stained wood, after having smoothed it with sandpaper and with a little olive or raw linseed oil, and then rub the polish on with a soft piece of felt; it may be applied warm if it is desired to penetrate deeply into the wood; then with a second piece of dry felt rub the waxen surface until a dull gloss results. If too much wax be not used and the rubbing well done, no greasy feel will be imparted to the wood, and an occasional rub up with a dry rag will renovate it very quickly, and prevent all dust and grime adhering.

No. 3—Put 1 quart of strong vinegar into a saucepan and boil it up along with 8 oz. of Berlin blue, and ½ oz. of nut galls. Boil the mixture for half to three-quarter of an hour, then strain and when cool the fluid is ready for use as directed in No. 1.

EBONIZING PROCESS FOR HARD WOODS.

Some hard woods do not readily take a black color from the application of a single staining fluid, but require to be treated with two different decoctions, of of which the following are typical: Dissolve 6 to 8 ozs. extract of logwood in 1 quart of water by boiling, and add ½ drachm of alum; stir the fluid and apply this to the wood, giving one, two, or three applications as required to produce a deep stain. When the second is nearly dry give an application of "iron liquor" (see No. 1); repeat the application of the iron liquor until a deep color is obtained.

With very hard woods it is often requisite to steep the wood in the coloring solution or even boil the wood in it. But it will be found in such cases that a spirit stain is preferable to an aqueous one; the spirit will penetrate the fiber much better. To prevent the stain being abstracted when the wood is polished or varnished it should be sized with a thin solution of glue size before applying the polish. Two ounces of good white glue in 1 pint of water will be sufficient. Soak the glue for several hours in cold water and then melt it by heating in a glue pot with the remainder of the water and apply when cooled, or else allow to set to a jelly and rub the jelly size into the wood and let it dry before varnishing. The size may be colored with a little of the dye liquor that has been used for staining the wood.

No. 4.—A good black spirit stain is obtained by dissolving 1 oz. of sheeline and 1 oz. of nigrasin in 1 pint of methylated spirit, *i. e.*, alcohol metholated with acotone, not with mineral oils, and apply several applications of this until the surface is a deep black; the dye liquor can be applied hot, but as hot fluids are liable to raise the fiber of the wood, a light sand papering with No. 0 sandpaper will be necessary, and if the abrasion thus caused shows signs of cutting into the black stain, that is, if it allows the color of the wood to appear beneath the black stain, a final application after sandpapering, of cold stain must be given; then size and varnish the wood as directed in No. 1.

No. 5.—A good black staining compound, to be used on all kinds of wood, and as a final application, is to dissolve 4 ozs. of logwood extract in 1 quart of water and add ½ oz yellow chromate of potash while heating; then allow the mixture to rest a few days until it thickens slightly; the fluid thus applied will form a good black surface. There are many other formulæ for producing black stain on wood, but the above will suffice for all the needs of the amateur.—"Hobbies," London.

MAKING A FLASH FOR PHOTOS.

It is sometimes desirable to produce a flash when only magnesium powder is at hand and there is no suitable lamp available, says Fayette J. Chute in "Camera Craft." At other times the matter of expense may be an item, and for that reason the following plan, which is both cheap and effective, may be of use:

Soak some thick blotting paper in a saturated solution of saltpetre and allow to dry. One has then only to place a small piece on the top of a piece of tin or other safe material; place a little magnesium powder in the center and fire by applying a match to the corner. The lighted match can be held by making a split in the end of a long pine stick or lath. The length of the flash is much less than that secured with an ordinary blow-through lamp, particularly when the powder is in a thin layer. Heaped up, the powder requires longer to burn, but there is some waste. Spread in a train the time is extended and a larger amount of light is secured from a given amount of powder than when it is heaped up. The plan is entirely satisfactory, and there is less smell and smoke occasioned than with many of the expensive compounds offered the worker.

To draw a fine gold wire, the gold may be enclosed a covering of copper, and the whole drawn down to the finest mechanical limit; then the copper layer is dissolved off, leaving the fine gold nucleus.

CORRESPONDENCE.

No. 119. SPRINGFIELD, MASS., FEB. 16, '06.

I have read with much interest the articles on the nine-inch reflector by Mr. M. A. Ainsley, and would like to ask the following questions:

Where may the glass for the speculum be obtained?

What does he mean by the tool? Is it a disc of glass the same size as the mirror, or is it flat when the grinding commences?

What does glass for a 6 in. and a 9 in. mirror cost?

F. S. I.

Unless one desires an exceptionally fine instrument requiring imported glass, plate glass, obtainable at any large dealer in plate glass may be used. A piece 6 in. square and 1 in. thick would cost about $1.00; 9 in. square and 1¼ in. thick, about $1.50.

The tool is a piece of glass identical with that used for the lens, both being flat before grinding. As grinding proceeds the speculum takes a concave form and the tool a convex form to correspond, this being fixed by tooling the pitch as described in the articles.

No. 130. CEYLON, MINN., FEB. 12, '06.

I would like to know the size of magnet wire to use in winding the armature and field of a dynamo. Is No. 18 wire all right, or is finer wire best?

How much magnet wire does it take for an 8-light dynamo, 16 c. p. each? A. R. L.

The windings of the field and armature of a dynamo are determined by the design, materials used, and output desired. As these particulars have not been supplied by the writer we are unable to answer the inquiries.

No. 131. BATAVIA, N. Y. JAN. 25, '06.

With a ½ inch spark coil and 50 ft. aerial with proper ground connection, should I be likely to meet with any difficulty in sending signals across two city streets a distance of about 250 feet?

How would it do to have several wires for my receiving aerial and arrange to cut out all but one while sending? L. C. H.

A half-inch spark coil, with the gap closed to about ⅛ of an inch, will transmit signals a distance of approximately 500 yards, when a very sensitive michrophonic detector is used. With a coherer made of 2-10 or ⅛ glass tube, with tight fitting brass electrodes and mixed silver and nickel filings, by proper adjusting you could operate a sensitive relay over a distance of 250 feet. Such a coherer would require more or less adjusting, but for experimental use should prove satisfactory.

It is customary in wireless stations to use one wire for sending, and a large network for receiving. There is no reason, in an experimental station such as yours, to go to this trouble unless you care to do so for the sake of making comparisons as to efficiency.

No. 132. TISDALE, GA., FEB. 16. '06.

When I connect my aerial wire to the spark ball the spark changes from a fat white one to a thin one. Why is this? When I connect the ground on, the spark almost vanishes at times. Does this affect the sending? R. P. M.

The aerial and ground wires are radiating or dispersing all the spark discharge in the form of energy. If you use a Leyden jar bridged across the spark gap and close the gap up to ¼ in., you will be able to send further.

No. 133. CAMBRIDGE, MASS., JAN. 29, '06.

A friend says that in magnetizing a steel rod by inserting it in a coil of wire connected to a source of electric current, that the longer the steel stays within the coil, the stronger the magnet. Another declares that magnetization is instantaneous, and that a long insertion has no value. Which is right? B. O. C.

The latter is right. A greater saturation of magnetism may be obtained by tapping it with a piece of wood or a wooden mallet while being magnetized.

No. 134. BEDFORD, Ind., FEB, 14, '06.

Please give formula for making the red shellac coating found on finished magnet coils.

Where can I buy or lease a machine for winding fine wire into sectional coils? Do you know the price of such a machine?

Please give method of marking steel tools permanently. B. N. S.

Dissolve common red sealing wax in wood alcohol.

Winding machines, such as you desire, are not purchased outright. Coil manufacturers design and construct their own machines and do not lease them.

Coat the steel with paraffine or beeswax. Scratch the initials with a sharp point, being sure to reach the metal. Fill the marks in the wax with a strong solution of nitric acid and water. Allow to stand for five minutes, then wash with water and remove the wax and the marks will be found permanently etched on the steel.

No. 135. S. WEYMOUTH, MASS., JAN. 25, '06.

I would be greatly obliged if you would kindly answer the following questions:

1. Can you give me some idea as to how small a propeller I can use in a 15 ft. boat, 4 ft. beam? The engine is a small bicycle motor rated at about 1½ h. p. I think most bicycle motors are regarded as high speed motors.

2. Would it be best to gear down so the propeller shaft would run slower than the engine? If so, about what rate would be best so that the engine wouldn't race?

3. What advantage is there in having a propeller with three blades rather than two?

4. Does the angle at which the propeller shaft passes through the boat have any effect upon the speed developed? By angle I mean that formed by the propeller shaft and the bottom of the boat. I want to use as small a propeller as possible so that the boat will draw very little water. R. A. S.

The information furnished is so meager as to make the answers only approximate and in accord with the usual practice in marine design.

1. A 12 in. propeller with three blades is about right for the size boat mentioned. The engine may or may not furnish the requisite pewer to drive it to speed.

2. Connect the shaft direct to engine; reducing gears use much power which had best be applied to driving the propeller.

3. The number of blades is determined by the area necessary to develop the required " hold " on the water. Three blades are also better balanced than two.

4. The angle of the shaft should be as small as convenience will allow, as the pitch of the blades is designed to work best at a low angle. In a small boat this is not as important as with large ones. It is rather doubtful if the motor you mention will drive the boat to speed especially in a strong head wind.

No. 136. MOUNTAINVILLE, N. Y., JAN. 17, '06.

Will you kindly answer the following questions: I have a small 25-volt dynamo and am trying to make a storage battery to be charged by it, but I am confronted by several troubles.

1. I have hard work making the lead oxide stay in the grids.

2. I have been unable to make a plaster mold that would stand casting over five or six grids before breaking up. The heat of the molten metal would soften the plaster next to the grid, and consequently it would drop off in thin scales when the mold was taken apart. Can I remedy this in any way?

3. After I have the lead plates in place in the jar, would it be advisable to fill in between and around them with clean gravel to keep the oxide in place? If not, give reason. G. B.

1. If the paste is properly mixed and firmly hammered into the grids, it should remain in place, if the cells are charged and discharged at the proper rate. Read the description in the June, 1904, number of this magazine.

2. Plaster molds are suitable for only a few castings. Make one of fine grained hard wood such as maple or birch, coating the inside with graphite powder and heating the metal only to the point where it will flow freely. Iron molds can be made at small expense, as described in the article above mentioned, and are recommended.

3. The positive plates should be fully insulated from the negative ones; even flakes of oxide which drop off are injurious, as they are very liable to cause a short circuit. The use of gravel as mentioned would have the same effect, and would be decidedly detrimental.

No. 137. DAYTON, OHIO, FEB. 13, '06.

Will you please answer this question in your correspondence column:

I have a small induction coil, rated at ½ in. spark. When I first received the coil I tested it on four cells of dry battery, and it gave the required spark, but only for a minute. Since that time it refuses to give any spark at all except when the space between the secondary terminals is very small. I have tried it on five and six cells of battery, but without any better success. Can you tell me what the trouble is and how to overcome it? M. M. H.

It is evident that something has happened to the coil, whether due to your improper use or a defect in the coil cannot be determined without taking it apart and making a close examination. As the coils sent out by all reputable manufacturers are thoroughly tested before shipping, the probability is that you may have accidentally done something which has caused the trouble. First examine the connections, and especially those between the secondary winding and the discharging posts. If a careful examination fails to locate the fault a complete rewinding of the coil will probably be necessary.

No. 138. FALL RIVER, MASS., MARCH 6, '06.

In the March, 1906, issue is an article by Oscar F. Dame, in which he describes a method of building condensers by using sheets of glass 18 x 24 in. with tin foil placed between. Can you tell me the number of layers to get the best results for a three or four inch coil? A. F. N.

The condenser described in the article mentioned is for a particular purpose only. You do not state for what purpose you desire the condenser, but as the coil you mention is rather larger than the one for which the condenser described was used, it is presumed you have some other use in mind. Personally, we favor a condenser made of waxed paper and sheets of foil, and specifications for same are given in the October, 1905, number of this magazine in the article on Induction Coils. For a three or four inch coil a condenser having 60 sheets of tin foil 8 x 5 in. would answer. It would be advisable to make it up in four sections so that the whole or a part could be used as required for different kinds of work.

No. 139. SAN FRANCISCO, CAL. MARCH 13, '06.

Can you inform me how to wind two magnets with what is called a "differential winding," which is claimed to produce absolutely no spark at break? A condenser or added resistance to same is not satisfactory as the spark still remains. I have two magnets, each wound with 400 turns of wire and use three dry cells. The object in view is to obtain the same energizing effect with the differential winding as when ordinarily wound, and not to use any more battery.

Is a condenser used on a spark coil to increase the spark? If so, how is it connected? Can the condenser be used to reduce the spark. T. W. H.

Differential winding is not suitable for induction coils, as one part of the winding opposes and neutralizes or balances the other part. A condenser acts as a capacity to store the energy created in the primary winding by the inductive effect of the "break" current in the secondary. In this way it has the effect of increasing the spark. If rightly proportioned to the size of the coil used with it there should be no spark at the contact points of the interrupter, provided the latter is properly designed and well made. The information you send is not sufficiently complete to tell what is the trouble, but the indications are that the fault is with the interrupter, or condenser.

SCIENCE AND INDUSTRY.

A communication by Mr. George W. Walker, of the University of Glasgow, Scotland, he describes a method of reversing static induction machines. He observed accidentally that on stopping a small Voss machine and giving it two turns in the wrong direction, the poles had been reversed. The experiment was repeated a number of times and invariably the reversal occurred. The effect was then tried with a vacuum discharge tube connected to the knobs. While the tube was fresh the reversal occurred but seldom. It was found, however, that if the discharge was made to pass by connecting one terminal of the tube to earth and the other terminal to one pole of the machine, while the second pole was kept insulated, the reversal invariably occurred when the procedure mentioned was followed. Next, a large Wimshurst machine was tested, with the same results. It was noticed, however, that when the induction rods were so arranged that the machine excited both ways, the reversal did not occur. The author believes that this provides a way of getting the discharge to pass in whatever direction is required.

An exhibit at the recent meeting of the Society of German Plumbers which attracted considerable attention, was that showing an inventien of Chemist Blau of Augsburg, for the manufacture of fluid gas from the residuum of petroleum and heavy mineral oils. The inventor says this gas may be manufactured very cheaply where there is an abundance of petroleum, and that it may be transported from one place to another in cylinders as easily as carbonic acid gas. The gas may be used for lighting churches, halls and detached buildings, and in small tanks may be used in lighting automobiles. The Blau gas makes a very brilliant light for street lighting, and is very difficult to explode.

It has been discovered recently that the slime or residuum from the thermal springs at the city of Baden-Baden, Germany, contains very powerful radium. Prof. H. Gertel, of Wolfenbuttel, Germany, says this radium is forty times more powerful than that found in the residuum of cold-water springs or in mud baths. Previously the residuum from the water at Baded Baden was considered worthless by the scientific world and was discarded, but it is now carefully collected and sent to laboratories. For hundreds of years, in fact since the time of the Roman occupancy, persons have claimed that this slime possessed healing qualities, but the matter was regarded by scientists as a superstition. The hot baths at Baden-Baden are very beneficial in the treatment of rheumatism, and are visited annually by thousands suffering from that disease.

Last April a Canadian company installed a plant at Vancouver for the manufactnre of wire-wound pipe, since which time between thirty and forty carloads have been shipped to the Northwest Territories, Manitoba and Vancouver Island, and other orders are on hand which will be filled within a very short time. It is claimed that this pipe is superior, for water-supply purposes, to iron pipe and can be furnished at less than half the price. Besides this, it is much lighter to handie and is not so liable to burst upon freezing, as pipe made of iron. Large quantities of this pipe are being put into use by mill owners and mining engineers in lieu of flumes, as its use results in the saving of water and repair. This new industry seems to have a good future before it.

An extremly simple method of cutting a gage glass is deseribed in the "American Machinist." It consists of taking a match, cutting it and thoroughly wetting the head. Then, after measuring the glass, put the wet match head inside the glass where it is to be cut and turn the glass several times until a ring is formed on the inside. Now hold a lighted match under this mark and the glass may be easily separated at the desired point. This method of cutting the glass should be more accurate than using a file to mark and break off the glass.

There are weather prophets and weather prophets, but there is a stone which it is asserted unfailingly foretells changes in the weather. This stone was found in Finland many years ago by an explorer and has been watched by scientists with great interest. It is known as the samakuir, and presents a white mottled appearance in sunshine, gradually turning from gray to black as a rainstorm approaches. The samakuir is made up of clay, nitre and rock salt. In dry weather the salt in the stone is prominent, but when the air is filled with moisture the salt absorbs the moisture and turns black, thus acting as a barometer.

Parchment paper is made by dipping ordinary unsized paper for a few seconds in concentrated sulphuric acid mixed with one half its volume of water and then quickly removing all traces of the acid. The paper thus treated undergoes a remarkable change, it having acquired a parchment like texture, translucent and becomes five times stronger than ordinary paper. Chloride of zinc is also used to impart a parchment effect to paper.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V No. 7. BOSTON, MAY, 1906. One Dollar a Year.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

II. Section Winder and Winding.

Except in coils giving sparks of ½ in., or under, it is advisable to wind the secondary in sections. Unless this is done, the difference in potential between adjacent turns of the wire will be so great as to produce internal sparking; the insulation will eventually break down and a "short circuit" caused, requiring rewinding, a matter which at best is quite difficult with the fine wire used.

The number, size and thickness of the sections depend upon the size of the coil, and as complete specifications were given in the October, 1905, number of this magazine, they will not be repeated here. For illustration, the dimensions and work for a coil giving a 4 in. spark will be given. This size is a very handy one for the amateur, as it is large enough, when used in series with a Tesla high-frequency coil, to do excellent X-ray work, and most of the experiments for which induction coils are used.

It may be well to state at this time, that coils for wireless telegraphy are wound with a larger wire in the secondary, than are those for X-ray and similar work. For wireless telegraphy the desideratum is a strong, fat spark, rather than a thinner one of higher potential, and this is obtained by using No. 32 or 34. B. & S. gauge in place of No. 36. If the coil is desired for various uses, the No. 34 gauge will best fill the requirements.

First let us consider the winder. If possessed of a small lathe, and the occasional cleaning off of wax drops is not objectionable, the attachments to be described can be fitted to the lathe. Otherwise it will be best to purchase a polishing head, similar to the one shown in Fig. 2. Be sure that the collars on the spindle run true and the movable collar fits fairly tight on the tread on the spindle. A polishing head sufficiently well made for the requirements can be purchased at most hardware stores for about $1.25.

A set of three face plates, *A*, *B* and *C*, are made to fit on the spindle, as shown in Fig. 3. These are made from sheet brass or planished steel about ⅛ in. thick and 4½ in. square, which should be perfectly flat and smooth. An easy way to make them is to first bore a hole in the center, the size to fit the spindle with a snug fit. Then place between the collars and screw up

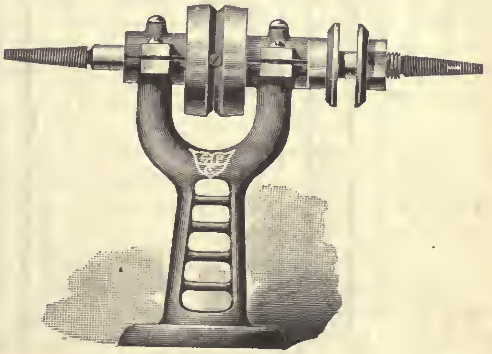


Fig. 2.

the outside collar to hold tight. By mounting the polishing head on a board and clamping to a sewing machine table and belting up to the treadle wheel the polisher can be rotated at a high speed. With a diamond point turning tool, cut the brass plate to a circle 4½ in. diameter, rounding off the edge and smoothing with emery cloth.

Two collars, *W*, are then made of wood ½ in. thick and 2⅓–2½ in. diameter, the circumference being turned to a slight bevel, as shown. This bevel is to facilitate the removal of a section after the winding. Holes are drilled in the plates at *a*, *b* and *c*, through which to run the ends of the wire, and small, round-head brass screws, *d*, *e* and *f*, are put in for temporarily fastening the ends by giving a turn or two of the wire around them.

The winding is done in what may be termed double sections, as follows: The plate *A* and *B* with a collar between are placed on the spindle, the end of the wire from the spool, after passing through the hot paraffine wax, is put through the hole *a* and turned around the end of the screw *e*. The open space is then carefully wound with the wire until the required amount has been put on. Cutting the end with spare wire of several inches, put the end through the hole *a*, and around the screw *d*.

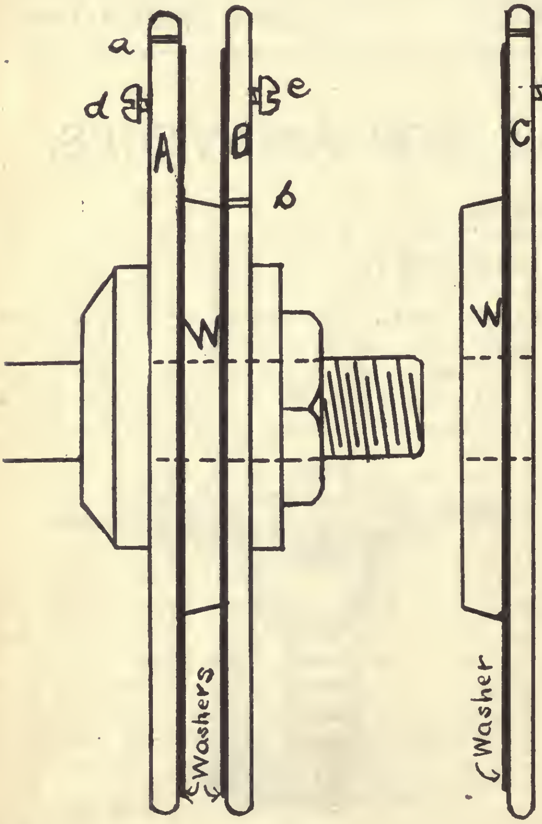


Fig. 3.

The wax will coil quickly so that the section and face plates can be removed from the spindle; in fact, the difficulty will be to keep the wax and wire hot enough to retain the wax soft enough to enable the necessary quantity of wire to be wound on each section. One way of doing that is to suspend the spool containing the wire in the wax tank, in this way bringing wire and insulation to the same heat as the wax, when it will not cool as rapidly as when only drawn through the wax.

The thickness of the sections mentioned above is rather greater than many authorities specify for a coil of this size, but the writer has had no difficulty with breaking down of sections of this thickness, and if care is taken throughout the work of winding the results should be satisfactory, and the labor is reduced almost one-half over what it would be with sections ⅛ in. thick. Some makers carry this fineness to the extent of sections only 1-16 in. thick, and readers who are doubtful about their ability to wind carefully can use the 1-8 in. section to good advantage, in which case the collars *W* should be of that thickness.

After removing the first section, the face-plate *c* is put on with a collar *W*, facing the same as did the face-plate *A*. The wound section is then put on after turning around and removing the face-plate *B*, the end of the wire which passed through the hole *b*, is soldered to the end from the spool, the joint is well covered with cotton thread and coated with wax applied with a small bristle brush. Great care must be taken with these joints, both in the soldering and subsequent insulating of them. In winding the section, the spindle

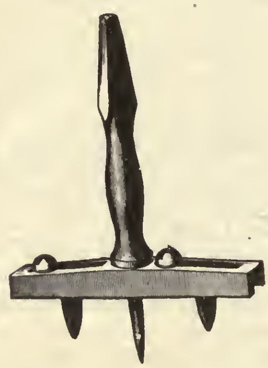


Fig. 4.

must turn in the same direction, as with the first section, and the wire fed in just the same, as the turning around of the first section has obviated the necessity of changing the direction of winding every other section. Mention should now be made of the paper washers which are placed against each face-plate before winding. These are made from a thin, porous cardboard or thick pulp paper; the kind which will readily absorb wax being needed. They are cut out with a washer cutter, or sheets to the thickness of ½ in. may be placed between two thin pieces, such as picture backing, the circles marked out with dividers, and the cutting done with a fret saw. A washer cutter, Fig. 4, that will make both the inside and outside cut at the same time, and having a capacity up to 6 in. can be obtained for about 75 cents and is recommended.

The outside diameter of the washers is a trifle greater than the winding, the hole inside will be 2 1-8 for one half and 2¼ in. for the other half. It will probably be necessary to sharpen the knives of the washer cutter to secure a clean cut and avoid tearing. After cutting out a stock of washers they are dipped in a pan of warm paraffine wax, and then after the wax is set, smoothed with a warm flatiron. The iron should not be so hot as to cause the wax to run, but simply to enable it to slide freely without gathering wax, which a cold iron will not do.

When winding sections, washers are first put on flat against each face plate. After completing the first part of a double section and in preparing to wind the second part, a washer on the second part will divide the two parts. If the washers are made of thick paper, a second washer should be added before commencing to wind the second part. When the double sections are assembled, each part will then be divided by two washers. If cardboard is used, one outside washer is removed from each double section when assembling them.

It is well to number each double section with a pencil as the winding proceeds, and to store them until all are completed in a covered box to avoid dust or accidental injury. It is customary with the first few sections to wind on several turns of paper before starting the wire. To do this cut the paper, which should be very strong and well waxed, into strips long enough to make several turns around the washer *W*. The object of this is to give added space between the secondary winding and the primary, as the sparking tendency is greatest at the ends of the coil, and most breakdowns occur there.

It may be well to state that in winding the secondaries of coils for wireless telegraphy, and using the coarser wire to obtain the equivalent spark length o a coil wound with finer wire, it is necessary to use more wire, consequently the sections will be of greater diameter. Spark length is not so important, however, and if, in using the specifications for a 4 in. spark and the coarser wire, a white, heavy 3 in. spark is obtained, the result may be considered as quite satisfactory.

BOOKS RECEIVED.

Engineers' Turning. By Joseph Horner. 404 pp., 8 x 5½ inch. Price $2.50. Crosby, Lockwood & Sons, D. Van Norstrand Co., New York.

A name that would more nearly indicate the contents of this book to American readers would be:—"The Metal Working Lathe," as the entire volume is devoted to that tool. For this reason, the treatment of the subject is much more complete than with books treating of all the tools of a shop. The author is well known to readers of technical books as a skilled writer, and this book fully equals, and in some respects surpasses, its predecessors. Anyone desiring to know lathe work in all its branches will find this book of the greatest value, as the illustrations are numerous and well drawn and the text clear and practical.

The book is divided into six sections, the first giving a full description of the lathe and its parts, including the special features peculiar to lathes of both American and English make. The second section treats of turning between centers, and section three takes up work supported at one end. In section four internal work is fully described, and section five covers screw cutting and turret work. The closing section includes miscellaneous matters, such as grinding, tool holders, speeds and feeds, tool steels, etc.

The above brief mention of the contents is sufficient to show how great a help the book would be to the apprentice, although its value is almost equally great for the regular lathe hand who desires to learn the most approved methods of turning out work. For teachers of metal working in manual training schools the book cannot be too highly commended.

INDUSTRIAL SCHOOLS IN BELGIUM.

Consul McNally, of Liege, says that in no country in the world does the government attach more importance to the industrial and professional education of its people than in Belgium. While some of the industrial and professional institutions are maintained by the grace of the central government, the majority are subsidized by the provincial or communal administrations. The city of Liege supports one large industrial school and nine professional schools.

The industrial school is one of the best in Belgium and has at present an attendance of 650 pupils. Many of its graduates have become noted in the industrial world.

The professional schools include one for tailors, where the lectures and practical work of a tailor as taught in conjunction are free. The course is five years. The school of horticulture is free, with a course of three years.

The commercial and consular high school is intended to offer an advanced education, both theoretical and practical, and is open to those contemplating the profession of banking, commerce, industry or a consular career. The government usually drafts from the graduates the young men wanted in the various consulates throughout the world, where they remain without compensation during a preliminary prescribed period.

The firearm school was established in 1897, and like the other schools the applicant for admission must have had a primary education. Every detail from the stock making to the barrel is taught, and the boys must pass an apprenticeship in every branch of the gun-making industry. The lectures include both the theory and practical information of firearm making.

The remaining schools embrace tanning, house painting, mechanics, plumbing and carpenter work. The mechanical school includes the study of political economy, hygiene, arithmetic, geometry, drawing (mechanical), physics, chemistry, mechanics, wood and iron work, bicycle and automobile making.

Plumbing is the only school in which an entrance fee is demanded.

"Professional jealousy is a public acknowledgment of inferiority on the part of the one who is jealous."

PHOTOGRAPHY.

METOL-HYDRO. AND ITS ADVANTAGES.

CHESTER F. STILES.

In comparing metol-hydro developers, recommended by the makers and others, one is at once struck with the difference between the various proportions of metol to hydrokinone. The metol-hydrokinone combination is an extremely popular one, proven by its universal use for films.

It is a notorious fact that hydrokinone is faulty in its rendering of tones in the negative, especially in under exposures. When the temperature of the solution is low, hydrokinone becomes inert and its developing energy ceases. Metol, on the other hand, is little affected by temperature conditions, and searches out the minute detail of the negative even in the deep shadows. If metol, on the other hand, has any fault it is in its lack of density power, but the hydrokinone supplies this deficiency and makes, with the metol, a most harmonious developer, which is always under perfect control.

The metol-hydro combination may be worked separately if desired. That is, we may make up a developer of metol and one of hydrokinone; use our metol first to get the image started and follow it up with the hydrokinone portion. By watching the action of the hydrokinone, we shall be convinced that it plays more the part of an intensifier than of a straight developer. This is proven by the fact that it seems to add density to a metol image at a temperature that it would have failed in straight developing without the metol.

In other words, it takes the active metol to attend to the faint impressions of light and overcome the "inertia" of the plates. Just as a bicycle wheel, once set in motion, continues its movement for an appreciable time, so does the hydrokinone pile on its share of the density after being pushed into activity by the metol.

Eminent German scientists have made some very searching investigations on the energy of various metol-hydro mixtures. By careful experiment it has been found that a mixture of two parts hydrokinone to one of metol is equal in strength and energy to that of three parts of straight metol. This curious fact suggested the existence of a definite chemical compound of metol and hydrokinone, and experiments prove the conclusion.

Lumiere Bros and Seyewer, Jr., of Lyons, France, announced the discovery of such a compound. Curiously, it explained some troubles which have occasionally been encountered in compounding metol-hydro combinations. The writer has heard several times of the developer chemicals being precipitated and made insoluble when being made up, and it being reasonably certain that cold solutions were not the fault, the trouble was looked for elsewhere.

The writer had several times mixed very concentrated solutions of metol and hydrokinone with similar concentrated solutions of anhydrous soda sulphite. A precipitate formed, and on distribution seemed to dissolve, showing that the precipitate was insoluble in the stronger sulphite but soluble in the weaker. Adurol gave a similar precipitate. The developers which precipitated were those whose metol and hydrokinone presumably were in the exact proportion to form the precipitate, and the strong sulphite of the concentrated developer, of course, prevented its solution.

No attempt was made to explain the precipitation of the concentrated metol-hydro solutions, for the Lumiere researches suggest a satisfactory reason.

We would, therefore, recommend the use of metol and hydrokinone in proportions of one to two respectively, and it will be seen that the price of this metol-hydro mixture is but slightly above pyro. Considering the energy of metol-hydro against the pyro, we find the former much the cheaper, and the keeping qualities are such as to enable one to keep strong stock solutions on hand for a long time.

It is desirable, where possible, to use distilled water in making up developers. Developers made with boiled water are also quite satisfactory, as the boiling serves a twofold purpose of expelling the contained air, which oxidizes the developer on one hand, and on the other by preventing the bubbles in the developer from reaching the plate. A number of small bottles filled to the neck will be found more stable in keeping qualities than one large bottle.

Metol-hydro is universally used for developing papers that print by gaslight. The formula below may be used with equal success on plates or films if diluted somewhat.

Metol	60 grains.
Hydroquinine	120 "
Water	32 ounces.

Then add 12 ounces of a sulphite of soda solution testing 60° by hydrometer. Be sure to rinse the white sulphate deposit from the sulphite crystals, if crystals sulphite is used, before the 60° solution is made. Next add 12 ounces of carbonate of soda solution testing 30° by hydrometer, and 240 minims of a ten per cent solution of potassium bromide.

The order of mixing noted above gives a clear solution which is approximately equal to the ready-for-use

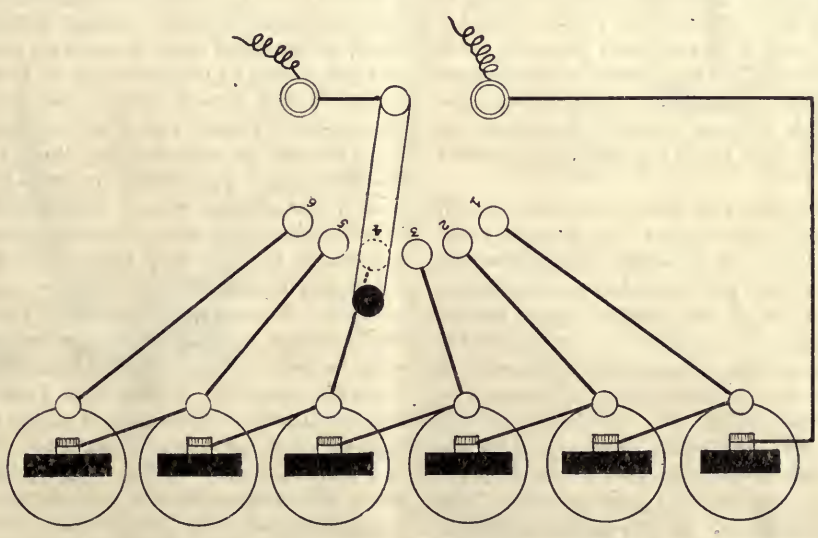
Velox developers on the market. The quantity of bromide necessary varies according to the water used. Velox prints usually reach their maximum density in about 20 seconds, therefore enough bromide should be added to keep an unexposed sheet from fogging in the developer until 30 or 40 seconds have passed. Perfect balance between the developer and the restrainers gives crisp blacks and avoids the dirty green tones.

Hydrokinone comes in snow white crystals which dissolve easily in water to a colorless solution. We cannot too strongly recommend the use of a pure sulphite in making up developers, especially anhydrous c. p. sulphite. Because of its compact nature, it is easily weighed, and while dry it is practically unchangeable, besides being more economical on account of the greater strength. If you must use crystal sulphite, rinse it from white impurities of sulphate which are almost always present. Should you weight white crystals in making up solutions, an error is being introduced and the sulphite will come out too weak. A slight rinsing will dissolve the sulphate impurity, since sulphate is extremely soluble. Roll the crystal sulphite thus rinsed upon blotters, and then weight it. This method is accurate enough.

Adurol is a modified hydrokinone. It has several good features, but the greatest is its advantage over hydrokinone in not being affected by temperature. Metol and adurol make a fine combination, and it gives graduations which are unequalled.

DEVICE FOR CONNECTING CELLS.

M. M. HUNTING.



It is sometimes necessary in making small electrical apparatus to test the work with one or more cells of battery. To avoid the trouble of connecting up several cells to do this work, I constructed a switch similar to the sketch here shown, which permits me to use one to six cells, as the case may require.

The switch is screwed on one corner of my workbench, the battery is on a shelf underneath. Two binding posts on the base of the switch form a convenient way to attach the apparatus to be tested. A battery of any number of cells may be arranged in this way, a point of the switch being added for each cell.

FREE INDUSTRIAL ALCOHOL.

In connection with the recent agitation for free industrial alcohol, the Ways and Means Committee of the House of Representatives has had hearings on the subject in Washington, when an interesting memorandum on the subject was presented by Prof. Elihu Thomson. We quote some portions of it as follows:

"Gasoline as well as kerosene has the great disadvantage that it floats upon water and is distributed by water. It is a well known fact that it is commercially useless to attempt to extinguish burning gasoline or kerosene by water alone. The use of water may, in fact, be a positive disadvantage in floating the burning material over considerable places in spreading fire. Not so with alcohol, which mixes with water in all portions, and which is at once diluted and prevented from remaining combustible.

We have recently tried at the Lynn works of the General Electric Company a Deutz alcohol engine, a type of engine made in Germany especially for use with alcohol, and the results have been such as to prove without a doubt the entire suitability of alcohol, if cheap enough, as a fuel for internal combustion engines. This particular engine is to be sent to the Island of Cuba and coupled to a dynamo for lighting. It will be operated with the cheap Cuban alcohol, which is, I am informed, sold there at about 12 to 15 cents per gallon. A few gallons of this alcohol were obtained and used in our tests here, and it was found to be a a high grade spirit, containing 94 per cent alcohol to 6 per cent of water, or about 91 per cent alcohol by weight.

While it is not methylated or denaturalized, there is no question that the behavior in the engine of denaturalized or methylated spirit would be identically the same as with the pure grain alcohol. To obtain this sample of Cuban alcohol it was necessary that we pay an import duty of $4 per gallon, with other charges, which made the cost of the material used in testing enormous as compared with its actual value in Cuba, and I may here remark that, as in testing an engine of this kind a considerable quantity of alcohol will be used, manufacturers in the United States would suffer a considerable disadvantage in building such engines as compared with those in a country where methylated spirits, untaxed, is obtainable. In fact, the cost of the material for testing the engines is probably a sufficiently strong deterrent just now to prevent the manufacture being taken up in the United States. The island of Cuba is, however, an excellent field for the use of such machinery, on account of the low cost of alcohol.

It may be mentioned here that our experiments developed the fact that alcohol is suitable as a motor fuel even when it contains as high a percentage as 15 per cent of water. Notwithstanding the fact that the heating value of alcohol, or the number of heat units contained, is much less than in gasoline, it is found by actual experiment that a gallon of alcohol will develop substantially the same power in an internal combustion engine as a gallon of gasoline. This is owing to the superior efficiency of operation when alcohol is used. Less of the heat is thrown away in waste gases and in the water jacket. The mixture of alcohol vapor with air stands a much higher compression than does a mixture of gasoline and air without premature explosion, and this is one of the main factors in giving a greater efficiency.

The exhaust gases from the alcohol engine carry off less heat. They are cooler gases. It is well known that the exhaust gases from a gasoline or kerosene engine are liable to be very objectionable on account of the odor. In our tests of the Deutz alcohol engine there was absolutely no such objection with alcohol fuel, the exhaust gases being but slightly odorous, or nearly inodorous, but what odor there was, was not of a disagreeable character.

There is just now the beginning of a large development in the application of the internal combustion engine to the propulsion of railroad cars on short lines as feeders to the main lines. In this case an ordinary passenger car is equipped with a power compartment at one end, in which there will be installed an engine of, say, 200 h. p. of the internal combustion or explosion type. The growth of such a system is liable to be hampered in the near future by the cost of gasoline as a fuel, and the difficulties of using kerosene are still quite considerable. Especially is the exhaust likely to be offensive. In this case alcohol, which could be produced in unlimited amount, could be substituted.

It may be mentioned in conclusion that the efficiency—that is, the ratio of the conversion of the heat units contained in the fuel into power—is probably higher in the alcohol engine than in engines operated with any other combustible, and doubtless, on account of comparative newness of the alcohol engines, there is still room for improvement in this respect."

A copy of the bill introduced in the House by Mr. Calderwood making ethyl alcohol free, if rendered undrinkable, has now been circulated with a petition for signature. Accompanying the bill is a very interesting pamphlet going over the whole field of arts and industries, pointing out the manufacturing and other purposes for which untaxed denaturized alcohol would be used, and arguing that the development of many important industries is hampered by an excessive alcohol tax. Reference is made, for example, to use in lacquer work, where the solvent is the principal item of cost.

Special note is also made of the use of shellac and alcohol in binding together the coil or layers of wires in motors and generators. The use of this alcohol-shellac solution is also noted in regard to the manufacture of mica and other insulating material used in electrical machinery.

TOKEN MONEY IN WAR TIMES.

Token money is doubtless a thing of the past, says the "Mining World". Token money is a name applied to pieces of money current only by sufferance and not coined by the authority of the state or government. Token money abroad was quite a common occurrence fifty years ago. In the United States small coins became so scarce during the Civil War that tokens made their appearance in great quantities. They were of two classes, war or patriotic tokens and trade or advertisement tokens. Both kinds were issued with a business view, as they passed for one cent, but cost much less to manufacture. There were about 400 varieties of the war tokens coined. The first coinage of trade tokens was in Cincinnati, where 900 varieties were issued. Other cities in the West followed Cincinnati's example. In 1863, New York folks issued the famous Lindenmuller cents, of which more than a million were put into circulation. These were followed by the Knickerbocker and many others, and there were about 700 varieties coined in New York alone. There were 1200 issued in Ohio from a hundred different places, and in other states the coinage was most numerous. In 1864 the government put a stop to the coinage of tokens, but not until 20,000,000 of them were placed in circulation.

AN ELECTRIC FURNACE.

The electric furnace is a great favorite with experimentalists, in consequence of the very high degree of heat which is readily obtainable by its use, reaching from 3500° to 4000° Cent. (7232° Fahr.), while with the ordinary blast furnace 1800° C. is rarely surpassed. With the oxy-hydrogen blowpipe, a temperature of 2200° C= about 4000 F. has been obtained. It is not at all difficult either to make or to use such a furnace; and we purpose here, in the interest of such of our readers who make chemical or metallurgical experiments their hobby, to describe the construction of a small laboratory furnace, that can be actuated either from a battery of 25 bichromate or from any electric light main capable of giving a continuous current of from 8 to 10 amperes at 50 volts pressure.

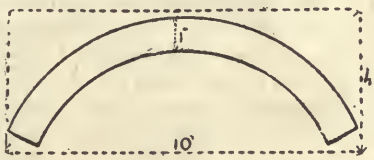


FIG. 1.

To make such a furnace, we shall begin by procuring or sewing up, a slab of slate, about 1 in. thick by 8 in. square. If not already smooth, this can be levelled by rubbing it over a flat stone surface along with fine sand and water. For the crucible, in which our melting or electrolytic operations are to be effected, we shall do well to select one capable of containing about 2 pounds of ore, and constructed almost entirely of carbon. As carbon is a very fair conductor of elec-

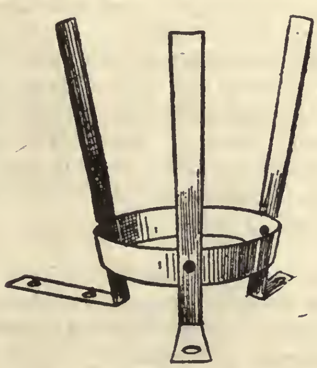


FIG. 2.

tricity, there is no necessity for using a separate negative electrode, the crucible itself serving that purpose. Besides, it is practically infusible, itself highly refractory, and does not contain any matter that would oxidize or otherwise contaminate the results of our operations. To mount this crucible in such a manner as to make a good electrical contact with the terminal that will afterwards be used as the negative of our furnace, we procure a sheet of No. 22 gauge copper about 10 in. long and 4 in. wide. On its surface, concentric to one another, we inscribe, with a pair of compasses, two segments of circles, one of 11 in. and the other 9 in. in diameter and 1 in. apart, as shown in Fig. 1.

We then cut off the superfluous metal, indicated by the dotted lines, and bend the segment, shown by the heavy black lines, into the shape of an inverted cone, which should be made to fit exactly around the bottom of the crucible; the ends overlapping by about 1 in. A mark should now be made at the center of the overlapping portions, a hole put through both, and the conical ring thus formed, joined together by riveting through this hole with a flat-headed copper rivet, carefully hammered smooth.

From a strip of hard brass ribbon, about No. 30 gauge and ½ in. wide, we cut three lengths, one being 9 in. long, the other two only 7 in. We bend all three into the shape of a letter L, the two latter having the horizontal portion only 2 in. long, while the former has

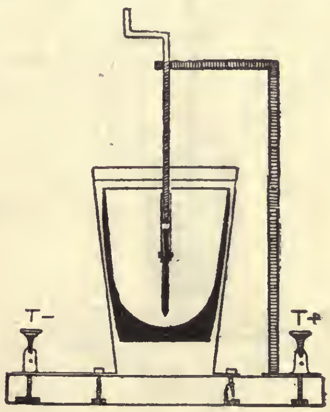


FIG. 3.

its horizontal portion 3 in. long. These we rivet at three equi-distant points on the circumference of our conical ring, so that the ring stands 1 in. from the shorter limbs, which are then bent more acutely, so as to allow the tripod thus formed to stand quite level on its three feet. See Fig. 2. A 3-16 in. hole is now put through the center of each of these feet, the tripod with the crucible firmly pressed down in it, is placed centrally on the slate slab, with the longer foot pointing to one of the corners thereof.

At the points where the holes have been made through the feet, marks are made on the slate slab, the tripod removed, and three holes, countersunk underneath, are put through the slate at these points, into which three small metal screws are inserted from below, these screws being fitted with nuts to hold the feet in position. From a strip of thin brass ½ in. wide a perfectly cylindrical ring, 3½ in. diameter, is now made by riveting the extremities together. This ring is used to draw the three prongs of the tripod towards one another, when the crucible has been placed between them, and this conduces to produce good electrical contact between the tripod and crucible. It is needless to say that the prongs of the tripod must be curved inwards, so as to follow as nearly as possible the curvature of the crucible.

A hole should now be made near the extreme end of the longer foot of the tripod, extending through the slate base, and here should be inserted and screwed in the shank of a fairly stout terminal fitted with a nut below. In the opposite corner of the slate we now drill a full ½ in. hole and countersink it underneath. We now take a round iron rod, ½ in. in diameter, and file, or better, turn down 1½ in. at one extremity, on which we put ½ thread by the aid of a screw cutting die. Inserting temporarily the screwed end of this rod into the hole just made, we make a mark on it, at such a height as will clear the mouth of the crucible and its clamping ring by about 5 in.

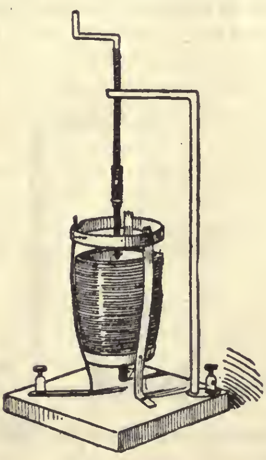


FIG. 4.

We then red-hot the iron rod and bend it neatly and squarely at right angles at this point, and afterwards cut off at the bent end, whatever projects over ¼ in. of the center of the crucible. At this extremity of the rod, exactly in line with the center of the crucible we drill and tap to ¼ in. Whitworth, a hole, in which we fit a screwed brass rod about 9 in. long, bent twice at right angles, so as to form a handle to the screw itself.

We now take a piece of solid drawn brass tube, 2 in. long 3-16 in diameter inside, and with a ¼ in. tap, put in it a ¼ in. female thread for a depth of about ½ in., so as to grip firmly the end of the screwed brass rod. With a fine hack saw we split the tube in four quarters for a length of about 2 in., at the opposite end and fit this with an outer ring, which should be a sufficiently tight fit to bring the sides of the split ends together. This tube serves as the carbon holder, the carbons to be used with it being known as the "6 millimeter," or ¼ in. size.

These carbon rods should be about 4 in. long and at least 2 in. should be inserted into the tube or holder. An oval brass washer, 1½ in. long by 1 in. wide, with a ½ in. hole at one extremity, is now put over the 1½ in. screwed end of the bent iron rod; this is inserted in its hole in the slate base, care of course being taken that the center of this iron rod and its carbon holder coincide with the center of the crucible. Lastly, we drill a hole through the extended portion of the brass oval washer, and partly into the slate base and fit therein a second terminal similar to the one at the opposite corner. To use this furnace, which we represent in section at Fig. 3, and in perspective at Fig. 4, it is only necessary to connect up the positive pole of the battery or dynamo to the terminal T+, the negative to T—, and lower the carbon by means of the screw S, until the arch has been struck between the carbon rod and the bottom of the crucible, immediately pouring into the crucible a little of the material to be operated upon, being careful to maintain the arc, by duly lowering or raising the carbon rod, and adding more material in proportion as it becomes fused or electrolysed. —"Hobbies," London.

Speaking of industrial education in the United States, Heinrich Back, of the industrial school at Frankfort-on-the-Main, Germany, expresses surprise that our government has taken no steps towards providing systematic training of its citizens in industrial lines. This is at present entirely in the hands of philanthropic individuals, and no schools intended for teaching trades have been established by government effort. In the larger cities, good schools such as the Drexel Institute of Philadelphia, Pratt Institute in Brooklyn, and Lewis Institute in Chicago, have been established, but there are large sections where it is impossible for boys to obtain any industrial training. This is in direct contrast to the policy of the German government, which maintains in every part of the empire good trade, industrial and technical schools.

The proper site for a windmill, where there is no danger of its being blown over, has been generally supposed to be a place sheltered by trees or barns. Actually, however, the safest place is on a hill, where the wind can strike it equally from all directions. In such a location shifting winds are less pronounced than behind buildings or hills, and it is also found that there is less lifting force to the wind in the open than behind structures.

A gallon of water, U. S. standard, weighs 8⅓ pounds and contains 231 cubic inches.

A 9-FOOT ROWING OR 12-FOOT POWER TENDER.

CARL H. CLARK

III. Canvas Covering—Interior Fittings.

The planking having been completed and smoothed off it may be left for the present and some of the inside fittings put in. These fittings should be put in before covering the boat with canvas, as they may then be fastened with through rivets, and be much stronger than otherwise. The gunwales having been fitted as already described, and fastened by riveting through the top streak, the ends of it are fitted with knees as shown in Figs. 6 and 7.

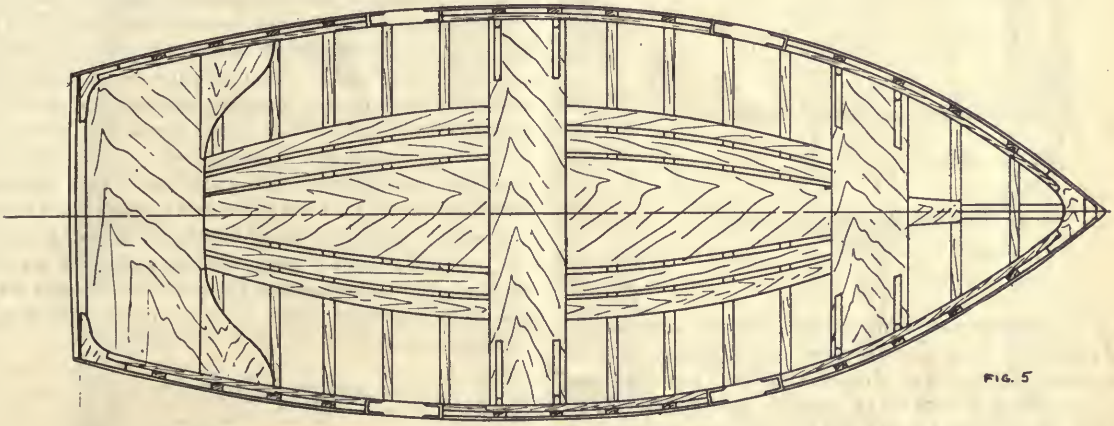


FIG. 5

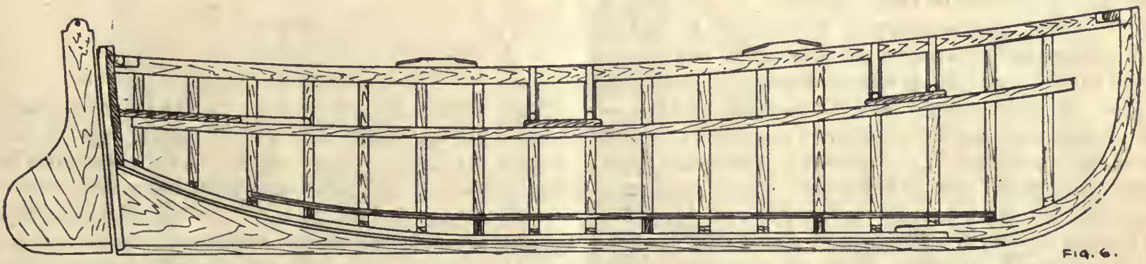


FIG. 6.

These knees are to be of natural growth and are 1 in. thick in the small boat, and 1½ in the larger. They fit in against the top streak as shown in Figs. 7 and 10 and the gunwales are let into them and fastened by rivets through the top streak. In as light construction as that being described, all fastenings wherever possible, should be riveted through, as screws or nails do not hold sufficiently strong in the light stock. The knees at the stern may, however, be fastened to the sternboard with brass screws.

The strips to support the seats should next be fastened in place, extending the full length of the boat. For the small boat these strings are 3 x 1½ in. of either pine or cypress, and are fastened with their upper edges 6½ in. below the gunwale. They should be through riveted, with the head of the rivet on the outside of the plank and the burr on the inside of the strip, a rivet being driven through each frame. For the large boat these strips are ½ x 2 in. and are fastened 7½ in. below the gunwale. The strips, besides supporting the seats, materially stiffen the boat.

The seats are next to be fitted; they are ⅞ in. thick and 8 in. wide in the small boat and 9 in. wide in the larger. The ends are notched to bear against the frames and should be clear of the plank about ½ in. Each seat has four knees, as shown in Figs. 5 and 6; they are of hackmatack or other suitable knee stock, ⅝ in. thick for the 9 ft. boat, and ¾ in. thick for the 12 ft. They are shaped as shown to fit between the seat and frame, and are notched out around this gunwale. A rivet should be driven through the upper end of the knee and the gunwale to the outside of the top streak and another through the lower end and the seat. The remainder of the fastenings may be brass screws driven into the knee from the outside, and into the seat. The seats should be of pine or similar light stock or, if desired, mahogany may be used. If the edges are beaded it adds a finish and makes a more workmanlike piece of work.

The after seat is shaped as shown and is 12 in. wide in the narrowest part in the 9 ft. boat, and 15 in, for the 12 ft. It rests on and is fastened to the supporting strips with brass screws.

Several heavy floor timbers must be fitted to support the engine bed; they rest on the top of the frames in the same manner as already described, and are 1½ in. thick and about 3 in. deep above the keel. Their tops should all be in the same level to facilitate fitting the bed. For fastening, the ends should be well riveted through, and screws driven at intervals, with a heavy screw into the keel amidships.

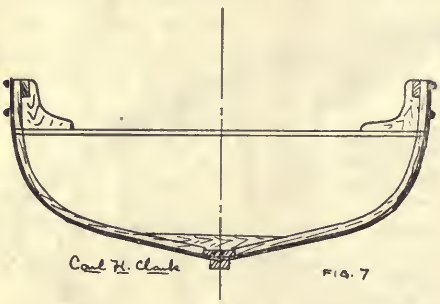


Fig. 7

All the outside fastening being complete, the boat is ready to cover with canvas, after all projecting nail or rivet heads have been driven tight, or else filed off even, so that the surface is smooth again. As there may be some rather wide seams which would cause cracks in the canvas after some use, the outside should be covered with two or three layers of tough manila paper. It will be necessary to put this on in rather narrow strips over the seams on account of the curvature of the surface, as all wrinkles must be carefully avoided. Shellac should be used to stick on the paper, a liberal amount being used, as the paper must be thoroughly protected from the water. The space to be covered with paper should be covered with shellac, the paper laid on, and it in turn shellacked, each layer being treated the same. The various pieces should overlay as seldom as possible, so as to keep the same thickness all over. Any unevenness in the final coating should be rubbed down with sandpaper after the shellac is dry. This paper coating also adds to the strength of the boat.

The next work is to put on the canvas covering, which is, perhaps, the most troublesome part of the whole work. Canvas for this purpose should be of No. 12 weight for the small boat and No. 10 for the large one. It can be obtained in all widths, and should be wide enough to put on in one piece. For fitting the canvas the boat should be fastened down securely, as a considerable amount of force will be exerted in pulling the canvas into place. For fastening the canvas, copper tacks about 5-16 in. long are to be used; some difficulty may be found in driving them into the oak, in which case tinned iron tacks may be used, but only where necessary.

The outside of the boat should be well covered with rather thick paint. The canvas is then laid on and tacked along the straight part of the keel; and is split at the ends where the curves of bow and deadwood begin. The ends are then carried over so as to make it fit as nearly as possible and tacked temporarily; the middle portion is then drawn tight and tacked to the lower edge of the top streak with tacks about 1 in. apart. It may then be tacked on either side of the middle, working gradually towards the ends, care being taken to pull it out lengthwise at the same time, to avoid wrinkles around the boat. It should be drawn as tight as is possible, one or two persons drawing it out while another drives the tacks.

At the bow it is drawn around and tacked to the face of the stern, while aft it is drawn over the curved part and tacked in the same manner; at the stern it is drawn over and tacked around just inside of the stern-board, and not to the ends of the planking, as it would tend to pull them out of place. No tacks should be driven in the body of the canvas, as if it is properly stretched out it will be tight on the plank. The surplus canvas is now to be trimmed off about ¼ in. outside the line of tacks, using a sharp knife and a guide, the rows of tacks should be nicely smoothed off, as mouldings are to be fitted to cover them, which must lie smoothly.

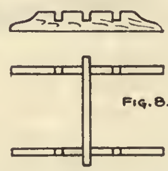


Fig. 8.

The outside should now be painted two or three coats, allowing time between for each coat to dry thoroughly; after this treatment the canvas should be firm and solid. Especial care must be taken to thoroughly fill around the tacks. The inside should now be treated with two coats of shellac, rubbing it well into the cracks. It would even be well to have given the inside a coat of shellac before bending in the frames, as then there would be no bare spots under the frames.

The stem, hull and deadwood are next to be fitted according to the plan of Fig. 6 and 7. The keel is straight, the curved piece of deadwood filling in the space between it and the boat. The stem is bent and joined to the keel as shown. The deadwood should be fitted first; the pattern may be taken from the original full size drawing, but some allowance must be made for fitting as there may have been a slight change in the shape. It must be a good fit, as otherwise it will be impossible to fasten it securely. It

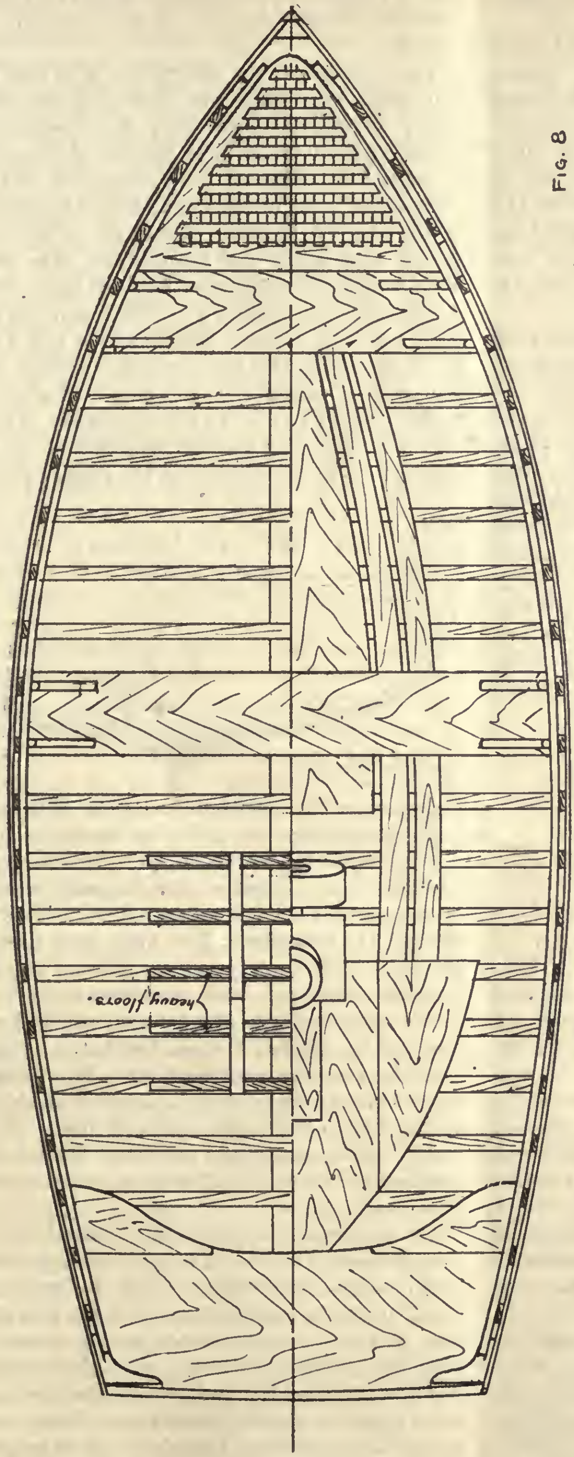


Fig. 8

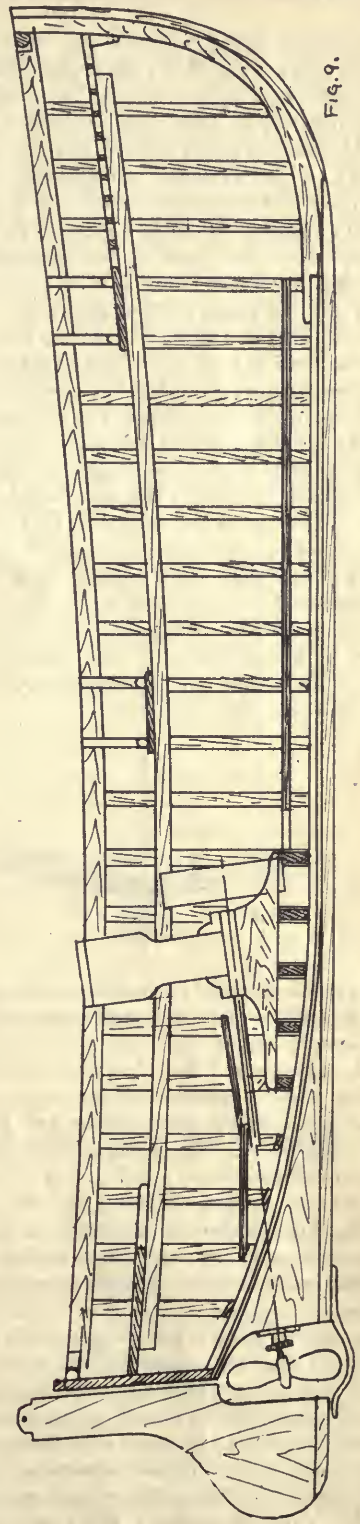
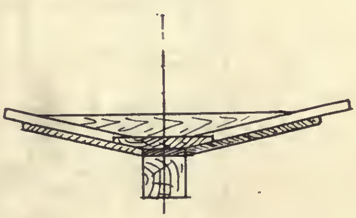


Fig. 9.

is 1½ in. thick in the small boat and 2 in. in the larger one.

Referring to Fig. 1, there will be noticed a curved dotted line at the after end of the deadwood; this is the shape for the power boat, to allow clearance for the propeller, as also shown in Fig. 6. The shaft hole would best be bored before fastening in place. It is about 1 in. in diameter; no specific directions can be given as to its direction as this will be governed by the style of engine. It is, however, 4½ in. above the base line on the other end of the deadwood. This hole must be accurately bored and, on account of its length, an extra long auger will be required.

To do this the deadwood is set up and firmly fastened in a convenient position and the boring carefully done, sighting both ways during the operation. It is well to begin boring at both ends, as any irregularity in the middle is not important and may be smoothed out by burning with a hot iron rod. It may be continued through the keel after the deadwood is fastened into place. The deadwood may now be fastened on, using brass screws driven from the inside except at the point, where a few flat head nails should be used. Each screw should be dipped in white lead before driving, as then it draws up tighter and is less likely to leak where it passes through the canvas. In the 12 ft. boat, a few screws can be driven up through the thin after end into the inner keel.



The outer keel is 1½ x 1½ in. for the small boat, and 2 x 2 in. for the large one, and in a straight length. At the forward end it runs out as shown to about ½ in. the stem being notched down in order not to leave a feather edge. Amidships the keel is fastened by brass screws driven from inside, and aft it is screwed to the deadwood. The vertical piece on the after end of the deadwood shown in Fig. 5 is of the same thickness as the deadwood and ¾ in. deep; it is notched into the keel as shown, and extends the full depth of the stern board; its object is to stiffen the deadwood. The deadwood may be thinned down on the after end to about 1 in. thick.

The outer stem is ¾ in. thick and wide enough to cover the face of the stem. Its forward edge is tapered to ⅜ in. to receive the stem band. It is well steamed and bent to shape, allowed to cool and then fitted and fastened in place with brass screws.

The rows of tack heads must now be covered with half round mouldings; of the same material as the top streak. These mouldings are ¾ in. diameter for the tender and ⅞ in. for the launch, half round. On the stm a piece of sheet brass, or even sheet lead shoulde be bent around over the tack heads and neatly fastened.

The floor board for the tender is of ⅝ in. pine about 8 in. wide, tapered at the ends to fit the shape of the boat. It rests upon the deep floor timbers already in place, and will require to be sprung down into place. It should be fastened with screws, so as to be easily removable. Just outside of the floor board one or more strips about 3 in. wide should be fitted to give additional foot space and protect the skin of the boat. Foot braces are to be fitted for each seat similar to Fig. 8, the side pieces being ¾ in. thick and the cross pieces ¾ x 1½ in. The rowlock blocks are of oak ¾ thick and 8 in. long, shaped to the curve of the side, bevelled as shown, and fastened in place with slim screws to the upper edge of gunwale and top streak. The best position for these can best be ascertained by trial. The rowlocks used should not be the socket pattern which

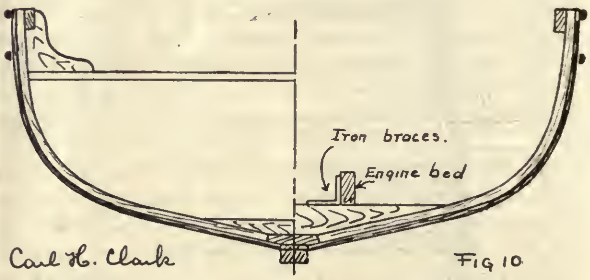


Fig 10

necessitates the cutting of a large hole in the block and gunwale, but should be of the plate pattern, fastening on the top of the block. Rubbing strips are to be fitted on the bilge to take the wear when the boat is pulled out on a float or wharf. They should be about ⅝ x 1 in. and 4 or 5 ft. long, very firmly fastened through with nails, as any movement of these strips will tear the canvas and cause a leak.

The shaft hole in the launch should be extended through the keel and smoothed out. In order to prevent the water coming in at the joint of the deadwood and hull, it is suggested that a piece of thin lead pipe be inserted in the shaft hole and the projecting ends carefully hammered out onto the surface, set in paint and tacked; this will effectively prevent any leakage from this source.

The engine bed should now be fitted; it is of 1½ in. oak, shaped as shown in Fig. 9. The exact dimensions of the engine bed must be known before building this boat. A line is struck through the center of the shaft hole and the measurements taken from the engine base laid off from it. The engine should be placed as low down in the boat as possible, the flywheel clearing the frames by two inches or more. The beds run fore aft and are placed at the proper distance apart to fit under the flanges of the bed. They should bear evenly on the cross floor timbers already fitted, and are fastened to them by screws wherever possible. Four or more angle braces should be fitted on the inside between the floors and the bed, to further stiffen it; these braces being of iron, 1 x ½ in. with 4 in. arms. This construction should make a very strong bed and allow very little vibration.

The floor boards of the launch are of pine ⅝ in. thick and should be fitted around to lie flat on the cross floor timbers. They should stop clear of the flywheel, leaving enough room for the hand, while starting the engine. They are fastened down with screws to admit of easy removal. Outside of the flat portion there are two or more strips about 3 in. wide and ⅝ in. thick bent around as additional protection extending, as will be noted in Fig. 9, to just abreast the engine.

The floor in the after end is raised, as shown, to a 2 or 4 in. higher level. It must be fitted by trial to the side of the boat, a few high cross timbers of light stock being put in to hold it. The shaft will probably cut through the floor; in this case a small sloping box of wood or guard of brass can be made to cover.

The triangular space in front of the forward seat should be filled in with either a solid piece nicely fitted or preferably a grating, as shown in Fig. 8. The latter is preferable, as it looks and is much lighter. In making this grating a frame is built of pieces 2½ in. wide. The fore and aft strips are ⅝ in. square, let into the side pieces and set ⅝ in. apart. The cross strips are ½ in. wide and ½ in. thick, let into the fore and aft strips and set ⅝ in. apart. This grating sets in on the same strips which support the seat, and a small cleat is fastened on the stern to hold the forward end.

The rudders should be shaped as in the sketches, that for the small boat being ⅝ in. thick, and that for the large one ⅞ in. Fig. 9 shows that for the launch cut out to admit the propeller. A cleat is fastened across the bottom to prevent warping. Regulation rudder braces are used to hang the rudder, two being necessary. The skeg is of galvanized iron 1½ x ⅝ in., bent so as to clear the propeller and still close the space and prevent lines and moorings from catching on the propeller or rudder. It is fastened to the keel with galvanized iron screws. The top of the rudder is tenoned down to fit the rudder yoke.

Stem bands should be fitted of the same width as that of the face of the stem. The pattern should be chosen that has a broad flat palm to fit over top of the stem, or else the upper end of the band must be bent at a right angle to fasten over on the stem and retain the several pieces in the right position. The band should be long enough to cover the joint between the stern and the keel. A strong eye should be fastened on the inside of the stem to fasten the painter to.

Rowlocks for the large boat should be of the pattern which screws on to the side of the gunwale, no blocks being required. One pair only will be required, and they should be fitted to the forward seat.

Spruce oars should be used; for the small boat 7 ft. are best for salt water, and 7½ ft. for fresh water; for the launch 8 ft. length is required. It is recommended that they be fitted with a joint similar to that of a fishing pole, as they should seldom be required; they should, however, always be carried.

The final painting and finishing may now be done. After the pores of the canvas are well filled with paint the surface should be rubbed lightly with sandpaper and another coat applied; this should continue until the grain of the canvas has entirely disappeared and the surface is smooth, when the finishing coat may be applied. The top streak looks very nicely if left bright, and the same applies to the inside work, if the stock is good. All bright work which has not already been so treated should have a coat of shellac and be rubbed down, afterwards putting on two coats of best spar varnish. None but the very best spar varnish should be used, as poor varnish will soon wear off and allow the wood underneath to suffer.

It must be remembered that boats of this type, while naturally strong and durable, must be well taken care of and not abused; they must be kept well painted, as lack of it will cause the canvas to wear rapidly. With proper care, however, this style of boat will last as long as any other.

The engine for the power boat should be 1½ or 2 h. p. and should be as light weight as possible and of moderately high speed, as this type vibrates the best.

The gasoline tank should be placed under the forward grating and the pipe led either under or alongside of a floor board, where it cannot be damaged About a ten gallon tank would be advisable for this size boat. The batteries and coil should be placed in a watertight box under the middle seat; a double set of batteries should be carried.

Detailed directions for installing the motor will not be given, as they have already been given in a preceding description, and also there are individual features regarding each engine which must be considered separately. Most builders of engines give a piping diagram with the engine or would willingly do so if requested at time of purchase, and from this the detailed directions may be obtained.

EXPLODING TEST OF CARTRIDGES.

In a recent test made at the suggestion and expense of the various manufacturers of cartridges, it was demonstrated that cartridges can be burned in a fire without danger to those standing near. As the shell of the cartridge is not confined, the force of the exploding powder tears the shell open instead of throwing the bullet, and these pieces of light shell will not produce serious injuries. The cartridges explode only one at a time instead of simultaneously, so that it is a continual popping instead of a large explosion. In the test, firemen were able to work within 20 feet of where the cartridges were burning without danger or inconvenience.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

MAY, 1906.

The competition of labor is not a new subject, yet it is so important that it can rightfully be given frequent and earnest attention. The feature now to be considered is the changes which have taken place in many manufacturing processes, whereby the opportunities for thoroughly learning a trade have virtually passed away. Even the few places which provide for apprentices, cannot give the variety of instruction once afforded—even required—of every youth. In the machinists' trade, chipping and filing, forge work, key-fitting, etc., are such a small part of the work that only a smattering of such work can be given. Special and automatic machines, jigs, etc., make much of the work so easy that a few months' experience will enable any intelligent man to earn the usual wage paid for that class of work.

This specialization of work does not mean, however, that the first-class, all-around machinist is no longer in demand, for just the reverse is the case. There is a dearth of skilled mechanics having the training and judgment necessary to properly fill such positions as foremen, superintendents, etc. The cause for this peculiar state of affairs is that the change in methods has been so rapid that the workman's side of the case has not received due attention.

It is useless to attempt a revival or extension of the old apprenticeship system. Why this is so, cannot here be stated owing to lack of space. New educational methods, which will supply the deficiencies of the shop must be supplied, and these methods must be extensive and thorough. Beginning at a comparatively early age the educational work must be progressive and practical, and in accord with actual shop methods. Completing such a course of instruction, the youth can then enter a shop with confidence that progress will be sure and rapid.

Owing to the difficulties reported by many readers in obtaining parts for induction coil-making, we are arrangeing to offer as premiums the supplies most difficult to obtain, and hope to be able to make definite announcement of the conditions in this issue. We are sure this will be greatly appreciated by all interested in coil making.

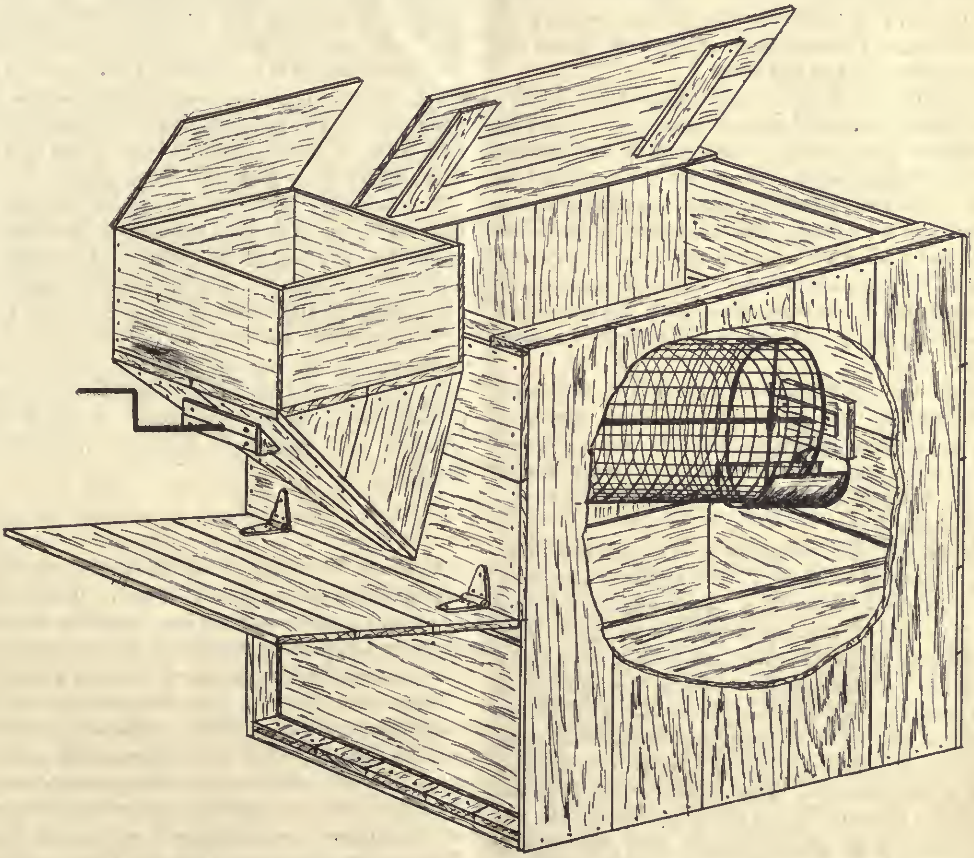
We are frequently in receipt of letters in which the wish is expressed that this magazine be issued weekly or semi-monthly. We are deeply grateful for these evidences of regard for our work, but we are inclined to doubt whether the increased cost of more frequent issues would be generally acceptable to our readers. We think the situation will be best met by increasing the size of each issue, leaving the number as at present, and we are confident, from the splendid subscription returns during the last half-year, that a substantial increase in size can be made in the Fall. If each subscriber would send us one additional subscription, the increased size would be forthcoming in short order. Let each one do his part.

There is more iron produced than any other metal. Copper is next and lead follows. Then come zinc, tin, nickel, silver, gold, quicksilver, aluminum and platinum in their order.

COAL-ASHES SIFTER.

JOHN F. ADAMS.

This is the season of the year when the big ash pile in the corner of the cellar demands attention, and usually it is a job which is approached with reluctance, as during the work of sifting and removing it, both the worker and the cellar become liberally coated with dust. The sifting device here described is one recently made by a neighbor, and he reports that the sifting of ashes is not only a quick and easy matter, but also that very little dust can escape during the operation.



The illustration clearly shows the design. The unsifted ashes are placed in the hopper and the lid immediately closed. The ashes fall into the cylindrical iron screen which is turned by the crank on the end of the shelf extending through the front of the hopper. The screen is inclined at an angle of 15°, so that the turning causes the coals to run out of the lower end, where they fall into a box or hod placed to receive them.

The ashes and all bits of coal fall through the screen, which is of ½ in. mesh, into a box underneath; the box being removed when full, and the ashes emptied. The box receptacle can be replaced by the usual wooden barrel, by making the bottom into a hopper shape, but this brings the feed hopper rather high from the floor as, owing to the weight, it is not easy to lift from one barrel to another. The box arrangement shown is to be preferred.

It will be advisable to construct the screen cylinder first, and then make the dimensions of the box to conform to the screen, keeping in mind that the screen shaft is inclined at an angle of about 15° and that allowance must be made for the overhang of the screen at the ends. With a screen 30 in. long an 15 in. diameter, this requires that the box be 33 in. long on the inside. The shaft is a piece of ½ in. cold rolled iron, 62 in. long. At the outer ends two bends of 5 in. each are made to form a crank, but the bending is not done until after the screen is finally put in place.

For the screen will be needed a piece of heavy wire galvanized iron screening with ½ in. mesh, 47 in. long and 30 in. wide. In cutting off, leave enough of the protruding ends to turn over the cross wire, thus preventing the joint from opening up with wear. It will also be necessary to remove one cross wire so that in making the joint the protruding ends can be turned over the cross wire of the opposite end, thus making a firm joint. A pair of long nosed pliers will be helpful in this work, the turns then being closed up with a hammer.

It will next be necessary to fit two arms to the shaft upon which to support the screen. In the one examined by the writer these arms were made of pieces of wood 15 x 2 x ⅞ in., fitted to the shaft with a jam fit and further secured by wire nails put through small holes drilled in the shaft with a hand drill, the ends of the nails being turned over. As these pieces of wood sometimes checked the free movement of the ashes, a better way would be to use some ½ in. half round iron strips, two pieces at each end, riveting to the shaft and to each other, and turning the ends outward and curving them to the shape of the screen, to which they are secured by wiring. These arms are located 3½ and 29½ in. from the inner end of the shaft.

The wooden case is made of lumber from a large case, or several shoe cases, and obtained at much less expense than if purchased in the board at the lumber yard. The constructing of the top is shown in the illustration. The two pieces running lengthwise are 34 in. long and 4 or 5 in. wide; the two pieces at the ends 20 in. long and 5 in. wide. These are nailed together with the end pieces underneath. The bottom is made the same size and in the same way, with the exception that it is completely covered with boards running lengthwise.

The sides are then nailed on and are cut from matched boards 38 in. long. The two lower pieces of the rear end are then put on, the boards running crosswise, and the front end from the top downward, for 32 in. A door, hinged at the top, is made to cover the lower part of the front.

The top part of the hopper is a box 12 x 14 x 10 in. with a cover hinged as shown. The board at the back is only 8 in. wide, to allow the lower edge to be set 2 in. below the level of the top of the large box. The lower outside edges are beveled off with a drawknife and placed so that the pieces forming the bottom of the hopper may be securely nailed to it. The pieces forming the V part of the hopper are about 10 in. long at the longest parts, and are cut to bevels to fit the end of the box at the corners. The front side at the bottom is about 3 in. wide. When correctly fitted they are nailed to the top, and after cutting a feed hole in the front of the box, the hopper is then nailed to the box.

The feed hole just mentioned is a shallow U shape about 10 in. diameter, with the lower edge about 14 in. from the top of the screen box. The lower end of the hopper is then covered with a piece of zinc or tinned iron from a large can, having a lip which projects about 2 in. into the screen box and serving to prevent the ashes from falling between the ends of the box and screen. It is fastened in place with tinned tacks, holes being punched in the tin plate for the same with a sharpened nail.

A thrust block bearing is then made for the rear end of the screen shaft. A piece of board about 6 x 10 in. is recessed on one side to receive a small iron plate, which may be made from a piece of tire iron, or similar stock, to be had at any blacksmith shop. Holes are drilled for screws for attaching to the board. A hole about 1 in. diameter is bored in the center of the wood to receive the shaft, the end of which rests against the iron plate.

The bearings for the shaft are then made from two pieces of flat bar iron about 6 in. long, 1 in. wide and 3-16 in. thick. They are laid side by side and a small circle laid out at the center of the joint. The circle is filed out with a round file, keeping in mind that the shaft is at an angle of 15° and the hole between the pieces must coincide. The hole is made slightly less than the diameter of the shaft, so that the wear can be taken up by moving the plates together as they wear. Similar plates are made for the front end bearings, but owing to the angle of the hopper front, it will be necessary to receive the plates. A 1-in. hole is bored through the front of the hopper at an angle to receive the screen shaft.

The screen is then put into place through the opening left at the rear, this opening is boarded up, covers made for the top of the case and hopper and lower part of the front. A box is made to receive the ashes and placed in the space under the screen, and the sifter is then ready for duty.

The pupils in manual training schools who wish to convince their parents that the instruction they are receiving is of some "practical" value, will find this sifter, if well made, an excellent illustration in that respect.

Bismuth is a hard, brittle metal, with a reddish-white color and metallic luster. It looks much like antimony, but is readily distingushed from the latter by its reddish tinge of color. When heated to redness it burns with a bluish flame, forming the yellow oxide of bismuth. It is not very abundant in nature. The most important ores of bismuth are the oxide and sulphide. Its chief use is in pharmacy, and the metal must be free from impurities, particularly arsenic. Bismuth ores are roasted, after which various methods of treatment are employed, according to the ore. When arsenic is present the last traces of it may be removed by melting the metal with niter. Hydrochloric acid has little effect on metallic bismuth; strong sulphuric acid forms bismuth sulphate, and when treated with nitric acid bismuth acid results. Bismuth is not known to form any combinations with hydrogen.

Among the uses that borax is put to are: In the manufacture of porcelain-coated ironware known as granite ware; in pottery and earthenware as a glaze; in the manufacture of paste used in glasses and enamels; in artificial gems, etc.

SPECULUM GRINDING AND POLISHING.

J. R. STEPHENS.

I certainly advise anyone interested in this subject, or in photographic astronomy past and present, to read the memoirs of Dr. Draper (date 1864) and Prof. Ritchey (date 1904). They are bound together in "Smithsonian Contribution to Knowledge," Vol. 34, and may be ordered though any bookseller. They cost together 75 cents. The address is Smithsonian Institution, Washington, D. C. To throw more light on what has gone before, I will make a few short abstracts from Prof. Ritchey's book. They are as follows:

"No greater mistake could be made than to assume that cheap and poorly annealed discs of glass, or those with large striæ or pouring marks, are good enough for mirrors of reflecting telescopes."

"The thinner mirrors suffer much greater temporary change of curvature from the very slight heat generated during the process of polishing, and they are undoubtedly more likely to suffer temporary disturbance of figure from changes of temperature when in use in the telescope."

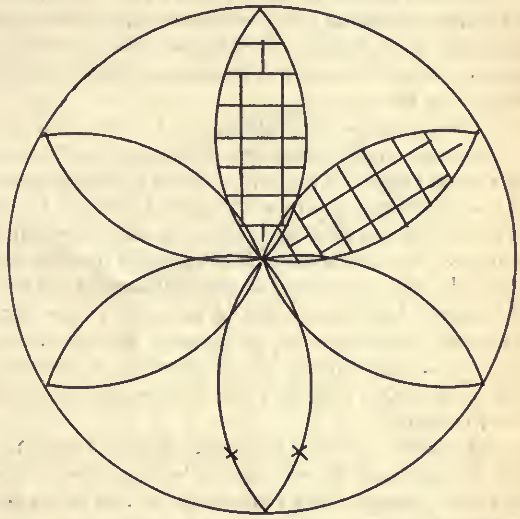
"All mirrors should be polished, not figured, and silvered on the back, as well as the face, in order that both sides may be similarly affected by temperature changes when in use in the telescope. For the same reason the method of supporting the mirror should be such that the back is as freely exposed to the air as possible.

"Half-size tools, 8-15 of the diameter of the mirror are economical, and are quickly prepared, and a much greater variety of stroke can be used with them, so that, with a well-designed grinding machine, I have found it easier to produce fine-ground surfaces, entirely free from zones, with half size, than with full-size tools. If temperature conditions and uniform rotation of the glass are carefully attended to, the surface of revolution produced by the smaller tools is fully as perfect as that given by the larger ones."

Grinding-tools for concave and convex mirrors are always made in pairs, one concave the other convex. These iron tools, when being cast, are poured face down, so that the face will be clean. They are turned in a lathe, to the proper curvature as shown by templets. The convex tool then has grooves cut across its surface in a planer. The tools are then ground together with the fine grades of carborendum, which is much more effective for this purpose than emery, and water. This enables the optician to secure the exact curvature desired. A very important point is that by grinding with the concave tool on the top, the radii curvature of both tools can be gradually shortened. When the convex tool is used on top, the curvature of both is gradually flattened.

By this means, and the use of very fine grades of carborundum, a most perfect control of the curvature of the tools may be had."

Prof. Ritchey does not use carborundum in grinding the mirror.



"Before beginning the fine-grinding of the face and back, it is well to round the corners at the edge of the glass. This is done by means of a smooth flat strip of sheet brass of the size and shape of a large flat file. This is worked over the corners of the glass by hand while the disc rotates slowly, emery and water being used for cutting. A quarter-round corner is usually made. Finer and finer grades of emery are used for smoothing the quarter-round. This rounding and smoothing are very necessary, as particles of glass from a sharp or rough edge are liable to be drawn in upon the surface during fine-grinding."

The grades of washed flour emery used for grinding are 2, 5, 12, 30, 60, 120 and 240 minutes. "A weight of grinding-tool on the mirror of ½-pound per square inch is not objectionable with emeries down to 5 or 10 min. washed. With 30 min. washed, and all finer grades, scratches are almost certain to occur with this pressure. The pressure on the glass is therefore decreased by counterpoising the tool to ¼ pound per square inch for 12 to 20 min. emeries; ⅛ pound per square inch for 30 to 60 min. emeries; and about 1-12 pound per square inch for 120 and 240 min. emeries. This obviates to a great extent the danger of scratches in grinding, provided that thorough cleanliness is practised on the preparation and use of fine emeries."

After the rosin squares are stuck to the polisher and warm pressed to shape on the mirror and redressed with a knife, they are ready for coating with wax. "A pound of best beeswax is melted in a large clean cup, and is very carefully strained through several thicknesses of cheesecloth, into a similar clean cup. A brush is made by tying several thicknesses of cheesecloth around the end of a thin blade of wood 1¼ in. wide, the width of the squares. Each rosin square is now coated with a thin layer of wax by a single stroke of the brush. The wax should be very hot—otherwise the layer will be too thick." The polisher is then cold pressed.

"The thin cream of rouge and water is applied to the glass by means of a wide brush, consisting of a thin paddle of wood, with thin cheesecloth wrapped and tied about one end. Brushes of the usual kind should not be used.

By taking these precautions and by the use of the wax surface on the rosin squares, scratches in polishing can be entirely avoided. The wax surface polishes more slowly than a bare rosin one; but it has the very great advantage that its action is more smooth and uniform. The rosin surface often tends to cling to the glass, and this unequally in different parts of the stroke.

When the bare rosin begins to show at the corners or edges of the faces of the squares, which will occur after six or eight hours' use of the tool, a new coat of wax must be applied and the tool again thoroughly cold pressed."

"Weight of polisher for large tools, 1-18 pound for each square inch of area, which is found to work well for all large tools. For tools 18 in. or less in diameter, somewhat greater pressure per square inch may be used."

"My practice has been to fine-grind and polish to a spherical surface free from zones, and then to parabolize by means of suitable polishing tools."

"On account of the ease of rigorously testing a concave spherical surface, this is the form which should be first attempted by beginners in optical work."

"The tendency of the edge to turn back or down is most pronounced when a long stroke is used to excess, or when the rosin squares are too soft. It is entirely prevented by rounding the extreme outside squares, all around the polisher, in something like a semicircular form, convex to the edge of the polisher."

Changing a Spherical Surface to a Paraboloid.—This is accomplished by shortening the radii of curvature of all the inner zones of the surface, leaving the outermost zone unchanged. There are two distinct methods of accomplishing this. First, by the use of full-sized polishing tools, the rosin surfaces of which are cut away in such a manner as to give a large excess of polishing surface near the central parts of the tool. Second, by the use of small polishing and figuring tools, worked chiefly upon the central parts of the mirror, and less and less upon the zones towards the edge."

The details of second method have already been given in the extract from Dr. Draper; but Prof. Ritchie further notes, that the squares around the edges of the small tools should be trimmed semicircular, as before described, in order to soften the action of the edge."

"Parabolizing with Full-size Tools.—The rosin surface can be trimmed in a variety of ways to give a great excess of action on the central parts of the mirror. The figure (scale 1 in. to 1 ft.) shows one of the best forms of tool for this purpose, six leaf. The small crosses indicate the centers from which the sides of the leaves are struck. The leaves are rosin, coated with wax. The grooves are made as shown, alternate leaves being alike, thus balancing the tool surface. The form of the edges of the rosin-covered areas can be altered, and thus the amount of action on any zone can be in some measure controlled. Length of stroke and amount of side throw are also very important factors in controlling the figure of the mirror. Tools of this kind serve admirably in parabolizing mirrors up to 36 or 40 in. in diameter, when an angular aperture is not very great."

"Small local tools, of the six-leaf form, are also excellent for polishing out zones."

"The use of an eye-piece in this test (one of Prof. Ritchey's spiral tests) is important, because it shows how fatal to good definition is even very slight convexity or concavity of a plane mirror, when used in oblique positions."

"The reflecting telescope defines well only at or near the optical axis; hence the mirrors must remain in perfect adjustment with reference to each other and to the eyepiece."

"Testing a Paraboloid on a Star.—With this method the mirror surface, as seen with the knife edge test, presents the same general appearance as in testing in conjunction with a large plane mirror. In testing on a star it is seldom indeed that the atmospheric conditions are sufficiently fine to allow any except the larger errors of surface to be seen."

And so on. In fact, I think that the two memoirs taken together, are most complete.

A new development in electric welding is the automatic production of continuous rolls of wire fencing, says the "Iron Age." A number of galvanized wires are fed from reels arranged vertically and parallel to each other, and from another reel placed transversely to these are cut off lengths of wire, which are fed horizontally across the vertical wires. Where the horizontal and vertical wires intersect, these are welded together by means of small transformers. The welded section then moves forward a predetermined distance, and the operation is repeated.

"It is easier to attend to another man's business than it is our own."

HOW TO MAKE CUTS FOR PRINTING.

J. BUTLER HAVILAND.

Every printer, publisher and large advertiser knows that good illustrations are not only necessary but expensive, especially when they are made by an engraver. But by the simple etching and transferring process herewith described, anyone with ordinary intelligence can, with but little practice and a very simple outfit, make first-class cuts from prints and pencil or ink drawings at trifling cost.

Lithotint cuts are the easiest and quickest made, and the operation is as follows:

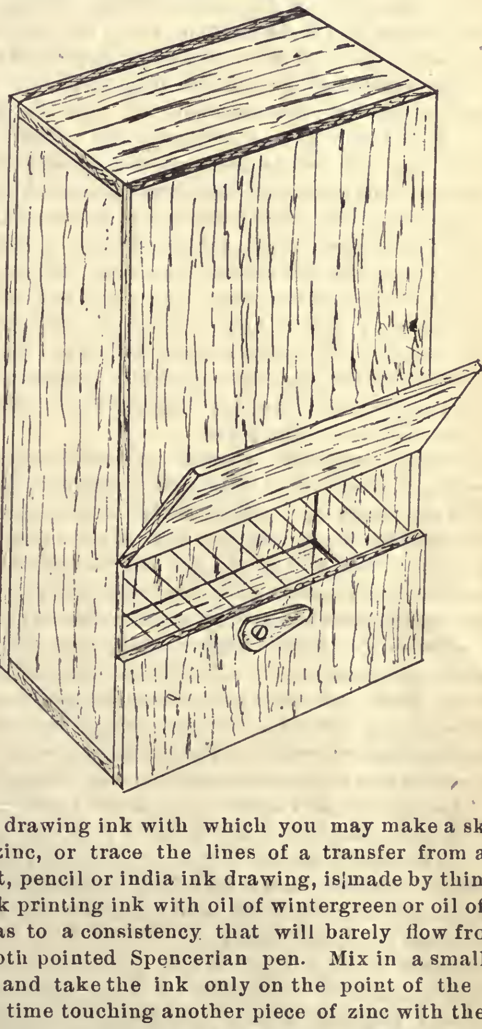
For the surface of the plates common sheet zinc is used, about 1-16 in. thick, but a thicker gauge may be used. Engravers' zinc can be purchased in most of the larger cities at but little higher cost than for common zinc, and is well worth the extra cost, as it has a much smoother surface.

Cut the zinc into strips of different widths, and with tinner's shear cut these strips into proper lengths as needed, always cutting the pieces a little larger than the size required for the sketch or transfer. Scour one side well with pulverized pumice stone or flour emery and a wet rag; rinse and dry and be careful to avoid grease spots.

Ordinary magazine prints, pencil or india ink drawings are thus transferred to the polished surface: Saturate the paper in a solution of 1 part nitric acid to 8 parts water in an etching vessel, which may be an ordinary glass developing tray, such as is used in photography; then lay the saturated sheet between other sheets of soft paper, and by rubbing lightly with the hand over the top sheet, absorb the surplus fluid, but avoid getting the print too dry. Before getting the drawing or print ready for transfer, have an electrotype of sufficient size, with level wood base, locked in center of printing press chase, with wood side up; take impression on tympan to get location, and set pins close to lower edge of impression. There should be 18 or 20 sheets of newspaper under the tympan, and the heavier the impression the better the transfer.

In the absence of a press a workable impression may be taken by placing the sheet of zinc on a smooth table top, with the drawing face downwards on it, and press the two into close contact with a hard rubber roller, such as is used for mounting photos. In taking a hard press transfer, place the wet sheet on the tympan in the desired location, after which the zinc is placed over it, bright side down, supported at the lower edge by the gauge pins. Now take a heavy impression, allowing the pressure to remain on for a few seconds. The fiber adhering to the zinc is rubbed off with soft paper; rubbing a pencil transfer improves it, but don't rub a transfer from a print much.

In transferring cuts printed with the finer inks saturate in caustic potash dissolved in two to four times its weight of alcohol, pour a few drops on the print and flow it over the whole surface, then wash the paper in weak acid solution, as before directed, blot and quickly apply to zinc with pressure. Pressure can also be obtained under clamp of paper cutter, in an ordinary copying press; lay zinc on a level block and place 20 sheets of newspaper over all.



A drawing ink with which you may make a sketch on zinc, or trace the lines of a transfer from a dry print, pencil or india ink drawing, is made by thinning black printing ink with oil of wintergreen or oil of sassafras to a consistency that will barely flow from a smooth pointed Spencerian pen. Mix in a small tin box and take the ink only on the point of the pen, each time touching another piece of zinc with the pen before continuing the tracing, which prevents an overflow of ink when the pen comes in contact with the work.

In ruling lines, elevate the rule slightly when crossing lines. When you desire to erase, first dust the whole plate with dragon's blood—as hereafter described—then erase with the point of a penknife. When the tracing is done the next operation is powdering the plate.

In a cigar or other tight box have two or three ounces of finely powdered dragon's blood. Shove one end of the plate under the powder and manipulate so that the powder will slide over the plate two or three times, that the lines may catch and take up all they will hold. Now jar off the loose powder and sweep well across the plate in all directions with a soft camel's hair brush, which leaves the lines as clear cut as before the powder was applied.

Next comes the tinted ground. This is made by rosin dust settling evenly on the plate. You can do this with a box, as shown in the cut. Make a tight box about 24 in. high, 6 in. wide and 8 in. deep. Hinge a 2 in. door across the front 4 to 6 in. from the bottom and flush with the bottom of the door, stretch three or four light wires through the box from front to rear. Next make a wooden slide that will slip into the box loosely; the wires are to support this slide, on which the zinc lies while the rosin dust is settling. Have three or four ounces of rosin well powdered in a mortar so there will be considerable dust in the mass, mix well in this three or four tablespoonfuls of lampblack, then put the mixture in the box. Have the plate ready on the slide outside the box, and with the door closed, turn the box so as to let the rosin mass fall suddenly from one side to the other. Then open the door, insert the slide and close it again; in ten or fifteen seconds draw out the slide and notice the deposit of dust on the plate.

If you think there is not a sufficient deposit, repeat the operation. If the dust deposit is too heavy, blow it off entirely, shake up the box and try it over again. A comparatively heavy deposit will admit of much deeper etching than a light one, but you can get it too heavy or too light, and it will require some experimenting to determine the deposit a plate should have. With a suitable deposit of dust, carefully and evenly heat the plate, back down, till the red lines of the sketch turn black and the fuzzy looking deposit seemingly disappears. The heat fuses the ink and the powder together and melts the particles of rosin.

Next spread a coat of thin asphaltum varnish on the back of the plate and varnish a quarter of an inch around the face edge of the plate; hold plate close to heat a few moments, and as it cools it will dry rapidly. Thin the varnish, when too thick, with turpentine. Shellac varnish is good substitute, but it takes alcohol to cut it off the plate.

Next comes the etching. In the glass developing tray pour enough of a mixture of about nine parts water and 1 part nitric acid to flow over the plate, when the vessel is raised and lowered at one end. Then lay the plate in, face up, and wash the solution back and forth, as indicated. After operating this a few minutes, take cut out and rinse in clean water and examine the groundwork; an ordinary magnifying glass will assist the examination. As long as the little elevations are not beginning to thin out in little patches, you can continue the etching. The etching exhausts the acid, and by adding to the bath a little full strength acid after a few minutes etching, the work may be hastened. When a slight simmering cannnot be heard on the plate when the ear is held close, it is safe to add a little more acid, but never quite as much as it originally contained.

Take the cut out when adding more acid and thoroughly mix before replacing the plate. If the bath is too strong, creating a froth, it is liable to ruin the plate unless it is instantly removed and more water added. The character of the tinted ground depends on the amount of rosin deposit and the depth of the etching. When the etching is finished pour a few drops of alcohol on the line work and rub it with the fingers, which removes the composition; then clean both sides of the plate with benzine, after which cut the plate to size required, removing all traces of grease from back with lye, saw a block base from ⅞ in. wood to size of cut and level the face of it with a sand paper block. The plate is then fastened to the wood base with small brads, first punching holes for same in the plate with a sharp pointed punch in places where the plate has been etched. The best impressions of lithotint cuts are on smooth finished paper.

PLAIN LINE CUTS.

To make plain line cuts, follow the foregoing instructions to the point where the plate is first placed in the acid bath omitting the rosin dust. Go through the same manipulation until you get a depth of about one quarter the thickness of the zinc plate.

Now the sides of the lines will need protection. As the plate lies in the bath remove the dissolved zinc from it with a camel hair brush. Occasional brushing in like manner is advantageous all through the etching process. Then quickly rinse the plate in water, dry, remove composition from lines with alcohol and clean plate free from grease with lye. With a roller put a smooth medium coat of job ink on a smooth, solid, heavy cardboard, lay it on a perfectly level surface, then lay the cut face down on the inked surface of the card and with a rolling pin, or something equally round and true, roll with considerable pressure across the plate in different directions until you see by examination that the faces of all the lines have taken ink; then apply the dragon's blood and in removing the loose powder that is not held by the ink, brush gently both ways across the plate, and both ways from end to end, until all is swept from the etched surface.

Between the lines that are close together the powder will remain, as it ought if you brush gently, for further etching is not necessary at such points. Now heat the plate well until the powder and ink fuses and you see a little smoke rising from the plate; the heat causes the fusing composition to flow down the sides of the lines which protect them. When the plate has cooled, in spots where the ink has caught in any of the open etched places, scratch it out with a sharp pointed penknife, then varnish the back of the plate and continue etching. When the dark coating on the plate can not be removed with a gentle touch of the brush, it is safe to add a little more acid to the bath; and when the bath gets thick and slimy it is best to throw it away and use fresh.

This time go about half through the zinc, then clean the cardboard, apply the dragon's blood and heat plate as before; then varnish the back and proceed to etch again until there is but a thin shell left. Next, clean both sides of the plate and trim up to about ⅛ in. of the part occupied by the line work and mount on a block. When mounted, cut out with the point of knife all open places as large as the end of your thumb and larger.

To make a plate from a type form, take a fresh, well inked impression on smooth paper, saturate paper in water, drain the water off and transfer by pressure to cleaned zinc, same as in making other transfers. Give the transfer the dragon's blood treatment, next the rosin dust, then heat the plate and proceed to etch the same as in making a lithotint cut. Fresh impressions from cuts can also be transferred and etched in this manner.

GENERAL INFORMATION.

A lithotint cut can be given a second and deeper etching by the re-inking process. When a design for a cut is not well covered with line work, the plate should be made in the lithotint style which, like a half-tone is solid printing surface, there being no white or open spaces to cut out. During the progress of the etching if you notice any weak point that is liable to cut away, dry the plates; with pencil, brush and asphaltum varnish, carefully touch it up, dry a little and continue etching.

To make a cut from a photo, draw with India ink right over the outlines of the photo outlines, dry, and proceed as with an ordinary drawing. Dragon's blood is preparation of rosin nature, which may be purchased at any druggist's.

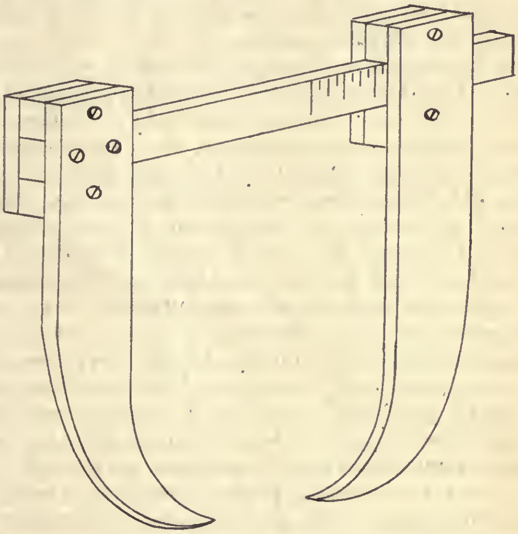
THICKNESS CALIPER.

CHARLES E. BURROUGHS.

The amateur boat builder, in working out a wooden hull, is frequently in a quandary as to the thickness of wood remaining at some particular place; he hesitates to make a cut fearing the gouge or chisel may go through, and yet desires to remove all the wood he can to get a light boat.

This is especially true of model steamers where the weight of the machine is generally so great as to necessitate the very light hull, to avoid too great a displacement. In pattern making similar difficulties are often encountered. In such cases a thickness caliper, like the one here described will be of great assistance. as the thickness of wood or metal can be very closely ascertained without trouble. The shape of the legs can be varied to meet the needs of the work, the principal requirements being stiffness and a close fitting joint between the sliding leg and the bar.

The bar should be a piece of well seasoned, straight grained maple. A piece of "reglet," obtainable from about any printer is suitable, as it is finished in oil. For a small boat a piece 12 or 15 in. long will answer, together with four pieces 1½ in. long.



If only approximate measurements are needed, the legs can be made of four pieces of a cigar box, which are cut out to the shape shown, and of a size to clear any projections on the work. Additional square pieces are needed for closing up the back. When cut out, the legs for one end are fastened together and to the bar with glue and small wood screws.

The sliding bar is put together in the same way, excepting that pieces of thin cardboard are put between the blocks and the piece at the back, which serve to give the necessary play so that this leg may slide freely, but not loosely. The two blocks above and below the bar should be spaced square with the bar and with only sufficient allowance to slide without binding.

After completing the two legs and mounting on the bar, the tips of the legs are brought together, and a mark made on one side or top of the bar with a knife. The sliding bar is then removed and a scale laid out, the divisions being made with the point of a knife and the marks filled in with India ink. If a very accurate reading caliper is desired, the legs should be made of brass; in fact, the whole tool may be made of that metal, in which case the joints are brazed. A combination tool can be made by slots in the two boxes on the bar and several sets of legs can be made, which are held in place by set screws. For general purposes, however, several different sizes made of wood will answer.

ELECTRICAL CONDENSERS.

OSCAR F. DAME.

There are two types of condensers which date back to the earliest days of electricity, before Franklin's time, when the only known electrical generators were the statistical machine and the electrophorus. These two types were the Leyden jar and the glass plate substitute for the Leyden jar.

The Leyden jar was used in connection with cylinder and plate static machines to gather the electricity collected by the "brushes" and hold the charge to the maximum capacity of the jar, when the discharge would take place disruptively and with great volume of sound. These jars were made of thin clear glass, similar to the ones in use today in all laboratories, with both inside and outside coated with tinfoil to one-half or two-thirds the entire height. The capacity of each jar in micro-farads was infinitely small, the average being roughly estimated at about .0005 M. F.

Considering capacity in micro-farads, as we speak of it in connection with induction coil and telephone and telegraph practices of today, it would necessitate thousands of such jars to equal in capacity the modern type of small condensers which can be slipped into one's pocket with ease. There is a scientfic reason for this, which should be understood by the amateur worker, because of the value of the information in wireless telegraphy as well as in other pursuits. Three things enter into the calculation of capacity:—The area of the thin metals we utilize for the purpose; the distance we separate these surfaces one from the other, that is to say, how far apart they are separated either in dry air, in oil or by means of an insulating substance like glass, mica, hard rubber, paraffined paper or the like; and thirdly, the value of this intervening substance as a dielectric or insulator.

We might take the best of metals, such as thin lead or tin-foil, and separate the sheets with poor, unwaxed paper, and get a very faulty condenser. We might use poor mica, full of pin-holes or flaws, or hardsheet rubber with metal specks in it, all of which would in time render the condenser worthless. In the selection of the insulating material we have two standards, oil and mica, the former the best liquid medium, and the latter the best solid. For oils, we have kerosene, paraffine oil, transel oil, linseed oil, etc.; for mica we have all grades at all prices, the best grades being very costly. Mica is not obtainable in very large pieces, the average commercial sizes seldom being over 6 in. square. Consequently mica condensers must be for very small capacities or built up of many layers. All the highest priced testing apparatus used in laboratory work have mica condensers, and many of them are silvered similar to mirrors instead of being coated with thin metal sheeting. For general purposes glass would answer, but is not procurable in sufficiently thin pieces.

As was before mentioned, the distance between opposite faces regulates the capacity. The sheets of metal of certain size, separated 1-64 in. apart, give just twice the capacity when separated 1-128 in. Then, again, if the material used in separating them was paraffine paper of ordinary quality, we could not expect so great a capacity, to use a shellac coating between, which in some cases improves the capacity coefficient. The co-efficient of inductive capacity is not as much considered in modern practice as it should be. Nowadays many foreign made induction coils are equipped with thin, poorly waxed paper dielectrics, which will hardly stand the strain of a primary core discharge of not over 20 volts.

This weakness demonstrates itself in the tiny thread like sparks from the secondary; the charge which should have returned to the primary winding short-circuiting itself in the condenser dielectric. High-grade condensers for coil work are made in two ways. In those of foreign make it is the usual custom to cut the foil and paper in small squares and connect the metal sheets alternately to common terminals, that is to say, 1, 3, 5, 7, and so on, form one terminal, and 2, 4, 6 and 8 the other. In ordinary condenser work in this country it is customary to arrange the condenser materials in long, narrow strips, the paper and foils being on rolls in such position that two sheets of very thin bond paper with a strip of foil between, will pass through a sort of clothes wringer attachment, through paraffine wax, and emerge stuck together as one. Such a strip forms a completely insulated side for a condenser, and two of these sheets about 5 in. wide and several yards long, may be laid one on the other and folded or rolled into desired shape.

There is one disadvantage about such a condenser, however, which has been overlooked by most American coil makers, and that is the "unloading value" of a condenser. Disregarding all that has been written about condenser theories, every man knows, whether electrician or not, that the more of the tail board of a wagon taken out, the quicker the load may be dumped. Now, when a condenser is made of two long, insulated strips of foil, flattened or rolled into shape, such a condenser is sluggish. It does not unload quickly. The charge stored within it leaks out through a sort of resistance which dissipates the quantity of electricity the condenser was calculated to hold and release. The reason these condensers are made this way is because of simplicity and cheapness of construction. Competition requires a minimum of expense and labor in all departments of coil manufacture, and in this type of construction there is a saving of fully 20 minutes work on each coil.

The latest type of condenser, however, is made up of two strips of the thin bond paper, as before described, and the roll of tinfoil between, but the foil instead of being narrow and hardly reaching within one inch of the paper's edge for the sake of insulation, projects on one side a full inch. In rolling up such a condenser, two of these strips are placed so that the foil of No. 1 projects on the opposite side from that of the No. 2. The sheets are then rolled in flat form and the foil projecting from the first side crimped together for one terminal of the condenser, and the other side pressed or crimped for the other terminal. Such a condenser will " unload " with a rush. When used on gas-engine coils having vibrators going at the rate of 1200 a minute, this condenser demonstrates its peculiar fitness for the work by giving a very lively and flaming secondary spark. Even on wireless telegraph coils the spark value is increased one-quarter by its use.

The purpose of the condenser as regards the induction coil is two-fold, it being used primarily to absorb the spark caused by the breaking of the primary circuit at the vibrator contact points. The second and more important value of the condenser is its intensifying power whereby the extra discharge from the primary circuit is held in store and at the proper time released into the primary circuit again. The value of the condenser in this second case is readily appreciated by disconnecting the condenser from any coil, and noting the depreciation in the secondary spark discharge. As a matter of fact, a 1-in. spark coil will hardly spark at all, with the condenser removed.

The question now arises: With given primary core and winding specifications and a vibrator operating a stated number of times per minute, by what formula or method is the proper capacity for the condenser calculated? Here is an instance where experience counts more than mathematics. Coil manufacturers, as a rule, have stock specifications for use with all kinds of coils, but it is true that some one had to figure out all the details carefully in the first place.

Let us consider the iron core of the coil. There are all grades of iron and steel wire used in the coil manufacture. The best wire is Swedish iron wire. This comes in all wire gauges. The finer the wire used the better the operation of the coil. In moter and dynamo construction we learn the value of laminated armatures. We find that all solid masses of iron are avoided. The thinnest discs of soft iron are bolted together to form a laminated armature so that the losses by hysteresis may be at a minimum. In such a small affair as an induction coil, the difference in results between a steel wire core and a Swedish iron core would seem so trifling as not to warrant the extra cost of several cents per pound for the iron wire. In the cheaper grades of coils, particularly in automobile coils manufactured by the thousands at a very low wholesale price, the finer details of core construction are not considered. It is purely a problem of getting a minimum cost for all materials and turning out something that will do the work and beat the other fellow out of the market. In such coils we find single cotton covered wire primaries, with no insulation between layers, and No. 20 gauge soft steel wire cores. If such unscientific construction was put into a watch or dynamo the manufacturer would soon have to mend his ways or go out of business.

It will be found that the more perfect the core, the easier it will be to provide a condenser to work in harmony with the primary winding. The more turns of wire about the iron core for the primary, the greater the magnetic effect of the core; subject to certain limitations.

The more turns in the primary the greater the spark at the contact points before the condenser is installed. Sufficient turns have to be made on the primary to make the core powerful enough to attract the hammer head of the vibrator. In building a coil, therefore, where the spark is to be not over one inch in length in the open—for automobile purposes, for example—it is advisable to put just as few turns of No. 16 or 18 waxed double covered wire over the core for a primary as will magnetize that core, (when the proper amount of battery is used) and attract the vibrator hammer head. The larger its area exposed to the end of the core and the shorter the vibrator stroke, the faster and fatter will be the secondary discharge.

It was once the custom in small coil manufacture to wind on four or more layers of No. 13 wire for the primary in the belief that the added resistance of 4 layers in preference to two of larger cross section would reduce the current consumption one-half and prolong the life of the batteries accordingly. Coil manufacturers have since found by experience what every electrician has long known to be a fact, that the proper way to get around the sparking at the platinum points was not through the increase of condenser capacity, but by reducing the number of turns on the primary as much as possible. It was found that a vibrator could not be constructed too speedy to fail to give a secondary discharge, and also that a fast vibrator did not require anwhere near the condenser capacity as a slower vibrator.

It was also found that a fast vibrator, working through a low inductive winding, was just as easy on the battery as the slower vibrator and the many-layered primary winding. Also, the wear on the platinum points was less. Based on the cost of platinum, as in comparison with the cost of batteries, the fast vibrator and low winding would prove more economical even if the batteries did become exhausted more rapidly than in the previous case.

The cost of constructing a condenser for the latter coil is much less than that of the former, owing to the less amount of tinfoil and waxed paper required. Summing up the cost in each case, we find that there is a saving in the primary wire of just one-half, (which permits the use of the best grade of core wire), a saving in cost of vibrator materials, and a saving in condenser cost.

With larger induction coils, giving two or more inches spark, we have much more wire on the secondary than in the one inch coils. This mass of copper wire is practically a shield of copper over and about the primary core and winding, and it is impossible to use a vibrator intended for a 1-inch coil on this larger coil and get maximum results.

The vibrator, if core-operated, must be much slower to allow a more complete saturation of the core, and the condenser will have to be correspondingly increased in capacity to handle the spark at the make and break.

The construction of a condenser for a coil will furnish the best lessons in the work—far better than any mathematical formulæ to be had at the present time. Any one undertaking this task, should make provisions for increasing or decreasing the capacity as needed until the proper size is ascertained, by making the condenser in sections.

SPEED OF THE STARS.

One of the most remarkable features of the universe is that every so-called fixed star is moving forward on an undeviating path which, so far as we can yet determine, is a straight line. Nothing is better calculated to give us an idea of the extent of the universe than the contrast between the speeds as we observe them from the earth. The actual speed is enormous when compared with any that we can produce by artificial means. The speed of a shot from the most powerful gun can scarcely, if at all, exceed half a mile per second. But if the motion of any star is as slow as one mile a second, it is only in very rare and extraordinary cases.

The average speed of the stars is about 20 miles a second; and this motion, it must be remembered, is not, so far as determined, motion round and round in an orbit, but a straight ahead motion, never relaxing and never swerving. Almost every star, there fore, travels hundreds of millions of miles every year, century after century. And yet so slow do the motions appear to us that the naked eye can see no change in the configuration of the constellations during a period of thousands of years.

A remarkable instance of this kind is afforded by "Arcturus," which is, so far as we know, one of the swiftest moving stars in the heavens. It seems quite certain that its speed exceeds a hundred miles each second of time and it may be much greater. And yet if Job could come again to life and study the constellation Bootis, in which Arcturus is situated, he would scarcely notice any change in its appearance. There is not a star in the constellation Orion moving so fast that any change would be noticed by the naked eye in 100,000 year. Every star in the heavens appears in the same position when observed night after night. There are very few in which the astronomer can detect any motion by one year of observations.

Accurate determinations of position commenced with the observations of Bradley in the eigthteenth century who determined the position of more than 3000 of the brighter stars. Since his time the position of several hundred thousand stars have been accurately fixed. Yet so small is the apparent proper motion in most cases that it has been actually detected in the case of only a few thousand stars. Even now there are scarcely a hundred stars of which the motions are known to exceed one second in a year. To understand what this means we must reflect that it would take a good eye to see that two stars in the sky, 200 seconds apart, were not a single object.

Had it not been for the great precision of the telescopic determination, astronomers would not have known to this day that any star in the heavens had moved from the place which it occupied in the time of Ptolmy, 1800 years ago. The star, Z. C. 5243, if it were to continue its course round the sky without ever stopping, would take more than 140,000 years to make the circuit of the heavens and the actual speed of this star is known to be about 100 miles per second.—"The Mining World."

"Our local newspaper had its lynx eye on a smoky chimney that belonged to an ex-mayor of the town. It held that public men should not be producers of public nuisances.

I called to see my friend, the ex-mayor, and he said, 'Look, here, they are at it again and now they threatening prosecution.' He told me what he had done to prevent smoke pollution. He had put in patent stokers, steam jets to aid the draft, a new sort of patent grate bars, raised the chimney 25 ft. and had used a better class of coal, and he said 'What more can I do?' He was a busy man and was glad when I offered to go to his works to see if I could suggest anything that could be done.

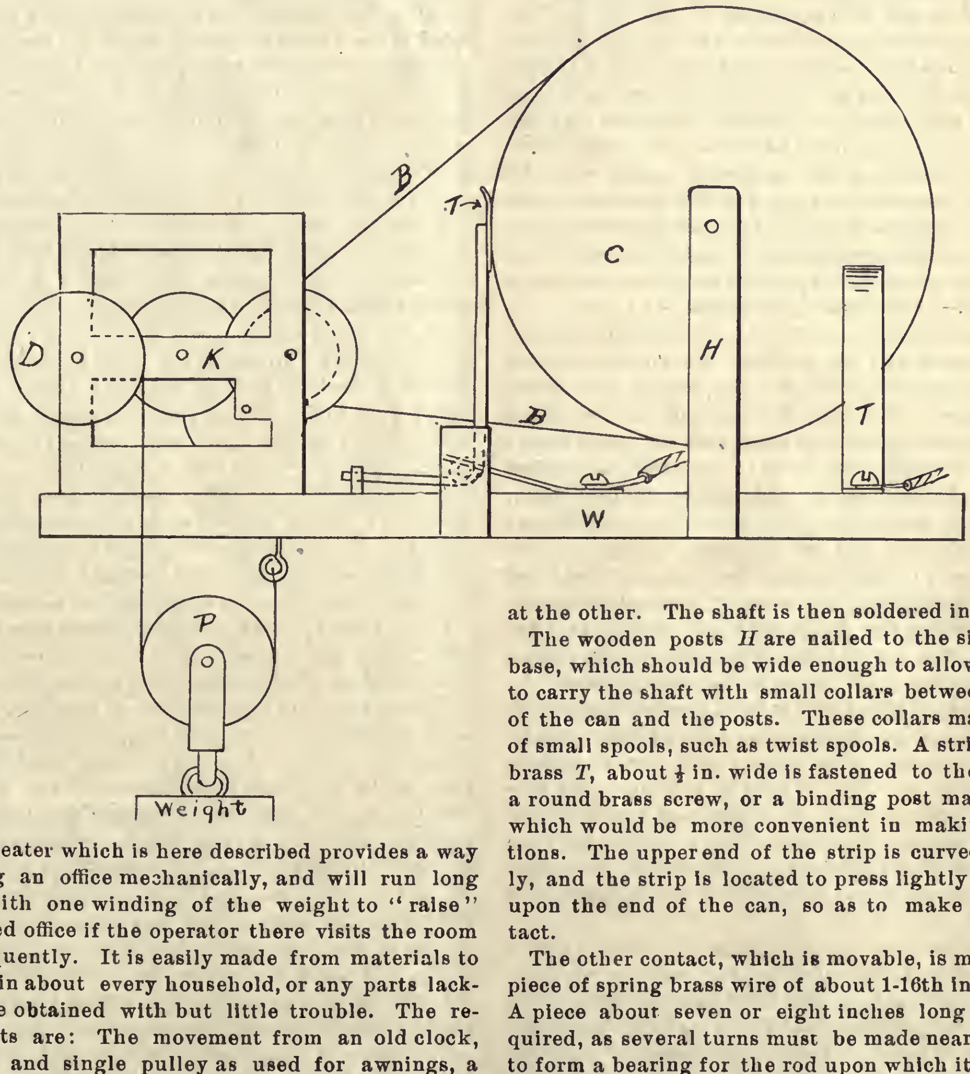
So much depends on the fireman that we came to the conclusion that it must be all his fault. I found, however, that the two boilers which had been quite sufficient for the works as originally planned were not so now a large dye house had been added and was in full blast.

I suggested that a 32-inch Sturtevant fan be put in at the root of the chimney—this fan to work at a varying speed to suit the demand for steam. A fan was put in and it ended the trouble, no more complaints about black smoke, plenty of steam for all purposes, the quantity and quality of the work was improved, and all at a comparatively small cost, which was soon repaid by less coal consumption."—"Engineer."

MECHANICAL TELEGRAPH CALLING DEVICE.

HAROLD P. DAVIS.

The amateur telegrapher working on a line connecting the residences of one or two friends, has undoubtly wished many times that he had some device which would enable him to repeat the "call" for several minutes at a time and so avoid being obliged to do so by hand. Repeating the same letters from ten to thirty minutes at a time becomes both monotonous and tiresome, and when the operator at the other station is busy with other matter this is sometimes necessary.



The repeater which is here described provides a way for calling an office mechanically, and will run long enough with one winding of the weight to "raise" the desired office if the operator there visits the room at all frequently. It is easily made from materials to be found in about every household, or any parts lacking can be obtained with but little trouble. The requirements are: The movement from an old clock, a double and single pulley as used for awnings, a clean tin can as used for coffee, some strip brass and brass rods and wood for a base and posts, as will be described.

The can should have one inch of depth for each "call" to be made, and an equal space for the belt. Measure off the can and cut to the required depth with tinner's snips, using care to avoid dents in the cutting. The cover is then put on and lightly soldered in place. Locate the exact center of each end and punch holes for the shaft, which may be cut from a piece of brass rod, as used for sash curtains. The shaft is cut to a length to project ½ in. at one end and 1 in. at the other. The shaft is then soldered in place.

The wooden posts *H* are nailed to the sides of the base, which should be wide enough to allow the posts to carry the shaft with small collars between the ends of the can and the posts. These collars may be made of small spools, such as twist spools. A strip of spring brass *T*, about ½ in. wide is fastened to the base with a round brass screw, or a binding post may be used, which would be more convenient in making connections. The upper end of the strip is curved outwardly, and the strip is located to press lightly but evenly upon the end of the can, so as to make good contact.

The other contact, which is movable, is made from a piece of spring brass wire of about 1-16th in. diameter. A piece about seven or eight inches long will be required, as several turns must be made near the center to form a bearing for the rod upon which it slides. On the end which rests upon the can must be soldered a short piece of strip brass like that used for the first contact. A piece of brass rod like that used for the shaft and a little longer than the round surface of the can must be supported at the ends by small blocks in which are bored holes only part way through. The sliding contact is put on the rod, and the rod placed in position by fastening the blocks to the base with screws. About two inches away from the rod is fastened a strip of wood, in the upper edges of which are cut slots spaced the same distance apart as the cali stencils on the can. The end of the sliding contact rests in the proper slot to sound the desired call.

The stencils for the different calls are made from thick, strong manilla paper, which is cut into strips about 1 in. wide and long enough to go around the can and have a small lap at the joint. The speed at which the can will turn is first ascertained, and the letters of the call are then cut out, or rather spaces corresponding to the dots and dashes making up the letters. The strip is then coated on both sides with shellac and immediately placed in position around the can. It should be smoothed down so as to present an even surface to the contact as it revolves. Any shellac which may run out into the open spaces should be removed, so that the can will make a good electrical contact with the sliding arm. As many of these paper stencils are made as there are stations to call. After all the stencils are in place the outside surfaces can again be coated with shellac, which with the paper makes a good insulation where the arm is not to touch the can.

To rotate the can, part of the train of gears from an old alarm clock will be needed. Movements of this kind can generally be had for the asking from many jewelry stores. The part of the train to be retained begins with the mainspring shaft and the three shafts and gears directly connected to it. The mainspring shaft projects through the side for an inch or more, and on this projecting end should be secured as large a wooden spool as can be made to hold on the shaft. One way of fastening to the shaft is to file a flat place on the shaft and put a screw through the spool until it reaches the flat space, thus acting as a set screw. On the shaft at the other end of the train a smaller wooden cylinder is fitted and fastened by means of two or three small screws, the heads of which bear on the gear on that shaft. This cylinder can be split for convenience in fitting, and the two parts united by glue, which will hold if reinforced by several turns of fine wire, as the duty is not heavy. From this pulley is run a belt made of tape which also runs over one end of the stencil can. The clock movement must be fastened to the base so that the tape belt will run in line.

To move the gears, and in turn the stencil can, a cord is attached to the spool on the mainspring shaft, the end of which is carried through the hole in the base and a weight attached. The weight is rigged just the same as in old-time clocks, by means of the awning pulleys, one being attached to the weight and one to the under side of the base. The quickest way to rewind the cord on the spool after it is all run out is to pull in the cord and wind it around the spool by hand.

In connecting this calling device into the circuit, it may be wired in shunt with the regular key, and cut out by means of a switch when not wanted. In this way it can be located in any convenient place in the room. It seems quite probable that this device could be used for wireless telegraphy if made a little heavier so as to take the larger current, but never having tried it for that work, cannot state absolutely that it would be satisfactory when used in that way.

STARTING A GAS ENGINE.

This is the question that comes up many times in the mind of the young engineer, when he finds out after a number of fruitless efforts to "get her started," that she will not turn her wheels or "go." Now there is a reason for this condition of affairs when the gas engine refuses to obey the behest of the driver, and I propose in this article to give such plain instructions that the novice may be assisted in starting the gasolene engine.

In the first place, see that the compression is right, admission valve is tight and will admit only enough of the mixture (gasoline and air) to make a charge that will take fire from the sparker and move the piston forward. In the next place see that the sparker is clean and will make a bright spark at white heat when the contact is broken and at the right time. And right here I want to say to you that "in time" means to go if everything else is right, and "out of time" means not to go if everything else is all right.

The valves of the engine must be kept well ground down with emery and oil so as to preclude a possible leak, for this will very seriously weaken the power of the engine even after it has started. The spark must be made when the connecting rod of the engine is on the "up stroke," with the crankshaft about three inches below the horizontal line of the center of the index, and herein lies the whole secret of the greatest efficiency from the least amount of gasoline. As there is an interval of time after the spark is made until it ignites the charge, it is very evident that the movement of the machinery continues and the moment of ignition should take place when the compression is greatest, and this will be when the piston is on its farthest "instroke," *i. e.*, in perfect line with the center of the cylinder. But if the charge be ignited at this point the engine will not develop the greatest power, as the interval spoken of will elapse and the piston will have started on its "out stroke," thereby not getting its full force of the expansive gases, liberated by combustion of the air and gasoline.

Therefore, it will readily be seen that we must allow for the interval spoken of if we would get full returns for the energy we use in propelling the motor. I have tried to make this plain and very easy to understand, and I hope my efforts will help out some experienced or inexperienced gasoline engineer, who has trouble with his engine, either in starting or developing the power at which it is rated.—"The Gas Engine."

CORRESPONDENCE.

No. 140. Toronto, Can., March 15, 1906.

I have some clean brass castings which I wish to dip bright. Will you kindly let me know the proportions of sulphuric acid and nitric acid to use for the dipping solution? Also, will it be necessary to pickle the castings first, and if so, what is the formula for the pickling solution? B. J.

The following is from "Polishing and Plating of Metals," by Herbert J. Hawkins: "A bright dip is one which is designed to obtain radically different results from the dull or satin finish dips. It is so composed that the metal, while corroded, is not covered with a dull sub-oxide, but remains bright enough to reflect the light more or less from the innumerable points left by the acid, so that while we have a matted surface, it leaves the metal bright and shining but not polished. Speed of operation and uniformity are the essentials in bright dipping, as the acids act very quickly, and the longer the work is allowed to remain in the dip, the more corroded and larger will be the granulations of the surface of the metal, and the duller will be the effect produced. Another very important point is the ability to keep water out of the dip without unduly slowing the output of the work. Water will convert a bright dip into a satin finish dip, if present in a very small quantity, thus destroying the dip, as it will no longer give the best results as a bright dip. * * * Bright dips are used to obtain two or three distinct effects, which depend chiefly on the amount of time the acids are allowed to work upon the metal; a second or two will give a bright effect, twice that length of time will give a very bright surface, while six or seven seconds will give a comparatively dull effect which is almost a satin finish. This time is given for a new dip which is working rapidly upon metal very easily corroded, such as the brass generally used in gas fixtures. As the dip gets older the time must be increased to obtain similar effects, and metals less easily attacked must also have longer time.

"The bright dip for copper, brass, bronze or German silver is:

Sulphuric acid	100 parts by weight.
Nitric acid	75 " " "
Common salt	1 " " "

"After dipping, the articles should be very quickly rinsed in cold water, then in hot water and dried in sawdust. Boxwood or hardwood sawdust must be used; soft wood sawdust will not do, as it tarnishes the work badly.

"It may be stated generally that work to be dipped should be dry and free from grease. It is the usual practice with brass or bronze goods to first hot potash them, then swing in the air until dry, then immerse in the bright dip, then into clean running water, then in boiling water and finally dry in sawdust. In this way the potash dries quickly upon the surface of the work, forming a film which protects it from the air while being conveyed to the bright dip, * * * thus producing brighter and more even results in the finish.

Pickles are used to remove sand or grease from rough castings, preparatory to polishing or plating. A pickle for brass or copper that is not to be polished is:

Nitric acid	200 parts by weight.
Common salt	1 " " "
Lampblack	2 " " "

After pickling until clean, hot potash them, swing in the air until dry, then into the bright dip, etc., as above.

No. 141 Wolfboro, N. H., March 31, 1906.

I have two telephones made of just two bi-polar receivers, with a suitable call. I have tried it on a line about 150 feet long, of No. 12 galvanized wire, but I should like to hear a little better. I can talk over it now fairly well, but it is not near as loud as a commercial telephone. Could a battery be connected into the circuit with or without an induction coil, and give better results? If so, please send a diagram of the connections. Also, please send a diagram of the connections for a magneto call line of two stations about 1½ mile apart. G. F. B.

The bi-polar receivers which you are using contain permanent magnets which, whenever the diaphragm vibrates as when spoken into, set up feeble alternating currents in the line and so influence each other. The addition of batteries to the circuit would cause currents to flow which would interfere with those set up by the magnets and serve to prevent the proper action of the receivers. Batteries can only be used in connection with the microphone transmitters. The diagram for the magneto circuit accompanies this answer.

No. 142. New London, Conn., April 9, 1906.

Will you kindly advise me how to take the solidly glued fingerboard from the neck of a violin? Also state how or by what process patterns, such as boat patterns, are made. Can you state where a varied line of cheap but reliable trade text books can be bought? J. M. H.

As the glue holding the finger board to the neck is old and absolutely dry, the first operation would be to use the edge of a thin-bladed knife as a wedge and get a crack started. Wet the crack with warm water, and after a few minutes use the knife again, continuing the process until eventually the glued surfaces will part.

The process for making boat patterns is quite fully described in the first chapter of the description of the tender contained in the March, 1906, number.

It will be necessary to know the subjects upon which books are desired before specific information can be given.

SCIENCE AND INDUSTRY.

A little chemical compound named "zorene," discovered by a Hungarian chemist, is said to possess very remarkable properties. A piece of friable slag, after immersion in it, defied the blow of a heavy hammer. Immersing substances in the compound seems to render them impervious to water, as shown by tests, in which no additional weight was observed after long soaking in water. Two pieces of steel, one of which had been soaked in the liquid, were submitted to an ammonia test equal to an exposure of five years in the air. The soaked specimen showed no effects from the ammonia, while the other was badly corroded. If these statements prove true the discovery should have considerable commercial value.

A way has been devised of extracting from coal tar many of the rapid developers so widely used by photographers, says the "Mining World". Besides these, there have also been discovered the perfumes just as fragrant as the natural odors of flowers, from which, indeed, they cannot be distinguished by smell. The host of artificial flavors from the same source, has almost completely displaced the natural products. True fruit flavors are rarely employed nowadays, wittingly or unwittingly. Their place is taken by coal-tar derivatives which are exactly the same in taste and chemical composition. Among the more remarkable of these is saccharin, sweeter than sugar by several hundred times and quite indispensable in the treatment of certain diseases which are caused by an excess of sugar in the system.

Consul-General Ragsdale writes from Tientsin that the Chinese Government has arranged to establish several stations throughout China for experiment with Marconi's system of wireless telegraphy and instruct Chinese operators in working the same. The apparatus has been installed on four Chinese men-of-war at Shanghai and at the three North China cities of Tientsin, Peking, and Paotingfu, the radius of action being about 150 miles and the cost about $15,000. An Italial officer has been appointed, not only instructor, but also as an engineer to superintend the installation, and under whom a number of students have already been detailed to act as operators and learn the art of management. It is also said that the viceroys throughout the Empire have been directed to consider the advisability of establishing other stations to work in conjunction with those above mentioned.

The property of dissolving metallic oxides makes it useful in soldering and brazing metals, as it cleans the surfaces to be joined so that the solder runs and fills the joint between them. In welding metals it is used as a flux.

The use of acetylene gas as an illuminant in Germany has not come up to expectations, and the latest use they have put it to is as an explosive material. The mixture is confined in a chamber and ignited by means of an electric spark. It can be used in blasting and it is said that the rock is not thrown out, but rent with innumerable cracks, so that it can be easily removed afterwards. About 1.7 ounces of carbide, which produce about 16 quarts of acetylene gas, is used for each cartridge.

A choice case of the newspaper bull in the technical china shop is the following quoted from an Indiana paper: "The power house will be a place of miracles to the lay mind, which may then watch electricity sucked from the air at 370 volts and multiplied to 33,600 volts by processes which electricians know as phenomena and not as science. The reason why is apparently beyond mortal ken, but the results satisfy commercial purposes, and the tendency of the great mass is 'to let it go at that.' The transformer that by the power that is called 'induction' for lack of a better name, will step up the number of volts, will be inclosed in oil, and the apartment walled in will have doors so that if it gets out of repair it can be easily and safely handled. It will be dangerous to approach it within six feet, and it will be controlled at a safe distance by those in charge."

A good cement for making tight joints in pumps, pipes, etc., can be made of a mixture of 15 parts of slaked lime, 30 parts of graphite and 40 of barium sulphate. The ingredients are powdered, well mixed together, and stirred up with 15 parts of boiled oil. A stiffer preparation can be made by increasing the proportions of graphite and barium sulphate to 30 or 40 parts respectively and omitting the lime.

Another cement for the same purpose consists of 15 parts of chalk and 50 parts of graphite, ground, washed and reground to fine powder. To this mixture is added 20 parts of ground litharge, and the whole mixed to a stiff paste with about 15 parts of boiled oil. This last preparation possesses the advantage of remaining plastic for a long time when stored in a cool place. Finally, a good and simple mixture for tightening screw connections is made from powdered shellac dissolved in 10 per cent ammonia. The mucinous mass is painted over the screw threads, after the latter have been thoroughly cleaned and the fitting is screwed home. The ammonia soon volatilizes, leaving behind a mass which hardens quickly, makes a tight joint, and is impervious to hot and cold water.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

Vol. V No. 8. BOSTON, JUNE, 1906. One Dollar a Year.

OUT DOOR ATHLETIC APPARATUS.

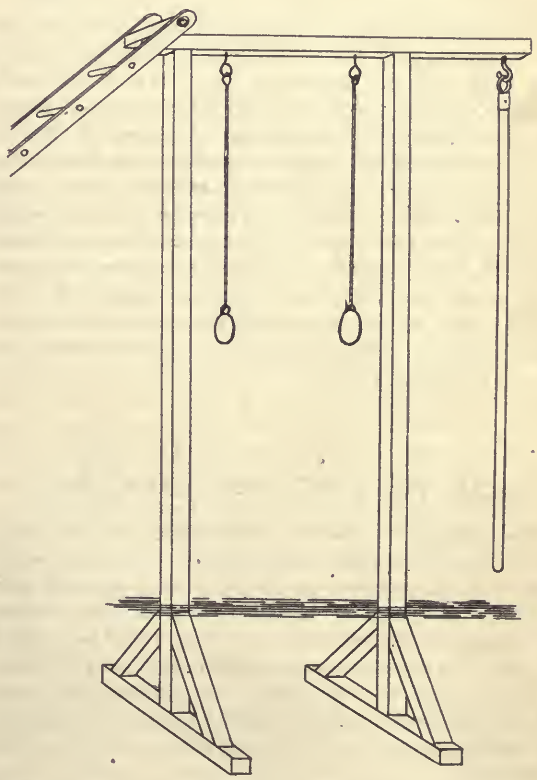
WALTER N. HANSCOM.

Physical training is too frequently considered a matter of interest only to young people, and the necessity of maintaining a proper physique by adults is, in these days of strenuous business life, rarely given proper attention, especially by those engaged in sedentary occupations, who are the ones most needing it. Gymnasium work generally means travelling quite a distance and the using up of the larger portion of an evening, with the result that it soon becomes tiresome and is eventually discarded for something more attractive. The average person in middle life is likely to be, therefore, in anything but good physical training, and unless afflicted with some noticeable ailment gives little thought to the benefits to be derived from a little regular daily athletic exercise.

The apparatus needed is not elaborate or expensive and requires no more room than can be found in the corner of many yards in the rear of residences excepting those in the crowded sections of large cities. In even these localities sections of the roofs of houses are railed in and floored for the purpose of hanging clothes, and the frames used for the clothes lines can be easily adapted for many excellent exercises.

The illustration shows a simple combination of athletic apparatus, permitting a variety of interesting movements, which can be supplemented by short distance running, making a sufficiently complete schedule as to enable those regularly following it to keep themselves in first class condition. It is well to emphasize the necessity of regularity of effort, as a few minutes daily, is of far more value than hours at irregular intervals. The great value of short distance running at moderate speed is only appreciated by those who have practised it. These facts are mentioned to show how easily one may engage in athletic training, and the writer hopes that what is here stated may influence those readers who are now doing little or nothing in this line to take up a few simple forms of exercise and the beneficial results will surely repay those doing so.

The apparatus included in the arrangement shown is that largely required to straighten the form, expand the lungs and develop the muscles of the arms, chest and back. Running will develop the muscles of the legs and abdomen, and expand the lungs, and as the distances are increased with practice, greater endur-



ance without undue fatigue will be acquired. The setting up drill of the regular army can also be included as a part of the course to good advantage, making altogether a well rounded schedule of training.

The framework consists of two upright posts 16 ft. long, 4 x 6 in.; a cross piece at the top 8 ft. long, mortised to the posts; a ladder with one end attached to one end of the cross piece and the other resting on the ground. From the other end of the cross piece is also hung a climbing pole or rope, or both if means and space will permit. Between the posts are hung adjustable flying rings, which may also have attachments permitting a trapeze to be substituted for the rings. A horizontal bar can also be attached to the sides of the posts.

All the woodwork should be nicely placed and the corners rounded off. It should be thoroughly inspected to ascertain that all points liable to cause splinters have been removed. A hand scraper will be useful in smoothing the surfaces. The bottoms of the posts should have cross frame work mortised to them, and this should be buried in the ground about two feet. All wood below the surface should be coated with a thick coat of asphaltum paint, and the earth firmly packed around it. All woodwork above ground should be given several coats of spar varnish, this being the only kind that will stand exposure to the weather.

The ladder should be of spruce and rather heavy. The climbing pole can be made from a length of 2 in. oak curtain pole, selecting one having perfectly straight grain. The fixtures for attaching the various parts of the apparatus can all be purchased of dealers in athletic apparatus, who can also furnish descriptive catalogues from which selection can be made. None other than general dimensions have been given, owing to the great variation in arrangement and sizes because of the limitations of space and means, but these suggestions and the advice of some carpenter will enable any one to put up a creditable arrangement and the subsequent pleasure and profit will more than repay them for having done so.

GLUE AS A BINDER FOR CORES.

The making of a core is matter which requires fully as much attention as the mold itself, and one is apt to think that as long as a core is made so that it will hold together and is well vented, that this is all that is necessary. Such an idea is wrong, says the "Brass World." A core for one purpose requires a different treatment from that of another, and to produce a core which will answer certain requirements, needs a careful understanding of the properties of the various binders.

The ideal core would be one which does not give off any gas at all when the hot metal strikes it. In addition to this, the core must be yielding so that the metal will not crack when it shrinks around it. Such a core material is unknown, and it is believed that the nearest approach to it is a core made of sand held together with glue. The virtue of the glue lies in its ability to bind the core together and, as far as known, glue is the best adhesive in existence. For a given weight, glue will hold more sand together than any other known substance.

This means that a smaller amount may be used for mixing with the sand than any other material, and with the accompanying virtue of giving off less gas when the hot metal strikes the core. It will, no doubt, be apparent that the less binder that is used in making a sand core, the less the amount of gas which will be given off. This is why glue is so useful in making the cores. So small an amount is used that very little gas is given off.

The method of using the glue for the manufacture of cores is to boil it up with enough water to dissolve it, and then add cold water until a very thin glue water is had. This is used to sprinkle the core sand mixture. The cores are then made in the usual manner and dried. If the cores are too hard, then less glue must be used in the water. The amount to be used can only be told by experience.

The advantage of glue is very apparent in the manufacture of small cores as the cost is not an item as it is in the use of a binder for large cores. For small cores, where there is little opportunity to vent them properly and little opening in casting for the escape of gas, glue will be found particularly serviceable. By its use it is possible to make a core which gives off practically no gas at all. This, of course, is on the assumption that a core can be used which is very soft. If trouble is experienced with cores of a small nature, core maker would do well to glue. Many know of its value but imagine that the cost is so much that it cannot be considered. As very much less can be used than in the case of flour, the cost is not so much as one might naturally believe.

Glue is very valuable in the case of large cores which are of such shape that they are apt to break in handling. By putting sufficient glue in the water which is used to wet the core sand, a core may be made which will stand a large amount of rough usage.

In casting the soft metal in plaster molds, it has been found that a very much thinner casting may be made if melted wax is allowed so soak into the plaster after it has been dried. The method of using this is to make the mold in the usual manner and then allow some wax to melt and permeate the mold. This can be done after it has been removed from the drying oven. This method causes the metal to flow with great fluidity, and every part of the mold will be permeated; therefore a much thinner casting than otherwise may be cast. Japan wax is what is used, as this answers the purpose and is a cheap form of wax. This method is now being used in one of the largest hollow-ware concerns with excellent results.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

III. The Condenser.

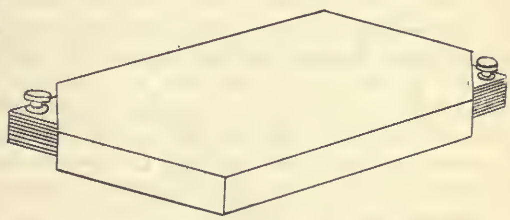
Owing to the long time required to complete a condenser to the working condition, it is described at this time rather than after the rest of the work on the coil is finished. The particular trouble referred to is the difficulty of drying out all moisture; this being necessary to guard against the possibility of sparking through the insulation and consequent failure of the condenser. One condenser made by the writer proved absolutely worthless because of the presence of moisture in the shellac, which was used as the dielectric. My experience has been that carefully waxed thin bond paper makes the best dielectric for amateur's use, two thicknesses of paper being placed between the sheets of foil.

Assuming, for the sake of illustration, that the condenser to be made is to be used on a spark coil rated to give a four inch spark, we find that the condenser requires approximately 3000 square inches of foil. It is necessary to state that condenser capacity is a variable quantity; no two condensers made from the same specifications having exactly the same capacity, but the results will be near enough to the estimated capacity so that no difficulty will arise from minor divergencies.

As the various uses to which a coil is put require different condenser capacities, it is desirable to make up the condenser in four sections with a plug or other large contact connecting device, which will permit of one or more sections being used as needed. This gives to each section 750 square inches, which works out nicely for sheets of foil 5 x 6 in. =25 sheets, each containing 30 square inches. To make an even division and also allow for loss or corners, 28 sheets will be used, 14 for each end, it being understood that the alternate sheets are connected as will be described. For the four sections there will be needed about 4 pounds of tin foil in sheets 5 in. wide, 1 ream of legal size thin bond paper and about 3 pounds of pure paraffine wax.

The legal size paper measures 8 x 14 in. and should be taken to a printer's and cut to 8 x 7 in. At the same time one diagnonally opposite corner should be cut off to a mitre cut of 45°. Measure off 3 in. each way from the corners and cut to the points thus obtained. The foil is then cut to the size 5 x 6 in. and one corner cut off, measuring 2½ in. from the corner for the points for the mitre.

To make up the condenser, an agateware pan 9 x 12 n. will be needed; also an iron pan about 10 x 14 in. and a squegee roller. The agateware pan is to contain the paraffine wax, and is placed in the iron pan; the space between the two being filled with water and the wax heated by means of the water. To heat the wax directly on a stove involves the risk of setting it on fire, which is avoided by using the water bath. If an oil stove is available it is preferable to use it rather than work over a cook stove, as considerable time is required and the work is rather "messy." A squegee well suited for the purpose can be made from a piece of glass tubing with thick walls, plugging the ends with wood and fitting a handle thereto. The ends of the tube should be ground smooth on a grindstone.



The materials being placed conveniently at hand, melt the wax in the agateware pan. When melted to quite a fluid condition, the wax is sufficiently transparent so that the foil and paper can be seen at the bottom. The wax should be boiled for at least half an hour before proceeding further. The paper should also be dried for several hours in an oven moderately heated, using care not to scorch the paper.

When all is in readiness, place two sheets of paper on the bottom of the pan, one at a time, and roll with the squegee roller. Then place a sheet of foil in the center of the paper with the corner overlapping the cut in the paper. Add two more sheets of paper, then another sheet of foil with the corner projecting at the end opposite that of the first sheet. Two more sheets of paper are followed by another sheet of foil; this time the corner projects at the same end as does the first sheet. The process is continued until all the sheets of paper and foil are laid for a section, the top layer being two other sheets of the paper. It will be seen that all the even numbered sheets of foil project at one end and the odd numbered sheets at the other.

After laying each sheet of foil on paper, roll smooth with the squegee to force out all air bubbles. An even, firm pressure, rather than a heavy one, is what is needed. The efficiency of the condenser is largely dependent upon the success with which the air is excluded, so the work should not be hurried.

After all the sheets are laid, the section should remain in the boiling wax for an hour or more. It is then removed and placed between two pieces of thin, strong wood, or thick binders board, which have previously been well dried in an oven and also soaked in the wax, binding all solidly together with lineman's adhesive tape, except at the corners where tin foil projects.

To clean the wax from the projecting corners of the foil suspend in turpentine until the wax is all dissolved, and then clean off the turpentine by dipping in grain alcohol. The projecting corners of foil are then firmly pressed together, using care not to break them from the sheets of which they are a part. In the center is placed a strip of thin brass $1\frac{1}{2} \times \frac{1}{2}$ in. having a $\frac{1}{4}$ in. hole at about the center of the projecting corner. Punch a hole through all the corners of foil and place therein a binding post having a screw of small wire gauge, and screw the nut down tight. Copper or brass washers should be placed under both the head and the nut of the binding post to prevent tearing the foil. To the projecting brass strips are soldered the connecting wires, which can be done much more easily and safely than by attempting to solder the wires directly to the foil, as the latter melts easily and repairing is then a difficult matter.

HOW TO FIGURE HORSE POWER.

TERRENCE TRENHOLME.

Attempting to follow the empirical constants evolved for the steam engine led the pioneer gas engine designers so far astray that one and all dropped them forthwith, and seemingly they, nor their successors have ever come together since. The indicated horse power of any engine is equal to 1-33,000 multiplied by the product of the mean effective pressure, the area of the piston, length of stroke in feet and number of power strokes per minute. In the case of steam engines this is usually expressed by the formula

$$\text{H. P.} = \frac{PLAN}{33{,}000}$$

in which:

P. Mean effective pressure in pounds per square inch.

L. Stroke in feet.

A. Piston area in square inches.

N. Number of power strokes per minute.

Taking into consideration actual working conditions and allowing for drop in pressure from various causes, the results of this formula will be found to fall within close limits of error. But with the explosive engine so many disturbing factors are present that it is almost impossible to predict from cylinder dimensions, speed and fuel, what power a given engine will actually develop. The most that can be done is to say what it should produce, granted that the numerous conditions of effective working are complied with.

Assuming a given compression sufficiently short of the practical limit as not to involve any danger of spontaneous combustion, a speed that is neither unreasonably low nor excessively high, that the various parts have been correctly designed, that the mixture is good and ignition takes place at the proper point, that the resistance of the various ports and passages is not so great as to prevent the cylinder receiving an approximately full charge, a formula may be evolved which will, as above mentioned, show the best result theoretically that may be expected from an engine of given bore, stroke and speed.

By omitting the compression factor, the man who reads in a catalogue that the stroke and bore of a motor are of given dimensions, and R. P. M. are of specified number, may obtain approximate results by following this simple formula, the calculation in this instance giving the brake or actual horse power.

$$\text{B. H. P.} = \frac{D^2 \times L\,N}{18{,}000}$$

in which:

D. Piston diameter in inches or bore.

L. Stroke in inches.

N. Revolutions per minute.

The denominator varying according to the design of the engine and the character of the fuel.

By assuming a piston speed, this may be simplified to such an extent that, given the piston diameter, what any engine is capable of producing may be known with but little calculation.

General practice in four-cycle engines favors a piston speed of 500 feet per minute, in small stationary and marine engines up to 700 feet, and in automobile motors 800 to 1000 feet, so adopting 600 feet per minute as a mean, we have

$$\frac{2L \times N}{12}$$

$= \text{piston speed in ft. per minute, or}$

$= 600$

$L\,N = 3600$

$$\text{B. H. P.} = \frac{D^2 \times 3{,}600}{18{,}000} = \frac{D^2}{5}$$

in which D, L and N represent the same values as above. Thus with this piston speed the horse power per cylinder would equal approximately one-fifth of the square of the bore. In other words, an engine with a 5 x 6 in. cylinder, should produce 5 h. p. at 600 R. P. M., but this somewhat lower than the speed of the average automobile motor. The denominator four will approximately express the difference represented by an additional one to two hundred revolutions per minute, will produce 6⅔ h. p., and so on in proportion as speed increases.

For gasoline, E. W. Roberts, in the gas engine handbook, gives the following:

$$B. H. P. = \frac{D^2 \times L \times N}{13.500}$$

and this has been found to work out well in practice. But the engine builder who blindly follows any set formula is sure to be disappointed at the concrete result, and the majority of those who have started with a formula as a working basis, toiled over a long and weary road, full of vexatious obstructions being producing a motor that fulfilled expectations to any extent. Formulæ, generally speaking, represent maximum values obtainable under ideal conditions, and this is particularly the case where they have not been continually modified and readjusted as the result of experience extending over a number of years.—"Automobile Magazine."

WIRELESS TELEGRAPH RECEIVER.

AUSTIN M. CURTIS.

The following is a description of a wireless telegraph receiver which is very sensitive, yet simple, and which needs very little adjusting.

Make a base of ⅞ in. mahogany, or other hard wood, 3½ x 3½ in. Plane it off smoothly and round off the top edges. In the center of this base drill a ½ in. hole, ½ in. deep. Shellac and polish the base. Next get a piece of glass tubing with 1-16 walls and an outside diameter of ½ in. Cut off a piece ½ in. long and smooth the edges by holding in the flame of a bunsen burner until the edges begin to fuse.

Get a piece of platinum wire one inch long, about 24 gauge, and solder it to a piece of No. 22 copper wire about six in. long. From a point on top of the base near one corner, drill a 1-16 in. hole at an angle, so that it comes out near the bottom of the ½ in. hole and ends there. See Fig. 1. Push the piece of No. 22 wire through this so that the part which has the platinum pointing upwards. Break up some good sealing wax into small pieces and pack these tightly around the point of platinum wire. Next heat one end of the glass tube until it is hot enough to melt the wax and force the tube into the hole. The wax will melt and adhere to the glass, making a perfect joint and leaving the platinum wire projecting above the wax.

Screw two double contact binding posts into oppo-ite corners of the base. Fasten to one of these the wire which comes from the bottom of the tube, and to the other piece of No. 24 copper wire which is coiled into a spiral for about ½ in. and the end left straight for 1½ in.

Get a cork to fit the top end of the glass tube and drill in it a hole about ⅛ in. in diameter with a hot wire or twist drill. Boil the cork in paraffine until it is thoroughly saturated.

Some glass tubing ⅛ in. in diameter and platinum wire .002 in diameter is needed. This will cost about 25 cents per foot and 6 in. is needed. Take a piece of the tubing 4 in. long. Heat the middle of it in a gas flame and draw it out until it is the shape shown in Fig. 2. Break the two pieces apart, leaving a minute opening. Put a piece of the platinum wire ½ in. long in each piece of tubing, leaving a short piece of the wire projecting outside of the small end of each tube. Heat the tube until the wire is sealed into the glass and the glass hardens. Next grind down the glass on

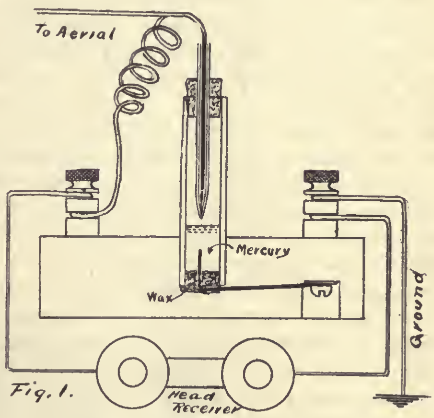


Fig. 1.

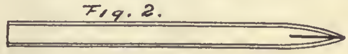


Fig. 2.

a dry whetstone until the wire flush with the glass. Fill the tube one half full of mercury, shaking it down until it touches the platinum wire inside the tube. Make about six of these points.

Put about one-half inch of mercury into the larger tube which is mounted upon the base. To the mercury add five or six small slivers of zinc. Put about ½ in. of dilute sulphuric acid (10 per cent) in the tube on top of the mercury. Now push one of the points in through the hole in the cork and put the cork in the tube. Put the end of the coiled wire into the point so that it touches the mercury. Connect a pair of head telephones of the highest procurable resistance across the two binding posts. A faint click should be heard when the wire is pulled away from the mercury in the point or touched to it. If no click is heard, grind the point down a little.

This receiver may be used untuned by connecting one binding post to the aerial wire and the other to the ground, with the telephones bridged across as above directed. It is particularly adapted, however, for working with a tuning coil.

Do not leave the cork in the tube all the time for the first three days or until all the zinc is dissolved in the mercury, otherwise the accumulated hydrogen gas may blow the cork and point out of the tube. If the point does not work satisfactorily, grind it down until it does.

With this receiver tuned the writer has received readable messages from a commercial station on a steamship over 500 miles away.

LARGE MARINE GAS ENGINES.

With the general development of the large gas engine there has come a natural tendency to apply it as a motor to nearly every variety of machinery demanding the effort of mechanical energy. It is to be expected, therefore, that the combustion motor, in more than one type, should be applied to the propulsion of boats; not only for driving the small, high-speed pleasure craft, but also vessels of larger size and less pretensions as to speed.

An article by Herr C. Stein in recent issues of the "Zeitschrift des Vereines Deutscher Ingenieure" reviews the practical applications which have been made of gas engines for propelling commercial vessels, and although the subject is in an early stage of its career it already demands attention and review.

The earliest attempts to use internal combustion motors for marine service involved the carrying of compressed illuminating gas, a freight boat called "L'Ide" having been so equipped to run between Havre, Rouen and Paris in 1885. The gas was compressed to 100 atmospheres, there being 80 tanks, each holding 22 cubic meters of gas, the total volume of gas carried being 1800 cubic meters. The 40 h. p. engine consumed 450 litres of gas per h. p. per hour, giving a speed of 10 kilometers per hour for 100 hours, or a ration of 1000 kilometers. The gas tanks themselves weighed 26,000 kilograms, and Herr Stein computes that this weight, if replaced by a tank of petroleum, would supply fuel for 1200 hours, or twelve times the period obtained with compressed gas.

By the use of modern benzine or gasoline motors the question of fuel is readily solved, and some very successful motors of this type have been made for marine use.

All such motors involve certain modifications to be made in the propelling machinery in use for steam propulsion, and these points are very fully discussed in Herr Stein's paper. Thus the gas engine is not easily reversed, and should be operated regularly at its normal speed, the speed changes being controlled by other means than by varying the velocity of the engine.

Reversals are effected either by changing the angle of the propeller blades, or by the use of reverse gearing, changing the direction of revolution of the propeller shaft. The shifting propeller blades are not found to work well for larger powers than 100 horse power, although this method is satisfactory for small boats. Herr Stein illustrates several arrangements of clutches for reversing the propeller shaft, some of these being combined with a pivoted tail shaft, so that the propeller can be raised out of the water when proceeding under sail.

The use of gasoline motors for marine service is necessarily limited, and hence the practicability of employing producer gas becomes a matter of interest. The development of the suction gas producer offers opportunity for the arrangement of a complete power gas plant for such a service, and Herr Stein describes such an equipment on a freight boat on the Elbe. This boat, the "Lotte," is 41 metres long, 4.6 metres beam, drawing 2 meters with a load of about 240 tons. This boat is fitted with a pair of balanced gas engines, the cylinders having the *vis-a-vis* arrangement, the suction gas producer being placed in an adjoining compartment, in order to protect the moving parts from the heat and dust. The engines develop about 100 h. p., this sufficing to propel the boat at a speed of about six kilometres per hour against the current. Experiments with this and other boats propelled by suction gas power show that the cost of transport falls as low as 0.64 pfennig per ton kilometre, or about 0.25 cents per ton mile, as against 1 pfennig for steamboat transport, and 3.2 pfennig on the railway.

The suction producer is especially applicable for use on shipboard, since an unlimited supply of water is available for condensing the impurities, tar, aud other volatile matter in the gas, and there is also ample opportunity for keeping the cylinders of the motors properly cooled. In general the conditions for operating the internal combustion motor are far more favorable on shipboard than on road vehicles. The question of weight is not of such controlling importance, and hence the various parts may be of ample strength. The difficulties from dust and dirt are absent, while the working parts may be made readily accessible. At the present time the larger sizes of gas engines have not been applied to marine propulsion, but for the propelling of boats of moderate size at the speeds common for ordinary river transport the engines now available have already proved their capability and high economy.

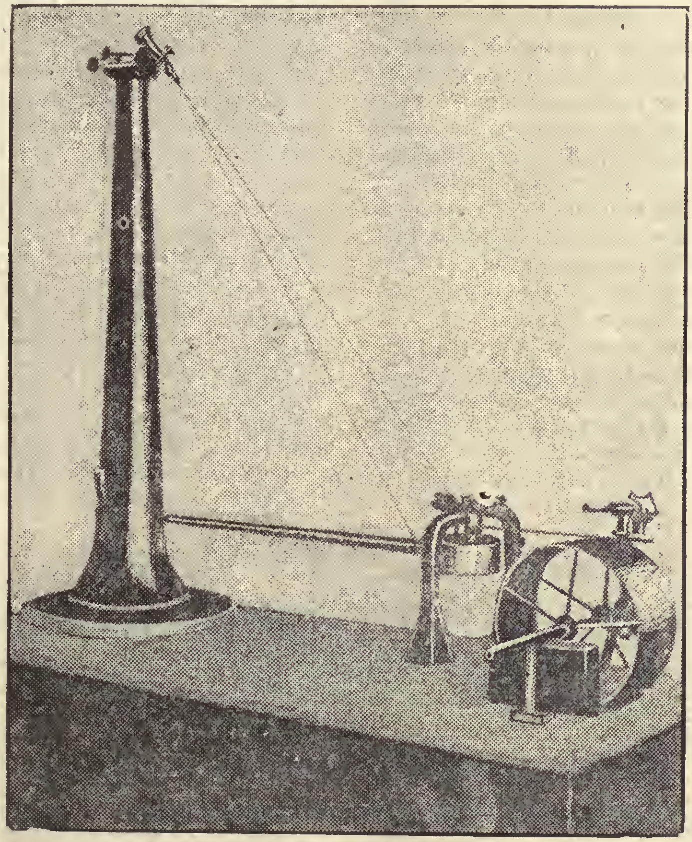
The Diesel motor has also been applied to marine propulsion, and it has the especial advantage of using heavy oil, petroleum and similar fuels directly in the cylinder, without requiring any carburetter.

Gas engine propulsion for boats may be said to be yet in its infancy, but the results thus far attained have been most encouraging, and there is every reason to believe that the use of internal combustion motors on shipboard will become widely extended.

THE SEISMOGRAPH.

RECORDS TIME AND INTENSITY OF EARTHQUAKES.

One of the most interesting places in Washington at this particular time is the earthquake or seismographic division of the U. S. weather bureau. There, in charge of Prof. C. F. Marvin, earthquake specialist and meteorologist, are kept the delicate machines known as seismographs, which record the time and intensity of any quake that may happen to pass this way, as well as a mass of data referring to earthquakes volcanic eruptions and other causes of disaster to humanity.



On one of the weather bureau seismographs was made a complete record of the great earth wave which brought death and ruin to the fair city of San Francisco.

The delicate needle of the seismograph had been tracing long, straight white lines on the gelatined surface of the record sheet Wednesday morning, when it suddenly became agitated at 8 o'clock .10 and 20 seconds, and began to make more or less elongated waves. At 8.25 o'clock the strong waves began, and the recording needle moved rapidly back and forth across the sheet. Then followed the most violent waves between 8.32 and 8.35 o'clock, 75th meridian time, as is shown by the record.

At one time the motion of the needle was so vigorous that its point went off the sheet, which is kept in motion by a clock machine, and the point did not return to the sheet until there was a secondary lull in the great disturbance. Then, when the needle had resumed its tracings, the earth vibrations and waves continued until 12.35, when the agitations ceased.

Each of the lines on the record sheet represents an hour of time, the movement of the sheet keeping time with the tick of the connected clock. The units of time are marked on this sheet, which is covered with gelatine, and thus the observer is enabled to tell just when the earthquakes began and when they ended by the markings made by the needle point.

The atmosphere which Prof. Willis L. Moore, chief of the weather bureau, has installed in his department is said to be one of the best in the world. It is installed in a basement apartment away under the weather bureau building, far removed from the noisy hurly-burly of the streets, and is practically a mechanical recluse, only Prof. Marvin and the immediate observers being allowed to invade the sanctity of its subterranean home.

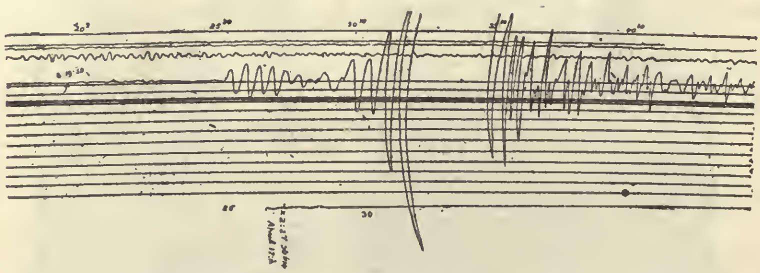
For purposes of exhibition and explanation a duplicate seismograph has been set up in a room adjoining the office of Prof. Marvin. This instrument has been shown and described to a large number of visitors since the San Francisco disaster.

ITS EXTREME SENSITIVENESS.

The extreme sensitiveness of the seismograph is shown in the following statement made by Prof. Marvin:

"The extreme sensitiveness to tilting is exhibited in several ways. The weight of the observer almost anywhere on the floor of the small room in which the instrument is installed suffices to tilt the pendulum enough to show on the record; a large displacement is produced by standing at one side of the pedestal. It has been noticed also that the weight of an ice wagon which stops daily to deliver ice at a basement entrance to a building causes a definite displacement of the trace of about one millimeter, which disappears when the wagon drives away.

There are no vibrations or oscillations registered, only a distinct elastic bending of the ground due to the load. This motion, moreover, is communicated through the foundation walls of the building. The distance of the wagon from the seismograph is about 20 feet; the asphalted drive and the basement floor are on the same level. The subsoil is a hard clay.



The earthquake wave recorded at such a long distance from the real seat of trouble, was in the nature of a long, regular motion like a sea wave. The motion at San Francisco was quick and sudden, and therefore very destructive.

This violent agitation produced destructive strains, with the tendancy to shake buildings to pieces, whereas at a distance where the movement of the earth is slow and regular all portions of the building may follow the motion of the ground.

Prof. Marvin said, in illustration, that the passing of a rapidly moving railroad train produces a vibration of the earth similar to that produced at the place where an earthquake is causing destruction, only in greatly reduced magnitude.

UNWRITTEN EARTHQUAKE HISTORY.

The professor gave the reporter a piece of unwritten earthquake history of recent origin and local application. He said that at 4.35 o'clock p. m. of April 10—eight days before the San Francisco visitation—a rather severe shock of earthquake was recorded on the weather bureau seismograph. Up to this time, however, nothing has been heard from the mysterious quake or its effects.

On another recent night three distinct shocks were recorded, but they remain unidentified as to effects, and it is not known whether the quakes occurred out at sea, or where. An earthquake was reported from Formosa on April 14, but it has not been connected with the mysterious quakes recorded at the weather bureau.

CAUSES OF EARTHQUAKES.

Prof. Abbe gives the causes of earthquakes in a statement which says, according to views commonly accepted in geology, the solid crust of the earth consists of an unknown depth of granite and gneiss, on top of which are five or ten miles of metamorphic and and sedimetary strata.

This crust is everywhere in a state of strain, due to various kinds of stress; in other words, the outward bulgings that make the continents and the mountain ranges, or the downward bendings that have made the ocean beds, represent strains that frequently become too severe for the rock to resist. Moreover, in special localities there are upward-pressing masses of lava or other plastic material that produce great local strain. In other places the strata that ages ago were tilted up to make a mountain, are still in a state of strain, and notwithstanding the long interval that has elapsed are occasionally cracking and sliding on each other.

These various stresses have produced the innumerable cracks that we see in the smaller beds of rock and the faults that the miner discovers in his attempt to follow up a vein of mineral ore. Even the tidal action of the sun and moon and the variations in barometric pressure and in the loads of snow and alluvium can produce appreciable effects.

Nearly all earthquakes are accompanied by a rumbling sound, due, I believe, to the small and rapid vibrations proceeding chiefly from the margins of the area over which the fault-slip producing the earthquake takes place. In some districts (Comrie in Perthshire; East Haddam in Connecticut; Pignerol in Piedmont; Meleda in the Adriatic, etc.) sounds without shocks are common during intervals which may last for several years, but slight shocks with sounds occasionally intervene, as if the sounds and shocks were manifestations, differing only in degree and the method in which we perceive them, of one and the same phenomenon.

In the great earthquakes the sound area is confined to the neighborhood of the epicenter; in moderate and slight shocks the sound area may even overlap the disturbed area. In the limiting case the disturbed area vanishes and the vibrations are perceptible only as sound.

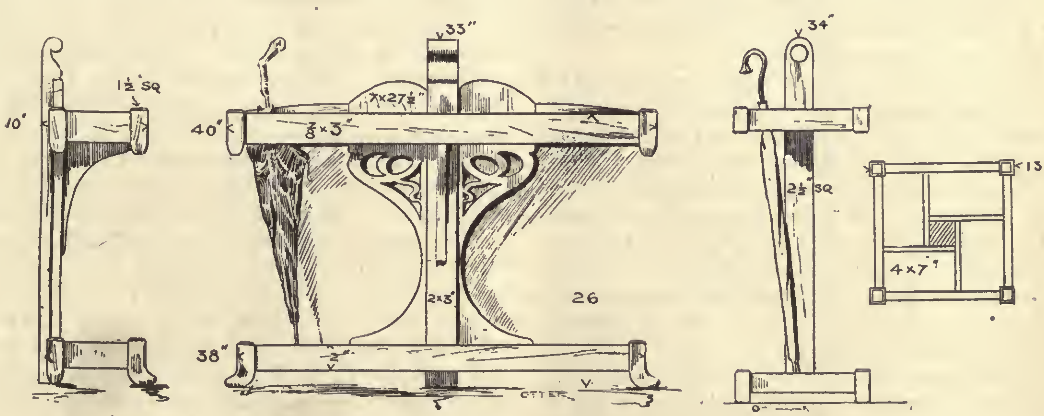
A weather observer describes the coming of an earthquake thus:

"The shock was preceded by a rushing or hissing sound, for three or four seconds, like the wind blowing through brush. It was followed by a rumbling sound, similar to a heavy wagon on hard ground. This lasted two or three seconds. Then came this heavy, jarring shock; two shocks were felt." — "Washington Star."

UMBRELLA STANDS.

PAUL D. OTTER.

It is an old saying that "all things come to him who waits," but many acquire "things" after they have secured the purchasing power. The handy man's wife acquires many articles after patient waiting on



her husband's ability to "just get around to it," The umbrella stand, while not of vital importance, is not the least of many articles that some day we will get around to having. Meanwhile in the more pioneer days of home building the corner of the wall in the hall supported the umbrellas at various unsightly angles.

For the large family, the pattern shown in Fig. 1 will fulfil all requirements. The perforated center adjoining the middle part is cut from one length of board and the edges doweled and glued to each side of the post and flush with the front face. To the outer edges is secured the back part, as shown, entering the block corner seen in the side and front views. Before the divisions are placed, a ⅛-in. batten should span the back part across the front of the post and between the back corner blocks, being glued and firmly secured to each piece by brads. This will insure greater strength for the four-part back.

The bottom of the base is floored and may be zinc lined, or the bottom may have grooves running to the center hole, in which a pan is placed to receive the running water that may drip from the umbrellas. Inasmuch as umbrellas properly cared for should be opened out to dry, pans in the homes are hardly needed. Fig. 2 is planned for four compartments, but its entire length may be shortened for three openings if desired.

For a small stand Fig. 3 will be found serviceable to go in a certain corner. The arrangement for the top is the same as shown in the plan, compartment being built around a 2½ in. square post and the sides set in 1½ in. square blocks with chamfered edges. A dull oil finish will be found most satisfactory to apply to this character of furniture.—"Carpentry and Building."

Many who have wondered at the name of Portland cement will be interested to know that it originated in Leeds, England. A bricklayer named Joseph Aspdin patented an artificial cement in 1824 and called it "Portland Cement," owing to its resemblance to the famous building stone then quarried at Portland, England. As then made, it was a lightly colored mixture of lime and clay, which was afterwards ground. He started a factory for making it at Wakefield in 1825, and some of the cement was used in the Thames Tunnel by Sir I. K. Brunel, the famous engineer, in 1828.

A NINE FOOT SKIFF.

CARL H. CLARK.

The skiff which is the subject of the present article is of very simple and cheap construction. There are many persons who either do not realize their need of a boat until late in the season, or who put off the matter until then; for these this boat is well suited. For a cheap yacht tender, especially for use in shallow water, it is particularly well suited. It can be built by an amateur in about three days time at an expenditure of about six dollars for lumber, nails and paint. The one of which this is the copy was built by the author in about a week, working at odd times at a boat-house with few tools. The boat is 9 ft. long, 3 ft. 8 in. wide and about 17 in. deep. The material may be of any soft wood, such as pine, cedar or cypress; the latter is to be preferred, as it is tough, easily worked, light and cheap.

The main material required consists of: — Four boards 10 ft. long for the sides, of ½ in. stock, two 8 in. wide and two 10 in. wide; also two boards 10 ft. long, 6 in. wide and ½ in. thick, for rails, etc., and two strips 12 ft. long of 1 in. square, for ribs.

Two boards 9 ft. long, 6 in. wide and ½ in. stock are needed for the bottom stiffeners, and about 30 ft. of ½ or ⅝ in. stock, preferably the latter, in about 10 in. widths, for the bottom.

The construction is very simple, as will be seen from the illustration. The sides are in two pieces stiffened by the ribs; the bottom is laid crosswise, and in the corner between the sides and bottom are fitted the corner strips. The bottom stiffeners run fore and aft and strengthen and protect the bottom.

Fig. 7 gives the pattern of the sides, formed of the 8 and 10 in. boards, the curved seat being cut out of the wider board. The edges of the boards should be carefully jointed and the outline cut out as shown. The boards should be fastened together temporarily with cleats on the inside, care being taken to keep them clear of all the points marked on the plan. The several lines should be drawn across square, on the side which will be the inside of the boat, for future use in placing the ribs. The seams between the two boards should be close and smooth.

Fig. 9 is the shape required for the form at the widest point; it is made of rough boards but must be strong and accurate. Fig. 8 illustrates the board for the stern, of ⅞ in. stock, cut to the shape shown, and the edges bevelled slightly, to fit the bevel of the sides.

The widest place in the boat occurs between the two 8 in. spaced lines at the middle seat. The form should be placed here and held in place by lightly nailing; the two sides should then be carefully bent around. Great care must be used in the work not to break or split the boards, and they must be bent slowly. A light frame may be made, a trifle larger than the stern, to slip over the after end of them, to hold them in place, leaving only the forward ends to be bent around. A cleat may be fastened across the forward ends and a rope passed around, and used for drawing them together. When the sides are sprung into place the bow will be found to be much more pointed than is desired; it must then be forced out by a board put across at about the after side of the forward seat, until the width here is exactly 3 ft. outside; the deck view should then appear as in Figs. 2–4.

The stern board should be fitted and secured in place; the sides may be forced down and held by driving the frame further forward. This should force them down firmly into place, and after painting the joint they may be fastened with screws or long nails. The frame should, however, be left in place until the sides have "set" and some of the spring is removed, as otherwise the joint may be opened slightly.

The forward ends of the side boards are brought to within about ½ in. of each other, leaving this amount all around the curved ends to be filled up by the stem. The stem on the inside must next be fitted. It will be necessary to do this entirely by trial on account of the curve of the bow. If a curved knee can be obtained the stem can be made in one piece, otherwise it can be in two pieces, as shown in Fig. 5. The bearing of the sides on the stem should be about 2 in., to allow good fastening. The sides are fastened on with brass screws and galvanized nails. All surfaces should be painted before putting together. Before finally fastening, great care must be taken to see that the boat is symmetrical and true, and should be held true by braces, to avoid any chance of changing shape.

The corner strips, as shown in Fig. 6, are next to be fitted; these strips are 2 in., wide and, as may be seen from the figure, are bevelled and fastened so that the bottom boards fit upon them and inside of the side boards. They are fastened about ⅝ in., from the lower edge of the side boards; at the after end when the curve is greater, they may require a saw cut at intervals to make them bend more easily. They are fastened to the sides with galvanized wire nails, clinched.

The ribs are now to be fitted from the 1 in. strips. They are cut out to fit over the corner strip as in Fig. 9, the object of this being to prevent the sides from warping. The ribs are fastened to the sides, one on each side of the lines already marked, the middle of the rib on the line. They are fastened with the nails clinched over on the inside of the rib, two nails should be drawn through the lower end into the corner strips and carefully clinched. These pieces should

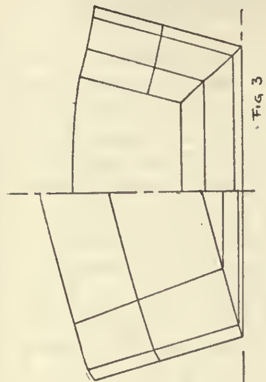


Fig 3

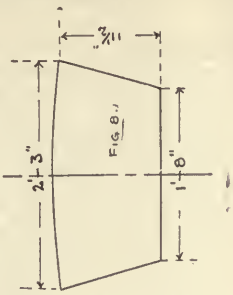


Fig 8
2'-3"
1'-8"

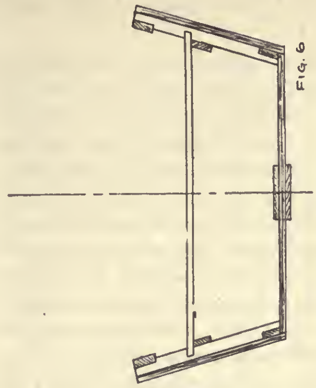


Fig. 6

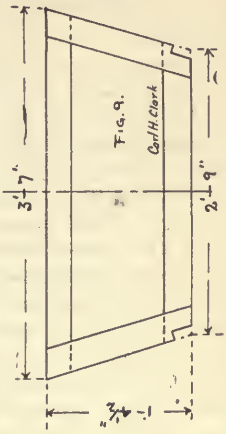


Fig. 9.
Carl H. Clark
3'-7"
2'-9"

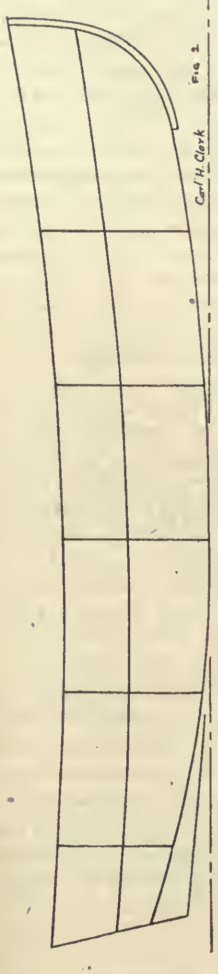


Fig 1
Carl H. Clark

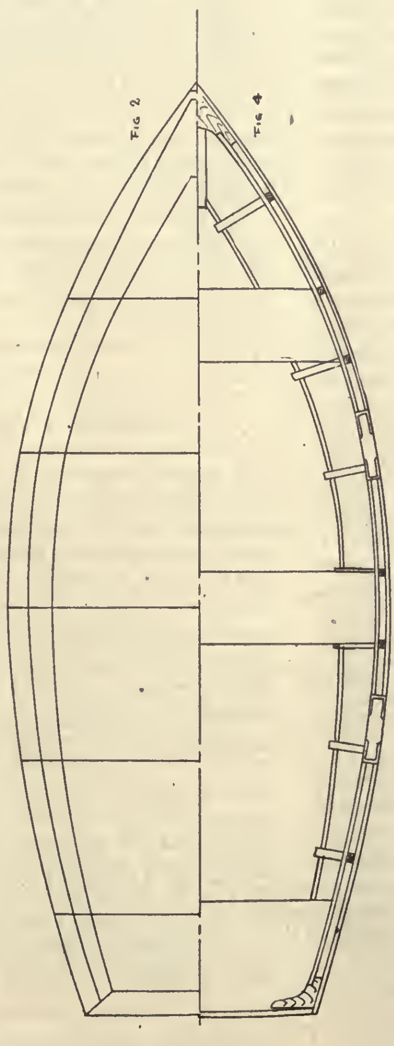


Fig 2
Fig 4

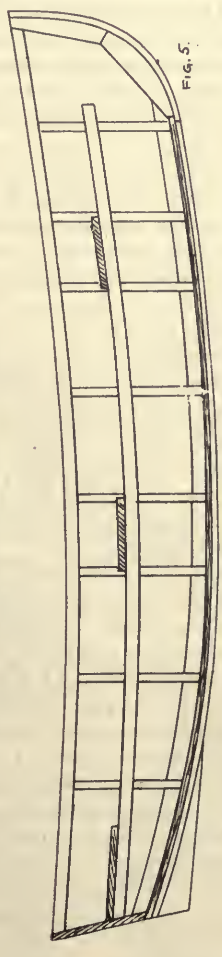


Fig. 5.

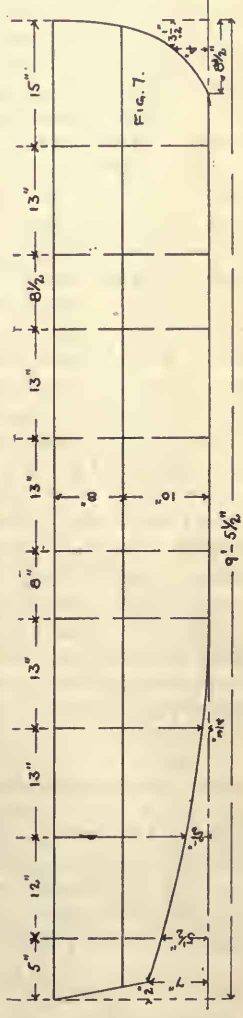


Fig. 7.
15"
13"
8½
13"
13"
8"
13"
13"
12"
5"
9'-5½"

make the sides very stiff and avoid any chance of splitting.

The bottom boards are laid crosswise, fitting between the side boards and resting upon the corner strips. The planks nearest the ends are fitted first, working toward the middle; the ends of the boards are bevelled to fit inside the sideboards, and the edges are made straight, with just enough bevel to make up for the curve of the bottom. The joint is well filled with paint and the boards nailed to the corner strips and also from the outside into the ends of the bottom boards; this nailing in the two directions makes a very strong joint. The nails for this purpose should be about 1½ in. long. The last board should be fitted before the adjoining boards are nailed, as the sides may then be sprung out to let this board down into place, otherwise the slight bevel would prevent its entering.

The bottom stiffeners are fitted inside and outside and are through fastened; they stiffen the bottom and prevent the joints from working. The forward ends of the side plank are now finished off square across and the false stem fitted; the latter is of oak of proper size to make a finish and is steamed and bent into place. It butts against the forward end of the outside bottom stiffener, which is tapered to meet it. A stern band should be fitted to cover the joint and take the wear.

The gunwales are 2 inches wide, and are let ½ in. into the tops of the ribs and well fastened; at the ends pieces are put between them and the sides to hold them parallel, and knees are fitted as shown in Fig. 4.

The seat braces are 1½ in. wide and are fitted about 7 in. down from and parallel with the top of the gunwale; they should run from stem to stern. The seats rest upon these braces. The seats are ⅞ in. thick, the after one 12 in. wide and the other 8 in. wide. The forward seats are fitted in the position shown, bearing against the ribs, and act as braces to keep the sides apart; the ends are notched to fit around the ribs; the bearing should be upon the ribs and not upon the plank. The after seat is fitted in the same way and fastened to the fore and aft braces.

The small skeg under the stern adds to the rowing qualities of the boat; it is of ⅞ in. stock with a cleat on the back extending up on the stern. Rowlock blocks are secured on top of the gunwale and fitted with galvanized rowlocks; foot braces may also be fitted.

All the seams should be fairly tight, but any which are not may be fitted tightly with cotton and puttied. The entire boat should be given two coats of paint.

Seven foot oars are the proper length for this boat, and with the addition of a ring bolt for the painter the boat is now complete. This boat should be very satisfactory as it is light, easy rowing, and has excellent carrying capacity.

Renew your subscription before you forget it.

FAHRENHEIT THERMOMETER.

According to Sir Samuel Wilkes, Fahrenheit constructed his thermometer from one made many years before by Sir Isaac Newton. "In the Transactions of the Royal Society for 1701 will be found the paper written by Sir Isaac Newton, who was at that time Secretary to the Society," says Sir Samuel. "He invented an instrument for measuring the degrees of heat in fluids by taking a tube and filling it with linseed oil.

On this he marked the freezing point as zero by putting the tube in ice, and in the same way he marked the point when placed in boiling water. The very awkward scale which we now use is evidently that of Newton, for, the decimal system not being then in use, he took the number 12 to denote the heat of the body; this he found, and made it the starting point of his scale, both upward and downward.

"It was some time after this, that, for the sake of convenience, the degrees were divided into two, and thus the body heat was 24 above zero and boiling point 53. When, many years afterward, Fahrenheit made his instrument and used mercury instead of linseed oil, which was far more convenient, he again divided these degrees, into four so if the number be multiplied accordingly we have 212 for the boiling point and 96 for the body heat.

"Fahrenheit, finding he could get a lower temperature than freezing, made this point zero, which brought the number 8 of Newton's to 32 of Fahrenheit. In this way the thermometer was constructed."—"Chicago News."

TRUING AN OILSTONE.

If your oilstone needs leveling, says the "Blacksmith and Wheelwright," scrape it with the edge of a piece of glass. A piece of glass can always be obtained when perhaps the ordinary methods of rubbing down are not available or would take too much time. If one end or one corner of the stone stands higher than the rest it is easier to reduce to a general level in this way than by the ordinary methods which make the surface flat, but cannot easily remove a slope to one end or one side.

A slight inclination in any direction causes the oil to run off the stone, and it is advisable, therefore, always to leave the stone slightly hollow so that the oil will tend to run to the middle when it is left standing. The greatest wear occurs, not in the middle of a stone but near the end at the places where the movement of the tool is reversed. It is, therefore, chiefly a small area at the extreme ends which require scraping down and sometimes a little in the middle and along the sides, to take some of the hollowness out.

Have you sent for the new premium list?

HINTS FOR MACHINE WOODWORKERS.

CHARLES CLUKEY.

FILING BAND-SAWS.

One very common fault of beginners in scroll band-saw filing is that of bearing too heavily on the file, and I may say that I have lately seen a man who has been filing more or less for the last dozen years who had never discovered why his saws got so badly out of joint. It is a fact that scroll bands need very little jointing if they are filed with the proper care and frequency. A small saw does not have to be very dull before it will refuse to cut freely, and the reason of this is because of its small teeth. So if the saw is filed as often as it should be, a slight stroke of the file will restore its cutting points without taking away much of the substance of the the teeth. But when a man gives a full, strong stroke to a little tooth it is quite perceptibly shortened, and at the same time takes fully twice the time that a light stroke requires, thus resulting in twice the time and half the efficiency of the proper method.

A SOLDER OR A BRAZE.

Another perplexing thing in connection with the band-saw, and it is not confined to scroll bands either, is that sometimes the man who makes the brazes does not understand the difference between a solder and a braze. If the irons or the torch are not hot enough to flux the solder with the steel, thus making an alloy, the two surfaces of the steel are apt to be soldered together and in appearance present a good joint. In such a case, however, the solder is apt to come apart when the saw is folded or while the joint is being dressed.

In this connection may be added a word about the mistaken idea that borax should be put in the joint between the lap of the saw. With that practice there will be generated a certain amount of gas which will partially prevent a perfect flux of the silver and the steel. Put the borax on the outside and a sufficient amount will find its way in from the outside.

CUTTING BELTS LENGTHWISE.

One of the mean jobs for the millwright is to cut a large or thick belt lengthwise. The writer spent some little time sweating over this kind of work before he caught on to the simple trick of splitting them on the rip-saw, although he had often cut the ends off with a fine handsaw.

LOOSE PULLEYS AND BABBITT METAL.

Loose pulleys with babbitt metal for bearing surfaces are easy on the shaft, but they have a mean way of wearing out so that they have to be rebabbitted occasionally. That this is to some workmen a puzzling job is evidenced by the length of time required to accomplish the task and the wobbly results after it is done.

The proper and simple way is to bore a hole the size of the shaft in a short piece of plank, and after turning a plug to a neat fit, slip this board on it and face up in the lathe to a true surface. Then turn a shallow groove that will just receive the rim of the pulley in a snug fit. If the hub projects farther than the rim it will be necessary to turn down into the middle of the plank far enough to accomodate the hub so that the rim will enter the groove. In the event of the countershaft having been taken out it is as well to put the board on this and babbitt the pulley on the shaft itself, but in the absence of the shaft a piece of wood turned to the same size will do as well.

When putting the pulley in place one or two thicknesses of paper should be pasted around the shaft before pouring the metal so as to give the bearing a running fit. The paper should not be pasted all over but merely a little streak at the end so that it will stay in position. Sometimes it is hard to get the pulley off the shaft and the looseness of the paper will facilitate this operation. But understand the paper must be smooth and tight when the pouring is done.

One of the common troubles of babbitted loose pulleys is that the babbitt gets loose in the housing and causes a bad knocking betore there is much wear in the bearing proper. This can be prevented by having the pulley good and hot when the babbitt is poured so that it will shrink about as much as the softer metal and so be tight forever after.

THE USES OF CHALK.

A neat trick known to most machine-shop men but not to many woodworkers, is to rub chalk on a file to keep it from filling up with the metal being filed. This knowledge is especially valuable in case of reducing a shaft by means of a file.

And speaking of chalk, it is good to use as an oil extractor for old belts. Rub the whiting into the belt as thoroughly as possible and then pack it closely in the same material and let stand for a day or two. The object of rubbing it in is to induce capillary action which will draw the oil from the saturated belt into the dry chalk. Of course all the oil will not come out but the belt will be dry enough for good service.—"Wood Craft."

It is commonly believed by non-technical persons that anything called "steel" must necessarily be stronger than iron. As a matter of fact, poor steel is miserable stuff, not to be compared with decent wrought iron, though the latter is a scarce material nowadays.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

JUNE, 1906.

The devices, attachments, and methods used by one mechanic to accomplish some certain result, are more than likely to be useful to others, and for that reason we hope all readers will make a point of sending us descriptions of anything in this line which they may use themselves or learn of others using to good advantage. The general co-operation of readers to this end would provide information of the greatest mutual advantage. Do not fail to do this simply because it may not be convenient for you to make an inked drawing; pencil sketches and a simple description are all that are needed. And do it while the subject is fresh in your mind; if you postpone it you are liable to forget. For such descriptions we will give liberal payment either in cash or in tools from our premium list. Here is an easy way to fill up your tool chest.

In the previous paragraph mention is made of one way in which this magazine can be made of greater interest and value to its readers. Here is another:

We wish to learn the opinions of our readers as to methods by which this result may be achieved and accordingly make the following offer:—For the best letter received during the month of June stating why the reader likes the magazine, and giving three suggestions as to what changes or additions would make it of greater value to the readers, will be given the choice of premiums from our premium list to the number offered for five new subscriptions. For the next best letter, the premiums for three new subscriptions; the third best letter, the premiums for two new subscriptions. For the ten next best letters, the premium for one new subscription. Each letter should contain not over 200 words, be written on only one side of the paper, with margins at top, left side and bottom.

This is a very liberal offer, and it is earnestly hoped that a large number of readers will find it convenient to favor us with their views on these subjects. We have in contemplation some important plans for developing the magazine, and the information received from these letters will be of material help in enabling us to carry them out. In complying with our request readers will benefit directly, and we have made this liberal offer to encourage a general response. Do not postpone writing, but give the matter your early attention.

A number of letters and orders have been received without the signatures or addresses of the writers. It is hardly necessary to state that it is impossible for us to fill orders or reply to letters unless we know who send them. If your orders for back numbers have not been filled, jog your memory a little, and send a postal repeating the order, date sent, and *sign it.*

A visitor at the Brussels automobile show, so it is related, by the "Horseless Age," after looking for a long time at the large jars for stationary accumulators and asking what they were used for, bought one of the jars, explaining that he wanted to pickle a haunch of deer in it. The incident was the cause of much merriment among the exhibitors of the show.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

I. Types of Engines—Advantages of Each Type.

The great increase during the last few years in the use of automobiles, power boats, and other units of small power, has led to the expenditure of a large amount of time and money in the development of the gas and gasoline engine. These engines are particularly well suited to their present uses, being as they are, self-contained, easily installed and operated and reasonably reliable when in good hands. Since there is no external generator or boiler, and no fuel to be handled, they are easily kept clean, and as the supply of fuel is automatic and continuous, they run with the minimum amount of care, and little labor is required other than the lubrication and the regulation of the fuel supply.

The principle upon which the operation of the gasoline engine depends is the fact that a body of gas tends to expand upon the application of heat, and if allowed to do so, has the power of doing work. The heat is contained in the fuel as potential energy and is freed by the combustion, causing a rapid rise of pressure in the body of the gas. When this body of gas is confined in the cylinder of the engine it is capable of doing work upon the piston.

The gas engine is of the type technically known as internal combustion engines. This name originates from the fact that the combustion of the fuel and the consequent generation of heat take place directly in the cylinder of the engine instead of in a separate chamber or boiler, as in the steam engine. In the latter engine the heat is generated in the boiler, raising the pressure of the contents, which are carried to the engine and allowed to expand, thus utilizing the heat. The steam engine is thus complicated by the boiler and extra piping, and the necessary care to feed the fuel and maintain the proper quantity of water in the boiler. These duties usually require the entire attention of one man, while with the gasoline engine one need only give an occasional oversight.

Gas or gasoline engines may be divided into two general classes, the two cycle, and the four cycle, the principles of operation of which are quite distinct. The former, or the two cycle type, is the simpler in operation and will be considered first. In either type of engine there are four operations to be accomplished; (1) drawing in the fresh charge, (2) compressing and firing the charge, (3) expansion of the ignited charge, and the absorption of its power, (4) expulsion of the burnt gases. The completion of this series of events is termed the "cycle"

The general outline of the two cycle engine is shown in Fig. 1, where *A* represents the cylinder, *B* the piston, *E* the connecting rod, *CD* the crankshaft and pin. *G* is the crank case, which must be air tight. F is the inlet opening into the crank case, which is provided with a valve allowing the gas to enter, but not allowing it to return. *H* is a passage leading from the base into the cylinder at the inlet port *I*, which is

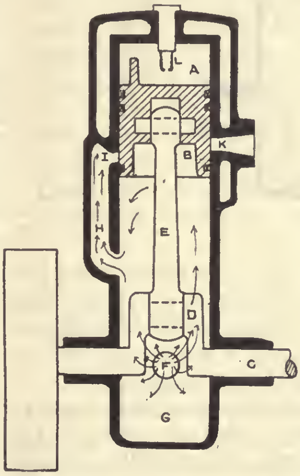


FIG. 1.

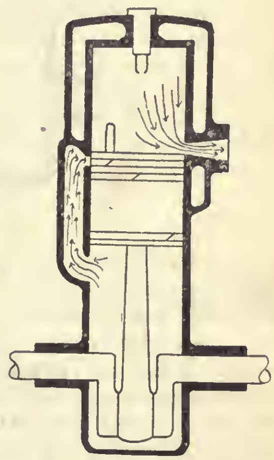


FIG 2.

above the piston when the latter is in its lowest position, as in Fig. 2; at *K* is another port called the exhaust port which opens into the air; at *L* is some means for producing an electric spark to ignite the charge. For the operation, suppose the piston to be at the bottom of its stroke, and to ascend; this action will create a suction in the air-tight crank-case and draw in a charge of vapor, as shown in Fig. 1. On the next downward stroke the non-return valve on the inlet *F* prevents the charge from being forced out again, and it is compressed slightly, banking up the pressure in the passage *HI*, the outlet of which is shown closed by the piston in Fig. 3. When the piston nearly reaches the bottom of its stroke it uncovers the inlet port *I*, and the charge rushes in and fills the cylinder, as in Fig. 2. Before, however, any of the new charge can escape through the exhaust port *K*, which is also open, the piston has begun its next up stroke and covered the inlet port, so that the cylinder is now full of fresh gas. The upward stroke continuing, the charge is compressed into the space above the piston, until the latter reaches its highest point, when the compressed charge is ignited by the spark at *L*, Fig. 1. This ignition produces a powerful impulse due to the heat generated by the combustion, which drives the piston down. When the piston has nearly reached its lowest point, as in Fig. 3, it uncovers the exhaust port *K* and allows the burnt gases to partially escape. A moment later in the stroke, the inlet port *I*

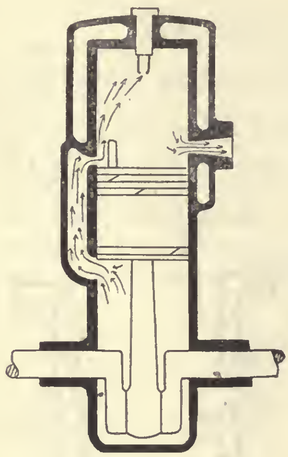


Fig. 3.

is uncovered and a fresh charge is admitted from the crank case which fills the cylinder, as before, and drives out the remainder of the burnt gases. This new charge is then compressed, and a new supply drawn into the crank case, and the operation continues.

Following the sequence carefully it will be seen that the cycle is completed during every revolution, or for every two strokes. It is thus called the two-stroke cycle, or as commonly stated, the "two cycle." This

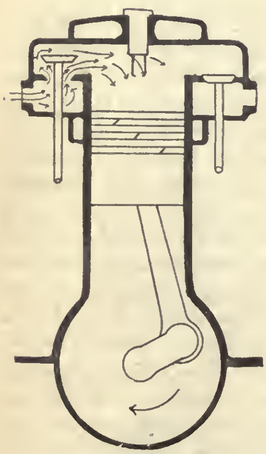


Fig. 4.

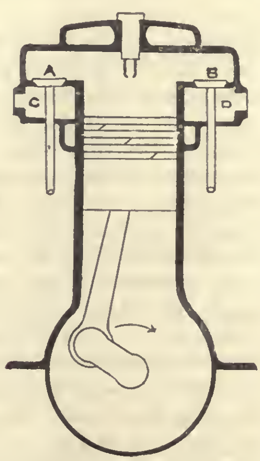


Fig. 5.

cycle gives an impulse or working stroke during each revolution. The momentum of the flywheel is depended upon to carry the piston up on the idle or compressive stroke. The projection on the top of the piston is a deflector or shield surrounding the inlet port to deflect the gas upwards and prevent its rushing directly across the cylinder and out of the exhaust port. The exhaust port is directly opposite and somewhat higher than the inlet port, in order that the pressure may be reduced and the burnt gases partially escape before the fresh gases are admitted. The relative size and position of these two ports is the key to the success of the two cycle engine. It will be seen that the piston acts as its own valve, so that this engine, from its very principles, is valveless. The claims of some engine builders as to the "valveless" features of their engines are therefore entirely superfluous, as it would be difficult to build this type of engine in any other manner.

In the four cycle type of engine the admission and exhaust of the vapor are controlled by mechanical means. In Fig. 5, *A* is a valve opening into the cylinder from the admission chamber *C*. *B* is a similar valve opening from the cylinder into the exhaust chamber *D*. The other portions of the engine are substantially the same as those of the two cycle engine, with the exception that the crank case does not require to be air tight. The valves are controlled from the main crank shaft.

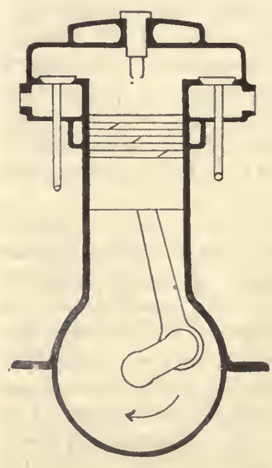


Fig. 6.

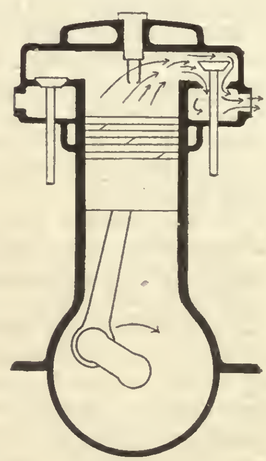


Fig. 7.

For the operation, suppose the piston to be at the top of its stroke and to travel downwards, as in Fig. 4; the inlet valve *A* is open and the suction draws in a charge of fresh gas, filling the cylinder. On the next upward stroke, shown by Fig. 5, both inlet and exhaust valves are closed, and the gas is compressed into the space above the piston. When the piston reaches the top of its stroke the compressed charge is fired by an electric spark, or other means, and it expands, driving the piston down as in Fig. 6 and furnishing the working impulse. On the next up stroke, illustrated by Fig. 7, the exhaust valve *B* opens, and the burnt gases are forced out by the piston through the exhaust port. The cylinder is now clear and ready for the admission of another fresh charge on the next downward stoke of the piston.

This cycle is completed in two revolutions, or four strokes, and is called the four stroke cycle, or "four cycle". There are three idle strokes and a working stroke for each cycle, thus giving an impulse for every alternate revolution. The flywheel must be heavy enough to carry the piston over the three idle strokes.

ADVANTAGES OF EACH TYPE.

The two cycle engine has the advantage of extreme simplicity, as there are no valves or other external moving parts which are likely to require adjustment. Since it receives an impulse for each revolution, more power may be obtained from the same size engine than is possible in the four cycle type; it might seem that since the two cycle engines receive twice as many impulses as the four cycle, twice as much power should be obtained, but this is by no means so, as owing to the superior regulation of the four cycle types the difference is much less. The more frequent occurrence of the impulses does, however, allow a lighter flywheel and produces a smoother running engine with the least vibration.

The valveless feature of the two cycle type gives rise to some uncertainties and irregularities in the action of the engine. The action of the gases in the cylinder is more or less uncertain, as it is hardly to be expected that the inflow of gases will continue until just the right time to fill the cylinder and no more; it is entirely possible either that some of the exhaust may not have time to escape, or that some of the fresh gases may pass over and out of the exhaust. It is hardly possilble, also, for the new charge to entirely scour the upper parts of the cylinder, and some waste gas is sure to be caught in the cylinder, thus diluting the new charge. The driving out of the burnt gas by the fresh mixture while some combustion may still be going on, frequently results in the ignition of the new charge and the explosion of the reserve in the base, producing a back explosion, causing irregular action, and even stopping the engine.

There are also some disadvantages which might be termed structural ones. While the working parts are very simple, they are entirely enclosed and not easily open to examination. Since the crank case requires to be air tight any leakage around the crank shaft bearings from natural wear, causes a loss of crank-case pressure, and consequent loss of power. Any leak around the piston and rings will allow the partially burnt gases to pass down and deteriorate the quality of the fresh gas in the crank case. If the workmanship on the engine is originally poor, as in some of the cheap engines, these troubles are likely to occur soon, and in any case they are apt to occur after prolonged use.

The four cycle type, although more complicated, is surer and more certain in its action, as the behavior of gas is exactly controlled. The idle stroke allows the cylinder a very short time to cool between explosions. As the flow of gases takes place only on each alternate revolution, and then during a whole stroke instead of in a puff, the four-cycle engine may be run at a higher rate of revolution. Owing to the mechanical regulation, there is less chance for loss of fuel and the economy is greater. No enclosed crank case is necessary, and the working parts can be more easily cared for. On the other hand, the three idle strokes require a very heavy flywheel, and since the impulse occurs on each alternate revolution, the four cycle engine must for the same power, be larger and heavier than the two cycle. Each explosion or impulse is much heavier than in the two cycle, and tendency to vibration is consequeutly much greater.

The two cycle engine, in spite of the more or less theoretical disadvantages, has reached a high state of perfection, both as to reliability and economy, although in the latter respect it is probably not the equal of the four cycle. As a general conclusion it may be stated that for small, light engines where economy is of small moment and especially for those of one cylinder, which as a rule receive little care, the two cycle type is to be preferred; while for engines of larger size, where economy of fuel is a consideration, together with great reliability, the four cycle type should be employed.

RAISING SHIPS WITH ACETYLENE.

An ingenious method of raising sunken ships has recently been devised by M. Pierre Hurzy, says the "Electrical Review." The system depends upon the use of calcium carbide for setting free gas when brought in contact with water. At suitable points in the vessel cases of carbide are placed, which, when brought into contact with water, force out the latter, thus emptying floats after they have been attached to the ship. The success of the method depends upon obtaining an equal buoyancy at different parts of the vessel.

For this purpose cans of carbide are placed at the points which are to be emptied of water. They are fitted with explosive caps, which are set off simultaneously by an electric current. In this way the case is ruptured, water is admitted and the emptying of all compartments begins simultaneously. It is suggested also by the inventor that the method can be used to advantage in operating floating docks. After such a dock has been sunk and has taken in the vessel to be lifted, the water is expelled from the ballast chambers by means of the acetylene gas set free from the carbide.

Lampblack is a soot, usually prepared by igniting resin or pitch, leading the smoke and vapor through an oily tube, where the oily products condense and then into a series of chambers, in which the carbon is deposited, the purest carbon being found in the chamber furthest from the point of combustion.

INTERCHANGEABLE BORING BAR CUTTERS.

The troubles experienced by some shops with their boring-bars and cutters if recorded would make a book of several chapters. This is written with the hope that it will be followed up by some of your contributors with their experiences.

The boring-bar L, shown in Fig. 1, I find unsatisfactory because the hardened edges of the cutter *G*, at *A*, cut the softer metal of the bar *L*, and thereby allow the cutter an uncertain amount of side-play in the slot, which is always doubled in the hole being bored. When this side-play becomes so great as to allow the cutters to be bore a hole larger than standard size, it is necessary to mill down the flats on the bar and make a new set of cutters throughout, which is very expensive, as the bar has to be out of service while this is being done.

In Fig. 2 we have the boring-bar which is theoretically correct, practically a failure, for the reason that it is next to impossible to drill the hole for the hardened pin *M* exactly through the center of the bar *L*. I think any tool-maker will agree with me in this statement, if he has ever tried to drill a ½ in. hole through the center of a 2-in. round bar of tool steel at right angles with the axis. I have overcome the defects of Figs. 1 and 2 by constructing our boring-bar as shown in Fig. 3.

I make all of our bars, keys and centering pieces of low grade tool steel, and our cutters of Jessop steel. All the work on these bars, except locating the centering pieces, drilling and reaming the taper pin holes *J*, and finishing the end of the keys *K*, is performed on the milling-machine.

For grinding-cutters for these bars I use a short bar *S*, made of tool steel, with hardened centers, and with a slot as shown at Fig. 4. It was necessary to make this bar first, in order to originate what I will call the master cutter *M*.

The key *K*, master cutter *M*, centering piece *N*, and screws *B* and *C* were hardened and assembled in the short bar *S*, as shown in Fig. 4. It was next put into the grinder, and the master cutter *M* was ground until both ends were trued up. The micrometer height gauge was then set to just touch the ends of the master cutter *M*, and the reading noted. The master cutter was then changed end for end in the slot and the height again taken. It was then readily seen which way and how much the centering piece *N* was out of center. By continued grinding, testing and adjusting of screws *B* and *C*, we were enabled to set the centering piece *N* so that the convex projection was within 0.0001 in. of the center.

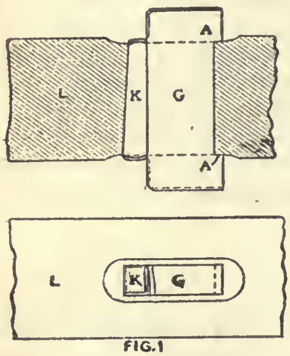


FIG.1

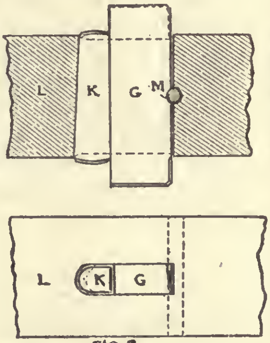


FIG.2

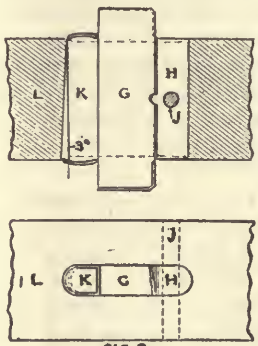


FIG.3

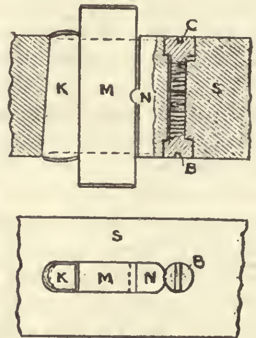


FIG.4

The same master cutter is used to locate the centering pieces in the boring bars as follows:—

The boring-bar *L* is mounted on dead-centers and straightened if necessary; then the centering-piece *H*, master cutter *M*, and hardened key *K* are put in place and the key driven up lightly. The michrometer height gauge is again brought into service, and by tapping the centering piece *H* with a light hammer the master cutter is brought to a position where the variations in the micrometer readings taken from both ends of the master cutter is within the 0.0001 in. limit.

The key *K* is then driven up tight, and the master *M* is again tried with the micrometer, and if still within the limit the bar is ready for drilling for the taper-pin *J*.

After fitting the pin, the centering-piece *H* is hardened, and if the hole has contracted in the hardening, it is lapped until the taper pin *J* will enter to the same depth as would previous to the hardening.

If, on the contrary, the hole has expanded, the hole in the bar will have to be reamed larger.

Boring-bars and cutters made in this way will bore within 0.001 in., if the bars are kept straight and are a good fit in the supporting bushings. This, I think, is near enough where holes are reamed by hand after boring.—A. V., in "American Machinist."

A WALL CABINET.

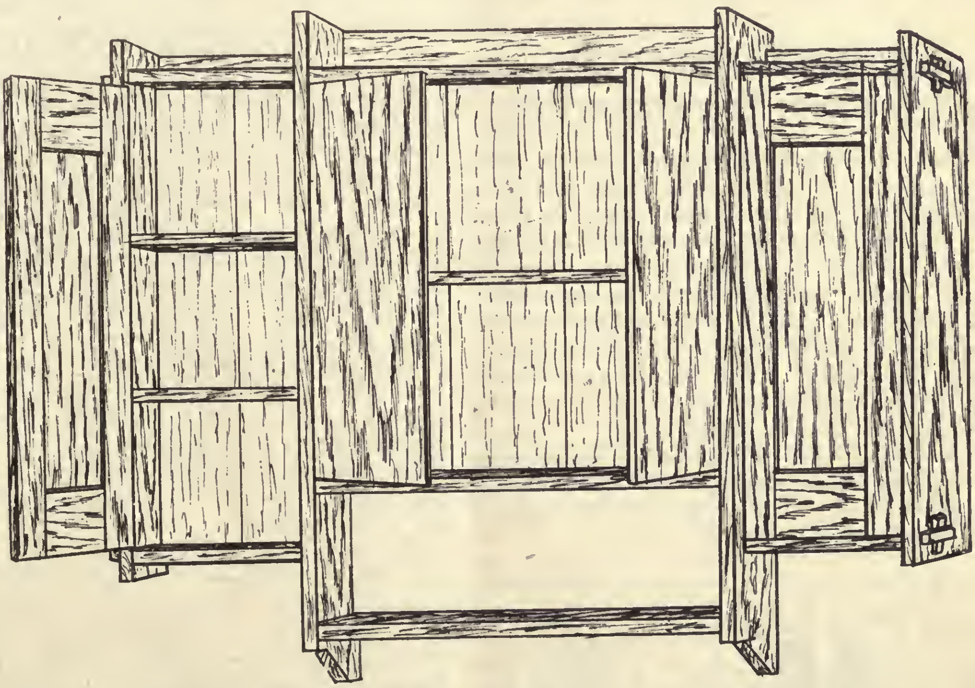
JOHN F. ADAMS.

Although wall cabinets are not now used as much as formerly, yet in many homes one like that here described would be found useful for storing the numerous small articles required in the den, library or bathroom. It is best made with wood of light weight, and stained as desired, so as to avoid a cabinet too heavy to easily suspend on the wall. The stock used should be about ⅝ in. thick.

To obtain the necessary strength the framing is somewhat peculiar. The top piece over all the cupboards is in one piece 38 in. long, 10 in. wide over the center, and 9 in. wide over the end compartments. The two pieces forming the sides of the center division are 30 in. long and 10 in. wide. They are cut through from the back to a depth of 6 in., the upper cut being 3 in. from the top ends, to receive the top board, which is cut from the front to a depth of 4 in. the cuts spaced to give 18 in. between the two side pieces. Care must be taken in sawing the slots on the sides not to break off the overhanging piece at the top. It is also advisable, after the cabinet is finally assembled, to cut out a piece at the back about ½ in. deep and 3 in. long, and fit a piece of the same size, which is nailed in place, one end to the top, the other end below the slot and the center to the top board.

The cross piece under the center cupboard and the shelf underneath are each 18⅜ in. long and 10 in. wide, allowing 3-16 in. at each end to fit in grooves cut in the sides. The height of the cupboard is 18 in. and the shelf is 6 in. below the bottom of the cupboard.

The two outside cupboards are 21 in. high, and 7½ in. wide. The pieces forming the outer sides are 25 in. long and 9 in. wide. The ends rise above the top board 1½ in. and drop 1 in. below the bottom of the under board. The projecting tenons, to receive the pins, may be single ones 4 in. wide or double ones 2¼ in. wide, as preferred, but this must be decided before beginning construction, to prevent error in cutting. It will be found that much aid can be obtained from drawings made of each piece one-half or one-quarter full size. All dimensions are marked thereon and checked off to insure corrections. The time taken to make such drawings is more than made up by the rapidity with which the work can be followed by their aid.



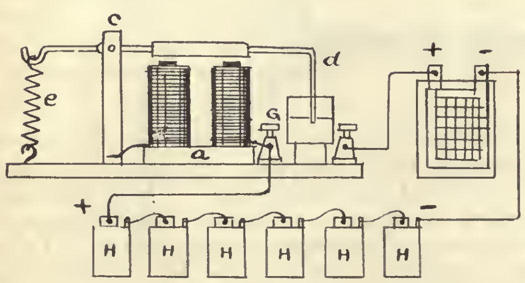
The pieces under the end cupboards are 9 7-16 in. long and 9 in. wide, allowing 3-16 in. on the inner end to fit into a groove cut in the space between the end and center cupboards, and 1⅝ in. for the tenon through the outer side piece. The rear edges of all the pieces mentioned should have rabbets cut to receive the backing, matched sheathing ½ in. thick being used; the rabbets should be, for stock of this thickness, ½ in. wide and ½ in. deep.

Above the cupboards at the back are fitted pieces, as shown in the illustration, that over the center being 3 in. wide, and over each end 1½ in. wide. Also, a piece is needed under the center cupboard which should be 6 in. wide, if no rabbets are cut for it, or 6½ in. wide with rabbets.

The shelves for the cupboards can be located to suit the convenience of the maker, and are 8½ in. wide in the center and are 7½ in. wide in the end cupboards. The doors may all be panelled as shown for the ends, or smooth as in the center. If made smooth there should be cleats 2 in. wide and ⅝ in. thick, fitted to the ends on the inside. They should be glued in place, the drying being done in clamps. The usual fittings of hinges, knobs and locks will need no description.

AUTOMATIC SWITCH
FOR CHARGING ACCUMULATORS.

Make a little horshoe electro-magnet out of a piece of ½ in. round soft iron rod, each limb being 1 in. long and yoke also 1 in., Fig. 1 *a*. Wind this with six turns of No. 20 d. c. c. Over this pivot a soft iron armature 1 in. long, *b* having a lever extension at the pivoted end *c*, and a curved piece of bare No. 16 copper wire, *d*, at the other. The poles of the magnet must be perfectly level, and to prevent the armature adhering when the current is off should have a disc of stamp paper stuck on the upper surface of each. A little metallic cup, in which a drop or two of mercury is placed, is fixed just under copper wire so that when the armature is pulled down by the magnet the copper wire should dip into and make contact with the mercury.



This mercury cup should be connected to a terminal leading by a stout wire to the + terminal of accumulator. The lever end of the armature is hooked on a small spiral spring *e* of sufficient tension to pull the armature away from the poles of the magnet, when the voltage of the battery falls to 5 volts, but not powerful enough to detach it as long as the volts exceed 5. One end of the magnet wire is connected directly to the iron of the magnet, say at *f*; the other end goes to the terminal *G*, to which the positive pole of the charging battery *H* is connected.

Finally, the negative pole of the battery is connected to the negative terminal of the accumulator. Now the battery and accumulator being duly coupled up to the switch, as described, the armature is gently depressed, so as to cause the curved copper wire to dip into the mercury cup. Now the current passes from the battery, round the magnet wires, through the pivot to the mercury cup; thence through the accumulator, completing its circuit to the battery; and as long as the voltage exceeds 5v., retains the armature down, and the copper wire in the mercury. Directly the voltage falls below, the pull of the spring overcomes the pull of the magnet, and releasing the armature, breaks the circuit.

METALLURGY OF TIN.

In the metallurgy of tin, its first process is that of grinding the ore. The ground ore is then washed, which removes impurities, tin being such a heavy metal that it is most easy to wash away the earthy matter, and even some of the foreign metallic ores often contained with it. When other metals of about the same specific gravity are contained in the tin ore, further treatment is essential. The ore is then roasted in a reverberatory furnace, whereby the sulphur and arsenic are expelled. It is then mixed with fuel and limestone and heated strongly in the reverberatory furnace, so as to bring the whole into the state of fusion, which is maintained for upwards of eight hours. The lime unites with the earthy material still mixed with the ore and flows with them into liquid slag, while the coal reduces the oxide of tin to the metallic state.

The reduced tin falls by its own weight to the bottom, and is, at the end of eight hours, let out by tapping a hole in the furnace, which had been filled with clay. The tin yet is impure, containing iron, copper, arsenic and tungsten. That it may be purified, the blocks of tin are placed in a furnace and moderately heated until the tin melts and flows into the refining basins, while the greater part of the foreign metals remain in the solid state. The molten tin in the refining basins is then stirred with sticks of green wood, whereby gases are given off and the metal is maintained in a state of artificial ebullition. The upper parts of the contents of the basin are oxidized and removed from the surface, while the greater part of the foreign metals collect at the bottom.

The tin is allowed to partially cool, during which process it separates into zones, the upper consisting of quite pure tin, while the under is so impure it is necessary to return it to the furnace and melt again. The layer of tin is removed into molds in which it is allowed to solidify. It is then marketed as block tin, the purest specimens being called refined tin.

METOL-HYDRO AND ITS ADVANTAGES.

CHESTER F. STILES.

When a plate has not been developed far enough, we find in printing that the light penetrates even the densest part of the negative before the shadows of the print are printed deep enough. Such a plate is thin all over, with detail in abundance, but density is lacking. The fault is called "under development." Opposed to this fault is the lesser one of "over development," where the tones seem all right and make excellent prints provided one prints long enough. Some plates have been seen by the writer which seemed almost opaque. They take hours to print by strong light with ordinary paper, and a number of minutes with rapid bromide papers.

Of course the above remarks refer to errors of development only. The exposure itself has been assumed to be fairly correct. The error of under-development is remedied by "intensification"; that of over-develment is corrected by "reduction". In this article only the first process will be treated.

In the early days of photography, intensification was done with nitrate of silver. With the advent of the gelatine dry plate came identification with mercury. The base of this intensifier is bichloride of mercury (corrosive sublimate,) which is placed in hot water till no more of the salt will dissolve, thus making what is known as a saturated solution.

The plates to be intensified must be thoroughly fixed and washed, so that no developer is left in the film. If not, the careless worker reaps his reward later in the form of indelible yellow spots. No satisfactory method has been found for correcting stains. To avoid them, washing from half to three-quarters of an hour is none too long.

The chemistry of the process of intensification is quite simple. We place the plate in a diluted solution of the corrosive sublimate and the black silver image turns white. The silver image has been replaced by a white compound of mercury and silver. Various agents are known which blacken this compound. Among these is ammonium sulphide, which forms an intense black compound of mercury, much blacker than the original silver image. Hence the intensification.

In practice we place the well washed plate in the diluted mercury solution and bleach till white throughout. A thorough washing is necessary to remove the mercury. Next apply the blackening solution and wash again when sufficient density is secured. If only a partial intensification is desired, bleach the negative to a grey appearance instead of white.

For ammonium sulphide may be substituted a solution of sodium sulphite or of ammonia. The latter gives the strongest intensification of all. It also helps contrast by blackening the darkest parts in a greater degree than the lighter portions. It is, therefore, a gain in quality of intensity, a flat plate resulting from over-exposure.

The time for intensification is immediately after washing. The film is porous and will take the intensifier easily. If an acid hardening and fixing bath has been used, the film is very hard to penetrate. It is well to double or even triple the washing times in the process, or, better than that, avoid acid hypo and hardeners. You will be surprised to see the hardening and lack of frilling which plain freshly made hypo baths will promote.

Notice an over-exposed plate carefully. You will see a wealth of detail from highest light to weakest shadow. The plates have a brownish cast and pass light in all parts, so that the prints are weak and flat. You can usually improve these plates by selecting a contrasty intensifier.

On the contrary, an under-exposed plate will not stand intensification to advantage. In this case, the contrast is wrong on the plate in the first place, since the shadows did not develop at all, while the high lights have piled on density by the prolonged development. Now, if an intensifier is applied, it still further increases contrast. A double error in tones is then present. To diverge a little from our subject: —In every case that you can duplicate an under-exposed plate, do so in preference to intensifying. The best place for an under-exposed plate is the ash barrel.

The bleached mercury image may be developed in an old developer if desired. Use an old tray and keep it for this purpose alone. Discarded developer is better than the stronger and fresher solutions.

The mercury chloride will dissolve better in water if some ammonium chloride (sal-ammoniac) is added. Equally good is muriatic acid. Mercury chloride dissolves very slowly, and the additions above quicken the speed of solution. Besides, the muriatic acid will destroy any traces of hypo which may cling to the plate from the fixing. The mercury seems to cling to the gelatine film and is hard to wash away. It is wise to use a weak solution of citric acid after washing from the bleaching solution, and before the darkening solution.

All the above methods are two solution processes. They have the disadvantage that one does not know the density until the process is finished. Yet, as in all photo operations, experience teaches, and a careful worker will have few real difficulties.

We will now take up an intensifier much used abroad, on account of its simplicity. It is known as the Lumiere intensifier, and consists of a mixture of mercury iodide and sulphite of soda. In this intensifier hypo matters little. A slight washing suffices, after which we intensify directly, watching the density as it increases. The application of an old developer at the end of the process will make the image permanent.

The great advantage of this intensifier is its direct method. If only a partial intensification is desired, one stops at the density desired. No fixing is necessary after the development, although the developer is allowed to act. The product is common in this country under the name of "Scarlet Intensifier," from the brilliant color of the mercury iodide, and in common with all mercury compounds, is poisonous internally.

The uranium intensifier is one which has gained much ground of late. Since the deposit is red, density is improved greatly by its use. Make two solutions of eight ounces water each, using 25 grains uranium nitrate in the first, and 3 grains red prussiate potash in the second. Mix 1½ ounces of each with ½ ounce glacial acetic acid. Skilful workers may intensify locally, for the uranium deposit is soluble in ammonia. It may be removed by painting with a brush dipped in the ammonia solution. Take a hint from the experience of others and try local intensification on an old plate until you get the hang of the process.

"Agfa" intensifier, made by the German photo chemists, is obtainable at most photo supply stores. It is a colorless liquid, containing a mercury salt in solution, which adds density directly to the plates. One part of the solution is added to nine of water, making working solution. It works directly, and the plate slowly gains a deposit of grey tint, which is quite non-actinic.

Many other processes are known, a large portion being variations of the mercury baths. It is possible to bleach in copper sulphate with bromide of potash, after which silver nitrate is the blackening agent. Potassium bichromate is used to bleach the image in another process, and the blackening follows by redeveloping.

In general, we may remark that cleanliness is the key to perfect intensification. Whenever one process is succeeded by another, have the intermediate washing complete. This is the greatest secret in intensification.

WORK FOR THE INVENTOR.

Some of the astounding facts revealed by recent agitations over the London fog which covered that great city like a black pall during the latter part of last December, says "Modern Machinery," may furnish our Yankee genius with a greater incentive to get to work upon the solution of a problem long under consideration.

A week of fog in London costs the railway companies $1,000,000 and the cabmen $6000 a day. The loss to shopkeepers is beyond calculation, but reaches millions. The excess of gas used on a foggy day would supply a town of 40,000 people a whole year, showing that the gas companies at least are benefited. One hundred and fifty million cubic feet of gas is consumed during one day of gloom, costing over $100,000. The Hon. Rollo Russell has estimated that in consequence of foul atmosphere Londoners are put to from $15,000,000 to $25,000,000 in unnecessary expenses annually and in winter they are deprived of three-quarters of the sunshine they are entitled to. The agitators claim that the cause of this state of affairs is due to smoke from 600,000 houses and 14,000 factories. According to the careful calculations of an expert these smoke-laden chimneys pour forth 7,000,000 tons of smoke-laden air, that carries 300 tons of coal in suspension. Can nothing be done to relieve London of this plague, every return of which brings an alarming increase in the death rate through accident and from diseases of respiratory organs.

BATTERIES FOR GAS ENGINES.

Each style of battery has certain fields of its own to fill but it becomes sometimes necessary for the owner of a gasoline engine to decide which he shall use, says "The Canadian Thresherman." In favor of the dry battery is the low cost, and the fact that there is no solution to spill around, and the weight is light compared to the wet cells. The objection to them is that they cannot be used on long runs without weakening, and then have to stand over night to recuperate.

The proper way to use them is to have two sets, making a double battery, and have them connected to a double throw switch. This enables you to run a few hours on one set and then throw in the other set and while it is being used the first set is regaining its strength. With a wet battery this is not necessary as they will continue to give a steady, equal spark until they give out almost at once. On account of this fact it is not necessary to use a double battery with them. Wet battery manufacturers can supply a special style that is liquid tight, but any of the ordinary types can be made so by wrapping the joint of the cover with common electric tape.

Liquid tight cells are required for engines that are moved around so that the jarring and shaking will not spill the liquid. In our opinion the best method of ignition is to use a battery for starting the engine and by means of a double throw switch, throwing from the battery to an automatic sparking dynamo, after the engine is up to speed. As made now, the high grade dynamos give good results and are to be depended upon for a good hot spark that will ignite charges, that the battery will sometimes fail to do. The ignition part of an engine is of the utmost importance, and must get frequent attention and care to get good results from it.

HARDENING STEEL.

S. W. GOODYEAR.

As a constant reader of your valuable paper I come in contact monthly with opinions and formulas and advertisements of books and recipes for hardening and tempering steel, and still the inquiries continue to come for best methods. "How shall I harden and temper granite drills?" says one, and at once come answers which advise use of rain water, brine, boiled linseed oil and salt. "A drop of water will prove to be ruinous." Now there must be in this, as in all other mechanical processes, a foundation fact. Good work in hardening is done by the use of rain water, well water, spring water, water saturated with salt and water in which have been a thousand and one nostrums, and oil is used in the same way, clear in great variety beside linseed, with additions of a variety of other things, all with good results sometimes, and with occasional "bad luck" as steel varies from what it should be or, begging the pardon of the hardener, the treatment is not just right.

If of two diametrically opposite methods of heating and cooling it can be said that both bring first-class results, one equally as good as the other, notwithstanding the advocate of each method persists in standing up for his own and denouncing the other as worthless and ruinous, is it not fair to suppose that the real foundation on which successful hardening depends lies deeper than any particular formula? A secret? No, a fact, free as sunlight, and that fact is that hardening depends upon heat and sudden cooling.

Rock drills—granite drills—let us make a good one. Don't forge it to shape at a low red heat, as someone advises. Get a good mellow heat and be sure the heat is even, clear through, not a heat got too quickly and only at the surface. Do not continue mauling and hammering down to a black heat, but stop with heat remaining sufficient so that if the steel used is of a right temper for first-class rock drills it will harden like glass at heat at which hammering ceases, at the thin edge.

In fact, I once watched for an hour a hand mining drill dresser who sharpened worn drills as they came to him from the mine, entirely with the hammer and a brush of the file, and hardened and tempered them, for there was no second operation of tempering, by dropping them into a bath of salt water, right from the anvil and hammer, without reheating, and by my test with a file every one was hard, and by testimony of users of the drills no better drills had ever been used by them. I saw no broken drills.

"Then," says somebody, "you advise this?" I say, "No; but it is one way, and there are as many apparently different ways as there are different steels," and just here comes up one of the most important factors in the whole matter—*i. e.*, right steel for any particular use. The man who says, "Follow my formula for heating, and use my bath for quenching, and no matter what the steel is, you will succeed," has certainly another guess coming; for if he has been so fortunate as to always happen to use a steel for which a good, bright orange color is safe, he will some day strike one which, with the same heat treatment will go to pieces like so much glass, and the chances are that it will be the very steel he should have used all along.

I said "fortunate," did I not? Yes, and in that very way are thousands of steel users measuring success—*i. e.*, "the steel which will bear most abuse, highest heat for hardening and still not break, but do good work," is held up as a standard, while there are some who measure success by comparatively ultimate value of hardened pieces, as quoting one satisfied steel user who was sounding the praises of a steel new to him, when asked to give some definite statement of comparative superiority over the old standard imported steel he had sworn by and thought he could not live without.

"Three weeks against three days." Another who, after years of practice with best average production from certain dies being fifty thousand, tries a new steel and says, "five hundred thousand." "High speed steel?" "No, but steel which can be annealed and tempered by old-fashioned methods. High speed steel has its uses, and is doing marvellous work, such wonderful work as to make us doubt the veracity of some who keep tabs and publish records of speeds, feed, depth of cut and aggregate removal of stock in given time, lifetime of tools, etc., and still investigation will show them to be in the main true.

I will wind up by stating that, as I see it, the subject of treatment of steel is inexhaustible. Best in steel is none too good; so with treatment; and to be fitted up with all the best appliances for proper hardening is desirable, and in no other way is it likely that money is expended more judiciously, and still I have before me the two-days-old vision, not of a stolid, self-reliant, self-possessed hardener, pumping wind by hand on an old-fashioned portable forge, one of the pump-handle variety, with a hatful of fuel, and it not charcoal, but coked bituminous coal, to heat as bad a tool to harden as often comes to the lot of any man; little fire, little wind, but constant care, measuring the stroke of the lever as carefully as though a life depended, and it did, *i. e.*, the life of the costly tool. "She's coming, coming good," says the man at the lever as he peeps through the thin layer of coals over the intricate shaped face of the tool being heated. It is a forming tool some 3 in. wide by 1 in. thick by 5 or

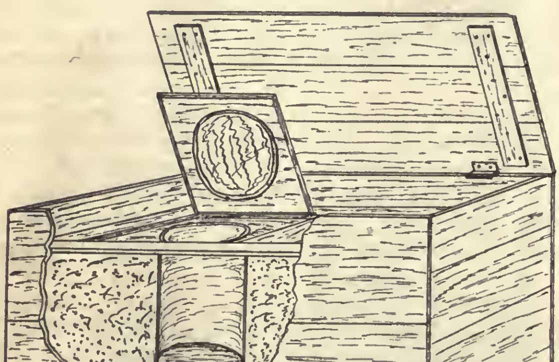
6 in. long, intent being to harden some 2 or 2½ in. in length of the working end, and "she does come," first a perceptible red and gradually changing color to that beautiful shade which delights the successful hardener.

"Coming good," says the man. Said I, "Yes, and it is about there," and out it comes and into clear water and is kept there, not until cold but until hardening has taken place and then the old hardener violently works the pump handle some more, making the sparks fly, and held the tool over the fire to equalize the heat, and with the tool as hard as glass, and a heat just inside of the tempering to straw color, the job is done. Methods most primitive possible, and still this man had it under his hat to do a good job, no matter what the facilities were; from start to finish he had been as alert as would have been the most experienced trout fisherman with a big one hooked and playing to land him. Such men are prizes.—"Blacksmith and Wheelwright."

FIRELESS COOKING.

FREDERICK A. DRAPER.

The expression "fireless cooking" is not strictly applicable to the process to be here described, but is sufficiently near it to make it applicable as a short title. For many years the "hay box" has been in regular use, and has proved of great utility for certain kinds of cooking. While not of particular value in many lines claimed by its over enthusiastic advocates, it is, nevertheless, worthy of careful consideration in every household, and this is especially true on hot summer days when a morning fire can be used to produce a hot meal to be served up in the evening.



The principle involved in the operation is that of retained heat. The food to be cooked is put in a suitable utensil upon the stove where it is thoroughly heated. It should remain upon the stove long enough to bring the contents to the boiling point, and continue at that temperature for an interval varying with the kind of food being cooked. The heated utensil and food are then placed in an insulated box constructed to prevent the loss of heat, where they remain for a number of hours. The contained heat in the food serves to thoroughly cook it in such a way as to retain the best flavors of the food, and it will be found that tough meat can be made much more palatable by this process than by any other method of cooking.

The experienced housekeeper will readily understand the limitations of this method of cooking. Stews, boiled meats, vegetables and cereals are the kinds of food particularly successful. Baked beans and roast meats must be browned in a hot oven before being placed in the cooker; otherwise they will lack the color desired in dishes of that kind. As there is no evaporation of the liquid contents from the vessel, it is necessary to have the portions of food exactly as desired when served upon the table. It is necessary, therefore, to have color and flavoring ingredients exactly proportioned at the beginning of operations.

The first attempt with an experimental apparatus made by the writer was that of a 10-pound ham which was boiled for 30 minutes in a ten quart enamelled ware kettle; placed in the cooker at 10.30 A. M. and removed at 6 P. M. The ham was found to be thoroughly cooked, tender and having a most delicious flavor. Corned beef, beef stews, and vegetables were afterwards tried with marked success. One peculiarity about cooking vegetables in this way is that they do not break up as when boiled upon the stove.

The essential feature of the cooker is perfect insulation of utensil and contents, and the better the heat is retained the more satisfactorily will the food be cooked. For a small family a cooker having two or three compartments for holding kettles of different sizes will be quite sufficient. The shape known as a stock kettle is preferable as, having straight sides it can more easily be thoroughly packed.

In making a cooker it is first necessary to select the kettles to be used therein, and for a two compartment cooker, one kettle holding ten or twelve quarts and one holding four quarts, will be found to serve most purposes.

A two compartment cooker holding kettles of this size will require an outside box 36 in. long, 20 in. wide and 20 in. deep, inside measurements. Such a case can be easily made up from two shoe packing boxes, selecting the boards with matched joints. This is divided into two compartments by a division board 16 in. high placed 20 in. from one end. An inside top is then fitted to cover the division board and extending the full length of the box, leaving a space about 3 in. between the top of the inside cover and the top of the box. This is shown in the accompanying illustration.

Holes are then cut in the center of each division of a size to admit the cooking utensils with about one-half inch space between the utensil and the edge of the hole. Discs of wood are cut out the same size as the holes cut in the inside cover. Sheet tin or the sides of some large cheese boxes are cut and bent to cylindrical form to fit inside of the holes, and the wooden discs are used for the bottoms of these cylinders.

After nailing the cylinder firmly in place the box is turned bottom side up, and the space between the cylinders and sides of the box is firmly packed with chopped cork, sawdust, or old newspapers. The bottom of the box is then nailed on. If chopped cork or sawdust is used it will be desirable to first paper the inside surface of the box and cylinder to prevent the fine particles of cork or dust from sifting through any fine cracks which may have been left.

Strips of wood two inches wide are then nailed around the top side of the inner cover. These strips should have the inner edges cut to a bevel of about 45 degrees. Two covers are then made to fit inside these strips with the edges to correspond with the bevel on the strips. The cover should be carefully fitted to make the joints as tight as possible. A top cover is then made for the box, the two covers being much on the same plan as that of an ice chest and serving the same purpose.

In using the cooker it is desirable to first heat the cylindrical chambers; it can best be done by filling the utensil to be placed therein with boiling hot water and allowing it to remain there as long as convenient. The heat absorbed from the water by the cooker reduces the amount of heat which will be taken up from the food which is later placed therein. The space between the top and inner cover may also be filled with a quilted cover, or any convenient piece of cloth or rug, which will further prevent the evaporation of heat at the top. The space between the kettle and the sides of the cylindrical chamber may also be filled to advantage with old papers, or what is better, a quilted wrapper may be made which will exactly fill the space.

In using the cooker it is necessary to keep in mind that the process of cooking is slower than when using a stove, but over-cooking is not detrimental, in fact, over-cooking is almost an impossibility. It may also be stated that the advantages of a cooker are much greater than at first thought may seem possible. Readers of the magazine who are desirous of helping the feminine portion of the family to save work are earnestly advised to make a cooker as here described, as by means of one kitchen work in the summer can be made much easier and more comfortable. Food can also be reheated in the morning to serve warm at night.

TYPES OF BATTERIES TO USE.

Each style of battery has certain fields of its own to fill but it becomes necessary for the owner of a gasoline engine to decide which he shall use, says the "Canadian Thresherman." In favor of the dry battery is the low cost and the fact that there is no solution to spill around, and the weight is light compared to the wet cells. The objection to them is that they cannot be used on long runs without weakening and then have to stand over night to recuperate.

The proper way to use them is to have two sets, making a double battery and have them connected to a throw switch. This enables you to run a few hours on one set and then throw in the other set and while it is being used the first is regaining its strength. With a wet battery this is not necessary as they continue to give a steady, equal spark until they give out almost at once. On account of this fact it is not necessary to use a double battery with them. Wet battery manufacturers can supply a special style that is liquid tight, but any of the ordinary types can be made so by wrapping the joint of the cover with common electric tape.

Liquid tight cells are required for engines that are moved around so that the jarring and shaking will not spill the liquid. In our opinion the best method of ignition is to use a battery for starting the engine, and by means of a double throw switch, throwing from the battery to an automatic sparking dynamo, after the engine is up to speed. As made now, the high grade dynamos give good results and are to be depended on for a good hot spark that will ignite charges, the battery will sometimes fail to do. The ignition part of an engine is of the utmost importance and must get frequent attention and care to get good results from it.

LITTLE DROPS OF KNOWLEDGE.

One of the commonest excuses which we are all apt to make when we do not know anything, says the "Practical Engineer," is the plea that we have not had the time to look it up because our other duties have engrossed our time. Hundreds of men, young and old, have thus cheated themselves with the notion that they would do some desirable thing if they only had the time.

The truth is, however, that the busiest of us could find leisure for doing the extra things by utilizing the odd chinks and crevices of time and turning them from idle moments into drops of useful knowledge and self-improvement. It is not the man who is surrounded by a luxurious library with whole days of leisure on his hands who makes the most of his opportunities. It is rather the man who, whenever he gets the chance to get hold of a book, will, for the five or ten minutes' leisure that he may have, bathe in its intellectual riches and bring up facts that can never be loosened from his grasp.

In estimating the time which a man can give to self-improvement, it has been figured out that if the average man lives to be 70 years old, or for 25,500 days, he will have only about 4000 days left at his disposal for direct intellectual development. Surely, then, in looking over the field of successful men it can truly be said that it has been the little drops of knowledge with the added grains of sense that have made this country mighty and its engineering achievements so immense.

INDUSTRIAL SCHOOLS IN BELGIUM.

Consul McNally, of Liege, says that in no country in the world does the government attach more importance to the industrial and professional education of its people than Belgium. While some of the industrial and professional institutions are maintained by the grace of the central government, more are subsidized by the provincial or communal administrations. The city of Liege supports one large industrial school and nine professional schools.

The industrial school is one of the best in Belgium, and has at present an attendance of 650 pupils. Many of its graduates have become noted in the industrial world.

The professional schools include one for tailors, where the lectures and practical work of a tailor as taught in conjunction are free. The course is five years. The school of horticulture is free, with a course of three years.

The commercial and consular high school is intended to offer an advanced education, both theoretical and practical, and is open to those contemplating the profession of banking, commerce, industry, or a consular career. The government usually drafts from the graduates the young men wanted in the various consulates throughout the world, where they remain without compensation during a preliminary prescribed period.

The firearm school was established in 1897, and like the other schools the applicant for admission must have had a primary education. Every detail from the stock making to the barrel is taught, and the boys must pass an apprenticeship in every branch of the gun-making industry. The lectures include both the theory and practical information of firearm making.

The remaining schools embrace tanning, house-painting, mechanics, plumbing and carpenter work. The mechanical school includes the study of political economy, hygiene, arithmetic, geometry, drawing (mechanical), physics, chemistry, mechanics, wood and iron work, bicycle and automobile making.

Plumbing is the only school in which an entrance fee is demanded.

Note the premium offer on editorial page.

CORRESPONDENCE.

No. 143. MERIDEN, CONN. MAY 3, 1905.

Will you kindly advise me whether it would be feasible to light my residence with a small lighting plant operated by myself. I have but little acquaintance with electrical matters and would not feel like investing any considerable sum in an outfit which required constant attendance by a skilled electrician. Would it be of any advantage if several of my neighbors combined with me and a larger plant was purchased? My residence is located some miles from the center of the city and the lighting company does not seem disposed to extend the wires the distance required to supply the section where I am living. H. S. C.

Isolated or self-contained lighting plants are now becoming quite common throughout the country, and if the first cost is not objectionable, a private lighting plant is both satisfactory and inexpensive to operate. The cost of lighting could undoubtedly be made much less than the rates required by the regular lighting company. You do not state the number of lights required, so exact cost of outfit cannot be given. Assuming that the residence contains ten rooms and that twenty lights would be the maximum load, the required output from the dynamo would be about 1000 watts, and a 2-k. w. dynamo would be desirable, running the same with a 3-h. p. gasoline engine. The cost of engine, dynamo, switchboard and switchboard instruments would be approximately $350 or $400.

Owing to the fact that the lamps can be lighted only when the dynamo is in operation, it would also be desirable to have a storage battery, and to keep the number of cells of the battery as small as possible a 55-volt current should be used. Thirty cells in the battery would then be sufficient, which would give two spare cells for use when the battery was nearly run down. Lamps of standard size can be obtained at about the same cost as for the usual lighting circuit voltage, 110 volts.

With a storage battery the size of the dynamo could be reduced to 1 k. w. and a smaller engine used, and the "peak of the load" between five and eight P. M. could be taken care of by the battery. With such an outfit the dynamo could be operated at any convenient time during the day or evening for charging the battery, and the lighting current drawn direct from battery. This would permit of the lamps being lighted at any time of the night, whether the dynamo was in operation or not. When the full number of lamps are required to be lighted, the current could be taken from both dynamo and battery.

Undoubtedly some young man could be found in your vicinity sufficiently acquainted with the operation of a simple outfit of this kind who would operate it for a limited time until you acquire sufficient experience to dispense with his services. Such lighting plants are very desirable and economical for any one willing to devote a small portion of their time to looking after its maintainance and operation. The expense of operation would be very small, costing not more than two or three cents per thousand watts as against 15 or 18 cents charged by the regular lighting companies.

No. 144. SEATTLE, WASH., MAY 6, 1906.

I recently saw a small model ship enclosed in a glass bottle and would like to know by what process the ship was constructed and placed in the bottle. The ship was considerably larger than the mouth of the bottle, and the bottle did not show any break so that, apparently, the model must have been made in pieces and put together inside of the bottle, which would have been a very difficult operation. Was it not done in some other way, and how? H. T. W.

Models contained in bottles are freqnently constructed in the way you state. They are also made up outside of the bottle; the bottom of the bottle is broken off in a special way and then remelted on so skilfully that no trace of the joint appears. Another way is to have bottles made with the neck unshaped, and after the model is placed inside the necks are drawn down to the usual small size.

No. 145. CHICAGO, ILL., MAY, 1906.

Some years ago the newspapers of this city mentioned an invention of an explosive which could be fired from high powered guns, and which was unexplosive until it came in contact with water, when it exploded with great violence. Since then I have heard nothing more of the matter, but am interested to know what substances explode upon coming in contact with water. J. W. C.

Two substances which will explode or give a semblance of explosion upon contact with water; these are the alkali metals, potassium and sodium. If a small piece of either metal is brought into contact with a small portion of water the water decomposes the metal evolving hydrogen and the heat of the reaction is so great that the gas takes fire with a slight explosion.

If potassium be thrown into water, the hydrogen given off will take fire, but this is not true of sodium which has a less powerful reaction and does not produce a sufficiently high temperature to ignite gas when brought in contact with a large quantity of water. In handling both metals great care must be used, as the moisture of the fingers will frequently cause them to unite. They must also be kept in air-tight receptacles, as they oxidize rapidly when exposed to moist air. Presumably the explosive you mention as being reported in the papers was some high explosive which was exploded by means of one of the two metals here mentioned, as neither of these two metals would have caused an explosion of sufficient violence to be valuable for commercial purposes in warfare.

No. 146. NEWARK, N. J., MAY 8, 1906.

Will you kindly advise if it is possible to solder a leak in a lead pipe in through which water is flowing. A. L. R.

It is not possible to solder lead pipes containing water, as the heat of the solder is drawn off so rapidly that it will chill on coming in contact with the pipe. We presume that for some reason it is not desirable to shut off the water, in which case the only way in which the pipe can be soldered is as follows:—Cut off the pipe at the leak with a hack saw and fill the feed end with a "stop back" made of very soft well kneaded clay or piece of soft bread or dough. This stopback should be forced 6 or 8 in. from the end of pipe. The pipe can then be soldered as usual, using a flux. Care must be taken not to have the stop back so hard as to prevent the water from eventually soaking through it and forcing a passage.

If it is possible to run a stout string through the empty section of the pipe, the end of the string could be carried through the stop back. After the joint is soldered, pull out the string, leave a small hole and the water will pass through it and eventually clear out the pipe.

No. 147. PHILADELPHIA, PA., MAY. 4, 1906.

I am using a magneto to spark a small gas engine. The spark is quite feeble and the magneto does not seem to be giving a very strong current. Will you please inform me what may be the matter with it? G. E. M.

Magneto igniters are constructed with permanent magnets. The magnetism in such magnets becomes weak in time and they require to be remagnetized. If you are acquainted with any one in an electric lighting station you could probably take the magnets to the station and have them remagnetized. There are also electrical manufacturing concerns in your city who could do it for you at small expense. It would be well to thoroughly examine the spark plugs and all connections to ascertain if the fault really is with the igniter, as it frequently happens that a poor connection or spark plug will cause trouble which may seem to be with some other part of the sparking apparatus.

To find the diameter of a driven pulley, when diameter and speed of driver and speed required are known, multiply the diameter of the driver by its speed of revolution, divide by the required speed; result will be the diameter of the driven pulley. To find the speed of a driven shaft when the speed of driver, diameter of driver, and diameter of driven pulley are known, multiply the speed of the driver by its diameter and divide by the diameter of the driven pulley; the result will be the speed of the driven pulley. To find the diameter of driver when the diameter of the driven are known, multiply the speed of the driven pulley by its diameter and divide by the speed of the driver; the result will be the diameter.

SCIENCE AND INDUSTRY.

Interposing low pressure steam turbines between reciprocating engines and their condensers is becoming an increasing custom. The provision of a producer and a gas engine in lieu of a steam plant for propulsion purposes on freight boats in Germany is also attracting attention. Eleven of these boats, carrying 240 tons of freight each, have been thus equipped. The fuel consumption has been found to be only 1.32 pounds of anthracite coal per h. p. hour.

To remove rust from steel, immerse the article to be cleaned in a strong solution of cyanide of potassium. Mix to the consistency of thick cream a paste of cyanide potassium, castile soap, whitening and water, and after immersion, brush the steel briskly, using the paste.

A fatal accident in a San Francisco sewer, due to the presence of foul air in a dead end, again calls attention to the necessity of care in entering such places unless it is known that they are properly ventilated. It sometimes happens that in old combined sewers an opportunity is afforded for foul air to collect, and anyone who enters such a pocket does so at the risk of death. In the San Francisco case a workman entered such a dead end in order to clean out a connecting sewer entering it. He was overcome by the gases and lost his life, and several men who entered the sewer to recover his body barely escaped. Such places in a sewerage system should not exist, but as they still remain in some cities, effective precautions should be taken to prevent any such fatalities to the men who must work in them.

The flaming arc lamp was rather late in securing a footing in this country, but is now receiving enough careful study by American electricical engineers to afford definite information before long concerning its place among our illuminating apparatus, says the "Engineering Record." Its brilliant light, yellow, white or pink, makes it an astonishing sight, while its efficiency is equally surprising. It gives from five to ten times as much light per watt as the common enclosed arc lamp, and bids fair to become as cheap as any illuminant. At present it labors under the disadvantage of evolving such a quantity of fumes that its use indoors is unadvisable until some remedy for this condition is found. It must also be trimmed more often than the enclosed arc lamp, being on a par with the open arc in this respect.

The "Boiler Maker" gives the following receipt for steam fitters' cement. Dissolve one part, by weight, rubber or gutta percha in sufficient carbon disulphide to give it the consistency of molasses, then mix with six parts, by weight, linseed oil and leave exposed to the air for twenty four hours; then mix to a putty with red lead. A less brittle cement is made by using oxide of iron in place of red lead.

When made in thin sheets, gold has remarkable properties, says the "Engineer." Gold leaf used by decorators is transparent, and the light which passes through it is green. If, however, a film of the metal thinner than this is obtained, its color by transmitted light inclines to blue purple. If these thin films are subjected to an annealing process, below the melting point of gold, the transparency is much increased and the color varies from pale brown to pale pink.

Progress in mechanical flight is slow but sure, says the "Engineer." Orville and Wilbur Wright have for three years been experimenting with inclined curved surfaces, first in gliding flight and more recently, with newer propulsion. Last fall they succeeded in making flights of 20 miles made up of straight lines, circles and ellipses, with and against a stiff breeze and in calm weather. The weight of machine and operator was 629 pounds and the gasoline engine used was a 34 h. p. air-cooled, four cylinder machine. Several eye-witnesses have substantially corroborated the statements of the Messrs. Wright in regard to these flights which were made near Dayton, O. This achievement which has recently been announced to the Aero Club of America seems to mark distinctly the beginning of successful mechanical flight by a power driven machine carrying a man.

A circular of the Crude Oil Power Co. 101 Life Building, Kansas City, Mo., is interesting in explaining a device handled to furnish the source of power for gas engines. The mechanism and principle involves a horizontal rotating drum with interior spiral ribs, enclosed in an outer casing. The crude oil enters the drum at one end, and by rotation and the spiral ribs, is carried slowly and uniformly through it. While the oil is passing through the drum it is exposed to sufficient heat to generate gas, which is drawn off and utilized by the engine in proportion to the amount generated and the residue is discharged.

The heat is supplied by the exhaust of the engine, which passes between the drum and the outer shell, keeps the drum at a certain temperature, just high enough to get all the gas out of the oil. The rotating drum stirs up the oil, turns it over, carries it in a thin sheet up on the sides of the drum and exposes it to the heat. This is the best method of generating gas from crude oil. By it the gas is generated without an excessive amount of heat, the residue is discharged as soon as the gas is extracted, thereby obviating the necessity of the continuous cleaning heretofore necessary, while it insures a regular uniform supply of gas to the engine. Owing to the difference in cost between gasoline and crude oil, comparing as some 18 to 4 cents, and it is stated one gallon of crude oil will develop nearly as much power as a corresponding amount of gasoline, the bringing of this California practice East deserves attention.

"The poorest workmen have more to talk about than a busy man."

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

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A HIGH SPEED LAUNCH.

CARL H. CLARK.

The small launch described in the present article is of the extreme speed launch type and is intended primarily for use on sheltered waters, such as lakes or rivers. With skilful handling, however, the boat will stand a considerable sea, but is hardly to be recommended for use upon other than quiet waters. It should appeal very strongly to those who are fond of canoeing, offering, as it does, a type of boat very similar to a canoe, but with far greater speed and endurance qualities.

general shape is not unlike a canoe except for the increased size and the full stern above water.

The general dimensions are:

Length on top	19′	6″
Length on water line	19′	0″
Beam at deck	3′	4″
Draft as designed	0′	6″

The actual draft of the boat will, of course, depend upon the lightness of construction and upon the weight of the crew carried, but this draft should easily

TABLE OF OFFSETS FOR 20-FOOT SPEED LAUNCH.

Number of Moulds.	Bow.	1	2	3	4	5	Stern.
Height of gunwale	2′ 0 1-2″	1′ 10 1-2″	1′ 9 1-8″	1′ 8 3-8″	1′ 8″	1′ 8″	1′ 8″
" " keel bottom					0′ 7-8″	0′ 3″	6″
" " No. 1 section		0′ 4 3-4″	0′ 1″	0′ 3-8″	0′ 1 3-8″	0′ 3 1-4″	0′ 6″
" " No. 2 section			0′ 4″	0′ 1 1-2″	0′ 2″	0′ 4	
Half breadths deck		1′ 0″	1′ 5 3-4″	1′ 8″	1′ 7 1-2″	1′ 3 3-4″	0′ 10 3-8″
Half breadths w. l. 4		0′ 9 3-4″	1′ 4 1-2″	1′ 7 3-4″	1′ 7 3-4″	I′ 4 3-4″	
Half breadths w. l. 3.		0′ 8 5-8″	1′ 3 1-2″	1′ 7 1-8″	1′ 8″	1′ 4 1-2″	
Half breadths w. l. 2		0′ 7″	1′ 1 3-4″	1′ 6 1-8″	1′ 7 1-4″	1′ 3 1-2″	
Half breadths w. l. 1		0′ 4 1-2″	0′ 10 3-8″	1′ 3 1-2″	1′ 4″		

Waterlines are spaced 3″ apart. Sections are 6″ apart.

No. 1 and No. 5 moulds are 3′ 0″ from ends of w. l., other moulds are 3′3″ apart.

To be successful, the boat must be very lightly and yet strongly built, all unnecessary weight must be done away with and all parts as strongly connected as possible. The canvas covered type of construction has been chosen, as it gives to the amateur a very easy method of boat building and at the same time the lightest possible boat. The general system of construction is very similar to that described in the recent issues of the canvas covered tender. The construction is, however, much lighter and simpler, as the launch is not likely to be subjected to as hard usage as the tender.

The small power required, 1 to 2 h. p. is a very attractive and economical feature, as it is both cheap in first cost and economical to run, a similar launch having attained a speed of 11 miles per hour with a 1½ h. p. engine. Referring to the lines it will be seen the

be obtained with two persons and with three she will trim lower in the water. The maximum speed will, of course be obtained with the lightest possible load.

To transfer the lines and make ready for building, the usual table of offset is given. As explained in previous articles, the measurements given under " heights " are measured vertically above the base line on the mould corresponding with the number at the top of the column. Those under " half breadths " are measured horizontally out from the center line on the water lines corresponding with the numbers of the moulds given at the top.

The shapes of the several moulds are laid out on thick brown paper, the water lines being spaced 3 in. apart from the base line, a center line is drawn square with the base line, and the two fore and aft section lines parallel with the center line and spaced 6 in.

apart. The object of these section lines is to locate points below where the waterlines are useful, for example, in the body plan. Fig. 4, the two points on mould No. 4 below the lowest water line are located by the section lines.

Referring in detail to mould No. 4 in the top line of the table, the measurements given opposite the half breadths are laid off on the proper waterlines and the deck, the "height of sheer" is then laid up, locating the curve below w. l. No. 1, and lastly, the "height of keel bottom" is set up, locating the center line point. The points should be laid out on both sides of the center line and the curves struck in with a slender batten. To allow for the thickness of the plank, a second curve should be drawn inside at a distance of 3-16 in. The other sections are laid out in the same way. It will be noted that the sheer and level from the stern to mould No. 3, where it rises toward the bow.

The actual outline of the stern is shown by the dotted outline in Fig. 4, and the offsets are:

Deck	0′ 1⅝″
W. L. 4	0′ 1½″
" 3	0′ 11¾″

This outline is laid out the same as the others. The outline of the bow is also laid off; it begins 6 in. forward of a vertical at the forward end of the low water line and has a slight outward curve; the curve below the l. w l. should be similar to that shown. This completes the laying out.

The method of construction is very similar to that of the canvas boats already described in the previous issues. The moulds are constructed to the outlines already laid out, and of comparatively rough stock, but accurately shaped and with the load water line and the sheer line marked upon each. The sternboard is also gotten out of ½-in. stock to the shape laid out, but a small amount must be allowed for the bevel of the sides, about ¼ in. on the sides and ½ in. on the bottom will be sufficient. The two sternboards are joined with a cleat at the center-line, and through fastened with brass screws. The angle between them is obtained as in Fig. 9, by measuring out from the center line 8 in. and forward 4 in. on each side; a templet would best be made for setting these, as the shape given is only correct when they are set at this angle. The two boards are bevelled at the joint; the cleat is also bevelled at the correct angle, and the whole fastened together. In addition to the outline laid out, the upper edge of each board should have a curve or curvature of 1½ in. and the grain should run horizontal.

The stem is ¾ in. thick, cut to the proper shape; it should be about 1½ in. wide and of pine or other light wood.

For the centerpiece inside, a piece of pine ¼ in. thick, 4 in. wide and the length of the boat is needed; the stem is fastened on at one end and the board is tapered down to the thickness of the stem at the extreme forward end.

A foundation is now built, consisting of a board cut to the shape of the keel and set up about 2 ft. above the floor. The proper outline for this foundation is obtained from the laying off table in the line of "height of keel" by measuring them up on the correct mould points, as laid out by the given spacing. The keel, from mould No. 3 forward, is straight.

The centerpiece, with the attached stem, is now laid upon the foundation in the proper position, and bent down into place and held by shores from above. The mould and stern points are also marked on the center piece. The stern should be shored so as to stand exactly plumb when looking at it from forward. The two connected stern boards are now to be attached to the center piece. It is to be noted that from the last mould point to the after end of the stern, outside, is 3 ft. The after end of the center piece is bevelled to the proper angle of the sternboards, and under the cleat joining the latter, which is bevelled off to receive it. The stern boards may now be fastened in place, and should be shored, taking care that the after side of the joint is at right angles to the base line and in line with the stern, fore and aft. The moulds are set up in place at the mould points; those forward of the middle being placed with their after faces on the mould point, and those aft with their forward faces on the mould point. They must be set exactly at right angles to the base line and square with the center line, and the middle points of the cross braces must be in a straight line from the center of the stern to the point of the stern. The setting of the moulds is one of the most important operations concerned in the building of the boat, as any inaccuracy in the setting will result in the two sides being unlike. When correctly set the moulds should be well braced.

A few battens should now be bent around the moulds and the edges bevelled so that the bottom will lie smoothly on the faces of the moulds. The edges of the stern boards and stem are also bevelled at the same time. A permanent bottom should be fastened around on the sheer line, and be allowed to remain until the plank is put on.

The planking is of pine or cedar 3-16 in. thick. Starting at the keel, it is put on in as wide boards as possible and fastened wherever necessary to the moulds with small nails. At the stem and stern it is strongly fastened with small copper or brass nails. The first plank fits alongside of the center plank already in place. The plank cannot be obtained in lengths sufficient to allow each one to be of a single length, but there should not be more than one joint in each plank and the joints in neighboring planks should be well separated. The frames are to be spaced, one at each mould and nine between, making the spacing just under 4 in. The spaces should be laid off, in order that the joints or butts in the plank may be made on the frames.

The planking may be continued, making each plank wider amidships than at the ends. The girth around

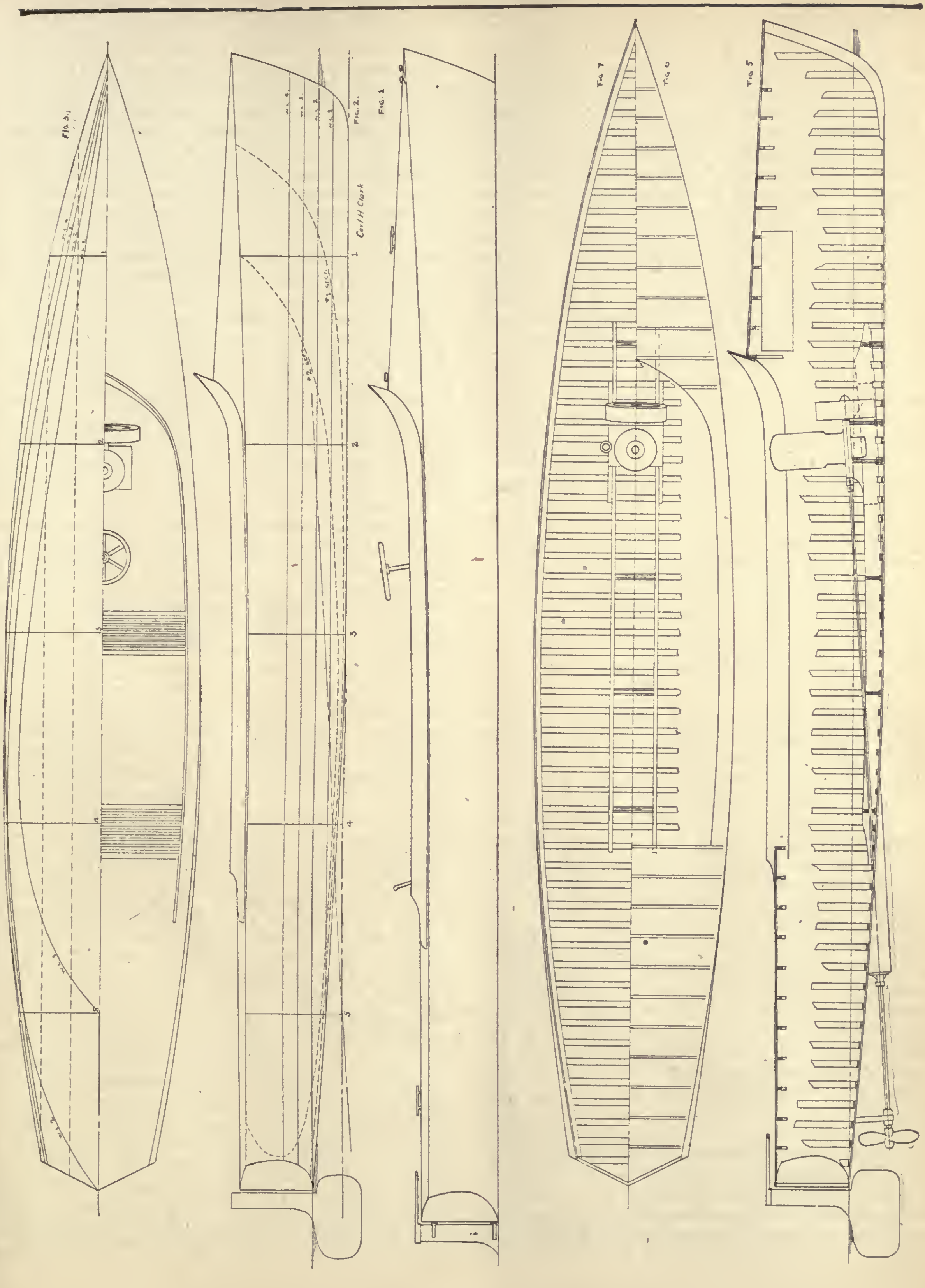


Fig. 3
Fig. 2.
Fig. 1
Carl H Clark
Fig 7
Fig 6
Fig 5

all the mould, should be divided into the same number of nearly equal parts for guidance in planking. By making the plank sufficiently wide amidships they can be run around without a great amount of spiling or curvature and should, if possible, be run the same as in the ordinary construction. If this is not possible or convenient, it may be arranged as in the canvas boat lately described, with the short, wedge-shaped piece on the bilge; the former method is, however, to be preferred. After planking as high as the turn of the bilge, the tops or sheer streak should be put on and the planking continued below. The plank should be cut to fit closely, and no attempt made to force them in place, as there would be a tendency to warp later. The butts of the plank can be fastened temporarily with blocks until the frames are in place.

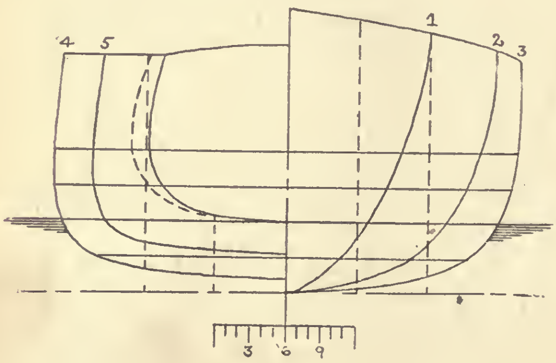


FIG. 4.

The frames are 1½ x ½ in., of spruce bent in flatwise. They are steamed in the usual manner before bending and should be at least partially fastened while hot. The frames extend from gunwale to gunwale continuous across the center line, and the two outer corners should be neatly rounded, as no sheathing is fitted. Fastenings for the frames consist of copper tacks about ½ in. long with flat heads; they are driven from the outside and clinched inside the frame. They should be used plentifully and carefully clinched to avoid splitting the frame, and should be clinched across the grain, not with it; they should also be driven as near the edge of both plank and frame as is convenient without risk of splitting either. A small brad awl may be handy in boring holes for them. In clinching these points, a heavy hammer is held on the head and a light hammer used for clinching; the point should not be nearly turned over flat, but a small hook should be formed and the point forced down into the wood.

Whenever a butt occurs, a piece of the frame upon which it occurs is omitted to allow the fitting of the butt block. The latter should be about ½ in. wider than the plank it joins and about ½ in. thick, it extends from one frame to the second beyond this cutting the intermediate frame, it should be a neat fit between the frames against which it butts and also against the ends of the frame which is cut. The ends of the plank are nailed to the buttblock with the usual copper nails, care being taken not to split either the ends of the plank or the block. It will be noted that the copper nails are slightly tapered and therefore have a tendency to split when driven home; if this tendency is noted, a small hole should be bored for each. The boat should be allowed to set for a day or two to allow the frames to set in place before removing the moulds. When the latter are removed a frame is bent into the place of each and allowed to harden. The shores may be removed and the boat should be quite stiff and strong.

As the moulds are removed braces must be fitted to avoid any chance of change of shape, and they should be left in place until the deck beams are fitted.

The outside should now be well smoothed up with sandpaper and all nail heads set well in. Although not entirely necessary, it is advised that the seams on the outside be covered with strips of rather thick paper fastened on with shellac and smoothed up; this keeps the canvas smooth and also tends to stiffen the boat somewhat.

The engine bearers should now be fitted, running, as shown, about the length of the cockpit; they are of ⅞ in. pine and should stand about 4 in. above the plank at the engine and taper to 3 in. at the ends. They are placed apart a distance equal to the width of the engine bed, and should be carefully fitted down over the frames so as to rest upon the plank. To obtain the curvature of these keelsons a straight piece of board, is put in the proper position and at certain points the distance from the straight edge down to the skin is measured. The straight edge is then transferred to the stock to be used, and the distances remeasured from it, thus reproducing the curve. The piece is cut out and bevelled to fit along the tops of the frames; the cuts for the frames are then made, and the final fitting done. For fastening these bearers in place copper or brass nails about 1½ in. long are used, driven from the outside. These bearers are really the backbone of the boat and must be well fitted and well fastened. In about the positions shown, short floors or blocks should be fitted between the bearers to hold them upright and also to stiffen the bottom; they are of ⅝ in. pine and are fastened through the bearers, and up from below.

The deck beams are of spruce 1 in. deep and ⅝ in. thick, with the exception of those of the cockpit, which are ½ in. thick. The forward deck beams should have a crown of about 6 in. in 2½ feet, the same curvature being used for all. The after deck beams should have a crown of 2 in. in three feet. Deck beams are all spaced about 6 in. apart. To support the beams at each end a clamp is fastened on the inside of the frames; they are of pine 1½ in. wide and ½ in. deep, and are set down 1 in. below the gunwale so that the deck plank will rest evenly upon the top edge of the top streak when laid upon the beams. The clamps are laid in horizontal, as shown in Fig. 10, and should be notched over the frames so as to bear both upon frames and plank, and are fastened in place from the outside. These end clamps should extend about a foot beyond the ends of the cockpit. Alongside of the cockpit the clamp is fitted even with the top of the top streak so that the deck will lie upon it; it should also be notched over the frames and should extend beyond the ends of the end clamps already fitted so that the deck will lie evenly upon it after leaving the beams.

The deck beams are now fastened in place at the proper intervals and are held in place by nailing down into the clamps and if desired through the plank into the end of the beam. The beams at the ends of the cockpit are heavier, to take the extra strain at these

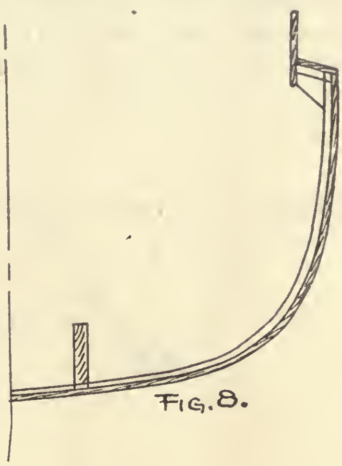


FIG. 8.

points. The cockpit extends from 12 in. forward of No. 2 mould to 8 in. aft of No. 4 mould.

The upper edge of the top streak is now bevelled off to the curves of the beams to allow the deck plank to lie evenly.

The deck planking is ¼ in. thick, of pine, and should be in as wide pieces as is possible, not more than three pieces being used for the whole. A wide nearly parallel piece is fitted in the middle of the deck and the two side pieces are fitted tapering. It is fastened to the beams with nails about ¾ in. long, and the joint between the boards should be close and even. Midway between each two frames which, as before stated, are 6 in. apart, a binder or thin strip about 1¼ x ¼ in. is fastened on the under side in the same manner as a frame to support the deck between the beams. The edges of the deck and the top streak are fastened together with slim brass nails, very carefully driven about 2 in. apart. The forward end of the cockpit is curved as shown, and the raw edge of the deck is to be reinforced by a piece of ⅜ in. stock cut to the proper curve and fastened on the under side. A piece of ½ in. pine is fitted under the deck at the point of the bow to take the bow chocks and another piece under the position shown for each of the two cleats. The deck may or may not be covered with canvas, as desired; the latter course is, however, preferable, as the woodwork does not reqnire to be as carefully done and the deck is more easily kept tight. In case it is not covered it should be 3-16 in. thick, and it may be finished bright in which case a mahogany deck is very ornamental. The entire boat should now be carefully smoothed over with fine sandpaper, and all nail heads well set so that there shall be no unevenness in the canvas.

The hole for the shaft will pierce the hull about 10 in. aft of No. 4 mould. In preparation for this a hole should be made in the canvas at the proper point and a ring of tacks driven around it after filling it with thick paint. This is to prevent the water leaking in between the canvas and the hull. This must be done before the wearing piece is fitted on the outside.

For covering the boat about 10 oz. canvas is to be used; if for any reason 10 oz. cannot be obtained, 8 oz. may be used but the former is to be preferred, as it makes a stronger boat, two 36 in. widths will be required, one for each side, the length of the boat. Specific directions can hardly be given for stretching the canvas. It should, however, be laid on and stretched out lengthwise along the bilge and a little considera-

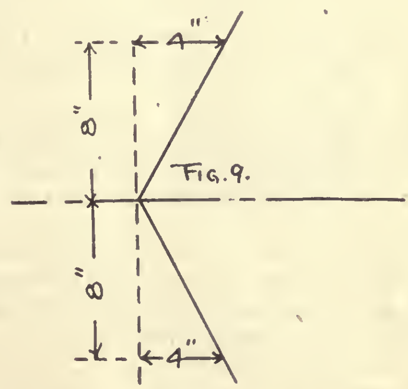


FIG. 9.

tion will decide in which way it can best be laid. It is most likely that it will best stretch out along the bilge, taking wedge-shaped pieces off at each end to fit the center line. The outside of the boat should be covered with thick paint just before laying the canvas. The latter is well stretched fore and aft, and the tacking begun at the center line amidships; a few tacks should be driven at the center line, and then the canvas stretched very tight and a few driven at the gunwale, some more are then driven at the center line, and so on. The first piece to be laid should lap over the center line about ½ in. so that the other piece will overlap it and form a tight joint. The first piece need only be tacked sufficiently at first to hold it, as the tacks driven through the overlapping piece also hold the first. The tacking should thus work gradually towards the ends, always stretching the canvas tightly in both directions. At the bow the canvas is drawn across and tacked to the forward face, and on the stern it is drawn inside and tacked on the flat of the sternboards inside of the line of the plank. The tacking should be about ½ in. apart.

The deck is covered with lighter canvas, 8 oz. being sufficiently heavy, it is stretched in the same manner and laid in paint; it is drawn over the edge of the gunwale and tacked over the other. The raw edge of the canvas is covered with a ½ in. half round moulding.

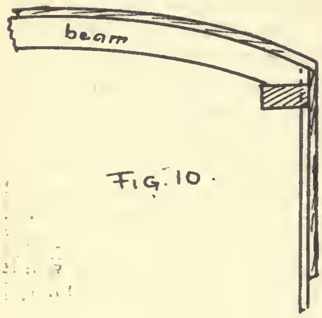


FIG. 10.

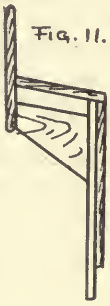
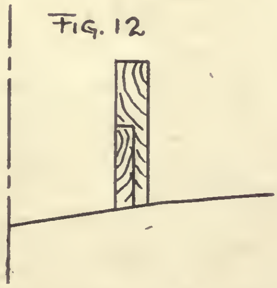


FIG. 11.

A wearing strip of ½ in. pine 3 in. wide is now to be run outside the entire length of the boat; at the bow it is tapered to the width of the boat and is fastened with small brass screws. A stem piece of ½ in. oak is bent around the stem, joining the rubbing strip just fitted.

The coaming is of ½ in. oak and stands 3 in, high above the deck and is curved up at the forward end, as shown. It is fitted and supported by small blocks, as shown in Fig. 11. At the after end it runs out on to the deck and is curved off as in Fig. 5. The forward end of the coaming is sloped forward somewhat to shed the water and also to enable it to be more easily fitted; at the point a small block is fitted on the inside to join the two sides together.

FIG. 12



The skeg is shaped as in Fig. 5, from 1½ in pine, and bored with a ⅜ in. hole for the shaft, to match that already made in the hull. It is fastened through from the inside and must be carefully lined with the center line of the boat. A very thin lead pipe is now to be fitted inside of the shaft hole extending from the after end of the skeg to the inside of the boat.

The inside of the hole is well covered with paint before inserting the pipe, which is then turned over on end and hammered down close upon the wood, thus making a watertight joint all through.

The rudder is of ½ in. stock of the shape shown and is 16 in. long; the part forward of the forward edge of the stock being 2½ in; the straight stock is 3 in. wide. A cleat is fastened along the lower edge to prevent its warping. The rudder is swung upon either the usual rudder braces or upon brass screw eyes. In the latter case four eyes are used and a brass rod is passed through, the lower eye taking the weight of the rudder. By so fitting the eyes that those on the rudder just fit between those on the hull, the rudder is held exactly in place. For a tiller a light brass casting may be made, or a wooden tiller may be used, with a strap of sheet brass passing around the rudder stock and fastened to the sides of the tiller.

The outside of the boat should be painted several light coats of lead paint, to fill up the pores and lightly rubbed with sandpaper after each coat is dry. The inside and the stern boards may be finished bright, being first given a coat of shellac.

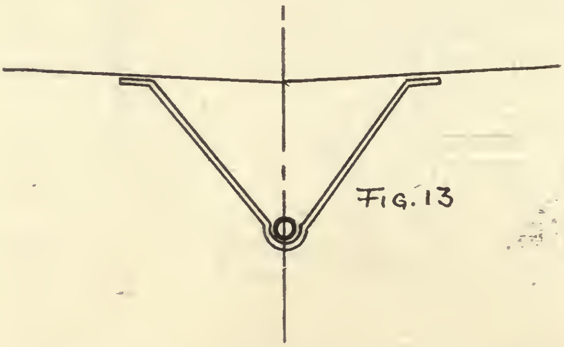


FIG. 13

The seats are best made of narrow slats, as shown; the positions may be noted in relation to the mould points. They should be supported upon strips fastened along the side of the boat, and should have braces near the middle. Across the deck aft of the cockpit a finishing strip is run, covering the corner.

If desired, a light floor may be laid over the engine bearers, but it is advised to leave it open and finish the bearers the same as the inside in order to save weight.

The engine foundation is constructed, as in Fig. 12, of 1½ in. pine plank cut out to fit alongside the keelsons already fitted, and is fastened to them. This gives the necessary width for strength and for fastening with the lag screws. The cross braces between the bearers before mentioned should extend as high as possible and cut out to fit around the engine base. In fitting the bed a line should be run through the stern tube and extended forward over the engine bed, and by reference to the engine the necessary position of the bed may be determined. The position of the extreme after end of the shaft should be also noted for use in fitting the propeller.

Lining up the engine should be a rather particular piece of work, as the shaft must enter the engine coup ing perfectly straight as otherwise it will bend at

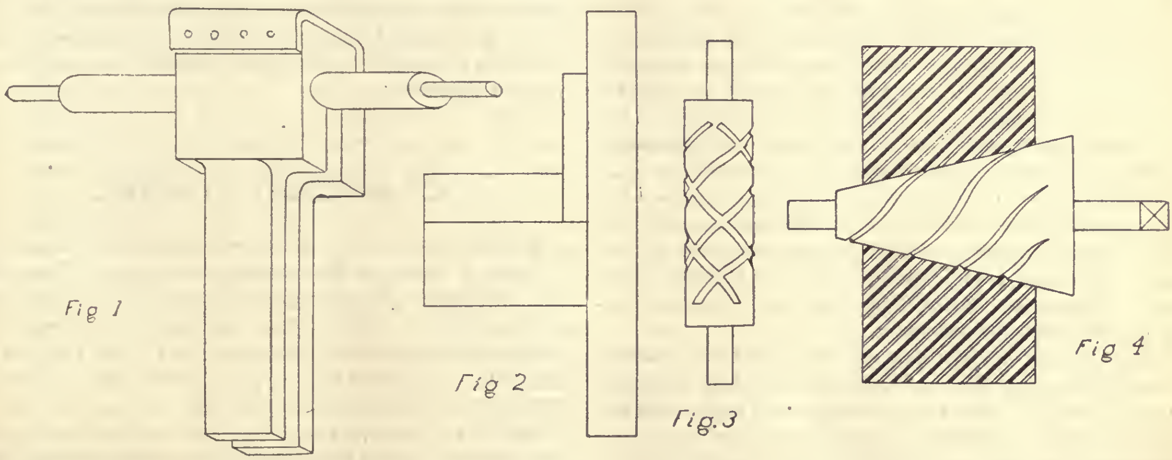
CONCLUDED ON PAGE 247.

LAPS AND LAPPING.

ROBERT GIBSON GRISWOLD.

The finishing of machined surfaces by the process of lapping is in reality a fine art. No other method presents such possibilities in the way of finished surfaces and accurate fits as does this very excellent method of grinding.

This process is used very largely for truing up holes in cylinders in which a very fine running fit is desired, such as the spindle of a boring mill or vertical drill. Guides of delicate precision machinery are frequently finished by this method, and in the construction of fine measuring instruments it is invariably used.



To illustrate with what degree of accuracy work finished by this method may attain, the writer begs permission to cite the personal experience of an expert tool maker. The question of accurate methods in the construction of sizing blocks was under discussion when the tool-maker took from his tool-chest a neat, flat case which, upon being opened, displayed neatly arranged each in its own velvet-lined pocket, twenty-four sizing blocks ranging from 1-32 in. to 1 in. in thickness. The workmanship was faultless and each bore a polished surface so bright that even the smallest exterior detail was perfectly reflected as if from the surface of mercury. These blocks were made of hardened tool steel, finished by hand exactly to size.

Accompanying this set was a signed certificate from one of the foremost tool-making concerns in the country, stating that this set of blocks had been tested by micrometers and found to vary less than the ten-thousandth part of an inch from size, and also that the angles were perfect right angles. So perfect were these blocks that if any two of them were wiped perfectly dry and placed together by sliding over one another, they would adhere very tenaciously, proving that this fit was so perfect that even a layer of air could not possibly be imprisoned between them. Not only would two of them hang together but almost the entire lot could be supported one from the other in a string when properly placed in contact. This beautiful finish and accuracy in size was obtained by hand lapping on a true cast iron surface plate, without lubricant or abrasive. Unless one has seen such work they can scarcely realize what patience and skill are required to accomplish this result.

The simplest piece of lapping which, by the way, is really nothing more than fine polishing, is the finishing of a cylindrical, turned piece in a lathe. This is shown in Fig. 1. Two pieces of hard wood are shaped so that they may be easily manipulated and a semi-circular recess cut in each to fit the work. The two pieces are then fastened together with a strip of leather to act as a hinge.

The clamps are now charged with a thin coating of rather fine emery and flour and oil and closed over the revolving piece in the lathe. This coating of emery soon cuts away the imperfections on the surface of the work when another charge of a finer grade of emery and oil should be applied. Plenty of oil must be used in order that the inside surfaces of the blocks do not become dry. When the grinding has brought the surface to a very smooth finish, clean out the blocks and charge with a thin coat of washed Turkish emery and oil, or crocus and oil. This will give the work a beautiful, smooth polish and the work will be found remarkably true and round.

These clamps are held in one hand and only sufficient pressure exerted to cause the charge to cut. The blocks are constantly moved to and fro along the piece so that the minute scratches cross each other, thus removing the appearance of a series of circular scores in the surface. With a little practice this method will produce beautiful surfaces, especially in hardened work. Soft materials are not so easily polished by this method as the pieces or grains of emery are easily embedded in the wood, and they often cut very deeply.

The lapping of a hole is not so readily accomplished. In the first place the laps are made of either soft cast iron, copper or lead, the latter being most frequently used. This lap is shown in Fig. 2. A mandrel is first turned up with roughened surface, to which the lead will stick, and around this mandrel is cast a layer or cylinder of lead slightly larger than the finished hole. It is then placed in a lathe and turned to such a size that it will just push into the hole. Several small grooves are then cut spirally around the circumference, with a small, round-nose chisel.

The lap is then charged with flour of emery and oil until the grooves are filled and the lap is pushed into the hole. It is then twisted backwards and forwards either by a machine or a wrench applied to a square end on the mandrel. As the grains of emery roll out of the slots between the inside surface and the lead, they imbed themselves into the lead, leaving numberless small teeth exposed which cut the surface of the steel as it passes over them. When worn down so that little cutting is accomplished a fresh charge is applied and the grinding continued. A final charge of crocus or washed emery finishes the hole to a beautiful polish and almost true to size.

Of course the most accurate way to finish a hole is by grinding, but there are many times when a grinder cannot be used and the above method forms a cheap and effective substitute. The same precautions are necessary in this case—keep the lap constantly moving to and fro in an axial direction so that the grains cannot follow their previous cuts, and always turn in one direction.

The lap for finishing a tapered hole is shown in Fig. 3. This lap is made in exactly the same manner as above described, but the grooves should all be cut in one direction. Then the lap should be turned in such a direction that the tendency of these grooves is to throw the lap out of the hole. If turned in the opposite direction the tendency is to screw itself into the taper so that it is impossible to twist it, especially where the taper is slight. It is more difficult to tap a hole of this character than a straight one, owing to the lack of the axial motion to prevent cutting.

The lapping of a square piece is undoubtedly the hardest job. A rather different scheme is used in this case. The block is first filed or ground nearly to size (within one or two thousandths) and one side is rubbed on a smooth cast iron plate with only a very small quantity of crocus and a light oil. This rubbing is a difficult operation to prevent the piece rocking slightly while being moved, which would undoubtedly cause the edges to wear faster than the central portions. While not entirely overcoming this tendency, placing the tip of the middle finger on the center of the piece and thus imparting motion thereto will afford a fairly even pressure over the entire surface.

When this surface has been ground perfectly true, the next one is finished until it is square with the first. Only patience and labor will bring successful results. When the four sides are ground true with one another, the ends, if the piece is oblong, may be lapped by holding against the blade of a small square to prevent rocking, as shown in Fig. 4. The finishing operation is done by rubbing the surface on a clean cast iron plate, free from oil or any abrasive. This puts on a beautiful polish.

The process of lapping, while only resorted to in cases where grinding cannot be done, is one that should be understood by all mechanics, as there are many cases where it is absolutely necessary to use this method. The finish produced on flat surfaces by lapping is beyond criticism and cannot be equalled by any other method, a buff finish being the nearest approach thereto.

AN ANCIENT TUNNEL.

Evidence exists that, 24000 years ago certain Hebrew engineers executed the same kind of work as that of the Simplon tunnel, though perhaps on a smaller scale, says the "Engineer." Owing to the bad state of the water supply of Jerusalem, the king ordered a reservoir to be made at the gates of the city, to which water was brought from various springs.

Recent explorations have enabled this predecessor of the Simplon tunnel to be identified, and it is said to be the Shiloh tunnel, by means of which water was brought down from a source to the east of Jerusalem and poured into the pool of Siloam. This conduit is 360 yards long, and the distance, as a bird flies, between the two mouths of the tunnel is also only 360 yards.

Work was commenced at both ends of the tunnel and the direction was altered several times. The floor of the tunnel is finished with great care, and the workings are from 1.9 feet to 1 yard in width and from 3 to 9 feet high. In the light of modern engineering ing science it may be asked how these old-time engineers gauged their direction and recognized and remidied their errors in alignment. What tools did they use in executing this work which has remained without equal for 2400 years?

Priming in a boiler is simply the mechanical rising of water by steam in its effort to get out, and if the steam space is drawn upon and emptied, the boiler is almost sure to prime. The steam space should not be less than one-third the volume of the boiler.

COLORING WOOD FOR INLAYING.

Fancy colored woods for inlaying very much enhance the effect of work of this character. The usual material employed for staining white deal and other plain woods to imitate woods of a different texture or superior quality are various decoctions of vegetable matters, such as logwood, Brazil and sandal wood, and tumeric, etc., are used for producing reds, browns and yellow; while various mineral bodies, such as picric acid, permagnate of potash, caustic lime, etc., are used for deepening the color of woods and otherwise altering their character; but none of these materials produce bright, vivid colors, such as blue, golden yellow, green, etc.

Of course, for furniture and woods used in decoration, such vivid colors are out of place, but for inlay work, bright, fancy colors are applicable, and by means of aniline dyes can be produced in an infinite variety of hues. But to produce successful results precautions are necessary, because these dyes act so energetically on all organic structures, such as woods, leather, ivory, etc., as to enable many different shades to be obtained by any particular dye. For example, a very strong solution will produce a coloration so deep and intense as to exhibit a bronzed appearance, but any number of successive applications of weaker solutions will not produce such a deep coloration; on the other hand, if only a very weak solution of the dye be used at first, it is possible to produce any gradation of tones by tho subsequent application of successively stronger solutions of the dye, but it must be borne in mind that the strength of the dye first applied, and the temperature at which it is applied, determines the resultant color; consequently, to produce any desired tone, experiments should be first made on small pieces of wood before proceeding to stain the whole of it.

AQUEOUS DYE SOLUTIONS.

There are two kinds of aniline dyes—one set soluble in water, and the other soluble in spirits. Both kinds may be used for producing dye solutions, but for penetration, especially on hard woods, the alcoholic solutions are preferable, but good results can be obtained with either class of dye.

To prepare an aqueous dye solution, put one ounce of the dye into a clean earthernware pan or jar; never use a metal receptacle, nor a wooden one, because metal will react on the dye and its color, and wood will absorb some of the dye and not only thereby lessen the strength of the solution, but the wood will become so impregnated with the dye it first comes in contact with, that such vessel cannot be used for preparing a dye bath of any other color. Pour one quart of boiling hot water on to the dye and stir it up with a glass rod or wooden stick and let it settle for an hour or two; then filter the dye liquor through a plug of cotton wool inserted in the neck of a glass funnel, and store the dye liquor in clean bottles for use, not forgetting to label it with the name of the dye and its strength, such as "the strongest solution."

Now one ounce of aniline dye will generally be more than one quart of water will completely dissolve, consequently the dye that has been collected in the filter will still yield a second decoction, so remove the plug of cotton wool from the funnel and put it in a glazed jar or pan and wash all the dye that adheres to the funnel into the vessel by pouring one quart more of boiling hot water on it, and when the liquor has extracted all the coloring matter it can, filter it through a fresh, clean piece of cotton wool.

Label the second batch of dye liquor and mark its strength as being second strength, or No. 2 solution. To use these dye liquors it will be found that the first quantity of liquor obtained will be too strong to use unless it is diluted, being of concentrated strength; the dye, as it dries, will exhibit a bronzed efforesence or irridesence; therefore a little of the liquor should be taken and diluted more or less with hot water, according to the tone of color it is desired to exhibit.

In using the dye liquor of the second strength, that will not be strong enough to produce a bronzed surface, and therefore may be used undiluted, if so desired. It is best to prepare these dye liquors in two strengths of solutions, as by that means one solution can be strengthened at any time by the addition of some of the concentrated solution.

PREPARING "TINCTURES."

To prepare alcoholic solutions or "tinctures" of the dye proceed as follows:

Put ½-oz. of the dye into a clean glass bottle and pour on it one quart of rectified spirits, or else methylated spirit (but the spirit must not be methylated with any mineral oil, such as paraffine or benzol, as these hydrocarbon fluids do not dissolve the dye); shake up the fluid several times during the first few hours, and then let it rest for 24 hours; then decant the clear fluid from the dregs. If it be filtered, a piece of clean blotting paper or filter paper should be used, and a plate or saucer placed on top of the glass funnel so as to prevent the spirit evaporating while filtering. The dregs or residue may be treated with a fresh portion of alcohol to produce a weaker tincture. Each of these batches of dye should be stored in closely corked bottles and labelled first and second strengths, together with the name and color of the dye.

Besides "water" and "spirit" dyes there is a new class of analine dyes, which are soluble in oils and fats. These dyes are known as "oil" dyes, and are very useful for coloring varnishes and wax compounds, but they are not so useful for staining purposes.

METHOD OF APPLYING THE DYE.

A brush and sponge can be used for applying the the dye liquor, but to prevent the coloration being uneven, patchy or streaky, the fluid should be quickly and evenly applied all over the surface to be dyed; the operation should be rapidly performed, and sufficient dye liquor be contained in the brush or sponge to flow over the whole of the surface at once. This is necessary, because wherever the dye just touches the wood it sinks into the fiber at once, and the tone of color obtained depends on the strength of the fluid; that is, a spongeful of the fluid produces a deeper coloration than that which is obtained when half the liquor has been absorbed out of the sponge; therefore, be rapid in the application, and keep up a plentiful supply of the dye to the surface, until it is all flooded evenly with the dye.

Then let the wood remain in a warm room to dry; owing to the thinness of fretwork it is liable to warp and curve up if too much liquid be applied at once. Therefore it is best to have the dye liquor of sufficient strength to strike the tone at once by a single application, but when graduations of tone are desired, the strength of the dye liquor can be weak at first, and successive applications of stronger liquor made, but each one should be nearly but not quite dry before applying the next.

Any attempt to keep the wood flat by laying weights on it while the surface is wet with the dye will only spoil the coloration. If the wood does curve up, it is best made flat again by first allowing the dyed surface to dry and then wetting the wood on one or both sides and laying if between two boards that are weighted down; the dye having soaked into the fiber and become combined therewith will not be so liable to be rubbed off when wetted subsequently.

Another way to straighten the wood is to hold it over the spout of a kettle from which steam is escaping, and then lay it flat between boards. If the wood is to be colored on both sides, and be stained throughout its thickness, it is best to steep the wood in the dye liquor for three to five minutes, at a suitable temperature, remembering that the hotter the temperature of the dye liquor the deeper the stain produced.

After coloring the wood, its surface should be smoothed by lightly sandpapering. If the fiber is not raised by the hot liquid, or if only slightly raised, it may be smoothed by rubbing it with a piece of stiff felt. To fix the dye in the fiber so that it shall not be rubbed off if the wood becomes wetted or damped, a wax polish can be used, or a solution of casein may be laid on the surface with a sponge or brush and allowed to dry. The casein solution is made by dissolving dry casein in a saturated solution of borax until the mixture results in a fluid of the consistency of gum mucilage.

Dye solution can be used in exactly the same way as above described for dyeing and coloring leathers, provided the leather has not been previously colored. In some few cases it will be found necessary to employ a "leveller"; that is, a fluid applied to the wood before the application of the dye liquid, so that the dye will spread on the fibre uniformly, and produce an even coloration. Such levellers are usually sulphate of soda, acetic acid, sulphuric acid diluted, common salt, acetate of soda, etc.

FORMULÆ FOR COLORED DYE LIQUORS.

The following formulæ will serve as a guide in preparing suitable colored dye liquors. In all cases the water is reckoned in 100 parts.

Reds, 1.—Eosine 1 part sulphate of soda, 10 parts; acetic acid 3 parts.

2.—Magenta No. 2 B, 1½ parts; auramine, 1 part; 10 parts sulphate of soda.

3.—Azo cochineal, 2 parts; sulphate of soda, 10 parts; sulphuric acid, 2 parts.

4.—Water, 10 parts; rose benzol, 5 parts; first wet the wood with alum solution.

Yellow. 5—Auramine, 4 parts; sulphate of soda, 10 parts.

6.—Naphthol yellow, 1 part; soda sulphate, 10 parts; sulphuric acid, 2 parts.

7.—Crocein orange, 1 part; soda sulphate, 10 parts; sulphuric acid, 1 part.

Brown. 8.—Bismarck brown R, 1 part; nigrosine, ½ part, soda sulphate 18 parts.

9.—Same as No. 8, omitting the nigrosine.

10.—Benzo brown, 3 parts; common salt, 10 parts.

Green. 12.—Brilliant green, 3 parts; Bismarck brown ½ part; soda sulphate, 10 parts.

13.—Brilliant green, 1 part; chrysoidine, 1½ part; soda sulphate, 10 parts.

14.—Green crystals, Y, 1 part; soda sulphate, 10 parts.

15.—Malachite green, 1 part; Nile blue, A, ½ part; soda sulphate, 10 parts.

17.—Victoria blue 42, 1 part; soda sulphate, 10 parts.

16.—Nile blue, 1 part; soda sulphate, 10 parts.

18.—Water, 8 parts; soluble blue, R, 3 parts.

By first giving the wood an application of some kind of dye, say a yellow, and before it is quite dry, an application of another kind of dye, say a blue, different colors, such as green orange, purple black, or brown stains can be produced. By such process of mixing the dye liquor, all sorts of color combinations can be secured and very beautiful results obtained.—"Hobbies, London."

When the first two tons of anthracite coal were brought into Philadelphia, in 1803, the people of that city, so the records state, "tried to burn the stuff; but at length, disgusted, they broke it up and made a walk of it." Fourteen years later, Col. George Shoemaker sold eight or ten wagon loads of it in the same city, but warrants were soon issued for his arrest for taking money under false pretenses.

PHOTOGRAPHY.

FOG: ITS CAUSES IN PLATES AND ITS PREVENTION.

COLVILLE STEWART.

A plate is said to be fogged or foggy when the portions of the film which have not been exposed to light in the camera become dark or black in the developer. Every plate on very prolonged development shows some signs of fog, and quick plates are liable to become fogged more readily than slow ones, though with normal development both should work quite cleanly.

Fog is caused, then by the developer acting upon the film even when unexposed, and the action of the developer in producing fog is always accelerated by forcing, by warmth, or by unsuitableness of character. All plates would fog if left long enough in any developer, so that normal time is always to be desired.

Sometimes too much exposure to an unsafe dark-room lamp will fog the plates, or a stray streak of white light which has no business in the dark-room; but this is "light-fog," and can only be caused by carelessness. The other kind of fog may be termed chemical fog, and this the kind which can almost always be obviated.

Now when a plate is very fast, besides being very sensitive to light, it is also sensitive to the developer. Any developer will fog if allowed time, as I said, but some developers are much worse than others, and some are much more suitable for certain brands of plates than others.

Metol and amidol are the developers most likely to produce fog, because they are the most energetic. Pyrogallic acid and hydroquinone are "clean-working developers, because they are less energetic and take longer.

Potassium bromide, sodium sulphite, and potassium metalbisulphite are three chemicals with which we can enable the developer to work cleanly. But for every improvement we make in a developer, there is sure to be some counteracting disadvantage, and so it is that the more bromide we have the slower will development take place and the less we shall get out of our exposure. If your plate is rather under-exposed, you naturally do not want to lose any of the effect of exposure, and this is why I think you will prefer, after an experiment or two, to dilute your developer with water and give the plate plenty of time, rather than use a vigorous developer with bromide in it to prevent fogging.

A fairly dilute pyro soda developer "wants a lot of beating," especially for the beginner, but at the same time any developer which the makers of a plate recommend is sure to be all right for that plate. Not necessarily for other makes, though! There is a certain class of photographers who try every make of plate on the market with the same developer, without thinking that it may be unsuitable for some brands, and they express an opinion on different makes which is neither correct nor reliable. So when you try a new brand of plate, use the developer recommended for it and give it every possible opportunity of showing its good qualities.

Prolonged development is, of course, sometimes necessary, and an impurity sometimes gets into the developer; both these circumstances may cause fogging of the clear portions of the negative. In such cases as these, try soaking the plate for a minute in four ounces of fixing solution, to which has been added a few drops of a one in five solution of potassium ferricyanide. Do not leave the plate in this too long, or it may reduce the negative itself.—"Amateur Photographer."

BACKING MADE EASY.

FREDERICK ALLEN.

There must be very few people at this time of day who believe that the results obtained on unbacked plates are equal in quality to those when the plate has been properly backed with an efficient backing. I have heard a photographer say that he hated backed plates because they were so "messy," although he did not explain in what way the messiness manifested itself. If he meant that the backing was messy to apply, I can only say that it is clear he did not set about its application in the proper way. If he meant that it washed off in the developer, and made that a little thick, I feel inclined to ask him—what did it matter?

The soundest objection to backing is the extra cost of backed plates. Those who do not mind the comparatively small increase in price will be well advised if they buy their plates backed, because not only does this save the trouble of applying the backing, but it also insures the backing being thoroughly dry, and prevents any risk of fogging the plate with actinic light, either while it is being backed or when it is being dried after backing. Besides, the backing applied by the maker is more likely to be efficient than when the plate is backed by the user; though if the method which I employ myself, and recommend, it adopted this should not be the case.

To make a backing frame is very simple. We first want a piece of flat board, a trifle larger than the plates in use; mine is a piece of deal 7 x 5 in., which is plenty big enough for half-plates. Even this is not a necessity, at a pinch a sheet of stout strawboard will answer every purpose. Two pieces of much thinner card are required, the same size as the thicker card or board, and having found the center of each, one of them should have a hole cut in it a shade larger than half-plate: say 6 17-32 in. by 4 24-32 in. and the other a hole 6 3-8 in. x 4 5 8 in. Both these holes, which leave a little more than a narrow frame of card, should be cut carefully central, so that when glued flat upon the board, the one with the larger hole on top of the other, they form a kind of rebate in which the plate rests without danger of moving, while except at the edges, its underneath side is not in contact with anything. When this has been done, and the glue is quite dry, a thumb-hole is cut at one side through both cards, extending a little way into the wooden base, so that when a plate is put into the frame it can easily be lifted out. The backing frame is then complete, though it will be all the better for a coat or two of good varnish. My own has had two coats of white enamel.

The use of such a frame is quite simple. The plate is laid in it sensitive side downwards, and the back is rubbed over with backing. I keep my backing in an old pyro bottle, and have a circular dabber made by tying up a ball of cotton wool in an old handkerchief folded in four. The dabber is kept in a pot with a lid such as shaving cream, etc., is sold in. This keeps it clean and ready for use. A few drops of backing are poured into the pot, the dabber well worked up with it, and then the back of the plate is rubbed over. The merest film is effective, and there is no need to give an even coating so long as there is enough everywhere. A piece of paper the size of the plate may be laid down on the backed surface, and the plate can then be put straight into the dark slide. It is a neater plan to stand it up in the dark to dry, but this is not always possible, and there is no serious objection to the other course.

The cost of backing in this manner is so trifling that it is quite unimportant to anyone able to afford to use a camera at all.

Lantern plates used for transparencies and for enlarged negatives are all much improved by backing—in fact, those who like to see clean, bright negatives, with edges free from fog, and with no suspicion of halation, will be wise if they make it a rule to back every plate they use.—Photography.

Renew your subscription before you forget it.

MOONLIGHT EFFECTS.

Although there is a particular shade of carbon tissue on the market that for moonlight effects leaves little to be desired, it is not every worker who is prepared to turn out carbon prints, says Fayette J. Clute in "Western Camera Notes." The ferro prussiate or blue print process does not exactly fill the requirements. I saw some bromide prints the other day that, without actual side-by-side comparison, I should say were even more pleasing than the same prints made in carbon. The method by which they were produced is as follows: The bromide prints, which should be rather light, are toned to almost a bright red in a bath composed of

Uranium nitrate	40 gr.
Potassium ferricyanide	40 gr.
Acetic acid	2 dr.
Water	16 oz.

and then immersed in a weak solution of iron perchloride. The change to a bluish green at once takes place.

WHEN THE GOVERNOR HUNTS.

With two-cylinder engines it sometimes happens that when they are throttled down to go slow, that the throttle valve, while open wide enough otherwise, keeps shutting off the flow of gas entirely. To obviate any difficulty of this kind, says the "Automobile Magazine," it will be found that a small by-pass drilled in the throttle valve allows the engine to run more slowly. This hole also prevents the objectionable "hunting" of the governor, with the result that the engine runs more regularly. A hole of about one-eighth of an inch in diameter should be quite large enough, but the exact size can only be determined by trial. It is, therefore, advisable to drill a smaller hole and file it out to the required size. To stop the engine when a by-pass is fitted, the ignition circuit must be broken by means of a switch, which should fit so that it can be conveniently operated by hand.

Electric power is now being applied to the currying of horses in Chicago and New York. Two small dynamos are secured to the stable ceiling, and from them long flexible tubes depend, attached to each of these being a small brush buzzing around in a dizzying whirl. All the men have to do is to keep moving brushes about from one part of the animal's anatomy to another. Expert hostlers say it takes about 20 min. to clean a horse with the ordinary currycomb, while only four with the the electric brush. The revolving brush is also said to be be beneficial in causing the blood to circulate properly.

MAKING BLUE PRINTS.

JACOB GLOGAN.

One of the important adjuncts to mechanical drawing is that of "blue printing." To obtain a blue print you must have what is known as a tracing of the drawing. To get the tracing transparent tracing paper or tracing cloth is used. This tracing paper is placed over the original drawing and the tracing is made. There are two surfaces on tracing cloth, namely: the smooth or glazed side and the dull side. The dull side is the side which you place against the original drawing.

After the tracing is ready the blue print is made. Blue print paper can be obtained in any mechanical drawing supply store, but if you wish to make it yourself, it is made as follows: Dissolve 1 ounce of ammonia citrate of iron in 6 ounces of water, and in a separate bottle dissolve the same quantity of potassium ferri-cyanide in 6 ounces of water. Keep these solutions separate and in a dark place, or the solutions will be of no use. To prepare, mix the same amount of each solution and with a sponge or soft cloth spread it evenly over the surface. Let the paper remain in a horizontal position until the chemical has set on the surface, then hang the paper up to dry. When drying, see that no light strikes the paper or it will lose some of its value.

To make a blue print from the tracing, place the tracing with ink side out against the glass surface of the printing frame, then take the blue print paper and place the sensitized side down on the tracing. On the top of the paper place a felt cushion, which generally accompanies a good printing frame, and then put in place the hinged back of the printing frame. After this is done expose to the sunlight. To make good blue prints, being guided only by the exposed edge of the sensitized paper, take a small test piece of the same paper and a piece of tracing cloth with a few lines drawn on it and expose that to the sunlight the same time that you expose the large print.

By having a dish of water at your side you may tear off at different times pieces of the test blue print and wash it in the water. If the test piece shows up in a deep blue color and clear white lines, then it is time to take the big print out. After the print is taken out, it should be washed in cold water for ten minutes and then should be hung up to dry. Corrections can be made on the print with an ordinary writing or ruling pen and a solution of washing soda, caustic potash, strong ammonia, or any other alkali.

To obtain sharp lines on a blue print, all lines on the tracing should be heavier than on ordinary drawing paper, and a sharp inking pen should be used.

By using the following solutions, prints having blue lines on a white ground or just the opposite of a blue print may be obtained: 3 oz. common salts, 8 oz. ferric chloride, 3¼ oz. tartaric acid, 26 oz. accacia, 100 oz. water. Dissolve the accacia in half the water and dissolve the other acids in the rest of the water, then mix the two together. The solution is applied with a brush to a well-rolled paper in a subdued light. The paper should be dried as quickly as possible on account of the acid eating into the pores. When the paper is dry it is ready for use. One or two minutes are sufficient in strong sunlight, and a considerable longer time in a dull light.

To develop the print, it must be washed, after leaving the frame, in a very weak solution of potassium ferricyanide. None of this solution should touch the back of the print. Developing takes but a minute or two. If the background of the print is of a blue color, the print was not exposed long enough, and if the background shows a pale blue color, then the print has been exposed too long.

When development is complete, the print is washed in clean water for two or three minutes, and then placed in the following solution for ten minutes: 3 oz. sulphuric acid, 3 oz. hydrochloric acid, and 100 oz. of water. In this solution all the iron salts not turned into blue compound, will disappear. After this is done the print is washed in water and then allowed to dry.

One of the important uses of blue prints is its use in the shop of the mechanic or engineer. The best advice to be given to them is to take the blue print and mount it on a pasteboard back, but if it is required to keep the prints in first class shape, mount them on sheet-iron or zinc backs and then apply a coat of varnish over each side to make it waterproof.

To make drawings from the prints, the blue prints may be inked over with waterproof ink and when thoroughly dry, washed with a solution of oxalate of potash; treated thus, the ink lines will remain and the blue ground will fade, leaving the background white and appear like an original drawing.

Erasing on tracing cloth, in case of mistakes or errors, should be done with an ink eraser or a sharp, round erasing knife. The surface of the tracing cloth must be made smooth in those places where erasing has been done. This is done by rubbing the cloth with soapstone or powdered pumice stone or talcum applied with the fingers—"The Practical Engineer."

The man who wants to "take it easy as he goes al ong" can do so in the full assurance of never being overburdened with a weight of this world's goods or responsibilities.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

88 Broad St., Room 522, Boston, Mass.

A Monthly Magazine of the Useful Arts and Sciences. Published on the first of each month for the benefit and instruction of the amateur worker.

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Single copies of back numbers, 10 cents each.

TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter Jan. 14, 1902.

JULY, 1906.

A large number of replies have been received in answer to the editorial competition mentioned in the June number. Many valuable suggestions have been given, and arrangements are already being made to utilize some of them at once. Others, requiring longer preparation, will be taken up at an early date. We are grateful for the very evident interest shown by such a large number of readers, and our sincere thanks are given to those who have generously responded to our requests. The winners of the awards will be given in the August number.

One prominent feature peculiar to all the letters received in this editorial competition, is the statement that the magazine is "practically helpful"; that the various topics presented in succeeding issues are completely and plainly treated, making the information given usable to the fullest extent. This idea is the one we have tried to continually follow in the conduct of the magazine, and this evidence that our efforts have been successful is especially gratifying.

In this issue we publish a description of a speed launch which will be of interest to all who obtain their boating recreation upon protected waters. The type of construction makes it particularly suitable for rivers and lakes, and the cost of building one is so small as to place it within the reach of anyone able to buy a light 1½ or 2 h. p. engine. It can be built by anyone having ordinary skill with wood working tools, and provides an excellent substitute for a motor canoe, being a much more seaworthy craft.

For these reasons we would request our regular readers to call the attention of friends to this boat, recommending them to buy a copy of this issue of the magazine, either of a news dealer or by sending direct to this office. We anticipate that the edition will be quickly exhausted, even though we are printing an extra large edition; so to insure getting a copy an early order will be necessary.

The constitution and by-laws of the American Society of Model Engineers is about ready for mailing to those who have made requests for the same. Some important changes from the original draft were deemed advisable, in the interests of simplified government. As during the summer, no general work would be probable, the beginning of active operations is postponed until the coming fall, when we fully expect to see formed a large and interested society membership in which will be of great practical value.

The "free" alcohol bill which goes into effect Jan. 1, 1907, will have an important influence upon the fuel market for motor cars and boats. Many important features bearing upon the manufacture and sale of alcohol have yet to be determined before it will be possible to tell how great a benefit will follow the advent of cheap alcohol. Motor manufacturers will have much experimenting to do to produce a motor capable of using both gasoline and alcohol to good advantage. Alcohol requires a much greater heat to produce a workable vapor, and motors using this fuel are run with very high compression.

From this brief statement it will be seen that denatured free alcohol does not mean an immediate relief from high cost fuel. The greatest benefit will probably come from a lessened use of gasoline in those sections the country where grain and fruit alcohol can be produced as a by-product, and consequently sold with profit at a very low price. The lessened sale for gasoline thus caused will tend to lower the price throughout the country.

One important benefit from free alcohol will be that farmers can, by distilling their own fuel, use motors for power purposes, and the farmer boy will no longer dread the wood pile and feed cutter, but become an amateurn egineer and have lots of fun running a small lighting and power plant.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

II. Two Cycle Engines.

The ordinary type of two cycle engine is illustrated in Fig. 8. *A* is the cylinder of cast iron, in which travels the piston *P*. The piston is shown in its lowest position, its highest position being at *a*. It will be noted that from a point just below *a* the bore of the cylinder is slightly increased; this is termed the counterbore and is for the purpose of allowing the piston to over run the edge of the working part of the cylinder bore and prevent it from forming a shoulder at the upper end of its stroke as the bore wears. There is a considerable space above *a*, which is called the compression space, for compressing the gas, as before explained.

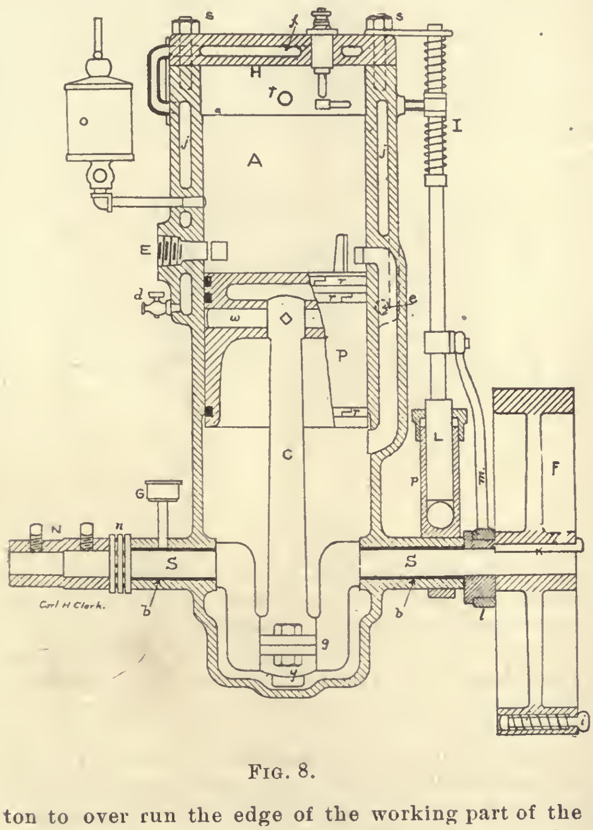


Fig. 8.

The cylinder is surrounded by the water jacket *j* through which water is circulated to carry off the excess of heat which is generated in the cylinder and which would otherwise cause the cylinder to become overheated and perhaps injured. The jacket surrounds the cylinder and sometimes the exhaust pipe, and extends well below the lower end of the bore.

H is the cylinder head, which is also hollow for water circulation, except in the small sizes. The head is held in place by the bolts or studs *ss*; the joint between the cylinder and the cover is filled by a thin sheet of packing to make it gas tight. The studs are from four to six in number. The water enters the jacket at *e*, and circulates around the cylinder and cover and passes out at *f*. It passes from the cylinder jacket to the head through the outside pipe, as shown, or through an opening directly upwards between the studs. The former method is preferable, as when the opening is cut in the packing there is liability of leakage and of water being drawn into the cylinder. Many engines have the cylinders and heads cast together, thus avoiding the joint; this saves all trouble with the circulating water and allows a rather more symmetrical head. It is, however, harder to examine and repair, as the cylinder, and sometimes a portion of the base, must be lifted to get at the working parts.

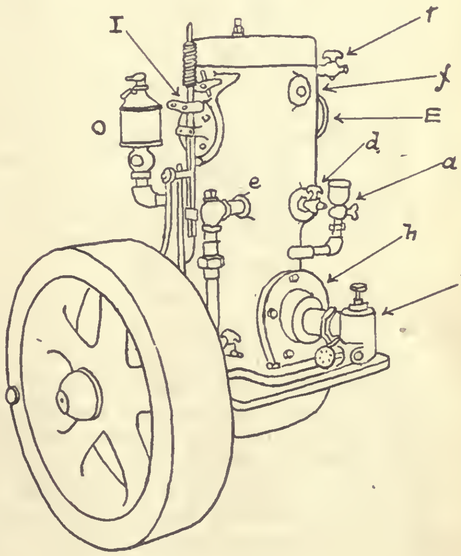


Fig. 9.

P is the piston; *r* the piston rings, usually three in number, which are set into grooves in the piston. They are turned to a diameter slightly larger than that of the cylinder and are sprung in, so that they press out against the walls of the cylinder and prevent leakage past the piston. The piston itself is a rather loose fit in the cylinder, and the rings are depended upon for tightness. Two of the rings are placed at the top of the piston, and the other one at the lower edge; this is to prevent leakage from one part to another. For example, when the piston is a part of the way down the gas in the base might be forced up past the piston and out of the exhaust port, were it not for this lower ring. The joints in the rings are shown halved; they are often simply cut across at an angle; the former is the preferable method, as there is no chance for leakage. Piston and rings are of cast iron.

W is the wrist pin, or pivot, upon which the connecting rod swings; this pin may either be fast in the rod and turn in the piston, or *vice versa*, being held in place by a set screw. In some cases it is left entirely free to turn in both, but this is hardly advisable, as there is a chance of the end of the pin scoring the bore of the cylinder. The wrist pin is of steel.

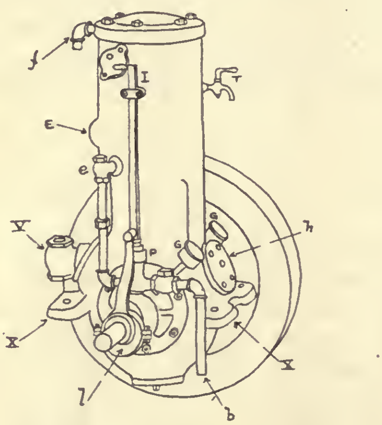


Fig. 10.

C is the connecting rod, of either steel or bronze; when of the latter metal, no inserted boxes are necessary, as the bronze and the steel pins will wear well together. The upper end of the rod consists simply of an eye, through which the wrist pin is inserted. The lower or crank pin end is cut, and the under portion of the bearing is fastened on with two bolts *g*; this is necessary in order to get it into place, and to allow a chance of adjustment to take up wear.

SS is the crank shaft, which should be made of the best of steel, as it is, perhaps, the most important part of the engine; the part encircled by the lower end of the connecting rod is called the crank. On the end of the crankshaft is the flywheel *F*, of cast iron; it is held in place by a key *K*, which is of rectangular section and is sunk half in the shaft and half in the hub of the flywheel, and prevents the flywheel turning on the shaft. The handle *i*, for use in starting the motor, is contained in a hole in the rim of the flywheel and is pulled out for use. It is encircled by a spring, which draws it in when it is released, and prevents injury to the operator.

The sleeves of composition *b b* which are inserted in the casting of the base, make a good bearing for the shaft. They not only make a better bearing than the cast iron of the base, but also allow of the insertion of new sleeves after wear has taken place.

P is the water pump, for circulating the water in the jacket: it is of the usual type of plunger pump, consisting of the plunger *L* working in the barrel. The plunger is made tight at the upper end of the barrel by the packing gland as shown, and at the lower end of the barrel are the usual two foot valves. The water is drawn in through one valve by the upward strokes, each valve allowing the water to pass in one direction only. The pump is operated by the eccentric *L* on the crank shaft, and the eccentric strap *M*, so that the pump has a stroke for each stroke of the piston.

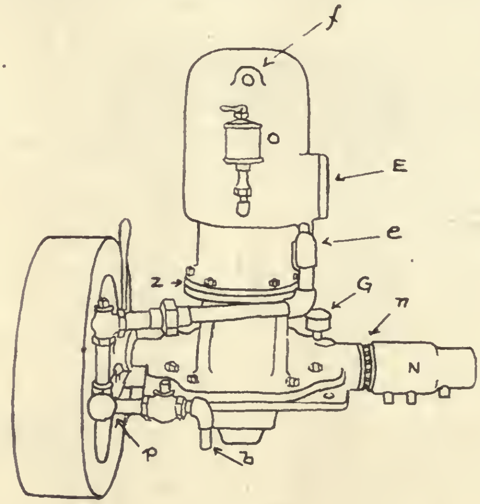


Fig. 11.

The thrust bearing, shown at *N*, takes up the forward thrust of the propeller and prevents the crankshaft being forced against the forward bearing by the pressure. It consists essentially of two hardened steel rings with steel balls running between them; the balls are held in a thin plate of composition and revolve freely.

N is the coupling by which the engine shaft is connected to the propeller shaft; it is a sleeve of cast iron, fastened to the shafts with set screws or keys.

At *d* is a pet cock, leading from the water jacket into the air; its purpose is to drain the water out of the jacket in cold weather, as the formation of the jacket is liable to split the casting. The opening at *t* also leads into the air and is provided with a pet cock for the purpose of relieving the compression when turning the engine over by hand.

I is the igniting mechanism, which will be described later.

G is a grease cup for lubricating the crankshaft bearing, a similar one being fitted to the forward bearing; it consists of a sort of cylindrical box with a screw and cover and a stem leading down to the bearing. It is filled with grease, which is forced into the bearing by screwing down the cover. It is advisable to use the grease in these bearings, as it is thick and forms a film between the shaft and the bearing, which prevents leakage from the crank case.

At *O* is a lubricator for oiling the cylinder and piston; it may be considered simply as an oil reservoir for the present, as it will be described in detail later. The oil is delivered upon the bore of the cylinder and is distributed by the piston. The wrist pin is oiled by an axial hole, through which oil is received from the cylinder walls and delivered to the wrist pin. As a matter of fact, the wrist pin requires little lubrication, as the movement of the bearing around it is slight, otherwise the lubrication received in this way would not be sufficient. On the lower end of the connecting rod at *y*, is a small scoop, with a hole above it leading into the crank-pin bearing; the base is partially filled with oil. and a small amount is scooped up on each revolution and delivered to the crank-pin bearing.

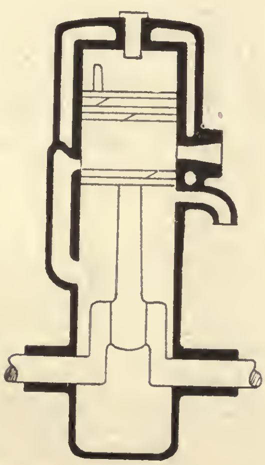


FIG. 12.

Fig. 9–10–11 represent the outlines of three standard makes of engine. In Fig. 9 the cylinder and upper portion of the base are in one casting, the lower part of the base and the cylinder cover being separate. At *n* is a removable cover over a hand hole leading into the base, allowing examination and adjustment of the crank-pin bearing. The gasoline vapor is delivered into the base through an opening in the cover plate *N* from the vaporizer *V* which will be described in detail later. The connection for the exhaust pipe is at *E*, on the rear of the engine. The water pump is just back of the flywheel and delivers water to the jacket through the pipe *e*; the water passes out of the jacket at *f*.

T is the compression cock, and *d* is the drain cock for draining the jacket. At *O* is the oil cup for oiling the piston and at *a* is cup and cock for introducing oil into the base.

I is the igniting gear, which will be explained in another chapter.

Fig. 10 is of the same general type, the letters referring to the same parts. In this type the cylinder and entire base are one casting, the main bearings being held in plates bolted on front and rear of the base. The water-pump and igniter in this case are on the rear of the engine, the pump drawing water from the outside through the pipe *b*, and discharging through the pipe *e* into the jacket; the cooling water flows out at *F* after circulating over the cylinder cover. *GG* are the grease cups for the main journals. *L* is the eccentric for operating the pump. *XX* are the flanges by which the engine is bolted in place.

Fig. 11 is of the type having cylinder and head in one casting. The upper part of the base is a separate casting bolting on to the cylinder at *Z*; the lower part of the base bolts on below. The pump is horizontal, directly behind the flywheel, and discharges into the jacket through the pipe shown, *n* is the ball-thrust bearing, and *r* is the shaft coupling. *F* is the cooling water outlet, and *E* the exhaust outlet, as before. No igniter gear is shown, as with one method of ignition none is required.

While no two makes of motor have the same parts in exactly the same place, the above description should enable the reader to become familiar with the various working parts and the attachments, as all must have these parts in some form or other.

THREE PORT ENGINE.

A variation of the two cycle engine, known as the "three port" type, is illustrated by Fig. 12. The general characteristics and operation are the same as the regular two cycle type, with the exception of the meanes for admitting the vapor. Instead of the vapor being admitted through an opening in the side of the crankcase, a third port is provided, which opens into the cylinder just below the piston when the latter is at the top of its stroke; the carburettor is connected with this port. The piston covers this port except when it is at the top of its stroke, and at this time it is opened into the base.

The piston on its up stroke creates a partial vacuum in the base, and when the third port is uncovered at the top of the stroke, the vapor rushes in. The gas is thus admitted in a sort of puff instead of during the entire up stroke, as in the ordinary type, and is, therefore, more energetic and positive at high speeds. Since the piston covers the port except during the admission, a non return valve on the vapor inlet is not necessary, and the admission of vapor is less obstructed.

For these reasons the three port engine can be run at a higher rate of speed, and practically all engines intended to run at a speed greater than 500 revolutions per minute are now built on this principle. The external appearance is, with the above exception, the same as the ordinary two cycle engine.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

IV. Vibrators and Interruptors.

To secure the maximum efficiency of a coil it is essential that the vibrator or interrupter be exactly proportioned to primary current and service for which the coil is used. For small coils where simplicity of construction is desired, the ordinary spring vibrator is suitable, but careful designing and workmanship are quite important for even this type. A quick, snappy break means a stiff spring, but one too stiff will not be self starting. On the other hand, a very flexible spring will vibrate slowly, making it unsuitable for wireless telegraphy. Some experimenting with springs both as regards length and flexibility will be advisable to secure the one most suitable. In general, this type should only be used on coils giving less than a two inch spark.

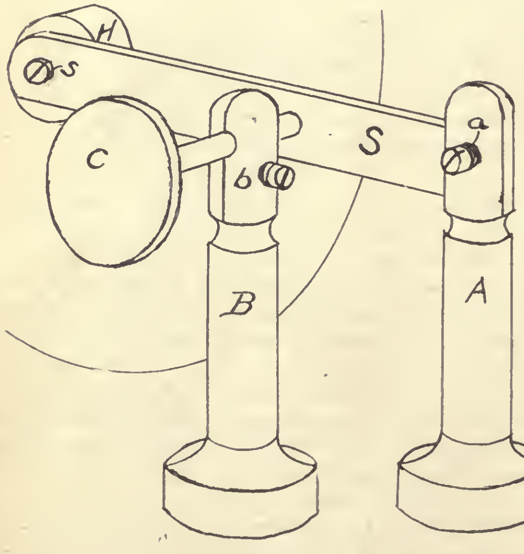


Fig. 1.

The design for a simple spring vibrator is shown in Fig. 1. The posts *A* and *B* are about ⅝ in. diameter, and high enough to bring the spring *S* in line with the core of the coil. For both rigidity and appearance the bases of the posts should be larger, or 1 in. diameter, but this is not absolutely necessary. Washers can be put under the heads of the screws which are used to fasten the post to the base, and the posts will be rigid if not too frequently adjusted. The top ot the post *A* is slotted with a fine hack-saw to receive the end of the spring *S*. A hole is drilled ⅜ in. from the top of the post *B* to receive the contact screw *C*, and the post is then slotted. A hole is then drilled through the post to receive the set screw *b* at right angles to the hole for the contact screw.

The spring *S* is of spring brass ½ to ⅝ in. wide, No. 30 to 24 gauge, and from 2½ to 3 in. long, these dimensions covering coils giving from ½ to 1½ in. sparks. A hole is drilled at one end to receive the screw *a*, and at the other end for the screw *s*, holding the hammer

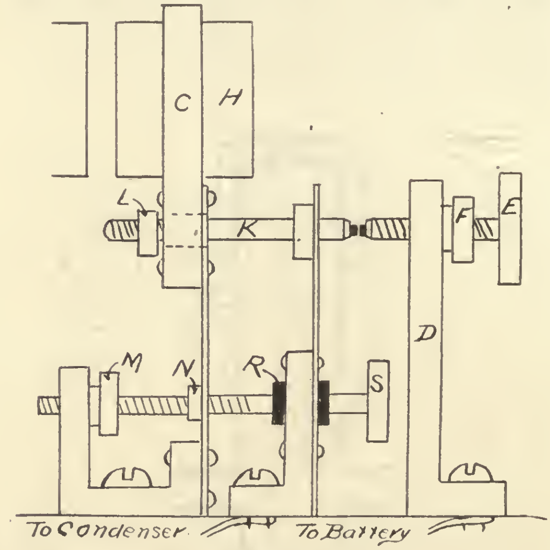


Fig. 2.

head. At the point where the contact screw c touches the spring, about midway between the post and hammer, a piece of sheet platinum is soldered, or a piece of platinum wire ⅛ in. diameter and 1-16 in. thick may be used. The contact screw should also have a platinum point. In soldering on the platinum, first clean the surface with a fine file or emery cloth; then with a blow-pipe or torch, melt a drop of hard brazing solder and, keeping the solder fluid with the torch, drop on the platinum and immediately remove the flame. Use only enough solder to firmly attach the platinum.

The contact screw c should be about 1½ in. long and 3-16 in. diameter, and have a large head at the outer end to facilitate fine adjustment. In testing the efficiency of vibrators, care must be used to learn if troubles arise from the vibrator, condenser, or weak or excessive currents in primary circuit, as the improper operation of the vibrator may result from any of these sources.

Another form of vibrator with a double spring has decided advantages over the one just described. From its action can be secured a long "make" and a short, quick "break," thus obtaining thorough saturation of the core and a maximum spark. The rate of vibration can also be varied to a small extent. It is suitable for use with coils giving up to 8-in. spark, but a motor-driven, mercury-dip break is advised for coils giving a 4-in. spark, or over. The design of the double spring vibrator is shown in Fig. 2. The hammer *H*, is supported by a brass collar *C*, to which is riveted the spring *A*. The lower end of the spring is riveted to the U-shaped brass base, which is fastened to the wood base of the coil by a screw.

H. As the hammer moves towards the core with accelerating speed the collar *C* closes against the nut L, and forces the arm *K* to "break" from the contact screw *E*, which occurs just previous to the striking of the hammer against the core. The value of this design of vibrator arises from the momentum attained by the hammer before causing the break, which is quick and sharp. As the hammer recedes from the core after the "break" the contacts are quickly united and remain so until the hammer completes its swing, and again returns under the impulse of the spring *A*, and the attractive force of the core.

The two forms of vibrators described are suitable only when the variation of the vibrations is within

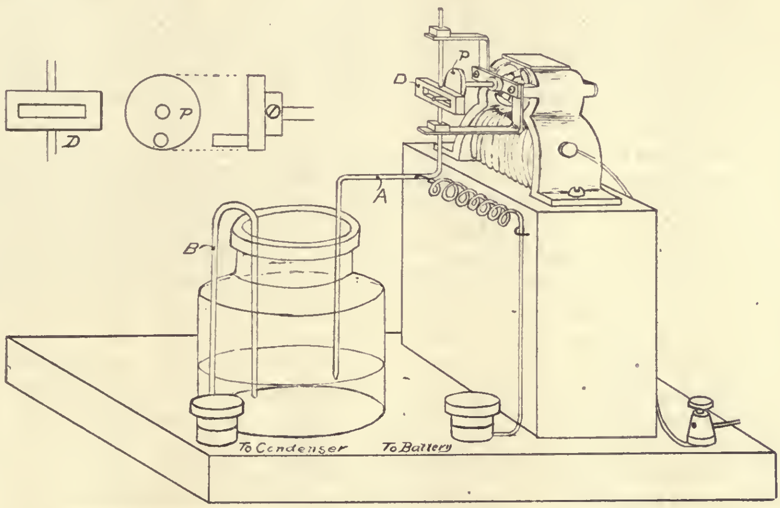


FIG. 2.

Near the lower end of the spring *A* is brazed a small nut *N*, which is threaded on the adjusting screw *S*. The end of the adjusting screw is threaded through a hole in the other arm of the brass base, and has a checknut *M* for binding fast when adjusted. A second spring *B* is riveted to an L-shaped spring base and has near the lower end a bushing of hard rubber *R*, fitting over the adjusting screw *S*. At the upper end is brazed a brass nut, which is used to more securely hold the arm *K*, one end of which projects to the front and is tipped with platinum, and the other end passes through a rather larger hole in the spring *A* and collar *C*, and is fitted with a threaded check nut *L*. The hole in the spring and collar should be large enough to prevent the arm from binding. The check nut *L* should fit tightly, and may also have a check nut outside for binding same to position.

The contact screw *E* is supported by the brass post *D* and has a check nut *F*. The end is tipped with platinum to prevent sparking. The platinum point of the arm *K* rests upon the platinum tip on the end of the contact screw *E*, which allows the primary current to flow around the core, thus attracting the hammer

in narrow limits. For experimental work or wireless telegraphy, where a wide range or a very rapid rate of vibrations is necessary they will not answer, and the motor driven mercury dip interrupter is more desirable. Such a device is not difficult to make, nor very expensive when made as shown in Fig. 3. An ordinary toy motor is mounted on a wooden block of suitable height, which in turn is supported upon a base board holding a short glass bottle with a wide mouth. Four binding posts are mounted, two on one side near the bottle, and two on the end nearest the block.

The motor is run by a battery of two dry cells and a rheostat is mounted on the outer surface of the block and connected into the motor battery circuit. By means of the varying resistances the speed of the motor can be varied over a wide range and adjusted to any required rate of interruptions for the coil. The bottle is partly filled with mercury, which is covered with a thin layer of turpentine or crude petroleum. The fixed lead *B* is a piece of heavy gauge copper wire running from one binding post, over the top of the bottle and into the mercury.

The vibrating terminal A is connected to the other binding post by a spiral of flexible wire, which is attached, at the outer end of the spiral, to the block holding the motor. This wire is soldered to the vibrator with soft solder to give good electrical contact. The movement of the vibrator is obtained by means of a brass box D, leaving a long slot which works on a stud put into the outer face of the small pulley on the motor. This stud is simply a short piece of brass wire, driven into a hole drilled in the pulley, or may be a round head, brass machine screw and the hole in the pulley threaded to receive it. The latter way is preferable, as the head of the screw serves to hold the box in position.

The upper and lower parts of the vibrator are brazed into holes drilled in the box. The box is cut out of a small piece of brass rod; the slot is formed by drilling holes and finishing with a small, flat file. The box and pulley are shown in enlarged view in Fig. 3. The vibrator should have a movement of about ⅜ in., and to obtain this it may be necessary to substitute for the motor pulley a disk of brass large enough to give room for the stud, which should be 3-16 in. from the center of the disk.

The bearings for the vibrator are made of strips of heavy brass, the ends of which are secured under the ends of the armature bearing on the motor. These strips are bent to an L shape, and holes are drilled in the outer ends to receive the vibrator with a sliding fit. To give a heavier bearing that will not quickly wear out, small brass discs are brazed over the holes, and bored out to a sliding fit for the vibrator. Graphite should be used as a lubricant for these bearings.

The vibrator is also given a short point at the end entering the mercury to prevent spattering. The duration of the "make" is regulated by the depth of the mercury; the greater depth the point enters the mercury, the longer the current flows through the primary. It is necessary that the point entirely clears the mercury on the up stroke, to ensure a good break. A little experimenting will quickly show the necessary adjustment. In place of changing the depth of mercury, alterations of the "make" can be obtained by placing pieces of cardboard under the bottle. To prevent the bottle from moving bore a shallow hole in the base board to hold it in place. This type of interrupter should not, for convenience sake, be mounted on the coil base, but may be made a separate fixture together with the condenser.

WHITE LEAD PAINT.

A great deal is said today of the adulteration of food products and drugs. Second only in importance are the frauds practiced in the paint trade. In point of magnitude they surpass the first. White lead, innocent of a trace of lead, is sold; one sample, bearing a label stating that $1000 would be paid if the lead in it was not pure, was found to contain no lead whatever.

The labor in painting is from two to four times the cost of the material. It is evident, therefore, that while the use of an adulterated paint works to the advantage of the painter, in that it makes frequent painting necessary, the house owner can ill afford any but the highest grade of materials. Many look only at the first cost, and imagine that a few dollars saved in the cost of the paint is so much money gained. This is due to ignorance.

The white pigments are of the most importance, as they form the basis of most paints and are often used for a first coat. Of these, white lead stands pre-eminent.

An easy test, requiring no chemical skill, is the blowpipe. A piece of close-grained charcoal is obtained, and in this a small hole is dug out. A fragment of the white lead, about the size of a small pea, is placed in this hole. With a common jeweller's blow-pipe a jet of flame is directed against the white lead, using the flame of the spirit lamp or a small gas flame. A pure white lead will melt down to a clean button of metallic lead, leaving no residue in the charcoal. The presence of adulterants will prevent this, and instead of getting a button a grayish white moss is obtained.

Another simple test is to treat the dry white lead with diluted nitric acid. If pure, it dissolves completely, with effervesence, to a clear liquid. If a lead in oil or mixed paint is to be examined, the oil should be first extracted by thinning down with benzine. The pigment settles to the bottom, and the benzine carrying the oil may poured off the top.

To cheapen white lead, barytes, whiting, terra alba, clay, silica, and zinc white are added. The latter, however, is said to prevent the chalking of lead. Any or all of these substances may be found in a mixed paint. The prudent buyer will do well to steer clear of mixed paints; he should purchase the proper ingredients and have the mixing done on the premises.

White lead may be bought absolutely pure in paste form, with 10 per cent of linseed oil. The manufacturers of white lead are not, as a rule, paint manufacturers, and if the lead is bought from the original maker, branded with his mark, there is no danger.

The paste lead is thinned with pure linseed oil; 5 to 10 per cent of a good light colored drier is added, together with the proper tinting material, and the mixture strained through a sieve before use. No turpentine or benzine is necessary.

An important saving can thus be effected. White lead is sold at a small margin of profit. The same is true of linseed oil, so that one who does his painting in this way is often able to find that he has obtained the best of materials at less than the cost of adulterated mixed paint, on which the manufacturer nets a large profit.—"Municipal Journal."

MAKING POCKET ACCUMULATORS.

BY "GEBON."

The following article on making pocket storage batteries or accumulators, is in reply to a correspondent who has asked for information on the subject.

Pocket accumulators are small cells measuring 4 in. from top to bottom, 3⅝ in. from side to side, and 1¾ in. thick. The cases are made of sheet gutta-percha ½ in. thick, or of sheet ebonite No. 14 gauge. They may be rectangular in shape with sharp corners, or curved to fit the pocket with rounded corners, the two forms being shown in full and dotted lines in Fig. 1. As gutta-percha is a material more easily worked than the ebonite, and the rectangular form easiest to make, this may first be tried.

If the cell is to be a 4-volt one, it must now be divided into two equal compartments by means of a vertical partition in the center.

To make this partition, cut a strip of the gutta-percha sheet, 3⅝ in. long and 1 in. wide, to fit exactly the inside of the cell to within ½ in. of the top, and then make all the seams tight with melted gutta percha. A cover, Fig. 2, must also be cut to fit in the top of the cell, and this must be perforated with four holes, two for the vent tubes *A*, Fig. 3, and two smaller end ones for the tangs *B* of the terminal.

The vent tubes are made of 1-in. lengths of ebonite tube. The top part of each tube is screwed to fit the

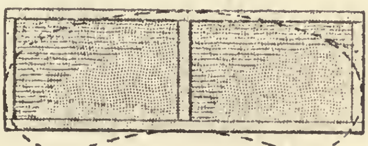


FIG 1

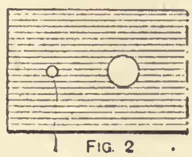


FIG. 2

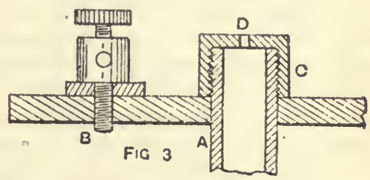
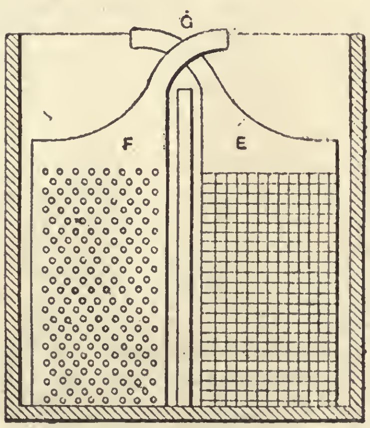


FIG 3



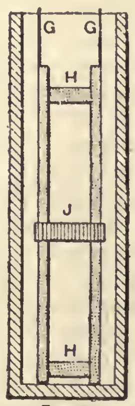


FIG. 5

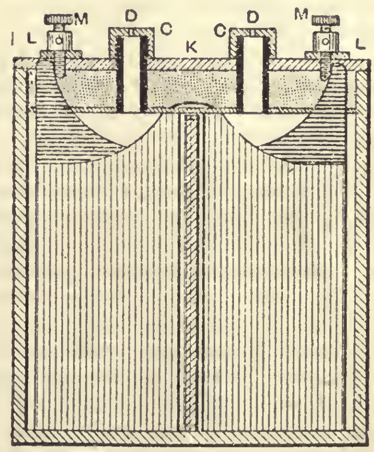


FIG. 6

First cut a wood block to the shape and size of the inside of the proposed coil, and smooth its surface. Next, get a sheet of gutta percha and cut from it a strip 9½ in. long by 3¾ in. wide, to form the two sides. Put this over the outside of a vessel containing hot water, until the strip is soft and pliable, bend it over the wood block to the required shape, and put both under pressure until cold and hard. Then cut two strips of the same material, 3⅞ in. long by 1 in. wide, to form the ends of the coil, and have them quite flat and straight with true edges. Fit three into the spaces at the end, press them close to the inside block, and melt some gutta-percha well into the seams to make the joints water-tight. This can be done with a hot iron.

inside of an ebonite cap *C* as shown in section at Fig. 3, and the top of this cap is pierced with a fine pin hole *D*. The lower part of the vent tube goes down into the top part of the cell, and is used to convey the acid charge into the cell while the cap is off. When the cell is charged and the cap screwed on, the pin hole in the top serves as a vent for the gas generated in the cell while working.

If the accumulator is to be of the curved form, it may be constructed as follows: Having first made a wooden curved core of the required size and shape, cut a strip of gutta percha 10½ in. long and 4 in. wide, scarf the two ends, warm the strip as before, bend it round the wood core to the right shape, and close the edges with a hot iron to make a sound joint. Then put the whole under pressure to keep the shape until cold. Then cut curved pieces for the bottom and the top, with the same arrangement for vent tubes and terminals as before.

The bottom piece must be fitted in and made water tight with gutta-percha, and the partition fitted in the center in the rectangular form. If an ebonite cell is preferred, the dimensions are as for a gutta-percha cell, but ebonite will need more heat than gutta-percha to render it pliable. Powdered shellac is used in making the joints water-tight, these being kept hot and under pressure to force out excess melted shellac and to make a good joint. Ebonite makes a stiffer cell which does not alter its form when worn as gutta-percha does, but it is not so easily worked, and the joints present some difficulties in being made water-tight, even when melted shellac is used as a cement.

The lead plates forming the elements of the cells are of two kinds, positive and negative, the first being coated with peroxide of lead, and the latter with finely divided lead. These plates are really grids of lead, the holes being filled with the required pastes. The grids may be made by hand as follows: Procure some sheet lead 1-16 in. thick, and cut from it four strips 7½ in. long by 1¼ in. wide. Mark off 6½ in. on each of these strips, and rule the surface with ⅛-in. squares. Then punch or drill a ⅛ in. hole in each square, and countersink both sides of the holes.

Now take some red lead in a saucer and make it into a stiff paste with equal parts of sulphuric acid and water, using a spatula for mixing. Lay two of the lead strips on a sheet of thick glass and cover all the holes with a layer of the lead paste well pressed in with the spatula. Then turn up 3¼ in. of each plate and bend over the other 3¼ in. to form a double plate with the paste inside. Press the two sides close together, scrape off the exuding paste, and coat the outsides with a layer of the paste, again pressing it well into the countersunk mouths of the holes. Then set the pasted plates in a warm place for fifteen hours to dry and harden. Meanwhile, make a strong solution of chloride of lime in rainwater and set aside to settle and clear. When the plates are dry and hard they will have a grayish-brown appearance and must now be immersed in the clear chloride of lime solution until the color changes from brown to puce, that is, until the sulphate of lead and red-lead have changed to peroxide of lead.

The plates must now be gently rinsed in clean water and they are then ready to put into the cells. The two other plates should be coated with a paste made of finely divided lead in water in a similar manner, but will not require the process of "forming" in chloride of lime. The finely divided lead is prepared from acetate of lead (sugar of lead) in the following manner. Make a strong solution of sugar of lead in distilled water, and in it suspend some pieces of clean zinc, which will separate the lead in small flakes. When all action ceases and all the lead is extracted, pour away the liquid and well wash the lead flakes in water. Drain off all excess water, leaving enough to form a stiff paste, which is then used to paste the negative plates, and they are placed in the coils while still wet.

It will have been noticed that 1¼ in. of single blank lead strip is left on each plate. These blanks are left to form the lugs or connections between the plates of adjoining cells and connections to the terminals. These connections need only be ¼ in. wide; the remainder can be cut off, making each plate of the form shown at Fig. 1. The plates are to be put in the cells with a positive on one side and a negative opposite, as at *E* and *F*, the positive in one cell being on the same side as the negative in the next cell, to which it must be connected by soldering together their two lugs *G* over the partition dividing the two cells.

Before doing this, the plates should be placed together, with a thin strip of ebonite *H*, Fig. 5, separating each pair, a rubber band holding all firmly. Each pair can then be slipped into their compartments and connected. Then cut an inside cover, similar to the outside cover, for the cells from a thin strip of ebonite. Lay this on top of the plates, put in the vent tubes *C*, Fig. 6, and fill up the space between the outer and inner covers with melted marine glue to seal the cells nearly water tight.

The top cover *K* must now be fixed. First note the marks on the five lugs of the plates on each side, and make corresponding marks on the ends of the cell, to distinguish the position of the positive and negative plates inside the cell. Bring the lugs *G* up through narrow slits in the cover, and solder them to small thin brass nuts, through which the tangs or terminals *M* will pass into the small holes in the cover. Then, on top of these nuts place ebonite collars, and screw down the terminals firmly. Next press the cover down into its place, flush with the top of the cell, and secure it with melted gutta-percha round the edges. The completed arrangement is shown in the section by Fig. 6.

The cells must now be filled and charged. They are filled through the vent tubes with a solution of sulphuric acid in water, made by adding in a thin stream 5 parts by measure of strong sulphuric acid to 31 parts of water. This mixture should be put into the cells when cold. They are charged by sending a continuous current of ¼ ampere through the two cells at a pressure of 5 volts during a period of four hours. If a primary battery is used to furnish the charging current, three bichromate cells should be employed and the carbon plates connected to the positive terminal of the accumulator. It is advisable to have an ammeter in circuit with the cell while being charged, and also to employ resistance to keep the current down to a ¼ ampere, since injury may be wrought to the plates by a higher rate of charge. This should also be done if the current is obtained from a dynamo.

The following hints may be useful in making and working pocket accumulators: The holes in the grids may be of any shape. When many grids are required, it is advisable to cast them in plaster-of-Paris moulds, as the hand punch method is tedious. In charging the cells, no injury can follow prolonged charing a low low rate, but much damage can be done from a short charging at a high rate. Cells should never be run down entirely, nor put aside uncharged. They should always be fully charged before they are placed in store, and frequently recharged while in store. Jolting and shaking tend to injure the plates, so also does short-circuiting the cells, as by spanning the terminal with a short wire. The E. M. P. of each cell should be 2 volts, and if it falls below this the cells should be recharged.—"Work," London.

HIGH SPEED LAUNCH.

[Continued from Page 230.]

every revolution and add friction. The engine, after being lined up, is fastened down with lag screws. The propeller will probably come fitted to the shaft, so that all that should be necessary is to put propeller in place on shaft and fasten with either nut or pin, as is provided. The propeller, when in its proper place, should should be 10 in. from the point of stern to center of propeller, and the inboard end of the shaft is cut off to bring the propeller in the proper place.

The propeller strut is shaped as in Fig. 13, from a piece of flat brass 1 x ¼ in. It is bent to the shape shown, of sufficient depth to suit the shaft and with a spread of about 6 in. For the bearing a piece of extra thick brass tube which is a running fit for the shaft, can be used. It is fitted into the eye and soldered in place. The strut is then adjusted until the bearing is free on the shaft and the arms have a good bearing on the hull, and it is then fastened in place with two copper rivets in each arm. If the rivets cannot be made to come through a frame, a piece of oak should be put inside to take them.

The gland on the after end of the skeg is fitted in place with plenty of thick paint underneath to make it water tight.

An additional bearing should be arranged about half way between the engine and the stuffing box; it can be made of a piece of extra heavy brass tube, the same as the strut bearing and secured in a wooden block. When all is set up and made tight, the engine should turn over freely and easily, otherwise there will be undue friction and the full power of the engine will not be realized.

The engine selected for use should be of 1½ to 2 h. p., of high speed type, and should not, for best results, weigh over 80 pounds complete with pump.

The installation is made in the usual manner according to the directions which accompany each engine, or can be obtained from the engine makers on request. The gasoline tank should hold about five gallons and be located under the forward deck, supported by straps from the deck above, as in Fig. 5.

The filling pipes for the tank should extend through the deck with a screw cap. The connection from the tank to the engine is ¼ in. pipe size, lead pipe, with a stop cock near the vaporizer.

A fixture of much value is a sediment trap quite near the tank, made by fitting a brass T to the tank and to the lower end of the T fitting a coupling and plug. Any sediment from the tank will collect in the neck having the plug, which can be removed at times when the tank is nearly empty.

The exhaust pipe should pass through the muffler and then directly outboard through the side of the boat. A brass collar is fitted to cover the edges of the canvas around the hole. The suction to the water pump must be below the water line, with a brass strainer over the end to prevent weeds or sand from being sucked into the pump; the discharge from the engine may be above water.

The batteries and spark coil are located in a box under the forward deck, as it is very essential that they should be kept dry; the switch is located on the side of the boat opposite the engine.

The steering gear may be arranged as shown, with an automobile type wheel steerer, or may consist simply of the usual wheel with ropes running around the cockpit with a block at the forward end, two blocks on the deck opposite the tiller, and a few screw eyes between. The cleats and chocks, backboard for the rear seat, and other furnishings are fitted to suit the builder.

In all this work it must be borne in mind that lightness and strength are necessary for success, and everything should be done with this end in view, and as little extra material added as possible.

The final painting and finishing is now to be done; when the final coat is put on the boat should be entirely smooth, with no sign of the grain of the cloth; the final coat may be of enamel paint, giving a glossy appearance. When well constructed the boat will present a very ornamental appearance.

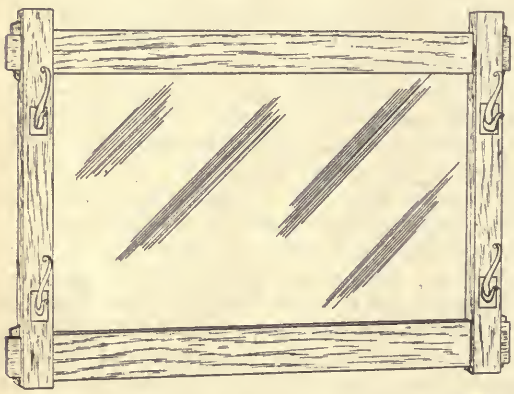
In handling this boat it must be remembered that it is of light construction and must be carefully handled, and when so treated it will be very durable. It should not be left afloat for long periods, and should be kept in a boat house under cover, if possible; this should be readily done on account of its light weight. It will, however, be found to be very satisfactory for the purposes for which it is intended.

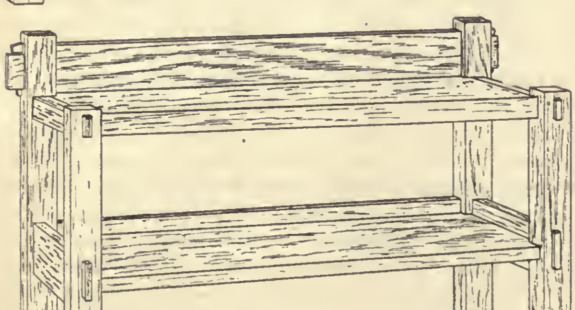
The term circular mills, which is often used for designating the size of large wires and cables is obtained by squaring the diameter in mills, a mill being one-thousandth of an inch. To reduce circular mills to square inches, divide by 1,000,000,000 and multiply by 0.7854.

HALL TABLE AND MIRROR.

JOHN F. ADAMS.

The hall table and mirror here described, are in the "Mission" style, and are given at this time as they are particularly suitable for summer residences. Those readers who are fortunate enough to possess the luxury of a summer place and have the leisure for cabinet work, will have no difficulty in constructing either of these pieces of furniture. They are equally suitable for other than summer houses, and can be kept in mind for winter work by those who find the design suitable for their needs.





The table requires two front posts 31 x 3 x 2 in.; the rear ones are 35 in. long. The cross pieces from front to rear posts are 19 in. long, which allows ½ in. at the rear ends for tenons, and 3 in. at the front ends. The distance between the front and rear posts is 16 in, and between the two front posts 39 in. The upper cross pieces at the ends are 2 in wide, the middle one 4 in. wide, and the lower one 2½ in. wide; all are 1¼ in thick. The space between upper and middle cross pieces is 10 in.; between the middle and lower ones, 8 in. The tenons on the ends are ¾ in. wide; those projecting at the front being bevelled slightly to take off the sharp edges.

The lower pieces connecting the two front and two rear posts are 40½ in. long, 2 in. wide and 1½ in thick, allowing ¾ in. at each end for tenons. The pieces are 2 in. above the floor. The lower shelf is 41 in. long, 17 in. wide and 1¼ in. thick. At the back edge is a piece 40½ in. long, 3 in. wide and 1 in. thick, mortised into the posts, and with the lower ends flush with the under side of the shelf. The corners of the shelf are cut out to fit around the posts and the shelf nailed in place when finally assembled.

The cross piece at the back of the top shelf is 50 in. long, 7 in. wide and 1 in. thick. The tenons on the ends are 3 in. wide and ¾ in. thick. The wedges and mortises for same are ¼ in. thick. Care must be taken in cutting the mortises to prevent breaking the ends, and to get them correctly located. The top shelf is in two thicknesses, using stock ⅝ in. thick. A front finish piece 2 in. wide and ⅞ or 1 in. thick is nailed and glued to the front edge, planing down smooth after the glue is hard.

The mirror frame is for a mirror 24 x 40 in., making the inside dimensions of the frame 23¼ x 39¼ in. The two end pieces are 33 in. long, 3 in. wide, and 1¼ in. thick. The top piece is 50 in. long, 3 in. wide and 1 in. thick. The lower piece is 50 in. long, 4 in. wide and 1 in. thick. The mortises on the ends of the top piece are 2½ in. wide, ¾ in. thick and with ¼ in. mortises for the wedges. The mortises on the lower piece are 3 in. wide, ¾ in thick and with ¼ in. mortises for the wedges.

On the inner edges of sides and cross pieces cut rabbets ⅜ in. deep and ⅜ wide for receiving the mirror and backing for same. Care must be taken in cutting the mortises to have them well made, otherwise the frame will not be firm enough to hold the mirror, which is rather heavy. Four ornamental hooks are hung as shown; two on each side piece. Brass plates are attached to the back for holding to the wall with screws. The wood used for both table and mirror frame should be oak, stained dark as desirod, and given a wax finish.

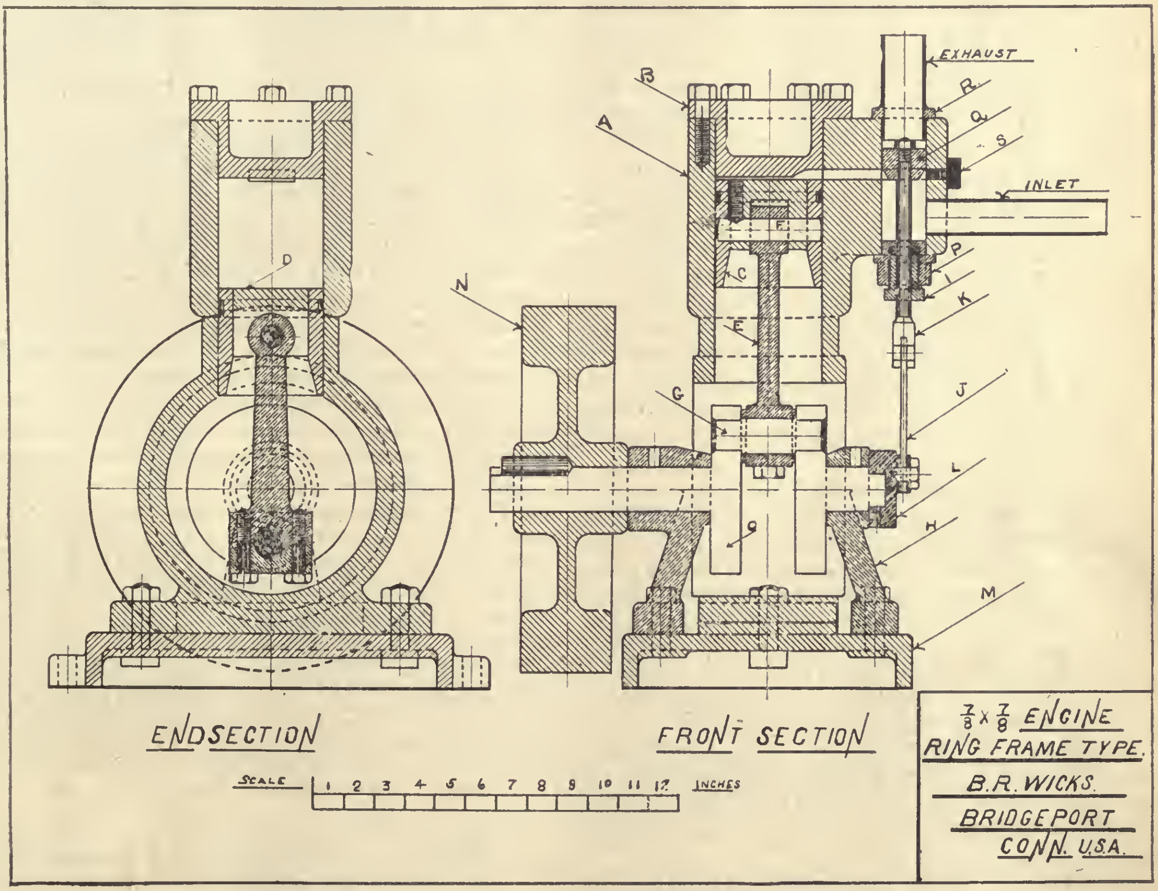
The per capita of money in circulation on May 1 was $31.22 for each inhabitant. That exceeds the record of any previous time. Most of the gain was in gold, $30,000,000 being added by imports, and gold certificates also gained about $11,000,000.

MODEL HIGH SPEED ENGINE.

B. R. WICKS.

The engine here described is especially designed for the benefit of the amateur who wishes to construct a simple working steam engine with his own tools.

This engine comes under a new name in the small engine field. It is called the ring frame, single acting, high speed, center crank steam engine, with piston valve and crank eccentric in place of the usual type of eccentric and eccentric strap. The crank eccentric



and piston valve is used on this engine to avoid friction. Under this system the engine will be able to give from 1000 to 2000 r. p. m., and develop from 1-20 to ⅛ h. p. according to the boiler pressure used.

All the machine work to be done on the castings can be done in the lathe, as there is no planer work on the engine. A lathe that will swing four inches and has a slide rest, will do the job. A few drills, reamers, taps and dies will have to be used, but very few.

The design and construction has been made as simple as possible. The drawings show the front and end sections. The various parts are lettered for clearness in distinguishing the parts to be used in the construction, one from the other. *A* is the cylinder, valve chest and frame cast in one piece.

The machinery operations on the castings are as follows: The bottom is held in the vise and filed off true, then bolted to the lathe face plate, trued up by the outside of the casting and bored and reamed out to ⅞ in. standard. The ⅞ in bore must be a perfectly straight and smooth hole. When in position, face off the top of the cylinder.

The ⅜ hole for the valve chest is now to be drilled and reamed. Lay out the center of the valve chest 1 3-32 in. from the center of the cylinder and drill with a drill slightly under ⅜ in. and finish with a ⅜ in. reamer.

The ⅜ in. bore of the valve chest is tapped with a 7-16–32 V thread tap, 3-16 in. deep for the exhaust pipe bushing, and the bottom faced off with a small fly cutter on a ⅜ in. bar, so that the valve rod stuffing box *P* will set flush when in position.

The cylinder cover *B* is finished all over and can be done in a three jawed chuck to good advantage. A bolt circle must be made with a sharp pointed tool on the side that goes next to the cylinder. Lay out the circle in six equal parts. Notice the location of the cut out for the steam port. Drill the six holes with an N 28 drill.

The steam port is laid out, drilled and filed out to 3-32 in. wide and ⅜ in. long. The steam drill inlet boss is drilled and tapped with a 1-4–32 thread. Also drill two 5-32 holes in the bottom as shown in the drawings, for holding the frame *A* in position on bed *M*. The piston shell *C* is bored out in the chuck, finished up between centers and faced to length, and the groove for the piston ring cut in. The piston must be a good fit in the cylinder, without the least shake.

The first piston plug *D* is held in the chuck and finished all over at one setting, so that it will tap in the piston shell *C*. The slot for the connecting rod is milled out.

The piston ring is made of steel, bored and turned in the chuck, cut off and fitted to the groove in the piston shell, then cut at an angle of 45° with a fine hack saw. Finish out with a file and spring into the groove in the piston shell. But putting the ring in position will be left till the assembling operations. The shell *C* and plug *D* are placed in position, and the 3-16 in. hole for the wrist pin *F* drilled and reamed. The wrist pin and the slot for the connecting rod must be exactly square so that the head of the connecting rod *E* will not bind and cause friction.

The ⅛ set screw holds all three, *C*, *D* and *F* in position. *F* is the wrist pin, made of 3 16 in. Stubs steel, and requires no turning. The connecting rod *E* is one universally used, and the machining operation is so simple that it will not be described. The two crank discs and shaft are made in one piece from steel.

They are turned between centers and finished both the same size. The hole for the crank pin *G* must be exactly the same in both pieces from the center; these should be drilled and reamed together to insure that these holes match. The crank pin *G* is turned between centers; the ends that fit the discs must drive and be left about 1-32 in. long, to allow for rivetting. The right hand shaft is turned smaller for the crank eccentric *L* to fit on the end.

The bottom of the two main bearings *H* are faced off between centers, mounted on a small angle plate and bored out, reamed to ⅜ in. and faced to width on a ⅜ in. mandrel. Drill two holes in the bottom of each of the main bearings to hold them in position on the bed *M*. The bed *M* is strapped to the face plates and the top faced off. The fly wheel *N* is bored out and reamed to ⅜ in. diameter and finished on a ⅜ in. mandrel between centers.

The crank eccentric *L* is to be made from steel. It is chucked and bored out to fit snugly on the ¼ in. diameter end of the crank shaft, with a small square pointed tool. A piece of 5-16 in. steel rod is held in the chuck and turned to fit the ¼ in. hole as a mandrel, and turned on all the surfaces and polished at one setting. Lay out the stroke of the eccentric ⅛ in. from the center and drill with a 6-64 in. tap drill and tap out with a 9 64–32 thread. The eccentric is held in position on the shaft with a 1-16 in. jib screw.

The valve rod *K* is made from 3-16 x ¼ in. cold rolled steel, turned between centers, threaded on the top end for a 7-64 in. nut to hold the valve *Q* in position. The bottom end is slotted to receive the eccentric rod *J*. A ⅛ in. hole is drilled for a ⅛ in. bolt to hold the two together.

The valve rod *I* is drilled and reamed to ⅛ in. diameter, and threaded with ¼–32 thread, to screw in the valve rod stuffing box *P*. *P* is the valve rod stuffing box. All the machinery operation is done at one setting in the chuck. and it is to be sweated into the ⅜ in. bore of the valve chest.

The valve *Q* is drilled, reamed and finished in the chuck. It should be ground with ground glass and oil to make a steam-tight sliding fit. *P* is the exhaust bushing. This must be turned on a mandrel, tapped the size for a 5-16–32 thread, turned and a 7-16–32 thread cut on one end 3 16 in. long, to fit the top of the valve chest.

The mandrel can now be forced out and the bushing be screwed in position in the valve chest, and the hole formerly occupied by the mandrel tapped out 5-16–32, V thread for the exhaust pipe. The eccentric rod *J* is filed out of 1-16 in. sheet steel, drilled and reamed on the eccentric end to 5-32 in. and the valve-rod end ⅛ in.

Two brass washers are required 5-16 in. diameter and 1-32 in. thick, one between the eccentric rod and crank eccentric, and one on the outside. The peep hole cover is made by pouring babbitt surrounded by fire clay and fastened to the outside with two 1-16 in. screws not shown in the drawing.

In assembling the various parts, see that there are no burrs in the cylinder or valve chest, or any working part. As all the parts have a letter given on the drawings, the builder will have no trouble in locating the parts as they are to be assembled.

An advantage as a steam raising fuel possessed by oil as compared with coal is the remarkably steady steam pressure which may be obtained by means of the liquid fuel. This is due to the fact that the oil fires do not require the periodical, and automatic logs of steam pressures on ships using oil as fuel can easily be made to show as little as two pounds maximum variation of pressure for a run of 27 hours or more. This of course, conduce to economy in the operation of the boiler, which is under conditions that are kept constant, insteadof having the 30 per cent drop in pressure which is sometimes noted on an overloaded boiler when it is found necessary to clean the fires.

BOOKS RECEIVED.

20th Century Machine Shop Practice. L. Elliott Brooks. 631 pp. 7¾ x 5¼ in. 423 illustrations. Price $2.50. Frederick J. Drake & Co., Chicago, Ill.

The author, in compiling this book, certainly desired to make it a complete handbook for the beginner in shop work, as the first quarter of the book is taken up by chapters devoted to arithmetic, geometry, mensuration, applied mechanics, properties of steam and horse power. Had much of this matter been omitted, and the space been given to a more amplified treatment of the main subject, a more useful book would have resulted. For the above reason the remaining chapters are barely more than descriptions of tools, with but little attention to their application to common shop processes.

This is illustrated by the subject "Taps," to which less than eleven lines are given, which can hardly be termed an adequate treatment. On the other hand, owing to the condensed treatment, nearly every hand and machine tool in general use is mentioned, and most of them illustrated. Anyone desiring a handbook of present day tools would find the book useful.

The Signist's Book of Modern Alphabets. F. Delamotte. 101 plates 9 x 6 in. Price $1.50. Frederick J. Drake & Co., Chicago, Ill.

The styles of letters shown are of far more value to the artist or engraver than to the sign painter or draftsman, very few being adapted for use by the latter classes. As over a hundred different styles of letters are given, there is ample variety to select from by those who have need of ornamental designs.

Pictorial Composition. Prof. A. G. Marshall. 61 pp. 10 x 6½ in. 180 illustrations. Price $1.00. Photo-American Publishing Co., Stamford, Conn.

If copies of this book could be placed in the hands of every photographer, artist and critic in the country, a wonderful amount of good would follow. It requires but a casual inspection to show the thoroughness with which this subject, so vital to good photographic work, has been treated. A great deal of space could be taken in mentioning the many excellent parts of the book, but all could be summed up in the statement that it is invaluable to all who desire to know the principles of composition. The low price places it within the reach of all.

CORRESPONDENCE.

No. 148. Marbass, N. D., April 29, 1906.

Will you please tell me what size of wire to use and the amount in the primary and secondary windings for an induction coil to give a one-half inch spark? Would a condenser be necessary? If so, how is one made? Where can the tinfoil for Leyden jars be obtained? E. D. C.

Specifications for many sizes of coils, including one half-inch spark, are given in the Oct., 1905, number of this magazine. For secondary windings, No. 36 B. & S. gauge single cotton covered wire may be used if extra care is taken in applying insulating wax. A condenser is necessary. Directions for making are given in June. 1906, number. See our premium offer for tin foil.

No. 149. San Diego, Cal., April. 29, 1906.

Will you please answer the following questions through the correspondence columns: Could the amateur runabout described in the March, 1905, number Amateur Work, be made by a boy 12 years of age, if the iron work was bought ready made and finished? Where could these parts be obtained? Is there any place where I can obtain the parts of runabouts ready to put together? H. S.

Age has less to do with making a runabout, or any other equally complicated machine, than has mechanical skill and experience. Our experience in this matter, and considerable time has been spent in investigating the subject, leads us to the conclusion that it is much more satisfactory to watch the advertising columns of the Sunday papers published in the larger cities, and buy a second-hand car, when a good trade offers, rather than attempt to make one. The agencies of standard makes of machines frequently have to take small cars, and such second-hand cars are sold at low prices. The difficulty, even in the largest cities, of obtaining certain parts, makes the expense of constructing a car great enough to nearly offset the saving in making one. Damaged cars can frequently be bought at very low prices, and a good mechanic can make the repairs necessary at a small expense. As conditions now are, the making of a car cannot be recommended.

No. 150. Buffalo, N. Y.. April 29, 1906.

I have a dynamo that gives 35–40 volts and 3 amperes. The armature is wound with No. 20 single covered magnet wire. I wish to increase the amperes and lower the voltage about 10 volts, but without changing the wiring on the armature, if I can. How many storage batteries can I charge with a current at 20 volts. J. P

It will be necessary to rewind the armature to obtain an equivalent output to that at present, at the same speed. Use No. 18 gauge wire, and at a slight increase in speed you will get about 25 volts and 5 amperes. You can charge 8 cells of a storage battery with a current at 20 volts.

No. 151. Newton, Ill., May 18, 1606.

I have a 1-12 h. p. motor on my peanut roaster, and the current for running the motor is supplied by a battery of 12 dry cells. Will a spark coil strengthen the battery, or what will give me a greater current? Please tell me the use of a condenser. G. W. H.

A spark coil transforms the current from a low voltage and large amperage to high voltage and low amperage, with slight losses in the operation. Introducing a spark coil into the battery circuit would be a positive detriment, as the current from the coil would not be suitable for running the motor, You need a different type of battery; one giving a large, steady current on closed circuit, as the motor is probably in use so much of the time that the dry batteries polarize more or less, and consequently do not properly run the motor.

If the expense and weight are not objectionable, accumulators would be the most suitable, and they could be recharged at the lighting station at such times in the day as they are not in use. If facilities for recharging are not convenient, get Edison-Leland, or some similar type of battery, or make a bichromate battery, as described in the June, 1904, number of this magazine. The objection to the latter form of battery is that the zincs must is be removed when the battery is not in use, as action continues whether a current is being taken off or not, so long as the zincs remain in the solution. The function of condensers is fully described in the May, 1906, number.

No. 152. BUFFALO, N. Y., MAY 14, 1906.

Will you kindly answer the following questions regarding the "Telegraph Recorder" described in the Sept., 1904, copy of AMATEUR WORK; Would the works of an ordinary alarm clock be strong enough to move the tape? Where can I purchase a small pen of the kind used on paper ruling machines? Will you kindly give directions for making the trip to be used on the clock gear? Kindly mention the name of some firm from whom I may purchase a length of Wollaston wire as used in electrolytic receivers. W. H. C.

The works of an ordinary alarm clock, if in good condition and not of too small a size, will move the tape without trouble. The ruling pen can be purchased of any ruling firm in your city. Ask any stationer where ruling is done, and apply at the address given. An article describing a trip for the clock will be published as soon as prepared. We know of no firm where Wollaston wire can be purchased at retail. As an accommodation we will send you three feet of .002 gauge wire from our own supply for 25 cents.

No. 153. PROVIDENCE, R. I., MAY 14, 1906.

Will you please inform me of a quick drying varnish which can be used to protect steel during the process of etching names. H. D-

Asphaltum varnish is the kind generally used for the purpose named. Paraffine wax can also be used, the latter being more easily worked when marking out the letters.

SCIENCE AND INDUSTRY.

Up to 1840 there were no iron bridges in the United States except suspension bridges, in which iron links were used in the cables and suspenders, the floor system being of wood. The first bridge in America consisting of iron throughout was built in 1840 by Earl Trumbull over the Erie Canal, in the village of Frankfort, N. Y.

The drill frequently penetrates hundreds of feet of solid salt in drilling wells for petroleum. The salt is often as clear as glass, as hard as rock and is frequently intensified with shale, as is freqnently the case with coal. In the region where there is a stratum of salt above the petroleum there is often salt water in the petroleum stratum. Especially is this the case where the material between the surface and the oil stratum is mainly limestone. The latter material, being very unyielding, its cleavage allows an easy access of water, often to a great depth; while clayey shales, being more plastic, often exclude all water from penetrating more than a hundred feet or so from the surface.

Francis J. McCarty, a 17-year-old San Francisco youth, believes that he has discovered the secret of transmitting the sounds of the human voice through the air without the aid of wires. It is said that experments made on the ocean beach with apparatus went far to prove that the problem of wireless telephony is solvable, if not actually solved already.

That the phonograph is a popular means of entertainment is obvious to everybody's ear, but few will fail to be surprised at the fact that the output of Edison records last year was fourteen millions. The company is now forty thousand machines behind its orders.

Many, many years ago, salt was so hard to obtain, but so necessary to have, that Roman soldiers were paid part of their wages in salt. Now, the Latin word for salt is sal, and from that came the word salarium, meaning salt money. Finally the soldiers were paid only in money, but the term salarium was still used to designate these wages. From this old Latin word comes our English word salary. Do you see, then, why we say of a worthless fellow that he "is not worth his salt?"

In answering the question, "How soon will electricity replace steam as the motive power of steam railroads?" it must be remembered, says the "Railway Critic," that electricity only shows an economy over steam locomotives under certain special conditions, among which are those that the distance should be comparatively short and the traffic dense. During the next few years we are likely to see the adoption of electricity as a motive power in the railroad terminals of the great cities, and, perhaps, between some of the great cities, such as between New York and Philadelphia, but the bulk of the long-distance hauling and and the freight traffic is likely to be done by steam locomotives for some time to come.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

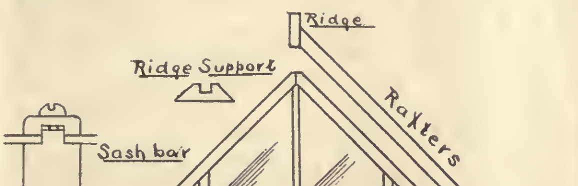
Vol. V. No. 10. BOSTON, AUGUST, 1906. One Dollar a Year.

A PORTABLE CONSERVATORY.

GEORGE S. KINGMAN.

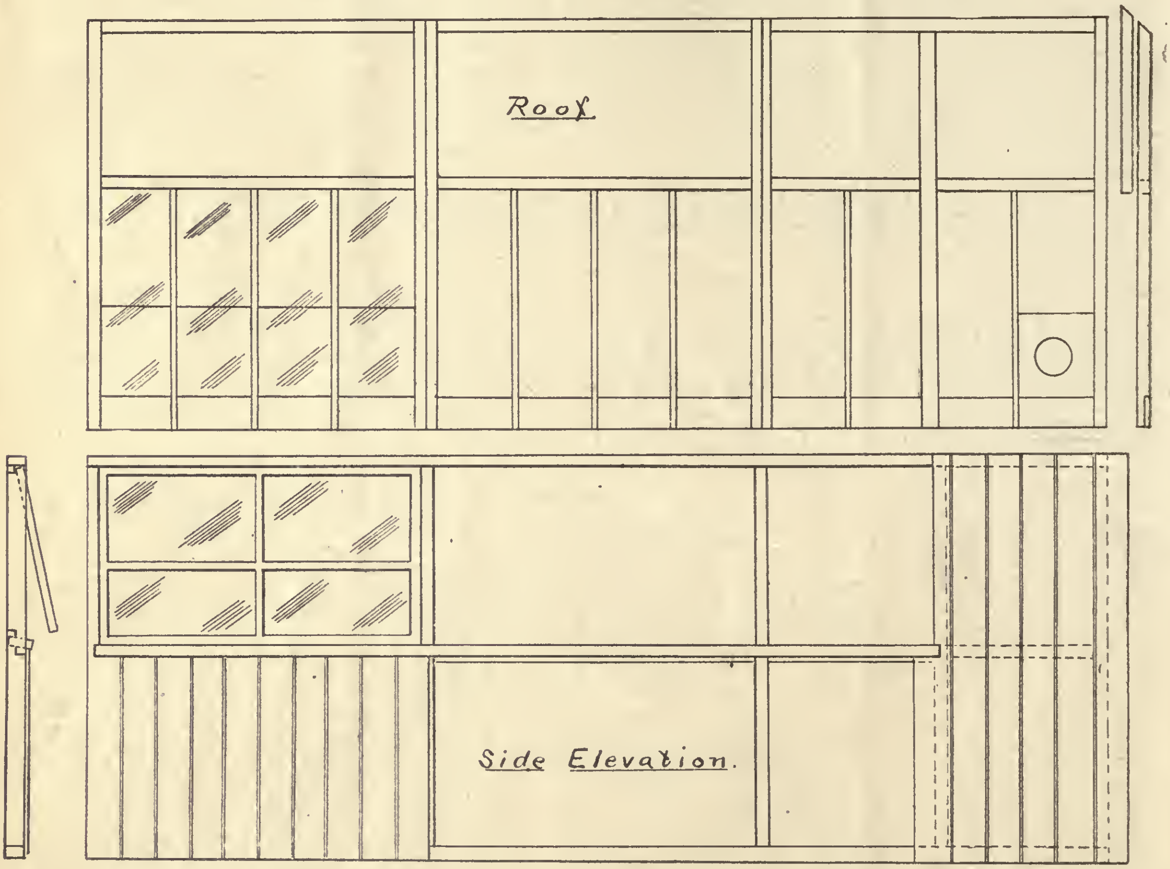
Lovers of flowers who desire to indulge in their pastime of gardening during the winter months, and are deterred from doing so because of living in a rented house and so object to erecting a permanent building, will find the portable conservatory here described both useful and satisfactory. It can be cheaply constructed and the cost of maintainance will be very little; in fact, it can be made a source of considerable revenue by any one desirous of raising flowers for local sale.

Should the portable feature not be required, a permanent structure can easily be adapted from the drawings, the changes being slight, consisting principally in leaving out the extra timbers required when made in sections.



Before beginning construction it will first be necessary to decide upon the location, and the end in which is to be located the heater, unless the heating is to be done by pipes taken off the heater used for the dwelling house. Ordinarily a conservatory of even span is located with the length running north and south with the heater in the north end, but it may so happen that while this direction is retained the heater may have to be placed at the south end. In such a case the sheathed end is placed at the south and the door at the north end.

cost about $75 without heater or piping. A small hot-water heater, expansion tank, and piping will cost $30, or if second-hand pipe can be obtained from a building being torn down, this item will be reduced slightly. All the lumber is planed all over except the first item, which is for the foundation.



If the occasion requires the houses to be run east and west, a design having a three quarter span roof to the south, and one-quarter to the north would be preferable, and the heater would be located in a northerly corner. The bill of materials required for the design given, 45 ft. long and 8 ft. wide, is as follows:

48 ft. 4 x 6 in. spruce, rough stock.
48 ft. 2 x 3 in. spruce, planed.
15 ft. 2 x 6 in. " "
300 ft. 2 x 3 in. " "
400 ft. ⅞ in. cypress sheathing.
120 ft. 1½ in. cypress sash bar with deep gutter.
120 ft. cypress sash bar for ends.
70 pieces, single glass 13½ x 21 in.
8 " " " 15 x 34 in.
4 window sash, with 4 lights 13½ x 26 in.
1 door 50 x 66 in., upper panels glass.

Also, a roll of thick sheathing paper, having no tar, lead paint, nails, hinges, etc., which altogether will

In beginning construction, the first thing is to cut out two pieces of 4 x 6 in. timber 15 ft. 6 in. long, and two pieces 8 ft. long. The shorter pieces have tenons cut on the ends to joint into the longer pieces. When this is done, dig a shallow, level trench in the ground, in which to lay the timbers.

The sides may next be made from two pieces 15 ft. long and five pieces 5 ft. long, or 2 x 3 in. timber. As this stock is planed it will actually measure only 1⅞ x 2⅞ in. In the shorter pieces cut tenons to joint into the long pieces. The spacing between the first, second and third timbers is 4 ft. 9 in.; between the third, fourth and back pieces 2 ft. 5 in. Between the front and fourth timbers and 2 ft. 10 in. above the bottom piece, put a piece 12 ft. 5 in. of 2 x 4 in., halving the joints with the second and third timbers. This piece is given a slight slant outward, to shed rain water, as it forms the sill of the side windows. The ends are carried by the uprights, as with any window sill, and the outside edge projects 1¼ in.

On the under side of this piece and flush with the edges of the uprights, nail a piece of 1½ x 2 in. stock, the upper edge being cut at an angle to fit under the sill and have the front edge vertical. This stock can be cut from 2 x 3 in. stock with a rip saw. Cover the frame under the sill and at the sheathed end with sheathing paper, and then put on the sheathing. Begin at the sheathed end and have the first piece lap over 3¾ in., so that the joint with the end section will be tight. At the front end a similar lap should be given for the front end. The piece covering the fourth upright should be cut to fit flush with the front edge of the upright.

The front is next to be made. The bottom piece is 7 ft. 11 in. long; the two corner pieces 6 ft. long; the two roof pieces 4 ft. 8 in. long of 2 x 3 in. stock. The two pieces on either side of the door are 8 ft. 4 in. long, 2x4 in. stock, set outward 1 in. The piece above the door is 30 in. long. All joints are mortised. Between the door and ends are placed pieces of sash bar, and also above the door, after putting in cross pieces of 2 x 4, set at an angle as on the sides. The sheathing paper and sheathing is put on as before mentioned.

The rear end, being sheathed all over, is framed up about as for the front, with the exception that in place of the door, a cross piece of 2 x 3 in. stock is put across level with the tops of the end pieces, and another piece 3 ft. above the bottom piece. A sheathed partition at the heater end is framed the same as the front.

The frames for the roof are next in order; five of them being alike and one having a galvanized iron opening for the heater pipe, as shown in the illustration of the roof. This frame, as well as the corresponding one on the other side of the roof, has wide center division pieces, which cover the top of the sheathed partition. These frames are made up of end and ordinary sash bars, excepting the lower sides, which are of ⅞ in. board, 4 in. wide, halved on the under side of the sash bar. The upper face of the board is made even with the rabbets in the sash bars, which allows the glass to rest flat upon the board.

The glazing is all to be done with butt joints whereever any occur, as will be described later. The upper part of the roof frames are to be fitted with ventilators made the same way as the roof frames and hinged to the ridge. The dimensions of the roof frames are 6 x 4 ft. 10 in., outside dimensions, and the ventilator frames, 4 ft. 10 in. by 2 ft. 7 in., which allows for bevels on the upper sides to fit the ridge. The sash bars are spaced to receive glass 13¼ x 21 in. in the roof frames, and 13¼ x 26 in. in the ventilators.

These parts being completed, they may be erected and fastened together as follows: The sides and ends are fastened to the foundation timbers with 3 x ½ in. lag screws, boring holes for same and putting washers under the heads of the lag screws. The corners are fastened with three 2 in. angle irons; one each at the top and bottom and one at the center. Where the side sheathing laps, the ends fasten with 2 in. galvanized wood screws countersinking the heads. It should have been mentioned that a pot of white lead paint should be at hand during all the work, and every mortise and joint liberally coated with paint when finally assembling the parts.

The ridge pole is next to be fitted; it is 15 ft. 10 in. long of 2 x 6 in. stock, and rests in saddle pieces nailed to the inner peak of the ends. The shape is shown in the end view, and the ridge is cut out 2 in. on the lower corners to pass over the peak of the ends.

Mortises are cut in the ridge and top pieces of the sides for two rafters on each side, 5 ft. 10 in. long and 2 x 3 in. stock. They are fastened in place with two 2½ in. screws at each end. It will also be advisable to put two 2 x 3 in. stringers across from the sides to hold the latter firmly in place during the erecting of the building. The roof frames are fastened to the ends, rafters, sides, etc., with angle irons and screws. The joints between the roof frames are covered with ⅞ in. battens 2½ in. wide, fastened with screws, and wider pieces over the joints at the ends. It will be necessary to fit pieces on the ends to bring the height equal to the frames before fitting the end battens, which should all be coated with lead paint when put on.

The door case is made with strips of ⅞ in. stock, 1½ in. wide, nailed to the timbers and set in ½ in. Similar strips ⅞ x 1 in. are nailed around the timbers on the sides where the side windows are located, the strips being inside the windows, which swing outward. The lower pieces must be beveled to the slant of the sill.

The plant stands are made separate from the building, being ordinary table frame construction, with front strips rising 9 in. above the level of the tops, which are 30 in. high. The center aisle should be 30 in. wide. No directions are given for fitting the hot-water heater, as, unless one is quite familiar with such work, it would best be done by a plumber. Good circulation is very important, and not to be obtained unless the piping is properly done.

The glazing is done last to avoid breakage. The "single" thick glass is specified in the bill of materials, but in localities where heavy hail storms are frequent, "double" thick will be advisable to avoid expensive breakage. When setting the glass, have at hand a smooth board upon which is a layer of white paint and putty, half and half, thinned with linseed oil to the consistency of thin paste. Press the edges of the glass into the mixture previous to setting. With nippers break off the lower corners of the glass to allow of ½ wire brads being driven into the sash, which will prevent the downward movement of the glass. Use diamond point glazier's brads, and coat the sash liberally with the paint-putty mixture before laying the glass using a flexible putty knife. Before and after glazing paint all the wood work with lead paint. The final coat may be tinted a light gray, if desired, and wears better than pure white.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

III. Four Cycle Engines.

Fig. 13 represents a section of a four-cycle engine of a common type. The working parts are very similar to those of the two-cycle type, but are further complicated by the addition of the valves and the means for controlling them. The piston, connecting rod and crank shaft remain as in the other type. The valves are controlled from the two lateral shafts *A* and *B*, which are run from the main shaft through the gears *c d e*. Since each valve only opens once for each two revolutions of the engine, the lateral shafts or cam shafts, as they are termed, must revolve only half as fast as the main shaft. For this reason the gear *d*, on the main shaft is only half as large as those on the two cam shafts. These cam shafts run in bearings in the base, and carry small cams or tappets, which strike the lower ends of the stems at the proper time and thus raise the valve from the seat. *F* is the admission chamber opening into the cylinder above the valve *f*. *G* is the exhaust chamber containing the exhaust valve *g*.

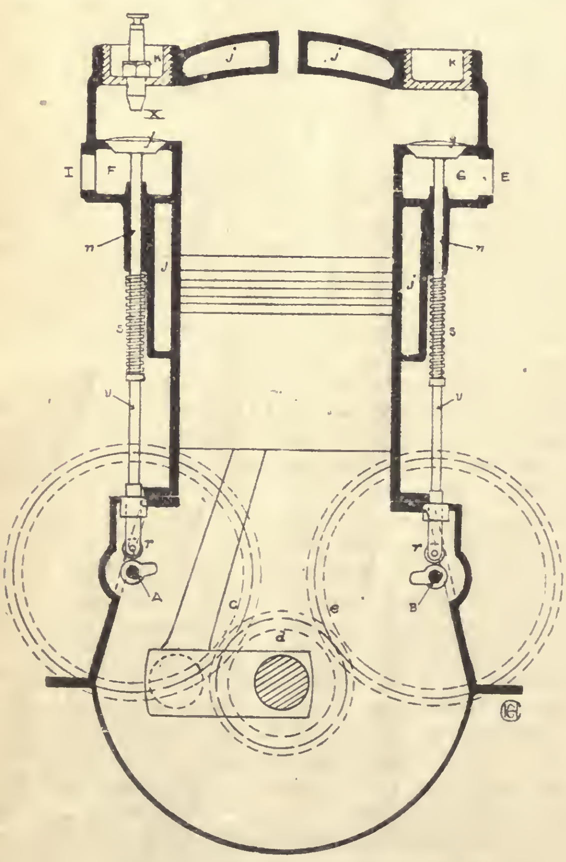


Fig. 13.

The valves have stems extending down through the casing in bearings to a point where they can be raised by the cam. The lower part of each stem is made square as shown, to form a guide, and the lower end is provided with a roller *r*, to reduce the friction. The square portion may be made a separate piece, with the valve stem just resting upon it; this facilitates the removal of the valves and stems, as the square guiding part will remain in place. At *ss* are coiled springs on the valve spindles to return the valves after being raised by the cams. At *k k* directly above the valves are plugs, either bolted or threaded in place, which, when removed, allow the examination or removal of the valves.

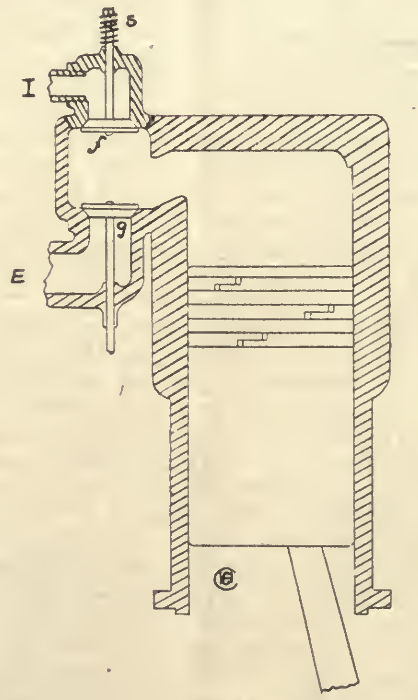


Fig. 14.

The cylinder and head is surrounded by the usual water jacket, *j*, which also, as far as possible, surrounds the valve chests. In the particular style shown the head is cast with the cylinder, but it may equally well have the bolted head. The base in this type is made more ample and easier of access, as size is of little moment, and it is not necessary that it should be air tight. The sides of the base are covered with plates to keep out dirt and prevent the splashing of oil. *I* is the admission port where the vaporizing device is attached, and *E* is the exhaust opening for the connection of the exhaust piping.

The sparking device is located at *X* and the engine is also provided with the usual compression cock, lubricator drain cocks, etc., as before described.

The devices for timing the electric igniting spark and driving the pump are also controlled from the cam shaft.

The long sleeve tube bearing around the valve stem at *n* is provided to form a guide for the stem, and also prevent the escape of the gas from the chamber out along the rod.

The sides of the base are enclosed by plates which may be easily removed for examination, exposing the entire base. These plates are swelled out around the cams and rollers.

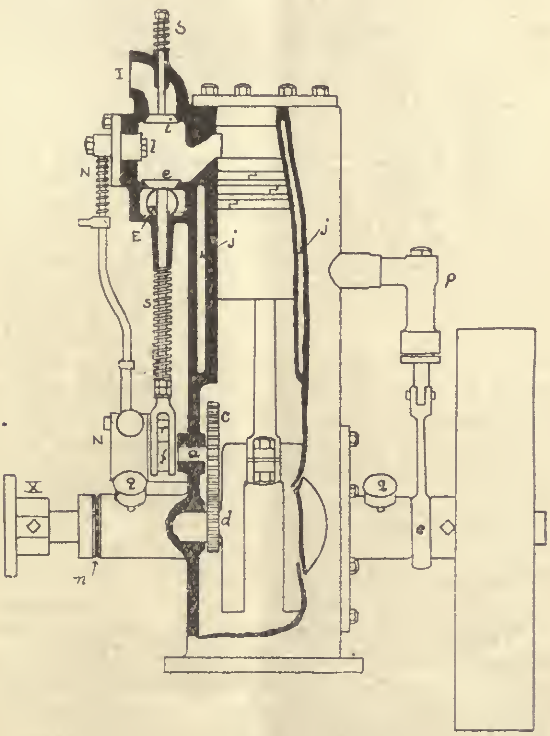


FIG. 11.

The gears *c*, *d*, *e*, are usually placed on the front of the engine with the gear *d* on the main shaft just behind the flywheel and the others just outside the main casing; they are then provided with a separate casing.

Referring back to Fig. 4 it will be plain that the suction of the piston on its down stroke will have a tendency to raise the inlet valve and allow the admission of gas. It is thus evident that is not entirely necessary that the inlet valve should be mechanically controlled, but may be left to be operated by the suction of the piston. The exhaust valve, however, as will be seen by referring to Fig. 7, must be raised against the pressure in the cylinder, so that it must be mechanically operated. Fig. 14 shows the relative location of the valves when this arrangement is adopted.

I is the inlet opening, *f* is the inlet valve, inverted in this case and held in place by the coiled spring *s*, although, of course the pressure in the cylinder will tend to hold it and press it closer against its seat; *g* is the exhaust valve, as before. This arrangement may be either on the side or the ends of the engines. This arrangement is, of course, simpler, as it dispenses with one cam shaft, and the accompanying gear. The question as to whether both valves should be mechanically operated, is much disputed at present, the representative builders being divided upon it in practice. It may be said, however, that while for slow or medium turning engines the suction inlet valve works well, for high speed engines the mechanically controlled inlet valve is preferred, as it acts quicker and more regularly.

Fig. 15 shows a very common arrangement for single cylinder engines; the valves are on the back of the engines. The exhaust valve is operated by the short cam shaft *a*, which is driven by the gears, *c d*, the gear at *d* being, of course, half the size of *c*. The inlet valve is operated by suction. To get at the valves the portion of the casting containing the inlet valve is removable, thus making both valves accessible.

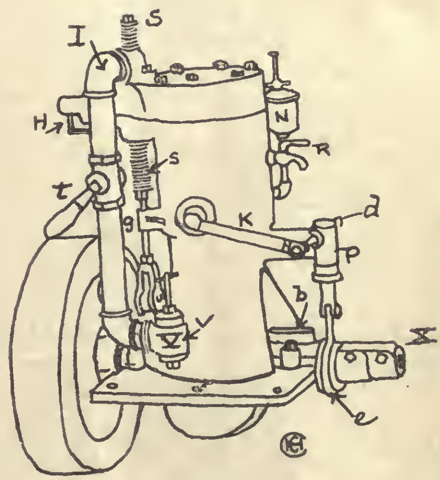


FIG. 16.

The flywheel, crankshaft and connecting-rod are of the same type as those already discussed, with the exception that the cranks are extended across the shaft and are broadened out to form counterbalances, to partially balance the weight of the crank pin and connecting rod, thus somewhat lessening the vibration.

The cam shaft is at *a* and is driven by the two gears, c and *d*. The exhaust valve *G* is actuated by the roller *r* and cam *f* on the cam shaft *a*. The inlet valve *F* is held up in place by the spring *S*. The inlet port leads in above the inlet valve; *E* is the exhaust outlet. The igniter gear *N* is also actuated by the cam shaft. At *P* is the cooling water pump, run from the eccentric *e*. The ball thrust bearing is at *n*. The coupling *X*, in this case is of the flanged type, the propeller shaft being furnished with a similar coupling, the two being held together by bolts through the flanges, each part of the coupling being fastened to its shaft by set screws or keys.

It will be noted that the cylinder, valve chest and base are a single casting, the head being bolted on, and the main bearings being contained in separate flanged castings bolted on to the sides of the base. The flange for bolting the engine to the bed, in this particular engine, is at the extreme bottom of the base, instead of about at the line of the shaft. The cylinder and valve chest are surrounded with the usual water jacket *j*. A grease cup *gg* is for lubricating the main bearings. The cylinder is provided with the usual compression cock and oil cup, which are not shown.

The gears c, *d* being inside the base, are well lubricated by the splashing of the oil by the cranks, and are less noisy than when outside the casing. The sides of the base are provided with round hand hole plates, a portion of which is shown.

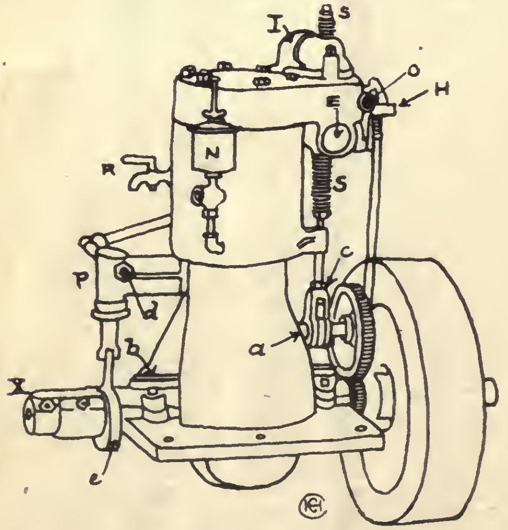


FIG. 17.

Two views of a representative small motor are given in Figs. 16 and 17. The cam shaft is located at *a* and is driven by the gears which are shown just in the rear of the flywheel. At *c* is the cam and roller which actuates the exhaust valve. The cam consists of a collar with a flat projection or toe upon its surface; the roller rests just above the surface of the collar, and is forced upwards by being struck by the projection. The roller is inserted to lessen the friction by rolling instead of rubbing. The valve stem extends upward into the valve chamber, and is encircled by the coiled spring *e*; the stem is guided by the guide at *g*. The exhaust is at *E*; *I* is the pipe leading from the vaporizer *V* to the inlet port in the valve chest. The inlet valve is directly below the spring *S* and is inverted, being held in place by the spring. The dome shaped cap containing the inlet valve is removable for access to both valves. The complete cover is also removable.

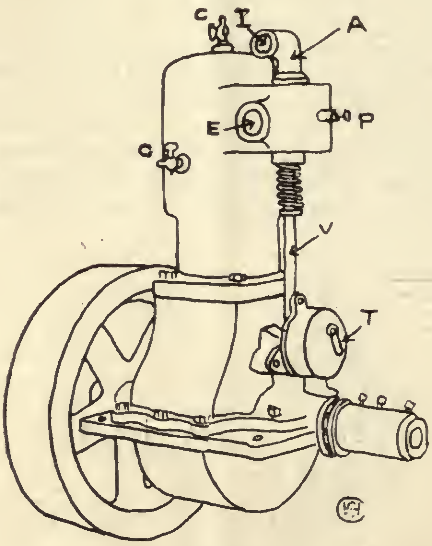


FIG. 18.

It will be observed that this engine has an open frame very similar to that of a steam engine, giving free access to the crank-pin and main bearings; the latter are shown fitted with oil boxes *b* instead of the grease cups, as there is no pressure tending to force the oil out along the shaft as in the two-cycle type. This open base not only makes the bearings, more accessible, but also renders it easier to lubricate them and keep them cool. At *H* is the ignition gear *P* is the cooling water-pump, run by the eccentric *e* The suction is piped to *d* and the pump discharges through the pipe *k* into the cylinder. The outlet for the cooling water is at *O*; *N* is the cylinder oil cup for oiling the bore of the cylinder. The compression cock *R* is for relieving the compression at starting. The coupling at *X* is for attaching the propeller shaft.

In this engine the cylinder, base and bolting flange are one casting, the upper half of the main bearings being removable for the insertion of the shaft. The cover is bolted on separately.

An engine of the light high-speed type, is shown in Fig. 18. The cylinder and valve chest are a single casting bolting on to the upper part of the base.

CONTINUED ON PAGE 276.

DEVELOPING NEGATIVES—FOR BEGINNERS.

Before starting development I arrange the following articles upon my table:

At the left-hand of the bench, as far removed as possible, is the dish containing the hypo. Laying beside it is a plate lifter, which is, of course, reserved for hypo only. In the center of the bench, right opposite the lamp, is the developing dish and graduated measure. Slightly to one side is a large box lid, which stands on end. Its use will be explained later. Close to it are my solutions, labelled "No. 1" and "No. 2." The "No. 1" bottle is nearer to hand than the "No. 2" one, because it is often necessary hurriedly to add some of the No. 1 to the developer, if the negative image is coming up too quickly; whereas there is always plenty of time to judge if it is coming up too slowly, and needs No. 2. Therefore I put No. 1 closer than No. 2. But whichever you do, always put them in exactly the same relative positions, so that the hand can find them instantly even if the light be poor. And as soon as you have poured some solution out of them, always return them to their proper place.

THE CAMEL'S HAIR BRUSH.

To the right of the bench stands a cup half filled with clean water. In it are a flat, broad camel's hair brush, and my second plate lifter. This plate lifter is reserved exclusively for developer. Whenever it has been dipped in the developer it is at once put back into the cup of water, where it soaks. The developer would dry on to it were it merely laid down on the bench. With the hypo plate lifter this does not matter so much, but the developer lifter should always be kept as clean as possible.

RUNNING WATER.

When all is ready, developer made up, etc., I turn on the faucet of my sink. It is kept running the whole time of development, but of course with only a slight stream of water. Then I rub a little toilet lanoline on my fingers, especially round the nails. This prevents them from staining, and keeps the skin from becoming chapped through being immersed frequently in cold water. In winter its use is especially recommended.

The red light is now turned on. The dark slide is opened and the plate lifted out, care being taken not to touch the film. Throughout all the operations the film of the plate should never be touched, as the lanoline might come off on it and make an oily patch partially impervious to chemical action.

DUST.

I do not dust the film before placing it in the dish, but gently puff upon it to blow off possible dust and specks. The plate is then put (dry) into the dish, which is held in the left hand. The measure-glass is held in the right hand, and the developer flooded on with one sweep, though not with such a strong rush as to spill any over the edge of the dish. As a matter of fact, a drop or two are almost sure to be spilled at some point of the proceedings, and for this reason the bench should be kept clear of all articles other than those in use. For instance, the dark slide should be put on a shelf or in one's pocket as soon as the plate has been taken out of it. It should never be put down on the bench lest it be wet.

The instant the developer has covered the plate, the dish and measure glass are put down on the bench again. I take the flat camel-hair brush from the cup, and, having flicked the water out of it, I pass the brush gently but firmly in parallel, overlapping strokes across the film of the plate. The object of this is to detach any air-bells which may have been formed on the film. The film is swept first lengthwise and then crosswise with the brush, which is then returned to place in the cup, where it soaks until required once more. Air-bells on the film are often so tiny as to be practically invisible; but the brush is a certain remover of them all. In any case, air-bells should never be detached with the finger, as some workers do. Always use the brush, and always keep it standing in a half-cupful of water while not in use.

AIR-BELLS.

If in doubt as to whether all the air-bells have been detached, pour the developer back into the measure for a moment or two, and inspect the surface of the film by holding it at a slight angle to the source of light. Any large air-bells will at once be visible. If any are noticed, the developer should be flooded on again, and the film brushed once more, though as a matter of fact, the mere flooding on of the solution will probably burst the air-bell.

The dish is now rocked gently to and fro. As little developer as possible should be used. Pour off all superfluous developer, leaving only just enough to cover the plate with a thin film of solution. Plenty of air should get at the film during development, though, needless to say, no part of the film should be left uncovered long enough to cause it to dry at all. If it is desired to increase the contrast in the negative, a good plan is to keep pouring the developer constantly in and out of the dish.

THE DEVELOPER.

It is hardly necessary to go into the question of over and under exposure. Obviously, if the image appear too rapidly, pour off the developer into the measure-glass and add some restrainer to it as quickly as possible. If it comes up too slowly, add accelerator. I use pyro-soda developer, and in the case of under-exposed snap-shots I usually put a little dry metol into my solution, with a little extra dose of the "No. 2" (accelerator). But it is always necessary to see that the dry metol is thoroughly dissolved before pouring it on to the plate. Sometimes it cakes into tiny undissolved blobs in the measure-glass; but if thoroughly shaken for a moment or two, these disappear.

I recommend beginners to develop their plates one at a time, finishing each one before another is begun. Personally, I always have too many to develop to be able to afford the time to do them thus, so I develop two at once. As soon as one of them is fairly started, and I see that it is not coming up too quickly, I place a second one in a dish, pour developer on it and brush off air-bells as in the first case. But previous to doing so, I place the dish containing my first plate a little to one side, so that it is in the shadow of the box lid which I mentioned at the beginning of these notes. This box lid stands upright on the bench, and casts a broad shadow. In no case should the dish be allowed to bask in the rays of a red lamp, however safe these may be supposed to be. After the solution has become a little discolored, the danger of fogging the plates is less; but even so, it is inadvisable, and really quite unnecessary, to leave it right in front of the lamp. As soon as plate number two has started off I take a look at number one. Then back to number two again; and so on, until one or both are finished.

WHEN TO STOP DEVELOPMENT.

A good way to judge whether a negative is sufficiently developed is to look at the back of the plate. All the outlines of the main objects should be distinctly visible through the glass on the back of the film.

When this is the case the plate is lifted, by the aid of the plate lifter, which is immediately afterwards returned to its cup, from the dish, rinsed for a moment or two under the running faucet, and then placed in the hypo. I at once wash my fingers under the faucet and dry them on a towel before returning to the development of another plate. It pays to be scrupulously clean. The fingers of a really clean worker never show a stain of any chemical.

I find a mixing tank more useful than a dish, and I can strongly recommend it to those who wish to develop a number of negatives at one time. When two negatives are developed almost simultaneously, as described above, one of them is almost sure to be only about half fixed when the other is ready to be put into the hypo. For this reason, two or more dishes of hypo should be prepared if the worker does not possess a tank.

THE HYPO TANK.

My tank is an ordinary cheap, tin one, and a rack to hold six plates fits inside it. Better still is a porcelain tank, but I find these too heavy for traveling, so use a tin one. Of course, a quantity of hypo solution must be made up and bottled for use. It can be used repeatedly. A further advantage of fixing plates in a tank holding six or a dozen, is that there is no fear of removing them from the hypo solution before fixation is complete, as sometimes occurs when it is necessary to fix one plate after another in a single dish. Curly films, too, are much more satisfactory in a tank where they can be stood upright than in a flat dish, where their edges often rise out of the solution.

When fixing is complete, the plates are transferred one by one, to the washing water. Each one is rinsed before being placed in the water. This is to remove any dirt or grains which may have become deposited on the film in the hypo. When the hypo has been in use some time it becomes muddy, and is apt to deposit a scum on the plates. If the plate is thoroughly rinsed under the faucet before being washed, this scum is at once removed; whereas it clings with wonderful tenacity if the plate is merely soaked.

A WASH UP.

As soon as the operations are completed, the dishes, measure glass, tank, brush and plate lifters are carefully washed and set aside to dry. The tank, after being washed, should be stood upside down to drain.

The main points to note in development are: Keep every object in its accustomed place on bench and shelves. Do not attempt to develop too quickly or to fix too quickly. Do not touch the surface of the plate. Rinse the fingers between each operation. Keep plate as much out of the reach of the light as possible. Be clean and systematic.—"Photo American."

WHY GROUPS ARE FAILURES.

WARD MUIR.

Probably the first problem on which the proud owner of a new camera tries his hand is a group. His family —and any chance friends who may be calling—are marshalled upon the doorstep, exhorted to look pleasant, and snapshotted to the accompaniment of facetious comments from passers-by.

Photographically nobody would deny that groups are, in most cases, a melancholy failure. As a source of amusement they will, however, never cease to be a success. Wherefore it is fitting that a few notes should be devoted to the subject. Folks will go on group-taking—notwithstanding the sneers of professionals and the weary protests of the victims—to all eternity; and the craze may as well be catered for.

Groups are generally taken under a misapprehension. The photographer seems to imagine that the aim of his labor is to provide likenesses of the "groupees"; and that, by taking half a dozen people on one plate he proposes to produce half a dozen portraits.

This theory is a fallacy. The object of taking a given set of half a dozen people at once is not primarily that of portraiture, but (though this at first seems a trifle exaggerated) that of historical record. The camera is utilized for the purpose of making a note of the fact that on a certain date certain friends were gathered together in a certain place. The proof and memorial of this occurrence is the photographic group.

Of course, if the individual faces of the group are satisfactory likenesses, all the better. But they never are, for the simple reason that they appear too small, and therefore almost impossible to retouch. And there are so many of them that some are almost sure to be bad.

No; groups are not wholesale portraits. The photographer who gets this idea out of his head will have gone a long way towards improvement. Why? Because once you realize that groups are records of the presence of given people in a given spot, you cease the atrocious habit of posing them unnaturally. You begin to perceive that the real reason why your groups were a subject of merriment was because they were so artificial looking. When friends meet, they don't squash shoulder to shoulder upon the cold, hard doorstep, nor do they habitually mass themselves in a clump of humanity under the back-garden laburnum tree. They stroll about, chat, read, shake hands. Why then not photograph them in the act of doing so? Instantaneous shutters and rapid plates have made this quite possible. Why then shirk the experiment?

The most sensational picture at the 1903 photographic Salon was a group. Never before had a group been accepted at the premier exhibition of the metropolis. Then what was the special distinction which singled out this especial effort? Wherefore was Mr. Reginald Craigie, its author, honored above all the other aspirants to fame who doubtless had submitted groups to the critical judgment of the Hanging Committee?

Simply because Mr. Craigie's group was true to life. It represented the members of the Court of Directors of the Bank of England—an august body, who by the bye, had never before recognized the existence of photography as a historical recorder. Mr. Craigie might conceivably have taken them on benches in the bank's quiet little central courtyard, or he might have induced them to cab down in a body to the Camera Club and pose in front of a painted background in its studio. He was too good an artist to commit such an eggregious error. He let them sit around their board-room table exactly as they were accustomed to do at ordinary meetings. They were apparently caught in the act of deliberating some weighty question of finance. Not one of them is "conscicus." The result is a triumphant proof that the mere fact that a photograph is a group does not necessarily condemn it as a work of art. There is no jarring note in Mr. Craigie's photograph, there is nothing unreal about it; it doesn't make you smile. And the group which doesn't make you smile is sadly rare.

Mr. Craigie, too, has taught the photographic world that the composition of a group need not necessarily be wooden. The lines of his group are excellent, and so is the massing; and the light is soft yet natural.

Now reflect for a moment what the average snapshotter's group looks like. In ninety-nine cases out of a hundred it consists of three straight tiers of bodies topped by three rows of heads. The faces from a treble row of white blobs, hideous in their mechanical symmetry. A lower series of black blobs, in the shape of feet, repeat and accentuate this melancholy and irritating pattern.

This, I think will be admitted, is a fair description of the usual family group, as perpetrated by the amateur. The professional's is a little better. Papa and mamma are seated in armchairs. The youngest olive-branch nestles between papa's knees or lounges in undisguised comfort upon his feet. Sons and daughters lean over their parents' chairs or turn the leaves of old-fashioned albums. Not one of the whole group is at ease.

As portraits the result is negligible, owing to the smallness of the faces. Historically the thing is nothing more nor less than a lie; for never in heaven or earth did a family exist who honestly enjoyed such close proximity to each other's persons, or who from preference spent their time examining albums or leaning over the backs of their parent's chairs. Wherein then, lies the merit of the group at all?

As I have said above, groups if they are defensible on any score, are defensible as mementoes. That is to say, they stand or fall on the question of their truth to the actual state of affairs when they were taken.

Is it picnic you wish to record? Then catch your company while they are boiling the kettle or pouring out the tea. What does it matter if a few of the picnickers have their backs to you or if one of them is caught in the ungraceful act of eating bread and jam? The photo will recall that jolly holiday far better than a posed affair on an uncomfortable rock. Do you want to make a note of a garden party? Snap them in the middle of a game of croquet. Is it a cycling tour which you are immortalizing? Take them mounting at the inn door, or repairing a punctured tire by the roadside.

What a delightful history of the trifling events which go to make up one's life a series of such unposed groups would be. Let every camera owner make it his duty and pleasure to start compiling such a series at once. I warrant his little black box will cease to be a terror to relatives and friends if he adopts this scheme.—"Focus."

On a switching locomotive in Brussels, Belgium, instead of braking by means of shoes bearing on the wheel treads, the brake shoes are thrust down on to the rails, somewhat after the plan well known with cable cars.

SUMMER THUNDER STORMS.

FRANK P. SMITH.

The massive clouds, the vivid lightning and pealing thunder, the heavy rain and gusty wind accompanying the summer thunder storm, are manifestations of nature's forces which produce in our minds feelings of wonder, and to the timid are a cause of uneasiness and fear. A brief presentation at this time of the meteorological causes and effects of such storms will be of interest to readers of this magazine.

It is the summer thunder storm only which will receive our attention, many storms with lightning and thunder being the result of rather different conditions from the heavy summer storm. The latter is generally a comparatively local affair, travelling but a few hundred miles, or less, from the point of its origin. Many of the storms traversing New England States, originate in New York and have spent their force before or shortly after reaching the Atlantic ocean.

The formation of such storms begins generally in the morning of a hot day with a fairly high humidity. The heat of the sun causes an expansive upward movement of the moisture laden atmosphere which, upon reaching the cooler heights, is condensed into misty whisps of clouds. These nebulous beginnings increase in size until about noon, or soon after, they have reached a towering size and the cloud masses extend to a great height, and assume the so-called "anvil" shape of the well developed thunder storm.

This anvil shape of the clouds is the result of air currents which have developed coincidently with the cloud masses. The illustration shows a cross section of a thunder storm, as far as present day knowledge enables us to graphically represent the action taking place. The long arrows show the air currents, and attention is directed to the low, projecting undercurrents which denote the approach of the rain bearing section. The preliminary wind squall is probably caused partly by the cooling of the atmosphere lying within the shadow of the clouds, which has been deprived of the heat of the sun and further, by the air movement which results from the upward motion of the central air currents.

As the heated and moisture laden air rises in the center of the cloud mass, it eventually reaches the cooler region of the upper air, and condensation of the moisture follows and continues until minute droplets of rain are formed. These droplets unite to form larger drops until they are of such a size that their weight causes them to fall to the ground.

Should the intensity of the storm be sufficient to cause the air currents to rise to a great height, where low temperature prevails, the condensing moisture may form into snow flakes instead of rain drops, and the flakes, in falling to the warmer, moist air, will collect moisture on their surface, which will freeze in successive layers until the weight eventually brings them to the ground in the form of hail stones. It is thought that from the first condensation of the snowflake to the final fall as a hail stone, the air movement has caused the condensing moisture to rise and fall several times, this theory being supported by the formation of hail stones, which are known to be of several distinct layers, the number varying somewhat according to size.

So far, no mention has been made of the causes of the thunder and lightning, the latter being, it is almost needless to say, of an electrical nature. The atmosphere is known to be at nearly all times, of a differing potential from that of the earth, the latter being negative and the atmosphere of a positive charge. This difference is greater as the height increases, but is comparatively small in quantity and variation during pleasant weathei. During thunder storms, however, the potential varies widely, and the charge may fluctuate from positive to negative and the reverse, but is generally of somewhat higher than normal potential and positive in character.

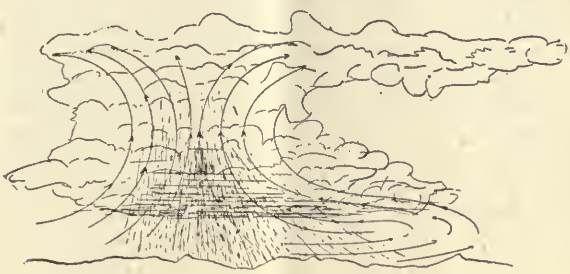
The moisture in the air is carried upward with the ascending air currents, and upon reaching the higher and cooler altitudes, condenses into raindrops. These raindrops undoubtedly become electrically charged upon their surfaces, and the potential of the charge increases as the smaller drops unite to form larger ones. When the magnitude of the cloud is considered, it will be apparent that these myriads of minute charges in the movement of falling, serve to give to the adjacent atmosphere a tremendous electrical charge, which, breaking down the resistance of the air, discharges to earth, for which it has an affinity by reason of its being of opposite polarity.

Hence the lightning flash or rather flashes, as what appears to the eye as one irregular flash is frequently several flashes or surges. Two or more flashes frequently unite near the earth to form one intense flash, the intensity and disruptive effects of which are familiar to all. The greater number of flashes do not reach the earth, but exhaust their energy in breaking down the air gaps between adjacent sections of clouds. The form of lightning having the appearance of flaming balls with comparatively slow movement, is not as yet fully understood, but may result from certain air currents which form a path for the electrical discharge.

The thunder results from the violent vibrations of the air caused by the lightning flashes, which in breaking down the resistance of the air, create a vacuum of an extent depending upon the intensity of the flash.

The air rushes to fill the voids thus caused, creating violent vibrations, which travel long distances, and do not differ in character from other sound waves, but are of greater amplitude than ordinary because of the greater forces causing them. The velocity at which sound travels is about 1100 feet a second, a rough approximation being five seconds to the mile; from which one may readily calculate the distance of the flashes.

What has been stated above is of a general character, and based upon the present knowledge of meteorological conditions.



Skilled observers in many sections of this and other countries have devoted much attention to the study of this interesting subject, and additional knowledge will undoubtedly be forthcoming in due time. The study of how to protect buildings from the disastrous effects of lightning is also being followed by scientific observers, and a more exact statement of how this may be accomplished will undoubtedly be available in the near future.

It has already been found that lightning rods, to properly serve their purpose, should have numerous sharp projecting points above the building; that these points should be well cross-connected with copper rods, making a sort of net-work, and that this network should have a number of conductors to earth. The earth end of the conductors should also be buried deep enough to be in permanent contact with moist earth, the essentials being to supply an ample path to the earth for heavy flashes. Single points on the roof. with rods direct to the earth and without cross connections, provide capacity for only the smallest discharges, and large ones, in seeking a path, leave the rod, with consequent liability to damage the building.

Should a person receive a shock from lightning, it frequently happens that respiration has stopped because of temporary paralysis. If assistance is at hand the usual methods for restoring respiration should be actively continued for at least an hour, the services of a physician being obtained as soon as possible.

RECLAIMING SAND HILLS.

Reclaiming the barren sand hills of the Middle West with forest cover, to supply timber when there is a dearth of it, is one of the more striking of the important forest planting projects of the Forest Service. Four of the National forests have been established in the non-agricultural region with the express purpose of getting a firm grip on methods which will overcome natural difficulties and set up object lessons for the benefit of the people. These are the Niobrara, the Dismal River, and the North Platte reserves in Nebraska, and the Garden City reserve in Kansas. The Nebraska reserves have responded so well to careful treatment that hundreds of thousands of seedlings have been planted out and millions more are being raised in nurseries for use in other reserves. Thus, for the first planting of the Garden City reserve, just completed, most of the trees were taken from the nurseries in the Dismal River reserve.

The Kansas reserve lies in a region of scattered, barren sand hills, interlaced with prairie on which grass thrives well enough to support live stock. The origin of these hills, in itself interesting, reminds one in a way of that of the sand dunes which encroached from the sea upon the fertile fields of western France and laid them waste. In both cases the wind has been the enemy of the soil, for in France wind drove the sand of the seashore inland, and in the middle-western region of our own country wind drove eastward the sand which the Arkansas river had carried down in floods and afterwards exposed to dry. The sand hills were formed long ago, and the action of the wind is now largely checked by the spread of the carpet of grass, which binds the sand wherever there is enough moisture to encourage it.

The semi-arid conditions of the region necessarily restrict the selection of trees. Right choice of species, the crux of forest planting generally, is here especially decisive. By its aid, together with right planting methods and right care of the plantation, a treeless region, one therefore in which wood is a scarce and a highly valuable commodity, can be made to produce useful woods, and at a cost so slight as to satisfy good business judgment. Thus on a light, sandy surface, whose only cover is wild grass and weeds, a merchantable forest crop is to be grown.

Honey locust, Osage orange, Russian mulberry, red cedar and western yellow pine are the trees used in the new project, of which 51,000 came from the Government nursery, near Halsey, Neb. The planting this season progressed under highly favorable conditions as regards weather and the physical condition of the soil, and at the expiration of six and one-half days thirteen men had completed the task at a total cost, exclusive of the trees, of $3.88 per acre.

Of the various chemical substances that have been used with a view of rendering wood fire-proof a solution of silicate of soda has been proved to be the best. Wood painted properly with the solution has been found not even charred after long exposure to fierce flames.

SITTING ROOM FURNITURE.

PAUL D. OTTER.

Very little information need be given for this table, Fig 2, in the simple style. The plain posts and under framing are laid out on a drawing in a square of 21 x 40 in. having the posts center along two intersecting diagonal lines, the open or top rails being mortised into the posts about 4 in. under the edge of the top. All edges should be chamfered 3-16 in. and just above the taper of the posts treated to a saw kerfed line, also chamfered to give finish. The top should be careful y matched from 1 5-16 in. lumber. Allow for the height of the table 30 in. to the top either with or without casters. The weathered oak finish is undoubtedly best for this much used piece of furniture.

terminate in a claw foot, the main rails and foot rail are made of not less than 1 in. boards.

The shape given for head posts will come from a board 7½ in. wide. From a previously drawn detail showing the continuous character of line in its constructed form procure the separate marking out patterns, and right here be mindful that with the cut out paper pattern allow in the wood, in case of the line arching from claw post joint to the horizontal rail, an excess of stock which, when the parts are glued up, may be sawed or shaved to the correct free arching line. The union of parts in this way creates one of the pleasing features to attract the eye, and the eye

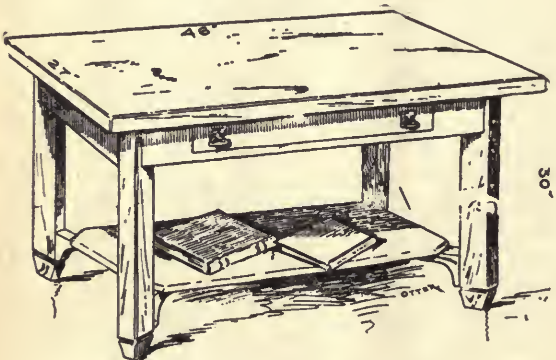


Fig. 2.—Sitting Room Table.

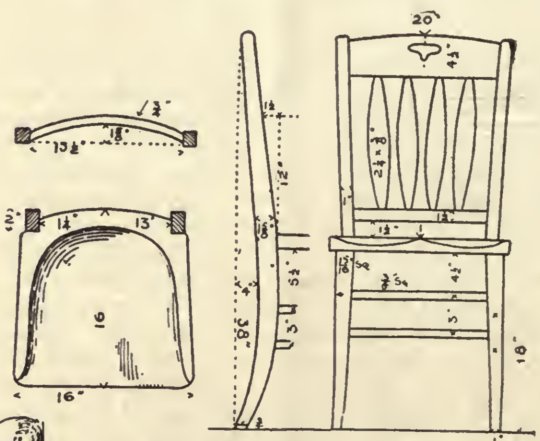


Fig. 5.—Details of the Side Chair.

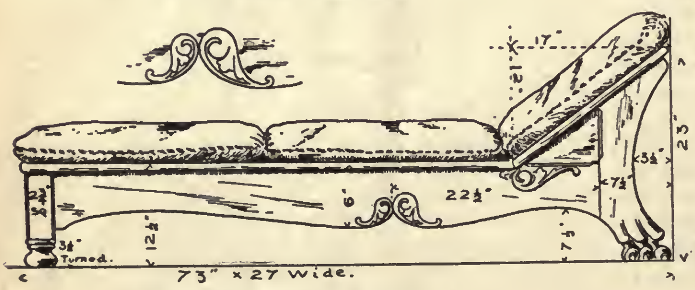


Fig. 3.—General View of Couch.

Fig. 4. —Method of Sewing the Leather Covers.

The couch should not be a difficult frame to construct. Indeed, after the inspection of the factory made article, the craftsman may, with a little practice with pencil and paper, lay out from observation a frame which will have a pleasing, substantial outline yet have the joints all cut square. With this thought Fig. 3 is presented with the necessary measuring memoranda given thereon. The frame is within a size of 27 x 73 in., making it ample in length for a "six footer," or generous enough for an overflow accommodation in the event of a surprise party. The head posts

following this line in fancy terminates in a foliated scroll as suggested, and the turn is met by a like but less forceful line springing from the foot post. In like manner, the inclination of head rest mold may have its abruptness folded up in a similar termination. The couch frame, of course, is to have the same treatment on the other side, for a one-side couch gives but one-half the number of positions in which it may be placed.

A little consultation with the wife will often save a man doing some foolish things, even as to furniture for the housewife tires of seeing her possessions always at the same angle or on the same side of the room. The fullness of the clawfoot is made by gluing on a 2-in. block, the upper portion of which will, by sawing or shaving, invisibly shade in a natural manner into the post. As treated in a previous article no set directions can be given for cutting or carving this claw; the carved claw is very much in evidence, and, as in everything else, a careful inspection will aid materially in producing a good effect, even with the chisel or gouge in use by the carpenter. The claw as a termination is selected, for with the inexperience of an amateur in carving the necessary unevenness and roughness will, by contrast to plain parts, make a pleasing feature. A rough claw is better than if it were produced from a turning lathe, if that were possible. A pleasing effect, in place of carving the ornaments on the side of a couch, is to jig saw the patterns detailed from a 2-in. block, then by passing them along a set straight gauge slit them on the band saw into frets 3-16 in. in thickness. Glue these along the proper line and direction, and after sanding the edges a very pleasing form of relief will result.

The foot posts are 2¾ in. square, with the three exposed corners chamfered. A turned ball 2½ in. in diameter gives a finished termination. The head end rail, 6 in. wide, is placed in line with the side and foot rail, and then panelling or veneer occupies the space between that and the inclined frame. The molded effect along the upper edge of the head support and rails may either be a narrow framing surmounting the construction or a moulded strip secured as an after finish.

The form of upholstery shown in the cut is now very generally a part of the simple class of furniture and stands for just what they are—bags, made in a primative manner, filled with soft material. Here again the craftsman of today will be equal to the occasion and find little that requires special skill in making the cushions to fit his frames. Soft, pliable Spanish leather (sheep skin) in all colors may now be secured in many towns. Unnecessary expense may enter here as in everything else, and it would be well to make the selection by samples. The bottom cover piece may also be of the same color and grain imitation, but of pantasote or other substitutes for leather. Likewise, instead of upholsterers curled hair a half quantity vegetable down may be used. It will be quite necessary, as well as satisfactory to guard against waste and to find the exact size of leather, to make a sample cushion one-half size of the couch body—that is, divide the couch into three pillows, using some cheap material and cutting it ample to allow for pillow when filled to the width of the frame. The filling should not be less than 5 in. in thickness.

From this bag material, if made to fill up properly, the exact size of the leather covers may be found, allowing more on these for ½ in. to be turned in on all sides. This ½ in. extra is turned and pressed or hammered into a crease, and the two creases of the four edges of each piece are brought together, rough side in, then held for a time while holes are made with a belt punch about 1 in. apart. Through these holes, as shown in Fig. 4, a thong strip, cut from the leather, is drawn, and in the after finish a second thong may be drawn, inserted so as to produce a cross weave effect. One side of the bag is of course left open to receive the inner filled bag, or the filling may be put in direct and the thong continued through the holes and finally tied in a neat manner.

THE SIDE CHAIR.

This is a pattern in the modern style, appearing well as a wall chair or making a good, light chair for the table. The chair would be in keeping with the present primitive construction to have the back slats perfectly flat, but a more shapely and comfortable back will result by using curved back slats as indicated in *A*, Fig. 5. A flat panel is usually steamed and bent, but for special purpose the curve is produced from a heavy plank, using an adz, or in default of this a gouge and heavy mallet, and after shaving to curvature determined by a wood templet, used as the work advances. Much of the convex side can be planed to line and even thickness by holding the work in a vise. The back post shape may be secured from a 1-in. surfaced board. If oak is used, show the quarter grain on the edge.

In making the seat none but thoroughly seasoned stock should be used, and after the saddle effect is obtained it should not be unprotected by finish very long. As you will need a heavy cleat, or batten, screwed to bottom as a means of holding it in the vise while shaping the hollow, it would be well to keep it on during construction of chair and until time for finishing, avoiding chance of warping. The hollow work is roughed out by a gouge and mallet, and then convex shaves and scrapers are used to bring about an even concave surface.

After all parts have been fitted with tenons and mortises, assemble them to see that they all come together well, also to give you an opportunity to note corrections which might be desirable to make and the final finish to be given each part. With the chair knocked apart the edges are worked off with a plane or shave, and the four slats in the back are greatly improved with edges turned off to a quarter round, likewise top edge of top slat, and hand hole smoothly filed in a rounded manner. The back part is glued up first and held in bar clamps under the seat; two square stretchers should be fitted at the same position, as shown, for stretchers. The side stretchers are indicated on the front leg.

The seat is now set in, as shown on seat plan, and secured at each post by a 2½ in. screw countersunk. Turning the back part down, with seat face down on bench, put on the front portion of chair, the legs and front stretcher having previously been glued up, then

CONCLUDED ON PAGE 274.

AMATEUR WORK.

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AUGUST, 1906.

This is the season of the year when vacations are uppermost in our minds, and relaxation and out-door pleasures the order of the day. We know that many boats, built from descriptions published in these columns, are affording the builders much enjoyment, not alone from the pleasure of boating, but because the boats are the product of the owner's skill and workmanship. Descriptions of other boats are in preparation and will be published in due time. The first chapter descriptive of a thirty-foot auxilliary yawl will appear in the November issue, and as boats of this type and size are rapidly coming into favor, we are confident this description will be received with much interest.

While many readers may not actively engage in constructive work, the summer months afford an excellent opportunity for tours of investigation, and plans can be made for winter work. An enlarged staff of contributors enables us to promise some decidedly interesting articles in new fields, and those "who like to make things" will find the forthcoming issues of the greatest service.

A number of recent inquiries from readers, requesting advice as to the most helpful books on technical subjects, prompts us to state that we shall be most pleased to recommend books for purchase by anyone making inquiry, provided stamp for reply be enclosed with inquiry. Having a large reference library at our command, information regarding technical books can be given from personal knowledge of the contents of the best books to obtain.

Many readers are familiar with some tool, instrument or device, a description of which would be of interest to other readers of the magazine. We shall be pleased to hear from anyone willing to supply us with such descriptions, for which suitable payment will be made. To avoid duplication of subjects already in hand, or in preparation, it is advisable that inquiry be first made as to the probability of an article being accepted before same has been written. We can then state whether a topic would be acceptable, and perhaps assist in making same more nearly in accord with our needs. Think over what you have made or done out of the ordinary, and write us regarding same.

We want photographs of articles described in this magazine which have been made by readers, and will give a year's subscription, or any one subscription premium, for each accepted photograph of this kind. A brief description of the article, mentioning any peculiarities of the work, should accompany the photograph.

Although Davy's lamp is the model miner's lamp, it has been the subject of numerous modifications. The best-known systems are divided into two classes, according to the principles on which based. In some the flame is surrounded by a thin metallic gauze. Should any quantity of explosive gas enter the lamp through this gauze an explosion will only take place inside the metallic gauze envelope and extinguish the light without outwardly communicating fire. In others the light is produced by an electric current inside a tube or small bulb filled with extremely rarified gas. The breakage of the bulb instantly causes the extinction of the light.

AN EXPERIMENTAL THERMOPILE.

The thermopile is an instrument consisting of one or more pairs of dissimilar metals, in the form of wires, bars or blocks, joined together at one extremity. On applying heat to the junctions, an electric current is set up, the pressure and volume of which depend partly on the size of the surfaces in contact and partly on the temperature to which the junctions are raised.

Such instruments are extremely useful for the production of such small, steady currents as are required for grading delicate ammeters and volt meters; for registering minute variations of temperature, etc., in which case they are used in conjunction with a delicate galvanometer, the readings of which are known to correspond with certain amounts of current, and

FIG. 1.

consequently to given rises in temperature attained in muffles and similar furnaces, wherein no ordinary thermometer could be employed, since the heat would melt the glass and dissipate the mercury.

The two metals which have been more generally employed in the construction of thermopiles are antimony and bismuth, but as there are some little technical difficulties in making good junctions between the metals, he advises the student to commence his attempts in this direction by procuring two 6 in. lengths of No. 18 wire, one being of copper, the other of nickel. Having cleaned them nicely by rubbing with fine emery paper, he will hold them parallel to each other between the jaws of a vise. In order not to crush the wires it is advisable to wrap a piece of paper around them before screwing up the vise. About 1 in. of the wires should be allowed to project above the vise, when the projecting ends should be tightly twisted together by the aid of a pair of pincers.

The wires should then be removed from the vise, the twisted extremity soldered together with a little tinman's solder. To prevent after rusting it is well not to use acid or soldering fluid as a flux, but to employ rosin for this purpose. When this has been done the two free extremities of the wires are opened out to about 4 in. apart, as shown in Fig. 1, *a*, *b*. If now the two "poles" or extremities *a* and *b* of this simple thermopile, be connected to the terminals of a fairly delicate galvanometer, the pointer of which should be brought to 0° it will be found that on applying the flame of a lighted match to the junction *c*, the sufficient current will be set up to deflect the needle or pointer, through 10 or 15°. A rather more powerful

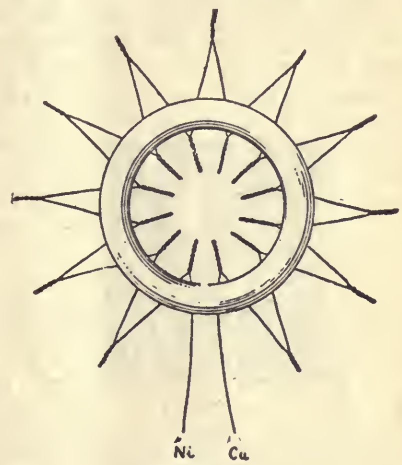


FIG. 2.

arrangement can be easily put together by making up a dozen such combinations, with the individual wires about 4 in. long only, and twisted up for a length of ¾ in. instead of 1 in. It will not be necessary to open the wires out to more than ¾ in. for this purpose. A common wooden curtain ring of about 3 in. internal and 4 in. external diameter is now chosen, and around its outer edge are drilled 24 equi-distant holes about 1-18 in. in diameter, just sufficient to allow the single wires to be pushed through. Then taking one of the pairs of wires with the copper to the left, the operator

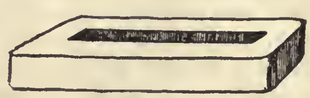


FIG. 3.

pushes the free ends thereof through the first pair of holes from the inside of the ring, until he clears the center by about ½ in. In like manner he inserts the remaining 11 pairs, taking care that each copper wire enters the left hand, and each nickel wire the right-hand hole of each pair, so that the ring, viewed from the outside, should show the free wire ends alternately copper, nickel; copper, nickel, and so on all round; and never two coppers or two nickels adjacent. Starting now on the outside of the ring, we twist and solder together the wire proceeding from one pair joined inside to the dissimilar wire of its next neighbor; that is to say, the nickel to its neighbor's copper, and so on all round, except only the first copper and the last nickel wires, which are left free for connection to the outer circuit. See Fig. 2.

On applying heat from the flame of a spirit lamp to the junction inside the ring, a current of electricity can be taken off the two free wires Cu and Ni. Having understood the principle of the thermopile, the operator will find no difficulty in making up the more powerful instrument generally used for measuring the temperature of different radiating bodies. We will

FIG. 4.

begin by making a little pattern of any hard wood 2 in. long, ½ in. square in the sides. From this, as a pattern, he will, after oiling it all over, to prevent adhesion, make half a dozen or more moulds in plaster of paris, as shown in Fig. 3. These plaster moulds must be allowed to dry thoroughly before use, otherwise in attempting to cast in them, the molten metal might sputter and fly into the operator's face. He will then cut 48 strips, 2½ in. long, ½ in. wide, out of thin tinned iron sheet. Taking one of the moulds in hand, he will insert one of these strips at each end, projecting downwards into the cavity for about ½ in. He will do likewise with all the other moulds he has prepared. He will then melt in an iron ladle about 2 ozs. of clean zinc, with 4 ozs. of metallic antimony, with which, when well melted and mixed, he will fill the moulds he has got ready. As soon as he sees the metal has set, he will pull out the castings by the side strips; since, as they expand considerably in cooling, they would break the moulds if allowed to get cold therein. The moulds must be again fitted with tinned iron strips, and the casting operation repeated until at least 24 little square bricks of zinc antimony have been satisfactorily prepared. These are then gone over with a file to remove any excresences, care being taken not to break these in doing this, as the alloy is as brittle as glass. The operator then joins these blocks together in five separate sets of five, one of which is shown at Fig. 4; the lower tin strip of the first block being bent upwards nearly parallel to the second block where it is turned at right angles, folded upon, and soldered to the upper strip of the second block, and so on until each set of five blocks is joined. Then each tin strip is separated from its neighboring blocks on either side, by the insertion of a thin sheet of mica 1½ in. long by ½ in. wide. It will be noticed that there will be two free strips of tin to each set thus formed; one at the left hand top corner, and one at the right hand bottom corner. Each set of five blocks, when thus completed, could be temporarily tied together with a bit of fine twine.

The operator then cuts out six pieces of thin asbestos board, or failing that, of stout common pasteboard, 1½ in. wide, long enough to cover the bundles of blocks from side to side, but to have the ends protruding about ½ in. at each extremity. Placing a length of 1 in. wide tape on the table, he lays one of the asbestos squares on it, puts one set of blocks squarely on it, removes the twine, then covers the first set with another square of asbestos, over which he places a second set in the reverse position, that is to say, that the free tin strips on the left hand top corner should be placed

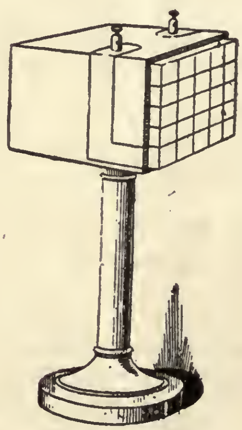


FIG. 5.

over the right hand top soldered junction of the first set. In like manner, with the same precautions of placing a layer of asbestos between each set, and of reversing the position of the free tin strip on the top corner with each succeeding set of blocks, the five sets are laid squarely one over the other, surmounted by a final square of asbestos or pasteboard. A piece of the same material is now cut to fit over the two sides; the tape bound tightly round the compound block, stitched firmly together and served out with a thin coat of shellac varnish. When this is quite dry all the projecting tin strips at the two ends, except only the first top corner left-hand strip of bottom row, and right-hand lower corner strip of top row, which must be left free for connection to terminals, are bent slightly diagonally over the side, so as to meet the free strip of the layer above alternately on the one side and on the other; to which they are neatly soldered, and any excess of tin strip cut off.

The finished thermopile should then be encased in a four-sided wooden case, about 1¾ in. wide, tightly packed in with sheet asbestos. The two free strips are then bent up to the sides of the containing case, and fitted with small terminals. The ends of the 25 blocks should project about 1-8 in. at both ends of the case, which may for convenience be itself mounted on a rather heavy column and base. In order that the temperature of the thermopile may be maintained fairly equal at both extremities when not in use, it is usual to fit the case with little covering caps at both ends, one of which can be removed when it is desired to expose one end to the effect of the source of heat to be tested. In Fig. 5 we give a sketch of the completed thermopile—"Hobbies" London.

CAISSON DISEASE.

The effects of compressed air on tunnel workers and the palliative measures to be adopted by those in charge, formed the subject of a lecture by Prof. Thos. Oliver, M. A., M. D., recently delivered before the British Royal Institue of Public Health. The author described the caisson used in such work as a strong box or casing which is allowed to sink below the surface of a body of water in order to carry on work. As the caisson has no bottom, its edges cut into the soil where it rests, sinking lower as the material excavated within is hauled to the surface and disposed of. To keep out the water, air has to be pumped in a at a pressure varying with the depth of water.

To allow the passage of material and men, what is known as an air-lock is provided at the top of the caisson, partly above water, so that access can be had to the working chamber while the pressure is maintained.

On descending into the lock, very little inconvenience is experienced by men accustomed to the work; they have a way of swallowing air and diverting some to the eustachian tube, thus avoiding injury to the ear. Once inside the caisson, very little inconvenience is felt, but loud conversation is difficult. Although it has been found advisable to limit the working period to a few hours, a man can do as much work in a given time as under ordinary conditions. It is during "decompression," on leaving the compressed atmosphere, that abnormal symptoms develop. In minor cases men suffer from pains all over the body, and bleeding from the nose, or even from the mouth and ears. In severe cases paralysis develops.

There are certain predisposing causes of this illness, among these being an insufficient supply of fresh air or the contamination of air by lamps or by gases emanating from the materials being excavated. Severe manual exertion is a predisposing cause, the men who guide buckets as they are hoisted not being subject to the disease.

When the decompressing process is carried on slowly, Nature allows the excess of gases to escape through the lungs. The red corpuscles of the blood carry carbonic acid gas, a waste product of the tissues, to the lungs. Interference with this process and the disturbance of the equilibrium between internal gases and the atmosphere are, in Prof. Oliver's opinion, the cause of caisson disease.

Since immunity from this malady among laborers will allow engineers to carry on public works requiring deeper foundations than hitherto attempted, preventive measures are of the utmost practical importance. Slow decompression, with recompression if any of the symptoms of the disease appear, is the chief preventive. Breathing an atmosphere of oxygen for five minutes before coming out of the caisson, by driving excess of nitrogen out of the blood, has been found to have a beneficial effect. In general, medical inspection and the use of every facility for the comfort and treatment of men on coming out of the caisson are advised.—"Municipal Journal."

TEMPERATURE OF THE EARTH.

The measurement of temperature at the bottom of the two deepest mines in Australia—both at Bendigo —indicates an increasing warmth, but less than that due to added depth; the difference being explained by the good effect of ventilation. The deep mines at Bendigo are close together, so as to be easily connected by levels, says "Mining and Scientific Press." The Government Inspector of Mines found the temperature at the 3856 ft. plat of the New Chum Railway mine to be 86° F., while at the bottom, at 4069 ft., the thermometer registered 88°. The water at the west end of the shaft was 94° and at the east end 96°.

In the Victoria Quartz mine, also near the New Chum reef, the temperature at the plat on the 3824 ft. level was 86°, while in the shaft at 4046 ft. it was 88°. The water was six degrees warmer. The New Chum Railway is warmer than the Victoria Quartz mine because it has an up-cast shaft, and receives air from an adjoining mine, while the Victoria Quartz receives fresh air through its down-cast shaft. As the mean annual temperature at Bendigo is 90° F, the increase at 4000 ft. is not excessive.

Two things are necessary for gasoline engine running. There must be gasoline in the cylinder and there must also be a spark. If the engine gets both spark and gasoline, it must run, providing some mechanism has not become misplaced. If an engine stops and refuses to start, first ascertain which is minus, the gasoline or the spark. Gasoline engines fail to operate properly from insufficient spark more than from any other cause.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

V. Assembling the Coil.

The secondary section windings, condenser, and other parts being completed, the important operation of assembling the coil is next in order. But little has been said regarding the core, it being assumed that the wire for the same will be purchased cut to length ready for use. This is extremely desirable, as two important requirements make the preparation of core wire by the amateur without special tools a quite difficult matter.

In the first place, core wire should be very thoroughly annealed, and this process, as carried out in kitchen stove or furnace, is not at all satisfactory, both because this kind of annealing is most imperfect, and the scale and dirt collecting on the wire prevents the subsequent gathering of the wire into a compact bundle. Wire, as annealed by wire manufacturers, is kept in the furnace for several days, and is entirely free from scale. The cutting is done by machine, and each piece is straight, and all are of the same length, making the work of forming the core much easier and better than it otherwise would be. A core made of such wire will also more strongly energize the coil than will one made of poorer and rougher wire. The importance of using the best possible core wire cannot be too strongly emphasized, especially with coils of large size, where the value of a heavy outlay for magnet wire may be to quite an extent lost because of a poor core.

The operation of forming the core should be very carefully done. The writer has found the following method gives good results, and is as convenient as any which he has seen described. A cylindrical bundle of loose wire slightly larger than the ultimate size of the coil, is gathered in one hand, and several small rubber bands slipped over it. The bundle is then rolled on a smooth, flat surface, to bring the wires as closely together as possible, adding additional rubber bands as the rolling proceeds. When the bundle is made as compact as possible, the size should be that desired for the core. If too large remove a few wires, one at a time, and continue the rolling until the correct size is reached. It is easier to reduce than to increase the size, so the bundle at first should be fully large enough.

The next process is to wind the bundle with strong, black linen thread, in close even layers, beginning at one end and winding to the other, removing the rubber bands as the winding proceeds, and using the greatest care that the bundle is not forced out of round by the winding. Only one layer of thread is necessary, allowance being made for same, as well as the primary winding in determining the size of the core. The layer of thread being in place, the core should form a round, solid bundle, which will be free from movement when the finger is applied to any part. A coating of shellac, or mixture of paraffine and beeswax, should then be given the core, the latter being preferable except in hot climates. Two or three layers of strong manila paper are then wound upon the core, the number being dependent upon the thickness of the paper and the purpose to give a smooth surface upon which to wind the primary. The primary is then wound in even layers upon the paper surface just mentioned. Finally, the core is given a complete boiling in the paraffine-beeswax mixture until all bubbles cease to rise therefrom. The mixture must be heated in a water bath, and owing to the shape of the core, utensils for this purpose will not be easily obtained by many. If a tin can, used for shipping photographic carbon paper, can be obtained from a photographic studio, it will be found just the thing, after cutting off to the desired length. Any deep kitchen utensil can be used to contain the water and tin holding the mixture.

After a thorough boiling in the mixture, the core is removed, but will have to be basted on the outside ends with the mixture, as the iron retains the heat longer than the mixture, keeping the mixture fluid in the center for some time after that on the surface has hardened. As it cools it contracts, and the basting is necessary to avoid cracks. Just before the mixture becomes cold and set, the core is placed inside of the ebonite or mica tube, which separates it from the secondary, and any space between the primary and ebonite tube, filled with the fluid mixture. The ebonite tube should be a fairly close fit over the primary, when the latter has been coated liberally with the mixture; too much space reducing the output of the coil.

The bobbin, or coil end, is then placed in position at one end, and the secondary sections put on, taking the greatest care to see that joints between double sections are well made by soldering and then fully insulated with thread. The paraffine mixture is kept at hand, and the space between the inside of the sections and the ebonite tube completely filled with the mixture, which is applied to the joint between sections. Care must also be taken to see that the sections are put on with the windings in the right direction, so that the current through them will be in a uniform direction around the core. Extra care must be taken at the ends of the secondary to see that the insulation is ample, as the tendency to break down and short circuit is greatest at the ends.

The leads from the secondary to the terminal posts should be taken from the tops of the windings, so that they will be as short and direct as possible. It may be necessary to unwind the ends of the two end sections to do this, but this is easily done. In connecting up the sections it is also advisable to test frequently for breaks, and if any are suspected because of poor sparks, careful inspection should be made and the trouble located before proceeding with the work. By testing for breaks is meant the use of a battery of four or five dry cells and a galvanometer, leads with detachable clips being used for connections.

HINTS FOR YACHTSMEN.

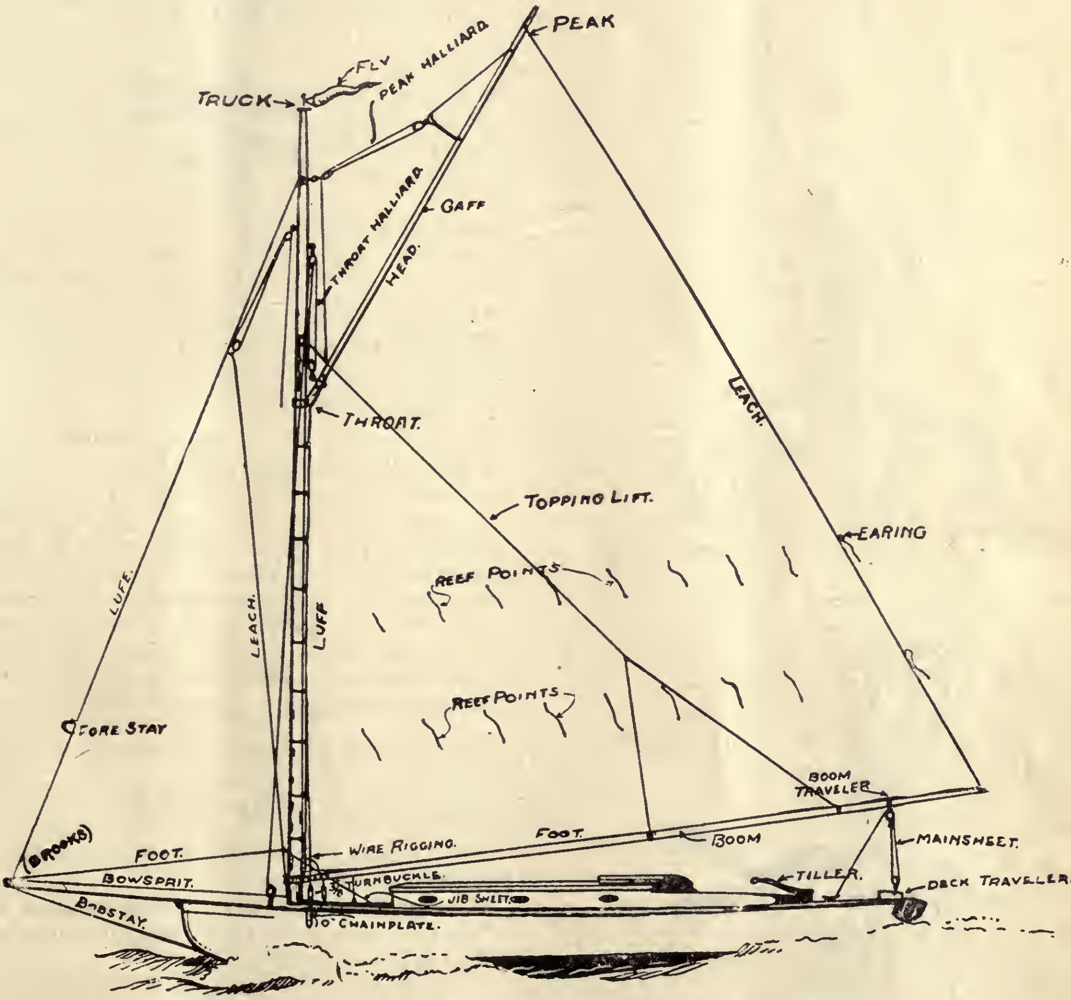


DIAGRAM SHOWING NAMES OF PARTS OF SAILBOAT.

NAUTICAL TERMS.

Starboard—Right hand side of boat.
Port.—Left hand side of boat.
Aft.—Toward the rear.
Forward.—Middle section of boat.
Fore and Aft—From bow to stern.
Athwartships—From side to side.
Aloft—Above the deck.
Below—Beneath the deck.
Abaft—Towards the stern.
Avast—To cease, stop.

A SHORT SPLICE.

The accompanying illustrations show the different stages of a short splice, such as is used for making an eye in the end of a rope. The strands are first unlaid

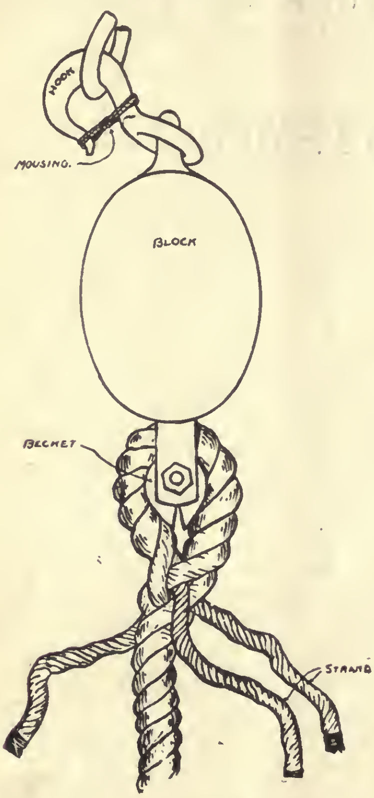


FIG. 1.

FIG 2.

or separated. For convenience of handling, the ends of the strands are sometimes whipped, as shown in Fig. 1. The strands are then tucked under the standing part of the unlaid rope, as shown in Fig. 1. This operation is repeated by tucking again and then each strand is divided, as shown in Fig. 2. The splice is then finished by tucking one-half of each strand, as shown in Fig. 3. This last tuck will taper off the splice. To loosen or raise the strands of the rope, so that you may tuck under them, a pointed marlin spike is used.

FIG. 3.

In splicing two ends of rope together the operation is the same, only in this case you will have two ends or six strands instead of three, and will of course tuck both ways from the center.

BELL TIME ON SHIP BOARD.

No. Bells.	Time.	Time.	Time.
1	12 30	4 30	8 30
2	1 00	5 00	9 00
3	1 30	5 30	9 30
4	2 00	6 00	10 00
5	2 30	6 30	10 30
6	3 00	7 00	11 00
7	3 30	7 30	11 30
8	4 00	8 00	Noon.

SIGNALS TO ENGINEER.

When engine is stopped, one bell means go ahead slow.

When engine is running either way, one bell means stop.

When engine is going full speed either way, three bells mean check down.

When engine is stopped, two bells mean go astern.

When engine is going ahead, two bells mean reverse and go full speed astern.

LIGHTS.

Lights must be carried on all boats from sunset to sunrise.

White light is placed forward and is screened so as to be visible over ten points of the compass on each side.

Red light is placed on the left or port side and is screened so as to be visible from straight ahead to two points abaft the beam.

Green light is placed on right or starboard side and is screened so as to be visible from straight ahead to two points abaft the beam.

Upon being overtaken by another vessel, a white light must be shown astern.

A sail vessel carries two side lights only, but when approached by another vessel shows a bright light or torch from the point in which the other vessel is approaching.

Rules regarding lights apply to boats under way only.

When laying at anchor a white light visible all around the horizon is shown.

A row boat should carry a white light and show it upon the approach of another boat.

BUOYS.

In accordance with Section 4678 of the Revised Statutes of the United States, the following order is carried out in the coloring and numbering the buoys along the coast, or in the bays, harbors, sounds or channels, viz.:

1. In approaching the channel, etc., from seaward, red buoys with even numbers will be found on the starboard or right side of the channel.
2. In approaching the channel from seaward, black buoys with odd numbers will be found on the port or left side of the channel.
3. Buoys painted with red and black horizontal stripes will be found on obstructions, with channel ways on either side of them.
4. Buoys painted white and black perpendicular stripes will be found in mid-channel, and be passed close to.

When perches with balls, cages, etc., are placed on buoys, it indicates that they are turning points, the color and number indicating on which side they shall be passed.

To use a buoy for mooring purposes with a boat is unlawful and punishable by fine and imprisonment, except when such mooring is done for the purpose of saving life.

The U. S. Government Sailing Rules, as applied to your district, together with a classified list of all lights, beacons and buoys, giving their description, character and location, will be sent you upon request to the Secretary of the Treasury, Washington, D. C.

STEERING AND SAILING RULES.

SAILING VESSELS.

When two sailing vessels are approaching one another so as to involve risk of collision, one of them shall keep out of the way of the other as follows:

(*a*) A vessel which is running free shall keep out of the way of a vessel which is closehauled.

(*b*) A vessel which is closehauled on the port tack shall keep out of the way of a vessel which is closehauled on the starboard tack.

(*c*) When both are running free, with wind on different sides, the vessel which has wind on the port side shall keep out of the way of the other.

(*d*) When they are running free, with the wind on the same side, the vessel which is to windward shall keep out of the way of the vessel which is to leeward.

STEAM VESSELS.

When two steam vessels are meeting end on, or nearly end on, so as to involve risk of collision, each shall alter her course to starboard, so that each shall pass on the port side of the other.

When two steam vessels are crossing so as to involve risk of collision, the vessel which has the other on her own starboard side shall keep out of the way of the other.

When a steam vessel and a sailing vessel are proceeding in such directions as involve risk of collision, the steam vessel shall keep out of the way of the sailing vessel.

Where, by any of the rules here prescribed, one of two vessels shall keep out of the way, the other shall keep her course and speed.

Every steam vessel which is directed by these rules to keep out of the way of another vessel shall, on approaching her, if necessary, slacken her speed or stop, or reverse.

Notwithstanding anything contained in these rules, every vessel overtaking any other shall keep out of the way of the overtaken vessel.

In all weathers every steam vessel under way in taking any course authorized, or required by these rules, shall indicate that course by the following signals on her whistle, to be accompanied, whenever required, by these rules, shall indicate course by the following signals on her whistle, to be accompanied, whenever required, by corresponding alteration on her helm; and every steam vessel receiving a signal from another shall promptly respond with the same signal: One blast to mean, "I am directing my course to starboard." Two blasts to mean, "I am directing my course to port." But the giving or answering signals by a vessel required to keep her course, shall not vary the duties and obligations of the respective vessels.

SAILOR'S RULE OF THE ROAD.

When both side lights you see ahead
Port your helm, and show your red.
Green to green, or red to red—
Perfect safety—Go ahead!
If to your starboard red appear,
It is your duty to keep clear.
To act as judgment says is proper;
To port—or starboard—back—or stop her.
But if upon your port is seen
A steamer's starboard light of green,
There's not so much for you to do,
For green to port keeps clear of you.

SITTING ROOM FURNITURE.

[Continued from Page 265.]

provided with the side stretchers glued to legs and treated with hot glue in mortise holes of the back posts. Drive these in them, gluing the seat mortises; drive into place the legs.

In this class of work—open and liable to spring out of true—it is well to have a rule, or trying stick, to immediately square the frame before the glue has positively set, the bar clamps sometimes being brought into good use, to pull into place a refractory part. When the chair is well set, cut the back posts at bottom ⅝ in. to give proper inclination. Clean off any excess of glue and hand sand from top to bottom, taking off any crude edges.

An arm chair to match this pattern may be constructed from a drawing making the size of seat proportionately 2½ in. larger than called for in Fig. 5, and the height 32 in., between arms 19½ in. and the height of arms 10 in. from the seat.—"Carpentry and Building."

THE ONDOSCOPE.

An excellent simple device, known as the "Ondoscope," has been devised by Prof. Ruhmer, of Berlin for examining alternating or pulsating electric discharges. The following description is taken from the "Electrical Review", London:

The principle of the apparatus is based upon the the discovery by H. A. Wilson, in 1902, of the fact that the violet glow round the cathode of a Geissler tube varies in dimensions in proportion to the current strength, while it is, of course, free from inertia and, therefore, follows changes in the current with absolute precision and instantaneity. The instrument devised by Ruhmer to take advantage of this phenomenon consists of nothing more than two wires sealed into an exhausted tube about a foot in length and one inch in diameter, with their inner ends close to a small hole in a mica screen.

Viewed directly, when it is connected with the terminals of an induction coil, a steady violet glow surrounds the end of each wire; but when viewed in a revolving mirror, it is seen that the glow occurs alternately on the one and the other of the wires, never on both at once. Moreover, the luminous images, drawn out by the inventor of the mirror, show by their outline the changes in the current strength with regard to time and in its direction. The effect of varying the frequency and duration of make and break, the potential difference applied to the primary coil and the nature of the secondary circuit can thus be studied with the greatest ease and convenience.

On inserting a Villard valve-tube in the high-pressure circuit, the current becomes unidirectional, though of course still intermittent. Using the ondoscope in a series with an X-ray tube, with a valve-tube in circuit, the strength of current can be estimated, or even roughly read off on a scale, with the instrument; the latter also serves to verify the fact that all the discharges occur in one direction only, testifying to the efficacy of the valve-tube which exercises an extraordinary powerful action as a rectifier. A singular fact which is shown by the ondoscope is that the discharge through an X-ray tube is practically instantaneous, the luminous image consisting simply of a narrow streak, no matter how rapidly the mirror was turned. By photographing the images a permanent record can, of course, be obtained.

The ondoscope with about 300 volts potential difference, so that it is available for use on ordinary high-pressure alternating circuits; while it is lacking in some of the advantages of the oscillograph, it unquestionably yields a considerable amount of information regarding wave-form, oscillations, etc., with the minimum of trouble and expense, and it can hardly get out of order.

NEW ELECTRIC LAMP.

Consul E. T. Liefield forwards from Freiburg an abstract from a Paris newspaper concerning a new electric lamp which, it is said, will revolutionize the present system of lighting. The article was wired from Vienna, and reads:

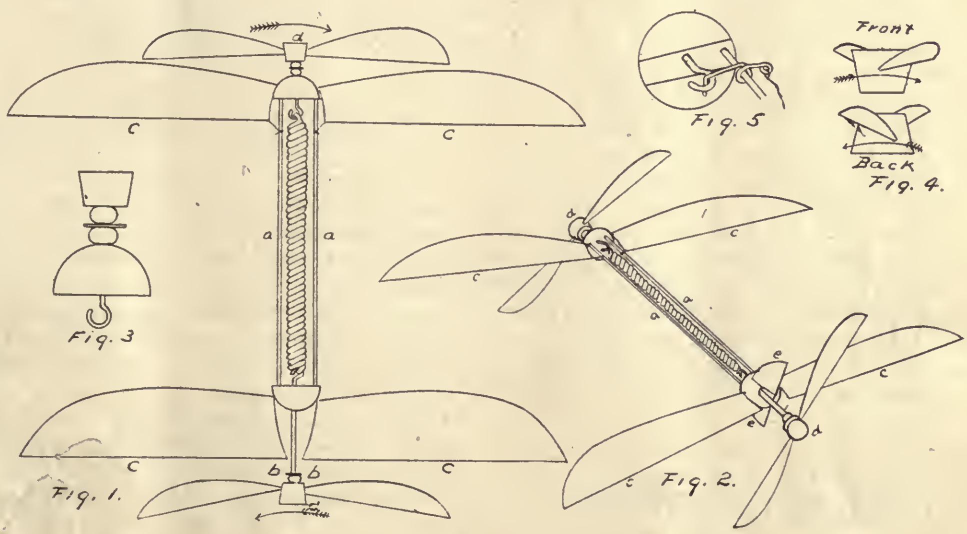
An Austrian chemist, Dr. Hans Kuzel, has, after many years' hard work, succeeded in constructing a new electric lamp, which he calls the Syrius lamp. As is well known, incandescent gaslight is cheaper than electric light, because the filament wires of the latter are very expensive and the glass bulbs soon wear out. Dr. Kuzel has now invented a new substitute for the glow-thread, by forming out of common and cheap metals and metalloids colloids in a plastic mass, which can be handled like clay and which, when dry, becomes hard as stone. Out of this mass very thin wire threads are then shaped, which are of uniform thickness and of great homogeneity. These two characteristics are of great value in the technics of incandescent lamps.

The Kuzel or Syrius lamp hardly needs one-quarter of the electric current which the ordinary electric lamp with a filament wire requires. Experiments, it it is asserted, have shown that the lamp can burn for thirty-five hundred hours at a stretch. Another advantage is that the intensity of the light of the new lamp always remains the same, the lamp bulbs never becoming blackened, as is now the case. The new lamp, it is said, will be put on the market next autumn.

A SMALL FLYING DEVICE.

J. CARSON PRESS.

The illustration shown here is that of a small flying machine, and presents a form of amusement that has seldom, if ever, been made the subject of experiment for boys. It is exceedingly simple, practical and inexpensive, and opens up a vista of enjoyment through the summer months that cannot fail of recognition, especially as there are several other types, not quite so simple, 'tis true, but equally well within the means of every owner of a penknife, and some constructive ability. Fig. 1 shows clearly the general outline and disposition of the wings, propellers, etc., and requires only a few general directions as to the measurements, and materials to make it plain to the reader.



Before starting to work procure, if possible, one of those 3ft. bamboo pipe stems the tobacconists sell; cut from this the strips used in the frame, wing arm, etc. This wood is light and pliable and is the best for the purpose. If it cannot be had, use a light wood that will bend. The frame at *a a* is made by inserting the ends of two sticks each 9 in. long, ⅛ in. thick, into two half cubes of cork, fastening with glue. To make the half cubes, cut half a cork to get pieces about 1 in. in diameter and ½ in. thick. See Fig. 9. A short round stick *b*, 3 in. long, is fitted to a depth of ¼ in. in one of the pieces of cork. The stick must have a hole through it, so it is best to use the stem of a corncob pipe.

The wing arms *c c c c* are 9 in. long, ⅛ in. thick, tapering at the outer ends. Insert the thick ends in the cork, giving them a slight upward pitch, making a very obtuse V. Then, after the glue has set, tie a light cord to the tips and bend until they measure 3 in. from tip to frame; fasten cord to frame. The wings should not be in exact line with the frame, but should point slightly downward; the proper angle is obtained by tying the cord to the under side of the frame sticks.

The propellers *d d* are two-bladed. The blades are made similar to the wings. Cut four sticks 7 in. long and very thin; bend until they measure 6 in. from tip to root. Fasten with thread, allowing for ¼ in. or so of the end to be pushed into the cork. Next take two corks the size of a dime and ¼ in. thick; fit the blades in these at an angle of about 40°. Remember in this connection that, as the propellers revolve in opposite directions, the blades must also be reversed. See Fig. 4.

Then take two pieces of brass spring wire, one 2 in. long, the second 3½ in. long, and fashion a hook on one end of each. To these hooks are fastened the propellers and rubber. Pass the long hook through the cork and length of pipe stem, the short through the other end. Place on each two small beads with a tiny washer between, push the free ends through the center of the propeller corks, taking care to see that the propellers, revolving in opposite directions, shall serve to lift the machine upward. Fasten the wire as shown at *a* in Fig. 3.

The small vertical rudder seen at *b* is made from spring wire 7 in. long, bent to a half circle by a cord running from two small hooks formed on each end.

The wings, propellers and rudder are covered with silk, or a good grade of linen paper might be best, as a smooth surface is an advantage. If silk is used, keep it spread out by pinning it to a board, then coat the sticks with glue and lay them on the silk, cut out afterwards; this will prevent wrinkles. The motive power is twisted rubber; you will require five small bands, each 3¼ in. long, and ⅛ in. wide. Knot them together double and pass the free ends over one of the hooks, and where it is doubled over the other hook, making two lengths. If, after trial, this seems insufficient, or the machine does not fly very fast, add another length of thinner bands and twist the rubber by giving the propeller about 75 turns.

You will need something to hold the propellers from turning until ready to fly the machine. Make two small catches of the shape seen in Fig. 5; fasten these to the frame so that one end engages in the hook with the rubber. To the other end is fastened a light cord, which runs back to the end of the second catch. By pulling this cord, both propellers are released at the same time. The machine should fly in a horizontal or slightly rising line; if it has a tendency to dip downward, reduce the angle of the back wings by twisting the cords around from the underside of the pipe stem to the side, and finally to the top if necessary.

The best way to commence is to first jot down the measurements of the different parts on a separate sheet of paper; first the frame rod *s*, then the wing arms, and so on. Then, with the directions in this concrete form, proceed to get out the different parts; the frame first, in the order of their presentation here. The corks used should be firm and sound, and all parts should be well glued together. Use a little judgement and your best workmanship, and the result will be highly gratifying.

GASOLINE ENGINES.

Continued from Page 258.

The base is in two parts, split on the line of the shaft and bearings. The valve chest is on the back of the cylinder; *I* is the inlet opening and *E* is the exhaust; *V* is the valve stem. The gears are inside the case, as in Fig. 15; *T* is the ignition device. This particular type requires very little outside lubrication as the base, being tight, may be partially filled with oil, which by the action of the crank, is splashed over the working parts, keeping them well oiled.

At *P* is the electric igniting device, and at *c* is the compression cock. The elbow *A*, leading to the inlet valve, is held in place by a clamp, and when removed exposes the two valves.

In a single cylinder engine, the valve chest may be in the most convenient position. Referring again to Fig. 13, the inlet and exhaust chambers may, instead of being on opposite sides of the cylinder, be placed alongside of each other on the same side, and may then be actuated by the same cam shaft, saving some complication and making the engine rather more compact. In multiple cylinder engines this is a very common arrangement although seldom used in single cylinder engines.

The mechanical operation of the valves and the fact that the impulses take place only on alternate revolutions, make the proper sequence of events possible for revolution in one direction only, with the usual types of mechanism. For this reason the four-cycle engine can be adjusted to run in one direction only unless by means of special valve gear. There are four-cycle engines built which may be run in either direction, but they are not common.

For starting the four-cycle engines, a handle in the flywheel rim may be used, as in the two-cycle, but the more common device is a removable crank fitting over the end of the shaft just in front of the flywheel and provided with some kind of rachet attachment to allow the engine to continue its rotation, leaving the handle stationary. This is possible, since the four-cycle engine runs in one direction only.

ELECTRICITY IN THE HOME.

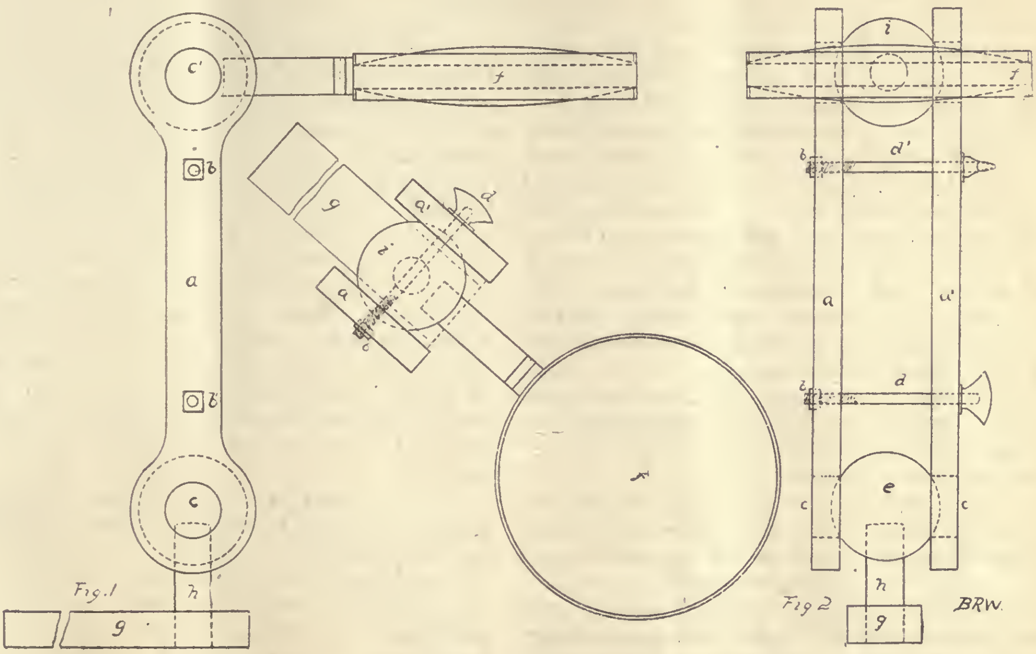
An interesting argument for the use of electricity in domestic heating is presented by Mrs. Ellen H. Richards, instructor in sanitary chemistry at the Massachusetts Institute of Technology, Boston, in her recently published book, "The Cost of Shelter." The point is brought out that this age of machinery has set free the human laborer, if only he will qualify himself to use the power at hand. The house will become the first lesson in the use of mechanical appliances in control of the harnessed forces of nature, and of that spirit of co operation which alone can bring the benefits of modern science to the doors of all. To manage the machine driven house will require delicate handling, but let women once overcome their fear of machinery and they will use it with skill.

The undue influence of sentiment retards all domestic progress. "Heating might now be accomplished," says Mrs. Richards, "without dust and ashes, without the destructive effects of steam, if enough houses would take electricity to enable a company to supply it in the form of a sort of dado of carrying wires safely imbedded in a non-conducting substance, or in the form of a carpet threaded with the conducting wire. Both heating and cooling apparatus could be installed in the shape of a motor to replace the punkah man and the present buzz-wheel fan, and to give fresh air without opening windows, which leads to half our housekeeping miseries.—"Electrical World."

The safety of illuminating oil is determined, not by its burning point, but by its flashing point.

MAGNIFYING GLASS HOLDER.

B. R. WINSLOW.



For very fine work in the drafting room and the shop, it is advisable to use a magnifying glass. It saves the strain on the eyes, prevents ruffled tempers and makes neater work possible. To work through a glass, however, some means must be provided for holding the glass in position and allowing a free use of both hands. Such a support must be so constructed that the glass may be placed at any angle and in any position. The drawing illustrates a satisfactory support, the construction of which is quite simple, and the cost of material a mere trifle.

The following material will be required: 2¾ feet of well seasoned oak strip, 1½ in. wide and 5-16 in. thick; two wooden balls about 1½ in. in diameter; two thumb bolts 1¾ in. long, and a reading glass at least 3 in. in diameter. The balls can be purchased at a toy store for a penny each. They are usually painted, but this can be easily scraped off.

From the oak strip cut two pieces 3 in. long, and with a bracket saw or knife, shape them as shown at *a*, Fig 1. The circles which form the ends are 1½ in. in diameter, and the connecting strip is ⅝ in. wide. In the center of each of the end circles bore a hole 9-16 in. in diameter, *c*, Fig. 1. Next bore two holes in each centerpiece, *b b*, Fig. 1, ¼ in. in diameter, about 2½ in. apart, and equal distances from the ends.

In one of the wooden balls, *e*, Fig. 2, bore a ⅜ in. hole about half way through the ball. In the other ball, *i*, Fig. 2, bore a hole large enough to take the handle of the reading glass, *f*, making a tight fit. From the oak strip cut a peg, *h*, Fig. 1, ⅜ in. in diameter, and about 1½ in. long, and fit one end tightly in the hole in the ball *e*, Fig. 2. Take a piece of the oak strip one foot long and bore a ⅜ in. hole in one end, *g*, Fig. 1. and in this hole fit the other end of the peg *h*, making it tight. Glue may be used in both cases.

Countersink the nuts of the thumb bolts in the holes *bb*, in one piece, *a*, Fig. 2. Insert the thum bolts *d* and *d* in the other piece, *e*, Fig. 3, and screw them part of the way into the countersunk nuts. Fit one end over the ball *e*, Fig. 2, and screw the lower bolt tight. Fit the other ball, *i*, in the other end and tighten the upper bolt. The assembling of the parts is shown clearly in the drawing. Fit the handle of the glass in the hole in the ball *i*, and it is ready for use.

If the thumb nuts shown in the drawing are not readily obtainable, ¼-in. machine bolts, 1¾ in. long may be used by countersinking the bolt heads in one piece and screwing a thumb nut on the other end in place of the regular nuts.

When in use the base *g* rests on the drawing board or bench, being held securely by the clamp. If clamps cannot be used, the support may be firmly attached by means of a long screw eye in the extreme end. A little manipulation of the support will soon demonstrate that the glasses can be held at any angle and in any position. To change the position of the glass it is only necessary to loosen the bolts a trifle.

BOAT SAILING FOR AMATEURS.

C. C. BROOKS.

The wind has four direct effects on a sail boat which must be understood by the amateur sailor before he can begin to see why his boat performs differently under different conditions of wind and sailing course.

The wind drives the boat ahead—most important of all; it also drives it laterally or, to speak in a nautical term, causes it to "make leeway"; it heels the boat over and lastly turns it around, according to the balance of her sails, distribution of weight, and what is known as the "center of lateral resistance." The proper handling of sails and rudder is what enables the sailor to so utilize these effects of the wind that he may sail his boat in any direction.

The propelling effect is the one most utilized, and it is for this reason that every boat is constructed to offer the least resistance to its forward movement with as little friction as possible.

Leeway is one effect to be avoided, and for this purpose boats are given either deep, stationary keels or center boards, or some other device for providing an extensive lateral surface below the water.

Heeling and the stability of a boat go hand in hand. The boat must be prevented from capsizing, and this is done either by putting lead or iron on the keel, or carrying ballast in the hull in order to lower the center of gravity, or by building a broad and shallow boat such as the cat boat, which is very stiff in a breeze and does not heel readily, but when a certain point has been reached, is apt to capsize quickly in the hands of an unskilful sailor.

The fourth effect is that of turning the boat around. This is done when the center of effort on the sails does not come on a line with the center of lateral resistance. This is always the case in a poorly balanced boat. A well balanced boat requires very little movement of the rudder to hold to a course.

Any novice can understand how a sailing boat can travel with the wind, but why it should go forward when the sails are close hauled is a question of dynamics which we will not try to explin in this short article. An easily understood explanation of why boats go ahead instead of sideways can be made by taking a V-shaped block of wood and pressing it between the thumb and forefinger. If sufficient force is used it shoots forward quickly. The thumb may be likened to the wind and the forefinger to the water on the opposite side of the boat. The pressure caused by the wind pushing the boat against the water on the opposite side causes the boat to go forward.

The center of effort and center of lateral resistance must be understood in the handling of a sail boat. The center of effort is the center of the total sail area. If, for example, this comes forward of the center of lateral resistance when the boat is sailing with the wind abeam, then the side pressure on the sails will turn the boat's bow in the direction towards which the wind is blowing, or away from the wind, and a boat doing this is said to carry a "lee helm."

On the other hand, if the center of lateral resistance is further forward than the center of effort, the wind will swing the boat in the direction in which it is blowing, thus throwing the bow up into the wind. A boat doing this is said to carry a weather helm. Every sailing boat should be so rigged as to carry a little weather helm as, if struck by squall under those conditions, it will luff quickly up into the wind and so be in safety, while if the lee helm is carried, the boat will fall off before the wind, presenting a broadside to wind and wave which is very apt to cause it to capsize.

Too much weather helm is also to be avoided as it makes it necessary to keep the rudder over at a sharp angle and retards the progress of the boat.

To reduce weather helm, move the ballast aft or shorten the after canvas or increase the forward canvas by setting a larger jib. If a boat carries a lee helm, shift the ballast forward or reduce the area of the head canvas.

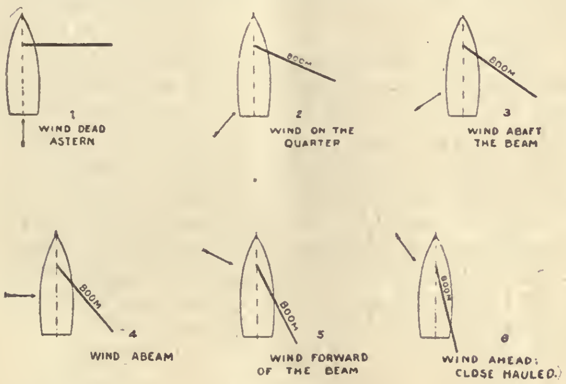
In considering the action of the rudder, the amateur sailor should bear in mind that as the boat is turned by the rudder it swings as on a pivot. The water, pressing against one side of the rudder, pushes the stern of the boat away from that side.

The pivot or turning point is always well forward of the center. This is a fact that should be remembered when steering close to a boat or other object. Don't delay turning out of the way too long or the very act of turning your boat will throw the stern over sufficiently to cause the collision you are trying to avoid.

SAILING.

Running before the wind may look like the ideal course to the amateur sailor, but a little experience cures him of that belief. Fig. 1 shows the location of the sail when on this course. Steering is difficult when running with the wind aft, especially in rough water, and there is danger of the sail gybing over when least expected. Except on smooth water it is better to haul the boat up so as to have the wind on one quarter, and after following that course for some distance, to "take the other tack," gybe over so as to bring the wind on the other quarter. Fig. 2 represents the wind on the quarter. Fig. 3 shows the wind abaft the beam. Fig. 4 shows the wind abeam, or directly at right angles with the boat. Fig. 5 shows the wind forward of the beam. Each figure shows the proper location or direction of the boom or, in a nautical term, how the sail should be trimmed. All of these are what are known as favorable winds, the sheet being hauled in such proportion as to give the best results. The positions in all of these figures show a boat when it is what is termed "sailing free."

To sail "close hauled" means to bring the boat up as close into the wind as possible and still keep it on its course, with the wind filling the sail so as to drive it forward. A properly built boat will lie within four or four and a half points of the wind, while some, especially those built on racing models, will do even better than this. Fig. 6 shows about the proper location of the boom when sailing close hauled. The wind, striking the sail at this angle will drive the boat forward and maintain a reasonable degree of speed, while to haul it closer would increase the leeway until, if the sail were hauled parallel with the keel, the only progress made would be to leeward. Most boats will sail closer to the wind in smooth water than in a rough sea.



SAILING.

When sailing close hauled, it is necessary to hold the boat on a course that will just nicely keep the sail filled with wind. This point can be ascertained by putting the helm slowly to the leeward. As soon as the sail begins to shake near the head, you have reached a point where it is not drawing as much as it should and, if the helm is kept down, the sail will begin to flap in the wind and the boat will lose headway. A little practice will enable an amateur skipper to see the beginning of this "tremble" in the sail, and at the first symptoms he must reverse the helm until the wind fills the sails fairly.

HINTS TO BE HEEDED IN SAILING SMALL BOATS.

To bring the boat up into the wind and reef a sail, lower the sail partially. First lash the cringle on the luff or forward edge of the sail, then stretch the foot of the sail taut with the after cringle and secure it. Roll the sail neatly and tie all the reef points with a square knot and haul the sail taut again. If reefing has been delayed too long, it may be necessary to lower the sail entirely before reefing. If sailing in a river or near shore, the safer plan when reefing is to run the bow of the boat on the bank before attempting to reef. Always stand to the windward of a sail when reefing.

To be always on the safe side, never belay the sheet. If desired, one turn may be taken about a cleat, holding the end so as to ease off quickly when necessary.

A good sailor will bring the boat up into the wind rather than ease off the sheet when struck by a puff of wind, but in sudden squalls both manœuvres may be necessary.

Remember that your boat is not liable to capsize if the sheet is free so as to permit the sail to move in a direction parallel to the wind.

In small boats the safest plan is to take the boat promptly towards the nearest land in case of sudden storms approaching. Don't wait for them to strike before seeking safety and, when preparing for a storm, all persons in the boat except the helmsman, should sit amidshsips on the bottom of the boat and stay there. Always have an eye on the wind, watching for the approach of sudden puffs which might cause trouble.

Do not attempt to tack when a big wave is coming on the weather bow, and do not forget to shift your seat to the windard of the tiller at every tack.

If sailing close to the wind in a sea and an ugly, breaking sea is coming, safety lies only in putting the helm down and luffing right into the wave so as to take it end on, or nearly so, and as the wave passes, put the helm up and fill the sails so as to avoid losing headway.

Table of specfic gravities:

Aluminum	2.68	Lead, cast	11.35
Antimony, cast	6.71	Phosphorus	1.82
Bismuth, cast	9.82	Platinum, rolled	22.07
Brass	8.38	Pyrites, iron	5
Coal, compact	1.32	Quartz	2.65
Copper, drawn,	8.88	Silver, cast	10.47
Copper, cast	8.79	Sodium	0.97
Diamond	3.52	Sulphur, native	2.03
Gold, stamped	19.36	Tin, cast	7.29
Gold, cast	19.26	Zinc	6.86
Graphite	2.30	Sulphuric acid	1.85
Iron, wrought	7.79	Mercury	1.52
Iron, cast	7.21	Nitric acid	1.42

Before water can become steam the upward pressure of its vapor must overcome the downward pressure of the atmosphere; hence it follows that the boiling point of water is conditioned by the atmospheric pressure. Water boils at a much lower temperature on mountain tops, where the pressure is comparatively small, than in the valleys.

CORRESPONDENCE.

No. 154. PARIS, TEX., JUNE 7, 1906.

Will you please answer the following questions:

1. Does heat destroy the resistance of German silver wire?

2. In using wire like samples enclosed (Nos. 23 and 30 gauge) for a ½ in. spark coil, what would be the specifications for winding, using the larger wire for the primary?

3. Please give directions for making a transmitter to work on a line 300 ft. long.

4. Could German silver filings be used in a coherer together with nickel filings. P. C.

Heat increases the resistance of all metals excepting carbon, but the rate of increase varies with different metals. It is very small for German silver, which is only one ninth that of copper.

2. The samples of wire you enclose are not suitable for making up spark coils. The larger gauge is too small for the primary, and the finer one too large for the secondary. As the cost of suitable wire for a coil to give a ½-in. spark is small, it would be advisable to purchase new wire.

3. An answer to this question requires too much space for this department. A special article will be published as soon as it can be prepared.

4. A coherer should be made as efficient as possible, as they are not any too sensitive at best. We have yet to learn of German silver filings having any advantages over the usual iron and nickel combination.

No. 155. SUMMIT, N. Y., JUNE 18, '06.

Will you kindly answer the following questions:

I desire to connect my workshop in the barn with the house by telephone, but do not care to spend a large sum to do so. Will you tell me the cheapest and simplest method for doing it? The distance is about 300 feet, and I have two single pole receivers. Can they be wired up to serve the purpose? Would it pay to use magneto generators for calling instead of batteries? Please send me a diagram of the connections of small, two station telephones. Is it possible to connect another instrument to these telephones by using extra wires, or other mechanism, etc. If so, please send diagram. A. J. M.

Two ordinary telephone receivers can be used for a telephone line by having a complete metallic circuit of insulated wire, except in the open air, where bare wire may be used. The connections should be made so that the coil windings of each transmitter will send the current in the same direction around the line; or, in other words, one coil should not oppose the other. The distance you mention is rather too long for satisfactory results by this method, and a microphone transmitter will probably be necessary. An article describing a simple and inexpensive telephone, suitable for distances up to 200 yards, will be published in an early issue. Magneto generators are necessary for calling only when the distance is greater than that for which a battery current is adapted, about 500 yards. The desired diagrams are enclosed with answer. Several battery telephones can be connected together by using an extra wire for each added station over two, and two extra wires for the ringing circuit.

No. 156. SOMERVILLE, MASS., JULY 4, 1906.

What size spark could I expect to get with a 10-volt current from a coil made as follows:—Coil is 10 in. long and 6½ in. diameter, with secondary made in eight sections, of No. 28 gauge wire. There are three layers of paper between each layer of wire. Shellac is used as an insulator. What size spark would I get on a circuit, cut down by a resistance of sulphuric acid batteries. J. P. C.

The information given is not adequate to even hazard a guess as to the length of spark possible from the coil, but the size of wire used in the secondary and the excess of paper between layers would indicate a very small spark. Complete specifications as to core, primary, secondary and insulation are necessary to calculate the capacity of a coil, and even then the workmanship is a large factor in determining the output. If the primary will carry a 112-volt current, presumedly from a lighting main, the spark might be increased slightly, but the information given indicates that the proportions of the coil are faulty.

No. 157 MINNEAPOLIS MINN., JUNE 10, 1906.

Will you please tell me whether or not an alternator will take the place of a current breaker and condenser. J. A. Fleming, in "Magnets and Electric Currents" says: "The condenser is, therefore, an essential adjunct in a coil intended to give long sparks from the secondary circuit, but is of no value if the induction coil is used with alternating currents." Can you tell me whether it is advisable to use an alternator? In the above I refer to the use of a 12-in. coil for use in wireless telegraphy. W. C. R.

An alternating current dynamo may be used to furnish current for operating induction coils in place of a direct current. In such a case, the vibrator, if there is one, is screwed up tight against the core and the condenser cut out of circuit. Currents from alternating lighting circuits are frequently used for coils, but special interrupting apparatus is generally needed to enable such currents to be used satisfactorily, especially with large coils. It is desirable that the alternating dynamo, where one is used especially for coil work, be specially designed for the purpose. We have no knowledge of anything in print giving information on just the points you mention, and we therefore will have an article prepared in which this information will be fully treated.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

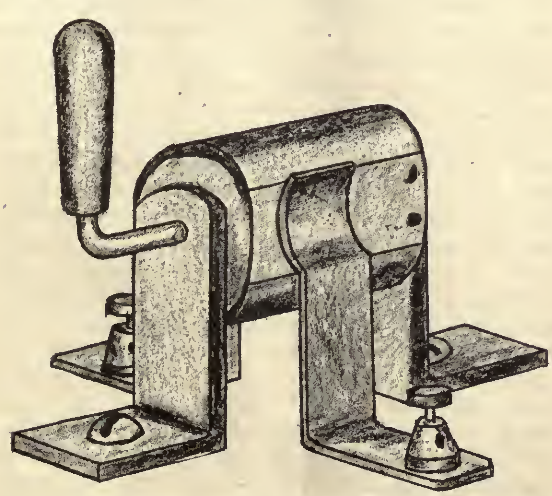
Vol. V. No. 11. BOSTON, SEPTEMBER, 1906. One Dollar a Year.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

VI. Current Reverser and Spark Gap.

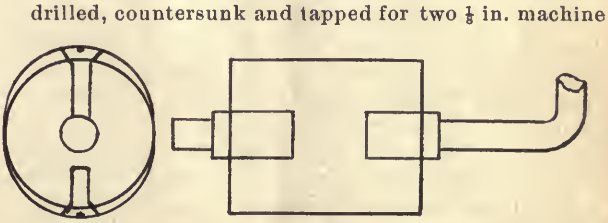
With all except the very smallest of coils, it will frequently be found desirable to have a current reverser by means of which the direction of the current through the primary winding may be quickly changed. In using Geisler tubes it is quite an interesting experiment to thus change the current, and note the color changes at the terminals of the tubes.



There are two forms of reversers in common use; the three point, two arm switch, and the ellipsoidal form having two brass contact surfaces, and the circuits completed through the shaft, shaft bearings and flexible contact springs, as shown in the illustration. The dimensions here given are suitable for a coil giving a two-inch spark, and may be reduced for smaller coils, but need not be enlarged for coils giving up to eight-inch sparks. To turn out a finely finished job will require a lathe having a slide rest and chucks, but passable work may be done with a hand drill and taps.

The first work will require a piece of round hard rubber rod 7/8 in. long and 1 in. diameter. Find the exact center of each end and drill 3/8 in. holes 3/8 in. deep. In these holes is mounted the shaft, which is in two pieces, the intercepting section of the rubber serving to insulate the two sections. The shapes of the two sections of the shaft are given in the illustration and they are turned or filed out of a piece of round steel.

A piece of brass tubing, 1 in. inside diameter and 7/8 in. long is then slipped over the rubber; holes are drilled, countersunk and tapped for two 1/8 in. machine



screws on opposite sides of each end. The screws must be long enough to reach into the shaft a short distance; the latter being drilled for same, after locating the points by boring the holes above mentioned. These screws serve the desirable purpose of keeping in place the sections of tubing and shaft ends.

When this work is completed, the heads of the screws are filed to conform to the surface of the tubing, which point should be kept in mind in countersinking the holes for same, so that the heads will not sink too deep. The important point is to be able to file the heads of the screws down so that but little of the slot remains, just enough to take a screw driver, should it ever be necessary to take it apart.

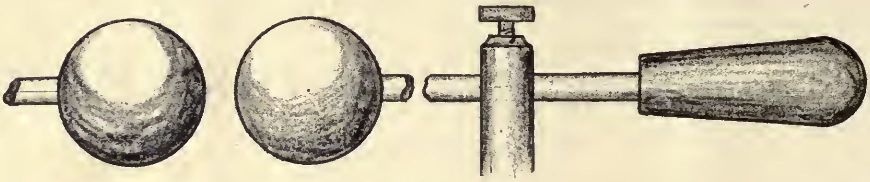
The larger end of the shaft is bent to a right angle and fitted with a hard rubber or composition handle. A suitable handle can be obtained from a cheap button hook. It is fastened to the shaft with shellac, after first roughing the shaft fitting some with a file.

The shaft should be so fitted to the rubber tubing that the handle will be exactly vertical when the springs rest easily upon the rubber; when turned horizontal in either direction the springs rest upon the brass faces.

The spring contacts are bent up from strips of spring brass, the top ends being bent as shown, and the bottom ends thrust out at right angles and holes drilled to receive the screws for binding posts.

en from the large button hooks, as previously mentioned for the current reverser.

A word of caution may be desirable to novices in the use of coils: Do not undertake to adjust the spark gap or connected apparatus when the current is on. The brush discharge from any, except the very small coils, is quite enough to give a severe shock. It is quite probable that in a moment of carelessness, however, most of us learn how true this is.



In connecting up, one end of the primary is connected with the wire from the condenser to the vibrator. The positive and negative wires from the battery are connected to the binding posts. It will be evident that when the handle is thrown horizontally to one side the current will pass in one direction. When the handle is vertical no current will pass, and it will be found very handy when adjusting the apparatus, thus to be able to throw off the current without disturbing the connections, as well as effecting a considerable wear on the batteries.

In many experiments with a coil it is desirable to make use of discharging balls, and this is especially true of wireless telegraphy. To make such balls, obtain two brass curtain pole ends, which are made of spun brass and come fitted with screws for attaching to curtain poles. These screws must be removed, which may be done by sawing them off with a hacksaw, leaving the heads inside the balls, which is not objectionable, or the small caps surrounding the screws may be unsoldered with a blow pipe and the screws removed. The latter method should not be used, however, unless the worker is rather skilled in soldering, or the resoldering of the cap is done by a jeweller, which service may be obtained at small expense.

If the screws are sawed off the brass rods carrying the balls are inserted a short distance into the screw holes and fastened with solder. If the screws are removed by taking off the cap, the rods are first soldered to the caps and these in turn soldered in place on the balls. Whichever way is used, all excess solder should be removed with a small, smooth file, and the joint polished with fine emery cloth, as all abrasions and points serve to dissipate electricity. The appearance of the balls is improved by a coating of thin lacquer.

Rubber or composition handles are fitted to the outer ends of the rods, after passing the same through the secondary terminal posts. These handles may be tak-

ELECTRIC DERRICK.

A novel application of electricity in the handling of iron and steel is now in operation in Cleveland, Ohio, in the way of a magnet.

This form of magnet consists of a large iron disk supported by chains, which may be fastened to the hook of a derrick or crane block. To the top of the disk is applied an electric plug device connected with insulated wires, which by an ingenious auxiliary pulley arrangement are led to a controller at some convenient point at the base of the derrick or in the operator's cab of the crane. The disk is lowered over the material to be lifted and the current turned on, and in this way enormous loads of material may be gathered together and held by the magnet as long as the current remains connected. Different forms of the disk are made for handling pig iron, heavy melting stock, such as crop ends, butts, steel risers, small castings, tin scrap, whether loose or in bales, shearing scrap, rod scrap, bolts, nuts, punches, rivet spikes, rail ends, machine borings, flats, sheets and, in fact, almost any form of iron or steel which affords a surface sufficiently large for the magnet to act upon. When the material has been carried to the place where it is to be deposited the current is turned off and the magnet at once releases the load. Scrap tin has always been an ugly form of material to handle satisfactorily, but by the use of this device it may be disposed of as rapidly and as easily as heavier stock.

At the present time all wire is made by the drawing process, and while permitting the production of a much thinner wire than could be obtained from the rolls, it also gives a wire of greater tensile strength, so much so that the smaller the size to which the wire is drawn down, the greater is its ultimate breaking strength.

DOVETAIL JOINTS.

These are employed chiefly for uniting wide and comparatively thin pieces of wood at right angles, as the sides and ends of box-like constructions. But the dovetail can be employed in many other circumstances and it is not by any means the only form of joint, or even the one most frequently adopted, for jointing under the conditions mentioned. In particular classes of work, however, the dovetail is invariably employed. In cabinet making dovetail joiuts are constantly used; in joinery and in pattern-making, less frequently; and in heavy carpentry scarcely at all. One reason for this is that in cabinet work appearance is a consideration of much importance. Another is that joints must be made as secure as possible in themselves, so that they can be held by glue alone. In a rougher class of work equal strength can be attained with less labor by the freer use of screws, nails, bolts, and other means of attachment between parts more simply fitted.

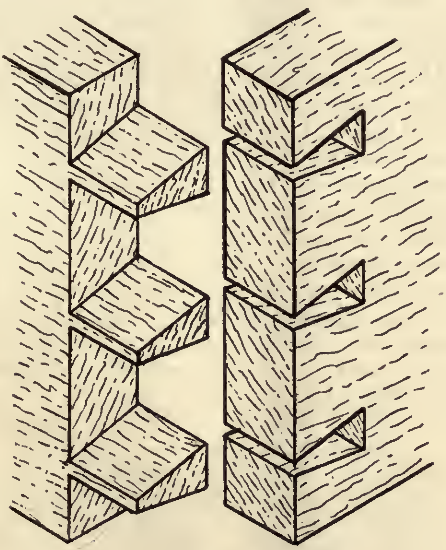


FIG. 1.

Well fitted dovetail joints are so strong that for most purposes there is no advantage in using anything besides glue to hold them together; but occasionally in carpentry and pattern work they are nailed as well. When they break it is not usually by direct pulling apart in either direction, but as the result of racking strains across the corners of the frame. If these are sufficiently severe the dovetails shear away in line with their grain.

Dovetails may be divided into three classes—common, Figs. 1 and 2; lap, Fig. 3; and secret, Fig. 4. The first two are the strongest and most easily made, the others only being preferred in some cases for the sake of appearance. The common kind may again be divided into two varieties—those in which pins and dovetails are of equal width, Fig. 2, and those in which the pins are narrower—generally about one-fourth the

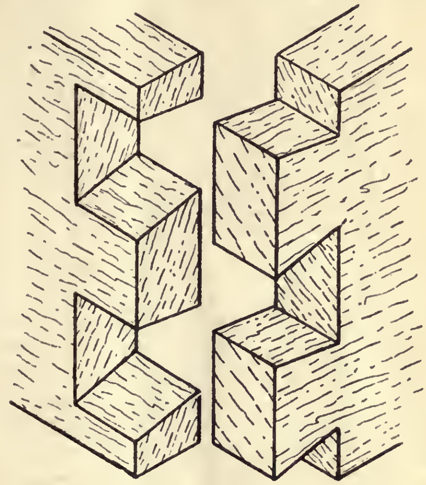


FIG. 2.

width of the dovetails, Fig. 1, or in some cases as narrow as it is possible to make them, their thinnest part being only the width of a saw-cut. Of these varieties,

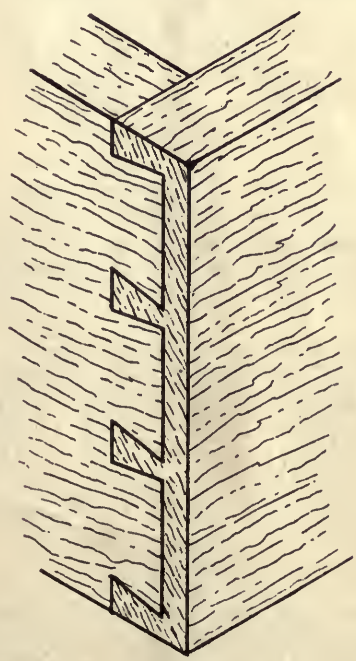


FIG. 3.

the equally divided type, Fig. 2, is the stronger, because each piece of wood is cut away to the same amount, and the parts interlock at equal intervals. The appearance of this joint, however, is not considered so good as that in Fig. 1, and consequently the form shown in Fig. 2, which is known as the "cistern dovetail," because it is employed for cisterns and similar large, heavy boxes, is scarcely ever adopted in cabinet work.

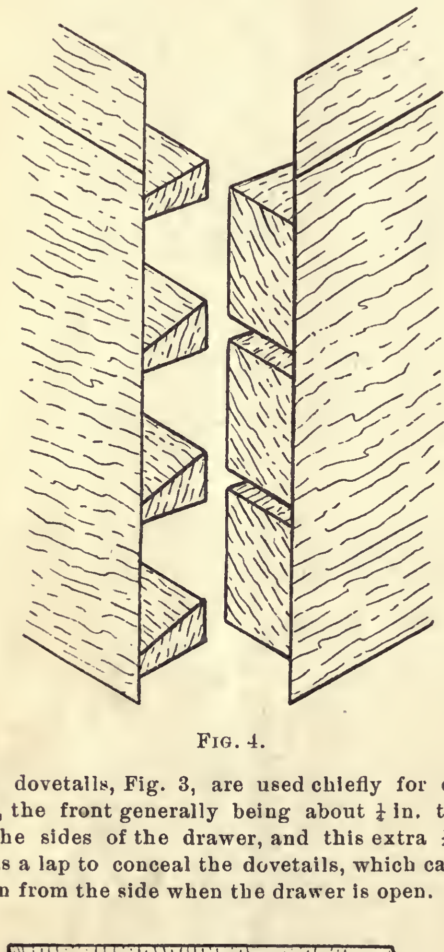


FIG. 4.

Lap dovetails, Fig. 3, are used chiefly for drawer fronts, the front generally being about ¼ in. thicker than the sides of the drawer, and this extra ¼ in. is used as a lap to conceal the dovetails, which can only be seen from the side when the drawer is open.

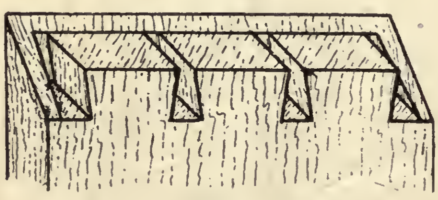


FIG. 5.

Secret dovetails, Fig. 4, are entirely concealed when the parts are together, the exterior appearance being either that of a plain mitre joint, the inner detail of one-half of which is shown in Fig. 6, or a mitre with a step or shoulder, Fig. 6, which represents the end dovetails in one of the pieces. Another form, in which the lap is not mitred, is shown in Fig. 7.

Dovetails, when done by hand, are first marked out and cut on one piece, and then transferred from that by direct marking to the piece that has to lock with them. This is more reliable than separate markings out on each piece would be, and it also renders very careful division on the first piece unnecessary. The pieces to be united must first be planed to thickness

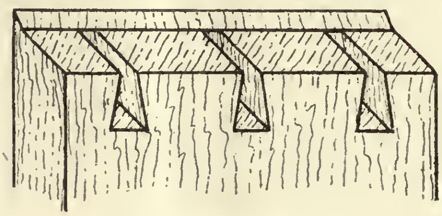


FIG. 6.

and width, and squared to length. This, of course, must be accurately done. Then a gauge is set to the thickness of the stuff, and lines are gauged from each end completely around each piece—that is, if the pieces to be dovetailed are 1 in. thick, lines are gauged 1 in. from the end of each piece across faces and both edges. Usually the pieces to be jointed are of similar thickness; but if they are not the parts must be gauged accordingly. It is now a matter of choice whether the pins or sockets shall be marked first. The projections on the left-hand parts of Figs. 1, 2 and 4 are called the "pins," the spaces which these fit into the "sockets." Many saw the pins first, but for work done in quantity it is better generally to take the sockets first, because a number of pieces can then be clamped together and cut without separate marking for each. It is not really essential that dovetails should be marked out other than by the eye; but careful men will divide and mark them with a bevel.

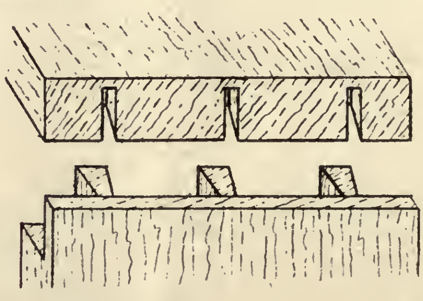


FIG. 7.

If a box or frame which has to be dovetailed together is longer in one direction than in the other, the longer pieces, or sides, are selected for the sockets and generally a half-dovetail is allowed at each edge of these pieces, Fig. 8. To mark them out properly a line, 0 0, Fig. 8, is gauged midway between the end of the wood and the root of the dovetails, which latter is already indicated by the lines previously gauged, and marked 1 1 in Fig. 8. The divisions are made on the line 0 0. If we take now about a third of the thickness of the material we shall have suitable width for the sockets on the line 0 0, and if we make the dovetails or intervening portions of wood four times that amount we shall have a good proportion for each.

however, it must be kept slightly to one side of the original mark to prevent the pins from being a loose fit. By the other method the sockets are first cleared out, and the marking done with a scriber, Fig. 10, the pieces in either case being adjusted in the same way in their correct relation to each other while the marking s done.

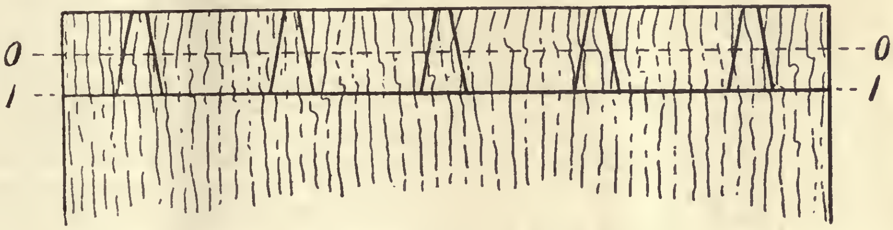


Fig. 8.

This, however, may have to be modified to make the divisions come out right on the width of the wood. A bevel is then set to the angle of 80°, which is the most suitable for dovetails, and lines are marked from the end of the wood through each of the divisions on the center line 0 0 to the inner line 1 1 at the root of the dovetails, the bevel being reversed to mark the slope in opposite ways. A line of dovetails thus marked is shown in Fig. 8. The next step is to make a number of sawcuts through these sloping lines, stopping each cut when the saw reaches the inner line 1 1. The sockets may now either be cleared out before the other part on which the pins have to be cut is marked, or the marking may be done through the saw cuts.

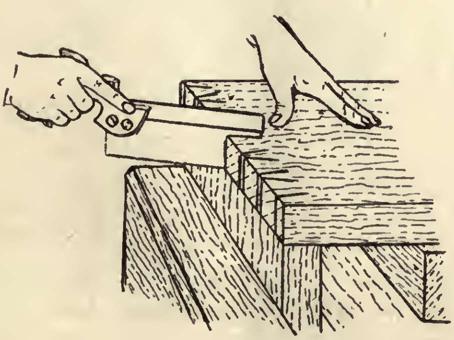


Fig. 9.

If the latter method is followed the piece to be marked is screwed end upwards in the bench vice, and the piece which has been sawed is laid with its end in correct position on top of it, Fig. 9. The marking is then done by the end of a dovetail saw inserted in each cut in turn and drawn over the end grain of the upright piece sufficiently for the teeth to leave a mark, which is sawed to after the top piece has been removed. In starting the saw afterwards,

By these methods, of course, no fitting is supposed to be afterwards required, the only parts that are touched with a chisel being the end grain at the roots of the pins and dovetails. These are cut slightly concave from each face of the wood to insure a close fit at the external faces. In small dovetails these portions are removed by a chisel and mallet in the same way as mortises are cut out with a bow or keyhole-saw, unless a bandsaw is available. Sometimes they are bored out, but in all cases a chisel is used to finish to the line.

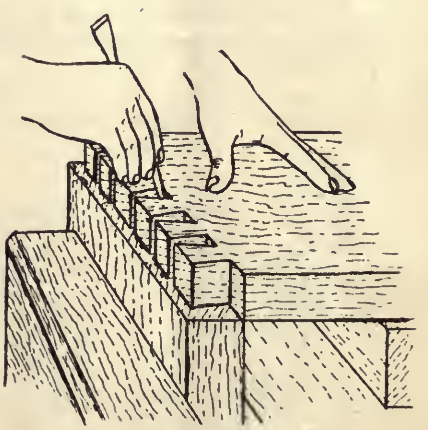


Fig. 10.

The part should be tried together before gluing. The glue should be applied to both parts, using a slip of wood if the sockets are too narrow to insert a brush. The parts should be an easy driving fit, and a block of wood is laid across the surface to receive the mallet or hammer blows, which would bruise the surface, and be rather too local is delivered direct.

Lap dovetails are more troublesome to cut because the saw cannot go through where the lap occurs. The marking out from this of the lapped piece is very simple, the end of the piece merely having to be adjusted to a line which leaves the thickness of the lap beyond. This line is gauged from the inside face, with the gauge set to the length of the dovetails of the first piece. The scribing or saw marking is then done as before. Fig. 10 shows the parts in position for marking a lap dovetail. In cutting the spaces out, however, and forming the lap, most of the work has to be done with a chisel.

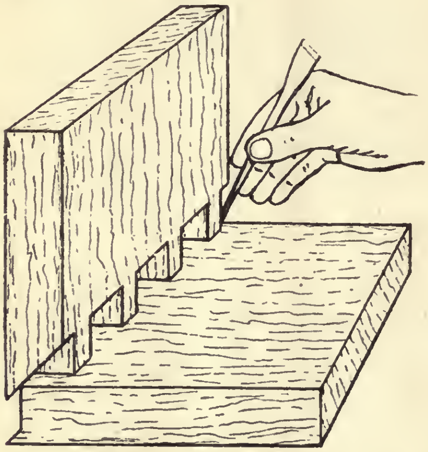


Fig. 11.

The secret dovetail, Fig. 4, may be regarded as a double lap with the laps mitred. A thickness of about one-fourth of the total is gauged from the exterior faces of both parts on the ends, and also on the sides if the mitre is to be carried across them. Then a similar distance back is gauged on the inner faces, representing the amount the lap extends beyond the dove-

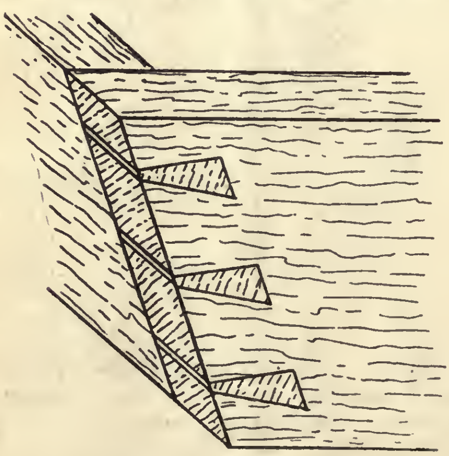


Fig. 12.

tails each way. In this case it is better to mark and cut the pins first because if the other procedure is followed, it is difficult to mark through the narrow entrances to the sockets, for the outside being closed by the lap, the marking has to be done from the back, as shown in Fig. 11. In these cases the rebate at the front should be cut before the dovetails are proceeded with.

The dovetails in this kind of joint are often continued along the complete width of the stuff, and only the front faces are mitred, leaving the joint edgewise like Fig. 6. This rather simplifies the work, but it is not, strictly speaking, a secret dovetail, as that in Fig. 5 is, in which the mitre extends over the edges as well as where the faces meet.

Another variety of dovetail sometimes required and rather troublesome to mark out, is that shown in Fig. 12, in which the dovetailed parts meet at right angles, but slope, or are splayed depthwise. In such cases it must be borne in mind that the dovetails must be parallel with the edges of the wood, and can only be marked from the sloping ends by having bevels set to two different angles, which must first be discovered by marking two oppositely inclined lines at 10°, with the edges. The pins may be gauged from the edges or a bevel set to the angle may be used; but they cannot be squared from the ends, as in other work.

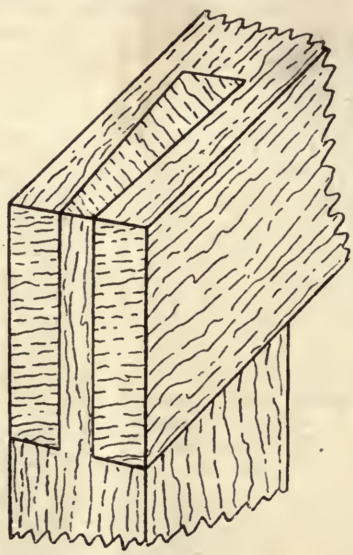


Fig. 13.

The remaining Figs., 13 to 16, show examples of dovetail joints in other circumstances than the box-form constructions of the preceding figures. Some of these are common in carpentry and pattern making. Fig. 13 is a single dovetail uniting at right angles the ends of the two pieces that are nearly square in section, and consequently not suitable for jointing by a series of interlocking projections and recesses, as in the previous cases. In a case like Fig. 13, it is a matter of considerable importance as to which piece the pin is formed on, for it is obvious that the joint would stand a great deal more internal pressure against the dovetail than at right angles to it, where it would only

CONCLUDED ON PAGE 304.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

IV. Vaporizers and Carburettors.

Before the gasoline can be used in the cylinder of an engine it must be converted into vapor and mixed with the proper proportion of air. The devices for performing these functions are termed vaporizers or carburettors. Although a certain distinction may be made between the two, their functions are the same and their methods of operation quite similar.

The fundamental principle of their operation is the picking up of the gasoline by a current of air; the gasoline in practice flows out of a small orifice direct into the stream of air which is drawn in by the suction stroke of the engine. The relative proportions of gasoline and air must, of course, be nicely regulated, as the proper mixture is far more effective than one either too weak or too rich. All vaporizers or carburettors to properly perform their duties should be provided with means for regulating the flow of both the gasoline and air.

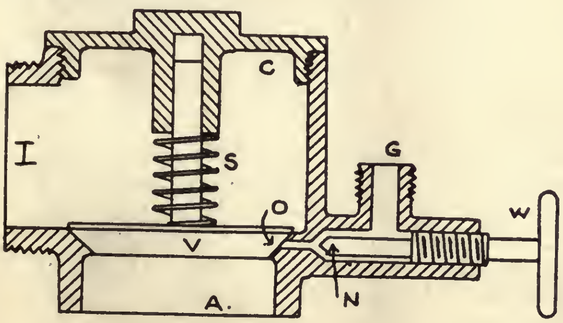


FIG. 19.

The simplest form of vaporizer, or mixing valve as it is sometimes termed, is shown in Fig. 19. It consists of a brass casting containing the valve V and its seat, and having the openings, *G*, *A* and *I*. It is attached to the crank case of the engine by the threaded end *I*.

The gasoline enters at *G*, flowing around the needle valve *N* and into the very small opening at *O*. The valve V has a spindle extending upwards and fitting the hole in the cover *C*. This stem acts as a guide to the valve and assumes its seating correctly after being raised. The spring *S* is inserted to return the valve to its seat quickly. The needle point *N* may be moved in or out by the thumb nut *W*, thus regulating the flow of the gasoline. The valve *V* when seated covers the needle opening *O* preventing the escape of the gasoline.

This form of vaporizer is most commonly fitted to two cycle two port engines. The suction created in the crank case by the upward strokes of the piston causes the valve V to raise and the air to rush in through the opening. The raising of the valve uncovers the needle opening *O*, and allows the gasoline to flow out into the incoming stream of air, which immediately absorbs it. The mixture thus passes into the crank case and is ready for use. As soon as the piston has reached nearly the top of its strokes and the suction has ceased, the valve *V* returns to its seat by its own weight, aided by the pressure of the spring *s*, and prevents the escape of the gases on the downward compression stroke; this valve *V* is the non-return valve mentioned on page 211 of Chapter I.

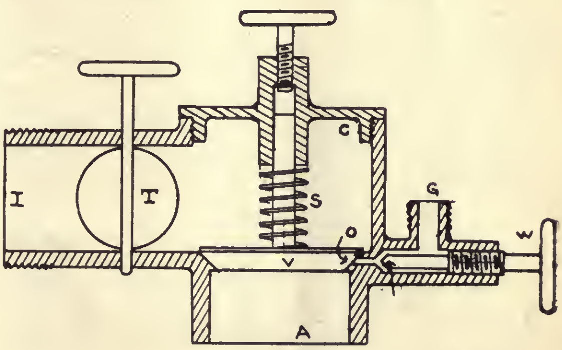


FIG. 20.

This vaporizer has no means for adjusting the supply of air. only the gasoline supply being variable. It is, consequently, not very sensitive. It is, however, owing to its simplicity, suitable for small engines, where it gives good results. For engines of large size this type of vaporizer is not sufficiently sensitive.

A more approved type of generator is shown in Fig. 20. Its principle of action is the same as that just described, but in addition to the parts already named, has the wheel *R*, which screws down on the stem of the valve and thus regulates its lift. It also has a sort of shutter or throttle valve *T*, consisting of a disc which may be turned to partially or wholly close the opening.

The proportion of the mixture may be varied as follows: The gasoline opening may be varied by the needle point *N* and the thumb wheel *W*, giving a weaker or richer mixture. The air supply is regulated by the screw *R*, which varies the lift of the valve *V*. These adjustments allow the regulation to suit the different conditions of running the engine. The spring *S* is fitted in order to make the valve seat more quickly without loss of crankcase compression, and thus allow the enine to run at higher speed than would otherwise be the case.

For regulating the speed of the engine a throttle, consisting of the disc *T* is placed in the inlet. It may be turned by the small handle outside and thus regulates the amount of the mixture without change in its proportion. The same result may, of course, be accomplished by the manipulation of the screws *R* and *W*, but in doing this the best proportions of the mixture may be lost and readjustment required. Some of the cheaper generating valves for this reason are not furnished with the throttle, but it is far more satisfactory to have one with this fixture.

The cap *C* may be unscrewed allowing the valve *V* to be taken out.

Vaporizers of this type are suited to two cycle engines of the two port type, which require check, or non-return valve on the crank case. For three port and four cycle types some form of float feed carburettor may be used to advantage.

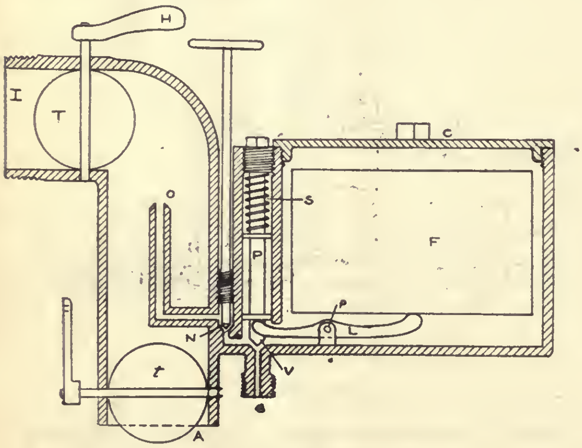


FIG. 21.

Although, as before stated, there is no difference in the function of vaporizers and carburettors, those of the types just described are commonly called vaporizers or generating valves, while those governed by a float and having no check valve are usually termed carburettors.

Fig. 21 shows the elements of the float feed carburettor which consists of a chamber containing the float *F*. Leading from this chamber is the small opening containing the needle valve *N*. The gasoline enters at *G*. At *V* is a small valve attached to the float which closes the opening of *G* when the float rises; the float is guided by the two stems as shown. The gasoline passes through the needle valve *V* and up the vertical tube to the opening *O*; the height of the opening *O* is so adjusted that the level of the gasoline is just below it when the float is in its highest position and the valve *V* is closed. The air, drawn in by the suction stroke of the engine, rushes past the opening *O*, draws up and absorbs a portion of the gasoline. At *w w* is a cone of fine wire gauze which catches any gasoline not taken up by the air current and holds it suspended ready to be taken up at the next stroke.

At *T* is a sort of shutter or throttle which may be turned by the handle *D* and wholly or partially close the opening *I* and thus regulate the amount of the mixture passing to the engine and consequently the speed; the gasoline supply is regulated by the needle valve *N*, as before. A small arrangement is sometimes fitted below the needle valve to regulate the air supply independently.

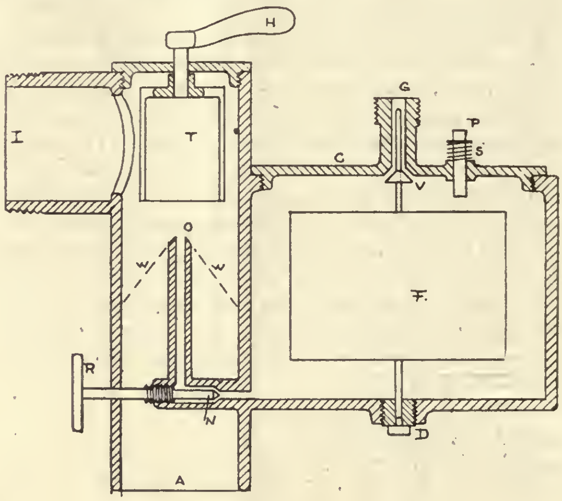


FIG. 22.

The float *F* is made usually of copper, although sometimes of cork; it is guided by the small stems as shown. At *P* is a small plunger for forcing the float down for the purpose of flooding the opening *O* and making certain of the flow of gasoline. The cover *C* unscrews to allow access to float chamber.

In operation, as the gasoline is drawn up by the air, the level in the float chamber falls slightly, finally opening the valve V, admitting gasoline and restoring the level, whereupon the float rises, closing the valve V and stopping the flow. Thus the level is maintained constant and the same amount of gasoline drawn out at each stroke. The proper mixture is obtained by the proper relation of the air and gasoline supplies.

Fig. 22 shows another form of carburettor, whose operation is similar to that of the one just described but which has, however, some points of difference. The gasoline is admitted at *G* as before, the valve V, however, is a separate piece and is held down to its seat by the spring *s*; the lever *L*—which is pivoted at *p* is forked and rests just below the projection on the valve V; the float *F* is free and rests just above the long end of the lever.

When the float *F* settles, owing to the using of the gasoline, it strikes the end of the lever *L* and presses it down by its weight, thus raising the valve V and admitting more gasoline. When the level has risen sufficiently the float ceases to press in the valve V, and it closes. The usual needle valve is at *N* and the orifice at *O* as before. At *I* is a disc which may be turned across the opening and act as a throttle to regulate the speed of the motor. At *t* is a similar disc to regulate the air supply; by means of this disc *t* and the needle valve *N* the correct proportion of air and gasoline may be maintained.

Although the actual details of the different carburettors will differ greatly, the principles governing their action will be found to be similar to the above, and the several parts will be found in one form or another.

It is necessary for proper performance that means should be supplied for the regulation of both gasoline and air supplies. Owing to varying atmospheric conditions the relative adjustments will require changing from time to time. Even for starting the engine a different adjustment may be required from that under which the engine will run after being warmed up. Any carburettor not having these adjustments is likely to give trouble in starting the engine.

The advantages of the float feed carburettor over the mixing valve are: The check valve is done away with, avoiding the noise and loss of the suction necessary to raise it; a more uniform mixture is obtained, as the gasoline is always at the same level; this is especially true in a sea, as there is a sufficient body of gasoline in the float chamber to draw upon at times when the boat is pitching and the tank is perhaps lower than the vaporizer, and the flow would otherwise be interrupted, causing the engine to work irregularly; the speed may be more easily controlled, and the engine may be run at a slower speed where the suction would not be great enough to raise the check valve of the vaporizer.

The vaporizer or generator valve is fitted to two cycle two-port engines which require a check valve. For two-cycle three port engines some form of float feed is used. The float feed may also be fitted to the two-port type by the addition of a check valve between the carburettor and the engine. Some forms of float feed carburettor are fitted with a check valve for this purpose. The four-cycle engine is commonly fitted with some form of carburettor.

Warm air will absorb a greater amount of gasoline than cool air; for this reason the air inlet *A* is usually connected to a pipe which can draw air from some warm place, such as around the exhaust pipe or between the cylinders. A very common idea is to encircle a portion of the exhaust pipe with a perforated sleeve of thin iron with an outlet leading to the air pipe; in this way the carburettor is supplied with warm air. The vaporizing of the gasoline also draws heat from the body of the fluid and causes the carburettor to become quite cold, even so cold as to cause some trouble; this is avoided by drawing warm air from some source.

The air inlet should be protected from spray, as the presence of water will spoil the mixture. It should also be provided with a screen of wire gauge to prevent the sucking in of particles of waste, or other light substance which would cause trouble.

COCOANUT OIL AS FOOD.

Owing to the relatively high price of butter there is a growing demand for cheaper fatty foods, especially among the poorer classes.

In the first number of the "Philippine Journal of Science" a series of papers deals with the cultivation of the cocoanut palm and the production of the oil. The nuts are split in two, the "milk" being allowed to run to waste and dried in the sun or in a kiln for a few days. The "meat" is then removed from the shell and further dessicated, when it forms the copar of commerce. A number of nuts which were stored for six months and had not sprouted, were found to contain 20 per cent of shell, 34 per cent of milk and 46 per cent of meat, equivalent to 19.5 per cent of copra or 12.4 per cent of oil, the percentages being calculated on the weight of the nuts free from husks. The dried copra therefore contains over 68 per cent of oil. Analysis showed that on an average the fresh meat of a cocoanut contains 4.683 grammes of nitrogen, 2.475 grammes of potash, and 1.74 grammes of phosphoric acid.

The milk of a cocoanut contains on an average 1.542 grammes of nitrogen, 1.313 grammes of potash, and 0.171 grammes of phosphoric acid. The analytical data given are by no means exhaustive; but they are sufficient to show that as regards the high yield of oil and the presence of considerable amounts of nitrogen potash and phosphoric acid, the cocoanut possesses a distinctive nutritive value. As cocoanut oil has been largely employed as a food without the production of unfavorable results, and as it is sold at less than half the price of butter, there would appear to be good reasons for the further extension of its use as an alternative to butter, especially since its peculiar flavor has been eliminated by a process of purification.

In cases of poisoning by illuminating gas, the treatment is most energetic. The patient should be brought into the open air at once, the clothing loosened and hot bottles applied to the extremities. If the air passages are blocked by vomited matter, these should be cleaned. Active rubbing of the skin with coarse towels, mustard water applications to the extremities, and artificial respiration should be instituted. The breathing of camphor vapor, or well diluted ammonia gas, may help the breathing. So long as the heart beats there are hopes of reviving the patient.

CASEHARDENING.

WALTER J. MAY.

Casehardening, as the term itself implies, means the formation of a hardened surface on otherwise soft metal, and the term is used more generally in regard to iron and steel, although to some extent a form of casehardening can be applied to copper and some of the bronzes having a high fusing temperature. Really, the process is one of alloying by absorption, and although this process in many cases causes a lot of trouble, when done with a well-defined purpose it has beneficial effects. With iron and steel, carbon is absorbed, and with copper or bronze, either metallic tin, manganese or arsenic will be the hardening material; but tin is the better hardening for general use. As a rule, however, only iron and steel are dealt with, as these have the most commercial use; but it might, perhaps, be well to give the results of surface hardening on copper as done by the writer experimentally.

Ordinary wrought-iron, mild steel and malleable cast-iron will caseharden well, the last being the least satisfactory, but still for some purposes being very successful. Ordinary cast-iron, if treated by the casehardening process, would rather be softened, owing to its then being annealed with an excess of carbon, part of which would be absorbed.

In some cases only part of an article can be casehardened, while the other parts are left soft; and although this may involve some trouble, yet for particular purposes the results are worth all the trouble taken. Take, for instance, the steel rings in rice-dressing machines; if these are hard right through, they break very readily; but if the outer part is hardened and the inner parts remain soft, there is little fear of breakage. Mild steel can be used for such rings, and the saving in time and labor in cutting more than compensates for the cost and trouble of hardening. Again, it is possible to harden pinions and such like in whole or in part as is required; and certainly it is a great advantage to do machining on soft metal and then to harden the work to a reasonable depth, and possibly in some cases tempering the metal.

Outside what might be called legitimate work the process of casehardening also enables manufacturers to turn out cheap goods for trade purposes which could not otherwise be done at the price. Even knife blades can be made in soft metal, and after being rough ground can be hardened, and in such a way that they will last a considerable time, both the labor and material costs being very considerably reduced, particularly where an annealing furnace can be kept constantly hot, as in such case costs are reduced to a very small amount. Intermittent working causes a large outlay in repairs, for although no very great heat is needed, cooling and heating the furnace will cause the very best brickwork to give way in a comparatively short time, be as careful as one may. At the most, only a cherry-red heat in the boxes is needed, and as this is only about 1650° Fahr., a maximum temperature of approximately 1700° Fahr. in the oven or furnace is ample as a working heat. Still, this is quite high enough to bring down brick arches with any but careful handling, and having this occur practically means that the furnace has to be rebuilt.

When iron or steel is casehardened, the articles are packed in annealing-boxes with animal carbon, and the boxes are covered and the joints luted, then heated to just that temperature at which absorption of carbon takes place. The time the heat is continued depends on the depth of hardening required, and usually the work is thrown into water and made dead-hard as soon as it is considered that a sufficient depth is penetrated by the carbon. With the carbon may be used chemicals to assist in its absorption, cyanides being very frequently used, and according to the skill and practice of individual operators success is secured.

Thin, rather than deep boxes should be used, and in no case should boxes be too large; otherwise the hardening will be very unequal through the mass of metal enclosed. Proper boxes are made and sold at a cheap rate, the method of fixing the covers varying somewhat. In all cases small holes are pierced in the covers for the insertion of test wires, these being used to ascertain the state of the heat and the penetration of the carbon. Both circular and rectangular boxes are used, and both forms have their special uses according to the articles to be hardened; but rectangular boxes usually heat most regularly. Personally, the writer would select malleable cast-iron boxes, but possibly this is more a matter of personal preference than anything, although cost may have some bearing in the matter. The actual size of boxes will depend on the size of the articles to be treated; but unwieldy sizes should be avoided as much as possible.

The packing may be bone or leather cuttings, and these may be used raw or after conversion into charcoal. A layer of the carbonized material is laid at the bottom of the box, then a layer of the articles to be hardened is put in and packed with carbon, and the process is repeated until the box is full. Powdered potassium cyanide or prussiate of potash may be dusted over and among the articles and packing; but in all cases, phosphorus-bearing materials should be avoided, there being quite enough of this in the carbonaceous matters used. When the box is filled a layer of the packing material should be put over the articles and then the box should be closed and the cover luted down, the test wires being inserted at the same time.

Care must always be taken that the packing is thoroughly dry; otherwise the steam will force out the luting, or in some cases force off the cover, in such cases the results not being extremely satisfactory.

In packing articles which have only to be casehardened in parts, the soft portions should have a protective covering; while the parts to be made hard should be left exposed. Perhaps for ordinary purposes a mixture of white ash from the boxes and enough fireclay or pipeclay to bind the ashes would be as good a mixture as could readily be made to save the soft parts from the carbonaceous packing; but usually each operator has his own especial mixture for the purpose. Lime should be avoided unless it is desired to burn out the carbon from the iron or steel; but only in very exceptional cases will this have to be done.

Rings and such like can be rammed tight with ash free from carbon without any adhesive, and tubular articles can also be filled with ashes in the same way. Only the parts to be hardened should be in contact with the hardening material, and if this is borne in mind, then very satisfactory results are easily obtainable. At the same time, considerable practice is necessary to make an expert operator, and a good many points can only be learned by actual practice.

When the boxes are ready they must be placed in an oven in such a way as to allow the heat to circulate all round them, and when raised to the necessary heat they must be kept steadily at that heat until it is judged that the necessary depth of hardening is secured. Small variations of heat will affect the results obtained, and it is safe to say that hardly any two ovens or operators give exactly the same result in a given time. Differences in the packing material will also cause some differences in the speed of the penetration of the hardening; but it will not otherwise differ much if the operator keeps his wits about him.

Loss of time and increased fuel costs are usually resultant effects of the use of inferior packing material and often increased costs result from the use of badly-arranged ovens or furnaces, especially where the hardening boxes heat unequally.

After the boxes are placed in the oven, they should be raised to the required heat steadily and quickly, and the heat should be tested from time to time—not too often, however—by means of the test wires. The progress of the hardening can also be tested if the wires are of steel, and are quenched in cold water on withdrawal from the boxes. On breaking the wires so treated, the depth of the hardening can be readily ascertained; but this necessarily only refers to a moderate depth of hardening. Large articles to be deeply hardened can only be worked by time, the effect being noted in practical working. Some articles will require packing and firing more than once, and in regard to these experience is the only guide.

When the boxes are opened, the usual thing is to dump the whole of the contents into a rather deep water-bosh, say one a couple of feet deep, and then to extract the hardened articles when they are practically cold, when they should be almost glass-hard on the surface. In some cases running water is used, and various additions are made in other cases—solutions of salt, cyanide, prussiates and other things being used; the chief apparent object being to increase the coldness of the water, the effects of the chemicals on the metal being nearly if not quite ignored.

Some things, and particularly the cyanides of potassium or potassium and iron, appear to affect iron and steel more than is generally thought, greatly increasing the hardness of a thin layer on the surface of the metal, and for this reason should always be used with some articles; but where tempering is to be done this is not necessary.

After the articles are cooled off they should be dried and thoroughly brushed with wire brushes to leave them clean; and if to be tempered, the surface should be brightened. Any fine grinding should be done before tempering; but the final polish should only be put on after the whole of the fire-work has been performed.

Tempering is done in the usual manner, and most articles which are casehardened and tempered should be finally quenched in hot water, covered with a ½ in. layer of some fairly thick oil, as this to some extent prevents cracking. At the same time, no hard-and-fast lines can be laid down in the matter, owing to differences in individual practice; but it is as well to remember that casehardened goods differ somewhat from those made of solid steel. The same tempering colors apply as with solid steel, however, and in this point there is no material difference. The real difference is in the fact that, instead of solid steel you have a soft metal coated with hard steel, and that these two layers do not contract so equally as an article of uniform content.

Coming to the surface hardening of copper and bronze, the surface has to be alloyed with, say, tin; and about the easiest method of doing this is to have a bath of molten tin ready at hand in which to plunge the article to be hardened; and after heating the article to as high a heat as it will stand short of fusion, to plunge and hold it in the tin until of the same temperature, and then after wiping off surplus tin, to allow the article to cool. A second or even a third heating may be necessary in some cases, and a coating of borax or boracic acid may often be of advantage; but usually one heating and plunging will be found enough for practical purposes, this rendering the surface almost too hard to file. In using arsenic the articles are packed with ordinary arsenious acid and subjected to a red heat for some hours, and the same applies to carbonate of manganese; but in general use these things are not so good as tin, according to the writer's experimental work.

Of course, the whole thing depends on the absorptive alloying of the article to be hardened, and in using arsenic or manganese these materials would be in powder and be mixed with bone-ash, or some other inert substance to reduce cost. The heat should in no case exceed 500° Fahr., or bright red; otherwise there is danger of fusion, and this is quite high enough for any absorption process of alloying. Even a lower temperature will be found better in the majority of cases, as copper and tin will alloy at a dull red, as in the case of soldering bits when they become burnt.

The materials needed for iron and steel are either raw or carbonized bone—not bone-ash—leather cuttings, or some specially prepared casehardening material with which to pack the articles; possibly some cyanide or prussiate of potassium, proper boxes and clay luting; a good oven or furnace, and fuel which will maintain a regular heat without serious fluctuations during the time the process lasts. Possibly a mixture of gas-coke and hard furnace-coke broken to the size of eggs would give the most regular heat in some furnaces, while in others hard coal would have to be used, each furnace having its own peculiarities. For small work, gas furnaces answer well; but they usually consume a sufficiently large quantity of gas to become expensive in working, although against this can be placed the entire control of the heat, which is so necessary with fine work.

The waste from the hardening boxes should be collected and dried, as in this will be found partly consumed carbonaceous material, as well as ash, and both of these have their uses; the partly consumed material for use in backing up the new material in packing, and the ash for annealing and for coating and packing parts of articles which have to be left soft. For annealing, many articles, if they are packed with the dead ash in close boxes and kept at a full red heat for some hours, it will be found that if allowed to cool in the ash before opening the boxes, they will be softer and less oxidized than if annealed in the usual way—a point which is often of some advantage with fine work.

In using leather waste, oak and chrome tanned leather should be kept apart if possible, as the resultant hardening would be probably more pronounced with the latter form. Necessarily, if the waste is carbonized before use there can be no selection, and probably the results would be practically the same; but where raw leather is used there is a difference. It must always be remembered that carbon is not the only thing that can be got into iron and steel by absorptive alloying and with very little experiment many persons would be able to get very useful results for particular purposes. At present a good many disadvantageous results occur in places where metal is kept in contact with heated fuel and with gases of different kinds, these results being quite of an unintentional character; but if experimentalists would pay more attention to the subject, in many cases they would find it profitable.

The writer has designedly left the question of ovens or furnaces in this paper, as each one must be designed and constructed to meet the requirements of the particular work which has to be done, and except in large works, probably no general size or shape would be useful. Probably down-draught furnaces are the best, as with these you hold the heat on the floor of the furnace better. But this is a matter on which furnace-builders do not always agree, as each builder is in favor of his own particular ideas on the subject. Anyhow, efficient heating with economy of fuel is the chief thing, and when this is secured little else is to be desired.—"Mechanic and World of Science."

DRY PROCESS FOR ACETYLENE.

We take the following abstract from the "Engineers," London:

The usual method of generating acetylene and calcium carbide is to treat the material with water. The gas may, however, be obtained if the carbide be brought into intimate contact with crystallized sodium carbonate, usually known as washing soda. The action in this case is to set free acetylene and to form water, caustic soda, lime and chalk. This reaction is made use of in the Atkins dry process for generating acetylene gas. The generator consists of a drum divided transversely into three chambers. The drum, as a whole, revolves on a horizontal axis. Into one end chamber the carbide is introduced. The second or central chamber contains the soda crystals. The third chamber is filled with coke and serves for filtering the gas and holding back the dust.

This generator is revolved slowly about its axis. Motion in one direction causes a small part of the carbide to enter the second chamber, where it comes in contact with the soda. If the drum be turned in the opposite direction the carbide does not pass out of its chamber, but that portion which has entered the second chamber is mixed intimately with the soda crystals by means of a stirrer. Acetylene gas is then generated, passes through the filtering chamber, out through the hollow axis of the drum, then percolates through oil and is carried to the holder.

It is said that by revolving this generator for about twenty to twenty-five minutes, enough gas can be generated to last a residence for twenty-four hours. The generator is fitted with a safety-valve to protect it against excessive pressure, though the pressure generated at any time should be slight. The mixing chamber has a large cleaning door, through which the waste products are taken out. These are in the form of a dry powder and are removed without difficulty. Such a generator is six feet, six inches high and occupies a space twelve feet by six. This includes the holder also, which has a capacity of about 250 cubic feet, sufficient for 120 burners.

"A man who sees nothing but evil in another knows how to look for evil. Don't trust such a one."

DRILLING HOLES IN GLASS.

THEO. BROWN.

The making of holes in glass is an operation generally accomplished with diamond drills, but these tools are expensive, so that the amateur naturally looks for a less costly method. The writer has found the following a most efficient way, as well as an inexpensive one. Any size holes may be quickly drilled through sheet glass of any thickness, or even plate glass, with precision.

A piece of ordinary brass tubing is fixed to a lead weight, as shown in section in Fig. 1. *A* is the weight, *B* a groove capable of taking a driving belt, and *C* the brass tubing forming at *D*, the cutter. If holes ¼ in. in diameter are required, a tube of such dimensions is used, and the head *A* should weigh about 3 pounds. The tubing may be placed vertically in a suitable mould and the molten lead poured into the mould. The whole is then placed in a lathe and turned up true, the groove *B* being made at the same time. Figs. 2 and 3 show the other apparatus necessary, namely, a supportiug framework for the drill, and a driving wheel *E*, consisting of a cycle wheel. The drill support F and G is fixed to a baseboard *H*, which may be fixed to any ordinary table *J* by means of the clamps *K*. Metal plates *L*, fixed to the wooden framework, act as bearings for the tubular drill *C*. *M* represents a sheet of glass to be drilled, *N* a rubber cushion consisting of an ordinary umbrella ring, and *O* a movable block placed just under the point of the drill. A wooden support *P*, is provided on which to mount the cycle wheel, which is held in a horizontal position and turns on its own hub. A handle *Q*, pivoted to blocks clamped to the spokes of the wheel, is used to operate the appliance. A crossed belt from the cycle wheel to the lead weight of the drill drives the latter. The teeth of the drill are formed with a triangular file.

It now remains to state the materials necessary for grinding and the mode of operating. The brass tubing alone would not make its way through the glass, however fast it might be revolved. Turpentine together with powdered corundum are the materials needed, the turps being poured down the tube from the top opening, and the corundum fed down the same channel while the drill is revolving. A loose wire rod may be used to ram down the corundum, but care must be taken not to cause a stoppage by a superabundance of this grinding material, otherwise it will give trouble, being most difficult to obtain a passage once the tube becomes choked.

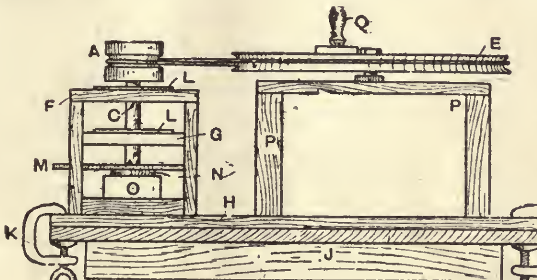


FIG. 2

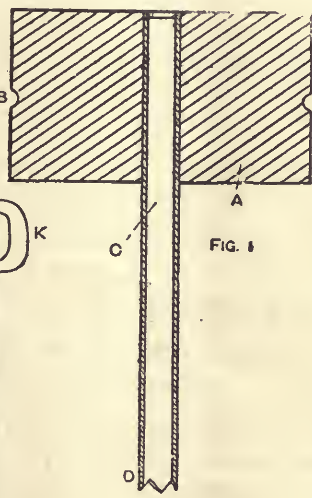


FIG. 1

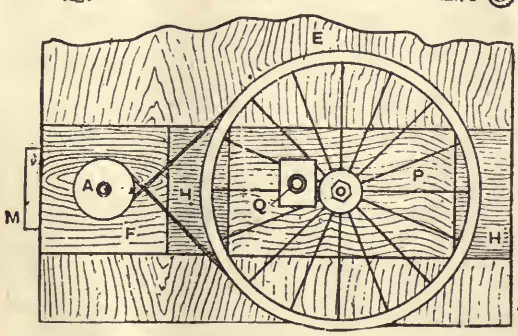


FIG.

The wire rod also serves to direct the flow of the turpentine to the bottom of the tube, where it is most required. If the corundum and turps have been properly inserted, a grinding sound will soon be heard after turning the appliance. The drill should be lifted slightly at intervals, so as to allow the corundum to get under the teeth of the drill. Properly operated, a ¼-in. drill can be made to cut a clean hole in a ¼-in. thick plate glass in less than two minutes. This is working the machine by hand.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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SEPTEMBER, 1906.

Owing to the nature of a number of communications recently received, and for which answers are requested through the correspondence department of the magazine, it is desirable to explain the purposes for which this department is conducted. The amateur worker frequently meets with problems the solution of which cannot be conveniently secured, owing generally to the lack of acquaintance with some one skilled in the particular matters at issue. As this magazine has a large number of contributors who are workers in many different lines, it is a simple matter for us to refer an inquiry to the one most acquainted with the subject, and an answer easily obtained. This service we are pleased to render when the subject matter would be of interest to anyone other than the person making the inquiry, as much interesting information is thus made available for all our readers.

When, however, an inquiry involves considerable mathematical work which would be of value only to one person, such as working out the winding specifications of a dynamo of unusual or discarded type, we shall hereafter be obliged to receive such inquiries subject to the convenience of those to whom they may be referred for answer, and no one should be disappointed if no answer is returned, although in such a case, if stamp is enclosed, the writer will be informed why no answer can be sent.

As we desire to make the magazine of the greatest usefulness, and as many readers are likely to have problems of a technical and personal character for which they desire solutions, we have decided to receive such inquiries subject to a fee, the amount of same to be as small as can consistently be made, and which will be communicated to the writer before referring the inquiry for answer. In this way we shall be able to give our readers skilled technical service at the lowest possible cost, and avoid the feeling of reluctance held by some, who wish information but have refrained from writing for it because of the amount of work required to properly prepare an answer.

Owing to the large number of replies received in the suggestion offer mentioned in the editorial column of the June number, the announcement of the awards has been postponed to next month. Our sincere thanks are given to those who have so kindly aided us with so many valuable suggestions, which will be acted upon as soon as possible.

A jet of burning oxygen from a blowpipe is now successfully employed to cut sheet iron, iron tubes and small bars. The cut made is almost as sharp and thin as that made by a saw. In the earlier experiments difficulty was encountered in clearing the cut of liquid metal, and in preventing the spread of the melting effect beyond the borders of the cut. In the process as now practised, two blowpipes are employed. The first has an ordinary oxyhydrogen flame, which heats the iron to redness at the place where the cut is to be made. This is to be followed immediately by the second jet, composed of pure oxygen, which instantly burns the metal without melting. The liquidized iron is blown swiftly from the fissure, so that there is no serious spreading of the heal to the surrounding parts.

A SECTIONAL SKIFF.

CARL H. CLARK.

The skiff herein described is arranged to be easily knocked down for stowage or transportation. Its length is 10 ft. and its beam 3 ft. 8 in. easily carrying four people. When knocked down it stows into a package 3 ft. 8 in. square and about 1 ft. 6 in. deep.

This kind of boat is very desirable for yacht tenders, as it may be taken apart and stowed in the cockpit on a long run, or in a heavy sea, thus relieving the yacht of the drag or the liability of the loss of the tender by swamping. For camping or fishing parties it is especially valuable, as it may be transported in a team along with the other dunnage.

It should be a matter of about five minutes to put it together, and somewhat less to take it apart.

The general shape and construction is similar to the nine foot skiff previously described, but is of somewhat lighter construction for the special purpose of making it light for ease in handling. As will be noted in Fig. 1 the boat is divided into three portions by cross partitions, forming three separate sections which are held together in a manner to be described and which, when taken apart, may be stowed one inside of another. The oars, also, are jointed and stow with the other portions

The boat may be built of pine, cypress or any other light stock. The sides are ⅝ in. thick and should, if possible, be in a single width of 15 in. and 16½ ft. long.

The bottom is ⅝ in. thick and is put on crosswise. The sternboard is ⅞ in. thick and the cross partitions are ⅝ in. Fig. 7 shows the actual shape of the sides before bending. The boards should be cut to this shape and stiffened temporarily by three or four cleats to prevent their splitting while being bent into shape.

Figs. 4, 5, 6 show the shapes of the sternboard and partitions. These are gotten out from the proper stock, two of each of the partitions. One of each of the partitions and the sternboard are now set up and the sides bent around. The stem is of spruce about 2 in. square and is fitted into the forward angle of the sides; the partitions should stand in the proper positions, exactly vertical and their lower edges ½ in. above the lower edge of the sides. The two partitions just fitted are *A* and *C*, the end partitions of the middle compartment, and should be 3 ft. 8 in. from outside to outside; the bevel must be correct for the sides, and they must fit neatly. The remaining two partitions, *B* and *D* are now to be fitted adjoining those already in place, to form the ends of bow and stern compartments. They must be very neatly fitted about 1-16 in. away from those already in place, to allow the insertion of a saw for cutting the sections apart.

Corner pieces of oak 1 in. square, as shown at *a a* are now to be fitted in the inside corners of the partition *A* and *C* and fastened well with 1½ in. galvanized wire nails driven both through the sides and the partitions. Boat nails should not be used on account of their size and tendency to split. When the partitions *B* and *D* have been fitted in place the corner pieces *b b* are to be fitted. The partitions *B* and *D* are now to be removed and the corner pieces fastened on to them. The partitions are then put into place with a 1 16 in. strip of board or paper between them and the others and well fastened. Light corner pieces should also be fastened in the corner between the sides and the sternboard.

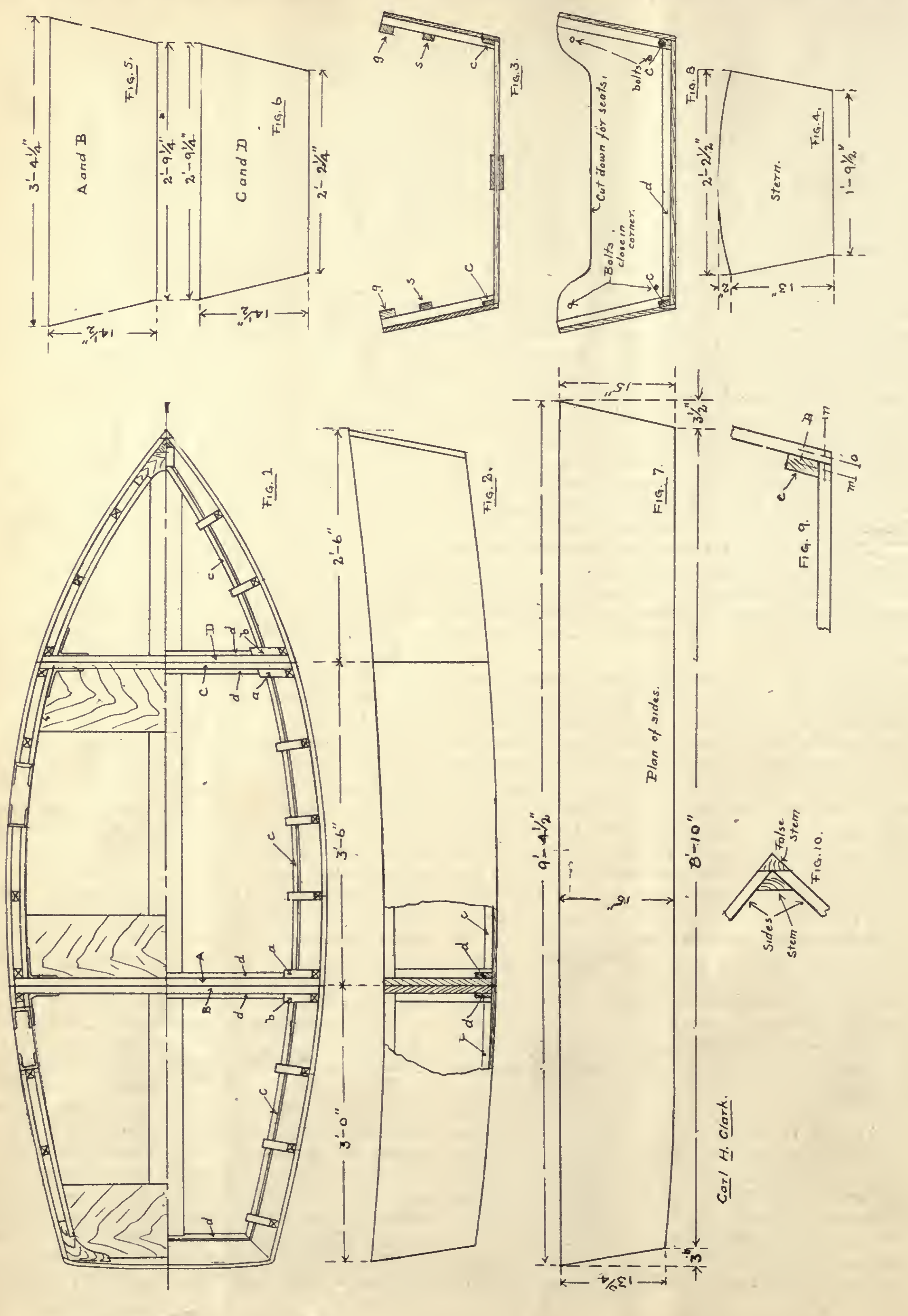
The boat is now turned over and the lower corner cleats *c c c* are fitted; they are ½ x 1 in., bevelled to the proper angle and bent around ½ in. above the lower edge of the sides; they fit neatly between the corner braces, which are cut off flush with their lower edges. Corner pieces *d d*, Figs. 1 and 8, of the same size, are also fitted on the lower edges of the cross partitions and sternboards to give adeitional bearing for the bottom plank.

The bottom boards are now ready to be fitted, beginning at the ends and working towards the middle; at the bow the boards should extend to the extreme corner, the stem being cut off to allow this. The bottom boards lie between the sides and the corner strips before fastening.

The ribs are of pine 1 x ⅝ in; they are notched at the lower end to fit over the corner pieces c. as shown in Fig. 3. They are placed as shown in Fig. 1 and are fastened from the outside with the exception of one nail in the lower end, which is driven from the inside; these ribs prevent the sides from splitting and stiffen them.

The gunwales are 1½ x ⅝ in. and are fitted as shown in Figs 1 and 8, on the inside of the ribs and corner pieces; these are, of course, put in in three pieces between the partitions. They should be steamed, or at least wet with hot water before bending in, as they are depended upon to preserve the curve of the sides *c c c*, thus making a double joint which is very strong and tight. Fig. 9 shows how the nails should be driven; *m* and *n* should be at close intervals, about 2½ in, *p* should be about 3 in, apart and *o* about 4 in. apart, as they are merely put in to prevent the sides being split by the number. The bottom boards should be put on in widths of about 8 in. It is advised that the boards be so arranged that a joint will occur between the partitions, thus avoiding the necessity of sawing the bottom and also of giving a good guide for driving the nails into the partitions.

The last board to be fitted should be at the widest part; owing to the under bevel it will be necessary to



A and B
Fig. 5.
3'-4½"
14½"
C and D
Fig. 6
2'-9¼"
2'-2¼"
14½"
Fig. 3.
g
s
c
Cut down for seats.
bolts
Bolts close in corner.
Fig. 8
Stern.
Fig. 4.
2'-2½"
1'-9½"
13"
2"
Fig. 1
D
C
A
B
a
b
c
d
Fig. 2.
2'-6"
3'-6"
3'-0"
Fig. 7.
Plan of sides.
9'-4½"
8'-10"
15"
3½"
3"
13¼
Fig. 9.
e
Fig. 10.
False Stem
Sides
Stem
Carl H. Clark.

spring the sides slightly to get it in; this can be easily done if the adjoining boards be left loose until the last is in place. All joints should be well filled with lead after cutting. For fastening these gunwales in place, copper nails should be used, which should be bored for, and clinched over burrs on the inside. Brass or galvanized angles should also be fitted as shown. At the bow a wooden breast hook should be fitted, and at the stern a wooden knee, as shown in Fig. 1.

It is advisable, if possible, to allow the boat to lie a few days before cutting apart, to allow the curved parts to partially set into place and thus reduce the tendency to straighten. In the meantime the bottom stiffeners, outside and inside, may be fitted, of ½ in. stock, 4 in. wide; they are through fastened and clinched. The false stem *s*, Fig. 10, is now to be fitted, the boards having been simply lapped on the sides of of the stem. The false bottom should extend ¼ in. below the bottom, the bottom stiffener butting against it.

The partitions should be cut down as shown in Fig. 8 to increase the inside room, and the edges bevelled off. A piece of oak half round moulding about ⅞ in. diameter should be run around the outside even with the gunwale and well fastened with brass screws. A screw should be driven closely on each side of each joint to prevent the moulding from springing off when cut.

Four 5-16 in. holes should be bored in each pair of partitions, as shown in Fig. 8, for the bolts which hold the sections together.

The sides should now be cut, the sections separated and the ends smoothed up.

The seat supports, *S* Fig. 3, are 1½ in. wide by ½ in. thick, and are bent around on the inside of the frames; the upper edge being 5 in. below the gunwale. They are fitted in all three sections.

The whole should now be given a coat of priming paint, except the gunwale and half round, which may be coated with shellac. To fasten the sections together, three 5 16 in. bolts, 2½ in. long under the head, will be required; they should be fitted with thumb nuts and two washers each. To prevent leakage around the bolts, soft rubber washers are inserted under the iron washers.

Rowlock blocks and sockets are fitted in the positions shown; the after pair are intended for use when one or three persons are in the boat, and the forward pair when occupied by two people; the blocks are about 8 in. long and are fastened to gunwale and top of planks with screws. For rowlocks any desired pattern may be used.

The seats, with the exception of that in the bow, are loose, but may be held in place by notches fitting over the frames. The bow seat should be permanent and be fitted with a locker underneath for the stowage of the rowlocks, bolts, etc., during shipment.

The oars should be of spruce 6½ ft. long. When used as a tender they need not be jointed, but for camping or fishing purposes they should be furnished with a joint consisting of two pieces of brass tubing, fitting closely, one inside of the other, the inside piece should be about 6 in. long, and the outside one about 12 in.

The oar is cut and the larger pieces fitted to a larger piece of the oar; the smaller piece is then trimmed down to fit inside of the smaller tube; this enables the oar to be jointed together for use. It should be so cut that the two portions are of equal length after the tubes are fitted.

A strong eye should be provided inside at the bow for the painter.

The whole should now be given two coats of paint inside and outside; all seams should be filled with putty, and if of any size, a thread of cotton may be forced in with the edge of a putty knife.

When joined together this boat should be as tight and satisfactory as an ordinary skiff, with the additional advantage of the sectional construction.

WINDMILLS FOR LIGHTSHIPS.

The Canadian exploring steamer, "Arctic" (Capt. Bernier), which has made an extended voyage North Poleward is provided with a novel electric light installation. Since fuel cannot be obtained for the generation of steam, and as the ship will have to spend many months in darkness, it was decided to instal an air-compressor plant which is being operated by a windmill. The compressed air is used to drive the generators, which in turn furnishes current for charging the storage batteries used for lighting the vessel.

It would seem that windmills might similarly be utilized on board of lightships and alongside of lighthouses, for generating electricity for illuminating purposes and for the signal lights, in connection with electric storage batteries.

On Nansen's ship the "Fram", there was a windmill electric set installed to give power during her Arctic voyage, and a similar set was placed on the ship "Discovery" during her Antarctic exploring expedition, both of which worked admirably.—"American Shipbuilder."

Very beautiful effects are now obtained by engraving the surface of diamonds. A French jeweller, Bordinet, has invented tools for this purpose, which, it is said, only his son is permitted to use. Among the surprising things produced is a diamond cut into the form of a ring, polished on the inside, and covered with delicate engraving on the upper surface. Another is an engraved diamond fish. Diamonds are also engraved with armorial bearings. Only in the past few years has it been possible to bore holes through diamonds, but this feat is now accomplished in many cutting establishments. The bored stones are then strung together with other gems, or with pearls.

INDOOR WORK FOR PHOTOGRAPHERS.

R. G. FRANCIS.

I propose in this article, which is intended for the beginner rather than for the expert, to give directions for some of the simple things which are not always simple for the beginner. In the first place, I will speak of printing. When the tyro commences to print from his own negatives, he naturally turns to a printing-out paper. This is inevitable. The simplicity of working, the visibility of the image, the sharpness of the results, all appeal to him. He vigorously makes prints from his negatives, tones them in a combined bath, soaks them in water for a while, and gives them to his friends, They are pleased with the results, and so is he—for a time. At the end of a few months he finds that his prints have faded, and is told that it is the fault of the paper, on which permanent prints cannot be made.

Possibly not. Yet prints can be made on printing-out papers, which, if not absolutely permanent, will last a number of years, even under poor conditions of exposure to light. The fault has been with the maker and not with the paper. If he had toned with a gold solution, fixed in plain hypo, and thoroughly washed his prints, they would probably have lasted as long as he cared for them. He gets disgusted with the process, however, and asks some friend or dealer what he shall use, and is told to use a gaslight developing paper. The advice is sound, and the examples shown him are good, so he invests in a package of paper and a tube of M. Q., and goes home to make some beautiful black and white prints.

DEVELOPING GASLIGHT PAPERS.

He gets into trouble immediately, for I never knew a beginner to make good prints from his first package of paper. The thing is very easy when you know how, but the difficulties of explaining in any way except by demonstration before the gas-jet, are very great. The beginner cannot appreciate the necessity for absolute chemical cleanliness which exists. He has developed plates, put his fingers in the hypo, and back into the developer, and it has had no effect on the negative, as far as he could see.

When he makes his Velox prints, he finds mysterious stains and streaks and blotches on them. His expert friend says they are hypo stains. The beginner protests that he washed his hands carefully each time he put them in the hypo. He forgets that once or twice he wiped them on the towel without washing them. That was sufficient. A very minute trace of hypo on the fingers is enough to cause the mischief. It is absolutely essential for the successful working of gaslight papers that the maker shall not touch the hypo with his fingers from the time he begins to print until the last picture is fixed. It is necessary to push the prints under the surface of the hypo, and for this purpose a smooth stick or glass rod should be used. This should be long enough so that the end which is held will not become wet with hypo. In this way it is possible to keep the fingers absolutely clean and avoid the most prolific cause of stains.

FIXING AND WASHING THE PRINTS.

The next most important thing to do is to wash the print free from developer before putting it in the hypo. If the print is allowed to remain in a large quantity of clean water for two or three minutes after developing and before fixing, there is no excess of developer to discolor the hypo or the print. Of course, to obtain this result it is necessary to properly expose the picture. If it is over-exposed, it will be necessary to hurry it from the developer into the hypo and give it only a hasty rinse. If, then, it is not properly immersed at once in the fixing bath, the developer will be oxidized rapidly in the thin film of liquid caught between the print and the air, and the result will be a patch of brown decomposition products which will ruin the print

Even if the individual prints are not stained, the result of introducing developer into the hypo with each of them is to discolor it to an extent which may finally cause deterioration of the purity of the whites of the paper. In order to insure the permanency of the prints, it is necessary to wash them well. The fixing should last at least ten minutes, the prints being kept well separated during this time. The washing should last at least half an hour in running water, with current enough to keep the prints moving and well separated. If this is not practicable, the prints may be washed by passing through twelve changes of water, leaving in each about five minutes. The process may be shortened by piling up the prints and squeezing out the water each time they are changed from one wash to the next. In this way the water is removed as completely as possible each time, and diffusion can take place more rapidly in the next water.

BLISTERS.

It sometimes occurs, especially in cold weather, that when the prints are taken from the hypo and placed in the wash water, blisters form, spoiling the result. One cause for these is a considerable difference in temperature between the hypo and the water. This may be remedied by keeping the hypo at the temperature of the wash water. Another possible cause is the use of too strong hypo. The easiest way to remedy this is to use hypo of a strength of not more than one to four. If a batch of prints shows these blisters, it may be put back in the hypo, when the blisters will probably disappear. If then a batch of hypo of half the strength of that used to fix the prints is prepared, and they are first changed to this and after a few minutes transferred to the water, they may be saved. The diffusion of the strong hypo solution does not take place so rapidly when this is done, and the blisters will not form.

A mistake which is often made by users of gaslight papers, is employing too contrasty brands of paper. The soft-working kinds are preferable for almost all negatives, and give much more harmonious prints. The so-called carbon brands, which give prints of great contrast, are not suitable for general use. Their special utility is the making of passable prints from negatives which are too thin to be printed on the special papers.

MASKING AND DODGING.

It often happens that the negatives which are employed for printing on these papers are far too dense in certain portions to yield good prints. For instance, it is very often the case that a full exposure has been made on a landscape with a cloud-covered sky, and that when the development is complete, the clouds have been buried. No possibility exists of properly printing the clouds and the landscape at the same time by straight methods. Gaslight papers are especially adapted for dodging, however. By masking the foreground, the clouds may be printed out, and then enough exposure given to the whole negative to print the landscape.

The usual method is to take a piece of cardboard cut roughly to the shape of the sky line. This is placed on the front of the printing frame and the exposure made to bring out the clouds, moving the frame continually in front of the source of light, so that no sharp line of demarcation appears. The space between the card and the negative assists in this vignetting. The card is now removed, and the exposure for the landscape given. If the handling of the card is skilfully done, the result will be very much better than a straight print from the negative. Very often it is not necessary to use the card. If the negative is inclined away from the light, and the dense portion brought very close to it, this part will receive a proportionately much greater exposure, and some very difficult negatives may be made to give perfectly satisfactory prints.

In the usual way of drying prints, they roll up and remain obstinately curled when dry. It is not possible to dry them face down, for they stick to the support and are spoiled; but if they are turned over when about half dry, the curling will be minimized. The dry prints may be flattened perfectly by drawing them under the edge of a somewhat blunt ruler two or three times in different directions.—"Photo Era."

No square peg was ever a success at filling a round hole. If you are a misfit, whittle off the corners, or find a square hole.

HOW TO CLEAN A LENS.

Custom teaches us that glass will stand any amount of washing and wiping without injury, but the lesson is wrong. It may hold good of tumblers and beer bottles, but when we come to the finer quality of glass of which lenses are made, and to the more highly polished and more accurately finished surfaces which they must possess, we find that it is hardly an exaggtion to say that we cannot touch the surface of the glass without permanently affecting it. Certainly a degree of roughness which is habitual in the cleansing of table glass would spell ruin to a lens in a very little while. Yet the writer has seen a photographer breathe on the glass of a costly anastigmat and give it a rub with the corner of a focussing cloth, with all the delicacy and care of a child cleaning a slate—but no more. Only two kinds of impurities should need removal from the lens—dust and grease.

Dust, and under this head we might include the dirt which may appear after a lens has got wet with rain or sea water, is best got rid of by a very gentle wipe with a piece of clean, washed cambric. Nothing is better for this purpose than an old handkerchief, washed out to remove laundry chemicals, and dried. Part of it should be dampened with clean water and the lens dabbed. In this way harsh particles of dust, and much dust is nothing but broken flint, are picked off instead of being ground round on the glass by rubbing. A gentle wipe with a dry part of the cloth completes the operation.

If the lens has got greasy from finger marks or otherwise, a little rectified benzine or ether may be applied to the handkerchief. Its surface must not be allowed to get quite wet with either because it might work into the cell and affect the cementing. The great thing is to remember that glass is easily injurable, and to act accordingly.—"Photography," London.

The "Mechanical World" recently contained an epitome of a lecture by A. B. Roxburgh of the National Gas Engine Company, Ltd., in which it was stated that about one-fourth of all the gas made in Great Britain is employed in driving gas engines. The lecturer estimated that in the United Kingdom alone there are manufactured at least 200 gas engines per week. Averaging them at the very low size of 10 h. p. each would give a weekly production of 2000 brake h. p. It was deemed likely, however, that the actual amount is double that figure.

Only the very best copper and the highest refined spelter are ever put into cartridge brass. The requirements are such that other metals will not answer the purpose. The standard mixture is two parts of copper and one part spelter.

BAND SAW ATTACHMENT FOR LATHE.

E. A. R.

The accompanying illustrations show a band saw which can be attached to and driven by any lathe ranging from 3½ in. up to 5 in. centers. The frame, wheels and guides are of cast-iron, the spindles, bolts, etc., being of mild steel. These materials will make a much more satisfactory and workmanlike appliance when finished, than if it were constructed mainly from wood

dimensions can be taken from the plan and the side and front elevations respectively, which are reproduced to a scale of 1½ in. to the foot, while the enlargements are 3 in. to the foot. The web of the frame may be about ½ in. thick, while the ribs are ½ in. thick at the root and tapering outwards to less than ¼ in., as shown in the section, Fig. 2, taken at x x, Fig. 1. The pattern for the pulleys should be constructed in seg

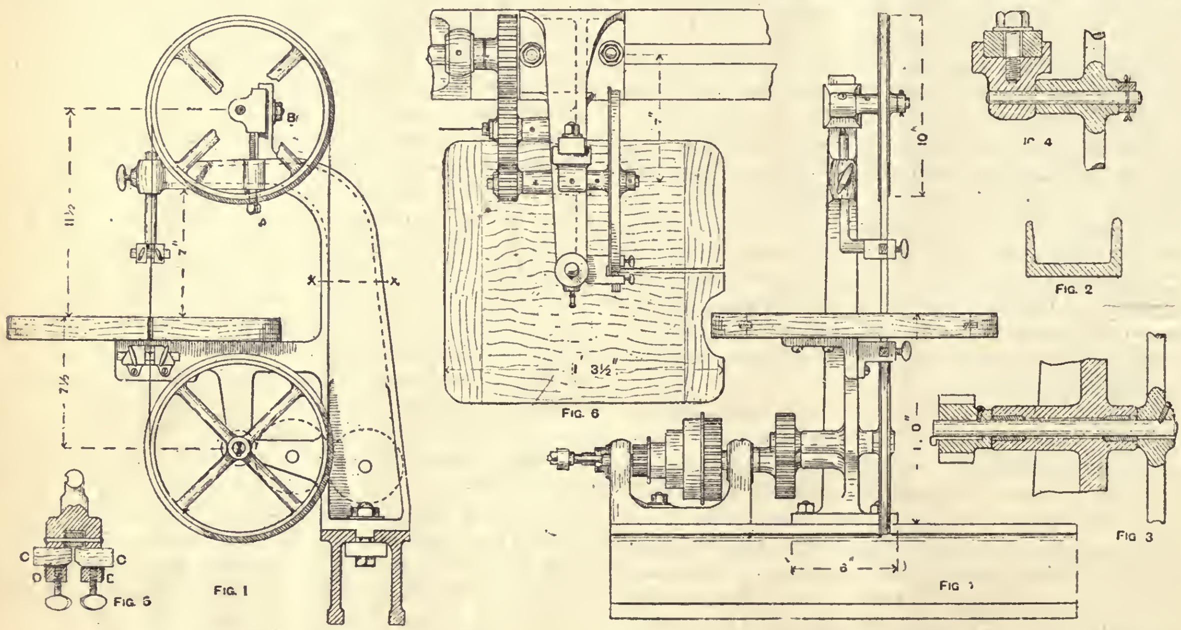


Fig. 1 gives a side view of the saw attached to the bed of a 3½-in. center lathe. The motion is imparted the saw direct from a 4-in. pitch diameter tooth wheel screwed to the mandrel nose and meshing to an intermediate wheel, also of 7 in. pitch diameter, which gears into a 2-in. pitch diameter wheel on the spindle of the band saw pulley. The gearing up, which is absolutely necessary, may be effected by a cycle sprocket wheel, bolted to a small face plate on the lathe, and a hub wheel on the pulley spindle with a suitable length of chain. The band saw will require a good deal of power to drive at anything like the prescribed speed for these tools, which is about 4000 feet per minute. It is doubtful if much more than 2500 ft. speed could be attained on the foot lathe, without excessive fast pedalling or high gearing, and in the latter instance it will probably be necessary to fit an extra flywheel to the crankshaft to get the required momentum to keep the saw going at a high speed.

It will be necessary to make a pattern for the frame for casting; pine is the best wood for the purpose. The mental ribs, glued and pegged together, and turned in the lathe; or the wheels may be purchased complete. A small pattern will be required for the adjustable slide which carries the upper wheel, and also for the lower saw guide under the table. The top guide may be a mild steel forging.

When the castings are received, fit the tenon and base to the bed, drill holes for the holding-down bolts and clamp plate, and place the frame close to the lathe centers and transfer the height on to the casting. Next lap the train of gear wheels in mesh flat on the bench, and carefully measure off their centers and transfer them to the casting by holding a square with the stock on the casting, and the edge of the blade exactly over the lathe center mark previously mentioned and measuring off the centers on to the bosses for receiving the intermediate and driving pinions.

Another method is to first secure the 4 in. wheel to the lathe either by screwing direct to the mandrel, or by fixing to a driver plate, and then to gear the remaining pair of wheels to the first. Hold them in this position and bring the frame up close to them and bolt down and scribe the centers on to the chalked bosses of the castings through the bored holes of the wheels, taking care not to have the teeth too deeply in gear while doing so. The same method can be adopted when using the cycle chain and sprocket wheel for driving. Next mark off a $\frac{3}{8}$ in. diameter hole for the shank of the top saw guide, and a $\frac{1}{2}$ in. tapping hole for the adjusting screw *A*, Fig. 1.

Also drill a hole $\frac{1}{2}$ in. in diameter near the bottom of the vertical arm *B*, Fig. 1, and with a hack saw cut the slot right down to receive the stud in the adjusting slide which carries the upper wheel. Drill six 5-16 in. diameter holes for securing the oak table to the frame. The most important holes are the $\frac{5}{8}$-in. tapping holes for the stud of the intermediate wheel, and the longer $\frac{5}{8}$ in. diameter hole for the driving spindle. This latter hole may with advantage be opened out to $\frac{7}{8}$ in. and bushed to receive a 11-16 in. diameter spindle, as shown in Fig. 3. The hole for the shank of the top guide should also be drilled carefully at right angles to the base.

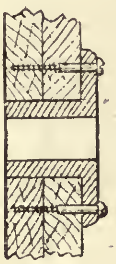


FIG. 8

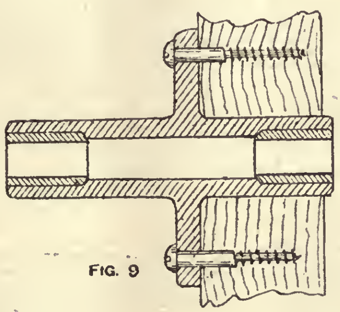


FIG. 9

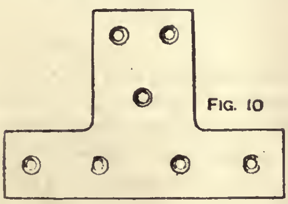


FIG. 10

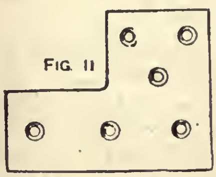


FIG. 11

Fit the adjusting bracket over its slide, and drill and tap the hole for the $\frac{1}{2}$-in. stud; see Fig. 4. Also drill the hole for the $\frac{5}{8}$-in diameter spindle which carries the wheel. If the latter cannot be obtained with a long boss as shown, the boss can be made to project out to meet it when making the pattern for the casting; or the alignment of the two wheels can be regulated by inserting a suitable washer between the wheel hub and the bracket.

The lower wheel and pinion is keyed and set-screwed to the spindle, while the top wheel runs on its spindle, the latter being either tapped in or fixed with a grub screw. Mount the wheels in position, stretch a fine wire around them and make a rough pattern in wood of the top saw guide. Get them forged by a blacksmith, a section of this guide being given at Fig. 5. The thrust of the saw is taken on a small, hardened steel roller, and the side play is avoided by fitting two small, hardwood guide blocks *C*, retained by the thumbscrews, which are set upon small pieces of sheet brass, *D*. The lower guide is of the same construction in detail. It is of cast iron or brass, as preferred.

The table is of oak $1\frac{1}{4}$ in. thick by about 1 ft. 4 in. sides, end clamped as shown in Figs 6 and 7. A slot about $\frac{1}{4}$ in. wide is cut in the table to facilitate the removal of the saw. The table and guides should be set and filed while the wire is in position. It may be well to mention that 10 in. diameter pulleys are about the smallest it is practical to use for a small saw. The makers of small treadle band saws generally use a wheel at least 4 in. larger in diameter, and some also cement on to their wheels an endless rubber band for the saw to ride upon, to prevent damaging or breaking the blade. If rubber bands are adopted, provision must be made for the extra diameter of the wheels, and the pattern lengthened at the outer arm carrying the top saw guide.

Fig. 8 shows a method of constructing the pulleys from layers of wood cut in sectors of a circle, glued, pegged and lap-jointed together, and fitted with a gun metal or cast-iron flanged hub, which is attached to the wheel with screws. Fig. 9 shows the method of forming the bearers for the stud and the spindle of the intermediate wheel and pinion. The framing should, in this case, be of oak or beech $2\frac{1}{2}$ x $4\frac{1}{2}$ in. and secured at the arms and base with a plate of T or L shape, as shown by Figs. 10 and 11.

The "Pyrophone" is a new automatic fire detector, for which it is claimed that it makes the detection of fire in its earliest stage certain, makes false alarms impossible, gives a "danger call" preceding each fire call, and requires no fixed degree of temperature in order to give the alarm. The apparatus consists of a small U-shaped glass tube half filled with mercury in each end. One branch of the tube is exposed, while the other is covered with insulating material. When there is a sudden rise of temperature the liquid in the non-protected branch expands, thus driving the mercury downwards below a platinum wire which enters the tube and causes a danger signal. If the rise of temperature continues the mercury still falls lower, and below another platinum wire, breaking the circuit and causing a fire alarm. The indicator board shows "trouble" "danger," "fire," "earth" and "battery" disks, thus providing for every emergency.

Gasoline, like all other products of crude petroleum, was for a long time disposed of as waste in the effort to make kerosene. It is the first and highest distillant of crude petroleum. Gasoline is extracted by distillation just as whiskey is produced and in much the same kind of apparatus.

CHUCKS FOR HOLDING SMALL TOOLS.

B. N.

Too little attention is given to the selection of means for holding the small sizes of tools in the lathe. This attention becomes all the more necessary in the case of tools used in specialized machines. In making a selection, it is necessary first to consider the conditions under which the chuck is required to operate. If the clearance offered by the work in hand, the jigs, fixtures, etc., is sufficient, then one of the several forms of inserted spring chuck will usually meet the case.


FIG. 1

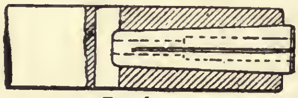


FIG. 4

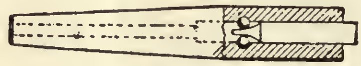


FIG. 7

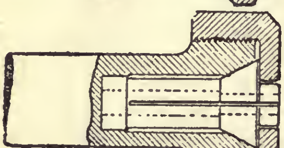


FIG. 2

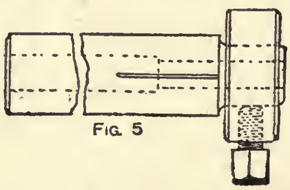


FIG. 5


FIG. 8


FIG. 9


FIG. 3

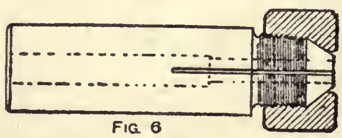


FIG. 6

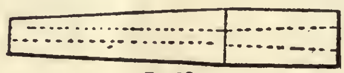


FIG. 10

Fig. 1 is a common form of hollow spindle chuck, with draw in spindle engaging from the back, this being undoubtedly one of the readiest, truest and most secure means for holding this class of tool. Where the use of the draw spindle is impossible or inconvenient, however, a modification of this chuck becomes necessary. Two methods are shown at Figs. 2 and 3. Although somewhat more bulky than the others, that shown at Fig. 2 is an excellent device, and its value increases if the tool to be used are of various sizes. The inserted spring collet—not the simplest part to replace—having no threads, lasts a long time. This cannot be said of either of the devices shown at Figs. 1 and 3. In both cases a stripped thread would give a lot of trouble, while one worn chuck, if sets are used, may cause complications necessitating the making of a new screwed spindle and perhaps chucks as well.

On the other hand, the adjusting cap of the device shown at Fig. 2, being large in diameter, has a greater thread bearing, and consequently increased wearing capacity. Moreover, when worn it is much easier to repair. The chuck shown at Fig. 3 is in every respect identical with that shown in Fig. 1, but of course requires no draw spindle; like Fig. 2, it takes a solid stock spindle or holder, according to the purpose to which it is to be applied. Adjustment of the chuck, Fig. 3, is effected by squaring the projecting portion of the collet for a suitable wrench.

Fig. 4 shows another independent inserted collet-chuck which the writer has used successfully on several jobs where an extended tool was necessary. Its adjustment is rather clumsy compared with that of the others. A hollow punch clearing tool is required to drive it home, and a taper drift passed through the cross-hole to eject it. In construction it is rather plain; about 4 or 5 degrees of taper should be given to the chuck, with the usual three slits for closing.

Figs. 5 and 6 are less elaborated devices, their chief differences from the others being that their use is confined to one size of tool. Still they are extensively used as a convenient form of fixed holder. If they are to be used in the hardened state, they require careful treatment, as they do not lend themselves readily to correction by grinding or other means; for this reason they are often finished and used soft. Fig. 5 is adjusted by a compression screw, and should have two slits; while Fig. 6 has a coned collar and three slits.

Figs. 6, 8 and 9 show chucks which are specially useful for outside clearance or long over-reach. Fig. 7 may be used as an extension for drilling or other operation giving pressure on the cutting end of the tool, and serving to keep the opposite flatted end tight between the two cross-pegs. Fig. 8 is a more familiar form, but not a very good one, the tool being liable to twist off at the back lip, which receives the cutting strain. Hardening throughout and judicious tempering (low spring) of the back of the cutting tool partly checks this tendency.

Fig. 9 has a wider range of usefulness than the last two. The small holding screw should preferably be pointed and the tool slightly countersunk to receive it. Each of these three tools must be made a fit at the commencement, or they soon become unreliable. For a good substantial and reliable chuck, where a minimum of clearance is admissible, there is no alternative but to revert back to the tapered chuck, as in larger tools; see Fig. 10. The taper must be well finished and a good fit.

FISH KEPT ALIVE OUT OF WATER.

Fish, alive and kicking, may now be received at any distance from the waters in which they are captured. In other words, the salmon of the Columbia, the trout of Maine, the bass of Florida may be shipped to any part of the United States with as great facility as a bale of hay or crate of oranges. And when the fish reach their destination they are as lively as if they were in their native element, although they have not seen the water since they were taken from the sea or river. The possibility of doing this we owe to the Germans, and in a recent issue of "Der Tag" (Berlin) Hans Dominik tells us how it may be done. Mr. Dominik says:

"A short time ago I went to the laboratory of Dr. Eugene Erlwein, and this gentleman showed me a large glass case which was fitted with shelves like a bookcase; on the shelves I saw a large number of fish of every variety. There were fat carp and pike, trout and bass, and other watery denizens, and they were all well and happy—they moved their gills and fins exactly as though they were in the water, although they had not felt this element for thirty hours. The manner in which this was accomplished was soon explained to me."

Mr. Domirnik says that the floor of the case was covered with a thick layer of damp cloth; this kept the air in the receptacle moist, and the gills of the fish in consequence never became dry. But further investigation showed that the air in the box was not air at all, but pure oxygen; beside the case there was a large steel cylinder filled with oxygen. A tube led from the cylinder to the base of a jar filled with water, and another tube led from the neck of the jar into the box containing the fish. Says the writer:

"As I watched the apparatus I saw the oxygen bubble through the water of the jar and then, after being saturated with moisture, pass into the case. But the oxygen in the case was not stagnant; there was a pipe at one end which allowed the excess oxygen to escape. It was now clear to me how the fish could be kept alive and happy without water—the oxygen passed through their wet gills and into their blood in exactly the same way as if they were in water, while the carbonic acid gas from their lungs was carried off with the excess oxygen.

The afternoon of my visit the fish were taken from the case and put in the water. For this purpose the the oxygen was cut off, the top of the case unscrewed, and the fish thrown into tubs filled with water. It was at once apparent that the treatment had in no wise injured the creatures. The tench immediately became lively and animated; the thick Polish carp at first seemed a little dazed by the pure oxygen, but after a few minutes was thoroughly awake; the pike were the slowest to react. After a period of ten minutes the pike were still sluggish; the oxygen tube was therefore pushed under the water and into the fishes' mouths, and when the gas began to bubble through their gills the creatures were at once restored."

Mr. Dominik says that in these experiments the case contained three hundred weight of fish, while the case itself only weighed one hundred weight—thus there was only one-fourth dead weight. Dr. Erlwein has, however, carried his experiments further along this line, and he has now patented a special fish-car for use on railroads; in this car the above principle is used, but with slight modifications. Thus the fish are placed in a little water in the car, and the water is kept in constant circulation by means of small pumps. As it circulates the water passes through an apparatus which extracts the carbonic acid and injects the fluid pure oxygen. The fish in this way may be kept alive indefinitely.—"Literary Digest."

REMOVING SPECKS FROM THE EYE.

Some engineers are very skilful in removing specks from the eyeball, states the "Engineers' Review." Take a splinter of soft wood, pine or cedar, and whittle it to a point. Then take a small, loose flock of cotton, and laying it upon your forehead, place the pointed stick in the center of it. Then turn the flock of cotton over the end of the stick, winding it round and round, so as to make it adhere firmly. If you will look at the end of such a probe with a 12-in. lens you will see that it is quite rough, the fibers of the cotton making a file-like extremity. As the material is soft, it will do no harm to the cornea when brushed over its surface.

When ready to remove the foreign body, have the patient rest his head against your chest, draw the upper lid up with the forefinger of your left hand, and press the lower lid down with the middle finger, and then delicately sweep the surface in which the foreign body is embedded, with the end of the cotton probe.

DOVETAIL JOINTS.

[Continued from Page 286.]

have to force parallel surfaces apart. In most cases, therefore, it would be better arranged in the position shown in Fig. 13, where there would be greater risk of the vertical member being strained outwards than of the horizontal one being forced upwards. A dovetail joint like Fig. 13 is often employed in preference to a mortise and tenons, in which the surfaces of the joint are parallel in both directions.

with only a very slight increase in efficiency, for in either case the parts are usually held by screws or nails. To insure a tight fit and easy insertion, a slight amount of taper is often given lengthwise to the dovetail, and the groove it slides into, so that the former will enter slack, and be driven tight when the two parts are in their correct position with each other. Both Figs. 14 *B* and *C* are often made with only one side dovetailed and the other parallel with the surface of the piece that enters. The main object of this is to avoid the extra work of dovetailing both sides.

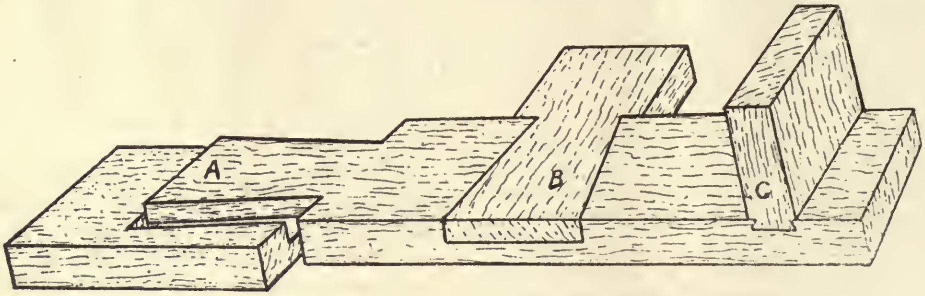


FIG. 14.

Fig. 14, *A* is a dovetail joint for uniting timbers end to end without the attachment of battens, or exterior means of securing them. An alternative to it is to cut the socket or recess in both portions, and insert a separate piece or key to hold them together. Fig. 14, *B*, is a dovetailed half-lap joint where the end of one member has to meet an intermediate portion of another. It might also, instead of going completely across, be stopped at some distance short, being then practically the same as Fig. 14, *A*, except for the difference in the direction of the grain.

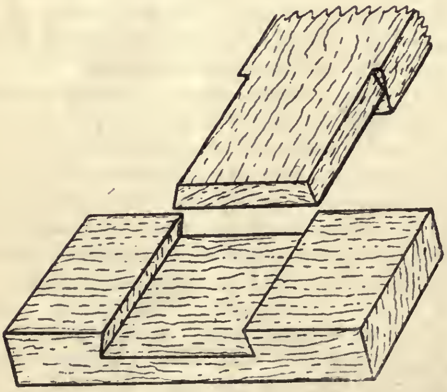


FIG. 15.

Fig. 14, *C*, is a dovetail joint sometimes employed for uniting pieces as shown, the dovetail usually being on end grain and the rebate across grain. It is an alternative to a plain rebated joint, but involves more work,

Fig. 15 is a half-lap dovetail joint differing from Fig. 14, *B*, only in the direction in which the dovetail is cut, Fig. 14, *B*, being designed to resist pulling backwards in the plane of the joint, and Fig. 15 to keep the broad surfaces together and flush on the exterior. Fig. 14. *B*. is employed more frequently than Fig. 15.

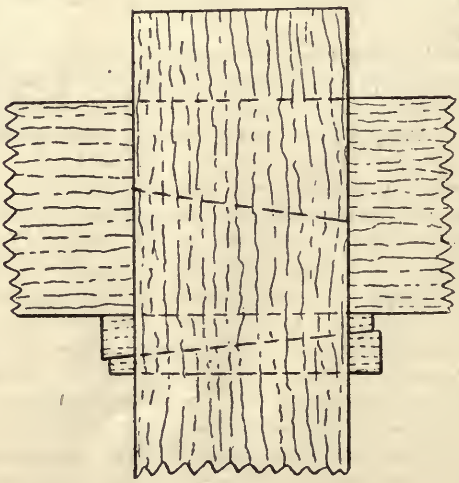


FIG. 16.

Fig. 16 is a dovetailed mortise and tenon in which the ends of two rails are united in a mortise in a post. A half dovetail is cut on the end of each rail, so that they will fit together with the rails in line with each other. The mortise is cut sufficiently wide to permit these ends to be inserted from opposite sides, and then the dovetail is closed laterally and kept so by folding wedges which fill the extra width of the mortise, thus making it impossible to withdraw the ends without first loosening and removing the wedges. A single end may be wedged similarly by sloping one of the sides of the mortises to fit the dovetail. This is a very useful joint for temporary work.

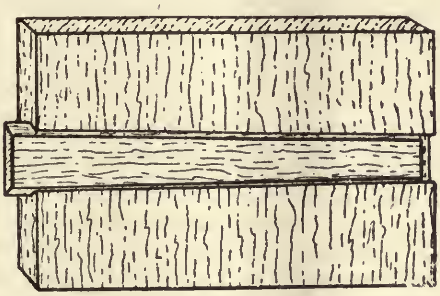


Fig. 17.

Fig. 17 is a dovetail key used for strengthening and keeping very wide pieces of wood from curving. Its edges are dovetailed similarly to Fig. 14, *C*, to keep it in place, and it is tapered lengthwise, so that it can be driven to a tight fit and further tightened if necessary subsequently to compensate for shrinkage. Sometimes the key stands above the surface of the other piece to give as much stiffness as possible; but it is, if necessary, planed flush.

A SMALL RHEOSTAT.

PAUL ZERRAHN.

The materials for making this rheostat are: A piece of hard black rubber 4x5 in. and ⅜ in. thick; ten short round-head brass screws; six inches of ¼ in. bore, hard black rubber tubing, two binding posts, a quantity of No. 24 gauge iron wire, a small strip of spring brass and four round-head machine screws 1½ in. long with nuts.

First cut out a piece of the rubber 2 in. square. Then cut out a bottom piece with projections the shape shown in Fig. 1. To know where to place the screws *c c c c*, draw four diagonal lines from corner to corner. This will give the center of the piece of rubber, as well as the points for the screws. Measure in on these lines ¼ in. from the corners, marking the points so obtained. On these four points drill ⅛ in. holes, and similar holes on the other piece of hard rubber. The points *e e*, are round head screws, with their points filed down until they are a trifle over ⅛ in. long under the head.

With a compass draw a circle, using the center obtained as above. Divide one-half the circle into seven parts, spaced ⅜ in. apart as in Fig. 1, and drill holes on these points just large enough to hold the screws *e e*, etc., firmly. Then put in the screws with heads on the bottom of the piece of rubber. The filed ends should come just through on the top.

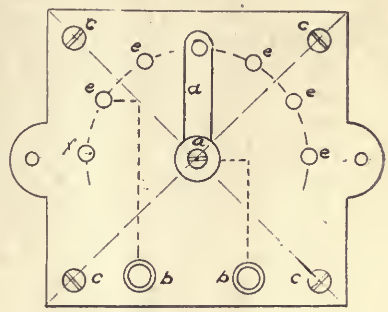


Fig. 1.

From the iron wire cut lengths about one foot long, and turn up spirals by twisting around a pencil or other cylindrical shape. Connect the points *e e*, by soldering to them the ends of the wire spirals, with the exception of point *f*, which has no spiral connection. Next attach the two binding posts, *b*. Connect one of the binding posts with last right-hand point *e*. The movable arm consists of a piece of spring brass with a hole at one end for the screw, by which it is attached to the center of the rubber piece having the points *e e*, and long enough to allow the outer end to make full contact with the points, *e e*. A knob *a* can be made from a small porcelain picture knob, or wooden knob such as are used on the covers of cooking utensils. To

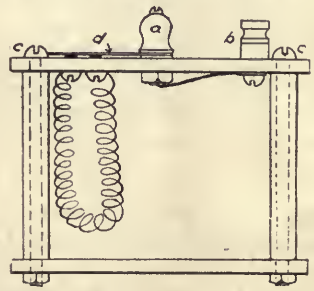


Fig. 2.

ensure the arm turning with the knob, a nut is placed on the machine screw binding the arm firmly to the knob. The screw is then put through the center hole drilled in the rubber and another nut added, fastening same with a drop of solder at the same time the wire is soldered to the screw connecting it to the other binding post.

The rubber tubing is then cut into four pieces 1½ in. long, the long machine screws are put through the corner holes in the top rubber piece, the tubing slipped over them, the bottom piece of rubber put in place, and the nuts then tightened up, holding all parts in position, as in Fig. 2. The resistance here described can be used for regulating the current from batteries to small motors, miniature lamps, etc.

WEATHER INDICATOR.

J. S.

Having tried many different styles of weather indicators, I have found the kind to be described here to work well, and as the cost of making one is small, it will undoubtedly interest many readers of the magazine. The base consists of a board 20 in. long and 12 in. wide, which should be fitted with cleats on each end to prevent warping. On the back are fastened with round head brass screws, twelve small spools, similar to those used for twist. The screws should be an easy fit for the holes in the spools, and the holes should be smoothed out with a round file to get a good bearing. It would also be an advantage to fill the pores in the wood with powdered graphite, which reduces the friction. The arrangement of the spools is shown in Fig. 1.

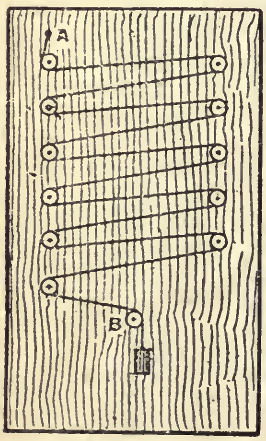


Fig. 1.

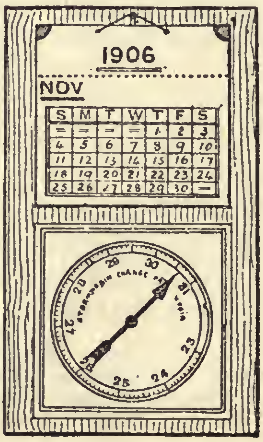


Fig. 2.

Obtain an E violin string and make a knot in one end and fasten with a screw at point *A*, Fig. 1; the string is then carried over the several spools and to the lower end is attached a lead weight, weighing about four ounces. On the front of the board a calendar or ruled record blank may be placed on the top portion. A dial is marked out on heavy card board, as shown in Fig. 2, cutting out a hole in the center to put the shaft or the pointer. The shaft is made of a piece of brass tubing or brass rod of a size to fit one of the twist spools with a drive fit. A hole is bored in the board at the point *B* Fig. 1, and a pointer is then fitted to the front end.

The pointer is cut out from a piece of thin brass or tin and painted black. The violin string is carried twice around this spool so as to turn the pointer in accordance with the variations in the tension of the string. The calibrating of the dial must be done after the indicator is in operation. The preferable way is to obtain the use of a regular instrument and by taking observations night and morning for several days, several points can be obtained from which intervening points can be worked out. If this method is not possible, it will be necessary to telephone to some weather observatory at stated intervals and get observations in that way. When complete the indicator is mounted in a vertical position in some place about the house, where it will not be reached by the rain or snow and yet be influenced by a change in the humidity.

GASOLINE NOT DANGEROUS.

Because gasoline can be used with better effect than any other hydrocarbon compound as an explosive mixture in the cylinder of an internal combustion engine, an impression prevails that gasoline must necessarily be extremely explosive, says the "Automobile Magzine." In this respect the more inert kerosene is much more dangerous than gasoline. If a vessel partly filled with kerosene is left open, air sufficient to create an explosive mixture is likely to accumulate in the presence of the liquid, but gasoline stored under similar conditions gives off its gaseous emanations so freely that an air-charged mixture does not accumulate.

The combustion of gasoline either in burning as a fuel or as an explosive in a cylinder is practically the same natural process as the combustion of any other fuel. The hydrocarbons of which it consists combine with oxygen when raised to the proper temperature and produce water and carbon dioxide. In the ordinary combustion of gasoline the vapor passing from the liquid ignites at about 1500° Fahr., when combustion will proceed as rapidly as the admixture of combustible and oxygen can be combined. When the air and fuel are mixed in the proper proportion combustion becomes explosion; but the mixture is the same as that which goes on in the slow combustion process, producing water and carbon dioxide.

Gasoline, although very inflammable, produces an inert gas, unless it is mixed with the proper proportion of air or oxygen that makes it an explosive. The effective mixture of air from which the oxygen is drawn and the vapor of gasoline varies from 6 to 1 to 11 to 1. Mixtures above or below these proportions may be entirely useless for power purposes, and they would not cause an explosion in the open air or even in a confined chamber.

Gasoline is so volatile that if left in an open vessel or in a vessel having a vent, the gasoline vapor will force its way out, precluding any admixture of air. If sufficient heat is applied to ignite this escaping current of air, no explosions can happen, but the gas will begin to burn the same as a gas lighting jet. People become panic stricken about gasoline because they do not understand its peculiarities.

CORRESPONDENCE.

No. 158. CAMBRIDGE, MASS., JULY 7, 1906.

Will you please inform me whether is is feasible to use a small balloon for elevating the aerial wire for wireless telegraphy, and if so, give description for making one. H. J. C.

Balloons have been used to elevate the aerial wire for wireless telegraphy, but such use has been almost entirely confined to military work. A balloon of considerable size is required to give sufficient capacity to lift itself and the weight of an aerial wire of say, 10 pounds. If illuminating gas is used for inflating, a balloon of 1000 cubic feet capacity would lift only 32 to 37 pounds, according to the kind of gas and humidity of the atmosphere. The diameter of such a balloon would be nearly 13 feet, and the expense of inflating it would be considerable, as well as requiring considerable time unless a large supply pipe was available. The lifting capacity of hydrogen gas is about double that of illuminating gas, consequently the balloon would need to be only half the size for the same capacity, but a generating plant would be necessa:y. As amateurs make use of wireless telegraphy intermitently, it is decidedly the best plan to put the money required for a balloon outfit into other parts of the apparatus and make up through increased efficiency in these parts what is lost in a lower aerial.

THE SIMPLON TUNNEL.

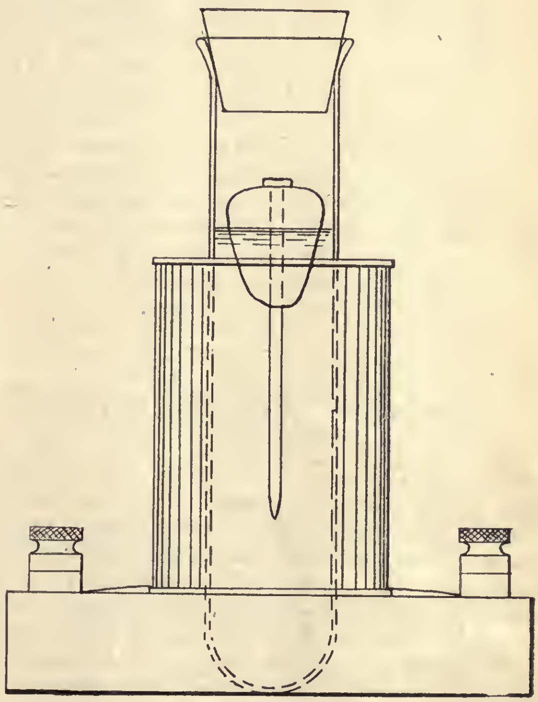
The new Simplon tunnel, which was recently opened to traffic, is being operated with little difficulty from the natural rock heat that is encountered near the middle portion. At the same time, the ventilation has proved very satisfactory, in spite of the use of the ordinary coal-burning locomotives which are required, owing to the impossibity of operating with the new electric motive power, until the locomotives are specially insulated and equipped to withstand the moist vapors encountered. The temperature experienced in the cars range as high as 80° Fahr. near the middle of of the tunnel and correspondingly lower near the portals, but owing to perfect mechanical ventilation this does not prove objectionable, and the gases from the locomotives are said to be nowhere evident.

The entire trip from Domodossola, near the Italian portal, to Brig, on the Swiss side, requires but little over an hour, at ordinary operating speeds. The unfortunate feature of the tunnel condensation of moisture from the heated air near the middle on the cooler surfaces of the cars and equipment passing through this condition having rendered the electrical operation troublesome until it can be provided against by enclosure of the apparatus liable to be affected.

SIMPLE CURRENT DETECTOR.

A. M. TROGNER.

To make a simple, yet effective current detector, procure a glass tube, some No. 25 wire, two corks, nails, and wood for base. Drill a hole in the base-board large enough to insert the test tube. Make a card-board bobbin to fit over the test tube, so that when the tube is through the board and the bobbin is placed over it there will be from one to two inches of the tube clear above the bobbin, as shown in Fig. 1.



Then take a cork and cut to the heart shape shown in Fig. 2, the dimensions depending upon the size of the test tube. Insert an iron nail in the cork, making sure that the cork will bear the weight of the nail when placed in water.

The next thing is the winding of the bobbin. Five layers are wound of No. 25 copper magnet wire, and then covered with shellac.

To assemble the parts, first fill the tube with water, then place it in the cork float and cork up the tube. Next invert the tube and insert it, from the bottom, in the hole in the base-board. Then place the bobbin over the tube and connect the ends of the wire to two binding posts, and the instrument is ready for use. On passing a current through the wire the cork will sink down within the bobbin. If it does not, then loosen or tighten the cork stopper, or change the direction of the current through the bobbin until it does.

VACCINATING TREES.

According to Consul-General Guenther, of Frankfort, German papers state that it happens frequently that the roots of fruit trees are more exhausted than the parts above the ground, and so the life of the tree is threatened.

In order to prolong its life in such cases, it has been recommended to vaccinate the trunk of the tree with a solution of sulphite of iron, the same article which is used in the so-called anæmia or chlorosis (Bleichsnckt) of the grapevine. A Russian scientist, Mr. Sigismund Monrjetski, has now made minute scientific experiments with reference to the results of such vaccinations, and by employing colored solutions he has shown that the solution never enters into the old wood. It only follows the young growth, but it penetrates into the roots down to a depth of 1 meter (about 39 inches), while on the other hand, it penetrates up to the top of the tree. It is therefore deemed best to vaccinate the tree through a single opening of the neck of the root, and it should serve not only for the introduction of nutritive substances, but also of such liquids which, by killing certain bacteria, tend to cure diseases of the plant.

SCIENCE AND INDUSTRY.

For some weeks past the French War Office has been engaged in conducting experiments with a view to securing reliable communication for military purposes between Paris and the eastern garrison towns by means of wireless telegraphy. Though many difficulties had to be encountered, these were eventually overcome, and after the system had been extended as far as Vardon and Chalons, the important stronghold of Belfort was furnished with apparatus for wireless telegraphy. According to the "Electrical Engineer," London, there is now complete and permanent communication between Paris and all the eastern garrisons.

Kerosene, which is used for fuel to a considerable extent in combustion engines, is made from the distillation of crude petroleum. It takes on an average 3½ parts of crude oil to render 1 part of kerosene. The heat of combustion depends, of course, on the composition, but will range between 22,000 and 24,600 British thermal units per pound. The quicker the distillation, the poorer will be the kerosene, although it will be obtained in larger quantities. The burning point of kerosene is between 130 and 140° F., and it will boil anywhere between the limit of 300 and 500° F., giving a vapor density of five times that of air and requiring for its combustion nearly 190 cubic feet of air per pound.

A new method for increasing the density of steel is described in "Stahl und Eisen". The object is to allow for the escape of the occluded gases in the metal by keeping the upper part of the ingot in a fluid condition until the mass of the ingot has solidified. To accomplish this a burner cap is placed on top of the ingot mould and a gas blast flame is directed downward upon the metal; vent holes at the side of the cap allows the gases to escape. The flame is so proportioned as to keep the upper part of the ingot considerably above the melting point, thereby causing the ingot to solidify progressively upward. The metal can thus follow the contraction in volume, and the gases are free to escape.

What is said to be the largest wind engine in this country is a great Dutch wind mill recently erected on the Ocean Boulevard, San Francisco. The concrete sub-base is 43 feet in diameter, with walls tapering in thickness from 48 inches to 30, and rests upon a concrete foundation 50 feet in diameter and 54 in. deep. The four great arms have each a radius of 51 feet and a wind area of 400 square feet, making 1600 in all. The main shaft, which is 13 inches in diameter and 18 feet long, is elevated 12 degrees above the horizontal on the score of efficiency. The big 24-foot turret which keeps the big wheel always facing the wind. The lowest wind velocity at which the mill will operate is eight miles per hour, at which 5 horse-power is developed; at twenty miles 200 horse-power is obtained. The tips of the long arms always travel more than twice as fast as the wind.

The earliest mention of coal among the ancient authors is by Theophrastus, in his "History of Stone," wherein he says: "There is a fossil substance called coal which is broken for use; it kindles and burns like wood. It is found in Liguria and in Ellis, in the way to Olympia over the mountains. These coals are used by the smiths." It is very probable that coal as we know it was used by the primeval Britons for metallurgical operations. The Romans were undoubtedly acquainted with coal, for cinders, or coke, was discovered amid the ruins of their iron forges. It was certainly used by them in their pottery furnaces at Condata, Warrenton, where quarries of wigan cannel coal, and cinders or coke were found, in connection with an extensive collection of pottery, now preserved in the museum of that town.

When solid water becomes liquid, or when liquid water becomes gaseous, a considerable amount of heat is rendered latent. Steam issuing from boiling water is no hotter than the water itself; water formed when ice is melting is no hotter than the ice itself, yet heat is being communicated to the ice and to the water.

There is a huge natural magnet in Upper Burmah, India, covered with great blocks of iron ore, which has a tremendous attraction, rendering compasses and watches useless.

AMATEUR WORK

A MONTHLY MAGAZINE OF THE USEFUL ARTS AND SCIENCES

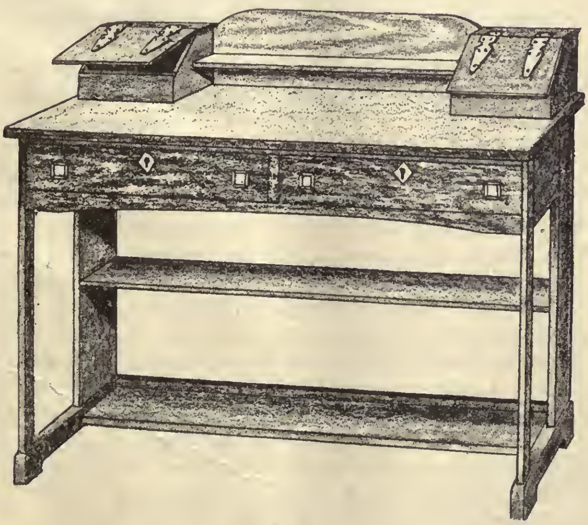
Vol. V. No. 12. BOSTON, OCTOBER, 1906. One Dollar a Year.

A STUDENT'S DESK.

JOHN F. ADAMS.

In the design here given for a student's desk, the aim has been to provide ample storage rocm for writing materials, shelves for books, etc., and yet retain an unobstructed surface for work, which shall receive as much light from all directions as possible. Possessing these requirements, it will undoubtedly interest others than the class for whom it is specially provided.

Oak is the most suitable wood of which to make it, and the finish should be a deep brown or green stain, and dull polish. Black iron or oxidized brass hinges and pulls should be used if obtainable.



The top measures 40 in. long, 24 in. deep and 1 in. thick, and the several pieces should be carefully matched as to grain. At the back is a board 39 in. long, 7 in. wide at the center, 5½ in. wide for a distance of 6 in. at each end and ⅞ in. thick. The ends of the wide portion are rounded down to the narrower part as shown in Fig. 2.

The fronts of the two covered pockets are 8 in. long, 2 in. wide; all the pieces in the same are ½ in. thick. The top pieces are 9 in. long and 2 in. wide, the front edges being bevelled square with the slope of the cover. The outer end pieces are 8 in. long, 6 in. wide at the back and 2 in. wide at the front. The joints with the back piece are mitred. The inner end pieces of the pockets are 7½ in. long and 7½ in. wide. A shelf 17 in. long, 3 in. wide and ½ in. thick is placed 3 in. above the top of the desk. It is secured in place by nailing through the inner ends of the pockets and the back.

The under framework requires two pieces 26½ in. long, 8 in. wide and ⅞ in. thick; two pieces at the

FIG. 2.

front the same length and thickness and 1½ in. wide. Also, two base pieces, 24 in. long, 3 in. wide and 1½ in. thick, the under edge being cut out as shown in Fig. 3. The cross pieces at the ends are 14 in. long, 7 in. wide and ⅞ in. thick. The joints, for all these pieces are mortised and firmly glued when put together.

The front cross piece over the drawers is 37 in. long, 1 in. wide and ⅞ in. thick. The piece under the drawers is 2 in. wide at the ends, cut down in a long curve to 1½ in. wide at the center. The piece dividing the drawers is 5 in. long and 1 in. wide. These dimensions all allow ½ in. at each end for tenons.

The under framework is attached to the top by means of strips fastened to the inner sides of the ends, and by screws through the front piece over the drawers.

The shelf at the bottom is 37 in. long, 19 in. wide and ⅞ in. thick, mortises ½ in. deep being cut in the base pieces for it. At the back is a stop piece 36 in. long and 1 in. wide, nailed on. The other shelf is 36 in. long, if nailed in place, 37 in. long if mortised, which is preferable, and 8 in. wide. It is located 10 in. above the lower shelf.

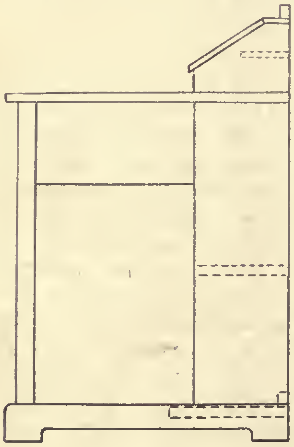


FIG. 3.

The two drawers are 17½ in. long, 22 in. wide and 4 in. deep. A frame work is glued up to form the run, the construction of which can be learned by examining any bureau or similar piece of furniture, as can also the proper way to make the drawers. The principal requisite to get a rigid desk is to have all joints carefully fitted and well secured with glue, adding nails sparingly where it may seem desirable.

PHYSICAL SCIENCE.

The accomplishments of physical science are truly wonderful. While, perhaps, not appealing as strongly to the lay mind as does the work of the engineer, they must nevertheless be counted among the greatest achievements of our civilization. One striking illustration of the marvellous potency of scientific methods is the addition to our knowledge of the nature of things has been gained through the study of radium.

The phenomenon of radioactivity has been known only ten years and was entirely new when discovered. It seemed utterly opposed to our previous conceptions of matter, yet in ten years we have made such progress that we now feel that we know vastly more about the molecule than we had any hopes of learning for a long time before the discovery of radioactivity. And that is not all, for ten years ago we had no basis for believing that an atom could be broken up, while now we seem to know more about the constituent parts of the atom than we previously knew of the atom itself. We have not only shown that an atom can be broken up, but we have shown that, in certain cases, this disintegrating process is exceedingly complex and takes place in successive stages, one following the other.

Uranium, for example, which is supposed to be the parent element of radium, first breaks up, forming uraninm X which then changes to radium. Radium then gives off the so-called emanation, and this, in various ways, goes through six stages, finally reaching the form known as radium F. As yet no further change has been traced, but Prof. Rutherford, who has been particularly instrumental in this remarkable work, thinks that it is probable that finally lead is formed, since this material is always found associated with radium ores in quantities suggesting the inference.

Besides this determination of the stages of decomposition of the radioactive materials, the character of these changes has been determined; in fact, it is from the peculiarities of the latter that the various stages have been recognized. During certain of the changes particles of charged matter—if we may still use this term—are thrown off at terrific velocities, and produce disastrous effects upon any other material which may lie in their way; in fact, these minute projectiles actually shatter to pieces molecules of matter which they encounter.

Naturally, the laws governing the movement of these atomic fragments would be of the greatest interest to science, and it is with the sense of gratification that one learns that recent researches seem to indicate that they are neither more nor less than the laws of motion enunciated by Newton for terrestrial matter, and later extended to the visible universe.

Truly, these developments of physical science are of the greatest importance, and it is worthy of remark that they have been accomplished by the means of simple apparatus, though, of course, constructed in a refined way. With mathematics as his dark lantern, and a simple electrical instrument as a jimmy, the scientific burglar is rapidly depriving Nature of some of her most cherished secrets. Fortunately for the pleasure of the burglar, the further he penetrates into Nature's treasure house, the larger does he find it to be and the richer the treasure.

Deserts occur at all elevations, from depths below sea level to thousands of feet above, and with numerous variations in the surface, from a flat expanse of sand, where the view for days of travel is bounded by a sharp circle as at sea, to rocky mountain slopes rent by rough defiles, bare and chiseled by driving sand.

INDUCTION COIL MAKING FOR AMATEURS.

FRANK W. POWERS.

VII. Experiments with Induction Coils.

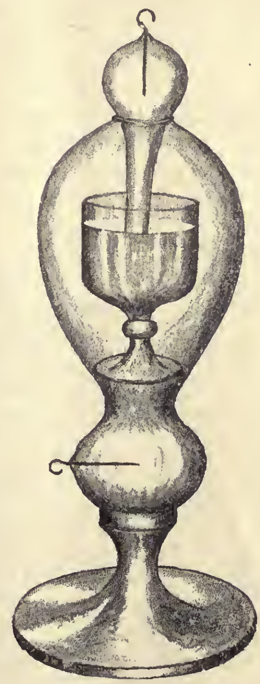
The experiments that may be performed with an induction coil are to some extent dependent upon the spark capacity of the coil, but as many attractive and interesting ones require a coil giving only a ¼ in. spark, the owners of small coils have no reason to be discouraged because of the lack of a large coil. For X-ray work a 4 in. spark coil is about the smallest with which radiographs of the bones of the hand can be satisfactorily obtained, and a coil of much greater capacity is generally used. A 4-in. induction coil in series with a Tesla coil gives beautiful results, but this branch of coil work must be held for a future series of articles.

The vacuum or "Geissler" tube is at once the most interesting and spectacular accessory of an induction coil, and owing to the great variety of such tubes, can profitably receive considerable attention from the amateur experimenter. These tubes are made of thin glass in a multitude of shapes and sizes, with platinum electrodes sealed into the ends and the enclosed space partially exhausted of air, or the air replaced by certain rarified gases, each one having its own peculiar color of incandesence when excited by the current from a coil. For instance, nitrogen will give a reddish light at the positive end, and violet or light blue a' the negative end. With hydrogen the colors are crimson and blue, while carbonic acid gas gives green and lavender blue, but arranged in rings or discs.

Compound tubes are also made, in which the tube having the electrodes is enclosed in another tube, the latter generally straight, and the space between the two tubes is filled with a colored fluorescent solution, which gives a beautiful tint to the light within the inner tube. Another type of tubes has the form of a large bulb, and contains what is seemingly a group of dull clay figures or spray of flowers with leaves, but which assume most beautiful colors when connected to the coil. The latter are quite expensive, however, and are not commonly seen, but are well worth the having by those who can afford them.

The size of tubes varies from the small, single tubes 3 in. long, to the large, compound tubes 15 in. long. The small ones can be made luminous with a coil giving only a ⅛-in. spark, but a ¼-in. spark is necessary to secure full brilliancy. An easy way of estimating the spark requirements is to allow from three to four feet of tube for each inch of spark, much depending on the "fatness" of the spark. The writer has a frame with six 12-in. tubes in series, which are very brilliant with the spark gap on the coil set at 1 inch.

If the electrodes of the tubes become quite hot with continued operation, the spark gap is excessive, or the connection have too much resistance. The connecting terminals of tubes are quite easily broken off, and to avoid such breakage it is advisable to use stranded wire, such as is used for electric drop lights. The strands are easily twisted around the loops of the tubes, and a better connection obtained than with magnet wire. In the event of the terminal of a tube

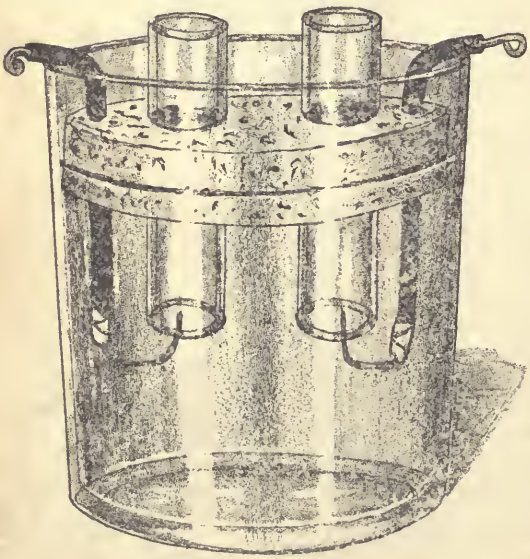


GASSIOT'S CASCADE.

being broken off, it can easily be repaired by placing a small bead of tin foil, softly rolled up, inside the cup shaped terminal, pressing same against the end of the platinum electrode and fastening with sealing wax, shellac or liquid glue applied around the edges.

Still another form of tube is that known as "Gasslot's cascade," the form being shown in the accompanying illustration. It was originally performed with table glasses under a bell glass of an air pump, but the special parts can now be imported made up ready for use. It makes a most striking class-room demonstration if the windows are shaded to darken the room, and would also make a fine window display after sunset. It consists of a large glass bulb enclosing a glass goblet which rests upon projections on the shoulders of the bulb to give a little space between the base of the goblet and the walls of the bulb. The cover has a neck projecting down nearly to the bottom of the goblet, and a platinum wire electrode fused into the top. In the lower bulb is another electrode, and all is supported by a suitable base. A partial vacuum is obtained with an air pump, and the electrodes connected to the coil, when the light seems to flow in a stream from the upper electrode down through the neck into the goblet, which appears to quickly fill and overflow around the top, down the sides into the lower bulb to the other electrode.

An interesting experiment which impresses those unacquainted with high tension effects, is to take hold of one end of a vacuum tube, place the other end of tube on the positive discharging rods of the coil, pointing with the other hand to the negative discharger, the discharge gap being about ½ in. As the moving finger draws near to the discharger, a slight shock will be felt in the arms and the tube will begin to glow, the brightness increasing the nearer the finger is brought to the negative discharger, and fainter as the hand is drawn back. The end of the free finger should not be brought into actual contact with the discharger, as a smart shock will be given should this occur.



DECOMPOSITION OF WATER.

An incandescent lamp will also glow under the same conditions, whether it has a filiament or not, by touching one terminal of the lamp to the positive discharge. With a large coil it is not even necessary to have actual contact; placing the lamp between the dischargers will cause it to glow.

If the coil be fitted with dischargers having sharpened points, paper, cardboard, glass and other substances may be perforated. Place the piece of cardboard between the points and start the coil; sparks will pass through, forming round, slightly charred holes. The gap between the points should be about one-half that of the coil capacity. To pierce glass it is necessary to support it so that it remains fixed and the spark continuously applied to the same point. If the spark plays around the surface of the glass, make two deep rings of sealing wax and affix to either side of the glass. Place the points of the discharges within the wax rings and start the coil. The rings will hold the spark to one spot and a hole will soon be perforated.

A miniature arc light can be made from a lead pencil having a large, soft lead. Cut the point into two pieces, remove the wood from each end, wind several turns of No. 20 magnet wire around one end of each piece and connect to the dischargers. Place the pieces of pencil on two tumblers and bring the free ends nearly together; start the coil and then adjust the gap until the arc is formed, when a brilliant white light will be given off.

Using the pointed dischargers, twist around the ends pieces of fine iron wire, bring the free ends of the wire together till sparks pass freely, and until one wire becomes white hot, when it will burn brightly, emitting sparks of burning metal. Substitute copper wire for the iron wire and note the change in the color of the light.

Prepare metal filings with a clean, coarse file, sprinkle a layer of fine filings upon a sheet of ebonite, start the coil and bring the discharger points to opposite edges of the filings. Part of the filings will be fired and the spark will have a zigzag shape with color varying with the metal. Copper, nickel and silver coins can be used to furnish filings of these metals. Strips of metal foil of the various kinds used for signs will be consumed in a brilliant flash, the color varying with the metal.

Take a discarded photographic plate and upon it attach with shellac a piece of tin foil cut to the shape of of a star or diamond. When the shellac is dry cut lines through the foil with a knife. Place the plate so that the discharger points are near opposite points of the foil figure and start the coil, when sparks will appear at the knife marks. With large coils, large foil signs can be illuminated with striking effect, a flaming discharge being the most effective.

The superior conductivity of heated air is shown by bringing the flame of a lighted candle near the discharger points. Blow out the candle and hold the wick between the points when the candle will be relighted, provided the wick still has a red glow.

The decomposition of water is an old but interesting experiment, and the materials necessary are easily obtained. Two pieces of platinum wire about 1 in. long are soldered to two pieces of No. 18, waterproof insulated wire, the joint being wrapped with electricians' tape and then thickly shellacked, so that only the platinum wire is exposed. Bend the platinums' ends backward to form hooks, and twist the outer ends of the insulated wire into spirals, so that when placed over the opposite sides of a glass tumbler the hooks will be a short distance above the bottom of the glass.

Fill the tumbler nearly full of water, strongly acidulated with sulphuric acid or vinegar. Obtain a disk of cork large enough to fill the top of the tumbler, bore two holes with centers about 1 in. apart to receive two 3 in. pieces of glass tubing $\frac{1}{4}$ or $\frac{3}{8}$ in. diameter. Place the cork and tubes in the tumbler and arrange the hooks so the points will be inside the lower ends of the tubes. Connect the free ends of the copper wires to the coil dischargers and start the coil. Bubbles will rise in the tubes, oxygen gas rising at the positive and hydrogen gas at the negative wire; the quantity of hydrogen gas will be about double that of the oxygen gas.

As frequent mention has been made of positive and negative discharger, it will be desirable to have a convenient way of determining which these are. Obtain some white photographic blotting paper, as this kind is free from intertering chemicals, and soak in thin, hot washing starch. After the starch is dry, dip in a solution of iodide of potassium, one ounce, and water one pint, and dry. To use, dip in water, place upon a sheet of clear glass and place between the dischargers. Start the coil and the paper around the positive pole will turn to a purple or brown shade.

HAULING OUT BOATS FOR THE WINTER.

CARL H. CLARK.

The beginning of the present month will, with the large majority of boat and launch sailors, mark the close of the season, and the next thoughts will be in regard to hauling out and storing the boats for the winter.

All cabin fittings and furnishings should be removed and taken ashore, and all loose dunnage and odds and ends cleaned out and removed. There is certain to be a large collection of loose stuff after a season's use, the larger part of which may best be thrown away.

The sails should be unbent and, together with the cushions and other fittings, should be thoroughly dried out in the sun. When completely dry and warm the sails should be tightly rolled up and packed away, preferably in canvas bags. If the cushions are expensive ones they may be done up in cotton cloth, otherwise they may simply be tied together in neat bundles. These furnishings and the sails should be stored in a dry place, such as a loft, as any moisture is sure to cause mildew and spoil the appearance of the sails. They should also, if possible, be protected from rats and mice.

Spars should be stored under cover, and in such po-position that there will be no tendency to bend out of shape. It is always advisable to unstep the mast and protect it from the weather, as it not only prevents it from rotting but makes it easier to scrape and varnish in the spring. When spars are left standing they should be either wrapped with strips of cloth, or covered with a preparation of tallow or similar substance to protect the wood from the weather and prevent its becoming permanently stained.

All inside ballast should be taken out, not only to make the hauling easier, but to relieve the boat of the unusual strain which would come from the weight during the winter. The boat should then be thoroughly washed inside and all rust and dirt cleaned out so as to have the bilge clean and sweet. It is far easier to get rid of the dirt in this manner, as chips and light matter will float and may be picked out, and then dirt will settle in the bottom and may be scraped up while it is soft. In this way the inside of the boat may be left clean. In the case of a power boat, all the grease should be carefully scraped out from under the engine and the plank and frames washed clean. Strong lye or potash will help in dissolving this grease.

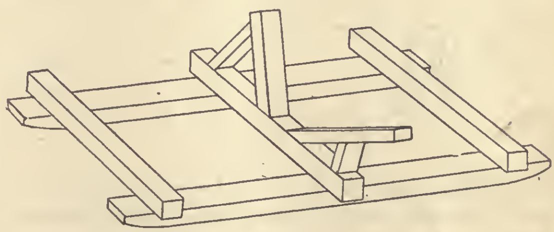


Fig. 1.

For storing the boat a dry spot should be chosen, but if possible it should not be exposed to the direct sun on account of this drying tendency. While the ground on which the boat is hauled should be perfectly dry, it is advisable to take advantage of the shade of some building or trees to shield it as much as possible from the direct sunlight.

For hauling out the boat a cradle of some sort should be used; the simplest and most convenient form, shown in Fig. 1, consists of a pair fore-and-aft timbers slightly shorter than the boat, with two or three cross timbers whose length is about the same as the beam. For small boats the timbers should be about 4 x 4 in. while for larger boats 4 x 6 in., 6 x 6 in., or even 6 x 8 in., are used, according to the size of the boat. The timbers are bolted together with $\frac{1}{2}$ or $\frac{5}{8}$ in. bolts, the cross pieces on the top of the fore-and-aft ones. Since rolls will most likely be used under the fore and-aft pieces, the ends of the latter should be bevelled off so as to more easily ride up on to the rollers.

To steady the boat on the cradle a pair of V-shaped chocks or braces are fastened on the middle cross piece, which fit up under the bilge and maintain the boat upright.

To put the boat upon the cradle, it is brought into shallow water, and in the case of a small boat a cradle may be pushed under her. With a larger boat this should be done at high tide; it may also be necessary to ballast the cradle in order to push it under the boat; when it is in place the ballast is pushed off and both boat and cradle drawn in until the latter grounds, taking care not to change the position of the boat on the cradle. When the tide receeds the work of hauling out may be done. Wood rolls 5 or 6 in. in diameter are used, with a double row of planks under each fore and aft piece. For motive power a winch or several purchases of tackle blocks are used, according to the size of the boat. For small boats, a cradle built according to Fig. 2 is very useful, as with it a boat of small or medium size may be hauled a considerable distance with the aid of a horse. In this manner the boat may be hauled into the owner's yard and be convenient for spring overhauling, repairs or alterations.

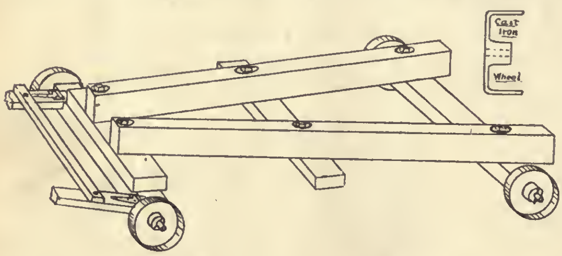


Fig. 2.

When hauled into place the boat should be blocked up level and well shored fore and aft. Shores should be fitted under the ends of the keel, and it should not be allowed to extend unsupported, as this brings an unnecessary strain upon the boat.

The boat should now be left open to the air for a few days in order to thoroughly dry out before being covered over for the winter. It should be arranged when possible so that a current of air will circulate through her at all times, as moist dead air is one of the best promoters of dry rot.

If the boat contains an engine it should now be thoroughly cleaned. Cylinder covers and hand hole plates should be taken off and the oil and deposits entirely removed. All bright parts should be polished and then smeared with thick grease for protection against moisture. Any parts which have shown signs of wear and need of repairs should be removed at this time.

In the case of a small engine it is advisable to remove the entire engine from the boat. It may then be taken to some convenient place and cared for, and any repairs or improvements may be made at leisure during the winter. All of the ports, passages and bearings should be liberally flushed with kerosene oil to remove all of the old oil which would become sticky and hard before the engine is used again. If the varnished work shows signs of wear it should be given a coat of shellac to keep out the weather and preserve it. A coat of tallow and oil is also an excellent preservative and facilitates the scraping in the spring.

A cover, either of boards or canvas, should be built over the boat; if the latter, a framework may be built over which the canvas may be laid. Some access should be allowed for the air, to prevent the interior from becoming stale and musty, with possibilities of rust.

The practice of hauling under a shed, which is becoming quite common in yacht storage yards, is greatly to be recommended, as it not only saves the trouble of covering up, but allows the boat to be well ventilated at all times, and allows of much work being done in the early part of the spring when it would not be possible to work in the open, thus saving much time. This is by far the most desirable method of storage and should be taken advantage of whenever convenient.

The higher the compression in a gas engine the weaker must be the mixture; that is to say, the ratio of air to gas increases with the compression. Broken crank shafts and bad plates, as well as cracked breech ends, are generally due to the lack of strength and stiffness of the engine. A gas engine requires to be built on the lines of a gun, since its action is of similar nature; therefore engines of the vertical type cannot have the stiffness which is present in the horizontal engine. When the running of an engine gives rise to shock or knocking, it is likely that the speed is too great. Current practice for a 500 h. p. engine would be about 135 r. p. m. with a piston speed of 700 ft. per minute; but the engine would do better at 120 r. p. m., with the same piston speed.

Palladium was discovered in 1803 by Wollaston while purifying crude platinum. Palladium occurs native in platinum ores and also alloyed with gold and silver ores from Brazil. It is a ductile, malleable white metal with a specific gravity of 11.8 and possessing the lowest melting point of all the platinum metals. It is used in the manufacture of fine scientific instruments, from its properties of hardness, color and resistance to the action of the atmosphere. Alloyed with silver it is used in dentistry to a small extent as a substitute for gold in the filling of teeth. It is quite rare and were it in more plentiful quantity the metal would be most valuable commercially.

The metre is the unit of length of the metric system of weights and measures and was intended to represent the one ten-millionth of the quadrant of the earth measured on a meridian from either pole to the equator. The gram is the unit of weight, which is the weight of a cubic centimetre of pure water at its greatest density—4.5 ° C., or 40° F. The latitude is a negligible factor.

EARTHED AND UNEARTHED RADIATORS IN WIRELESS TELEGRAPHY.

W. H. ECCLES, D. SC.

Recent commendations of certain new Lodge-Muirhead wireless telegraph stations equipped with insulated oscillators and resonators of the 1897 English patent, make the moment opportune for a brief review of the reasons and facts that have made the use of the earthed radiator almost universal and the use of one unearthed rather exceptional. A plain statement of the present position of the rival cults—the earthed and the unearthed—in the light of widely accepted theory, can be made and is best made without recourse to mathematics.

In the early days of Hertzian space telegraphy, say ten years ago, the solution of the signaling problem was expected in the employment of straight beams of electrical radiation. The electric rays used, produced of course in the Hertzian manner, were to be projected in any desired direction, and were to be capable of penetrating all obstacles between the sender and receiver. Hence it was that radiation of short wave length generated at the focus of a parabolic mirror was the vogue among the "wireless" experimenters of that day. It was probably in an endeavor to get a bigger output of radiation per spark that Marconi in 1895 connected large insulated conductors — storehouses—to one side of his oscillator. Contrary, perhaps, to what he had expected, signals were better when these insulated conductors were lifted to a distance from the earth (and their capacity thus reduced) and better still when the far side of the spark-gap was earthed. In fact, capacity in itself seems of so little account that the large elevated conductor could be removed and the connecting wire left supported alone in the air without greatly diminishing the strength of signals. Thus Marconi followed Popoff without copying him, to the use of the plain earthed air-wire, originally designed, it seems, by Popoff for other purposes than wireless telegraphy.

The scientific basis, as we understand it, of these rapid successes of Marconi have been given numberless times. We see clearly enough now that it supports Marconi's own opinion that his success was largely due to the earthed air-wire. It is necessary here to write down once again the virtues, as oscillator and radiator, of the long vertical earthed air-wire. Put shortly, its merits are: First, its great length inspires slow vibrations, and therefore long waves; second, it sets up the waves so that the electric force in a wave front is, from the very beginning, in a vertical plane; third, what is partly implied in the last, it attaches to the surface of the earth the free ends of the moving lines of force; fourth, it is a good radiator and absorber.

Long waves are advantageous largely for reasons connected with diffraction; the setting vertically of the electric force near the earth avoids losses such as would otherwise occur from the generation of profitless currents in the earth's substance; and the attachment of the waves to the earth's surface prevents them straying wholly into space, and gives them such guidance (similar to that given by a wire to the current it carries) as enables ranges of hills to be surmounted without suggestion of penetration. But the air-wire's power as a good radiator, valuable at a time when the object was to "get there," has become in this era of syntonic ambition, its cheafest fault if it is in itself the whole oscillator; for, as has often been explained, rapid radiation shortens enormously the train of effective waves if, as must be in the case of the simple air wire, the energy stored electrostatically, just before each spark, is small. There is no need to do more here than mention that by using a closed (non-radiating) oscillator of great energy capacity to feed the simple air-wire, sustained trains of waves can be omitted and the earthed air-wire thus retained in its old post of honor.

At a very early stage of this story, Lodge seems to have perceived this inadequacy of the simple air-wire for syntonic working; and at least as early as 1897, was using in preference a symmetrical Hertzian wave-maker. The one at Heysham, for example, consists of two horizontal conducting plane areas about 80 feet square, one vertically above the other, and connected to it by a vertical central wire about 80 feet long. The lower square is about three feet from the ground and, like the upper, is insulated. The vertical wire is interrupted at its middle by a spark gap. This structure is from its geometrical configuration, a slower generator than a simple air-wire, and gathers before each spark a much greater charge.

For both reasons it produces trains or waves more sustained than those of the air-wire. Moreover, it possesses most of the merits of the plain air-wire. It makes very long waves, and it sets them up with their moving lines of force in vertical planes. But it fails in this, that it does not attach the waves to the earth's surface. The waves have to do that for themselves, as they may do when free later on. To compensate for this, however, there stands the complete freedom from earth connection. What this means can only be appreciated by recalling one, let us say, of the difficulties that beset the radiator that is earthed, namely the variability in the goodness of the "earth."

This variation of quality of "earth" did not matter so much in untuned working, but in tuned telegraphy it is more important; and when making comparisons with the Lodge-Muirhead wave-maker, we must look to tuned systems. Suppose then, that in a syntonic transmitter the radiator is tuned to the closed feeding circuit when there is a good earth, and that by some means the earth goes bad—*i. e.*, acquires an unwonted resistance. Then, inevitably, foreign overtones, of kind and strength depending on the badness of the earth, are introduced into the vibration. These overtones are produced at the expense of the fundamental by reflection at the resistance of the pulses descending the air-wire.

There is, besides, absorption of energy in the resistance; indeed, it has been shown both theoretically and experimentally, that with a certain critical resistance, the absorption of the vibrations in the resistance may be extremely rapid. If this last condition is ever happened upon in practice, it must be of serious import even when forced vibrations of the correct period, namely, that of the distant receiver, can be maintained upon a transmitter air-wire by a heavy feeding system behind it. All these considerations apply with equal or even greater force to the earthed absorbing wire of the receiving system. Hence it will be seen, to be earth free is something worth striving for. Thus the question is, does the attainment of this desideratum by the Lodge-Muirhead wave-maker, compensate fully for the fact that the waves as at first emitted are free, that is, unattached to the earth's surface?

If one traces in imagination the movements of the lines of electric force near the Lodge-Muirhead radiator when in action, he concludes that the lines which detach themselves from the conductor to form waves appear as rings situated in vertical planes passing through the vertical central wire, moving outward horizontally with the speed of light and expanding as they go. They will resemble, in fact, the rings familiar to us in diagrams of the ordinary Hertzian oscillator, but will probably be more distorted than those in the pictures and will include a smaller proportion of the whole number of lines of force initially present in the fully charged oscillator. As each ring moves forward and expands, its lower bend strikes the earth and is reflected or absorbed there. If the earth's surface were of very good conducting material, the lower half of each ring would ultimately be folded up towards coincidence with the upper half.

Now, in this process of reflection, the direction of the horizontal component of electrical force is reversed. Thus, high reflection at the earth's surface would involve considerable strengthening of the waves near the earth—just where the strength is wanted. As a matter of working experience, this strengthening by reflection seems not to be experienced at the earth's surface in any degree so completely as has just been indicated; but it is well admitted that the earth's surface cannot be supposed a perfect conductor. The folding up of the lower half of each looped line of force is probably very incomplete. Allowing for this, it seems possible that perhaps one-half of the whole wave energy—the half carried in the lower portion of each ring of force—may be wasted ohmically in the earth comparatively near the radiator.

On the other hand, the earthed radiator, placed normally over a conducting sheet (the earth to which it is connected) detaches, in the popular theory, half rings, which move outwards in vertical radial planes, with their cut ends sliding perpendicularly over the conducting plane. This arrangement seems ideally perfect. But here again the earth's surface is, in reality, not a good conductor. Therefore, in the very act of electrical vibration—which may be interpreted, as is well known, in terms of positive and negative reflections of electricity at the top and bottom of the earthed air-wire—great wastage may occur before the detachment of the waves.

In both cases lines of force travelling over a bad conductor must acquire a forward slope which will involve the propagation of energy into the earth or, to put it in another way, will involve the creation of currents in the earth's substance with consequent ohmic losses. Taking all this into account, however, as well as may be done by these descriptive methods of examining the question, the advantage, on the whole, seems to lie with the earthed radiator. The conclusions we are driven to amount, in fact, to these: That in the case of the Lodge-Muirhead radiator working over the badly-conducting earth a 50 per cent. ohmic loss of the whole output of radiation is possible; whereas with the earthed radiator there are losses in vibrational energy amounting probably to a smaller figure.

MAKING ROADS IN ALASKA.

A serious detriment to the making of a road in Alaska is the thawing of the ground beneath the moss. It has been the universal experience that whenever the moss is cut into, thawing immediately commences, and the trail which was passable becomes a filthy, slimy mass of mud, roots and broken stones—a difficult route for men on foot, a slow and tiresome road for loaded animals, and an impassable obstacle to any sort of vehicle. In regions further south, under temperate conditions, trails frequently are developed into fair wagon roads by much usage. Such developments can never take place in any part of the Northwest.

A VALUABLE MINERAL SPECIMEN.

One of the most valuable of mineral specimens for the cabinet is the mineral rhodochrosite, or native manganese carbonate. When in fine crystals of rose pink color, a specimen of fair size is as valuable as an equal bulk in silver. A collector to purchase a really fine specimen of rhodochrosite today, would in all probability have to secure the same from some mineral collection, as there is an absolute scarcity of good specimens in the market.

PHOTOGRAPHY.

ART TONES IN P. O. P. DEVELOPMENT.

STANLEY C. JOHNSON, B. A.

What a delightful range of tones may be secured with comparative ease by partial printing and subsequent development of P. O. P! Red chalks and ivory blacks, it is true, are not obtainable, but all sorts of pleasing greens, rich browns, and many useful shades of violet are well within the limits. The process from end to end may be carried out at night-time in an ordinary sitting-room; it might almost be said in an armchair. The reader therefore cannot complain of its intricacies.

The working will be familiar to all those who use gaslight paper. Open a fresh packet of P. O. P. and fill the print frames in a shaded corner of the room. Odd sheets taken from an almost finished packet left over from last summer will not do. Keep the supply intended for development quite separate, and do not allow it to be handled in daylight or in strong gaslight.

The length of the exposure depends, in a great measure, on the developer used and the color of the print desired. As a basis for trial exposures, light a yard of magnesium ribbon, hold it six inches from the negative and keep it continually on the move. When actually making prints arrange the frames five or six at a time in a semicircle, and burn the magnesium at a point equidistant from them all. This will save both time and money.

Quinol gives tones ranging from red brown to greenish grey, according to the strength of the developer, and the time taken in developing. If the bath is strong and its action rapid, there will be a tendency towards green, but if it is weak and slow, we may expect a brownish print. A good formula is:

Quinol	1½ grs.
Soda Sulphite	6 "
Soda, caustic	2½ "
Water	1 oz.

Another useful formula is

Water	10 ozs.
Gallic acid solution (concent)	10 "
Sodium acetate	½ ".
Fish glue	1½ "

The last ingredient is included to arrest the decomposition of the gallic acid. Prints that develop in this solution in one minute are a fine brown, while those that take double the time are a pleasing greenish black. Vigorous negatives only are satisfactory with this formula. By lengthening the exposure and substituting potassium oxalate or sodium or potassium tartrate for the sodium acetate, warmer tones may be secured. No previous washing is required with this bath; remove the prints as the shadows begin to blacken, and fix after a very brief and hasty rinse.

Chestnut prints are obtainable with pyro 15 grains, glacial acetic acid 25 minims, alcohol (90 per cent solution) ½ oz., water 9 ozs.

Violet tones of a very pleasing nature result from developing with pyrocatechin 2 grains, sodium acetate 10 grains, and water 20 ozs., followed by immersion in any ordinary combined bath, without intermediate washing. Pyro developed prints also become violet when placed in the combined bath.

Except where otherwise stated the undeveloped picture must be bathed for five minutes in a solution of potassium iodide 6 grains and water 1 oz. Many workers use a bromide instead of the iodide, but the latter facilitates a greater range of colors.

The various steps are thus summed up as (*a*) printing, (*b*) bathing in iodide, (*c*) washing, (*d*) developing, (*e*) rinsing, (*f*) fixing, and (*g*) prolonged washing. As a precaution against acidity of the hypo solution, it is well to pass the prints quickly through a bath of soda sulphite previous to fixing.

Whenever the color of a developed print is considered unsatisfactory, toning should be resorted to. The combined bath gives purer whites than the separate ones, but if we cannot reconcile ourselves to its use it will be well to fix before toning, and wash plentifully between. Patchiness is the outcome of insufficient washing.

Negatives that have thin or dense areas are unsuitable. With them forcing must be practised, and double tones nearly always result.

The colors to be obtained with this method of working are by no means vivid. On a semi-rough paper the effects of the various greens, drabs and browns will be highly suitable for winter landscapes, and in all those cases where minuteness of detail has been suppressed. Readers who have grown tired of the never-varying tone of bromides will find the foregoing hints of some value. Almost any brand of paper will do, but there are just a few kinds specially labelled by the makers as unsuitab.e. These must be guarded against.

In conclusion, it may be well to add that magnesium is selected as the illuminant solely on account of its convenience. Prints exposed to gas or daylight are equally suitable.—Photographic Monthly.

Water, though colorless when in small quantities, is blue like the atmosphere when viewed in mass.

USE OF DEVELOPING PAPERS.

C. H. CLAUDY.

I. Contact Printing with the Slower Papers.

There are certain things about the use of developing papers which are common to all instruction books. There are other things which are left out of many of these manuals, or included only partially. The things that are left out are usually the things the beginner most needs to know; they are left out, presumably, for lack of space, or because the manufacturer dislikes admitting that there is anything which his paper lacks in the line of perfection, or which cannot be done with it.

Now it must be understood that these three papers are more for the beginner than the advanced amateur, and that no attempt is being made to tell anything brand new. But they are written from personal experience not only with my own troubles when I was a beginner, but from knowledge of the troubles of a somewhat large circle of photographic acquaintances who have also tried and failed and wasted paper by the box and so won their way to success.

In this present paper I shall confine my attention mostly to contract printing with the slower papers. In the second paper I shall undertake to speak of development and fixing and after processes, and the third paper will be devoted to the faster or bromide papers.

For convenience and because it is the largest of the family I am going to hang my remarks in this paper on Velox. Personally I have had more satisfaction with this brand than with others, but I am not saying that there are not other good brands. If a man can work Velox he can work any developing out paper of similar speed. Not because Velox is the most difficult but because it is made in so many surfaces and varieties that a thorough knowledge of it gives a knowledge of all.

In the first place then, for average negatives, for thick negatives and for thin ones full of contrast, use the special emulsion; if another paper than Velox, get the "soft" grade. Most of these papers are made in two grades one soft, the other the contrasty. But the soft grade is the one to employ nine times out of ten—the tenth time the regular grade or hard paper is most useful, but its employment the other nine times is fatal. I do not think enough stress is laid on this in the books and advertisements relating to these papers, hence I want to emphasize it.

In the second place, do not bother with any contraption for printing. Don't buy yourself a neat little wire and metal frame with a gas jet at one end and a rack for the frame at the other. It is money wasted. Don't make a light box. That limits you. But if you have a dark room and gas, get yourself a gas jet that can stand on the table or work bench and provide yourself with a weight or block of iron or lead. One of the great charms of the developing paper is the facility it affords for variations in prints, due to the different distances the frame is from the light and the various angles at which it may be held. A printing device or a printing box in a large measure prevents the full use of this feature.

In making any print, for a certain length of time of exposure, you must consider that you are using so many light units. If you halve the time you have halved the units; if you double the time, you have doubled the units. But if you change the distance of the frame from the light by a divisor or multiple of that distance, you change the number of the units the paper receives by a root or a power. Does that seem dreadfully complicated? It isn't in practice. Suppose that you find a certain negative gives, with a certain brand of paper, the kind of print you want at one foot from the light in one minute. If you make a second print, removing the frame to a distance of two feet from the light, you must give not two minutes but four minutes in order to have as full an exposure. The intensity of light diminishes with the square of the distance; that is, at twice as far the light is four times as slow; at three times as far, it is nine times as slow; at four times as far it sixteen times as slow, and so on. Consequently, if you know the exposure for a given light at a given distance, you can find it for any other distance by finding out the square of that distance and multiplying that by the first exposure.

Now the reason all prints are not made at one distance is that the further away from a light you hold a negative, the more opaque the high lights become in proportion to the shadows, and consequently the greater contrast secured in the print. Hold any negative two inches from a gas flame, and then two feet, and notice that you see the flame clearly enough through the thin parts in both cases, but that a decided difference is apparent in the looks of the flame through the high lights. In other words, a certain penetrative power of the light is used up in getting through the negative—what is left does the printing. This penetrative power is stronger close to the flame than far away from it. Therefore, if you have a flat negative, print far away from the light; if you have a contrasty negative, print close to the light.

If your negative is uneven and one side will print too fast or too contrasty—slant the printing frame on the bench so that one end or one side is closer to the light than the other. What is the block of metal for?

So that when you wish to make more than one print from the same negative, you can mark the place for the frame on the bench once the proper location has been determined, then by setting the frame against the block the second and other successive times, the same distance and angle is secured, and if the time given be the same the prints must be duplicates.

If you have mastered these few points you can proceed with your printing in the certainty that you will get results. You must eypect to spoil your paper before you get the hang of exposing. To spoil as little as possible, get a couple of dozen small sheets—say four by fives—even if printing large negatives, or cut some large sheets in strips. Make test exposures by exposing a strip at a time—the first for half a minute at one foot, the next for a whole minute, etc., or, if a very thin negative, the first for five seconds, the next for ten, etc. Develop, and note whether the whites are clear and the shadows dark, or whether the print is grey and muddy, or light and washed out, or black all over. The first means a correct exposure. The grey and muddy print is too long exposure, too short development—the washed out print is too little exposure, the black one over exposure. Instructions as to the way to develop belong to the next paper so for your tests follow the maker's directions.

If you stand across the room and put the paper in the frame on the negative in the shade of your own body, you will be perfectly safe. Suppose the correct exposure is half a minute at one foot; at eight feet the proper exposure would be thirty-two minutes, and in the shade of your body it might be three hours! Consequently the light which hits the paper while being transferred from package to frame amounts to nothing.

The sensitive side of the paper is the side that curls in. If the paper is moist from humidity, it will not curl. It is the side that tastes sweet—it is the whiter side of the paper. Laying two sheets side by side, one front up and the other back up, you can easily see which is which by the color. All such paper comes packed with the sensitive side all facing the same way with sometimes an exception in the last sheet which faces in.

Don't handle the sensitive side. Finger marks show in development, the oils from the fingers preventing the developer from taking hold. Handle small sheets by the edges, large ones by taking hold of as little of the paper near the edge as possible.

Get yourself a box, either wooden or pasteboard, with a hinged lid. Put your unexposed paper in this, face down. It is very inconvenient to take one sheet from the package when doing printing, and most easy to get it from the box, letting the lid fall into place when that one sheet is extracted. Develop each print as made, at first. When you get expert it is easier to do all the printing at once and then all the developing, but at first development should immediately follow exposure in order that errors of exposure may be seen and noted at the time.

A watch lying face up near the light should be used for timing unless you have one of those new dark room clocks, which ought to be very convenient. As a matter of safety I use a dollar watch for this purpose instead of my cherished pocket time piece, because I do not think the occasional slop of developer or fixing bath which gets on the work bench is good for it.

There is one more point in printing which deserves consideration. That is the facility for "dodging" the print. If you have a slow printing negative to do in solio and platinum, you know what hard work it is to vary results by waving a piece of cardboard between the negative and the sun for ten or fifteen minutes. With a gas light paper which produces a print in a few seconds, however, such dodging is a pleasure instead of work. Use heavy paper or cardboard, and put the side or edge of the negative to be dodged at the top—leaving that part which is to be continuously exposed at the bottom—when the frame is stood on edge. Do the dodging first.

Keep the paper or cardboard moving gently in front of the part you wish to shade from too much exposure and finish up by making the exposure of the entire negative. This way is preferable to dodging last, as any join in the dodging is less likely to show if a subsequent exposure covers the work. By this simple means an obdurate sky may be made to print out beautifully or a too thin face held back. In dodging a face alone, stick a hat pin into the edge of a small circle of cardboard and manipulate it so that the shadows of the hat pin do not fall in the same place all the time.

For learning, I would advocate the use of a smooth paper—such as special portrait Velox, or special Carbon, which is a semi-matte. If you can manage these you can manage the rough papers without any trouble and the glossy surfaces you will not want to bother with until you are an expert.

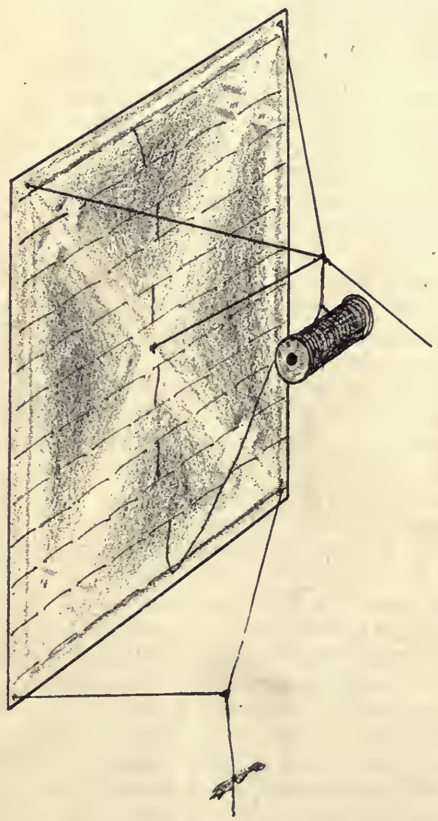
Lastly, do not be discouraged if your first end in disaster. I have keen recollections of spoiling two dozen sheets to get one passable print the first time I used the paper, and my troubles all disappeared once I was able to correlate correct exposure, proper development, with proper manipulation. Of course printing is in a way bound up with the process of development, and in the next paper I shall revert to this part of the subject, but the points given above are important enough in themselves to demand close attention from the beginner without reference at all to subsequent processes required to make a print.—"Photographic Times."

The great inequalities of the earth's surface are the result of unequal radial descent of the surface due to contraction brought about by cooling. Mountains represent portions of the exterior where it has been thickened by abundant sediment and then exposed to lateral crushing with proportionate upswelling.

KITES FOR ELEVATING WIRELESS AERIALS.

OSCAR N. DAME.

In many instances amateurs are not able to erect poles suitable for the elevation of aerial wires, and while light wire strung from insulators placed on trees has served the purpose temporarily, a very efficient way to erect the antenna is by means of the kite. In some of my experiments I utilized the square kite because of its large surface. One objection to the square kite is its occasional unsteadiness, whereas the box kite "stays put" when properly handled. But I found that the flat kite could be specially designed so as to be very applicable to my experiments, and the cost of construction was less than half that of a box kite; also the entire time consumed in building was much less.



My reason for wishing to elevate my atenna to a height of 500 to 600 feet, was to experiment with the radiation of horizontal waves, rather than for experiments in receiving, and I required as many square feet of radiating surface as could be controlled handily with ordinary manila twine. It must not be assumed, however, that the flat kite is superior to the box kite for general purposes of elevation, as elaborate experiments by both the War Department and the Smithsonian Institution have repeatedly proved the superiority of the box kite.

There had long been a diversity of opinions as to the sending distance of small spark coils, and also as to the superiority of a plate atennæ over the harp form consisting of many fine wires, or a single wire. Researches abroad tend to show that a metallic plate properly elevated will send waves a greater distance than any other kind of aerial. To disprove this theory prompted me to construct the kite described in this article, and I hope every wireless enthusiast will try the experiment in the field as soon as convenient.

The flat or square kite is made of two light but strong sticks fastened together like a cross or X. Nearly every boy has made one or more of these kites with varying results, but I will go into the details quite specifically so every amateur will meet with perfect success.

First procure two strips of spruce free from knots and splints, 1½ in. wide by ¾ thick, and 5 ft. long. Measure to the center of each piece, and at this point which is 2½ feet from the end, fasten the two by winding with fine, strong wire. With four staples, a piece of No. 18 copper or iron wire is run from end to end of the strips and there fastened. About this wire the cloth covering of the kite is to be glued. In fastening this wire the frame should not be made a perfect square, but one-third longer than its width.

Sufficient unbleached cotton cloth of extra width is procured, or what is better, some Holland such as is used in the manufacture of window curtains. This latter is more expensive than cotton, but has a finer texture for kite purposes. An old curtain is obtainable in nearly every home. A piece of the goods is cut 3 in. larger all the way round than the kite frame, and then fastened to the wire frame with good fish glue, the cloth being lapped about the wire on all sides. The cloth is not stuck to the wooden pieces, but on the back side of the kite strips of stout cloth may be pasted over the strips near the ends.

The slings of this kite are of heavy twine. It will be noticed that the upper V piece of twine is of just the length to reach to the center of the kite, and the twine from the center which is fastened to the V piece is as long as from the center to the top edge of the kite. If these proportions are not followed, the kite will not fly accurately, but tend to bob and dive beyond control with every little variation of the wind. A short loop is fastened at the lower end of the kite, to which is affixed the tail. This tail is of the rag pattern, and for this size of kite should be made of four inch strips of old cotton cloth fastened together. The tail length should be in the vicinity of 35 feet. A bob or tassel of short pieces of cloth, weighing two pounds, will be required on the end of the tail. Additional weight may be affixed to the bob when a heavy wind demands.

I might say right here that there is no reason except that of durability, why this kite cannot be made of brown manila paper or newspaper, for that matter. Most kites fall once or twice before being flown successfully, and for this reason cloth is used.

About sixteen square feet of tin foil of thinnest texture, such as is used in making spare coil condensers, is next procured, and the outer or front surface of the kite covered. This foil comes in long strips 5 in. wide and weighs little more than paper of the same size. The foil is stuck on with glue. Some very fine bare copper wire is then threaded on a needle and very coarse stitches placed all across the surface of the kite. This answers to connect all the foil strips together metalically, and also helps hold the foil to the kite. Some more bare copper wire is fastened through the covering of the kite and foil at the center cord, and wound about the cord to the point where the flying string is affixed.

The kite string is stout hemp twine, purchasable at any hardware dealer's for 15 cents per ball. The distance above the earth the kite is to be flown must be roughly estimated, and considerably more than that length of No. 36 copper wire, insulated or bare, wound on a reel or spool. The outer end of this wire is affixed to the fine copper wire coming from the kite, and the spool itself fastened to the bottom of the kite by means of some thin cotton thread or rotten string. After the kite has been elevated a few minutes, the spool may be released by jerking the kite string. This wire, after falling to earth, is then run along in parallel with the flying string until it reaches the operator, where connection may be made with the sending apparatus of the wireless outfit.

As a result of experiments with my kite, numerous conclusions were reached. First of importance was the fact that with an electrolytic receiver at a distant point, very little spark coil discharge gave excellent results, whereas the same coil attached to a single aerial wire was very erratic. It would seem, therefore, that experiments with kites of this type will establish what foreign experimentalists have long believed to be true, that large capacities at considerable height require but very small transmitting energy.

COST OF ELECTRIC LIGHTING.

They are having an electrical exhibition in London, and in connection with this have secured prominent electrical men to make public lectures. A number of these have been of particular interest to the public, one especially so, since it touched upon the use of electric lights in the home. This lecture was delivered by Mr. James Swinburne, past-president of the Institution of Electrical Engineers of Great Britain, and a past-master of the lecturer's platform. Mr. Swinburne never has difficulty in holding the attention of his hearers. He can take what, to many, would seem a dull subject and turn it so that every one listens earnestly, and yet he always has some useful message to deliver and he manages to deliver it in such a way as to impress it upon the minds of those who hear him.

In his lecture Mr. Swinburne told his audience the interesting story of the development of the incandescent lamp. Then he got down to business and showed how much superior this lamp is to the older forms of illumination in which a flame is employed. It not only gives a better light, is safer and can be arranged so as to give a better illumination but, everything considered, is cheaper. Perhaps this would not appear true if one compared merely the cost of gas with the cost of electrical energy; and perhaps the comparison might seem still less in favor of electricity if, as is frequently done, one changes over from gas to electricity and then compares the cost of a satisfactory lighting by a later method with the unsatisfactory lighting by gas which preceded. Under such conditions it would be an exceptional case in which the cost for the gas alone was not less than that for electricity.

But this is only one way of looking at it. In fact, to get the two systems on a fair basis, every item should be considered. The estimates should be made for an equal illumination in each case. The relative risks must be determined as closely as can be, and the effect on the house of the two methods must not be overlooked. As was shown by Mr. Swinburne, the gas flame assists very materially in spoiling the decorations of a house, as well as increasing the dust and dirt. It seems that it is necessary to redecorate a London house about once every four years when gas is used; but when electricity is adopted, the house need be decorated not oftener than once in five or six years; and this is an underestimate. In fact, Mr. Swinburne is convinced that, in the long run, the electric light is cheaper than gas, even if the latter be free. This was an eminently satisfactory conclusion for the lecturer. Unfortunately, it is more difficult to persuade the possible consumer of the economy of electric lights. It is easier to work it out on the blackboard than it is to drive it through the consumer's pate—a work, by the way, to which the electric-lighting companies are devoting not a little time and energy just now. Mr. Swinburne has, however, brought out a new and interesting phase of the lighting question, of which the companies will doubtless make good use. It is one which has received almost no attention heretofore.

The chief use of copper is for electrical purposes, especially for dynamos and motors. Copper drawn into wire is employed for submarine cables, long distance telephone and telegraph lines, light and power service, etc.

AMATEUR WORK.

DRAPER PUBLISHING CO., Publishers,

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TO ADVERTISERS.

New advertisments, or changes, intended for a particular issue, must be received at this office on or before the 10th. of the previous month.

Entered at the Post Office, Boston, as second class mail matter, Jan. 14, 1902.

OCTOBER, 1906.

The following awards have been made in the editorial suggestion offer announced in the June number:

First, Chas. C. Trump, Syracuse, N. Y.

Second, M. M. Hunting, Dayton, Ohio.

Third, Ralph L. Bugbee, Methuen, Mass.

Additional awards have also been made as follows:

Jacob Daniel, Philadelphia, Pa.; W. C. Mansfield, Cleveland, Ohio; H. W. Hewest, Dartmouth, N. S.; Frank O. Potter, St. Louis, Mo.; A. Talluraphus, Omaha, Neb.; Harry E. Staples, Providence, R. I.; Edward M. Boggs, Oakland, Cal.; James B. Reed, St. Paul, Minn.: Harry T. Demarest, Warwick, N. Y.

We would again express our sincere thanks for the numerous responses to our offer, and the many valuable suggestions received. We shall utilize these ideas as far as possible, and as soon as arrangements can be made therefor. Owing to lack of space it will not be possible to publish the papers received, although many of them are of considerable general interest.

With the approach of long evenings and cool weather, the thought of the amateur mechanic naturally inclines towards the work which has been held in abeyance during the summer. Many of our readers have already formed plans for a systematic course of study or work, but many others have not. The importance of pursuing some line of study or work, which may at the same time furnish much pleasure, cannot be too strongly emphasized. "Work" is the watchword of success, and he who would achieve success must utilize his time to the best advantage.

We are too much inclined to think that work means drudgery, but this is true only when the worker has no interest in his occupation, or when that occupation is so mechanical as to require no mental effort by the worker. We should, therefore, give careful thought to both our work and our pleasure, and our constant efforts should be directed towards fitting ourselves for and engaging in the work for which nature has best endowed us.

It is rarely an easy matter to reach a desired position quickly, but drifting along without purpose will not bring it. Well laid plans, persistently followed, will accomplish much, and will in time become so interwoven into our mode of life and thought as to be of material assistance in accomplishing our aims.

With this number we complete the fifth year of this magazine. Our sincere thanks are given to the many who have assisted us with their subscriptions and in other helpful ways. We look forward to the next five years with much encouragement, and the plans now under way will, we trust, make the magazine even more helpful and interesting than in the past. The many letters expressing the appreciation of the writers, which we are constantly receiving, are but a spur to increased effort on our part.

Ozone is a colorless gas like oxygen, having a peculiar odor like that of air and a chemical activity. The density of ozone is one and one-half times that of oxygen and is changed into oxygen only at a higher temperature.

ECONOMICAL METHOD OF CONSTRUCTING INDUCTION COILS.

W. S. DENT AND L. B. WEEKS.

The induction coil is indispensable to the experimenter in wireless telegraphy, radiography, high frequency work and, in fact, all work for which a high tension current is needed. On account of the high prices usually charged for coils or for the materials generally used in making them, many are unable to obtain this most useful apparatus. It is the purpose of this article to describe a method of building coils which requires far cheaper materials, takes much less time to construct and yet produces a coil distinctly better than the average. The total cost of making a 6-in. coil to be used with an electrolytic interrupter, that is, without condenser and mechanical break, is somewhat under twenty dollars. If the builder does not care for exterior finish, the cost would be considerably less.

The only expensive tool used in the method is a lathe which can cut sixty threads, both right and left hand, to the inch, and which swings, or can be made to swing, by blocking up the head and tailstocks, 10 in. over the carriage. If such a lathe is not at hand, a substitute can readily be rigged up with the expenditure of a dollar or two and a little ingenuity.

As the exact dimensions of the rest of the coil are dependent upon those of the secondary, the construction of the secondary will be taken up first. For this the following material will be needed:

12 pieces ⅛-in. sheet fiber, 7 x 7 in.

12 strips medium unglazed paper (0.018 in. thick, 2¼ x 22 in.)

600 strips thin unglazed paper (0.0045 in. thick, 2 x 24 in.)

6 pounds bare No. 36 B. & S. copper wire on a spool.

6 ft. 3-16 in. round fiber rod.

1 ft. ⅝ in. round fiber rod.

100 ft. bare No. 25 B. & S. copper wire.

20 pounds best white paraffine.

A form constructed of pine according to Fig 1.

Thick shellac varnish.

Other materials as mentioned below.

Wind two strips of the medium paper on the mandrel of the form, fastening down the second with thick shellac varnish. Cut holes in the center of two of the 7-in. fiber squares so that it will fit over the paper as tightly as possible; put on the form heads and screw a fiber square to each of them. Drill a hole diagonally through the paper next the core; slip through a foot of cable, made of half a dozen strands of bare No. 25 wire; take one turn of it around the paper on the mandrel; splice the No. 36 wire to the cable and the section is ready to wind. See Fig. 2 for the relative positions of the parts. The spool of wire should be supported so as to unwind easily. From the spool the wire goes under a rod to increase and steady the tension, then over the V-shaped guide, constructed according to Fig. 3, in the tool post of the lathe and finally is wound on the section which is chucked in the lathe—the gears being set for cutting 60 threads to the inch.

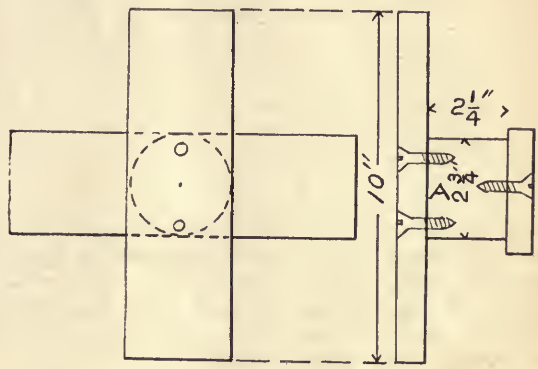


Fig. 1.

When the lathe is started, the wire will wind evenly upon the mandrel and each turn will be one sixtieth of an inch from the one next to it. Begin widing one-fourth of an inch from the inside of one head and wind to the same distance from the other head. Reverse the direction of the carriage; slip the end of a piece of thin two-inch paper, long enough to make one layer with a lap of about one inch, under the wire; wind back over the first layer of wire, letting the paper wind on with the wire. Reverse the carriage again, slip in paper between layers and continue winding in this manner until 130 layers of wire have been put on.

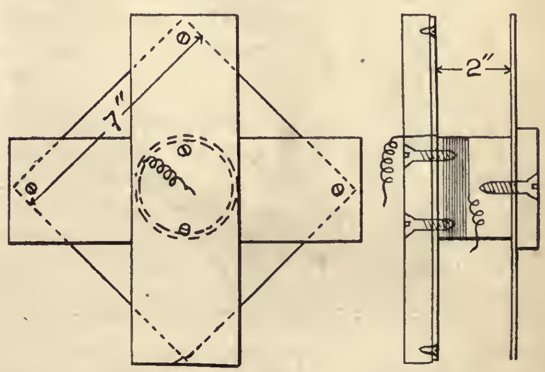


Fig. 2.

This will make a diameter of about 5¾ in. Finish the section by attaching a piece of cable and bringing the wire out by drilling through the coil head.

See Fig. 4 for relative positions of ends. Put a layer of paper and one of thread spaced by the winder, over all. Take the section from the form and run a bolt with nuts made of the fiber rods through each corner, as in Fig. 4. Bake for half an hour at a temperature of 120–130° C.; immerse immediately in melted paraffine until all air bubbles cease to rise, the paraffine being kept at a temperature not exceeding 120° C. When the bubbling ceases, let the paraffine cool down until it is nearly hard; take the section out and brush off the superflous wax.

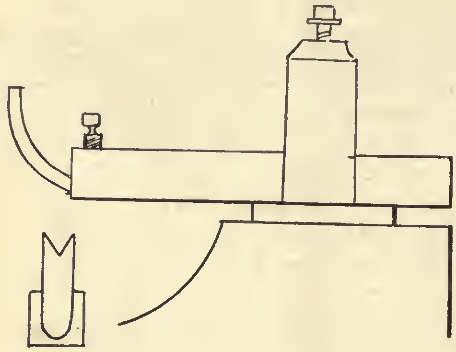


Fig. 3.

Build six sections in this manner, winding in the same direction and bringing the ends out in the same way. Test each for continuity of the wire. When the six sections are complete and after they have been saturated with the melted paraffine, place them in a box (7 in. inside breadth, other dimensions according to Fig. 5) in the position shown in Fig 5. Arrange the sections so that the holes will be concentric with the fiber tube shown in the figure. Connect the terminal wires of the sections as shown in Fig. 5, and test the whole series for continuity with a high resistance voltmeter. If there is no break, continue with the construction.

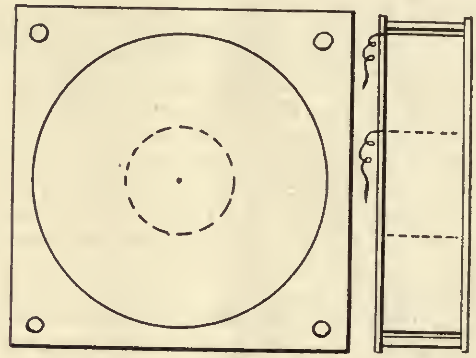


Fig. 4.

Place the fiber tube, shown in Fig. 5, in position in the box and make the bottom and sides air tight with putty. Melt about 15 pounds of paraffine, being careful not to let the temperature exceed 120° C. (248° F.) aad fill the box from the top, pouring in more paraffine as contraction takes place. Attach the secondary terminals to the rods leading through the hard rubber

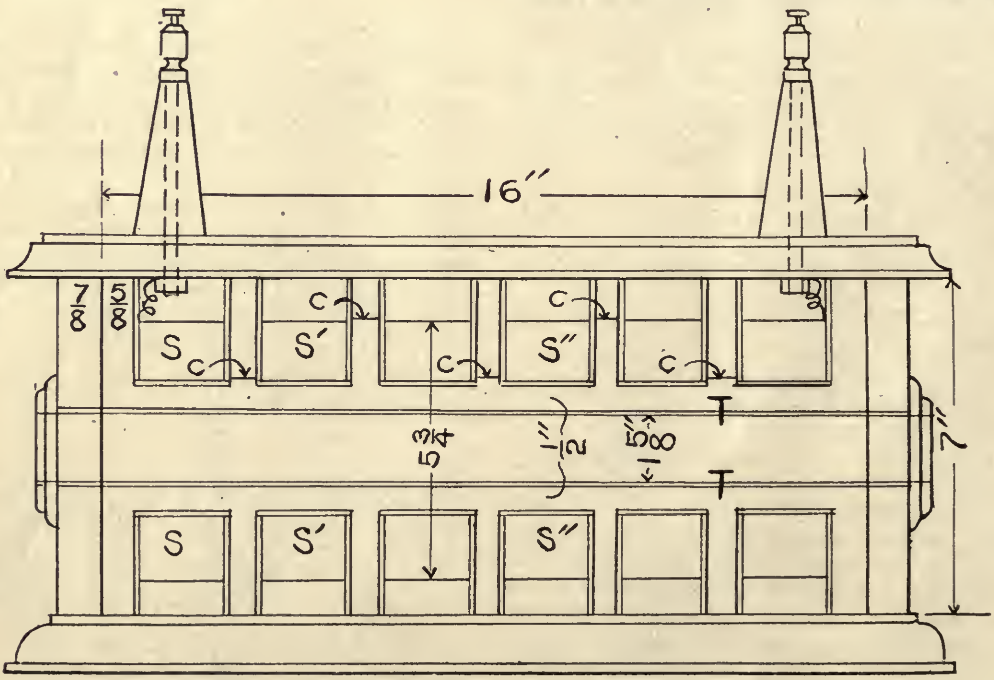


Figure 5.

posts to the binding screws, shown in Fig. 5; screw down the lid and the secondary is complete.

The core is made by packing a fiber tube 18 in. long by 1 in. inside diameter with one-sixteenth inch walls, full of No. 18 B. W. G. iron wire, specially annealed for coil cores. The ordinary annealed iron wire is not suitable. The core is wound with two layers of No. 12 B. S. single silk-covered copper wires to about one-half inch from each end. The space allowed for the primary is so closely calculated that it is necessary to wind the layers separately and in the same direction. This method also has the advantage of allowing either series or parallel connections of the layers. When the primary is completed, soak it for fifteen minutes in hot paraffine; let the wax cool until it is nearly hard; then remove and scrape off the superfluous wax. Slip the primary into place in the tube of the secondary, connect its terminals to binding posts and the coil is ready for use.

The principal advantages offered by the method of construction above described are as follows:

1. The use of paraffine as an insulator between the primary and secondary coils, which was found to be a very satisfactory plan of insulation, though by no means essential to the successful building of a coil with bare wire.

2. The substitution of bare for insulated wire, which reduces the cost — insulated wire being about five times more costly than bare—saves in the coil building, and is much more convenient in that it can be handled with less care.

We have treated a coil, according to the above method, on a Wehnelt electrolytic interrupter run on a 110-volt lighting circuit up to 25 amperes with no unsatisfactory results other than the partial melting of the wax in the primary. The longest sparking distance tried was 7 in., though, judging from the thickness of the spark, the distance might have been considerably greater without the least damage to the insulation of the secondary. We hope that others may have as much satisfaction from the use of a coil built according to this description as we have had." —Elect'l World."

Editorial Note.—By adding another feed tube on the tool post, a thin, strong thread could be wound between the turns of wire serving to better insulate the wire, as well as give a more even surface to the several layers. If this be done the layers could be basted with a hot paraffine wax, applied with a brush, and the subsequent baking would make the whole section well insulated.

If a battery current be used to supply the current the condenser should have about 4000 square inches of foil area. This would divide nicely into 100 sheets 8 x 5 in. and should be made up in four sections. A mechanical or motor operated interruptor would be suitable for this coil.

Owing to the difficulty of obtaining the material required to make the coil in the manner described, by retail purchasers, quotations are now being obtained from manufacturers and the necessary parts will be offered as premiums as soon as possible.

EXPERIMENTS IN PRESERVING MEAT.

In a report by the Italian Minister of Agriculture on the subject of refrigerating in Italy, Mancini gives some interesting results obtained by the Craveri process for preserving meat—a process which was much discussed some months ago, but of which a more definite idea can now be formed, since a series of experiments have been conducted under the direction of a number of university professors.

The Craveri method would seem to have solved the problem hitherto unsolved—of preserving meat in a form fit to be eaten by means of chemical treatment. Excluding for hygienic reasons ordinary antiseptics, and recognizing as insufficient for practical purposes the usual method of salting, Craveri resorts to injection into the veins of slaughtered animals, from which the blood has been drained, of a solution of 100 parts of water, 25 of kitchen salt and 4 of acetic acid; in other words, of a solution of a mixture of substances as are found normally in our bodies and which form part of our nourishment. The solution is injected to the amount of one tenth of the weight of the living animal.

Prof. Brusaferro, of Turin, experimented upon two animals, a sheep and a calf; the two carcases were hung in a subterranean room for 75 days, at a temperature of 16° C. (about 61° F). After this time they were skinned, dressed and cut up. The heart, brains, liver and intestines seemed somewhat macerated but were normal in appearance. The fat beneath the skin was perfectly preserved, the flesh appearing bright red, moist, and giving out an agreeable, slightly acid odor. In no part was there any trace of putrefaction, even incipient. This meat boiled produced an excellent broth, resembling in every particular that obtained from fresh meat. Roasted it was tender and even tasted better than ordinary meat, was digestible and nutritious.

As a result of these and other experiments, Prof. Brusaferro declares it as his opinion that the Cravari method promises great advantages over others. The other professors engaged in the experiments came to exactly the same conclusions. Submitted to a bacteoriological examination, the meat proved free from bactyria; in the long period of preservation given, the beginning of dissolution was noticed in the visceral and muscular tissues, but without the production of any toxic principle whatever.

Each watch movement requires from 30 to 50 screws. By the earlier methods a skilled workman could make 700 to 1200 screws daily. Automatic machines now produce from 4000 to 10,000 screws per day, and one man can operate six machines.

FUNCTIONS OF A D=SLIDE VALVE.

Notwithstanding the fact that the D-slide valve is almost as old as the steam engine itself, there are many engineers who still have only a hazy idea of its functions. While many engines are now equipped with valves differing very materially from the D-slide valve form, yet the method of steam distribution in a cylinder can best be explained by referring to the action of a slide valve because it embodies all the functions of other valves in the shape of a simple piece of iron of the D-form.

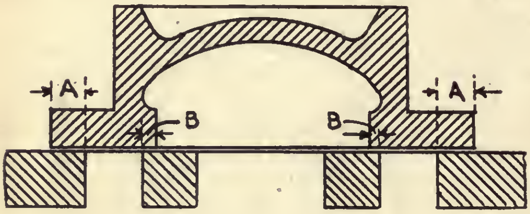


FIG. 1.

There are five principal functions which a slide valve must perform in order that the engine may do efficient work: First, it must admit steam into only one end of the cylinder at the same time. Secondly, it must cover the steam ports so as not to permit the passage of steam through both steam ports at the same time. Third, it must allow the steam to escape from one end of the cylinder before it is admitted at the other end, so as to give the steam that is to be exhausted time to escape before the piston commences the return stroke. Fourth, it must not permit live steam to enter the exhaust port direct from the steam chest. Fifth, it must close each steam port on the steam side before it is opened on the exhaust side, so that the expansive force of steam may be utilized.

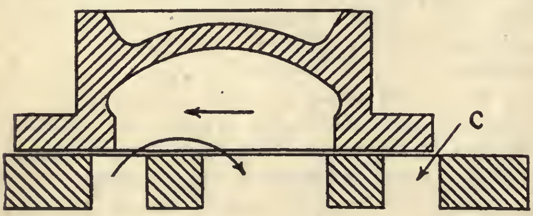


FIG. 2.

The general construction of the D-slide valve is shown in Fig. 1 and represents the valve in its central position. The two terms, steam lap and exhaust lap, can here be explained. The steam lap is that portion of the valve which overlaps the steam ports when the valve stands in its central position. This is shown at *A A*, Fig. 1. The exhaust lap, or inside lap, is that portion of the valve which overlaps the the two bridges of the valve seat when the valve is in its mid-position. This is shown at *B B*, Fig. 1. The purpose of steam lap is to allow the steam to be used expansively in the cylinder, and the purpose of exhaust lap is to delay the release of the steam and to hasten compression. If a valve had no steam or outside lap, it would admit steam throughout the whole stroke and another effect would be a late exhaust, by which is meant that the exhaust would occur at one end of the cylinder at practically the same moment that admission occurred at the other end.

When the engine is on center, the valve is usually moved on its valve stem, or the angle of advance is adjusted until the port just begins to open. This amount of port opening, as shown at *C*, Fig. 2, is called the lead, and all successful engines must have some little lead. The object of giving a valve lead is because the steam port should be slightly opened for the admission of live steam just before the piston reaches the end of its stroke in order that there may be a cushion of steam to receive the piston and reverse its motion at the end of the stroke.

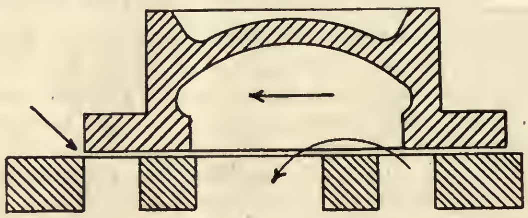


FIG. 3.

When the valve is cutting off, it takes the position as shown in Fig. 3. The valve is just covering the port, as shown by the arrow. Compression begins when the exhaust port is closed, before the piston reaches the end of the stroke. A small portion of the steam is thus retained in the cylinder to be compressed by the advancing piston, which thus meets with a slight cushion at the end of the stroke and all shock and jar are thus prevented. The point of compression begins when the inside or exhaust edge of valve has closed the steam port, as shown in Fig. 4, assuming the valve to be travelling in the direction indicated by the arrow.

Release occurs when the exhaust edge of the valve opens the steam port and allows the steam to escape into the exhaust port. This is shown in Fig. 5.

The travel of the valve is the distance through which the valve moves, sometimes called its stroke. This depends upon the eccentricity of the engine. The valve should always move enough to open the port its full width, and it is generally better to allow it to move further. The amount the valve travels after the steam port is wide open is called over-travel and is indicated by the distance OT in Fig. 6.

Unless the above principles of the valve are understood, trouble will always be experienced when setting a valve. It should also be understood what results are obtained by adjusting the position of the eccentric. When the valve is direct-connected, the eccentric will be ahead of the crank by an amount equal to 90° plus a small angle called the angular advance. When a reversing rocker is used, the eccentric will be diametrically opposite this position, so that it will have to be moved around 180° and will follow instead of lead

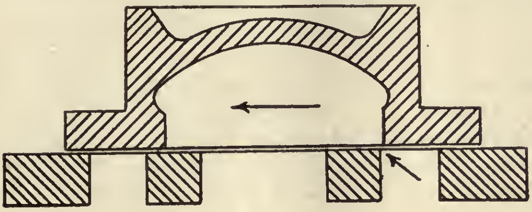


Fig. 4.

the crank. Shifting the eccentric ahead has the effect of making all the events of the stroke come earlier, and moving it backwards has the effect of retarding the events, such as cut-off, release, compression and admission. Lengthening or shortening the valve stem cannot hasten or retard the action of the valve, and its only value is to make the lead or cut-off, as the case may be, greater on one end than on the other. The general practice is to set the valve so that it will have equal lead.

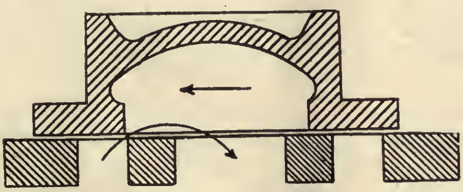


Fig. 5.

To set the valve, put the engine on the center, remove the steam chest cover, so as to bring the valve into view and adjust the eccentric to about the right position to make the engine turn in the direction desired. Now make the length of the valve spindle such that the valve will have the requisite amount of lead. This amount will depend upon the size and speed of the engine, but about 1-16 of an inch may be tried. Turn the engine over on the other center and measure the lead at that end. If the lead does not measure the same as before, correct the diffierence by changing the eccentric to correct half the difference and changing the length of the valve stem to correct the other half of the difference. For instance, suppose that the lead was ¼ in. more on the head end than on the crank end. Lengthening the valve stem ⅛ in. would make the valve open too soon at both the crank and head ends, and to correct this, the eccentric would make the valve have to be moved back far enough to take up the other ⅛ in.

When it is not convenient to turn the engine over by hand, the valve may be set for equal lead as follows: To obtain the correct length of the valve stem, loosen the eccentric and turn it into each extreme position, measuring the total amount that the valve is open to

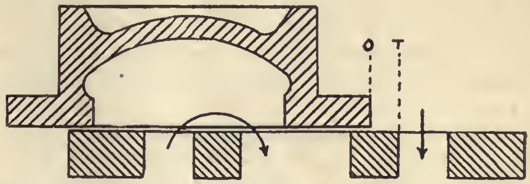


Fig. 6.

the steam ports in each case. Make the port opening equal for each end by changing the length of the valve stem. Now put the engine on center and move the eccentric around until the valve has a correct lead. This will determine the angular advance of the eccentric, and after fastening the eccentric in that position the valve will be set.—"The Practical Engineen."

TOWING WITH ELECTRIC LAUNCHES.

In a recent issue of our esteemed coutemporary, the "Amican Shipbuilder," an interesting suggestion is made. It is said that since many of onr large coasting schooners are fitted with pewer apparatus for hoisting cargo, sails and pumping, and frequently are supplied with dynamos for lighting the vessel, that this power might be still further ntilized by applying it to one or two suitable launches, which could be used for towing the vessel in calm weather and for shifting her berth in small harbors. Having plenty of power at hand, the launch could easily be hoisted out, the motor connected to the dynamo by means of an insulated cable, and the vessel towed at three or four knots. At four knots an hour in a dead calm a vessel would make ninety-six miles per day. and in this way the cost of the equipment would soon be made up in towage fees and in the saving of time.

This is a very interesting suggestion. Although we are not familiar with the amount of power required for this work, it sounds reasonable. If the launch were equipped with batteries it would be of considerable service to the vessel when she lay in a harbor. For this purpose the battery equipment need not be large. It would probably be well to have the motor as large as the electrical equipment of the vessel would stand, for since, when towing, it would draw its power directly from the dynamo, the small battery equipment would not limit its output. The outlay required for this launch should not be large, and it would be quickly repaid. Even if the vessel were able to make only two knots, in the course of a day nearly fifty miles would be covered, and she would possibly be carried beyond the calm. The suggestion embodies another instance of the flexibility of electric transmission, and is one well worth trying.

FREE ALCOHOL AND ITS NEW APPLICATIONS.

FREDERICK A. DRAPER.

After Jan. 1, 1907, no internal revenue tax will be imposed upon denaturized or undrinkable alcohol, and the indications are that after that date there will be a rapid and immense increase in its manufacture and uses. Under the conditions hitherto prevailing, 95 per cent proof alcohol has cost to profitably manufacture about 30 cents per gallon, and the internal revenue tax has been $2.20 per gallon, making the cost prohibitive to many lines of industry, and greatly limiting its uses.

Greatly enlarged consumption will follow the comparatively low price; new sources of raw material will be utilized for its manufacture, and the farming sections of the country will here find a new market for certain crops. It is estimated by Dr. Wiley, chief of the National Bureau of Chemistry, that from corn alcohol may be distilled at a cost of about 12 cents a gallon; from molasses 10 cents a gallon, from potatoes specially cultivated for the purpose, 9 cents a gallon.

Dr. Hanson, an expert of the Department of Agriculture, has secured seed from Europe of a variety of potato which grows to a size several times larger than the common edible potato and is capable of yielding a large quantity of alcohol. It is, however, too coarse for the table. Rusty or smutty grain, surplus fruit and vegetables, instead of being a loss to the farmer, will hereafter be turned into the still and supply the farmer with fuel for running an engine with which to saw wood, pump water, grind feed, churn butter, run a cream separator in the daytime and light the premises at night.

The pumping of water at low cost will make an important difference in the cultivation of farms in the arid regions of the country, as land can be irrigated without regard to the distance from petroleum, coal or wood. The sugar beet, which can be very easily grown on irrigated land, yields an abundance of alcohol which, as fuel for pumping machinery, would enable the irrigated area to be greatly extended.

As a fuel for the kitchen alcohol possesses many advantages, being odorless, non-explosive and clean. For lighting purposes, by means of the incandescent mantle lamp, it is excellent, but some inventive work will probably be advisable before it will be commonly used for either cooking or lighting.

It is not to be assumed, because no tax is to be levied, that alcohol can be manufactured by anyone who wishes. The temptation to omit the denaturizing part of its preparation would be too great to allow of its manufacture without proper supervision. The processes must still be conducted by properly licensed establishments where the addition of other fluids to make it undrinkable will be made. In all probability it will be necessary for farmers to organize and operate small distilleries on the co-operative or some other plan, special arrangements being made for those living in remote sections of the country.

As it is its application to the internal combustion motor which will be of most interest to readers of this magazine, it is well to state that but little reliable data is obtainable in this country upon which the designs of explosive engines can be based. Much has been done in Germany and France in the way of perfecting such engines, and the leading manufacturers will thoroughly investigate the results in these fields before catering to the home market. Even with such information as may be obtainable abroad, much experimenting will remain to be done, and new designs should be thoroughly investigated before being accepted.

It is of interest to understand the cause of the difficulties which confront the engine builder. The higher a liquid fuel is in carbon. the more readily will it explode under the heat of compression, while a fuel low in carbon but high in hydrogen, permits of high comcompression without generating excessive heat with combustion. A mixture of gasoline vapor and air may be exploded under low compression, but the customary pressure found in engines varies from 70 to 100 pounds.

With alcohol, however, another factor must be taken into consideration, and that is its affinity for water, so called pure alcohol "pure" alcohol carrying from four to six per cent of water. As water may readily be added, forming a complete mixture, adulteration with water will be easy and detection will be difficult. The boiling point of a mixture of 95 per cent. alcohol and 5 per cent water is 460° F., while a mixture one-half alcohol and one half water requires 930° to evaporate it, or over twice as high temperature.

The degree of purity of alcohol becomes important when we consider the means for vaporizing it. In all probability the solution to successful vaporization of commercial alcohol will be found in some method of utilizing the heat of the exhaust gases to heat the air feed before carrying it through the alcohol receptacle. The use of heated air in this connection will not entail a loss of power, because the evaporation of the alcohol will cause a sufficient loss of heat and contraction of volume to produce a mixture of relatively low temperture.

Referring again to the compression, it is evident that it must be proportionate to the grade of alcohol to be used, as the greater the quantity of water the higher must the compression be carried to secure sufficiently rapid combustion.

Owing to structural conditions there is a limit to which this can be advantageously carried, and 150 pounds for 90 per cent alcohol, and 175 pounds for 75 per cent seem to be that limit. The necessity of using a fairly uniform grade of alcohol for a given engine is evident, although variations within reasonable limits will not seriously interfere with the proper working of an engine

The water contained in alcohol is not without its useful purposes, however, as it serves to take up much of the excessive heat due to combustion. Air cooled engines will probably be the rule in all except the very largest sizes, and the troubles of water cooling will be avoided. A lessened cost of manufacture should also follow unless the requirements of vaporization offset any saving from this source.

Some difficulty has been experienced in starting engines using alcohol as a fuel, gasoline or benzine being used to assist until sufficient heat has been developed to permit of alcohol alone. It is quite probable, also, that these fuels may be mixed with alcohol to provide fuel for existing engines, such a mixture having distinct advantages for such application.

From the foregoing it is evident that much experimental work remains to be done, before the alcohol engine can be considered as being sufficiently perfected to command an unquestioned position in the power world. How soon it will reach such a condition remains with the inventive abilities of manufacturers to determine. We shall know more about the success of their efforts by the time the additional distilleries have been equipped and have begun to put upon the market alcohol in sufficient quantity as to make it readily obtainable.

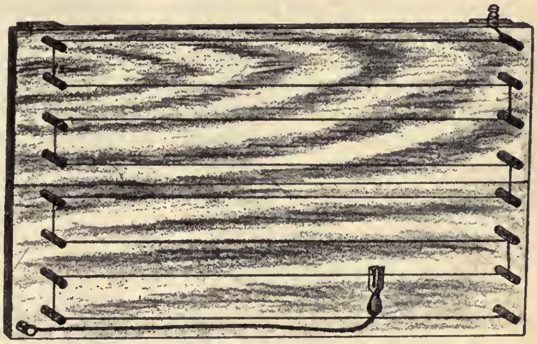
WIRELESS TUNING COIL.

W. C. HUTCHINSON.

To obtain the best results with wireless telegraphy apparatus it is necessary to have the sending-receiving stations tuned as near as possible to the same wave length. As considerable difference will always exist in the workings of coils of the same rated capacity, caused by variations in the rate of vibrations, strength of current, etc., some quick method of adjusting the receiving apparatus must be used, by means of which the wave detector can be made as sensitive as possible to the incoming waves. This is done in part by what is known as a tuning coil, and the one here described has the advantage of being shaped so that it can be fastened to the wall and, while convenient for use, is out of the way of the rest of the instruments which of necessity occupy considerable room and cannot be thus disposed of.

The materials required are: A base of well seasoned wood about 40 in. long, 15 in. wide and ⅞ in. thick. Whitewood is excellent for the purpose, as it is easily obtained of the required width. Two cleats about 3 in. wide are fastened near each end at the back with 1½ in. screws to prevent warping.

Several maple or birch dowel rods 1 in. diameter are then sawed into 12 pieces each 3 in. long. Shallow grooves are turned about ½ in. from one end of each piece, and the ends smoothed off. Holes are then bored near the ends of the base, spaced 2½ in. apart, to receive the pins, which are put in with glue.



The whole frame is then given two coats of shellac, and an additional coat in the grooves of the pins will be an advantage, as it improves the insulation. The wire is then strung back and forth over the pins, beginning at the top, where connection is made with the aerial wire, ending with one of the bottom pins, around which a full turn is taken and the end twisted around the main wire. The first pin to be used is either on the right or left side of the board, according as the coil is placed on one side or the other of the aerial, so as to make as direct a connection as possible. The length of wire in the coil is about 33 ft., which should be sufficient for an aerial not over 100 to 125 ft. high. The wire used should be the same gauge as that used for the aerial.

A clip for adjusting is made from two pieces of spring brass about ½ in. wide and 1-32 in. thick, which are riveted or soldered to another piece of flat brass a trifle less in thickness than the diameter of the wire. The corners are then rounded off and a cover for one end is then made from a piece of hard rubber tubing, so that the clip may be adjusted without the possibility of shock. The wire connecting the clip to the wave detector may be a piece of flexible electric light wire, one strand only being used. It is best connected to the clip by means of a round head brass screw, which necessitates drilling and tapping a hole in the clip. If this is not convenient, the wire may be wound around the clip near the handle and then fastened by winding a strong thread over it, but the latter is not as good a joint, as the wire oxidizes and the wave impulses, which at best are quite feeble, will not pass as freely as if the screw fastening be used.

When water passes from the liquid to the solid state it expands to the amount of about 1-11th of its volume.

A WATER POWER BLOW PIPE.

M. M. HUNTING.

An apparatus for producing a blast for a small blow pipe by water power may be made in the following manner.

A piece of 4-in. iron pipe, 6 ft. long, is fitted with a cap at each end. About 1 in. below the cap at the upper end, drill and tap a hole and screw in a short piece of ⅜-in. pipe; *C*, Fig 1. At the other end, about the same distance from the cap, drill and tap a hole for a ½ in. pipe and screw in a short nipple to which may be attached the exhaust pipe 2½ in. long, with valve as shown at *B*, Fig 1.

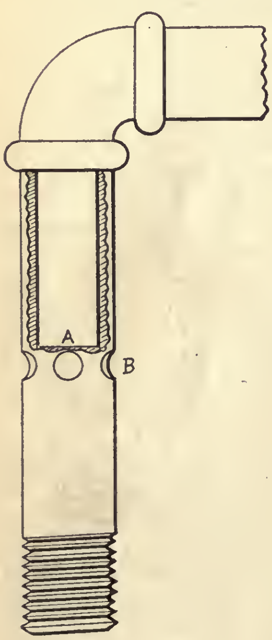


Fig. II.

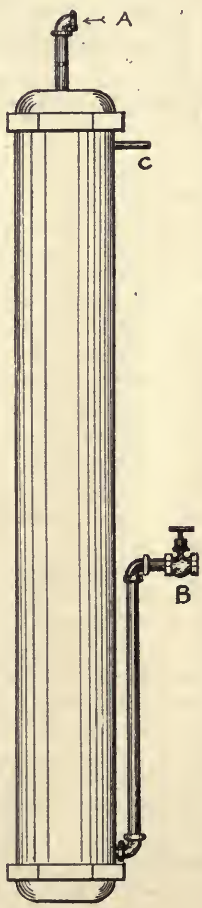


Fig. I.

In the center of the cap at the upper end of the large pipe a hole is drilled and tapped for a ½-in. pipe and the aspirator shown in Fig. 2 is attached at this point

The aspirator is made asfollows: In a piece of ½ in pipe 4 in. long and threaded on both ends, drill four ¼-in. holes, *B*, Fig. 2, at equal distances around the circumference, and at a line on the pipe equi-distant from the ends.

Into one end of this piece run a ½-in. tap so as to thread the inside of this pipe down to the point where the holes are drilled. Cut a thread 2 in. long on a piece of 3-in. pipe and screw it into the ¼ in. piece until the end comes nearly down to the ¼-in. holes; *A*, Fig. 2. Saw off the other end flush with the end of the larger pipe.

An elbow may now be screwed on the upper end of the aspirator for convenience in attaching to the source of water supply. The lower end should be screwed tightly into the cap on the large pipe.

When a stream of water enters the aspirator at *A*, Fig. 1, it draws in the air through the four small holes. As the water rises in the large pipe the air is given a pressure and flows out of the small pipe *C*, Fig. 1. A rubber tube connects this pipe with the blow pipe.

The valve *B* may be connected with a waste pipe and should be partly closed so that the water may rise in the large pipe enough to give the air an even pressure. All threads should be well leaded before screwing together in order to secure air and water-tight joints.

WOOD MADE FROM PEAT.

Frequent attempts have been made to use peat as raw material for the manufacture of artificial wood. The material must, for this purpose, be fully reduced to a fibrous condition, so as to produce a mealy mass. This mixture is mixed with an emulsion of plaster and water, and is subjected for considerable time to heavy hydraulic pressure in molds, then artificially dried, polished and oiled, painted or varnished.

Another process, says the "Industrial World" is to wash the peat without destroying its natural fibrous state, and to mix the resulting moist mass with a mixture of hydrated lime and an aluminum compound and press it in molds for a short time in the moist state, after which the resulting plates are allowed to harden in the air. The resultant product needs only a comparatively low pressure, and this for a short time only, and is then set out to dry in the air. The artificial wood thus produced is not hygroscopic, and in order to use it for open-air work needs no painting or further impregnation.

Copper becomes soft and malleable when strongly heated and immersed in cold water, its behavior under these circumstances being diametrically opposite to steel.

CONSTRUCTION AND MANAGEMENT OF GASOLINE ENGINES.

CARL H. CLARK.

V. Ignition Devices.

During the development of the gasoline engine there have been many different devices used for igniting the charge. These have consisted of various forms of hot tubes, naked flames, and electrical devices; the two former have, however, been gradually superceded by the electric ignition, and at the present time the latter is, in this country at least, the only one in common use.

Electric ignition is used in two ways, commonly known as "make and break" and the "jump spark" forms. The principle upon which the former depends is the formation of a spark when an electric circuit is broken. A property of the electric circuit, which need not here be discussed, causes the current to flow for a short time after the circuit is broken; it thus jumps across a short space and causes the spark. This quality is accentuated by the use of a spark coil, which will be taken up later. For the make and break spark the current from the batteries is used direct, after transforming to a higher potential by means of a suitable coil.

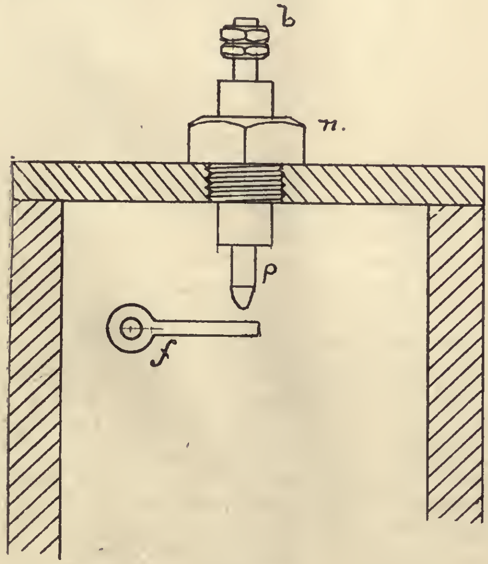


Fig. 23.

The jump spark is formed by causing a high tension current to jump across the air space between two fixed points of a spark plug. In this case the low tension battery current is transformed by passing it through an induction coil, and the high tension current is used to produce the spark.

In substance, the make and break ignition consists of two points inside the cylinder, one of which is insulated from the engine and the other is movable, allowing the circuit to be made or broken at will. The igniter gear, already referred to in a previous chapter, is connected to the movable point and is so adjusted that the points are brought together while the piston

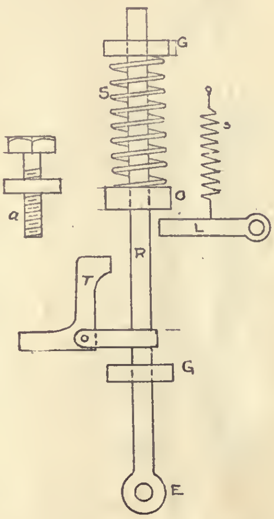


Fig. 24.

is on its upward stroke, the current then flows for a short time. At the moment of ignition the points are quickly drawn apart by a spring or some other means, and a spark occurs. The two points are shown in Fig. 9, the lower one being the moveable one and connected with the gear *I*. The igniter gear is shown in that same figure, and also at *I* in Figs. 9 and 10, at *N* in Fig 11, and at *H* in Fig. 17.

The jump spark, on the other hand, occurs between two fixed points very similar to those shown at *L* in Fig 4. One of these points must, of course, be insulated from the surrounding metal. The current then, by a commutator, is made to pass between the points at the proper time.

The engines shown in Figs. 4 ,11, 13 and 18 are of this type, no igniter gear being necessary.

A very common form of make and break igniter is shown in Figs. 23, 24 and 25. Fig. 23 is a view inside of the cylinder, showing the two points, *p* and *f*. The point *p* is at the end of a rod which is insulated from the cylinder by the insulating material *I*. It passes through and has a binding post on the top. The whole is provided with a thread for screwing into the cylinder head. The other point *f* is pivoted, its spindle running through the walls of the cylinder and being moved by the igniter gear on the outside. Fig. 24 shows the outside gear in which *l* is a lever on the outer end of the spindle connected to the movable point *f*; and *R* is a rod guided by the guides *GG*. This rod is reciprocated by the same eccentric which operates the water pump, the eccentric strap being pivoted at *E*. On this rod is a stationary collar carrying the tappet *t* and the movable collar *c*. The screw *a* is in line with the outer end of the tappet *t*.

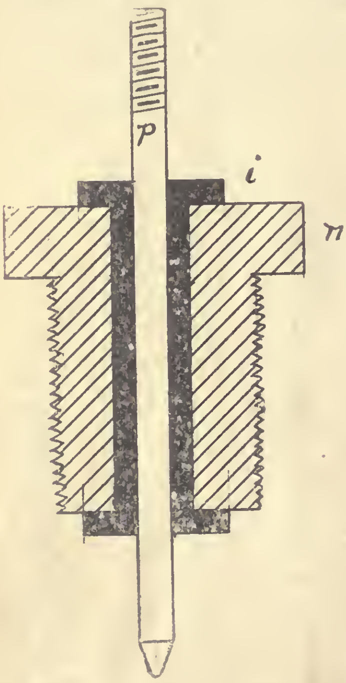


Fig. 25.

In operation the collar *c* is forced down against the lever *l* by the spring *s* pressing the lever and separating the sparking points. When the rod *R* ascends, the tappet *t* strikes the collar *c* and raises it out of contact with the lever *l*. The spring *s* then raises the lever *l* and brings the sparking point into contact, allowing the passage of the current. As the rod *R* rises still further and arrives nearly at the top of its stroke, the screw *a* strikes the outer end of the tappet *t*, throwing this end down and the upper end out, and allowing the collar *c* to snap off and descend rapidly. Forced by the spring, this collar then strikes the lever *l* and forces it down quickly, breaking the contact in the cylinder and causing the spark. As the rod *R* descends, the tappet *t* snaps over the collar *c* and is ready for the next stroke.

The contact is thus broken suddenly; the more suddenly the break, the better and more effective is the resulting spark. By turning the screw *a* up or down it may be made to strike the tappet *t* sooner or later, thus changing the time of ignition. An engine having this particular gear is shown in Fig. 9.

It will be noted that there are two rods attached to a projection on the vertical rod; the outer one is the eccentric rod and the inner leads down to and operates the water pump. This illustrates the principle of the make and break ignition, namely, that the points are brought together at some time on the up stroke, held together for the passage of the current, and then snapped apart suddenly at the proper time. The

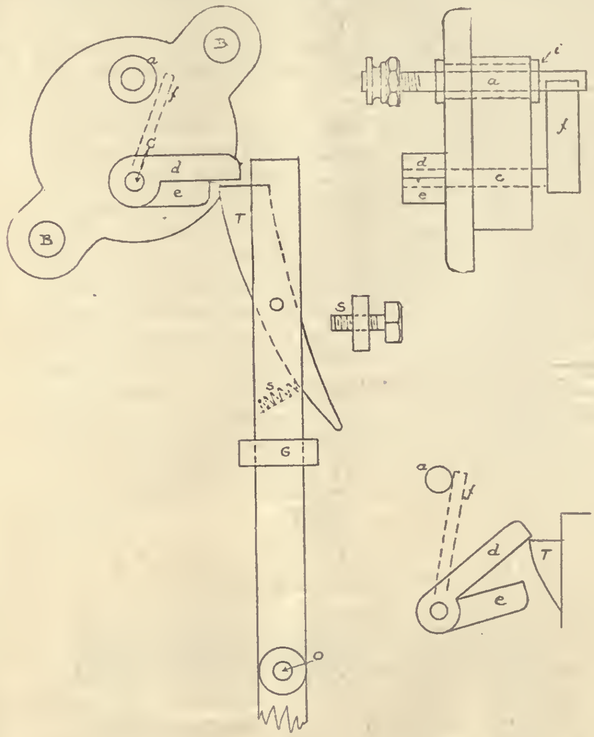


Fig. 26. Fig. 27.

points should not, of course, be held in contact longer than necessary, as this would cause unnecessary waste of battery. The mere separation of the points is not sufficient, as they must be snapped apart quickly. The collar *c* does this by its hammer action. The adjustment of the sparking points to the type of gear is a nice matter, as the pin *p* must be screwed down to the proper point by trial.

The spark points require to be cleaned at intervals, which is done by unscrewing and removing the entire upper construction. The lower point can thus be cleaned through the hole, and the upper part be cleaned and replaced.

Another type of sparking gear is given in Fig. 26, such as is fitted to the engine shown in Fig. 10, the right hand view being a side view of the other. As will be noted, both points are on a sort of plug which is bolted on to the side of the cylinder by the bolts *B B*, allowing the points to project inside the cylinder. The point *a* is insulated from the metal of the plug by a mica bushing or sleeve. The rod *c*, which can revolve, has on its inner end the strips of metal, or flipper *f*, which makes the contact with the point *a* when the rod *c* is turned. In this case the whole combination may be removed for cleaning by taking out the bolts *B B*, without in any way disturbing the adjustment of the sparking points.

The outer end of the rod *a* has a binding screw for fastening the wire. On the outer end of the rod c are the two small levers *d* and *e*. The lever *e* is fast upon the rod; the lever *d* is loose and may turn, but is always held down against *a* by a coiled spring, the other end of which is attached to the rod c.

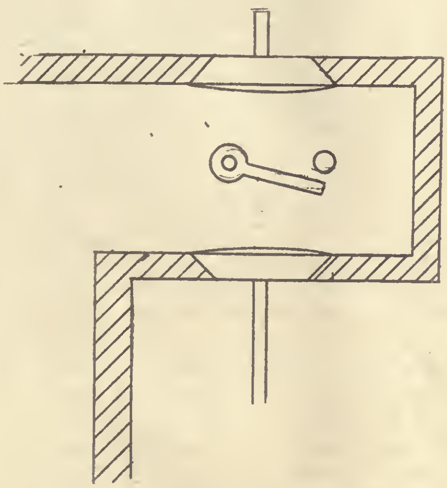


Fig. 28.

The rod *R* is given an up and down motion by the eccentric whose strap is attached at *O*. The upper end of the rod is slotted to admit the tappet *t* which is pivoted as shown. A coiled spring *s* forces the tappet out into position. In operation, the rod *R* is raised by the eccentric and the tappet t strikes the lever *d* and raises it. By means of the coiled spring before mentioned, the lever *e* and the rod c are turned, bringing the points inside the cylinder into contact. The position at this time is shown by Fig. 27.

The lever *e* can only rise a short distance owing to *f* striking the other spark point; the lever *J* is, however, raised higher, separating the two as shown and compressing the outside spring. As the rod *R* rises still higher the set screw *s* strikes the tail of the tappet *t*, forcing it in and drawing in the upper end. This allows the lever *a* to snap off; it descends with considerable force owing to the action of the coiled spring and, striking the lever *a* forces it down, quickly separating the sparking points. This illustrates the action of the "hammer break."

On the down stroke of the rod *R*, the tappet *t* is pressed into the slot by striking the end of lever *d*, and is forced out into place again by the spring *s*. By varying the position of the screw *s* it may be made to strike the tail of the tappet *t* earlier or later, thus regulating the time of ignition. The rod *R* is extended below and works the water pump, as shown in Fig. 10. The two gears just described are used on two cycle engines as they are driven from the main shaft and ignite on each revolution. A similar gear may be used on a four cycle engine, being driven from the valve or half time shaft, in which case the points are sometimes placed as shown in Fig. 28.

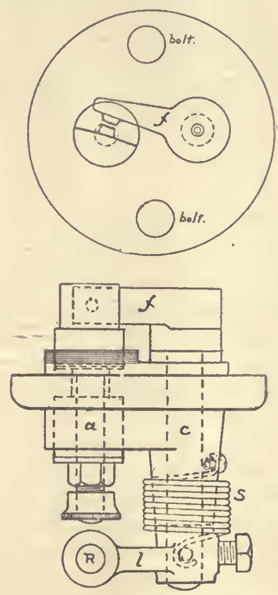


Fig. 29.

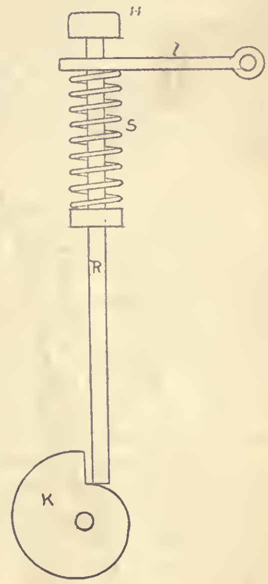


Fig. 30.

A very simple gear is shown in Figs. 29 and 30. It is in some respects similar to the preceding one, both points being on one plate. On the end of the rod *c*, Fig. 29, is the lever *l*, having at its outer end a hole through which the rod *R* passes. The coiled spring *s* is connected to a pin in the lever *l*, and tends always to keep the points separate. The rod *R*, Fig. 30, passes through the hole in the end of the lever *l*, and is encircled by a coiled spring whose upper end bears against the lever *l*, holding the head *h* of the rod *R* down against the lever *l*. On the end of the valve shaft is the cam *k*, having a step, as shown. The lower end of the rod *R* rests upon this cam. In operation the cam *k* turns toward the left, raising the rod *R*, the pressure of the spring *s* also raising the lever *l*, bringing the sparking points into contact. The lever *l* then remains stationary and the rod *R* continues to rise, separating the head *h* considerably from the lever *l*. When the cam has turned sufficiently, the rod drops off the step, and is forced down by its own weight and the spring *s*; the head *h* strikes the lever *l* a sharp blow and carries it down with it, separating the points. The time of ignition is varied by moving the lower end of the rod *R* to the left, causing it to drop off earlier or later. This gear will only operate in one direction;

The cam *k* is, however, provided with a ratchet arrangement to prevent damage when the engine is turned in the opposite direction to that in which it runs.

These examples will illustrate the principles of action. A successful ignition should have the following qualities: viz., it should separate the points quickly, as the strength of the spark depends upon this; it should be simple, with as few parts as possible; some means should be provided for changing the time of ignition while the engine is running, as the best point of ignition is likely to vary for different speeds; it should be easy to clean and keep in order; the sparking points should preferably be tipped with platinum or similar metal, as steel points are worn away rapidly and soon become fouled.

FREAK ENGINE INVENTIONS.

The advent of the steam engine was the signal for a host of ingenious and amusing inventions, and the writer is enabled, through the courtesy of an official of the Patent Office at Washington, to afford this brief account of these old railway patents.

One inventor, who appears very early on the scene, says the "Industrial World" was very sure that in winter the steam engine would be comparatively useless, because the thin coating of frost that would gather in the morning upon the rails would effectually hinder the wheels from moving along. Of course, this objecter had a remedy to offer. His rails were to be hollow in order to allow hot water to circulate through them, thus keeping the metal warm and preventing the formation of frost.

Another ingenious spirit, fully persuaded that no smooth wheeled vehicle could be made to move along ordinary roads, fitted his piston rods not to wheels, but to a set of legs that kicked into the road beneath the engine, moving it much as a punt is poled in the water, only in this case there were to be found several poles instead of one.

Decidedly more interesting than an engine that kicked its way along was one that was to actually walk on four legs. There were several varieties of these steam-walkers, one of which burst on its trial trip and killed ten persons. It was not till Hedley exploded all these ingenious theories by simply trying how a smooth wheel would really act on a smooth road that the wonderful inventions ceased.

The idea of danger was always a very prominent one in the minds of these early inventors. One was so convinced that "accidents on railroads would be frequent,' that he proposed to minimize the loss of life by attaching the train to the engine by a long rope, so that in the event of collision only the enginemen would suffer.

Another adopted the expedient of a feather-bed placed between the buffers of the cars, so that "a shock could not be transmitted," and a third and still more ingenious patentee, proposed fixing a pair of rails along the top of the train, falling at a gradient fore and aft, so that in the event of another train meeting or overtaking it, the two could pass over and under each other and both could go their way rejoicing.

CHARGING STORAGE BATTERIES.

Storage batteries are now used in so many central stations that station engineers should be familiar with their peculiarities. When a battery is being charged it is important to know when to stop charging. If a battery is only partially charged it is not being used to the best advantage because there is no use in having a battery of large storage capacity if this capacity is not made use of. On the other hand, it is equally true that a battery is not being used to the best advantage if it is repeatedly overcharged.

The question then, is to determine the point at which charging should be stopped. When a battery is discharged, the voltage of each cell falls, and it is never advisable to discharge the battery to such an extent that the voltage falls below 1.7 volt per cell. In every-day work it is advisable to keep the voltage above this point, say 1.8 volts, because it is always well to have some reserve capacity in the battery.

We will assume then, that the voltage per cell is about 1.8 when the charging begins. As the cells become charged, the voltage gradually rises until it reaches about 2 6 to 2.7 volts per cell. In passing, let us state that these voltage readings are taken when the normal charge or discharge current is flowing, as the case may be. In storage-battery work readings of voltage taken while the current is not flowing are of little use. The normal current is usually taken as the current which will discharge a fully charged battery in 8 hours. Batteries should be charged at about the 8 hour rate. It is not advisable to charge at the maximum rate except in cases of emergency.

After the voltage has come up to about 2.5, or 2.7 volts, it remains stationary, and further charging at the normal rate does not increase it. Of course if the charging current is increased above normal, the voltage will increase somewhat, but under ordinary conditions the charging current should not be forced above normal, particularly at the charging where the voltage attains a fixed value, and does not increase during, say 15 minutes, it is a sign that the battery has become fully charged. The exact value that the voltage will attain depends somewhat on the age of the plates and also, as stated above, on the value of the charging current. The point to note is not so much what the final value of the voltage is, but whether it has reached a stationary value or not.

Another indication of full charge is the specific gravity of the electrolyte, an acid solution in the cells. As the battery becomes charged this solution becomes denser, because of the formation of sulphuric acid. The specific gravity, which is readily measured by means of a battery hydrometer, therefore gradually increases. The specific gravity is usually about 1.2 when the cells are charged, but the point to be noted is that when the electrolyte ceases to increase in density. When this occurs, it is another sign that the cells are fully charged.

LIQUID AIR AT LOW COST.

Reduced cost of liquid air production is indicated by an article in the London "Times." Recent experiments in England of an invention by Mr. Kundsen, a Dane, furnished liquid air at one-sixth of the present market price, and give promise of an ultimate low price of a fraction over 2 cents per gallon. The result is secured by purely mechanical means, without an atom of added chemicals. Atmospheric air is first purified and then compressed by 2500 pounds to the square inch. It is finally reduced to 135 pounds to the square inch, which then cools and liquefies the high-pressure air.

The oxygen gas produced by separating the nitrogen from the liquid air is claimed to be purer than by the old methed, and can be supplied in the liquid as well as the gaseous form. One gallon of liquid air equals approximately 128 cubic feet of oxygen gas, which retails at 6 cents per cubic foot. The new price is 1 cent. Liquid air has been successfully used in coal mines as as an explesive, being quite safe where fire damp and other explosive gases exist. Liquid oxygen is also used for welding steel pipes, boiler shells, and plates for shipbuilding instead of riveting.

That oxygen and nitrogen can be separated from liquid air and sold at retail at $1.20 per gallon shows great commercial possibilities. The use of nitrogen for agricultural purposes opens yet another field. The maturing ef liquors will be helped by liquid air. as also the preservation and purification of milk. As a motive power its use is considered to be quite practicable for small powers. The British Government is already carrying out a number of experiments with a view to the utilization of liquid air for various purposes.

WHY IRON RUSTS.

It was formerly believed that the reason why iron exposed to the atmosphere rusted was because it simply oxidized. Afterward it was suggested that the first stage in the rusting of this metal is the production under the influence of carbonic acid, of ferrous carbonate, which is afterward converted into rust. Five years ago, however, Professor Dunster put forward a new explanation. He thought that pure oxygen in the presence of water attacked the iron, giving rise to ferrous oxide and hydrogen peroxide, and that a portion of the latter converted the ferrous oxide into rust, while the remainder directly attacks the iron, causing a fresh quantity of ferrous oxide, when this is again oxidized in a very similar way.

Dr. G. T. Moody has shown that if very special precautions are taken to exclude all traces of carbon dioxide, then iron may be left in contact with pure oxygen and water for many weeks without undergoing any change. In one of the experiments thirty times as much oxygen as is required to convert the whole of the iron into oxide was passed during the course of a few weeks, but there was absolutely no rust. But if the air were not freed from carbon dioxide rusting commenced at once, and in seventy-two hours the whole of the metal was corroded. There would seem to be no basis, therefore, for the assumtion that iron can be caused to rust by pure water and pure oxygen only.

TRAINING ELECTRICAL ENGINEERS.

One of the problems in many of the larger of America's industries is the necessity of always having available a corps of carefully trained men to take positions which may become vacant and to fill new places, the establishment of which is made necessary by the growth of an industry. This is done by the apprentice system, by night schools, or by private or "works high schools." An example of the last mentioned of these methods in the lighting field is the School of Practice recently organized by the president of the Denver Gas and Electric Company, a school in which the students will be properly drilled in every branch of the gas and electric business.

The students in this school are to be only those who are the graduates of the highest technical schools and colleges in the country. Although all the students will have already completed various courses in engineering, yet their training will have been rather along theoretical lines, while the training afforded by this school will be a two years' course along practical lines. In addition to the technical subjects naturally embraced in this higher course, the students will be obliged to also study subjects connected with the commercial side of the lighting question, such as the best methods of selling gas and electricity, etc. It is expected that upon the completion of this two years' course that the students will be all-round lighting engineers, fitted to run a plant and sell its products.

SCIENCE AND INDUSTRY.

A waterproof cement has been patented in Germany. A mixture of vegetable wax and caustic lime, in boiling water, is added to unground Portland cement clinker, and all ground together. The inventor makes the claim that one-half-inch coating of this cement placed on a brick wall will render it absolutely waterproof. The formula is given as follows; To each 200 lbs. of cement clinker is added a mixture of three-fourths pound of Japan vegetable or berry wax, and one ounce of caustic lime, which has been dissolved in fourteen pints of boiling water. These ingredients are thoroughly mixed and, when cooled, are dried and ground very fine with cement clinker.

The "Mechanical World" recently contained an epitome of a lecture by A. B. Roxburgh, of the National Gas Engine Company, Ltd., in which it was stated that about one-fourth of all the gas made in Great Britain is employed in driving gas engines. The lecturer estimated that in the United Kingdem alone there are manufactured at least 200 gas engines per week. Averaging them at the very low size of ten brake horsepower each would give a weekly production of 2000 horse power. It was deemed likely, however, that the actual amount is double that figure.

In Cuba alcohol is produced and sold from 12 to 15 cents a gallon, and it is said to make an excellent fuel for running engines. It produces no soot or disagreeable odors. When the law recently passed by Congress to denaturize alcohol in the United States becomes operative, it is expected greatly to increase the use of the article both for fuel and other purposes.

Uranium is a remarkably heavy metal having the high specific gravity of 18.6. It was discovered in 1789 by a German chemist in the mineral uraninite or pitchblende. Uranium is contained in uraninite gumnite, a hydrated calcium lead uranium silicate, torbenite, a hydrated copper uranium phosphate. The metal is prepared by heating a mixture of uranium chloride, sodium chloride and carbon or of uranium chloride, sodium chloride and metallic sodium. It is a white metal resembling nickel.

The practice of hardening steel dates back to the remotest antiquity. Homer, Pliny and Lucretius refer to the hardness imparted to iron taken from the forge and plunged in water. The ancient Egyptians heated meteoric iron in the forge at a temperature somewhat below the melting point, until it had absorbed enough carbon from the fuel to give it the requisite hardening properties, and then fashioned their weapons and tools from the metal thus obtained.

The units of weights and measures in the United are practically those used in the colonies prior to the formation of our government. While Congress has never definitely authorized the weights and measures in common use, it has sanctioned their use by its act of June 14. 1836, providing that accurate copies of the yard, pound, etc., be furnished as standards to each state.

The volumometer is an instrument for determining the specific gravity of solids by measuring the amount of water or other liquid displaced by it. A simple form is a flask having a long narrow neck and an opening at the side through which the solid may be introduced, the neck being graduated from the bottom upward. The flask is filled to the zero mark with some fluid in which the solid is not soluble; on turning it on its side the stopper is removed and solid introduced. When turned back to an upright posture again the liquid is forced up the stem and the volume reading is the amount of liquid displaced by the solid. From this the specific gravity is easily obtained.

The lifetime of a good watch is 50 years. In its daily duties the balance vibrates 18,000 times every hour, 432,000 time a day, or 157,680,000 times a year. The hair spring makes a similar number of vibrations and an equal number of ticks from the escapement. If it is a really good watch, multiply 157,680,000 by 50, which gives 7,884,000,000 pulsations for 50 years. The chances are that the watch may even then be in serviceable condition. This is a marvellous record, considering the small quantity of food that has been consumed by its constant action. We say food because whatever labors must be fed, and the watch "lives" on about 16 inches of mainspring every 24 hours, which furnishes the power.

In paints the most permanent of blues is ultra marine, while Prussian blue and indigo are liable to fade. Cobalt, however, is the most lasting of all blues. Among the reds the only really unchanging colors are vermilion and the ochres; madders, carmines and crimson lakes are likely to fade, the latter two quite rapidly. Oxide of chromium is a permanent green. The staple yellows are Naples yellow, cadmium, raw sienna and yellow ochre. In brown, raw and burnt umber retain their tint forever.

Water gas is a mixture of gases produced by the action of steam on incandescent carbon. The carbon first decomposes the steam, forming hydrogen and carbon dioxide and the latter gas then combines with more carbon to form the inflammable carbon monoxide. Thus water gas is mainly a mixture of hydrogen and carbon monoxide. Pure water gas is non-luminous, but it is rendered luminous, by mixing with various gases obtained from petroleum, the luminous material being known as carburetted water gas.

It is stated in Washington on good authority that the War Department will probably buy several automobile ambulances. A car of this type was recently purchased from a company, and has been subjected to trials by the medical department of the army. The officers have pronounced the ambulance of great value although they are of the opinion that some changes in the arrangement and equipment of the vehicles should be made. It is understood that these ambulances will be used in the field in case of war, and will be attached to every brigade hospital. One of the principal advantages of these vehicles is their speed and the fact that they do not require horses. The medical officers who have been examining the motor ambulances say that there will be no great difficulty in making the required changes in the ambulances.