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BY BROUGHTON BRANDENBURG

April 1905 20c. a copy

The TECHNICAL WORLD

Vol. III. Chicago Ill. U.S.A. No. 2

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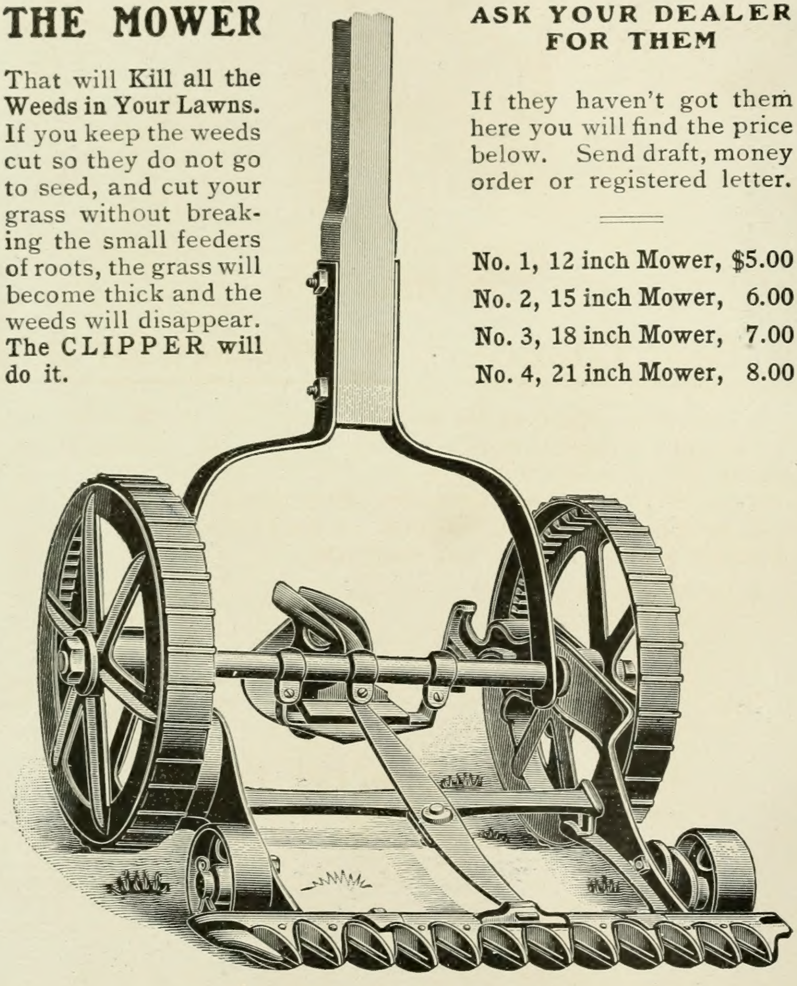

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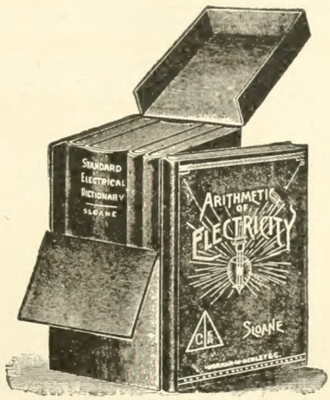

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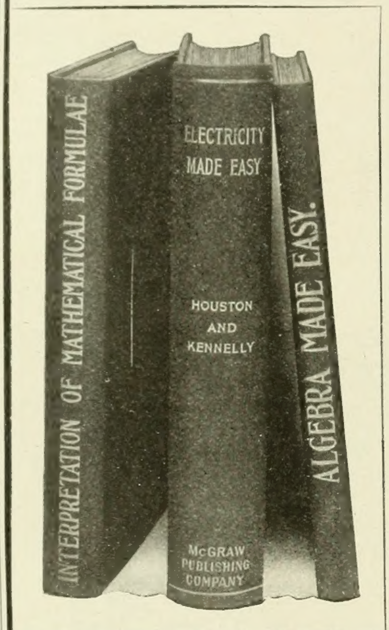

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APRIL, 1905

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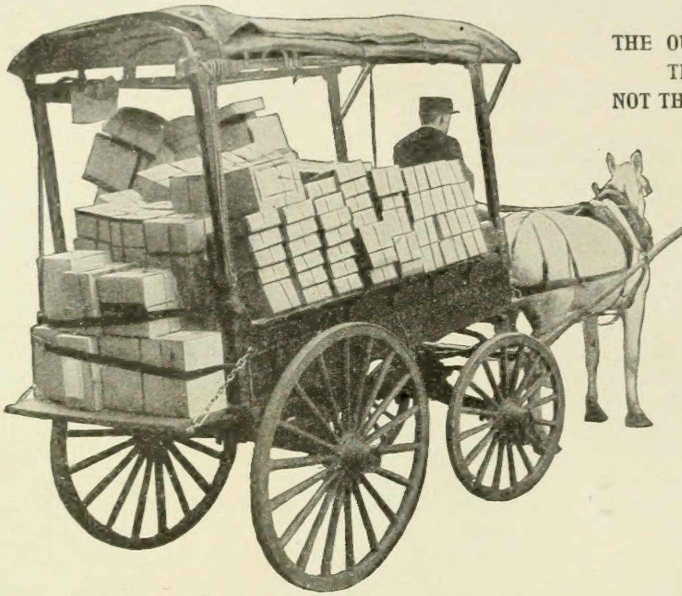

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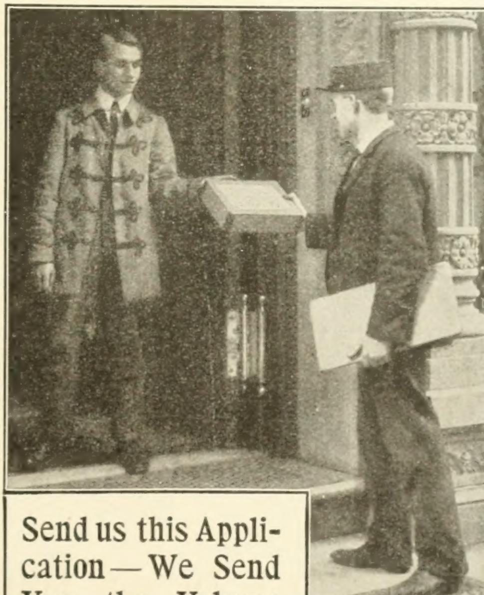

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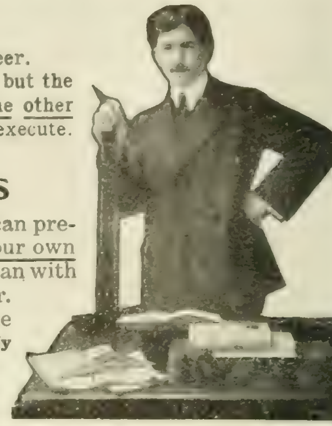

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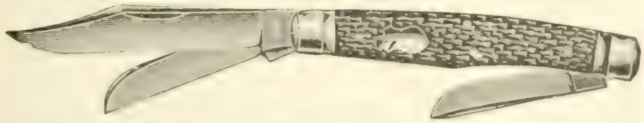

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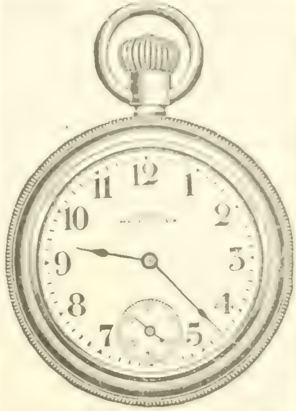

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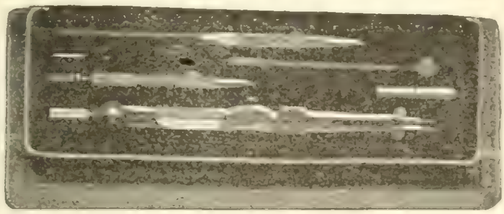

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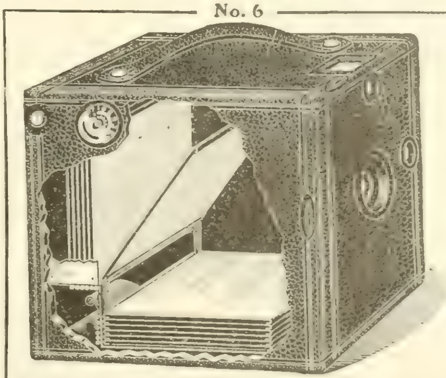

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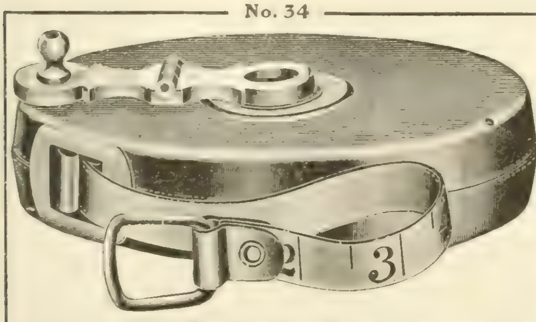

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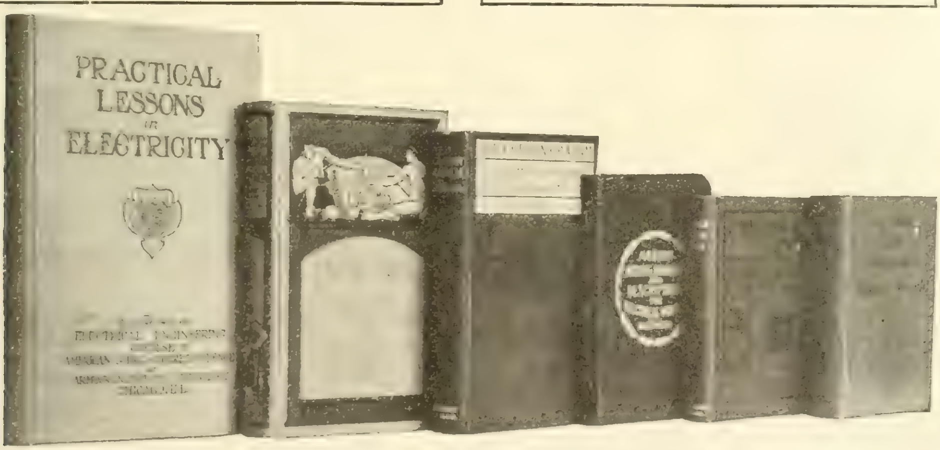

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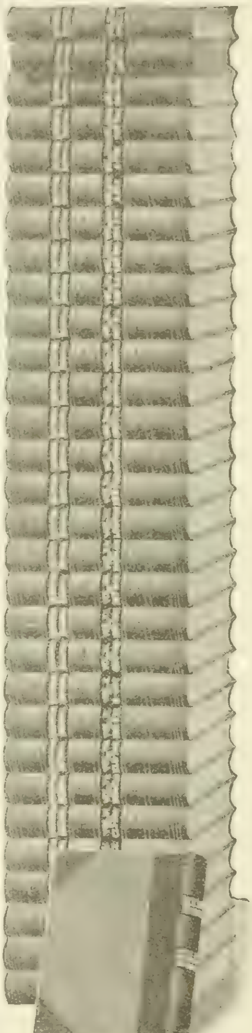

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The
Technical World

Volume III APRIL, 1905 No. 2

A Revolutionary Engine

An Account of William M. Hoffman's Marvelous Invention and the Thirty Years' Struggle It Involved

By BROUGHTON BRANDENBURG

INSIDE of brick walls the mortar of which is still fresh, in the grimiest section of the industrial heart of the city of Buffalo, New York, there is a small half-shop, half-laboratory which contains the only existing and operating Hoffman rotary engines. There, also, is the inventor of the new type of steam motor the success of which, when announced not long ago, sped on wires around the globe as might some great political or military triumph.

There has never been another great invention so received. Sewing machines, telephones, electric lights, wireless telegraphy came slowly into recognition after first successful demonstrations of their principles. The reason is that there was only one Howe, one Bell, one Edison, one Marconi, while merely from the letters Hoffman has received it is known that 18,214 inventors in the United States and Europe have been striving to attain the goal at which he has arrived. Thus it was that the world was so thoroughly prepared for a comprehension of what was meant when it was announced that Hoffman had achieved a completely successful rotary engine.

Millions understood at once that travel could be doubled and even tripled in speed rate, that great liners and trains must be constructed very differently to meet new conditions, that steam had taken on a new lease of life. A clear-headed thinker, given the fact that this new engine may be run as fast as it can revolve and yet keep from bursting under the centrifugal strain, could spend days in sketching out the vast number of changes which might be wrought in human affairs by this achievement.

A Life Work

The story of the engine is almost the life story of the inventor, for it is his life work. Born of German parents in Buffalo in 1853, Mr. Hoffman received a limited education, and when but nine years of age began to shoulder the burden of earning his own bread. When he was twenty he had prospered, but then met misfortune and took the first job he could find, that of a fireman on the Erie railroad.

But the very difficulties he had to overcome as a locomotive fireman drove home the conviction that an engine in which the power was obtained by expanding the steam in a cylinder, first on one side of a piston and then on the other, so jerking it back and forth and forcing a drive-

END VIEW OF 300-H. P. DOUBLE-CYLINDER ROTARY ENGINE.
Compound type, with high- and low-pressure cylinders.

wheel into revolution by a crank operated by the piston, was at best a clumsy thing involving a waste of power. He saw before him every hour of the working day the action of the piston, with its starting and stopping twice for each revolution of the wheels; and he decided to build an engine in which there should be no such starting and stopping, but in which the power should create a direct rotary movement.

At the first dip into the problem, he realized the slenderness of his qualifications and set out to prepare himself for his first attempt. For eight years he studied the technical branches of his chosen field, at the same time earning his living in the cab or the engine room. At the end of the period mentioned he was chief engineer of a large tannery in Buffalo.

In order to obtain funds for his greater experiments, he designed a new and complete set of "fleshing" and "putting out" machinery for use in the tannery. Some conception of his ability as a machinist and inventor may be obtained when it is said that not only did the machinery do the work for which large numbers of expert and highly paid operators had been required, but so complete was every detail that the inventions have outlived the patents without any improvements being made upon them, and are in world-wide use in tanneries today.

Various Attempts

Mr. Hoffman went to Detroit, and organized a company to produce the machines, becoming its general manager in 1886. He had used his first funds to build the initial experiment in what was destined to be a long series of rotary engines. Much time and thousands of dollars were spent on this first machine; but when it was connected up for the first time and steam turned into it, it remained absolutely motionless, and under no amount of pressure was it in any way operative. It would not stir.

In Detroit Hoffman built a second engine. This actually ran, but was a clumsy, uneconomical affair. One after another he constructed three more machines, and each eliminated some of the faults of the previous ones, until, in the fifth engine of the series, he spent the last of his resources. When it was as nearly perfect as his own and employed mechanical ingenuity could make it, he found it to be a flat failure.

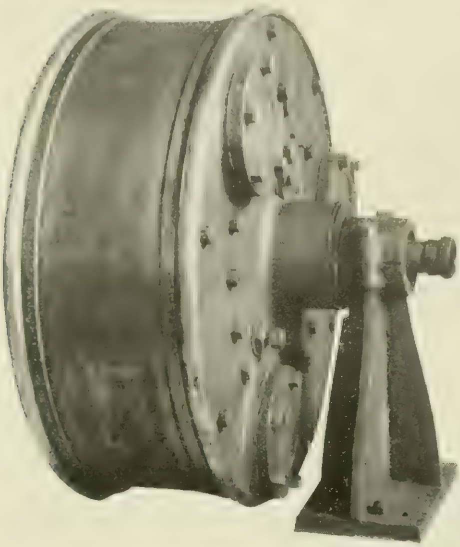
Up to this point, Hoffman had had encouragement; now he had none, nor did he have money. So, like the general who turned his soldiers into farmers to grow supplies for the next campaign, he turned his faculties to the invention of some new device from which he could derive sufficient revenue to continue the search for the rotary principle.

The growth of electric traction at that time brought the "flat wheel problem" to the front. The wheels of cars in constant use were becoming flat frequently, necessitating the withdrawal of the car for repairs. Hoffman invented a brake shoe to be applied to the wheel in such a manner that, as the wheel wore away, the brake trued it and kept it from becoming flat. This invention was a pronounced success, and without material improvement or change is in extensive use to-day.

In the winter of 1898-99, Mr. Hoffman began the series of labors in Buffalo which have been consistently maintained and have brought success. The first engine there produced was Number six in his attempts, and, though but a small unit, gave such encouragement, and was so favorably reported on by engineers, that one of greater horse-power was constructed and men began to say that the problem was solved. His new machine was of a type in which the piston revolved in the cylinder; and it showed remarkable results in control and speed, as well as in sustaining varying loads. None of the others had afforded such good opportunity for studying the friction load; and, after long tests, Hoffman was con-

WILLIAM M. HOFFMAN,
Inventor.

vinced, despite the reports of experts, that the internal friction was too great, under conditions that must obtain in general power-plant use, for the engine to be anything more than a success as a laboratory toy. Determined to prove that the "annular cylinder" type, as it is technically known, either was or was not practical by reason of the excessive face travel of the piston and cylinder in contact, he used all known and many provisionally invented devices for lessening this friction. In economy he had attained all that could be asked, but nearer and nearer approached the certainty that his best efforts were barren of any commercial success.



EXTERIOR OF ENGINE No. 9
First engine of revolving-cylinder type.

At this time, when things seemed blackest, there was one man to whom Hoffman never fails to give high credit for his support. That man is Robert W. Day, at present Secretary of the Ellicott Square Company in Buffalo. Not being a mechanic and knowing nothing of the technicalities involved, Mr. Day's faith was not in the engine but in the man.

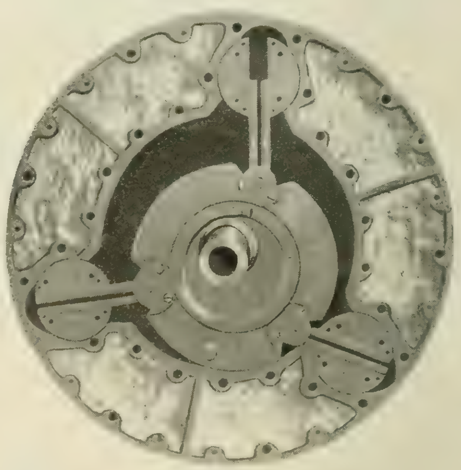
Hoffman would work all day without leaving the shop, even for food, and, when night came and he was exhausted, would get a few cents' worth of bologna sausage, crackers, and apples, and a candle or two; and when the men came back to work the next morning, they would find him still at his engine. More than once, weak, almost blinded, and with his brain numbed by the long strains, he would stagger from the place, and, boarding the nearest trolley car, ride all over the city, whither he did not know, until clearness of thought came back, and then he would go back to work again.

Revolving-Cylinder Idea

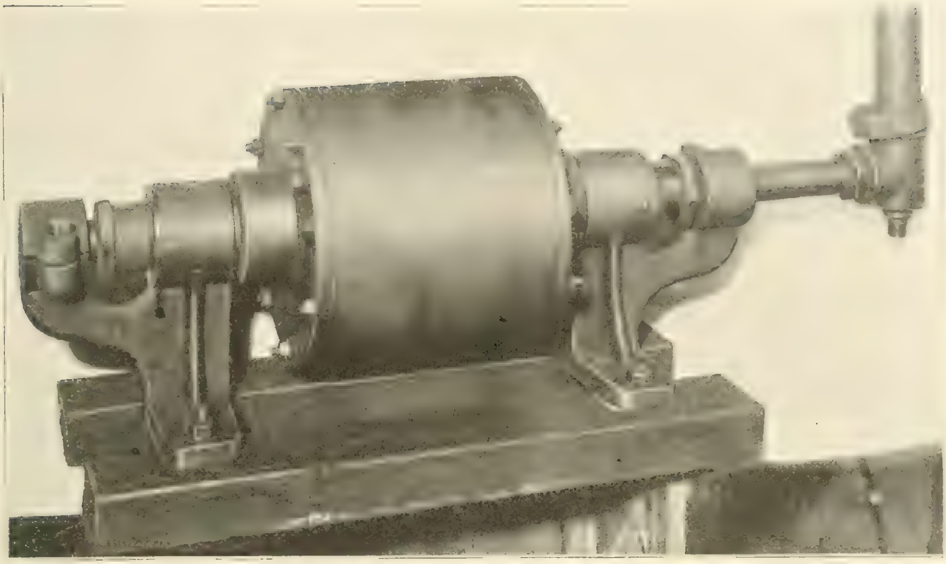
It was on one of these rides, after he knew he had failed on the lines he had been following for years, and after he had seen some necessary outside financial support withdrawn, that he hit upon the new principle which, as perfected to-day, has achieved the long-sought end.

"If the piston will not revolve inside the cylinder, perhaps the cylinder will revolve around the piston."

Bringing all his experience and high technical knowledge to bear, he designed an engine in which the shell or cylinder revolved around the eccentric abutment or core, achieving his end by the introduction of radial wings extending from the shell toward and against the stationary eccentric core. This design is clearly shown in the accompanying illustrations. A peculiarity of this device was that one wing became an abutment for another which acted as a piston, and yet both moved with the cylinder. Some Wall Street financiers called Mr. Hoff-



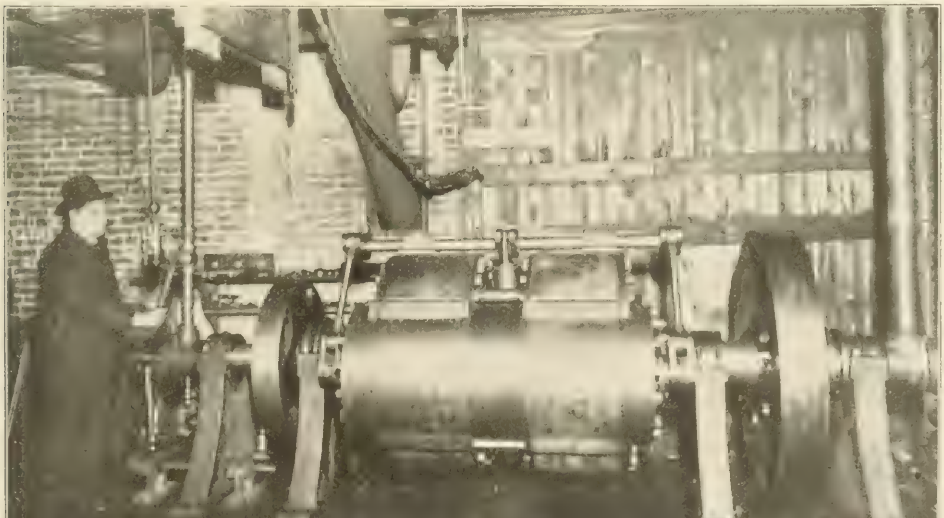
INTERIOR OF ENGINE No. 9, FIRST REVOLVING-CYLINDER TYPE, SHOWING BLADES WHICH ACTED AS PISTONS.
This photo is especially interesting, as showing just where thousands of rotary engine inventors are to-day.



ENGINE NO. 10.
This 28-H. P. machine was installed in the basement of Ellicott Square, Buffalo. It was the first to have blades or pistons swung from a wrist pin, thus avoiding the destructive friction previously encountered on the back of the blade.

man to a conference in New York, offering financial support if he could demonstrate prospects of success. When he had explained the new principle, funds were furnished; and in August, 1902, the first engine on this principle was put into operation.

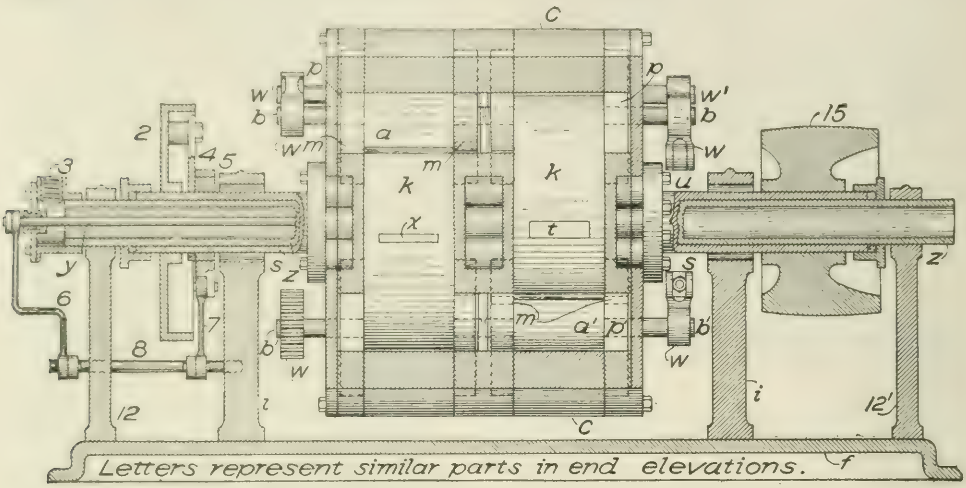
This motor was used continuously during the next eighteen months, and it and another of its type were severely tested by several of the most prominent engineers of the United States and Europe. All made favorable reports. When the last of these was received, and the suc-



FRONT VIEW OF ENGINE NO. 12.
Mr. Hoffman is shown standing at the throttle, starting the engine at ¼-horse-power load. The high- and low-pressure cylinders are shown.

cessful tests of the turbine type of engine were announced almost simultaneously by cable, the only informed man who did not believe that the fight was won, was Hoffman himself. His years of toil and study had taught him things the experts did not know; and, had failed, and insisted that he should go on. This he agreed to do if they accepted a warning from him of the chances against him.

Out in the West, one of Hoffman's two young sons, Bertram F. Hoffman, was winning his own way as a mining



LONGITUDINAL SECTION OF HOFFMAN ROTARY ENGINE NO. 12.

In above diagram, *c* represents cylinder revolving around stationary hollow shaft *z* on its hollow shaft or hub *s*: *a a'*—blades or pistons extending into cylinder automatically and receiving impact of steam; these blades are carried between two circular plates *pp'*, forming a segment of a ring between the two plates, the latter extending into housing provided in cylinder heads and partition wall between the two cylinders; *k*—elliptical stationary core held in position by stationary hollow shaft *z*, itself held in position by standards 12 12'; these elliptical cams conform to the curve of the interior of the cylinder for a distance a little less than one-half its circumference, but do not touch the cylinder at any point, thus avoiding friction; the stationary cores in the respective cylinders are so located as to bring extreme radial throw of one below, and the other above, center of cylinder, thus causing one elliptical cam to actuate and hold the blades in contact with the other throughout the entire revolution, and *vice versa*. This is acomplished through wrist pins *b*, which carry blades and countershaft *d* extending across the entire engine, together with segmental gears *ww'*, cranks *ww'*, and connecting rods *n*.

When blade *a* in high-pressure cylinder is being forced into housing *h* by contact with cam *k*, wrist pin *b* transmits through the segmental gears a motion the reverse of its own to countershaft *d*, causing the opposite blade in the low-pressure cylinder to be extended from its housing by means of the cranks *ww'*, and to keep in contact with its respective ellipse, during that portion of the revolution where the curve of the ellipse leaves that of the cylinder. This operation is identical in the case of both blades *aa'*. It causes the blades of both cylinders to remain in constant contact with their respective stationary cores.

The circular shoes or gudgeons *gg*, forming the ends of the blades, have a portion of their surfaces curved to conform to the ellipses; they are carried by pins *m* extending into the plates *p*, and are provided with packing bars to insure steam-tight contact with cam *k*.

One blade in each cylinder receives the impact of the steam. The other acts as a packing bar, to form an abutment for the working piston by closing whatever opening there may be between the lower curve of the cam *k* and the interior of the cylinder; it also acts as a means for actuating the opposite blades in their respective cylinders.

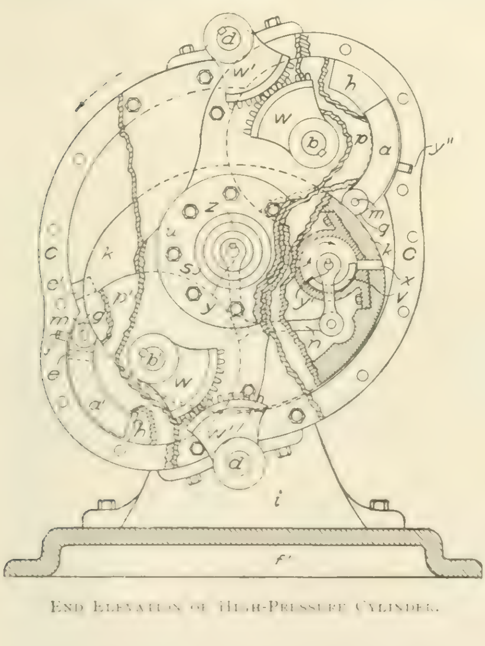
Spring packing bars *y'' y''*, in contact with the face of the blade, prevent steam from passing over top of it to exhaust ports.

The rocking valve stem *y* shown in end sectional drawing on opposite page, by means of rod *n* and crank *y*, transmits motion to the valve *v* for proper regulation of steam admission. The rod *y*, extending from the stationary hollow shaft to the interior of the ellipse, is caused to oscillate, and transmits to the valve the motion desired, by means of the device shown in the longitudinal section, *2* being a hood securely fastened to revolving hub *s*, and from which is suspended, by means of arm *4*, an eccentric and eccentric strap *5* and *6* normally eccentric to the hub of the engine.

This eccentric is provided with an oblong opening which allows it to swing on arms *4* from position of greatest eccentricity—necessary to impart full motion to valve *v*—to a position concentric with shaft *s*, when it completely closes, and imparts no motion to valve *v*; thus arm *4*, being provided with proper weights to throw the eccentric *5* out of motion when excessive speed is attained, and with springs to hold the eccentric in normal position, acts as a means of operating the admission valve as well as the automatic cut-off, the motion of eccentric being imparted to rocking stem *y* by means of rocking shaft *8* and connecting rod and lever *6* and *7*. In the different drawings, *i i* are the standards, which are provided with roller bearings; and *15*, the pulley.

laughing at their reports, he told his backers that the engine as it stood was a failure, and out of pride mortgaged all of his small property, and came to New York to lay before them a certified check for the amount they had so far expended. They refused to believe that he and mechanical engineer. Though but a boy in years, he showed some of the inherited characteristics of his father, and had a fine career before him; but, realizing that his father needed him, he relinquished his chances in the West, and soon the two were working side by side in the little shop in Buffalo. There is another man, too, who shares the honors of the invention. He is Randl Riehl, one of the machinists who worked for Hoffman in the darkest days. When finances were at the lowest, he went without pay for months, and at last broke open a little iron bank in which he had been saving nickels and dimes, and shared his slender store with the man in whom he believed. Since then he has received every cent and more, doubled; and one day not long ago he was called into the offices of the company into which all of the Hoffman patents have been merged, and was presented by its president with a large block of the company stock.

In July, 1904, Hoffman produced a 28-horse-power engine, which was put into operation in the basement of the Ellicott Square Building in Buffalo. This machine embodied in construction,

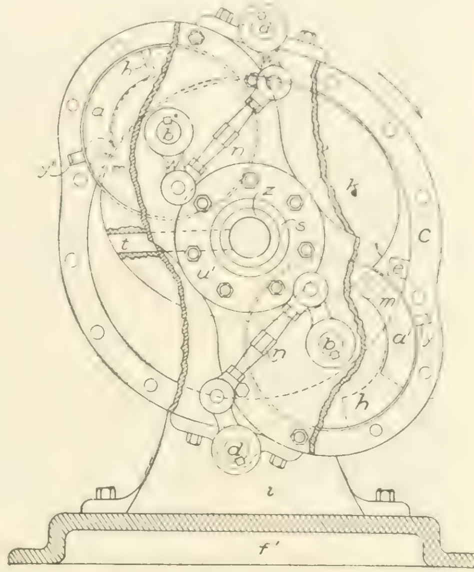


End Elevation of High-Pressure Cylinder.

maintenance, and economy of operation everything that was necessary to a complete success.

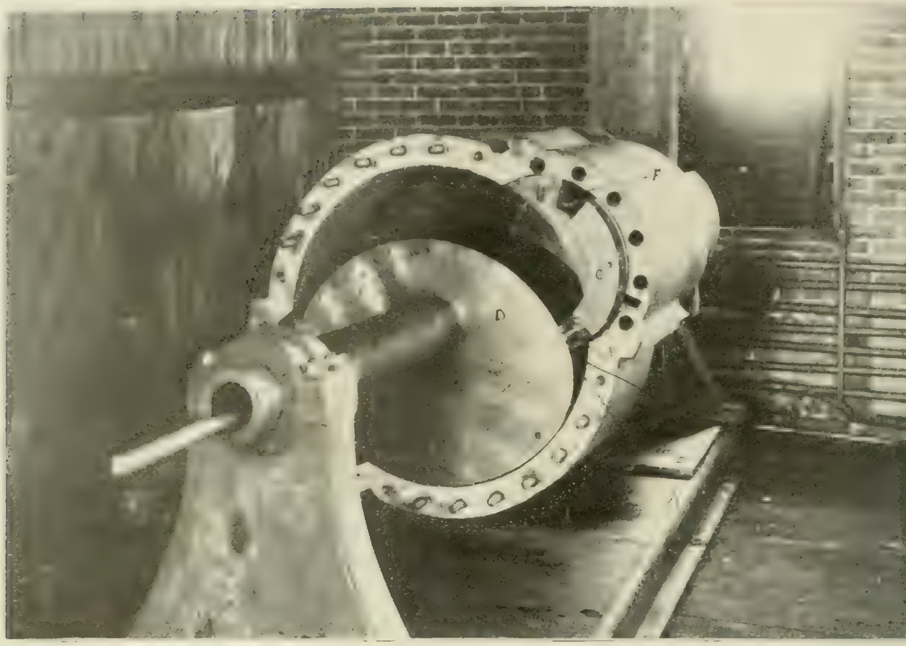
Immediately the construction of the twelfth and last design was begun in a 300-horse-power compound engine the principles of which are described below. This is the engine now operating in the company's shops; many of the world's famous engineers have traveled from afar to see it for themselves.

The principle of the invention is extremely simple. The interior of the shell



End Elevation of Low-Pressure Cylinder

is perfectly cylindrical but the eccentric core is elliptical in form. The shell revolves supported on sleeves, and the ellipse is stationary on a hollow shaft. The ellipse is the steam chest, and contains an automatic cut-off, whose design is secret as yet, which admits steam in sixths of a revolution, and allows the exhaust in other sixths. Steam is introduced in one end of the hollow shaft, and exhausts from the other. When the throttle is opened, steam passes into the ellipse, through the cut-off, and out of a single port in the upper face of the ellipse near one of the greater dimensions. The ellipse has no contact with the interior of the shell, but the lower face is very close to the bore. That leaves a chamber — in cross-section the shape of a new moon—between the upper face of the ellipse and the interior of the cylinder. Into this chamber protrudes a curved blade arbitrarily termed a "segmental" blade, which is cranked outside the ends of the cylinder in such a way that it retreats into a housing in the shell when the packing bar, which gives it contact with the ellipse, moves toward the

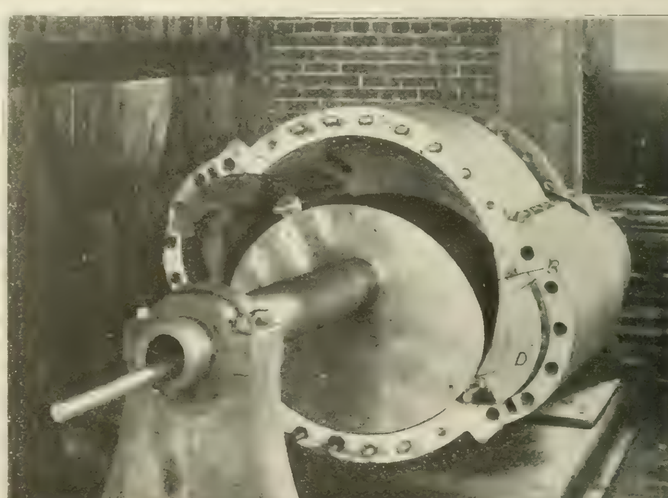


END VIEW OF PARTLY DISMANTLED CYLINDER SHOWING ELLIPTICAL CORE AND ONE BLADE OR PISTON IN POSITION JUST AS STEAM IS ADMITTED.

A—Location of steam port midway of the length of the ellipse. *B*—Packing bar in sliding contact with ellipse. *C*—Blade beginning to protrude from housing. *D*—Ellipse which is stationary, and acts as steam-chest incasing cut-off which admits steam the first sixth of revolution, sustains expansion the second sixth, etc. *E*—Hollow shaft through which steam is admitted to high-pressure cylinder and exhausted from low-pressure cylinder. *F*—Housing for blade. *G*—Chamber as it forms when steam is admitted.

greater dimension of the ellipse. A duplicate of this blade is located diametrically opposite it in the cylinder.

Say that blade No. 1 is barely past the steam port as steam is introduced. The expansion of the steam meets five surfaces—the two ends of the cylinder, the inner surface of the cylinder, the upper face of the ellipse, all of which are rigid; and the convex face of the blade, which is not rigid, but which, in order to move, must take the cylinder with it into revolution. This it does, the blade protruding farther from the housing until the greatest width of the chamber is reached, and then receding until, when it reaches the point where the cylinder and ellipse are almost in contact, it is completely within its housing, and forms an abutment for the expansion which will then be taking



END VIEW OF PARTLY DISMANTLED CYLINDER, SHOWING POSITION AT INSTANT EXHAUST FROM HIGH-PRESSURE INTO LOW-PRESSURE CYLINDER TAKES PLACE.

A—Steam port to low-pressure cylinder. *B*—Steam port to high-pressure cylinder, shut during third sixth of revolution. *C*—First blade retiring into housing, but still receiving pressure, though the second blade (*D*), advancing to act as a piston, is not yet where it will receive any back pressure from steam in chamber.

place in the new chamber formed by the same rigid parts and the second blade, which, having been carried around by the power applied to the first, passes the port just as steam is admitted during the fourth sixth of the revolution. Further operation is a repetition. Steam is admitted the first sixth, expands the second sixth, exhausts the third sixth, is admitted the fourth sixth, expands the fifth sixth, and exhausts the sixth sixth, of each revolution.

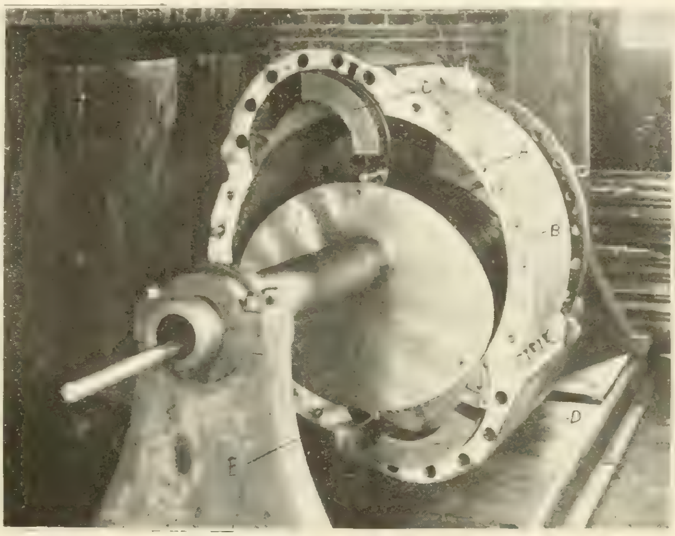
One of the unusual features is the cut-off. This is adjustable so that the instant the engine makes one more revolution than a desired number per second, steam is shut off until the engine drops to its rated speed. Thus an engine carrying 100 horse-power can drop instantly to less than one-half of one horse-power.

The tests which have been made during the past seven months have given the following results:

The 50-horse-power engine which is running the shop, compared with the highest type of reciprocating engine, has consistently shown an economy of 30 per cent and a saving of 75 per cent in floor space, as well as proportionate reductions in friction load. Under the most favorable circumstances the friction load was 1½ per cent, as compared with 7 per cent in the reciprocating engine. This engine consumes 21 pounds of steam per horse-power per hour.

In the 300-horse-power compound engine which is the largest of its general type ever built, the economy has been increased to 33 per cent, and the saving in floor space to 80 per cent, while the friction load has been reduced to 1.1 per cent.

In both sizes there is a complete absence of vibration. As to speed, Hoffman believes that in the present types the resistance of the steel to centrifugal force is the limiting condition in the smaller sizes, while in larger types the limit will be the expansion speed of steam. At first glance it seems as if the reverse should be true. A specially constructed 48-inch drive-wheel will stand 2,000 revolutions per minute. Taking this as a basis for speculative calculations, one can figure that a train could travel 250 miles an hour, making allowance for friction and air resistance — or more than four miles per minute. It seems probable that a liner could be driven across the Atlantic in less than two days. The things that are really attainable, however, remain to be proved in the next decade. They may be even more wonderful than present indications warrant us to assume.



END VIEW OF PARTLY DISMANTLED CYLINDER AS EXPANSION CONTINUES.
A—Chamber in which steam is expanding. *B*—Location of steam port. *C*—Blade acting as piston, protruding at greatest extent from its housing. *D*—Second blade acting as an abutment. Shows clearly how packing bar closes slight opening between ellipse and cylinder bore. The cam does not touch interior bore of cylinder, but runs close to it. *E*—Packing bar.

AN ICEBERG ON THE GRAND BANKS.

A floating menace to shipping.

Repairing Crippled Ocean Liners

Perils of the Newfoundland Coast—Ships Rescued from the Graveyard of the Atlantic Find at St. John's a Safe Haven where they are Restored to Seaworthiness

By P. T. McGRATH

Staff Correspondent, *Evening Herald*, St. John's, Newfoundland

BECAUSE of Newfoundland's advantageous geographical position —equidistant, as it is, from Queenstown and New York, and likewise from Queenstown and Montreal —its chief port, St. John's, has become the half-way house of Atlantic commerce, the hospital wherein marine fabrics that meet mishap in traversing the great ocean lanes find shelter and effect repairs. Owing to the enormous tonnage annually crossing the Grand Banks, accidents and disasters are frequent; and this little harbor on the rim of the western hemisphere is rarely without some wounded or helpless steamer whose very appearance testifies to the gravity of her plight and the need for prompt remedial measures.

A Port of Refuge

All the St. Lawrence traffic must pass within sight of the Newfoundland coast, whether *viâ* Belle Isle Strait or Cape Race; and therefore St. John's is the natural haven for its shipping when in distress; while steamboats bound to or from American ports, if ill-luck overtakes them east of the Grand Banks, also find this their most convenient landfall. Especially is this so if the vessel has many passengers or her injury is critical, for in such cases it might prove disastrous to attempt to reach another inlet, even if it afforded greater prospect of speedy curing of the wounds from which she suffers.

Until recent years this isolated center of maritime activity suffered from inadequacy of facilities and insufficiency of workmen, which were inevitable because of its circumstances. Many expedients had therefore to be devised to prevent excessive delay to "lame ducks," which are unnecessary in more frequented shipping resorts, where a steamer can be docked and repaired as thoroughly and speedily as in the yard where she was built. Chief among these makeshifts were the fitting of ships whose prows had been damaged, with wooden stems; the inserting of wooden sections in the bottom of those which had gashed themselves below the water line; the patching of lesser breaks with iron plates securely bolted over the apertures; and the cementing of the interiors when ships were merely strained and leaky, without any special parts being grievously affected. The reason was that the long wait for material from abroad or while small crews of riveters keyed up an entire hull, was far more costly than to make temporary stop-gaps and hurry the vessel to a home port where she could be put in order expeditiously.

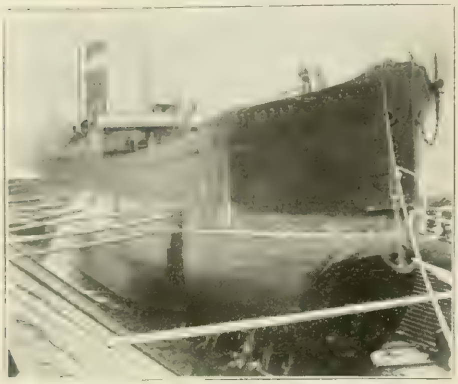
The chief causes of misfortune to shipping in the North Atlantic are ramming icebergs, striking derelicts, breaking shafts or propellers from the jars caused by heavy seas, colliding with other crafts, or meeting wreck on the terrible Newfoundland seaboard. This last is usually fatal, for not one fabric in ten that strand there ever floats again or escapes a lodgment in the ocean graveyard—which it has proved to be—the worst in all the seas.

SS. *PETUNIA* AS SHE SANK IN ST. JOHN'S HARBOR.

Historic Instances

A few ships, however, have triumphed in this respect, and, being taken to St. John's, have undergone repairs there. One was the German liner *Grasbrook*, which took the rocks near Cape Race in 1885, while bound to New York, driving in over a reef, and impaling herself on some jagged fragments which entered her bottom, holding her tightly fixed. A wrecking company successfully essayed the task of getting her off again, having divers blast away all the obstructions, save one boulder which she brought with her as powerful tugs plucked her back into deep water, and this rolled out through her shattered underbody as she pitched about in the seaway.

Being shepherded to St. John's, a distance of fifty miles, by tugs with capacious pumps, she entered dry dock, where it was found her entire bottom required stripping and renewing, scarcely a sound plate remaining on the flat section. New material was ordered by cable, and before the stripping was completed had arrived. It was then substituted, a thorough job being made, the first done on the dock, occupying two months and costing about $40,000. All the ship's cargo had been unloaded as she lay on the reef, and was sold on behalf of the underwriters and salvors. It included large consignments of German concertinas, some of which



SS. "Rotterdam" with Broken Bow.

are yet to be found doing duty in the fishing hamlets along the coast.

This dry dock, one of the largest in the world, had but shortly before been built, its construction having been dictated very largely by the fact that six years previously, when the Guion liner *Arizona*, then queen of the ocean greyhounds, had succeeded in reaching here with 700 souls aboard, after having stove in her bows against an iceberg which she struck full tilt on the Grand Banks, the port was without a dock. The yawning gap had to be closed by a wooden forepart, constructed by local shipwrights, a caisson being sunk under her forward to elevate her sufficiently for the whole broken area to be covered. The entire work was completed in eighteen days, and was regarded as a marvel at the time, being the first such repair ever attempted to a ship of her size, and put out of hand so quickly in a port so inadequately fitted for such emergencies.

The Anchor liner *Anchoria*, in 1887, broke her shaft while crossing the Grand Banks 200 miles off St. John's; and, meeting boisterous weather which threatened worse consequences to an unmanageable ship with nearly 1,000 people aboard, a boat's crew volunteered to row to land for help. This boat's crew made St. John's on a Sunday afternoon. The steamer *Miranda*, then in port, was sent in quest of the damaged vessel, but missed the prize, for, as a northeast gale was blowing, the *Anchoria* made her own way to the harbor mouth, a tug leading her in. The shaft was repaired by filling her forehold with water, thus elevating the stern so that the injured section could be conveniently removed.

The *Anglia*, in 1891, sheltered here with a gaping wound in her side from having struck a lumber-laden derelict. The inrush of water listed her over to an angle which made walking on her deck almost impossible, and she virtually worked her way into port on her beam-ends. A wooden section had to be built into her flank after she was docked, for she had sustained injury to her ribs and stanchions which put permanent repairs here out of the question. The wooden screen was fastened to great timber beams buttressed to the decks and sides by tie-rods and girders, and she successfully crossed the ocean to Glasgow some weeks later.

The case of the *Scottish King* was almost unique in marine annals. She went on the rocks near Cape Race in October, 1898, and, after remaining there eighteen months, outlasting the storms and ice-blockades of two terrible winters, was refloated, nursed along to St. John's from harbor to harbor, and docked and repaired here. She went in over a reef, puncturing her bows and goring her bottom, but lodged on a shelf in shallow

Wooden Temporary Bow Fitted to SS. "Rotterdam."

water, where she lay secure, her cargo being unloaded and she moored by wire cables to the shore. It was she that had consignments of champagne and apollinaris in her lading; and the salvors, in discharging her, drank heartily of the latter in mistake for the former, voting the aristocratic beverage they supposed themselves to be imbibing as "not worth a d—." The refloating of this ship was a task of great engineering difficulty, no pumps being procurable that would overcome the inflow of water through the rents in her hull. So the alternative method was devised, of securely fastening her hatches and converting her several holds into air-tight compartments, which were then filled with compressed air from engines fixed on deck. This plan checked the rise of water inside her, and so elevated her hull that she skimmed out over the reef at high tide.

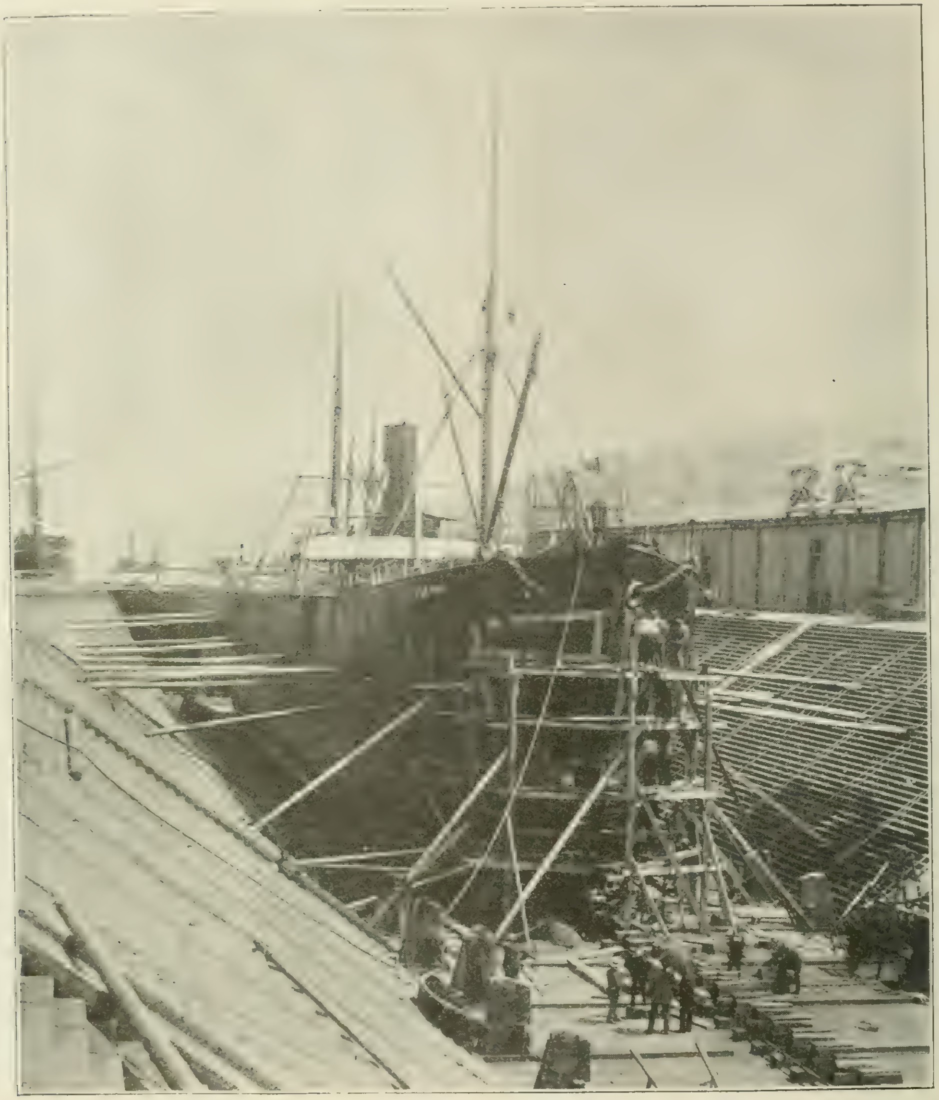
The whole bottom of the *Scottish King* being shattered, she got a wooden one here, the interior being thickly cemented as a further precaution. Thus fitted to essay the transatlantic voyage, she succeeded in making it safely, being then permanently renovated, and renamed the *Aboukir,* as which she is now running. The next year the steamer *Petunia* went ashore in the same vicinity; but the whaler *Cabot,* being near, plucked her off before she had time to settle on the rocks, perhaps to remain there altogether. She had torn away her keel and forefoot for a considerable distance; and the whaler towed her, stern foremost, to St. John's. The water, however, gained on the pumps, and she sank on a shoal in the harbor, resting there as the picture shows. To get her into the dock, she had to be made partially buoyant again by having a diver fill her forehold with empty barrels closely corked so as to reproduce the conditions which would be caused by pumping air into it. Her bottom was patched with iron plates over the orifices made, and a wooden shield over the gap in the bow, which was too great for that.

The *La Flandre* was a German oil-tank steamer which was rammed by the British freighter *Cyphrenes* on the Grand Banks on Christmas night, 1893. In the fearful wound that crippled her, was wedged the stem-piece of the other ship, which backed off and soon sank, having shattered her first bulkhead with the impact. The *La Flandre,* having several compartments, as became her calling, escaped this fate, and succeeded in crawling into St. John's with her holds full of water. Her repairs had to be complete, because the remedying of the damage done compelled the strengthening of every plate in her forward parts, all her skin, ribs, and bulkhead having been started, so that her tanks were no longer oil-tight, even if waterproof, and therefore necessitated a thorough overhaul be-

SS. "Concordia" with Bows Stove In.

fore she could be employed in the petroleum trade again. Her bill of damages was $50,000, this job being one of the largest and most difficult ever undertaken by the dock, the vessel occupying the basin for several months.

The *Rotterdam,* a sister ship of the *La Flandre,* was as bad a case two years later. She was the largest "tanker" afloat at that time, and was bound to Germany with 2,000,000 gallons of petroleum on board, when she struck near Cape Race on a splendid starlit night, a haze on the water obscuring the land. Fortunately the steamer *Barcelona* was near her, and, by towing at her, the *Rot-*



SS. *FURTOR* UNDERGOING REPAIRS.

terdam meanwhile pumping hundreds of tons of oil overboard, got her off in a few hours, though she had been going at full speed when she struck. The *Barcelona* accompanied her to St. John's, where she was docked after a sister ship had called and transferred the rest of her cargo. It was found that besides a great gap in her bow, every plate along her bottom, from stem to stern, and also the rudder-post, were started and leaky, where they were not shattered by the rocks. Only the fact of her being a "tanker," with a lading so much lighter than water, enabled her to escape foundering at once. Fully $30,000 was spent on temporary repairs here, a wooden bow being fitted in place, the holes in the bottom being patched and the whole inner skin being thickly cemented. When she was undocked, her crew refused to sail in her and had to be put on board by an armed patrol from the British warship *Emerald;* but she made the passage across the herring-pond in nine days. She had previously run ashore on her trial trip at Newcastle-on-Tyne, just when her owners were about to take her over, and her repairs then cost $90,000. Probably, when the outlay for the temporary work here and for the permanent restoration in England which she had to undergo were taken into account, it would be found that at least a similar good the damages she had sustained. Fortunately she met good weather, else she must have foundered. Being docked, she was fitted with a wooden bow, a peculiarly difficult task in her case because she had none of the original stem in posi-

SS. *JOHN BRIGHT* WITH HOLE STOVE IN BOW.

sum was spent because of her unfortunate encounter with the destructive coastline of Newfoundland.

The view of the *Concordia* given herewith sufficiently indicates the character of her mishap. She struck an iceberg in Belle Isle Strait and battered in her stem, so headed for St. John's to make tion, and the problem of fastening the new one securely was therefore rendered doubly hard. But it was accomplished by building a solid breastwork outward from the crumpled forepeak, and planking her fore and aft against this.

The *Furtor* was less fortunate in her temporary expedient to offset the damage sustained from striking a berg on the Grand Banks, for, after pulling into St. John's with her forehold full of water, being docked, and installing a wooden bow, she went to sea again, and two days later encountered a hurricane, in battling with which she had this wooden contrivance not only work asunder, but also tear apart her front bulkhead, to which it was attached, so that she became a hopeless derelict. Her crew abandoned her, and were adrift in open boats for slaughts of wind and wave and she was already leaking badly; so she was headed back to port again, and the structure strengthened, whereupon she accomplished the ocean transit safely. The *Turret Crown* was in a similar plight while proceeding up the St. Lawrence after having been lanced in several parts of her bottom by jagged ice-pans off Cape Race and being patched with wooden slabs and iron plates at St. John's. But it is contended that she

SS. *JOHN BRIGHT* TEMPORARILY FITTED WITH WOODEN BOW.

two days and nights before they were rescued. She herself, having a cargo of lumber, did not sink at once, but was sighted some time after, on her beam-ends, and doubtless went to pieces gradually, as the great balks in her holds battered her sides out.

The *Furtor* was the only one of all the scores of ships mended with wooden sections at this port, that ever met misfortune while voyaging onward in this condition. The *John Bright*, however, which had met with a similar accident and been subjected to a like repair, found, after she sailed and struck rough weather, that her temporary repairs were not strong enough to withstand the onslaughts... struck other ice in Cabot Strait and loosened the patches so that she leaked seriously; yet she contrived to reach Quebec before the worst occurred.

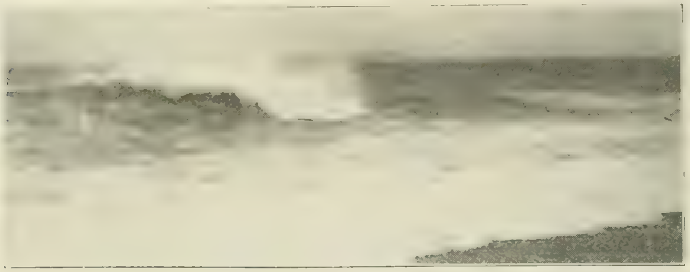
Another unique case of misfortune to an ocean steamship which had to be repaired at St. John's, was that of the *Boston City*. She was crossing to New York in ballast, and had a spare propeller in her hold. In a tornado on the Banks the fearful motion of the ship caused this to break its lashings; and with one heave of the ship it was flung against the steel side, one blade of the propeller being driven out through the plates clear to the "boss," or hub, on which the blades are fixed. The next roll of the vessel to the other

ICEBERGS AT ENTRANCE TO HARBOR OF ST. JOHN'S, NEWFOUNDLAND.

side caused the heavy battering ram to be withdrawn, and a second blade forced through the starboard quarter, where the mass caught against a beam. Meanwhile, through the cavity on the port side, now open to the ocean, a stream of water was pouring in, supplemented by what gushed through the crevices in the plate where the propeller now lay. At the risk of their lives, every available man on the ship helped in securing the destructive engine that threatened their end, and in plugging the hole on the port side with mattresses, blankets, and such gear, the apertures around the outlet through which the blade still projected being stopped in the same fashion. Spars and booms were cut up and converted into stays and supports; and in this way, with four feet of a steel wing driven out through her side, she contrived to reach St. John's, and, going on dock, was made sound again with iron patches over these dangerous wounds. This was her third visit to St. John's in distress, her first appearance being with her bows smashed by ice, and her second with broken machinery. After her third mishap, she was sold and renamed the *Norman,* under which guise she showed up last summer—for the fourth time—short of coal.

Perhaps the greatest repair job ever undertaken on the St. John's dock was that on the French cable-ship *Pouyer Guertier.* She was driven ashore at St. Pierre, the little French island colony south of Newfoundland, in the winter of 1896; and, after great difficulty, was refloated by tugs with wrecking gear from St. John's, to which port she was conveyed for repairs. There was scarcely a sound plate in her bottom; only the inner skin formed by the beds of the cable-tanks enabled her to float at all, and she and the tugs had to skirt the coast, from harbor to harbor, to get her to this haven. She was three months in dock, was thoroughly renewed in every damaged part, and, after an expenditure of almost $80,000, put to sea again to resume her work, having a narrow escape from foundering through the eruption of Mont Pelée, at St. Pierre, Martinique, near where she was cable-repairing at the time.

These are only a few of the many "lame ducks" which have found shelter and recovery in St. John's, their cases being those which embody the most interesting features. The temporary repair of ships here is now discouraged, for the dock has been sold by the Government to the great industrial corporation, the Reid-Newfoundland Company, which has equipped it with the most modern appliances worked by electricity or pneumatics. Also, the providing of steel shipplates at Sydney, and of propellers, shafts, and castings at New Glasgow, now enables the fullest permanent treatment to be given an injured steamship at St. John's as quickly and cheaply as the same can be done anywhere else.



The Engine's Song

THROUGH city and forest and field and glen,
  I rush with the roaring train;
My strength is the strength of a thousand men;
  My guide is my master's brain.

I borrow the senses of him within
  Who watches the gleaming line;
His pulses I feel through my frame of steel;
  His courage and will are mine.

I hear, as I swerve on the upland curve,
  The echoing hills rejoice
To answer the knell of my brazen bell,
  The laugh of my giant voice.

And, white in the glare of the golden ray,
  Or red in the furnace light,
My smoke is a pillar of cloud by day,
  A pillar of flame by night.

—ARTHUR GUITERMAN in *Four-Track News.*

ASSEMBLING THE PARTS OF THE CHASSIS.
Setting the Motor on the Framework

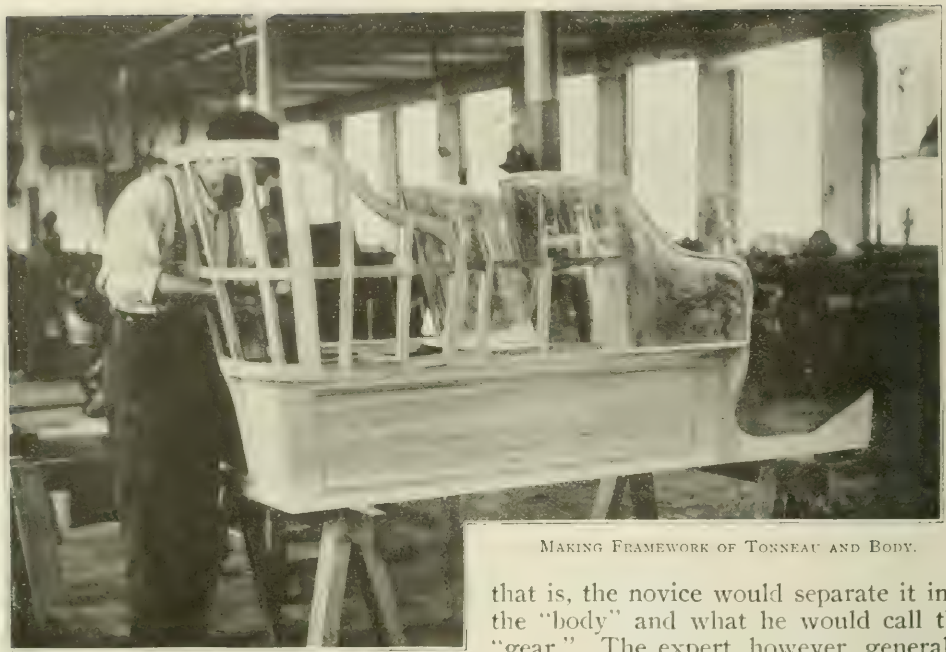
Through An Automobile Factory

The Making and Assembling of a Modern Touring Car

By DAY ALLEN WILLEY

OF the hundreds of different industries carried on in the United States, it is a question if any one represents a greater variety of processes and requires a greater variety of raw material than the manufacture of the modern touring car. This industry has been compared to the making of the ordinary carriage; but, in addition to the woodwork, the upholstery, and the gear, the automobile must be fitted with its engine, transmission system, controlling mechanism, and tanks, all of which are absolutely essential, since the automobile without the engine would be like the play of "Hamlet" with Hamlet left out. In fact, the number of minute parts required is astonishing. To fit together the sections of a large stationary engine, or even the locomotive itself, needs a skill which is acquired only by years of experience. Therefore, in constructing and installing the mechanism of the touring car, it is evident that the machinist must be an expert in his particular line; but in addition to the serv-

COVERING A TONNEAU WITH SHEET ALUMINUM.



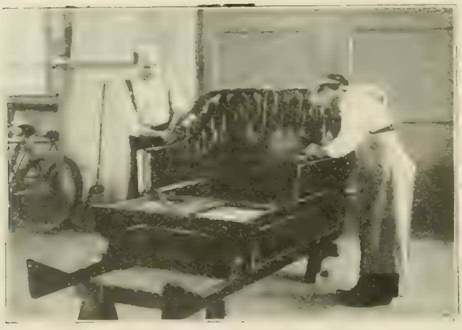
Making Framework of Tonneau and Body.

ices of the ordinary machinist, those of the electrician as well as of others who are specialists in their particular vocation, are essential.

In the construction of the ordinary touring car, so many different sets of work can be performed at the same time, that if a large manufacturer had an order to make one within a week, he could probably execute the order without difficulty, including the thorough testing of the car before delivery, for the principal feature of "auto" building is in the preparation of the various parts for assembling.

Parts of the Automobile

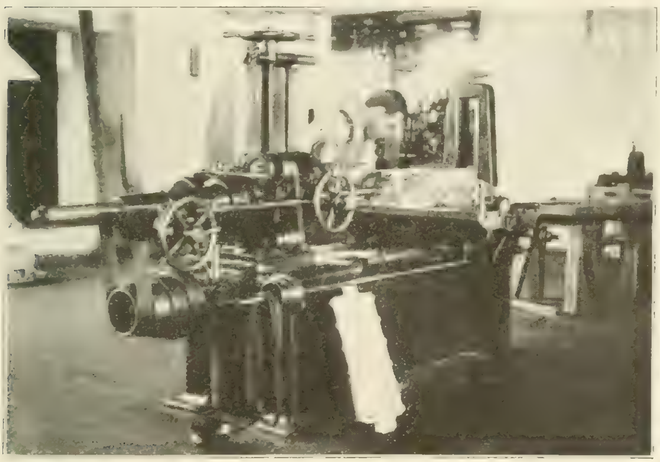
For the purpose of study, the car may be divided into two general portions—



Lining a Tonneau.

that is, the novice would separate it into the "body" and what he would call the "gear." The expert, however, generally includes under the term "body" the part which comprises the box resting immediately above the frame of the gear, and the front seats. In nearly all types, the rear seats, as is well known, are separate, so that they can be detached from the box when desired. They really form what is known as the "tonneau," if the car is provided with them. To the expert, the gear is the "chassis" — which means not only the wheels and axles, and the metal framework holding them in position, but the propelling mechanism and in fact all the machinery required. Consequently the workmen on the automobile may be divided into two sets—those who complete the body and tonneau, and those who complete the chassis. The first set are further divided into carpenters, upholsterers, and painters; while the chassis makers may represent a dozen different trades, depending upon the style of car on which they are engaged. Since, in a large establishment, the various operations are carried on in different departments, all portions of the automobile may be in process of manufacture at the same time. Hence it is that one of these vehicles can be so quickly finished ready for service.

As in other lines of manufacturing, automobile makers frequently avail themselves of the opportunity to obtain parts that can be secured ready made. For example, many of the cylinder and piston castings, as well as parts of brass and aluminum, are imported—especially from France, where a specialty is made of high-grade work of this class. The tires are usually purchased finished for immediate use.



Special Machine for Boring the Aluminum Crank-Case of an Engine.

Tubing in the form of steel, rubber, and copper is used in large quantities. Some makers buy their wheels entirely finished, as well as radiators, induction coils, bearings for the front wheels, steel balls for bearings, springs, spark plugs, and storage batteries. The "raw material," as it might be called, embraces bar iron and steel; aluminum, brass, and iron in sheets; a great variety of wood for bodies; as well as leather, cloth, and hair.

The Various Shops

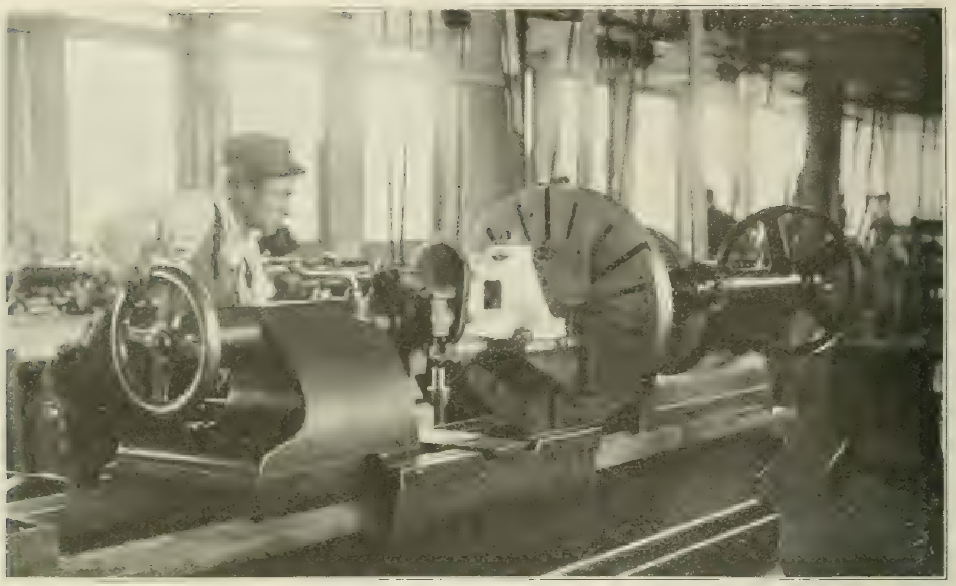
Although many parts of an automobile can be bought ready made, as intimated, so many processes are required that the large factory is usually provided with a blacksmith shop, and a machine shop containing lathes, drilling presses, milling machines, planers, and other special apparatus designed for finishing and fitting the minute pieces which go to make up the chassis. Other departments include the woodworking shop, where the bodies and tonneaus are built; the paint shop; and the upholstering room, where the padded lining and cushions are made.

If we were to follow the construction of one of the modern touring cars step by step, it would be necessary to visit the woodworking department and the blacksmith and machine shops, to study what might be called the preparatory work — the making of the parts from the raw material.

The Woodwork

The woodwork of an automobile requires as skillful artisans as those employed on landaus, broughams, and other high-grade carriages. In the framework of the tonneau, aluminum is now used considerably, to avoid weight as much as possible. Some of the French cars and models of the Packard design have tonneaus composed entirely of this metal with the exception of the upholstery; but in the majority of the American cars, wood for the panels is utilized. It may be unnecessary to say that the material must be carefully seasoned, since it is

Testing a Storage Battery for Ignition Apparatus.



BORING A TRANSMISSION GEAR CASE TO RECEIVE THE BALL-BEARINGS.

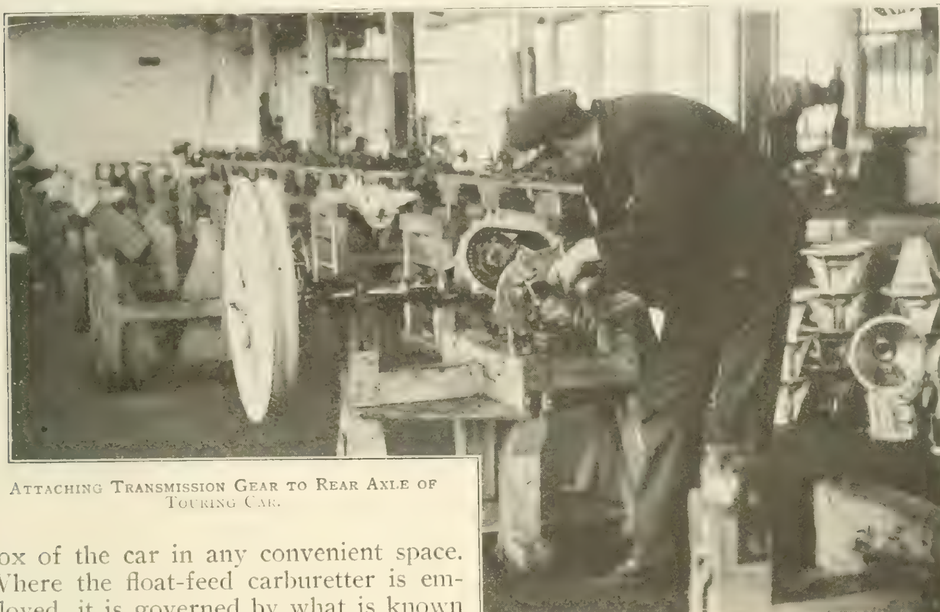
required to be bent to the exact shape of the model. Nearly all large establishments have a special plant for bending and seasoning the wood. The leather or cloth used for covering the interior of the tonneau is generally stuffed with hair, the outside being fastened to the wood by means of upholstery buttons or ornamental screws.

SETTING UP A 4-CYLINDER ENGINE FOR A TOURING CAR.

The Motor and Attachments

The amount of work required in building and putting together the engine obviously depends upon the kind used. In many of the ordinary touring cars, a four-cylinder engine of the vertical pattern is employed, the pistons having a stroke of about six inches. As the cylinders come from the machine shop, they are attached to the crank-case by bolts. In some designs the crank-case is made in two pieces for the sake of convenience, as, in case of repairs or for inspection, the case can then be quite easily removed. There are comparatively few parts to the engine proper when contrasted with its connections, but, as the engine is one of the weightiest parts of the automobile, it must be securely fastened together and firmly attached to the framework. Usually it is set vertically, and lengthwise to the framework, being mounted as far forward as possible while still allowing room for the ventilator.

The most delicate processes in connection with automobile making are the adjustment of the motor attachments, such as the spark system, the commutator, the carburetter, and the wiring and piping which are essential to operate them. Various ignition systems are utilized, and opinions differ as to the most practical one; but what is called the "jump spark," operated by means of the electric battery, is preferred by many manufacturers. The spark is regulated by a lever, the cells of the battery being carried in the box of the car in any convenient space. Where the float-feed carburetter is employed, it is governed by what is known as a "needle-valve" working in connection with a float of spun copper. The proper adjustment of the carburetter is perhaps the nicest point in the making of an automobile, as its proper arrangement is of the greatest importance.



Attaching Transmission Gear to Rear Axle of Touring Car.

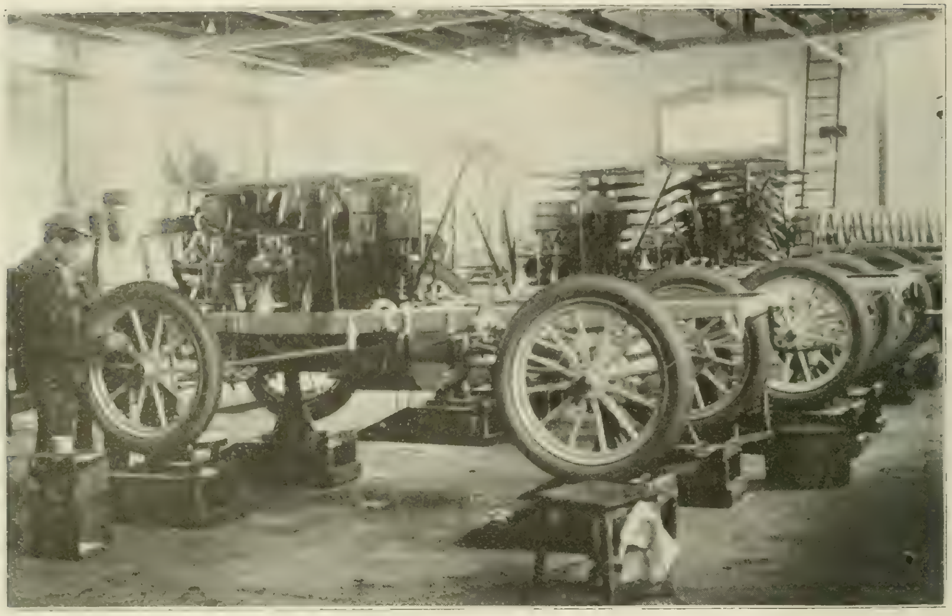
Another essential attachment to the motor is the lubrication apparatus. Usually the oil is fed by a simple plunger-pump driven by means of a worm gear, the latter being operated by the commutator shaft. As the modern touring car is used frequently for long-distance runs, provision is made for an ample supply of oil; and the reservoirs contain from two quarts to a gallon, naturally depending to a certain extent on the size of the automobile.

The framework of the chassis is usually composed of pressed steel of a high grade, having two side bars and at least four cross bars, the sections being fastened by heavy rivets. Since this framework supports most of the weight represented by the touring car and its occupants, special care is taken in its manufacture. Another item requiring close attention is the construction of the spring, which consists of three, four, or sometimes five leaves. There are a number of plants in the United States which confine themselves exclusively to making automobile frames, and which furnish them to touring car manufacturers ready for the transmission gear, the motor, and the other parts. The transmission gear is generally attached to the rear axle separately from the balance of the mechanism, so that when the rear wheels and axle are connected with the balance of the automobile this portion is practically ready for service.

Assembling the Chassis

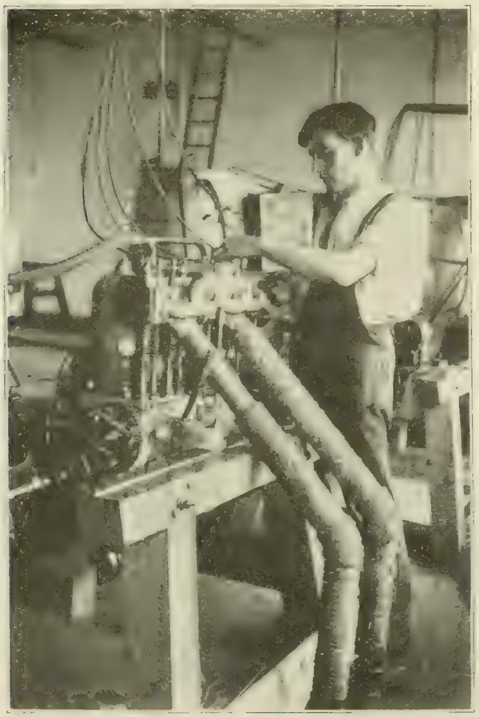
Really, the chassis of the ordinary touring car is assembled in two operations.

Adjusting Parts of the Carburetter, and "Setting the Spark."



COMPLETE CHASSIS OF PACKARD TYPE OF TOURING CAR.

First comes the installation of the engine and its direct attachments, and the connection of the transmission gear to the rear axle. With this operation completed, the next step is to complete the equipment of the chassis, which is usually done in a special department. The motor is swung into its proper position on the framework by means of hand or power cranes, and is bolted to its bed. Then the levers are set in place and the wheels slipped upon the axles. With a little brazing and wire connecting, the mechanism of the automobile is completed.



Making Shop Test of Motor and Other Running Parts.

Tests

The machinery is now ready for a service test, for, before being sold, it is fitted to an old body and run perhaps 50 or 100 miles over the highways, in order to make sure that every portion of the apparatus is in good condition. At the end of the run, it is given another inspection and any necessary alterations are made. Thereupon, finally, it is fitted with the body constructed for it.

The road trial, however, is but one of several tests which are given the machinery. For example, the engine is submitted to a test before being placed on the framework. It is operated for several hours, beginning with a small load, which is gradually increased until the maximum horse-power which it is intended to develop is reached. It may be said that the performance of a 20- or 22-horse-power engine is considered satisfactory when it develops its highest power at a speed ranging from 800 to 900 revolutions per minute. The test is usually made by connecting the engine to an electric generating unit or by attaching to it a "prony" brake.

As the different parts of the modern automobile can be manufactured simultaneously in large plants, a stock of the various sections is made up in advance and stored away, so that when the "busy season" arrives the company has so much finished material which it is necessary only to assemble to make practically ready for sale. In this way the output of a plant may be double its ordinary productive capacity.

PAINTING AND FINISHING BODY OF TOURING CAR.

"I'll Do What I Can"

WHO takes for his motto "I'll do what I can,"
  Shall better the world as he goes down life's hill;
The willing young heart makes the capable man,
  And who does what he can, oft can do what he will.
There's strength in the impulse to help things along;
  And forces undreamed of will come to the aid
Of one who, tho' weak, yet believes he is strong,
  And offers himself to the task unafraid.

"I'll do what I can" is a challenge to fate,
  And fate must succumb when it's put to the test;
A heart that is willing to labor and wait,
  In its tussle with life ever comes out the best;
It puts the blue imps of depression to rout
  And makes many difficult problems seem plain;
It mounts over obstacles, dissipates doubt,
  And unravels kinks in life's curious chain.

"I'll do what I can" keeps the progress machine
  In good working order as centuries roll;
And civilization would perish, I ween,
  Were not those words written on many a soul.
They fell the great forests, they furrow the soil,
  They seek new inventions to benefit man,
They fear no exertion, make pastime of toil —
  Oh, great is earth's debt to "I'll do what I can."

—ELLA WHEELER WILCOX.

Drafting Room Organization

Outline of a Drafting System for Standard Manufacturing

By ALBERT F. HEMINGWAY

IT is always of interest to manufacturing engineers when anything additional to the subject of systematic commercial drawing is brought to their attention. The development of a universal drawing process or system sufficiently general to meet all practical needs of manufacturing concerns, will likely come about at some future time, and this may form part of the engineering curriculum in schools and colleges, much the same as bookkeeping has been taught in commercial colleges for years.

The present is a period of standard manufacturing, and the tendency toward standardization is naturally growing, thereby creating a demand for different methods from those employed where the articles of manufacture were unsettled and undergoing ceaseless and uncertain changes. It is of course true that improvements in standard lines of manufacture will be continually required, but these changes take the form of revisions, to a greater or less extent, of designs that previously have been reduced to a fairly definite basis. The drawing office is where things are built on paper, and it is subject to a change of methods when approaching standard manufacturing as much as are the factory departments doing actual construction work.

To illustrate—the following list brings out a few of the essential features that usually appear for consideration in conducting a drawing office for developing specialized products:

1. The desirability of one uniform size of drawing sheet for all drawings.

2. The necessity of drawing parts independently of any mechanism to which they may belong, for the reason that any part is likely to be found available for use in the manufacture of a number of different mechanisms.

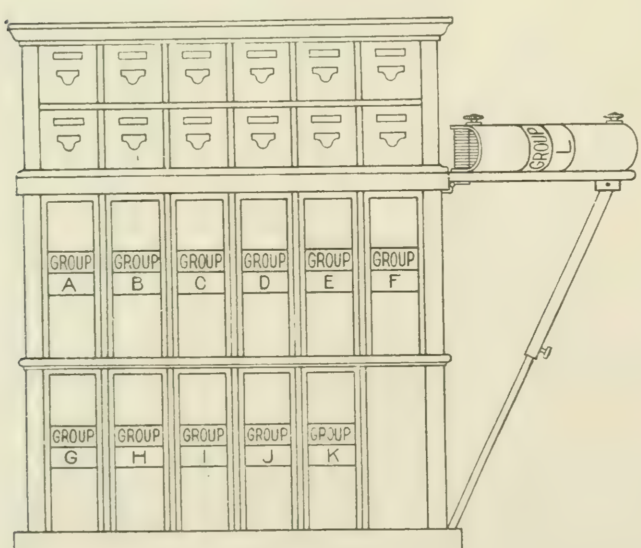
3. The necessity of knowing and being able to identify all parts by symbols.

4. A suitable system of drawing parts.

5. The necessity of classifying parts into groups or collections and grading them according to the primary operations that are required in forming them, or according to their elementary nomenclature or design.

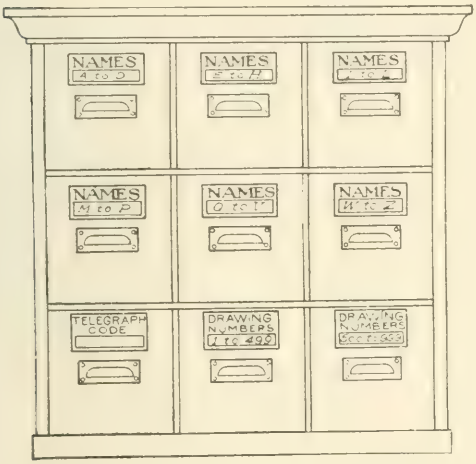
6. As parts and constructional views cannot be shown on the same drawing, some means must be employed by draftsmen to specify and identify the parts that are involved in a general drawing.

7. Once typical general drawings have been made, how is it possible to avoid the delay and expense that are inevitably attached to redrawing practically the same thing for the many modifications arising from time to time?



Cabinet Set Forming Portion of Part Drawing System.
Comprises, in the upper part, a card index; and in the lower part, a bound blue-print file containing records and drawings of finished material or parts.

Standard manufacturing may be looked upon as differing from special or miscellaneous manufacturing inasmuch as, under the former, parts take a system-



Section of Cabinet Set for Finished Products.
Contains material record list cards arranged alphabetically under names of mechanism, general view drawing numbers, and telegraph code for drawing office reference.

atic course from one set of machines to another until they finally become finished material.

Part and General Drawings

The work of constructing or assembling the various parts to form a finished product, involves an entirely separate office. General drawings are of service principally where assembling is done, while the part-producing departments, on the other hand, require but those drawings that give working dimensions of parts. It is therefore seen, that, so far as the uses of drawings are concerned, there is no occasion for showing parts associated with the finished mechanism, even were it possible to do so. Moreover, the fact that any single part may be found available in a variety of places, suggests the principle of showing parts collectively as a body of things having individual entity; and, if they are to be thought of as associated in some manner, it seems preferable to regard them as members of some group or collection.

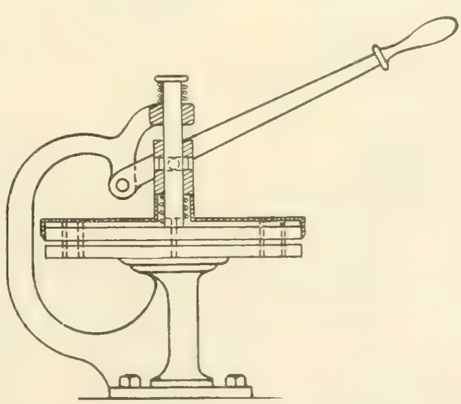
Where numerous parts are involved, the idea of drawing each of them separately on an independent sheet—which is a very general practice—incurs the disadvantage of a great collection of small sheets; whereas, by the use of a no less convenient but larger sheet, their number may be materially reduced by placing five to seven or more part views on the one drawing, arranging them, of course, according to their respective groups.

One uniform size of drawing sheet can be used, which is of great advantage in filing and binding blue-prints for circulation.

Symbols

Symbols for parts usually take the form of numbers, with characters or letters annexed which signify the association of the parts. Each and every part is numbered in numerical sequence; and in the present instance, letters may be annexed which signify the group of which the part is a member, and the groups established according to the basic operations by which they are first formed. This is illustrated by the following list:

Cast Metal Parts.—*Group Symbol, A.*
All parts originally formed by moulding or casting, and which are not magnets.

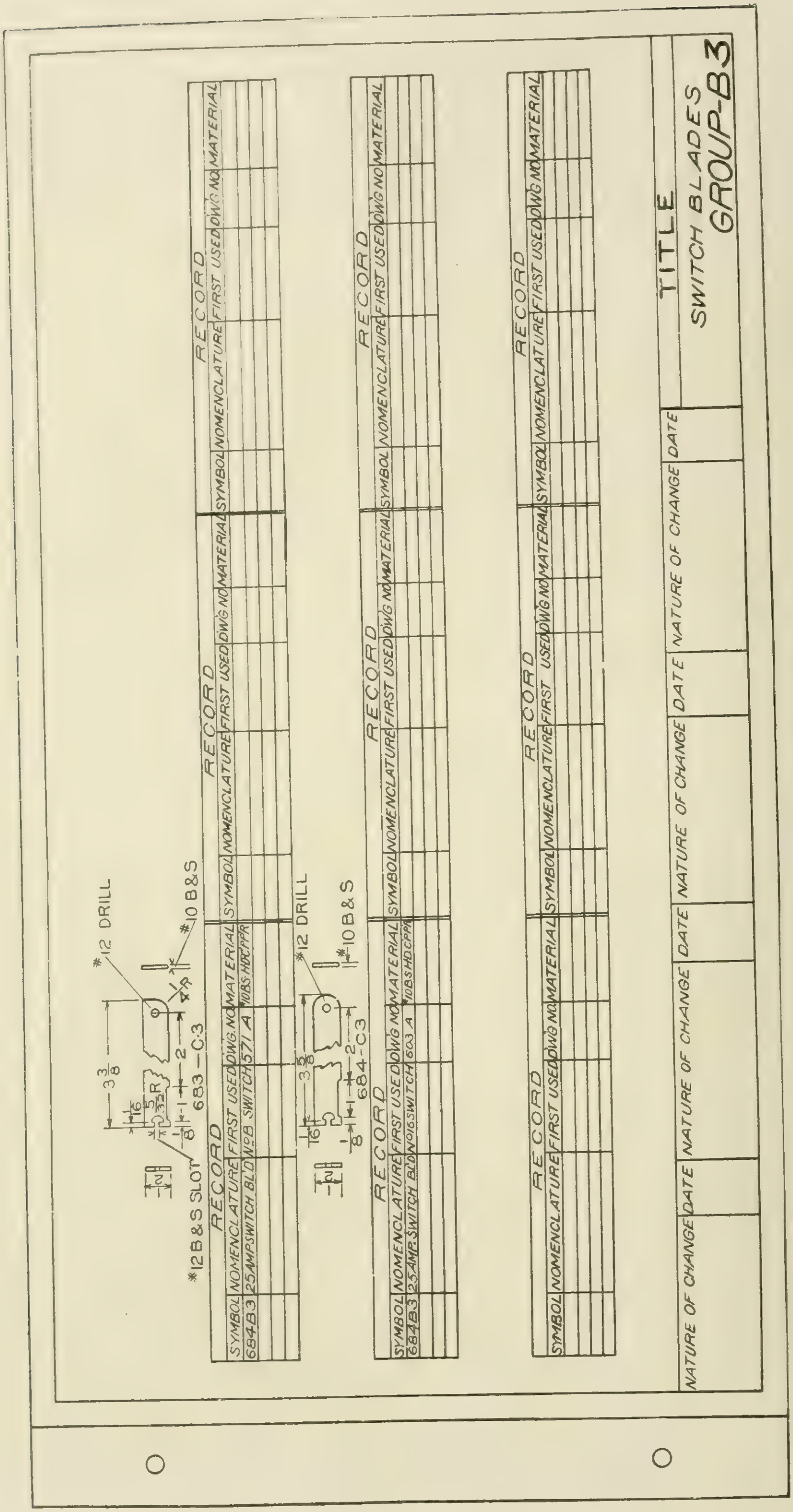


Trimmer and Punch-Press.

One advantage in employing a single standard size of sheet for part drawings is that the blue-prints can be machine-trimmed by a lightly constructed punch-press, which at the same time will pierce the holes for binding.

Sheet Metal Parts, Die Formed, etc.—*Group Symbol, B.*
All parts originally formed from sheet metal by puncturing, shearing, spinning, stamping, etc., and which are not magnets.

Machine-Formed Parts.—*Group Symbol, C.*
All metal parts machine-formed in lathes, shapers, milling machines, screw machines, threading and tapping machines, etc., such



SPECIMEN PART DRAWING.

parts being made from raw material in the shape of rods, bars, tubes, plates, etc., and which are not magnets.

MAGNETS.—*Group Symbol, D.*

Cores of electro-magnets, armatures, pole-pieces, and shoes, frames, permanent magnets, shells, yokes, etc.

INSULATORS.—*Group Symbol, E.*

Tubes, strips, bushings, collars, handles, knobs, etc., of porcelain, glass, rubber, fiber, wood, paper; fabrics or parts made of other material for insulating purposes.

COILS.—*Group Symbol, F.*

Electro-magnet coils, resistance coils, condenser coils, or current-carrying coils of any nature; to comprise only the coil governed by its winding measurements, size of wire, number of turns, resistance, grade of insulation, and material wire is made of.

FORGED OR WROUGHT PARTS.—*Group Symbol, G.*

All parts such as hooks, rivets, rings, wire springs, which are made of wire and which are not resistance coils; supports, brackets, fixtures, and all such parts, which are hand-formed, forged, or wrought, and which are not magnets.

WOODEN PARTS.—*Group Symbol, H.*

All wooden parts such as strips, pins, blocks, bases, moulding, ornaments, knobs, and brackets, which are not used for insulating purposes.

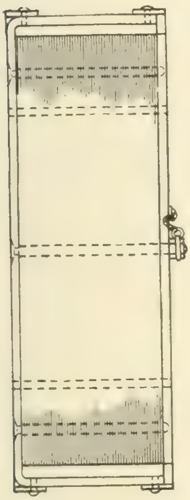
COMPOUND PARTS.—*Group Symbol, J.*

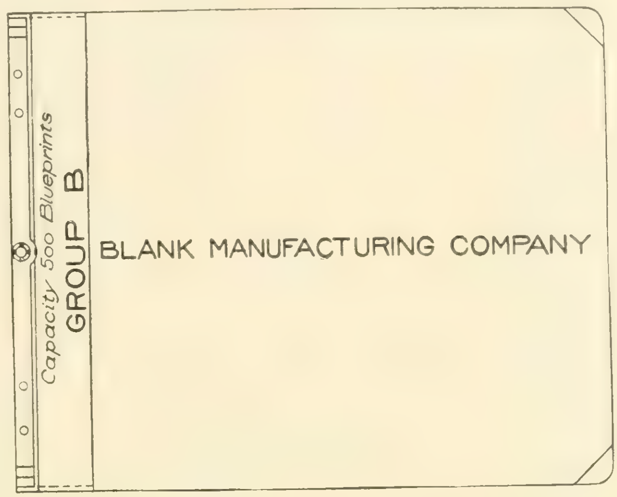
All parts consisting of more than one member, where it is necessary to join them to produce the part as completed material ready for assembling.

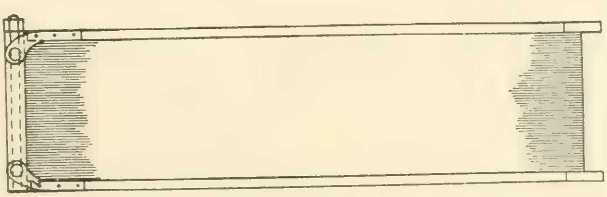
PURCHASED ARTICLES.—*Group Symbol, K.*

All articles such as locks, door or drawer knobs, fixtures, receptacles, and ornaments, which are compound parts, being purchased, not manufactured.

The above classification enables an intelligent analysis of the parts to be made, placing them in their respective group order according to the directions or codifications given.





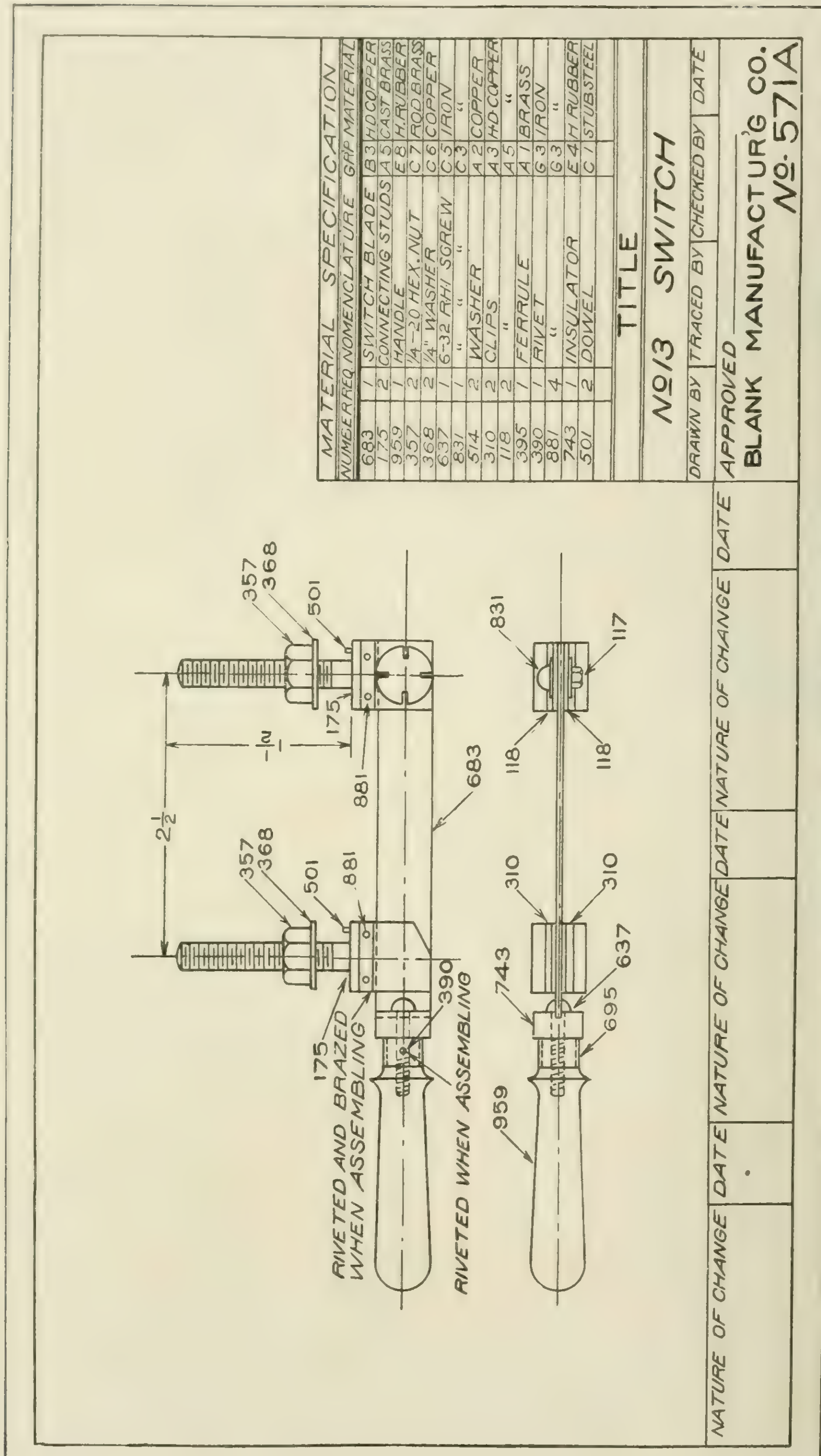


DETAIL OF BLUE-PRINT BINDER DESIGNED FOR PART DRAWING SYSTEM.

The binding clasp is independent of the covers, which are hinged and can be opened clear back, allowing free access to the prints. Any print can be removed or inserted at any point, and the binder conveniently rejoined by use of a combination key and guide.

The drawings of each set exhibit a convenient number of part views, and the title of each sheet indicates the name and group of the parts it contains. The sheets are numbered serially, beginning each set with *No. 1,* the number increasing by one for each successive addition.

If, for illustration, the number portion of a part symbol is *368,* then, in order to signify its groups and still more its drawing, we might write *368A3,* which means that the part belongs to the *A* group (Cast Metal Parts), and is shown on the third drawing of the series.

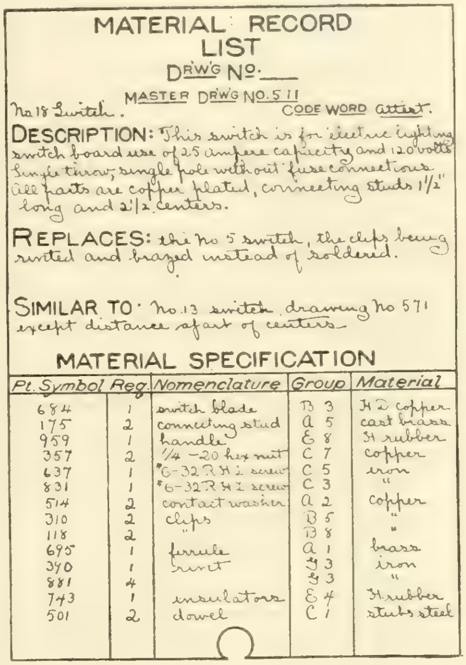


SPECIMEN GENERAL VIEW DRAWING.

Material Lists

Where articles of manufacture are repeatedly reproduced, as is the case in standard manufacturing, and where, as often occurs, they are, for various reasons, not made in all cases just exactly alike, there is involved the question as to how far the reproduction of general view drawings should be carried. A record at least is necessary of each article, just as it is built. The old and familiar but serviceable plan of employing material lists, developed through the use of part symbols, etc., serves admirably in combination with a typical or master drawing. Such lists enumerate the various parts used in each mechanism; and when the construction changes, it must occur through a change in the combination of parts. Therefore, when the parts are enumerated there can be no mistake about the construction. To illustrate the use of such lists, let us assume the instance of a switch which is represented by a general drawing and called the "No. 13 Switch." Occasion later arises for a modification, say in the distance between stud centers. This will require a different blade, which is practically the only difference between the switches. The material record list shown in the accompanying illustration fully serves the purpose, as it reveals and identifies the component parts which, accompanied with a master drawing, furnish complete manufacturing data.

The "Material Specification" portion of the record card is in form a duplicate of the material list appearing in general drawings, being used for the same purpose—that of identifying the parts involved in a convenient tabulation.


MATERIAL RECORD LIST

DRW'G NO.___

No 18 Switch. MASTER DRW'G NO. 511 CODE WORD attest.

DESCRIPTION: This switch is for electric lighting switch board use of 25 ampere capacity and 120 volts single throw, single pole without fuse connections. All parts are copper plated, connecting studs 1½" long and 2½ centers.

REPLACES: the No 5 switch, the clips being riveted and brazed instead of soldered.

SIMILAR TO: No. 13 switch, drawing No 571 except distance apart of centers.

MATERIAL SPECIFICATION

Pt. Symbol	Req.	Nomenclature	Group	Material
684	1	switch blade	B 3	H D copper
175	2	connecting stud	A 5	cast brass
959	1	handle	E 8	H rubber
357	2	¼-20 hex nut	C 7	copper
637	1	#6-32 R H I screw	C 5	iron
831	1	#6-32 R H I screw	C 3	"
514	2	contact washer	A 2	copper
310	2	clips	B 5	"
118	2	"	B 8	"
695	1	ferrule	A 1	brass
340	1	rivet	G 3	iron
881	4		G 3	"
743	1	insulators	E 4	H. rubber
501	2	dowel	C 1	stubs steel

MOUNT ST. HELEN'S, WASHINGTON.

Height, 9,750 feet.—One of the highest peaks of the Cascade Range.—Situated in the southwestern part of the State.—Said to have shown signs of activity in 1843.

MOUNT JEFFERSON, OREGON.
Situated 75 miles southeast of Portland.—One of the peaks of the Cascade Range.—Height, 10,200 feet.

Our Volcanoes

Are They Still To Be Feared?

By JOHN ELFRETH WATKINS

THAT forecasting of volcanic eruptions will soon become an exact science, savants are now promising the people of the earth. Such a consummation were devoutly to be wished, indeed. Timely warnings, admitting of a general exodus from such localities as the cities in the shadow of Mont Pelée or Mount Vesuvius, would be worth centuries of worldwide preparatory research.

For forty years there has been a seismic observatory near the crater of Vesuvius; and since 1892 the French have maintained a similar station on Mont Pelée, in the West Indian island of Martinique. It is true that this latter institution was of little practical benefit at the time of the outburst of 1902. In a former article, "Our Earthquake Survey" (see THE TECHNICAL WORLD for March, page 36), were described the seismographs lately distributed over our domain by the Government. These delicate instruments are of as great value in the study of volcanoes as in that of earthquakes. These two dreadful phenomena are, indeed, so closely interrelated that science hesitates as to which is the cause and which the effect. Great volcanic outbursts, however, are generally preceded by slight earth tremors readily detected and recorded by seismographs.

The Government having installed all of the tools essential to the forecasting of volcanic eruptions, the next question to be considered is the probability of such catastrophes within our territory. As explained in the article referred to, our seismographs are in place in government observatories situated in the District of

SUMMIT OF MOUNT HOOD, OREGON.
Height, 11,934 feet.—This peak, visible from the city of Portland, from which it lies far to the east, is one of the most celebrated summits of the Cascade Range.

Columbia, Maryland, Kansas, Alaska, Porto Rico, Hawaii, and the Philippine Islands. Our continental domain lies within the very center of the earth's great volcanic belt, which is distributed to our north as well as to our south.

"Are we especially favored by Providence, or is our time yet to come?" This is the question which the writer has lately passed about among our great corps of official geologists.

Earth's Fire Belt

Lying dormant along our western coast are many volcanoes, forming the center of a great volcanic belt which begins at Tierra del Fuego, creeps upward along the western coast of South America, through Central America, and into Mexico, where it broadens so as to cover our Pacific coast ranges. Thence it ascends along the shore of British Columbia, skirting Alaska, and passing over Bering Sea to descend along the Oriental coastline of the Pacific and its outlying fringe of islands, through Japan and the Philippines to the more southerly islands of the Malaysian, Australasian, and Polynesian archipelagoes. The volcanoes of the West Indies are offshoots from this great chain of fire, which embraces also the craters rising from the bed of the mid-Pacific. In the West Indies, in Alaska, in the Philippines, cones strung on this long string are breathing fire; but within Uncle Sam's domain a peaceful quiescence obtains, and why?

Is the United States Exposed?

"There is a possibility that our volcanoes will again become active, but the probability is slight in the light of science," said Geologist J. S. Diller, of the United States Geological Survey. Of course we cannot predict such phenomena, for it must be remembered that previous to the year 63 A. D., Vesuvius was not recognized by the Greeks and Romans as an active volcano. The summit was then a large crater, for centuries looked upon as extinct. Disturbances, however, were renewed, culminating in the historic disaster of the year 79, which destroyed Herculaneum and Pompeii.

"There is now some volcanic activity in the United States proper," added Mr. Diller. "Close to and at the southern edge of Lassen Peak, California, there is a spot known as Bumpus' Hill. It emits hot, sulphurous gases, which in places bubble up through boiling mud pools. A short distance east of the same locality there is another small, boiling mud lake. Once there was great seismic activity in the large volcanic field stretching from Yellowstone Park to Mount Rainier, and embracing large parts of Washington, Oregon, Idaho, and California. This field was particularly active during the Miocene period, but this was many thousands of years ago. From that time the activity has been gradually diminishing, and probably ceased only within the past two centuries. Generally, volcanic action wears itself out, but it not infrequently happens that it repeats itself."

Within our continental domain, according to Prof. I. C. Russell, who carefully studied the Martinique catastrophe, there are numerous craters still steaming.

Mount Hood, which bears to Portland, Oregon, the same relation which Vesuvius bears to Naples, has lately been observed to be dotted at the top with steaming jets and other openings, the sulphurous fumes from which are sometimes so strong as to be overpowering, while able to discolor silver at a distance of half a mile from where they issue. Clouds frequently collect in the shelter of Mount Hood's majestic peak; and from time to time these give rise to fear of an eruption. But no such event has taken place at its crater within the memory of man.

In California there are signs of lingering volcanic life. In the center of Mono Valley, at the eastern base of the Sierra Nevada, lies Mono Lake, a body of intensely alkaline water. In this lake are two islands, on the larger of which—a volcanic crater—hot springs bubble up, while many orifices exhale hot vapors. These phenomena are remnants of volcanic energy. The smaller island is a partially submerged crater which bears evidences of having been in eruption at a recent date. To the south of the lake rises a range of volcanoes, known as the Mono Craters—more than twenty in number.

Mount Rainier, the best specimen of a single peak within the United States proper, which rises practically from sea-level near Tacoma, is a volcano more

CRATER LAKE, OREGON NATIONAL PARK.

This remarkable sheet of water, 6 miles long by 5 miles wide, and nearly 2,000 feet deep, lies at an elevation of 6,238 feet in the crater of an extinct volcano. Its shore-line consists of almost perpendicular cliffs 1,500 to 2,200 feet high, from whose crest-line there is a descent away from the lake on all sides. The lake is fed by springs and has no visible outlet. Near its western side, a basaltic cone projects from the surface as an island.

MOUNT ADAMS, WASHINGTON.

A peak of the Cascade Range, 9,570 feet high, southeast of Mount Rainier, in the central southern portion of the State.—It has not been in eruption within historic times.

probably dormant than dead. Geologist F. M. Emmons, of the United States Geological Survey, says that when he climbed it in 1877 he found upon it evidences of internal heat at no great depth below the surface. He saw issuing countless jets of steam and gas, varying in size from a pin-head to an inch in diameter, all coming out of the crater's rim. Near these the ice was melted so as to form hollow caverns large enough for himself and his companion to enter and warm themselves. These same phenomena were observed by Mr. E. C. Smith, who took a daring party to the summit in 1893.

A French Canadian told Mr. Emmons that Mount St. Helen's in Washington State, sixty miles north of Mount Hood, was in active eruption during the winter of 1841-42, and that the light from its crater was then so intense that at a distance of twenty miles one could see to pick up a pin in the grass at midnight. With the aid of his field glass, Mr. Em-

MONT PELÉE IN ERUPTION.

This view from Martinique, French West Indies, was taken in June, 1902, some weeks after the outburst of the preceding month which destroyed the capital city, St. Pierre. It graphically portrays the tremendous power and awful grandeur of the pent-up forces which from time to time have altered the configuration of the island.

DISTANT VIEW OF MOUNT RAINIER, WASHINGTON.
This snow-capped peak, sometimes known as Mount Tacoma, lies southeast of the city of that name. It is 14,526 feet high—the highest elevation in the State. In the foreground are minor peaks of the Cascade Range.

mons distinguished the apparent track of a lava flow which had cut its way through many miles of the forest on the mountain side. Lava has flowed nor.h for twenty miles, and in some places has passed through forests of fir, coiling about large trees and taking exact casts of their charred trunks.

Mount Baker, in the State of Washington, the most northerly volcano in the United States proper, was in eruption in 1843, according to the testimony of natives, as well as of officers of the Hudson Bay Company. In that same year, Mount St. Helen's is said to have been in eruption again, covering the whole of the neighboring country with ashes. The Skagit river, near by, was obstructed, and all of the fish therein are said to have died. Indeed, as one contemporary puts it, "the country was on fire for miles around."

Mount Adams, near Mount St. Helen's, in Washington, is another of our great volcanoes, but it has not been in eruption within historic times. Mount Pitt, in southern Oregon, bears the remnant of a crater at its snow-covered summit, and has openings at its sides from which lava has flowed in years past. The Three Sisters and Mount Jefferson, to the north of Mount Pitt, are ancient volcanoes; while Mount Mazama, also in Oregon, bears in its burned-out funnel Crater Lake, a cavity six miles in diameter, filled with water 1,975 feet deep and 6,239 feet above sea-level. This lake is surrounded by nearly vertical walls, in some places 2,200 feet high, making the great cavity from rim to bottom more than 4,000 feet deep.

The Cinder Cone, a volcano ten miles northeast of Lassen Peak, California, is said to have been in eruption as late as January, 1850; but Geologist Diller has made an investigation of this crater which proves to his satisfaction that its latest outbreak was before the beginning of the nineteenth century.

Mount Shasta, the great volcano of northern California, is known to have been alive 300 years ago. During one of its eruptions it sent forth a great lava stream in two branches. One of these was twelve miles in length. The other entered the canyon of the Sacramento river, and extended for a distance of fifty miles before cooling. This flood of lava displaced the river, but the latter has partially refilled its ancient channel.

ON A CRATER'S BRINK.

Fascinated by the wild and awful grandeur of the sight, men will risk their lives to gaze into the frightful depths.

In southeastern Idaho there are two or three small, extinct craters. In Utah, 125 miles south of Salt Lake City, there are several others that once burst from the bottom of Lake Bonneville, which, during the Pleistocene period, thousands of years ago, flooded the now low and arid valleys of Utah.

In Nevada, twenty-two miles south of Wadsworth, are remnants of volcanoes in the form of extinct craters filled with a strongly alkaline water still bubbling from some mysterious source in the bowels of the earth. These are known as the "Soda lakes."

The volcanic chain shows itself in New

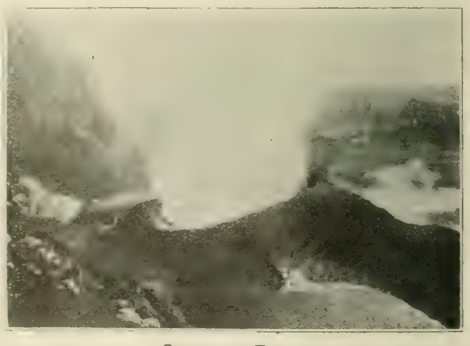
THE CINDER CONE, CALIFORNIA.
Situated near Lassen Peak in the northeastern part of the State.—It is said to have been in eruption in 1850.

Mexico at Mount Taylor, and in Arizona at San Francisco Mountain, both of these volcanoes, however, being long extinct.

In Central America twelve were said to be active in 1902, while nineteen others were reported as in quiet eruption. In Mexico there were outbursts that year, simultaneous with the Martinique disaster. In Alaska, according to Geologist Becker, forty volcanoes have been in eruption within historic times.

Activity in Alaska

Twenty-five of the Aleutian Islands, stretching well across the Pacific on the southern border of Bering Sea, now show signs of activity in their craters. Mount Wrangell, Alaska, was in eruption in 1819, and still sends forth a column of steam. Iliamna, on the west coast of Cook's Inlet, awakened from a period of repose in 1778, and has since kept in a



CRATER OF TAAL.
This volcano, formerly of great height, but reduced by eruption to an altitude of about 900 feet, rises as an island from the center of Laguna de Taal, 34 miles south of Manila, Luzón. Its crater, about two miles wide, contains several lakes of molten matter displaying most wonderful changes of coloring

state of mild activity. Within the past thirteen years, this volcanic peak has been known to kill timber over hundreds of square miles.

Mount St. Augustine, another of Uncle Sam's volcanoes on Cook's Inlet, went into violent eruption in October, 1883, causing a tidal wave thirty feet high, which deluged houses in the village of Alexander. Geologist Dall, of the Survey, says that he saw a cloud of steam issuing from its crater in 1895. At the same time, Bogoslof, in Bering Sea, went into eruption.

MOUNT SHASTA.
A volcano of northern California, said to have been in eruption three centuries ago.—Height, 14,380 feet, one of the highest peaks in the United States,

Our Pacific Islands

Uncle Sam annexed a monarch of modern volcanoes when he put the Hawaiian Islands under his flag. Kilauea is the greatest active volcano in the world, and its fiery lakes are among the modern wonders of the world. This great volcano is in constant activity, and it is but one of many scattered among the Hawaiian group. Active volcanoes are also found throughout the Philippines, the most notable of these being Mayón and Taal, in Luzón, and Apo in Mindanao. Violent earthquakes are frequent in our new Oriental possession. In 1863-64 the entire province of Zamboanga, Mindanao, was fearfully devastated. Mayón and Taal are in almost constant activity. In May, 1897, the former

MAYÓN, THE PHILIPPINE VOLCANO.
This great volcano, also known as Albay, is located in the province of that name in Southern Luzón. It is extremely regular in form, rising gradually from a base about 50 miles in circuit, and attaining a height of 8,234 feet. A destructive eruption occurred in May, 1897.

showered red-hot death-dealing lava like rain over a radius of twenty miles. Bulusan, in the extreme south of Luzón, resembles Vesuvius in appearance, but is almost extinct.

The Atlantic Plain

There are no evidences of recent volcanic activity in the central and eastern portions of either the United States or Canada. Recently there were reports of

"LAKE OF FIRE, CRATER OF KILAUEA, HAWAII.
Kilauea (elevation, 4,040 feet) has an oval-shaped crater nine miles in circumference and 1,000 feet deep, ranking as the largest active volcano in the world. The remarkable "Lake of Fire" here shown affords at night a scene of indescribable grandeur with its kaleidoscopic color effects.

an outburst in Nebraska, but Geologist Barton, of the Survey, who has lately studied that region, tells me that this was but a bank of lignite coal, set afire either by lightning or by spontaneous combustion.

In early geologic times there were active volcanoes all along our eastern coast. These were located chiefly on the axis of the Blue Ridge Mountains, and in other old ranges now composed of the most ancient crystalline rocks. It is probable that the most recent eruption occurred near Meriden, Conn. Some of these craters are found also in the vicinity of Boston, and along the coast of Maine.

None of these ancient craters, however, will ever become active again unless an earthquake of great power shall lay open rocks now hiding fiery furnaces which, although they have long been sealed by time, may yet lie smoldering beneath us.

STONES AND LAVA THROWN UPWARD BY SUDDEN ERUPTION OF MOKUAWEOWEO, IN JULY, 1904.
This crater forms part of the great volcano of Mauna Loa (13,675 feet high), on the island of Hawaii, the largest and most southerly of the group of islands bearing that name. It is only intermittently active.

The majority of seismologists are coming to the belief that earthquakes cause volcanoes, rather than that volcanoes give birth to earthquakes. The researches at the Government's new seismic observatories may throw some new light on this problem.

GATEWAY TO THE OLD HOMESTEAD.

In this picture, an attempt is made to convey a sense of direction and to arouse an emotion of tender sentiment, as when a homesick heart turns in thought to old scenes. Note that all the principal masses and all the dominant lines point toward the vague screen of foliage in the distance, behind which, we may fancy, lies the old homestead of our childhood days. The feeling of tenderness is prompted—at least much encouraged—by the sumptuous detail of the foreground and by its wealth of tonal beauty and variety. The half-tone screen, of course, eliminates much of the delicacy of the original.

Principles of Artistic Photography

Manipulative Work—Development of the Exposed Plate

Third Paper*

By LOUIS A. LAMB

Editor, *Pit and Post*

ONCE the worker has acquired skill in the choice and arrangement of subjects, and facility in the use of his apparatus, it remains for him to gain skill in those operations which lie without the province of the optician and the instrument-maker. First—and most important of all—comes the development of the latent image in the gelatino-bromide film of the plate. Volumes might be added to the libraries of nonsense already written concerning this part of the craft. We might advise the use of a multiplicity of trays, with graded solutions ranging from pure water to the most concentrated of developing solutions; or we might applaud the merit of "stand development," in which plates are left for hours on edge in tanks containing the weakest possible developing solutions; or we might expatiate on the great efficacy of half a hundred patent reducing agents of the coal-tar series, used singly or in an infinite variety of mixtures—but it would be of no avail.

Machine Development

After all is said and done, the fact remains indisputable that the modern method of development is the cheapest, the simplest, the surest, and the best, because it eliminates entirely the "personal equation," obviates all the variables of the old school, and, within the exposure coefficients of any given plate, produces

SCYLLA AND CHARYBDIS.

One of the loveliest and most impressive pictures at Niagara is that which is reproduced in this vigorous photograph. The beauty of the picture lies in its fine characterization of elemental fury on the one hand, and elemental repose on the other. The feeling in the middle distance is very delicate.

*NOTE.—The next paper will deal with special photography, "dodging," and printing processes. The first and second papers of this series appeared in February and March respectively.

THE EVER-SHIFTING SHORE.

A portion of the Chicago water-front. This is a fair type of the pictures which must be taken for "record" purposes. The essential is accuracy, but it does no harm to embody as much beauty as possible.

the best possible negatives, absolutely without aid or interference by the photographer.

What is known as "machine development" proceeds upon the principle demonstrated by Messrs. Hurter and Driffield in England—namely, in brief, that the character of the deposit in a negative is a function of exposure, and not at all a function of the process whereby silver bromide is reduced to the metallic state. In other words, these men demonstrated by experiments ranging over thousands of cases and during ten years of incessant investigation with refined photometric apparatus, that *a standard developing solution gave ideal results regardless of the period of exposure, provided only that the time was within the "latitude" of the plate.* Widely different exposures, indeed, gave negatives of very unlike appearance; but the difference was found to be merely in the density or opacity of the deposit, not a difference of gradation, hence not such a difference as would yield unlike results in the printing frame. To use a musical analogy—it was found that exposures differing by a constant ratio, if developed in the same solution, at the same temperature, for the same length of time, gave negatives precisely similar in scale though starting from different keynotes. That is to say, the plate of briefest exposure afforded a negative of slight opacity, but of correct tonal progression; the plate of normal exposure gave a negative of perfect gradation, and of sufficient opacity for any kind of printing in the minimum of time; and the plate which was given a double over-exposure also yielded a negative correct in scale, but of such general density and opacity as to be inconveniently slow in printing, though otherwise as good as either of the others.

Latitude of Plates

Inasmuch as the latitude of commercial dry plates may be shown to be at least twenty points above and below the normal, it is obvious that the Hurter-Driffield system may be used advantageously even by the veriest tyro, and with great economy of time and labor by the professional photographer. However, the real truth is that plates usually have much more than forty points' latitude. Though it is not safe to indulge in the folly of under-exposure, over-exposures have lost most of their terrors to those who employ the "machine method" of development and subsequently apply suitable chemical reagents for the reduction of the opaque image.

In the practical application of the Hurter-Driffield method, the worker has three constants and one variable to deal with—the developing solution, its temperature, and the duration of its action, being constant; and the exposure of the plates, being variable within the latitude of the brand.

Function of Bromides

We cannot too strongly deprecate the usage almost universally indorsed in books on photography, of adding Bromide of Potassium to the developing bath "to clear up the shadows"—meaning to keep the glass clear in the shadow parts of the image. The function of bromides in lantern-slide work and in processes requiring the production of clear-line negatives is to suppress the subtle half-tones and gradations which are the soul and life of a negative for use in pictorial or record photography. Bromide is worse than useless in ordinary work, and its use explains most of the hard and harsh pictures in the print album of the amateur.

LIONS AND CAMPANILE.
Here we have a treatment of a street scene (Michigan Avenue, Chicago, opposite the Lake front) different from that shown in the Tremont Street view (Boston) illustrating the March paper (see page 60). The disposition of lights and darks is very effective in this as in the other view.

Formula for Developer

An ideal developing solution for general work is compounded in the following proportions:

Pure Water	8 ounces.
Dried Sulphite of Soda	80 grains.
Dried Carbonate of Soda	55 grains.
Dry Pyrogallic Acid	14 grains.

This solution should be used at 65 degrees Fahrenheit, and the plate should remain immersed for six minutes, except in case of gross excess in the exposure, when longer immersion will be required.

The Ruby Lamp

Equally futile is the practice formerly insisted on, of examining a negative by ruby light, during the process of development. Bromide of silver is sensitive to light of all kinds, though not as sensitive to red, yellow, and green as to blue and violet. Even the dim red light

THE SNOW-BOUND CORN.

Here we have a picture in the flat, depending not so much on tonality as on the decorative suggestion of the masses and the graceful occupation of the space. The obvious intention being to lead the eye of the beholder to the distance, where the hospitable farm house nestles in the trees, we have focused sharply on the horizon line, at the point of convergence of the pictorial elements.

of the dark room lamp, if allowed to act too long, will degrade the whole image. But the prime objection to any meddling with the plate after it is immersed in the Pyrogallic Acid solution, is that it is wholly ineffectual, for the proof is overwhelming that nothing can be done to modify the reduction of the silver image after the action has begun. If a grave error of exposure is suspected before the plate is immersed in the developer, it is possible to remedy it, in part, by proper treatment; but no such modification can take place after reduction begins.

It follows, therefore, that the developing tray should be covered and protected from all kinds of light throughout the period of action, nothing being required except gentle rocking to prevent possible unevenness of development. Even this may be omitted if the solution be carefully filtered before using, and if a sufficient quantity be used to cover the plate completely.

Every beginner should satisfy himself of the truth of all we have said, before going farther. Expose three plates of the same kind, with the same stop, and in the same light, giving one a normal exposure, another only half the right time, and the other twice or four times as much as conditions require. Mix a sufficient quantity of developer for three plates, and divide it into three portions, so that each of the plates may have fresh solution free from bromides and from the products of decomposition which would affect the result if the three plates were developed in succession in the same solution. Have the solution at 65 degrees, and let it act on each plate exactly six minutes by the watch, in total darkness. Rinse each of the plates in cold water to remove the alkaline pyro solution, and transfer to a fixing bath of acid hyposulphite. When the yellow emulsion disappears, wash the negatives in running water for fifteen minutes; swab the surface of each with a tuft of wet absorbent cotton, to remove dirt and lint; and place them on a drying rack. If the negatives dry at a constant temperature and in the same time, they will be found to be almost identical in quality.

MORNING MISTS.

This is a study in tonalities, and the values of the original are exceedingly fine, though in the process of reproduction some of the fineness is lost. As a problem in repeating vertical lines, the picture is interesting.

To determine which of the three is best, it will be necessary to make a further comparison in the printing frame, and in all likelihood the choice will finally be determined by the time required to produce a standard tint in the high lights, without undue blacking up of the shadow parts.

Besides proving the value of machine development, such a test will give the novice valuable data on which to base future exposures in the camera.

Rules for Developing

The rules for developing may be generalized in five sentences:

1. Adopt a standard developer, and stick to it, without variation of its proportions, throwing it away after using once.

2. Develop at a constant temperature, and for a standard period to be determined once for all as best for each brand of dry plate.

3. Develop in total darkness, or cover the tray.

4. Develop as many plates as you can conveniently in the tray at one time; but do not use the same developer for more than one lot of plates, if uniform results are desired.

5. Use an abundance of developer; use good chemicals; and determine temperatures with a thermometer, not by guess.

Fixing Plates

Fixation, too, calls for a few rules, as follows:

1. Use an acid bath of constant strength, or capable of dissolving the yellow emulsion in a constant time. Maintain the bath at this strength by adding fresh solution as necessary.

2. Filter the fixing bath occasionally to remove bits of gelatine and other dirt, throwing it away when it becomes much discolored.

3. Allow plates to remain in the fixing bath at least twice as long as is necessary to dissolve away the yellow film.

A CAST FROM SHORE.
The charm of this photograph, that which most delights the beholder, is the swing of all the lines and masses toward the distant Izaak Walton of the Fox River. Besides this, the darks and lights are well grouped and balanced.

Washing Plates

Washing is an important process, for on it depends the permanency of the negative:

1. See that the water is cold. If it is not convenient to wash in running water, the same result may be gained by soaking the plate in frequent changes of water in a tray or basin. Half an hour is ample time for washing in running water; and a dozen changes will suffice.

2. Dry negatives on edge, in a well-ventilated place, free from dust, and with a temperature as nearly constant as possible. Drying should progress uniformly and without interruption, otherwise inequalities of density are likely to result.

Doctoring Plates

Automatic development involves a certain facility in the use of reducers and intensifiers, since it is virtually impossible to avoid all errors of exposure. Now and then a negative will be too dense or too thin. The best time for "doctoring" is after washing and before drying. If

FLIGHT OF THE GULLS.

It is obvious from this picture that *position* is very expressive of motion. The forward yacht, sailing out of the space and the close pursuit of the larger boat, instantly suggest wind, speed, momentum, dash, excitement, transition—in fine, a race! Which was the object to be attained.

the negative is too opaque all over, a few grains of Potassium Ferricyanide and an equal amount of Hyposulphite of Soda crystals may be dissolved in water enough to cover the plate. The action should be very closely watched, and, when proper reduction is accomplished, should be stopped by washing under the water faucet. To avoid overdoing the reduction, have the ferricyanide solution very weak—merely a pale yellow color. This solution is very poisonous and deteriorates rapidly; hence it should be made up only as needed, and thrown away as soon as used.

In cases of under-exposure, the high lights often develop out with excessive density, making harsh prints. Such negatives may be improved by reduction in a solution of Persulphate of Ammonium, 15 grains to the ounce. To stop the action, soak the reduced plate in a weak Sulphite of Soda bath, and thoroughly wash before drying.

Intensification is necessary for weak negatives, free from fog and rich in detail, but wanting in opacity. The image is first bleached out in a saturated solution of Bichloride of Mercury, and the negative washed. It is then soaked in a weak solution of Sulphite of Soda, or of common ammonia water, until blackened. A subsequent thorough washing completes the process.

Various chemical intensifiers are sold in one solution, and, as a general thing, they give good results if the operator is careful to use them as directed.

(To be continued)

HELIOGRAPHING DOWN A VALLEY.

Japanese Signal Service

The Application of Science to the Art of War, and the Resulting Increase in Efficiency as Demonstrated by the Japanese in Contrast with the Russians

By M. C. SULLIVAN

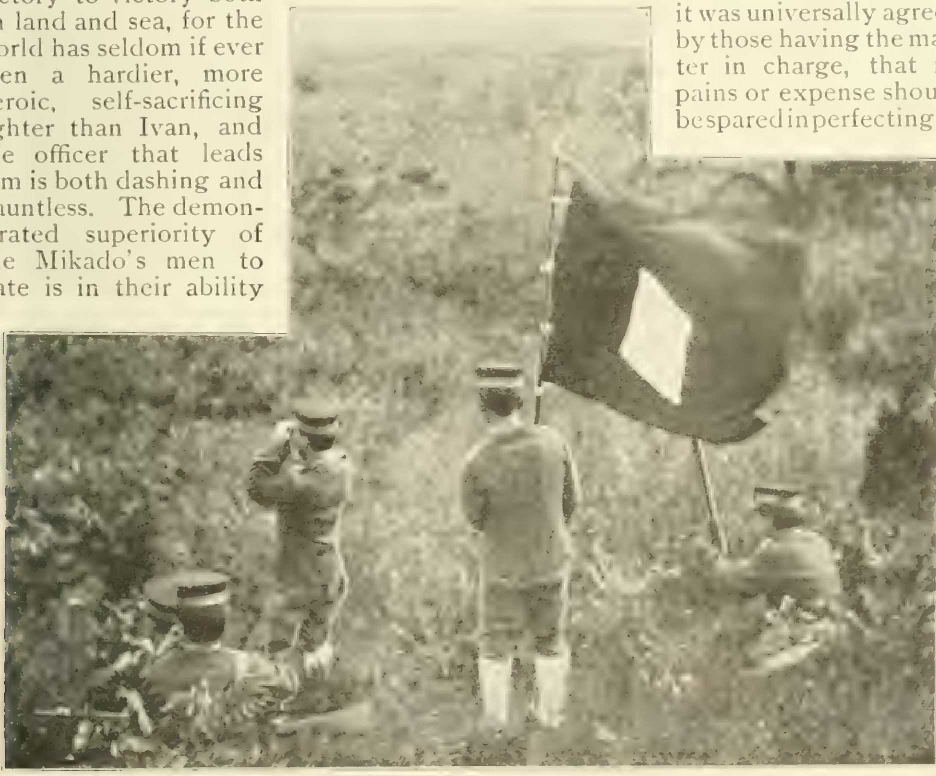
TO-DAY the science of war has become so exact and its instruments of execution so mechanically terrible that individual or national heroism can no longer be depended upon as the important factor in determining the result of a conflict. Napoleon's statement to the effect that God is always on the side of the combatant having the most cannon, is true to-day only when the cannon are of the most modern make, handled with the greatest degree of accuracy, and reinforced by technical skill and appliances in all branches of the army, so perfect as to be practically flawless. In other words, war to-day is not a question of men but of machinery. This is the lesson which the little yellow men of the Orient are now engaged in teaching the great northern giants of the Occident. The tactics, strategy, or military science of the Jap—it is all the same whatever term one may apply—has blocked the advance of a nation whose vaunted aggressiveness and might have long been accepted as the acme of military power.

It was not Russia's vast armament alone which induced this belief; for her army leaders have long been regarded as representing the fruits of generations of academic learning and the greatest military skill and experience. If evidence were needed to prove that a nation whose chief claim to greatness is based upon militarism is most likely, when a trying test comes, to prove lacking in the highest essentials of initiative and execution, it has been abundantly forthcoming in the present war.

Unlike Russia, Japan's main endeavor and development, until within the last decade, has been in the arts of peace. But events show that in fostering and cultivating these, in utilizing the forces of nature and of civilization for the betterment of their country and themselves, the Japanese were splendidly qualifying for their terrific struggle with the Bear. It is not superior courage and pluck alone on the part of the Japs, either officers or men, that are sweeping them on from victory to victory both on land and sea, for the world has seldom if ever seen a hardier, more heroic, self-sacrificing fighter than Ivan, and the officer that leads him is both dashing and dauntless. The demonstrated superiority of the Mikado's men to date is in their ability to apply science to warfare better than can the soldiers of the Czar.

It is both paradoxical and significant to note the remarkable manner in which the Japs have out-Heroded Herod. For years they have been making a most scientific and minute study of the military and naval establishments and methods of each of the great powers. They seem to possess an almost infallible accuracy of conception and judgment in that they have copied from each nation that which was best, rejecting whatever was of questionable value.

In no department of the Japanese army is this fact more clearly demonstrated than in their Signal Corps. The Japanese seem to have realized that even more thoroughly handicapped than an individual with faulty eyesight is an army to-day with an insufficient means of intercommunication. In the development of the Mikado's forces according to modern standards of efficiency, the superlative importance of "the army's eye" was generally recognized; and it was universally agreed by those having the matter in charge, that no pains or expense should be spared in perfecting it.



WIG-WAGGING FROM TOP OF MOUNTAIN.

The American Model

The wisdom of this course has been even more than justified in the last year. The Japanese military experts made a careful and extended study of the various means of signaling by flag, torch, heliograph, telegraph, and telephone employed by Kitchener in his Soudan campaign, by the United States Army in Cuba and the Philippines, by the British in South Africa, and by the various continental armies in their annual manœuvers. The result of this investigation was that the United States system was adopted practically in its entirety.

Japan is not alone in this estimate, for leading military experts of several Eur-

OUTPOST TELEPHONE STATION.

opean nations believe the United States unrivaled in this department. In view of the high compliments which aliens have paid our Signal Service, it is astonishing how little it is known at home.

It was in the bloody grapple between the Blue and the Gray, July 21, 1861, on the historic field of the first battle of Manassas, that battlefield communication was first acomplished by mechanical means. Compared with the splendidly efficient Signal Corps of our Army at present as demonstrated recently during the army manœuvers over the same ground, those of '61 were indeed primitive, but nevertheless determined the result of this first great struggle of our Civil War, and forever established the helplessness of an army, however powerful, which lacked a thorough means of prompt communication between all divisions.

One who has carefully studied this first great battle of the Rebellion, finds that the part played in it by the Signal Service was of vast importance. Had not a Confederate signal detachment discovered and reported to Generals Beauregard and Johnston the advance of McDowell's flanking column, in time to enable them to rush reinforcements to General Evans, at the same instant signaling to the unsuspecting Evans the great danger he was in, the left wing of the Confederate army would have been overwhelmed, and this would undoubtedly have resulted in a decisive victory for the Federals.

There can be no question but that the moral effect of the practical victory achieved at Manassas was of incalculable benefit to the Confederacy. It inspired both army and people with a superb confidence, and nerved them for that terrible four years' struggle which was to bring so many other and greater victories to their gallant standards before they were overtaken with final yet honorable defeat. It is idle to speculate as to what would have resulted from an overwhelming Federal victory in that first great engagement of the war. But, as the battle hinged upon the sending of the reinforcements to the left, and as these would not have been sent—at least not in time to have checked McDowell's flanking movement—save for the timely warning given, the important part played by the Signal Service even in its initial test is patent.

Having briefly chronicled the birth of the Signal Service and noted an instance of its efficient application in American warfare, it is well to call attention to the fact that the system has never been applied to greater advantage than by Lord Kitchener in his Soudan campaign.

This great master of the machinery and detail of war was three years in laying his plans for the one annihilating defeat he proposed to administer to the Khalifa. Slowly but surely the silent, grim British general was ever pushing forwar l but never for one instant breaking his line of communication or failing to have each and every portion of his forces in complete and perfect touch. It was here that the value of the telephone and telegraph over any other method of signaling was particularly demonstrated.

The Arab plan was never to attack save when they thought the British were unprepared and unsuspecting. Hence it was that though scouting parties were continually sent out to secure information, it was but rarely that the usual visual system could be employed without endangering the scouts and exposing the exact position of the army to the cunning enemy. By the use of the telephone and telegraph, this difficulty was overcome, and the Commander-in-Chief was enabled to be in constant touch with all points of his command, at all times. It was this paintstaking attention to detail, and careful application of modern scientific and mechanical aids, that enabled Kitchener, at Omdurman, finally to annihilate the Dervishes at one blow, and with a loss to himself trifling in comparison.

Despite previous applications, however, it remained for the Japanese, by their universal and diversified uses of them, to render the telephone and the telegraph as essential to modern warfare as they are to modern commerce.

But while it is true that the Japanese have adopted our signal system in its practical entirety, yet it is most inaccurate to speak of them in this particular as being copyists. They have made so extensive an application of the system, and have, on their own initiative and unaided, worked out so many new problems which have arisen in connection with it, as to have not only relieved them of any charge of being mere imitators, but unquestion-

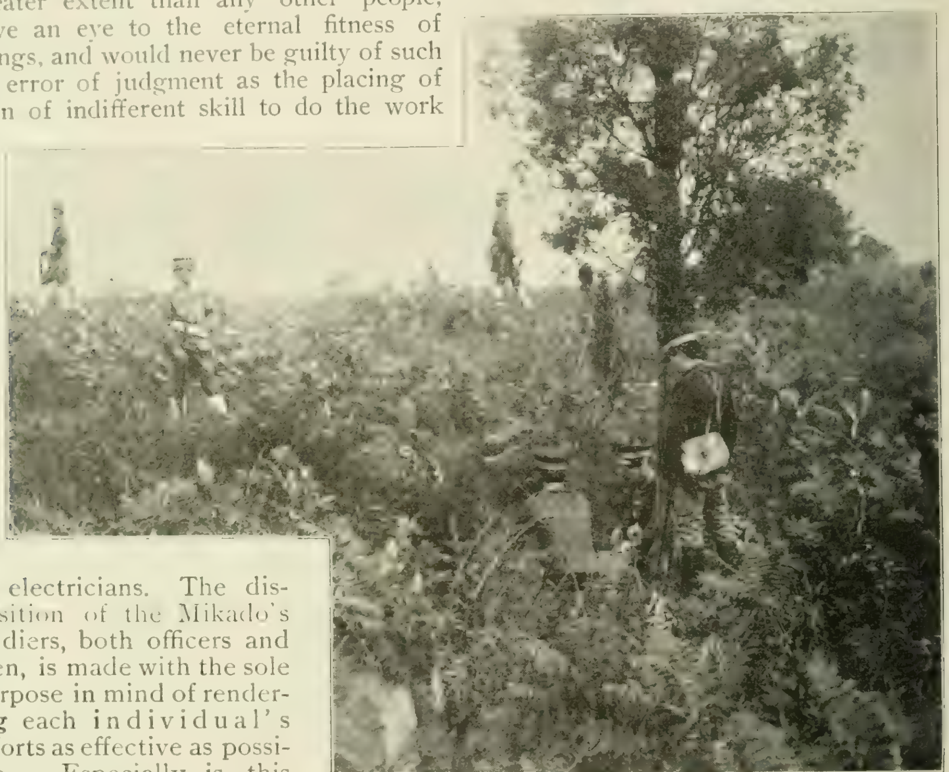
TEMPORARY FIELD HEADQUARTERS.

ably to place them in the position of instructors.

One should bear in mind that the splendid results attained by the Japanese Signal Service, and the remarkable efficiency of the Corps individually and collectively, would be impossible were the members of it ignorant or untrained in the handling of telegraph and telephone appliances. The Japs, probably to a greater extent than any other people, have an eye to the eternal fitness of things, and would never be guilty of such an error of judgment as the placing of men of indifferent skill to do the work of electricians. The disposition of the Mikado's soldiers, both officers and men, is made with the sole purpose in mind of rendering each individual's efforts as effective as possible. Especially is this true of the Signal Service Corps, and so its ranks are filled from the walks of civil life with those who have learned much along the line of their military duty.

So it is that in serving their country in war time, each is merely doing his day's work, more or less; going through at least a part of the same routine of labor that he would perform if war did not exist, save that his work is of necessity accomplished under conditions more difficult and exacting than the requirements of civil life. In no regard have the Japanese demonstrated their superiority over the Russians so completely as in the application of the various means of battlefield communication. Their triumphs have almost invariably been due to an intelligent adaptation to the uses of warfare, of the telephone and telegraph, especially of the former.

While the movements of the enemy must be known at all times, it is equally important that the commander shall have constant, accurate information concerning every division of his army, though they may be separated miles apart, as is often the case. This is not always a simple problem, owing to the seemingly endless movements frequently required in checkmating the enemy.



FIELD TELEGRAPH STATION.

The Telephone the Main Reliance

While the Mikado's soldiers are adepts in the use of all accepted methods of signaling, and do not hesitate to use one or the other as the occasion seems most to require, they have found that for communication within their own lines the telephone can be most easily and satisfactorily utilized.

Under the Japanese system no part of the force is ever isolated for long. Hastily constructed telephone lines, the military term for which is "flying telephones," keep the commander constantly advised as to what is taking place along the army's front and at the distant outposts. This enables him to dispose his forces in such a manner as to meet all probable contingencies and direct the movements of his troops with a remarkable degree of exactness.

Wherever a camp is established, even though it be but for a few hours, a temporary telephone exchange, with a special switchboard, is installed. This exchange is connected with the main headquarters exchange, and, through the headquarters exchange, with the nearest shore station. All of these shore stations have cable connection with the Mikado and his Ministers in Tokio, who, by means of wireless telegraphy, are enabled to keep in touch with both army and navy. Almost every Japanese scouting party sent out is accompanied by a signal detachment, which, unreeling its lines as the scouts advance, keeps constantly in touch with the larger body in the rear, reporting minutely all observations made. The advantages of this method over the old one of sending messengers back with dispatches and reports, is very great at all times, but is especially marked in night scouting. Their efficient signaling often saves the labor and fatigue incident to the unnecessary marches which in past wars have frequently been undertaken upon false information. Even though such a march be begun, it can, as all divisions of the army are in perfect touch, be immediately stopped at any stage of its execution, and other dispositions made if it be deemed advisable. Time—always one of the most important factors in battlefield operations—to-day more than ever before enters into the determination of the final result. Consequently the necessity of promptly forwarding orders and information cannot be overestimated.

It has also been clearly demonstrated in the Russian-Japanese war, that a few concealed field telephone stations posted along in advance of the main body can secure and transmit far more information in much less time than could scores of old-fashioned scouts. Military officers who are familiar with the skill, care, and arduous labor with which the positions on both sides of the Taitse river were prepared at Liao-Yang, consider that this battle will fully establish the efficacy of the simultaneous flanking movement as accomplished by the Japanese. This movement would be practically impossible without a constant and instantaneous means of intercommunication. Time and time again during the present war, have redoubted trenches, gun pits, entanglements, ditches, tunnels, and every method of protection known to military engineering skill, proved useless against a single turning movement and mobility. Strategy throughout the campaign has vanquished fixed fortified positions, and flanking operations forced the abandonment of the most elaborate entrenchments, sometimes without the firing of a shot. Every intelligent student of the lessons the war is daily teaching, is learning that the part played by the Japanese Signal Service Corps in all this, has been most vital.

In no sense are the men composing this Corps warriors of the old accepted type; rather are they men of science, students, skilled in the arts of peace. This very fact may prove a strong contributive cause towards the abolition of warfare. For war, rapidly becoming strictly scientific, and hence appallingly destructive, soon to be stripped of all its one-time pomp, circumstance, and uncertainties, is bound to prove most commonplace and unattractive for mankind.

A 2½-YARD DREDGE USED IN PLACER MINING AT OROVILLE, CALIFORNIA.

Gold-Mining Dredges

Fleets of Powerful Vessels that Invade and Destroy the Land in the Search for Gold

By RUTLEDGE RUTHERFORD

Special Correspondent, THE TECHNICAL WORLD

GOLD mining has been given a new impetus since the advent of the dredge in that industry. Especially has this proved a boon to miners in California, where it is used more extensively than in any other gold-producing region. In that State, fields which had been abandoned as not worth working are now being worked over with wonderfully paying results.

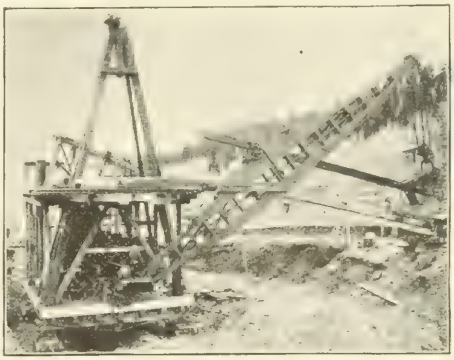
It is in placer mining—separating and securing gold from auriferous gravel deposits—that the dredge is used to its best advantage. The perfected excavating machinery handles the gold-bearing material with great economy of time and labor; and with its aid, practically every particle of the gold can be reached and saved. A good make of dipper dredge, simple in design, but powerful and effective, is used by the most progressive miners. The dipper machine is the only one that will successfully handle all-around soft, hard, or rough-and-ready material, such as is invariably found in placer mining work. Both the first cost and the incidental running expenses of this type of machine are small when compared with the expense of mining the gold by several other methods.

The accompanying illustrations show modern dipper dredges used in placer mining work. As will be seen they are of the floating type.

But there are placer mining dredges for use on dry land as well as in water, one of these also being shown in the illustrations. These machines are self-propelling, and are complete with excavating and washing machinery and also sluicing apparatus. Their field is in places where little water is available, or where there cannot be found suitable dumps for refuse. They are also required where there is a great amount of overburden to be removed before the auriferous material can be reached. The machines are capable of handling a boom of very great length, enabling them to dump in the ordinary sluice box located on top of the bank. In one type of machine, the material is dumped into small skip cars, which elevate it to the hopper located high over the car body. The material, after reaching the hopper, passes over the screen bars, the coarse going directly to the dump, and that which passes over the "grizzlies" falling into the revolving screen, and thence by gravity to the dump. The finer material washed through the screen passes down the sluice, in which the gold is recovered.

These dredges are of different styles, and some of them are of gigantic size. One type in particular that is now in service in California is attracting wide attention. It is ship-shaped device that cuts its way through the land. A great steel ladder extends in front of the vessel like an inverted bowsprit. Up and down the ladder march in endless procession bucket-shaped plows, with mouths of forged manganese steel. The chain that carries these plows will support a weight of 500 tons. These keen-edged scoops will cut through solid rock. A marine engine drives them with irresistible force. They delve into the banks ahead of the ship, literally eating up the land.

Gorged with rock and sand the buckets mount the ladder again, and along a huge gangway are carried back to a rotary, cylindrical screen, into which they discharge their contents at the rate of thirteen buckets a minute. Each one of these steel carriers contains five cubic feet of earth, so that an amount of material equal to the contents of three city dump

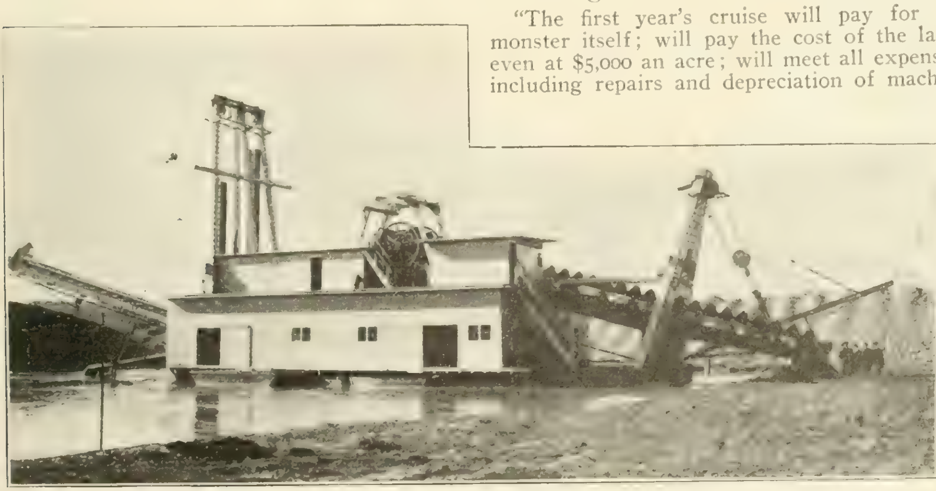


A 2-Yard Dry-Land Placer-Mining Dredge.

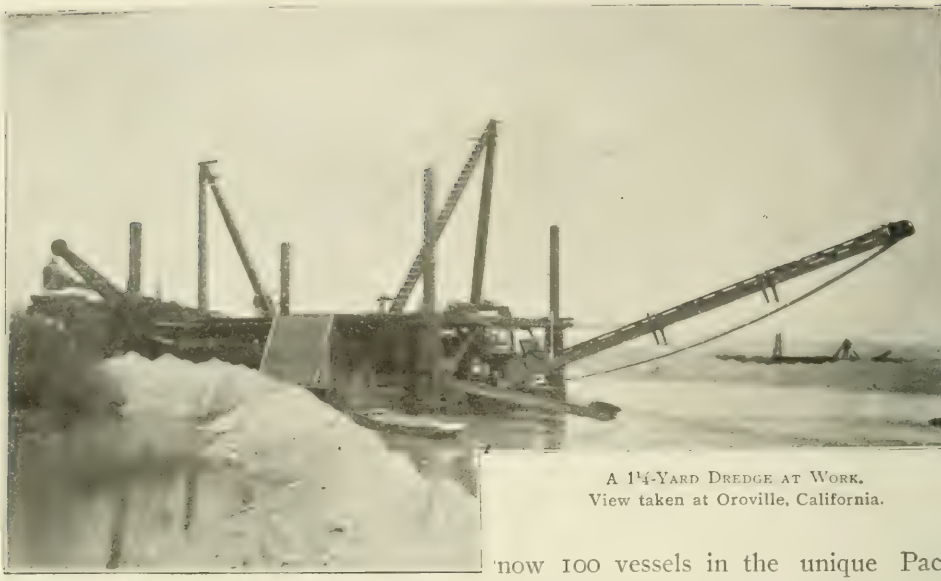
carts is poured into the whirling cylinder every minute of the working day. Other machinery separates the gold automatically.

The total expense involved in a day's operation of one of these great gold-mining vessels, is sometimes less than $30. The ships cost from $50,000 to $95,000, according to size. One writer declares:

"The first year's cruise will pay for the monster itself; will pay the cost of the land, even at $5,000 an acre; will meet all expenses, including repairs and depreciation of machin-



GOLD-MINING DREDGE AT WORK IN THE CHANNEL IT HAS CREATED.



A 1¼-Yard Dredge at Work.
View taken at Oroville, California.

ery, and still net the owner more than $100,000. These are figures of actual operations, and regarding land carrying a low proportion of gold. It is little wonder that the men who own these mining fleets do not advertise. Many of them are reaping a profit of more than 600 per cent on their investment. The industry is, of course, legitimate in every sense, but it has all 'get rich quick' schemes absolutely eclipsed."

One of the gold ships will devour an acre of earth every month. As there are now 100 vessels in the unique Pacific coast fleet, 100 agricultural acres are being destroyed every thirty days. In the valleys thus far prospected and purchased by the operators, there is an assurance of at least fifty years of mining activity. At the end of that period, even if no additional boats be launched in new sections, 60,000 fertile acres will have been deducted from the tillable land of the West. Of course, no amount of yellow

ONE-YARD DREDGE USED IN PLACER MINING AT DAHLONEGA, GEORGIA.

metal can actually offset the annihilation of the fairest valleys husbandry has made to bloom. As these ships tear up alluvial acres at a cost of three and four cents a ton, and can work at a profit land that contains a very small proportion of yellow sands, it means that few valleys whose rivers rise in the mountains are safe from invasion.

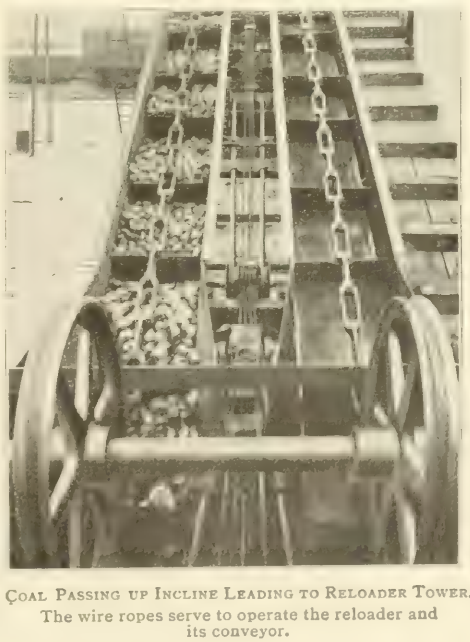
And so the Western States have reason to regard with grave seriousness the cruising of those semi-subterranean squadrons which can gather yellow particles so microscopic that the human eye cannot detect them, and in reaping this precious harvest can metamorphose fertile dominions into regions of perpetual desolation.

Modern Coal-Storage Methods

Ingenious System which Combines Economy with Picturesqueness

By PAUL ARR

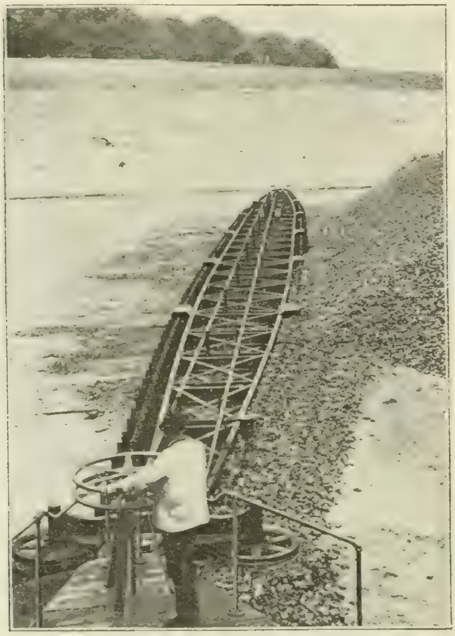
THERE is art even in storing coal, as has been demonstrated by the new system employed by many of the leading railroads and manufacturers in America. Handsome-appearing piles of uniform size now dot the grounds where once a confused mass of coal and coal dust covered the space and spread its blackening smudge to all surroundings. In the new system of storing, the amount of breakage is reduced to a minimum; and hence there is little dust compared with the old method by which the coal was jammed, and crushed, and hurled promiscuously from points high and low. Moreover, neatness is combined with remarkable economy. In fact, the new method—it is called the "Dodge Anthracite System"—seems to be the acme of convenience, and as a labor-saver it has but few equals in modern mechanical contrivances. The storing process is such that the coal is never dropped more than a few inches in falling from the conveyor to the apex of the pile; and thus there is little chance for it to break. Then, there is another arrangement at the foot of the stacks, by which the coal may be taken away and reloaded as fast as it is unloaded. The process of stocking or "trimming out" the coal is almost entirely automatic;



Coal Passing up Incline Leading to Reloader Tower. The wire ropes serve to operate the reloader and its conveyor.

COAL-STORAGE PLANT OF LEHIGH VALLEY COAL COMPANY AT WEST SUPERIOR, WIS.
Providing for 100,000 tons of anthracite coal in two circular steel buildings, each 246 feet in diameter and 90 feet high.

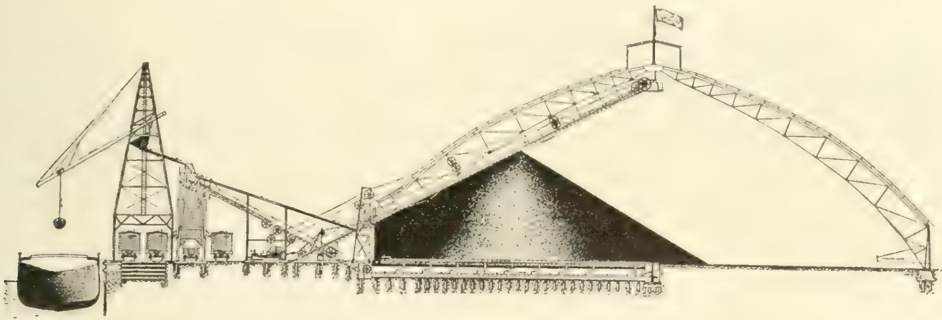
and one man is all that is required to do the work of reloading. A fully equipped modern plant can stock 9,000 tons per day, and reload the same amount, if there be sufficient trackage and car service.



RELOADER AT WORK.
View looking outward from pivot.—As the reloading from the base of the pile proceeds, slides or avalanches are frequent. These would bury the reloader were it allowed to await them; but the operator, by a turn of the wheel, swings the reloader away from the pile until the slide ceases, when, by a reverse turn, he brings the machine again in contact with the pile.

To accomplish these seemingly phenomenal results, an ingenious yet simple combination, consisting of sheer trusses, chain conveyors, ground conveyor, and flighted chain, is required. The coal can be stored with equal facility either in the open or in inclosures with roof protection.

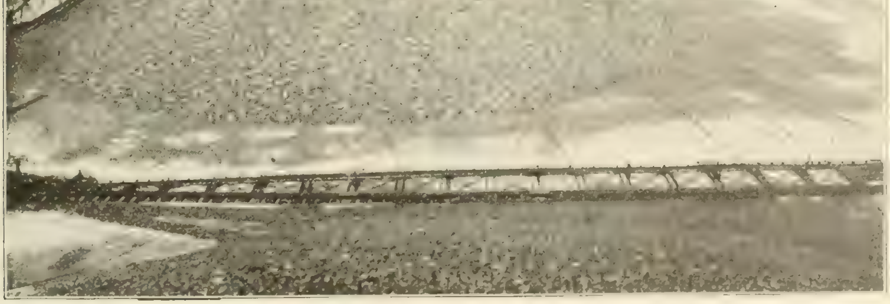
The chain conveyor and sheer truss, constituting the "trimming machine," are employed to stock out the coal. The sheer truss of each trimming machine is arranged to span the pile to be formed, and is fixed at about the angle the top surface of the coal will represent when stacked. The coal is received from cars in a hopper located beneath the receiving track, and is fed through a chute to the conveyor of the trimming machine, which delivers it upon the ground or at the apex of the pile of coal as it forms. The arrangement is such that this apex, at first low, extends outward and rises, climbing parallel with the truss until it reaches the top of the latter, or until the pile is full-grown. This is accomplished by the method of operation of the trimming conveyor. It first discharges the coal on the ground at the foot of the truss; and, as the apex of the coal pile nears the conveyor, it extends the point of discharge further and higher, and so on until it has climbed the extent of the truss, when the pile is completed. The bottom of this trimming conveyor is a steel ribbon, usually 12 inches wide, which is wound upon a drum located at the foot of the truss, and arranged to be drawn out in grooves fixed in the conveyor trough so that its end—the only discharge point for the coal from the trimming machine—shall always be at the constantly rising and receding apex of the pile. Thus it can be seen that the coal is necessarily prevented from dropping but an insignificantly short distance at any time of the operation.



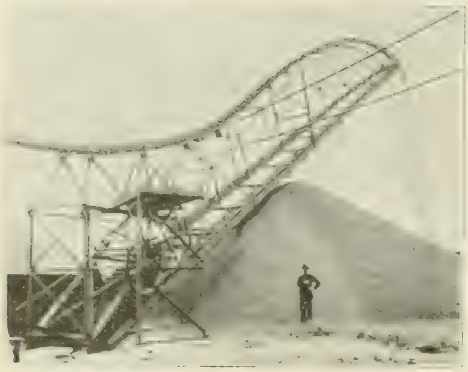
SECTION OF HOUSED STORAGE PLANT OF LEHIGH VALLEY COAL COMPANY AT WEST SUPERIOR, WIS.
Capacity of each building like the above, 50,000 tons.—The walls of these buildings are without exterior bracing, the bursting pressure of the coal being entirely taken off the circumference by the sheet steel anchoring band, which is held in position above the floor by bolts secured to the I-beams of the exterior wall. The reloading conveyor is operated within an underground tunnel extending from the center of each building to its exterior.

The other important half of the plant is the reloading machine. This is a pivoted or swinging ground conveyor, consisting of a flighted chain suitably mounted on a steel frame and actuated by power in all its movements. As usually arranged for open-air storage on level ground, two trimming machines and one reloading machine located between them constitute a "group," and the storage plant consists of the required number of these groups, which may be either of the same or of varied capacities.

The reloading machine is composed of a horizontal and inclined portion, both working together so as to render the carrying of the coal continuous from any point on the horizontal portion to the upper end of the inclined portion, where a small pocket is provided, into which the coal flows, and from which it is dis-



PENNSYLVANIA RAILROAD COAL-STORAGE PLANT AT SOUTH AMBOY, N. J.
Consisting of six 50,000-ton piles with three reloaders.—The service tracks at this plant are graded for drilling cars by gravity.—Power is supplied by three engines and boilers located near the reloader tower.



TRIMMER IN OPERATION.

charged over screens into cars or vessels. The horizontal portion of the reloader is pivoted at the foot of the incline, and is provided with wheels which run on circular tracks between and under the two piles of coal. The power mechanism is so arranged that one man on the operating platform handles the reloader with ease, taking coal automatically from the base of either of the two piles as is required.

Each trimming-out and reloading machine has a capacity of three tons per minute, or 1,800 tons per day; and as one size of coal may be stocked out on one pile, and another size reloaded simultaneously from the other pile in each group, the handling capacity of the plant is equal to 3,600 tons multiplied by the number of units or groups composing it. Thus a plant composed of five units or ten piles can receive 9,000 tons per day and reload the same tonnage. This is certainly a great showing in efficiency.

Power

Responsibilities gravitate to the person who can shoulder them, and Power flows to the man who knows how.

—ELBERT HUBBARD.

Electricity from Wind Power

A Technically and Economically Successful Solution of the Problem

By DR. ALFRED GRADENWITZ

Berlin Correspondent, THE TECHNICAL WORLD

THE accompanying photograph (Fig. 1) represents an electrical central station operated by wind power, which has been in successful operation at Askov, Denmark, for about two years, supplying the inhabitants of the neighboring district with electric current for light and power. The constant normal current supplied is 60 amperes; while the tension is 220 volts. The plant has so far given every satisfaction, requiring no material superintendence. The capacity of the accumulator battery provided is sufficient to yield the maximum amount of energy required during 48 hours. The electric current is supplied to consumers at the same price as in Copenhagen, *viz.,* 14 cents per kilowatt-hour for lighting, and 4 cents for power purposes. This central station was intended mainly to serve as an experimental plant in connection with practical investigations into the utilization of wind power, which have been conducted by Professor La Cour for a number of years on behalf of the Danish Government.

FIG. 1. WIND-DRIVEN ELECTRICAL PLANT AT ASKOV, DENMARK.

The regulating device for controlling the speed of the dynamo, was designed by the experimenter, and is especially interesting. It comprises two different devices, one being mechanical, and working

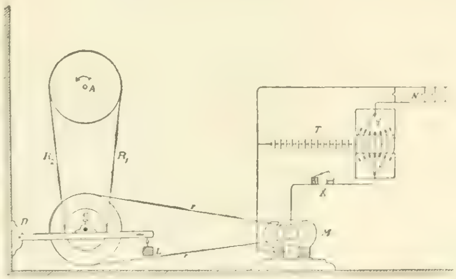


FIG. 2. MECHANICAL DETAILS OF WIND-DRIVEN ELECTRICAL PLANT.

in case the wind motor runs too fast; while the other device is electrical, and is actuated in case the speed is too low. The mechanical apparatus is intended for maintaining at constant figures the peripheric force transmitted to the belt disc of the dynamo.

A belt R_1 R_2, which is about vertical (see accompanying diagram, Fig. 2), actuates an intermediate gearing. The belt *r r*, driving the dynamo, is arranged at right angles to the outer belt, that is, about horizontally. The axle of the intermediate gearing is mounted on a movable lever arm which supports a counterweight *L*. The resulting tension of the belt is thus maintained constant, at figures depending on the weight of the gearing and on the counterweight. The tension of the belt controls the maximum pull which may be transmitted by the belt, so that the torque transmitted by the motor cannot exceed a given value. As soon as the resistance attains the magnitude of the motive force, the belt begins sliding; and the excess of pull — that is, the motive force—is maintained about constant, independently of the more or less considerable sliding of the belt. A similar gearing is thus driven by a constant force, independently of the speed of the dynamo and of the driving-shaft *A*. The speed of the dynamo will therefore adjust itself so that its tension exceeds the tension of the accumulators just sufficiently for the current traversing the latter to take a given intensity, this intensity being easily controlled by modifying the load of the lever.

The electrical regulation is located in the interrupter (Fig. 3), which is mainly a minimum-current interrupter, disconnecting the dynamo as soon as the current decreases below the normal number of amperes. This arrangement is necessary to prevent the accumulator battery being discharged through the dynamo, in case the strength of the wind is diminished, and setting both dynamo and wind motor rotating backward. The interrupter will automatically switch in the current as soon as the wind again assumes greater strength. To this effect, the current interrupter is provided with a tension regulator, inserting the current as soon as the speed of the dynamo has increased sufficiently. A continual opening and closing of the connections is thus brought about in the case of a wind of variable strength.

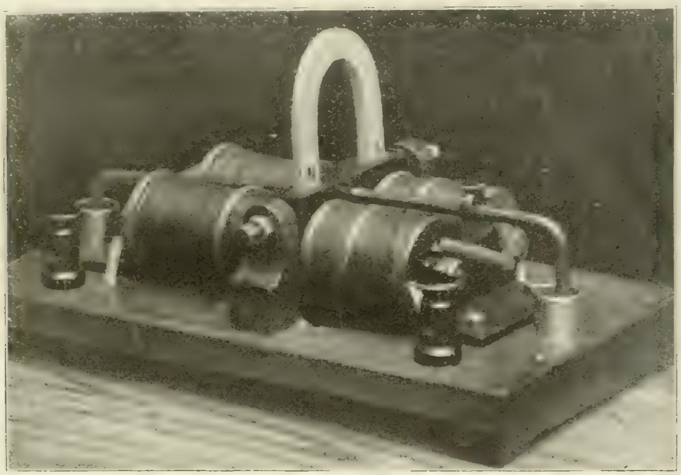


FIG. 3. INTERRUPTER OF WIND-DRIVEN ELECTRICAL PLANT.

A petroleum motor has been provided as a reserve source of power in case of several days of calm weather, when the accumulator battery would be idle.

The Social Engineer

A New Field for the Application of Expert Knowledge

By HENRY M. HYDE

Editorial Writer on the *Chicago Tribune*

SPEAKING GENERALLY and broadly, the engineer is the man who knows how. A great railroad is to be built through an unexplored country. It is the business of the civil engineer to make the necessary surveys, to lay out the shortest and—all things considered—the best route. In the building of the road and its practical operation, there is room and necessity for the skilled work of a dozen other highly specialized types of engineers—mechanical, bridge, electrical, and locomotive engineers among them.

Suppose, now, that all these various kinds of work have been and are being done. The road is running, thousands of men assisting in its operation. Out on one division serious friction may develop between the firemen, for instance, and the management of the road. There, very evidently, is a job for some man who knows how to deal with and handle men. At this point, what is coming to be called the "social engineer" will be called in. As a matter of fact, however, it is his work to take such measures as will prevent the friction from becoming serious rather than to deal with and subdue it after the crisis has become acute.

In social—as in all other branches of engineering—the master of his profession meets difficulties long before they arise.

Nor is the "social engineer" only a phrase—more or less happy—an idle fancy. He is a fact. Call him by what name you please, he finds place and employment in scores of large commercial and industrial enterprises all over the United States. Every year his place becomes more important. His work offers a profitable opening and an inspiring opportunity, at the same time, to hundreds of bright and ambitious young men.

Consider, for a moment, the logic of the situation.

Every large employer of labor, in this day of labor-saving machinery, must rely largely on the trained services of engineers of various kinds. He wishes to cut down the running expenses of his factory—the electrical engineer designs and builds for him an electrical power plant, with individual motors, perhaps, for each of the large machines, so that one or any number of units can be operated with the greatest possible economy of power. It is the business of an electrical engineer to keep a skilled and ever watchful eye on every part of this system so that there may be no costly breakdowns and every part of the plant may be kept running at its highest efficiency.

But here are, perhaps, 1,000 workmen, without whose coöperation the best work of the electrical engineer counts for nothing. Who shall see that they work harmoniously and loyally, every department in tune with every other, all keyed up to the highest possible efficiency? Who but the social engineer?

And, as said already, the social engineer is already at work. Men, in the mass, are more diverse, more complicated, harder to handle and to keep in good working order, than the most complicated of automatic machines. But they operate, in the mass, according to ascertainable laws; they respond to good treatment; they need lubricants to keep them running smoothly.

Far-sighted employers, who know what strikes and lockouts cost, both directly and indirectly, are beginning to realize these facts and to understand the necessity of having trained experts at work on the problem.

It is the business of the social engineer employed at a certain plant to get a thorough acquaintance with the workmen employed at that plant; to keep closely in touch with them; to make, so far as possible, the conditions which surround them at their work comfortable, pleasant, and satisfactory. If a spirit of dissatisfaction and disloyalty begins to break out in a certain department, the social engineer sets himself to discover the causes and to remove them, if he can.

Perhaps the men are paid in checks; then, in too many cases, they cash their pay checks at the nearest saloon, which, in turn, inevitably means the consumption of considerable quantities of malt and alcoholic liquors in return for the favor—for one of the first things your social engineer must learn is that the American working man is not looking for favors. He rather resents them. He pays as he goes, and he will continue to buy a round of drinks just so long as he is practically forced to go to a saloon to get his pay check cashed. The social engineer studies the resulting situation and, very possibly .he recommends that the workmen at the plant which employs him be paid in cash, or that convenient facilities be provided for getting checks cashed close to the factory.

Investigation shows him that the men in some department of the factory—the brass polishing room, for instance—are working under conditions which are not healthful. The same fact has struck other people; but the social engineer, as a part of his equipment for the work, knows how to do away with these unhealthful conditions at no great original cost to the employer. At any rate, he is able to convince the employer that as a mere matter of dollars and cents it will pay him to make the change. In the same spirit, he may go through every department of the factory, and gradually suggest and secure changes which will greatly increase the daily capacity of the working force and, as a consequence, pay his own salary many times over.

His experience at other plants and his general study of the subject may convince the social engineer that the workmen at the plant which employs him would be the better off for the establishment of a mutual aid and sick benefit association. He knows, of course, as an axiom which some employers seem still to have difficulty in believing, that whatever makes the workmen more happy, contented, and prosperous, is of equally great benefit to their employer. Consequently, exercising much tact and patience, he suggests the establishment of such a voluntary mutual aid association to some of the more thoughtful men, furnishing them with printed accounts of the success of similar associations elsewhere and acting generally as a counsellor and adviser in the matter. For, very early in his career as a social engineer, he will have discovered that to be at all successful he must go on the principle of helping the men to help themselves and must, on no occasion, go any further.

The vast majority of well-meant efforts on the part of employers to raise the condition of their "hands," have failed and are daily failing and will continue to fail, simply because they are undertaken in a paternal attitude of mind. The American workingman—any more than any other adult—does not appreciate anything which is done for him in this spirit, it matters not how kindly the motive that prompts the act. As he will express it himself, he wants not charity, but justice. If free baths are established in a manufacturing plant, and the benefits of using them frequently are explained to him in a tactful and unobtrusive way, he will be likely to take full advantage of them. But if, after they are established, he is practically ordered to take two baths a week, and that under the eyes of "philanthropists" and others who are invited to come and see the "animals fed," he will revolt and curse the man who built the baths.

The social engineer knows this and the other primary laws of human nature, and he is careful not to violate them.

If the social engineer knows his business and is tactful and honest with both workingmen and employer, he will be able to do away largely with the danger of costly strikes, lockouts, and labor struggles of various kinds. Witness, for instance, the Commissioner of the Coal Miners' Association of Illinois. He stands, as it were, between the two interests involved, and has for a number of years succeeded in preventing strikes in the coal mines, which previously were frequent and productive of much violence as well as loss of time and money.

The social engineer will be vastly the better, of course, for a course of university study in psychology and sociology —the science of human nature and of the organization of men into society. But he needs, first of all, and more than all else, a deep-seated sense of honesty, fairness, and tact in his dealing with men. Given these fundamental qualities with experience in handling men — employers are even harder to handle than workingmen, and often more unreasonable—and he will be able to do an important work in the world. There would seem to be no good reason why some of the universities should not institute courses for the training of social engineers, which might lead to the degree of S. E.

The Proctor & Gamble Company at Ivorydale, Ohio; the National Cash Register Company of Dayton, Ohio; the Sherwin-Williams Company of Cleveland, Ohio; and dozens of other large corporations in various parts of the country have had men at work for a number of years along the lines outlined above. Whatever may be the official title of these employes, they are all doing the work of social engineers.

There is a large field, too, for women in this work, particularly in factories which employ large numbers of feminine "hands." Thus, for instance, the Shepard Company, Providence, R. I., has on its pay roll a "Social Secretary," a young woman whose duty it is to assist in improving the conditions of life among the people employed in its factory, both inside and outside of its plant. She seeks to provide needed comforts, rest and lunch rooms; helps in finding suitable boarding places and in caring for the sick, and also mediates in cases of friction.

Four years ago the manufacturers of Cleveland, Ohio, formed themselves into an association and jointly employed a Social Secretary, who gives his whole time to assisting in the improvement of local factory conditions. He was, in a very real sense, a Consulting Social Engineer, and the first of his kind on record anywhere.

It must not be supposed that the employment of a social engineer will at first hand and within a few months solve the labor problem. There have been and there will be strikes in factories where social engineers are employed. But that the employment of such an expert is a step in the right direction, there can be no possible doubt.

Story of the Simplon Tunnel

The Fourth of the Artificial Highways Overcoming the Historic Mountain Barrier of Central Europe

By ARTHUR TARBELL

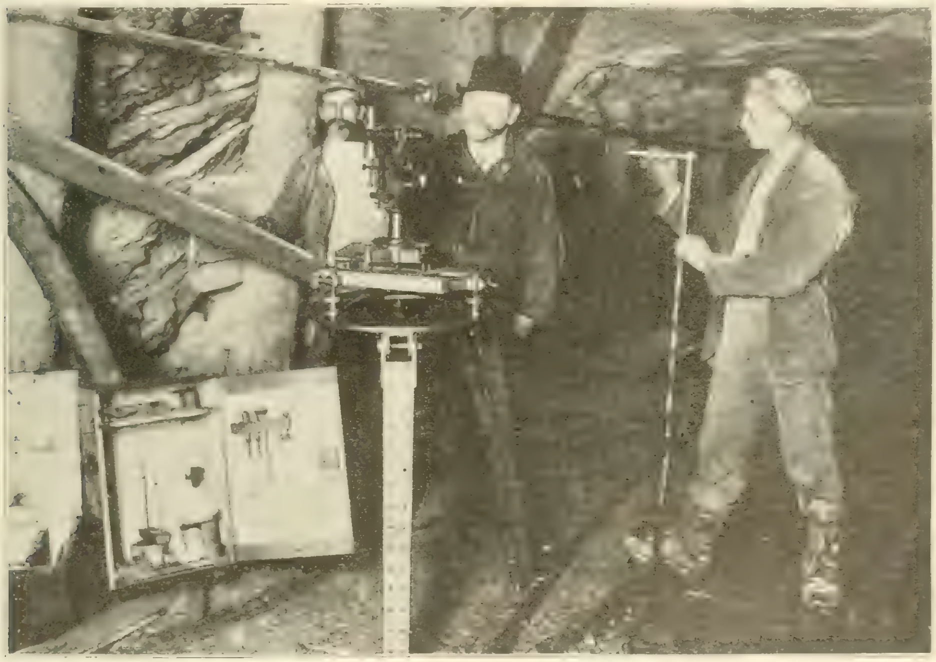
IN the great book of engineering achievements, where truth is always stranger and more interesting than fiction, a new chapter has just been added. The boring of the Simplon tunnel through the Alpine barrier between Italy and Switzerland, was completed on the morning of February 24. It is the longest tunnel in the world, is one of the most amazing conquests of nature, and is the finest tribute yet to the skill of the technician. If nothing unforeseen happens, it is to be thrown open to travel some time during the summer of 1905.

The Route and the Problem

The Simplon plunges directly into the base of that Alpine giant, Monte Leone, at a point a short distance above Brigue, Switzerland, on the left bank of the Rhone; and daylight is not again seen until, after traveling twelve and a-quarter miles, it emerges on the other side of the lofty Alps at Iselle in Italy. Since Roman times the Simplon pass has been the avenue of the trade of Milan with the Rhone valley, and along the same route have run the trains of the Jura-Simplon Railway. On the Swiss side of the frontier, however, the ruggedness of the rock formation compelled a long detour. Both the interested governments, accordingly—the Swiss and the Italian—joined in undertaking the boring of a tunnel. The first blast in the work of construction was fired in the fall of 1898. Work was carried on simultaneously at both the Swiss and the Italian ends, and the headings of the two holes met in a dead check, constituting a triumph in engineering science.

As distinguished from the other existing Alpine tunnels, which are single borings with double tracks, the Simplon is a two-tunnel affair, each with one track, thus permitting of traffic both ways at the same time. For the present, however, but one tunnel is finished to the full size, the other being excavated only enough to serve for ventilating purposes and to hold a narrow-gauge line. These two corridors travel along about fifty feet apart, axis to axis, and are connected every 600 feet by transverse galleries. When a new cross-shaft is opened, the preceding one is hermetically closed, so as not to interfere with the ventilating scheme.

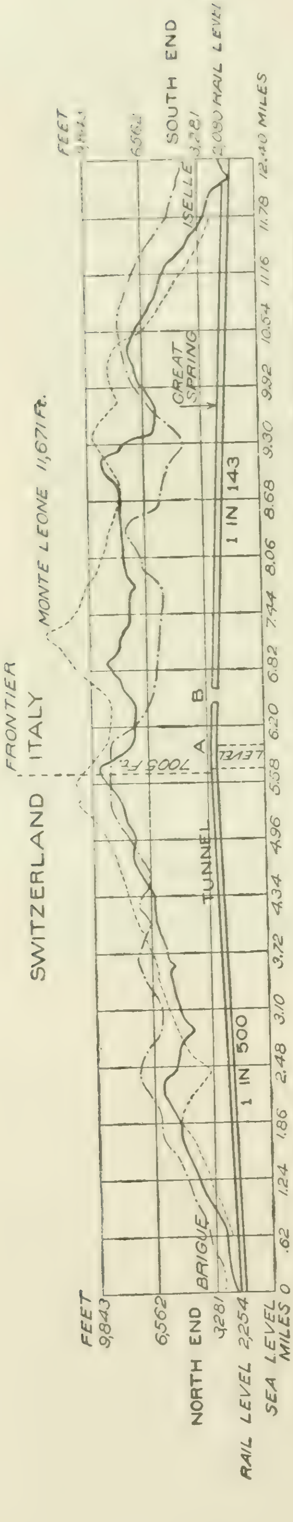
The tunnels are 18 feet high by 17 feet wide, and run in a straight line under the whole Alps, except for a slight curve at each extremity. From the north entrance — the Swiss end, which is 2,254 feet above sea-level—there is an ascending gradient of 1 in 500 for five and three-quarters miles, until the highest point in the tunnel is reached. This spot is 2,312 feet above sea-level, and lies about a mile and a-half below the crest of the mountains between the Furggenbaumhorn and the Wasenhorn. It is here that the central station is located, the gallery having been excavated to double width in order that two trains may pass each other. The tunnel then remains level for a quarter of a mile, after which it descends for six and a-quarter miles at a gradient of 1 in 143, to the south entrance at Iselle, which is 2,080 feet above sea-level. These easy gradients were wisely planned by the engineers to effect a saving in the cost of transportation. The rise in the Simplon never becomes more than 1 in 150; while in the Mont Cenis and the St. Gothard tunnels it is sometimes as steep as 1 in 40, the cost of haulage—always a perpetual item of expense — being considerably increased thereby.



THE ENGINEERING PART OF TUNNEL CONSTRUCTION.
Determining the Axis.

Hydraulic Perforators

In this tremendous piece of tunneling, the honors belong largely to the Brandt hydraulic perforator. About a dozen of these boring machines have been in operation at each end of the tunnel since the start. The day of the diamond drill, once so universally used on tasks of this type, is apparently over. What the Simp-



LONGITUDINAL SECTION OF SIMPLON TUNNEL, SHOWING CONTOUR OF SURROUNDING COUNTRY.

Heavy black line shows contour of surface directly over tunnel; dot (.) and (–) dash line, about ¼ mile northeast of tunnel; dotted line, same distance on southwest.- For more than 2,300 years the Simplon Pass has been the great highway between Italy and Western Europe. Through it Hannibal led the armies of Carthage; and later, Cæsar marched over it with his legions to lay the foundations of the Roman Empire.

lon engineers employ is a hollow steel stem with a diameter of seven centimeters (2.75 inches). Three tempered cutting points are mounted at one end, and so severe is their service that they have to be frequently replaced. Through the hollow passage in the stem, water flows constantly, keeping the edges of the teeth cool, and washing away the debris. A hydraulic engine, with a pump pressure of from 80 to 120 atmospheres and an available force of 10,000 to 12,000 kilos (22,046 to 26,455 pounds), furnishes the power. These teeth bite into the rock at the rate of one centimeter (.39 inch) to each rotation, from four to eight revolutions, according to the hardness of the rock, occurring in a minute. When the drills have penetrated to a depth of about five feet, they are withdrawn and the dynamite inserted and fired. As this part of the work is always more or less dangerous, unusual precautions are taken to protect the laborers. For example, it is one man's special duty, when the mines go off, to count the reports, making certain that all have exploded. One and one-half million charges of powder have been touched off since the beginning. The daily advancement of the tunnel has been on an average seven yards, although, during the first three months of 1902, so many springs were encountered, and so many rock-slips, that only fifty feet was gained.

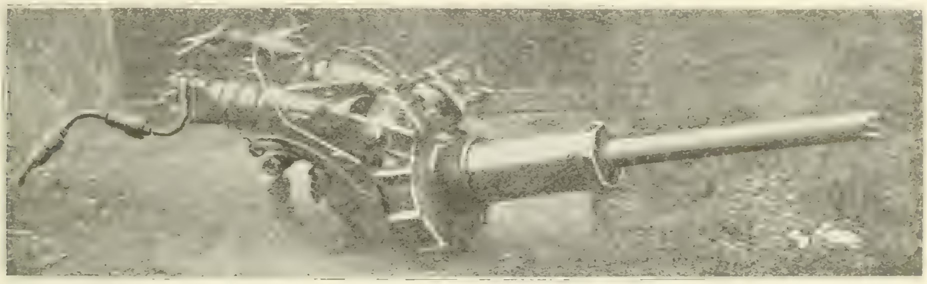
The men behind the drills, the laborers who excavated this subterranean gallery, were Italians. Herds and crops appeal more to the Swiss than blasting rocks and clearing away debris in the bowels of a mountain range. The working force numbered about 1,000, and the division of labor was on the eight-hour basis. Night and day for over six years, work was practically never stopped, three shifts of men being employed. One shift worked from 6 A. M. to 2 P. M.; another, from 2 to 10 P. M.; and the third from 10 P. M. to 6 A. M. This good-sized army of artisans live in well-arranged quarters erected across the river from the Swiss end of the tunnel. The Italian Government has temporarily stationed a consul at Brigue to look after the interests of these foreign workers.

Healthful Precautions Necessary

In the construction of the St. Gothard tunnel, but little attention was paid to the health of the men, and in consequence many succumbed. The Simplon management has profited by this experience. Uncommonly generous and efficient measures have been introduced to secure both good health and personal safety for the employees. A system of insurance is in force; if a man is injured, he gets a pension; if he dies, his family receives an indemnity. Near the entrance of the Swiss end is a splendid hospital, with exceptional facilities for taking care of emergency and contagious cases. When the miners come out from working in the hot tunnel, they are required to take a bath immediately, so that they shall not at once be exposed to the keen Alpine air. After their bath, they are further obliged to hang their damp tunnel clothes in a dryer, and to don another suit while off duty. To these two precautions, more than to anything else, is to be attributed the constant fitness that has characterized the men.

As the Simplon workers had to be fifty per cent deeper below the earth's surface than men had ever before worked, it can well be fancied that the problem of heat was an important one, as heat and pressure increase with penetration and depth. At one point the Alps towered to a height of 7,005 feet (more than a mile and a-quarter) above the tunnelers. A temperature rising frequently to 110° had to be coped with. A new process, used for the first time in carrying out this Simplon contract, was invented to do battle with these conditions of torridity. Cold water, brought from the outside, was run through pipes pierced with little holes, and was thus made to fall in a fine rain. Through this liquid curtain, fresh air was forced, reaching the laborers so cooled as to be perfectly endurable.

From the very commencement, the ventilation feature of the enterprise has been successfully handled. The auxiliary tunnel has been used as an air-shaft, into which great blowers have driven the outside air at such a speed that at the tunnel's entrance one could barely stand up against it. Compressed and sent along at a low pressure, the air passes through the smaller boring until it reaches the last cross-section, going then into the bigger working where the men are located. It reaches them at the rate of 1,000 cubic feet a minute. The vitiated air is forced back and out through the main tunnel. A steady current is thus established, bringing in a new supply of oxygen and carrying off all injurious gases.



BRANDT HYDRAULIC PERFORATOR USED IN BORING SIMPLON TUNNEL.
The cutting teeth at end of stem are cooled by running water forced through hollow shaft.

Hot Springs Encountered

The great Nemesis of Herr Hugo von Kager, the chief engineer of the project, has been, not the hard strata of gneiss, gypsum, and dolomite, although these have been met with in plenty, but the continual occurrence of hot springs. Professor Schardt, official geologist of the tunnel, estimates that 1,000,000,000 cubic feet of water have poured out of the openings since the first spring was struck. In the fall of 1901, a boiling volume, discharging 8,000 gallons a minute, burst suddenly into the Italian workings, the two headings of the tunnel becoming at once veritable canals. It required three months to take care of this difficulty. The worse disaster of all, on the very eve of the tunnel's completion, was met last September, when a huge underground reservoir was accidentally tapped, and a parboiling cataract of water, with a volume of 18,000 gallons a minute, rushed into the tunnel. An appalling tragedy was narrowly averted, for the inundation, fortunately, came just as a shift was being made. The few men, however, that happened to be on the spot had to flee for their lives, some not being able to make good their escape. The temperature of this torrent was 112°, and so unbearable did it make the tunnel that work had to be suspended until the facilities for drainage and refrigeration could be doubled. Even when the men resumed operations, they had to be sprinkled constantly with ice water, otherwise they would have succumbed in this deadly portion of the cavern.

In the case of the minor springs, the very simple and ingenious plan has been to throw a stream of cold water into the fissure emitting the geyser, the flow thus being cooled down to such a degree that the routine work suffered no interruption. As the center of the tunnel is higher than either end, the descending gradients carry off the water to the outside. The channel in the floor of the tunnel which performs this drainage is covered with a non-conducting top to prevent the hot vapors from rising.

COMPRESSED-AIR LOCOMOTIVE IN TUNNEL.
Used for forcing water through the hydraulic boring machines and for cooling purposes.

The Item of Cost

When this herculean undertaking was started, the Swiss Government entrusted the work of construction to a company called the *Bangesellschaft für Simplontunnel Brandt Brandau und Co.*, extending to it a credit of $14,000,000. The tunnel was to have been finished in May, 1904; but the Government, recognizing the enormous obstacles that had confronted the engineers, granted an extension of time to April 30, 1905, and an additional payment of $1,600,000. As the tunnel is a little over twelve miles in length, this makes the cost about a million and a-third a mile. The Italian Government, as already said, united with the Swiss in financing the undertaking.

Other Alpine Tunnels

The first Alpine tunnel in point of time — the Mont Cenis — cost $1,100 for every yard of its length, the total expenditure being about $15,000,000. It is eight miles long, took fourteen years to

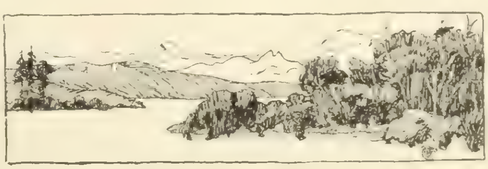
MASONRY ARCHING IN TUNNEL.
This form of support was necessary where the strata were found to be soft and rock-slips likely to occur.

bore, and was finished in 1870. Next came the St. Gothard. This is nine and a-quarter miles long, was constructed in nine and a-half years, and was completed in 1880 at a cost of $710 a yard, or a total cost of $11,500,000. The third tunnel—the Arlberg—is six miles long, took three years to build, was opened in 1883, and cost $500 a yard, or a total of $6,-000,000.

In the matter of approaches to the tunnel, the Simplon engineers have been more fortunate than the St. Gothard builders. In the latter case great artificial landing places had to be constructed at heavy expense, to afford an entrance to the tunnel; but the Simplon is naturally easy of access at both ends. The present Jura-Simplon railway, coming from Geneva, has a terminal only a short distance from the northern gate; while on the other side of the Alps, the Italian road at Domo d'Ossola can make a ready junction with the tunnel trains.

It is not yet announced what form of motive power will be used in driving trains through the tunnel; but the fact that the Swiss Government has ordered 160 cars for the line, to be built with closed platforms, would seem to indicate that steam, not electricity, was to be the motive power employed for the present.

With the completion of the Simplon, seven railroads reach Italy, four going under the mountains, two around, and one over. As far as traffic and travel are concerned, the Alps are now practically annihilated. No longer does this mighty, snow-capped barrier separate the north of Europe from the south.



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¶ Pull never had a show as against brains.

¶ Take time by the forelock, but don't pull it off.

¶ Applause has made fools of more men than criticism.

¶ Man wants but little here below—and that's about all he gets.

¶ More time may be lost by labor on Sunday than by loafing all the week.

¶ It is just as easy to find fault with an electric light as with a tallow candle.

¶ Some men know nothing, and know it and say nothing. Others know nothing and cannot keep from telling it.

¶ Hope is the one thing you can't bunko the average man out of.

¶ Most of the lectures delivered by women are to a one-man audience.

¶ There is in the worst of fortune the best of chances for a happy change.

¶ Many a man doesn't know what he is talking about until after it is too late.

¶ The world is full of professional sympathizers, devoted to all sorts of causes, who lift never so much as a finger in helpful action, but hope to turn the stars from their courses by philosophizing, dreaming, and discussion. From all such, Good Lord, deliver us.

Health in Shops

TWO agencies, independently examining the sanitary conditions in Massachusetts factories, have come to the same conclusions. One is the State Board of Health; the other, Professor Sedgwick of the Massachusetts Institute of Technology. Both have decided that the conditions are bad—in some instances very bad; and both agree that the danger to the health of the operative comes, in large measure, through the neglect of that individual himself to observe simple and obvious sanitary precautions. The report of the State Board of Health discloses a lamentable indifference on the part of workmen to their surroundings. In shops where dust is created in large quantities, and where the death rate from consumption is remarkably high, many of the workmen have been known to discard the simple appliances which are introduced to minimize the danger. In one brass-polishing shop, for instance, where hoods connected with a forced draught are put over the buffer wheels to take away the dust, some of the workmen have removed the hoods because they were "in the way," allowing the dangerous and poisonous dust to be scattered through the atmosphere. Spitting on the floor is exceedingly common in industrial establishments, and one consumptive can poison the whole atmosphere of the rooms, spreading death and disease among his fellow workmen.

While it is the duty of the manufacturer to provide, as far as possible, sanitary conditions for his workmen, something more than this is needed. It is the duty of the manufacturer, as well, to see that his workmen are compelled to use them. It is of little use for the State to pass laws providing better conditions for operatives so long as the latter themselves disregard obviously necessary sanitary precautions. The manufacturer can do more than the State to compel sanitary conditions in his workshop; and if cleanliness and neatness are insisted on as requisites for employment, there will be a great improvement in many of our manufacturing establishments. The only effective way in which the Legislature can act is, first, to see that the shop-owner provides proper sanitary conditions, and then, to hold him responsible to the State for the observance of those conditions by the men in his employ. The men themselves will not do it. At least, that is the state of affairs in Massachusetts shops, as discovered by two investigating agencies working independently.

Chances for Inventors

IN spite of the many wise heads at work on the unsolved problems of the day, so many of them are still unsolved, and so many new ones continually come up, that the chances for the man of inventive turn were never better. Many vast treasure fields remain intact. For instance, investigations have proved that huge areas of the floor of the Pacific are strewn with nodules of pure manganese. Invent a practical and economical method for recovering these nodules, and you will become rich beyond the dreams of avarice. Another crying need of the day is a complete substitute for Para rubber. Celluloid, oxidized linseed oil, and other preparations have been used for some of its purposes; but for cycle and automobile tires, only the real Para has sufficient elasticity. A perfect substitute at a less cost would make its inventor many times a millionaire. Malleable glass was manufactured and used by the Romans 2,000 years ago. The process has long been lost, and it seems odd that in this mechanical age no one should be able to rediscover it. Real photography in colors is still an open field, and offers boundless prizes for the inventor. In smaller matters, too, the need is endless. Jewelers, for instance, are still quite without any safe method for fixing pearls on jewelry, such as rings, where the gems are mounted without a surrounding setting.

Gold Ships of the Rockies

MODERN engineering skill and invention create such a constant succession of paradoxes that while we cease to be surprised we must perforce continue to wonder. Power continually manifests itself in new forms. With horseless carriages, engineless trains, wireless telegraphs, and voices reaching our ears from hundreds of miles away through telephones connected with nothing in particular, we have been taught to familiarize ourselves. Yet sea-less ships, which plough the land, making their own floating docks and taking them with them as they go, never reaching port, yet tremendously profitable to their owners, are calculated to make us pause for a moment in the hurly-burly of mechanical progress and admire such a topsy-turvy manifestation of engineering genius.

Hundreds of such ships are now afloat in the valleys of the Rocky Mountains and the Coast Range of the Pacific. They are built a thousand miles from the smell of the sea in many instances, where neither lake nor navigable river exists. Such are the gold dredges of the West. They carry machinery weighing sometimes 300 tons. They are built on dry land where no water exists for their floating; they take a drink from an irrigating ditch and then proceed to burrow. Water from the underground sources wells up in the excavation, then they are afloat and begin to move slowly on. The soil they take up is washed through their sluices and passes again into the little artificial lake beneath them, leaving its gold behind.

All the complicated machinery of this modern land steamship is handled by one man, who inhabits a pilot house surrounded by levers like a railroad signalman among his semaphores, operating the ship at will. The cost of operating these great ships is so slight that gold-bearing earth can be handled at an expense of five cents to the ton, so that if a cubic foot of earth contains even a cent's worth of gold a profit results.

These wonderful new machines have appeared only within the last few years, but already they are cutting a very important figure in the rapid increase of gold production in this country. Placer ground hitherto considered valueless on account of its small proportion of gold to the acre, is now workable; and the ships are producing great wealth and spreading devastation at the same time. Orange groves and olive plantations are being ripped up for the value of the sand beneath them; and the ships plough their way on, leaving barren nakedness behind.

The situation thus created is as unique as the machines, and government experts have been sent out to study it, hoping that it may be so modified as to let the dredges produce the gold while leaving the land behind them in such condition that it can be replanted. There is an old proverb that says: "One may not eat his cake and keep it too," yet the engineering skill which devised the dredges may yet hit upon such modification of their form and use as to make this possible. Great faith may well be placed in the modern engineer. He is invincible.

To Harness the Tides

AS more and more the great forces of the rivers are being taught to pull and haul for the service of man, so the eyes of the inventor turn to the power of the tides and waves of the sea, feeling sorrow that such should not be put to work. A hint in this direction is already before the public in the wave motor invented by William Armstrong, of Santa Cruz, California. A brief description of this motor, with illustration, appeared in the January, 1905, number of THE TECHNICAL WORLD (page 561). Here two wells have been sunk in a cliff to six feet below low water, and connected with the sea. In one well is a float, in the other, a force pump. An incoming wave lifts the float, which falls with its 1,600-lb. weight when the wave recedes. This weight pushes on the piston of a force pump in the other well and sends the water through pipes to a tank 125 feet above. The motor has been working satisfactorily since 1897, and thus in a small way a great problem seems to have begun to reach solution. Mighty enterprises, however, are also on foot for utilizing sea power on a very large scale. Power producers have their eyes on the almost unlimited energy embodied in the tides in the Bay of Fundy. Twice a day the flow fills the great Minas Basin to a height of nearly forty feet; then ebbing, leaves it bare. This is the greatest rise and fall of tides in the world, and its aggregate power is far beyond that of Niagara. A series of locks and basins sending this mighty force through penstocks, and with turbines converting it into electricity, is said to be the mechanical basis of the proposed scheme.

Greater Speed of Vessels

SOME flying trips across the Atlantic may be expected soon if the claims of many inventors and manufacturers may be credited. Several new turbine devices have been put forth as able to carry a ship across the Atlantic in four days and even in less time. The Cramp Shipbuilding Company claims to have a boat which will cross in three days. If by that they mean the run of 3,000 miles between Liverpool and New York, their claim is a sustained speed of nearly 42 miles an hour, or greater than that of any railroad train at present for the same distance including stops.

Carl J. H. Flindt, once sea captain, new tug-boat master, is said to have spent twelve years of time and $37,000 in perfecting a boat which he believes will work wonders. The Cramp boat, he says, will not cross the Atlantic in four days, while his will do it in two and a-half days, or at the rate of 50 miles an hour, assuming that he, too, means the voyage of 3,000 miles. Flindt has not given the public anything more than a hint of his methods, but it is a suggestive hint. He says he has accomplished two things—improved the propeller and improved the form the hull. His claim of speed is very extravagant, in view of the resistance to be overcome. Yet to one taking merely a common-sense view of the matter, without pretending to scientific or technical knowledge, it looks as though Captain Flindt were pursuing the right method to secure the highest practical speed. While Flindt does not give a hint as to his propeller, it seems evident that the pitch of the screw is a very important matter if a high speed is to be maintained. As to the form of the hull, it is self-evident that the form which offers the least resistance in passing through or over the water will be most conducive to speed. It shows that the form is of prime importance. Upon that point Captain Flindt says: "I accidentally hit on an improved bottom based upon the idea of the hull of a catamaran." This serves to convey a suggestion as to the nature of his improvement in this direction. He claims to have about doubled the speed by improving the propeller, and then to have doubled it again by improving the hull. Maybe efforts in this direction toward acquiring greater speed will prove more productive of good results than those inventions which have caused the increased tonnage of fuel carried to offset the increased speed of the vessel.

Increasing the Earth's Capacity

THE chemist and the engineer now walk hand in hand with the farmer in increasing the earth's capacity, with the National Government behind the two. The Agricultural Department is busy experimenting and devising new methods whereby the planter can get better returns from his crops. Its chemists analyze and synthesize fertilizers, and study the obscure habits of bacteria as no farmer could, teaching him in a pamphlet what he might not learn otherwise in generations. Now into the field also steps the engineer, with an even larger usefulness before him. Experts have figured that the food-producing area of the United States can be doubled by the solution of the two problems—which engineers alone can solve—drainage and irrigation.

Within the area of the United States, Professor Shaler of Harvard University has estimated that the fields improvable by drainage would add to the tillable area of the country more than 100,000 square miles, with a food-giving value greater than that of the State of Illinois, wherein the producing power of the soil would be far greater than that of any uplands. The complementary process, that of irrigation, promises to afford yet larger gains, including the area of the South and the Middle West. The field before the engineer in the workshops is a great one and is ever increasing; but the solution of the greatest problems of the coming age lie still before him in the great out-of-door world, giving ever-increasing opportunities for men with large technical training.

The Largest Locomotive

THE electrification of steam railways at terminals and in suburban traffic may be proceeding apace, but the good old steam mogul still continues to buck freight up heavy grades and do yeoman work on long distances, and probably will for some time to come. The Baltimore & Ohio road has just put in use the largest compound freight locomotive in the world. This is in use in the "pusher" service over Sand Patch Hill in the Alleghany Mountains. It is in fact a pair of locomotives with one boiler. The engine in working order weighs 334,500 lbs.; and the weight of the tender, filled with 7,000 gallons of water and 13 tons of coal, is 143,000 lbs. This engine has the greatest heating surface ever put into a locomotive—5,586 square feet. Of this area, 219.4 square feet is in the fire-box, and 5,366.3 square feet in the tubes, the latter being 21 feet long. These proportions outdo anything of the kind ever before designed for a locomotive. The immense power of this engine may be conceived from the drawbar pull, which is 70,000 lbs., working compound; or 80,000 lbs., in simple gear. The boiler will carry a working pressure of 235 lbs.

MINUTE MAN STATUE AT LEXINGTON.

Minute Man Statue, Lexington, Mass. A bronze statue of Capt. John Parker, commander of the Lexington Minute Men, surmounting a drinking fountain constructed of field stone. The sculptor was H. H. Kitson, of Boston. The statue, which is the gift of Francis Brown Hayes, was unveiled April 19, 1900. The term "minute men" originated at the time of the Revolution. It was applied to certain militiamen who held themselves in readiness to march at a moment's notice. Captain Parker was commander of the first military organization to meet the soldiers of England, and dispute with them by force of arms their right to intrude upon the rights and properties of American citizens. At the time of the Revolution, Captain Parker was living at the old homestead in the southwest part of the town. He had 120 men under his command at the Battle of Lexington. On the 6th of May following, he joined the American Army with a troop of 45 men. At the Battle of Bunker Hill, he was stationed with 61 of his command at Cambridge, to prevent the British from crossing the Charles River. He died September 17, 1775.

The Harlow House, Plymouth, Mass. Also known as the Water-hole House. Built in 1677 by William Harlow, of timbers taken from the old fort. Probably more of the original timber in it than in any other house now standing in Plymouth.

Site of the First Meeting-Place, Plymouth, Mass. There are few spots in America hallowed with more sacred associations than this first "church site" in New England.

LEARNING TO ASSEMBLE AND ADJUST THE MACHINERY.
View taken in the school at Aschaffenburg, Germany.

The School for the Chauffeur

Now An Established Institution—An Outgrowth of the Necessity for Expert Training in the Running of Automobiles

By FRITZ MORRIS

AUTOMOBILING having passed its infancy and graduated from the "fad" period into a recognized mode of transport—and one with an immense future—its safety must be looked after. The school for the chauffeur, therefore, has become an institution; and there are already such schools in New York, in Chicago, in Berlin, in London, and in Paris.

REPAIRING THE ENGINE.

These schools have their regular classes, but it is in the operative class that the trials of the novice become most painfully apparent. Machines which theoretically have been "set up" in the most approved fashion, have a mean habit of refusing to work when needed. Sometimes the ignition spark won't "spark," and at other times the starting-crank falls into the exasperating habit of jumping backward instead of going ahead. When this happens, the chauffeur in embryo usually gets it in the chest and is tumbled over backwards in the dirt.

Even when the difficulties of getting the engine working properly have been surmounted, the beginner learns that sometimes at that stage a really wicked motor car will refuse to "mote" properly. It displays a fondness for curbstones, fences, and posts, and is not entirely averse to attacking unsuspecting pedestrians. The chauffeur-to-be learns that at times such as these, the steering wheels and brakes have a way of mixing themselves up and running together that is aggravating in the extreme. Some of the students say that at times a really good chauffeur must simply turn the goodness on full head, to prevent his becoming as wicked as the devil wagon he is driving. There is, too, a sense of relief conveyed at such times by a sight of the flat-capped, leather coated professional, who goes along with each class of beginners. Though he is not, perhaps, a graduate of an automobile school, his hand on the right lever at the right moment is looked upon as an essential part of the course by the timid beginner.

Learning to Steer Backward.

In Europe, these schools for the chauffeur are usually under governmental or municipal supervision, and the students, for the most part, are young men of good family and education. In London, there is a school especially for teaching men motor driving through the most crowded streets, and the school has several powerful four-cylinder cars of up-to-date construction for practical study by its pupils. There are also numerous workshops in which all branches of instruction and repairs are demonstrated. Every pupil, too, is thoroughly grounded in the rules of the road and in speed laws. When proficient, the motor cabman applies at Scotland Yard, the London Police Headquarters, where he has to prove to the Inspector his capability of driving and managing an automobile before he is permitted to take his stand on the rank

PRACTICE IN MAKING CLOSE PASSES.

INSERTING NEW TUBE.

with other cabs. The result is that motor accidents and the running down of pedestrians in London are few, at least, when one considers the millions who throng its thoroughfares.

The first German school for chauffeurs was established last November at the "Technicum" (a technical academy for the teaching of constructing of machinery and electro-technics), in Aschaffenburg, under the management of Director Kempf. The statutes of this school were submitted to the Royal Bavarian Government for approval, and, after careful study, were approved. Director Kempf was prompted to found such a school because of the many accidents occurring last summer, which, in most cases, were attributable to a steering and driving that lacked the proper understanding.

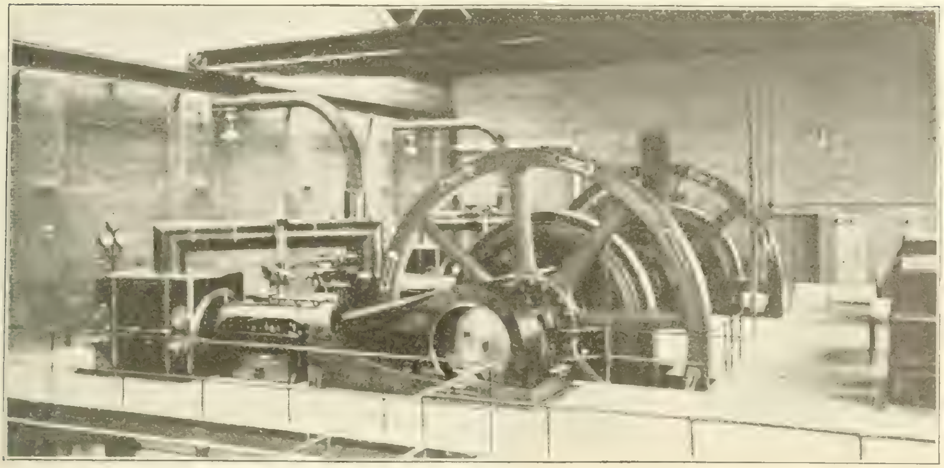
According to the statutes, there are four training courses a year, each covering ten weeks. At the end of each course, a very rigid examination, conducted by a commission composed of experts, is held; after which those who have entered for such examination and have passed the same in a satisfactory manner, receive a certificate stating their ability to act as chauffeurs of automobiles. The curriculum, besides the theoretical part, demonstrates, first of all, a practical training, consisting principally of work done in shops where mounting, equipping, and fitting are attended to, and especially of driving exercises; the putting on of pneumatic tires; keeping clean the motor parts, etc. The various types of gear and other mechanical parts are demonstrated to the pupils from a theoretical as well as a practical standpoint.

Keep a Goin'!

EF you strike a thorn or rose,
Keep a goin'!
Ef it hails or ef it snows,
Keep a goin'!
Tain't no use to sit and whine
When the fish ain't on yer line;
Bait yer hook and keep a tryin',
Keep a goin'!

FRANK L. STANTON.

INTERIOR OF POWER HOUSE, INDIANAPOLIS & CINCINNATI TRACTION COMPANY.



A New Type of Electric Railway

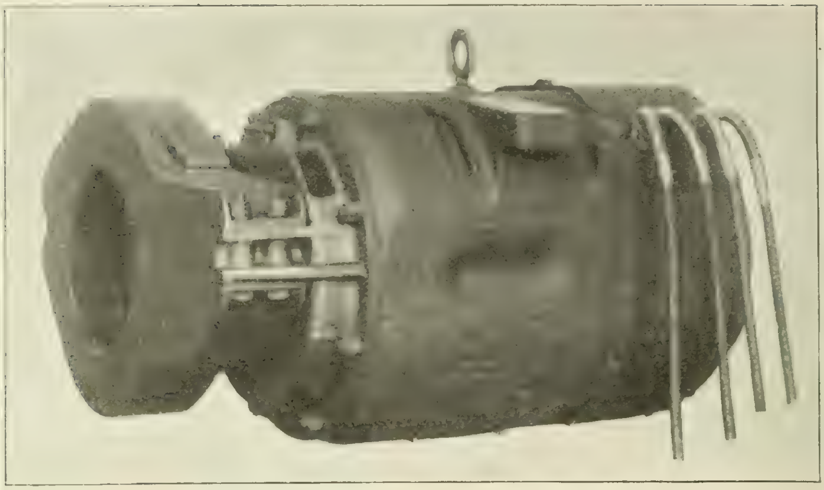
Ths Single-Phase System of the Indianapolis & Cincinnati Traction Company

By R. G. MERTON

THE first single-phase electric railway built for commercial operation is that of the Indianapolis & Cincinnati Traction Company, which was first opened to the public but a few weeks ago. This road, which, when completed, will run from Indianapolis to Cincinnati, passing through a number of other towns upon its route, has been finished between Indianapolis and Rushville; and this portion of about twenty miles is now in operation under the new system.

In practically all of the electric railways which have been built during the last five years, the current for the entire road is generated at one main generating station in the form of three-phase alternating current; and this alternating current is transmitted to sub-stations about fifteen miles apart, where the three-phase current is changed into direct current, and fed out into the trolley wires for use on the cars. The object of this method of distribution is to reduce the size of the copper conductors, as the size of the wire necessary to transmit the standard railway current of 500 volts to a distance of over seven or eight miles would entail an almost prohibitive expense. For this reason, three-phase alternating current of a very high voltage is used to convey the current from the generating station to the sub-stations, as a current of very high voltage can be transmitted over very long distances upon

TRANSFORMER STATION AT REEDVILLE, INDIANA.

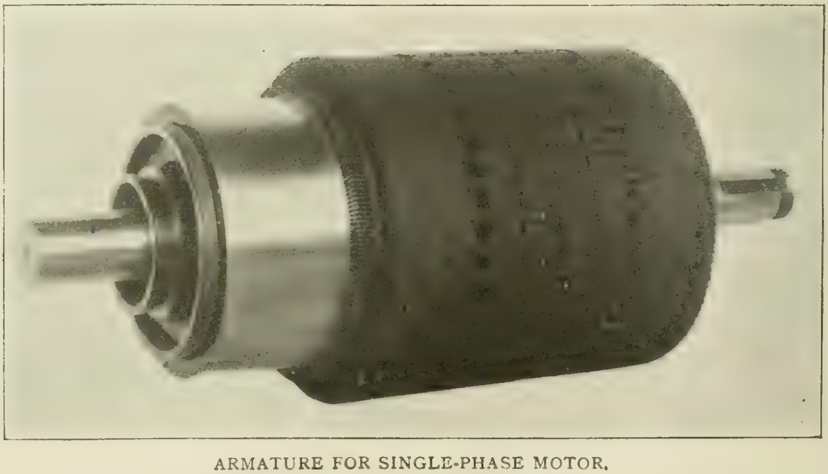


SINGLE-PHASE MOTOR.

very small wires with but little loss in voltage.

The rotary converter sub-stations in general use are a large source of expense, as they contain complicated moving machinery and regulating apparatus, and require the attendance of skilled electricians. It should also be explained that single-phase motors which could start under load have not heretofore been built; and for this reason the use of three-phase current has been necessary in order that the sub-station machinery could be self-starting. Some three-phase systems using alternating current directly on the car motors have been developed in Europe, but are not favored by American engineers, for the reason that at least two overhead trolley wires are required, and the cars of this system can operate only at two fixed speeds.

In the new system which has just been put into operation an alternating current is used throughout, from the generating station to the motors under the car. This was made possible by the production, a few months ago, of a single-phase motor which is self-starting under load and which exhibits practically the same characteristics as the standard 500-volt direct-current motor universally used on electric cars in this country. The new single-phase motor is in general appearance very similar to the direct-current motor, except that its poles are built of laminated sheet steel with insulating material be-

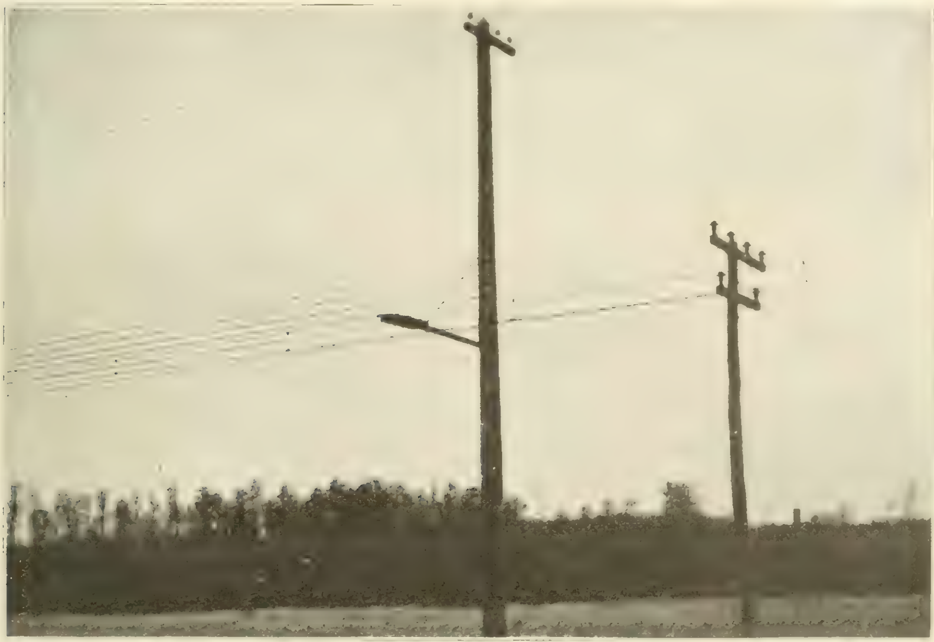


ARMATURE FOR SINGLE-PHASE MOTOR.

tween the sheets of metal to prevent excessive overheating, and certain changes are made in the armature winding to prevent destructive sparking of the brushes on the commutator.

The entire current for the new road is generated at a single power house situated at Rushville, Indiana, an interior view of which is shown herewith. A boiler room occupies about half of the building; and the rest is divided into two parts, the larger room being the main engine room, and the other part being known as the "high-tension chamber." The engine room contains two alternators, generating current at 2,300 volts, three-phase. This current is led to the high-tension chamber, where it is changed by means of transformers to two-phase current at 33,000 volts, at which pressure it is transmitted along the line of the road to the different transformer stations.

The road is divided into sections of ten or twelve miles in length, each section being supplied with current from a transformer station. The 33,000-volt current is led into each of these transformer stations, where it is reduced to 3,300 volts, single phase, and fed into the trolley wire for use on the cars. It is largely in these transformer stations that the economy of the system lies. As already said, the cost of attendance for the rotary converter sub-stations is a large item of expense. The transformer station contains no moving machinery; and for this reason no attendance is necessary, and the station requires only occasional inspection. There are three transformer stations on this road between Indianapolis and Rushville. It is estimated that the annual saving in wages, in these three stations alone, would amount to about $6,500; and on the ten stations which will be installed between Indianapolis and Cincinnati, the annual saving in wages alone would, on the same basis, amount to nearly $22,000.



OVERHEAD CONSTRUCTION SHOWING CATENARY SUSPENSION.

Another feature which makes the operation of the single-phase system extremely flexible, is the ability of the motors to operate not only between wide ranges of voltage, but also to operate with equal facility on both alternating and direct currents. This feature is taken advantage of in meeting the conditions imposed by the franchises of the Indianapolis & Cincinnati Traction Company.

OVERHEAD CROSSING NEAR JULIETTA, INDIANA.

On its private right of way, which is continuous, except in passing through cities, the trolley wire is fed with 3,300-volt current. In passing through some of the cities along its route—as, for example, Rushville—such a high voltage is prohibited; and in this case the 33,000-volt current is transformed down to a 550-volt alternating current, for use within the city limits. In passing through the city of Indianapolis, the cars of this road operate over the tracks of the local company, which are equipped with the standard 500-volt direct-current system, and the same motors are used as on the alternating-current part of the line. The cars are each equipped with two trolleys, one of the usual type, and the other a bow trolley which makes a sliding contact with the alternating-current trolley wire.

105-FOOT BRIDGE OVER BIG SUGAR CREEK, NEAR PALESTINE, INDIANA.

In entering the city of Indianapolis, the bow trolley is pulled down and the ordinary trolley with a wheel is used on the direct-current line.

The construction of the alternating-current trolley line is novel. The trolley wire is supported by what is known as "catenary" suspension. A strong steel cable is suspended from pole to pole; and the copper trolley wire is carried eight inches underneath this steel cable, to which it is supported at intervals of ten feet by special steel clamps. Owing to its strength, the steel cable can be drawn tight, so that the trolley wire is practically level. This system offers the greatest immunity from danger of broken trolley wires, as, in case of a break, the copper wire being supported every ten feet, the broken ends could not reach the ground or hang low enough to come within reach of pedestrians.

This road has been designed to operate cars at a very high speed. The local cars have a schedule speed of 30 miles per hour; and to handle the through service, limited cars are to be put on the line, each of which will be equipped with four 150-horse-power motors designed to operate at a schedule speed of 60 miles per hour. The road has been built with a view to handling heavy freight as well as passengers, and its construction throughout is very substantial. The new system has operated so far in a highly satisfactory manner; and its success in this instance will undoubtedly inaugurate an era of long-distance electric railways operated throughout with alternating current.

Since the foregoing was written, the last spike has been driven on the line of the Vallejo, Benicia & Napa Valley Railway, to run between Vallejo and Napa City, California, a distance of 16 miles. This is the second single-phase line to go into operation; a third one, in northern Illinois, is nearly completed.

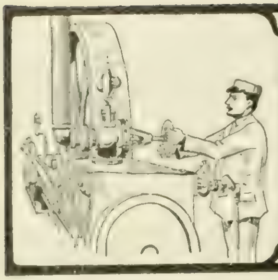
A Song of Worry

WHAT'S the use to sit an' worry if you lose, who thought to win?
Kick the worry out the winder—let the livin' sunshine in!
Time ain't sighin'—
He's a-flyin';
Worryin' is half a sin!

What's the use to work for worry? Ain't there any hope in sight?
Kick the worry out the winder, in the blizzard an' the night!
Time don't worry—
Too much hurry!
Swifter than an eagle's flight!

What's the use? There ain't a reason, nor the shadder of a rhyme,
When the worl' rolls on in music, an' the stars are keepin' time!
Time ain't cryin'—
He's a-flyin',
An' you're on the wings of Time!

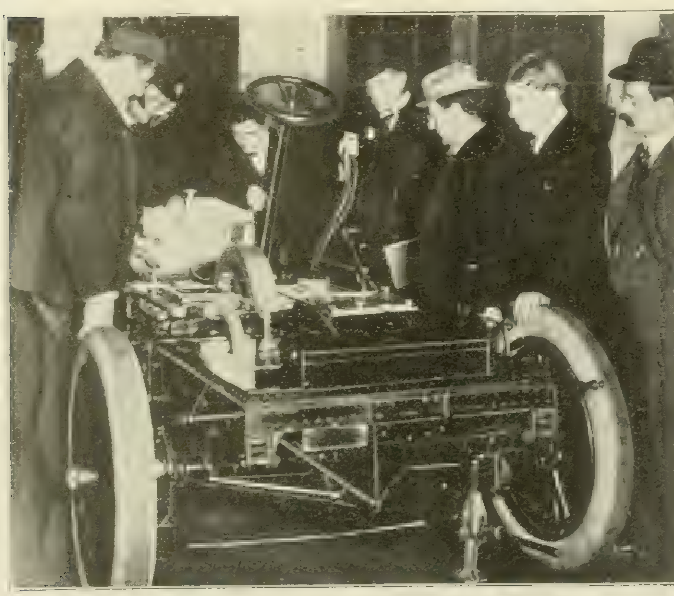
—FRANK L. STANTON in *Atlanta Constitution.*



ENGINEERING PROGRESS

A School for Chauffeurs

THE Young Men's Christian Association of Boston has inaugurated a school for the training of chauffeurs, believing that this vocation offers an excellent opportunity to young men out of employment. In the school are several chassis, which form object-lessons in the construction of automobiles of various types. Daily lectures are given by an expert in automobile construction and management, which might be said to form a mechanical clinic, as the various parts of the chassis are examined separately. The course of instruction includes not only the general management of the car, but the best methods of lubricating its mechanism, instruction how to make simple repairs, and an explanation of the uses of the various parts. The accompanying photograph shows a class of applicants at one of the lectures.



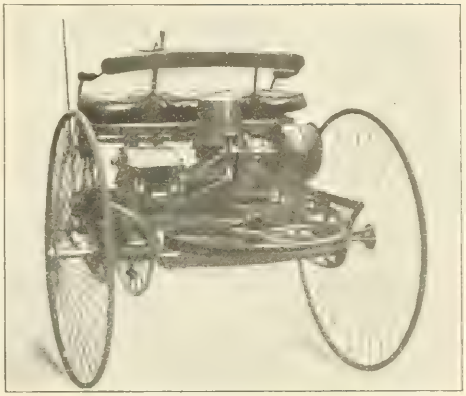
BOSTON Y. M. C. A. SCHOOL FOR CHAUFFEURS.

First Gasoline Auto

EARLY types of automobiles are already beginning to look extremely ridiculous when compared with the modern graceful tonneau and palatial limousine. What will they appear like when the automobile has advanced as far as has the present-day locomotive? The first locomotive will probably look handsome beside the first automobile when subjected to our critical gaze.

The first gasoline automobile is shown in the accompanying illustrations. What a gawky, "woggle-bug" looking tricycle it now appears to be, though a few years ago it was considered quite a beauty. This machine is named the "Adam," and is still in the possession of Benz & Company, Mannheim, Germany, its makers. It is the invention of Carl Benz. The patent protecting this contrivance is dated January 29, 1886. The propelling power was a three-horse-power gasoline motor, firmly secured to the frame in the rear of the seat. The drive was through a flat belt to the countershaft on which was located the differential gear. From the

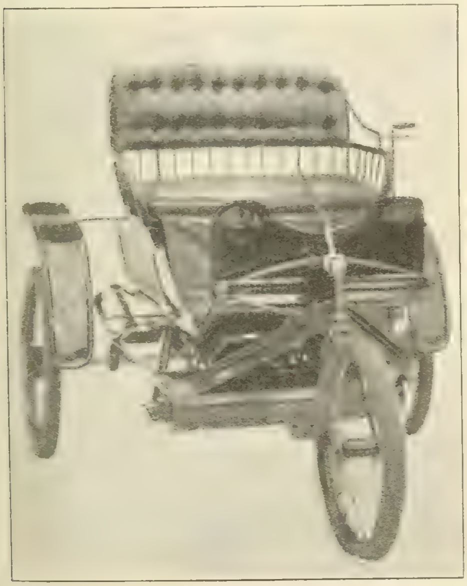
THREE-QUARTERS FRONT VIEW.



REAR VIEW.

ORIGINAL BENZ CAR.

countershaft a double-chain drive transmitted the power to the rear wheels. The cylinder was water-cooled by means of a thermosyphon system. The Bunsen system of electric ignition was employed. A supply of gasoline and water sufficient for a 20-mile trip was carried in respective tanks. The vehicle was steered by means of a lever mounted on a vertical column, which communicated with the forked crown of the front wheel. The seat, with accommodation for two, was luxuriously upholstered for those days, and the hard rubber tire was considered most satisfactory. When first exhibited at Munich, Bavaria, in 1888, these cars took the gold medal, and they at once created a furore in transportation circles.



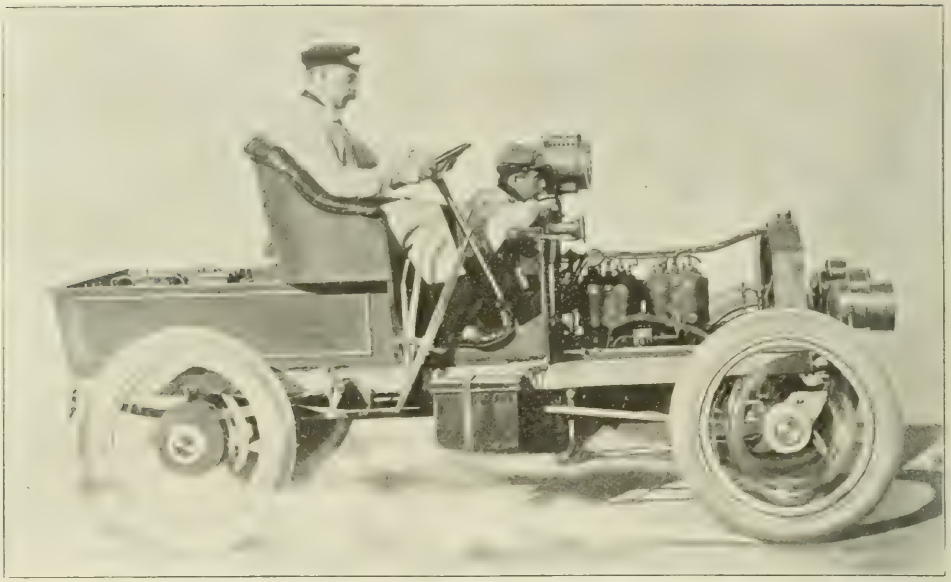
FIRST WATERLESS KNOX MOTOR VEHICLE.

A Mail Auto

IN various portions of the West, the automobile is now being utilized quite extensively in mail delivery and collection service, not only in the cities, but in

U. S. MAIL AUTOMOBILE.

the rural districts. The accompanying illustration shows a runabout specially equipped for rural service in winter. To the rear portion is attached a wooden box, which is divided into apartments for mail to be delivered and mail collected. As a substitute for horses, even in the winter, the automobile has been proved to be a pronounced success.



TOURING CAR MAKING 33½ MILES AN HOUR ON A 1,000-MILE RUN.

Automobile Makes 1,000 Miles at 33 1-2 Miles an Hour

ONE thousand miles in an automobile at 33½ miles an hour without a stop of the motor, was the remarkable record recently made in a test on the Grosse Pointe, Michigan, mile track by a machine of American make. The feat has demonstrated conclusively that America can build motor cars of just as high standard of excellency as can any other country.

Of course it was impossible to make this extraordinary run at the high speed without stopping the car, for the tires could not endure the wear, and had to be replaced several times. It was also necessary to stop the car at times to change drivers and mechanicians, and for other purposes. Charles Schmidt was the driver at the beginning and end of the run, though E. Roberts and S. D. Waldon, of Detroit, had manipulated the motor at intervals during the performance. The illustration shows the car in motion with Charles Schmidt at the helm. The automobile made the thousand miles at the speed mentioned, including stops for replacing worn-out tires, replacing drivers, lighting lamps, and taking on board needed supplies. A report of the performance states:

CHANGING WHEEL AND TIRE.
On long runs, this method of changing complete wheel, and then changing tire at leisure, effects great saving in time.

"Never before has anything created by man ever traveled so far at such a speed under its own power. Transatlantic steamers come the nearest to it by making the distance but not the speed. Locomotives make the speed, but relays of from eight to ten are required to make the distance; yet the automobile made both the speed and the distance with perfect ease, without the briefest moment of rest or relief for the motor, and with a uniformity of operation as evidenced by the times for the individual miles as shown in the tables, which altogether makes the record stand with absolutely no parallel in engineering history."

The car started at 6:16 P. M. on a Saturday and finished at 12:9:37⅗ A. M. the following Monday. The start and finish of the run were witnessed by a large number of people who cheered Schmidt to the echo when he stopped the motor at the finish for the first time during the test.

Auto Climbing Test

SINCE the advent of the automobile, it has been put to some remarkable tests in ascending grades, but one of the most remarkable experiments ever attempted was successfully accomplished in the city of Lansing, Michigan. A runabout driven by a gasoline engine of 4½ horse-power was forced up the steps leading to the main entrance of the City Hall, without other aid than its own propulsive power. The height of the entrance from the street is no less than thirty feet; and the tier of steps comprises forty in all, each being less than a foot in width. The automobile was given a start of about fifty feet on the smooth pavement before beginning its climb, but was successfully driven to the top without stopping. The accompanying photograph shows the vehicle when halfway up.

Auto Speeding

WHEN a train or an automobile travels at the rate of 60 miles an hour, this means going a mile a minute, or about 90 feet as quickly as you can snap your finger. In fact the velocity is such that it cannot be appreciated, yet the lens of the camera has been developed to such an extent, that a fairly good picture can be taken of a vehicle traveling at this speed. The accompanying photograph shows two automobiles actually speeding

AUTOMOBILE CLIMBING STEPS OF PUBLIC BUILDING.

at the rate of 60 miles an hour, as proved by the stop-watches of the judges. It is a picture taken recently, of a race in Columbus, Ohio, where the world's record for automobiles at that time was beaten. The outlines of the vehicles are very clearly defined. In taking this picture, the shutter which covered the lens was moved in about one-thousandth of a second. Various world's records were beaten on the Ormond-Daytona beach race-course, Florida, the last week in January of this year, one "freak" machine making a mile in 32⅘ seconds.

COURTING DEATH MERRILY.
Automobiles racing at sixty miles an hour.

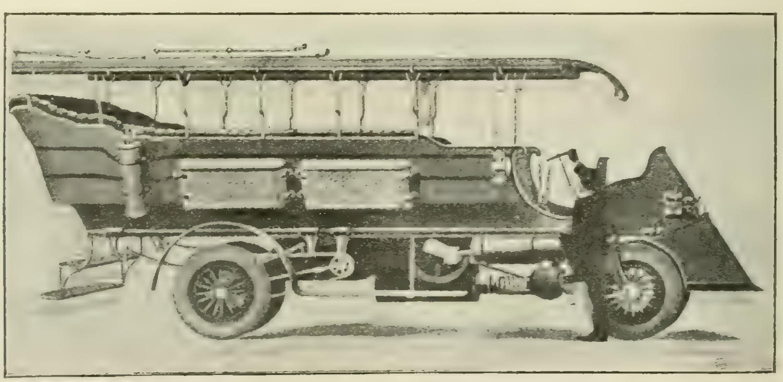
THREE CENTURIES OF TRANSPORTATION AT A GLANCE.
View taken at Ormond, Florida.

Three Centuries at a Glance

ON the Atlantic coast between the towns of Ormond and Daytona, Florida, can probably be seen more types of motor vehicles than elsewhere in the world. As is well known, the surface of the beach on this section of the coast is so hard and smooth that it affords an ideal racing course, and each winter a large number of chauffeurs are attracted to it. Not only runabouts and touring cars can be seen, however, but bicycles, tricycles, and occasionally the old-time ox-cart. The accompanying photograph, which was taken at Ormond, shows four different kinds of vehicles which, as types of locomotion, may not inappropriately be said to represent the eighteenth, nineteenth, and twentieth centuries.

World's Largest Automobile

ACCOMMODATING ten persons, containing separate sleeping apartments for long-distance trips, and arrangements for serving meals in the vehicle either at a party table or at private tables beside each berth, a new automobile that has been built at Cleveland, O., is a modern triumph in motor-car construction and is the largest automobile in the world. The machine is of 408 horse-power, and was built at a cost of $35,000, for Mr. Louis D. Schoenburg. There is a complete



SCHOENBURG AUTOMOBILE WITH TOURING BODY.

kitchen and dining room, and the interior throughout is richly ornamented, handsomely furnished, and as luxuriant as a home. It carries a dynamo for electric lighting and heating. Three separate bodies are provided—the Pullman body, touring body, and racing body. The machine is thus adapted to all the requirements of modern automobilists, and is nearly equivalent to three separate automobiles. With the Pullman body, the Schoenburg automobile is a veritable palace on wheels; with the touring body it is an ideal vehicle for overland trips; and with the racing body it will make a speed of 100 miles an hour.

Hydraulicking Railroad Obstructions

SLUICING away vast masses of earth and sand from a railroad track is a method of opening up traffic quickly, which has been successfully adopted by the Great Northern Railway in the State of Washington.

Some distance north of Seattle, the railroad runs along the shores of Puget Sound. Back from the line is a steep ridge, along the base of which the grade was established. The soil is rather sandy, with small gravel intermixed; and during heavy rains the water percolates through the embankment and follows the descent down to the road. The seepage and pressure are continually causing great masses of earth, sand, and gravel to slide down on the track, creating vexatious and costly delays.

The "old shovel route," as it was called, has now been superseded by much faster methods. An immense steam pump has been substituted for the army of shovelers formerly needed to clear the track. This pump, operating in connection with a large hose, rapidly removes the earthy obstructions. A powerful stream of water is sent through the hose, and the masses of earth and sand melt away very fast. In a very short time the steam pump and hose can perform the work of hundreds of men.

Motive Power for Automobiles

IN discussing motive power for automobiles before the American Motor League in New York, Prof. R. C. Carpenter said:

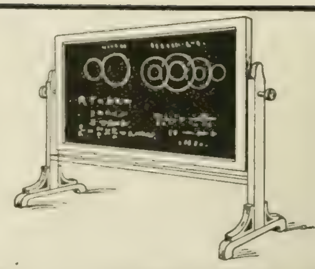
"At the present time the gas engine motor is the most economical and most convenient means of propulsion known; and, in view of the general developments in the art of power

REMOVING RAILROAD OBSTRUCTIONS BY HYDRAULICKING.
Illustrating method adopted by Great Northern Railway in the State of Washington, near the coast of Puget Sound, where landslides are continually obstructing tracks.

engineering, it does not seem probable, nor possible, that it is likely to be superseded to any great extent by any other motive power. On the contrary, it is possible that still further advances will be made in the art relating to its use, and that it will continue to be more and more the dominant and principal motive power used for automobiles. The electric carriage enjoys the distinction of being the easiest to operate and control, the most nearly noiseless in operation, and the most cleanly in use. Despite the inefficiency of the steam engine as a means of converting the energy of fuel into work, it is never likely to be superseded for certain classes of work required of automobiles, because of the advantages it possesses in the way of reliability, easy and ready starting, quick and accurate control."

CHALK TALKS

by CARL S. DOW.



Number Fourteen—Turning Tapers

THE turning of a given taper is a point in machine-shop work that has puzzled many a mechanic. The turning of tapers by setting over the tail-stock seems to present greater difficulty than the other methods; hence it will be more carefully considered here.

Tapers

Tapers are usually designated by the amount per foot, that is, "¾ inch per foot," or "2 inches per foot." This means that if the piece is one foot long, one end has a diameter ¾ inch greater than the other end. If the taper is 3 inches per foot, the diameter of one end is 3 inches greater than that of the other, provided the length is one foot.

Sometimes the taper is stated as "1 in 8," or "1 in 12." In such cases, it is easy to reduce to "amount per foot." A taper of 1 in 8 is evidently 1½ inches per foot, for $12 \div 8 = 1.5$. A taper of 1 in 12 is 1 inch per foot, for $12 \div 12 = 1$. Although the taper is thus designated, the length of the tapered piece is not necessarily twelve inches. The statement means that the piece has a taper such that if it were one foot long, the difference in diameter would be the stated amount.

Fig. 1 (see blackboard) shows a piece of which one end has a diameter of 3 inches, and the other end a diameter of 3¾ inches. As the difference in diameter is ¾ inch, and as the piece is one foot long, the taper is ¾ inch per foot.

The Lathe

We all know that if both the live center and the dead center are in line, a piece will be turned having the same diameter at each end. In other words, the piece will be "straight." We also know that the cutting tool is rigidly fastened to the carriage, which must move parallel to the center line because of the guides or V's. It is easy to see that if either center is moved from the center line, the piece will be turned smaller at one end.

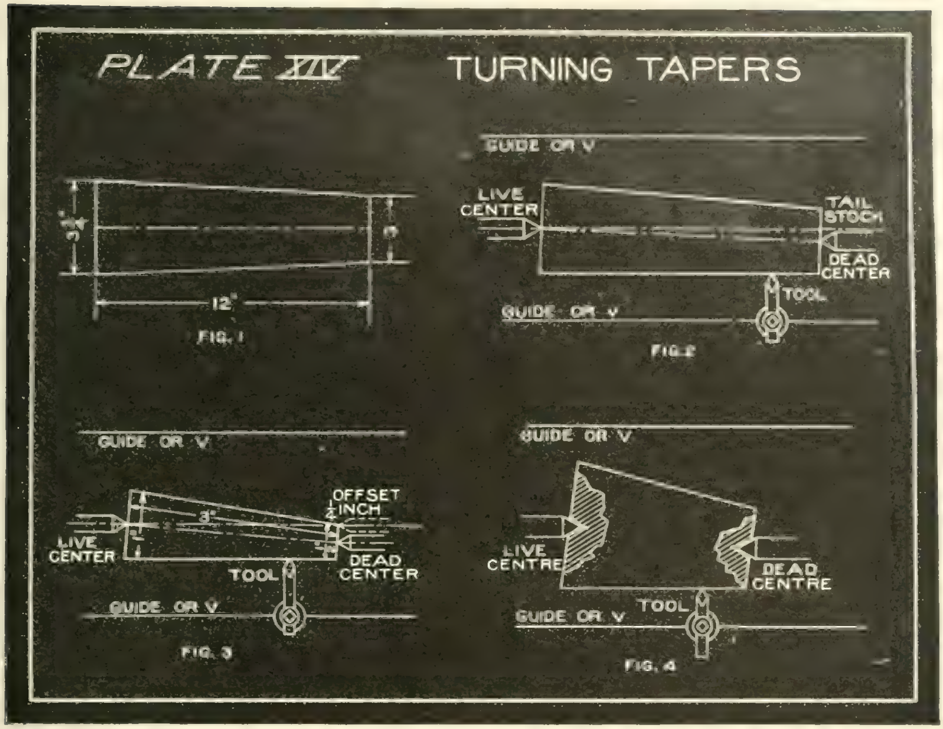
Fig. 2 (and also all the rest of the illustrations on the blackboard) represents a tapered piece in a lathe. The observer is supposed to be looking down on the lathe. From Fig. 2, we see that the end nearest the tool will be the smaller. As the head-stock is usually immovable, it is customary, when turning tapers, to move the tail-stock from its central position. Since most tapers are turned having the small end at the tail-stock, the dead center is usually moved toward the tool or toward the front of the lathe.

In Fig. 2, it is assumed that the centers merely touch the ends of the piece; this is not true in practice; but this assumption makes the calculation easier. The effect of inserting the centers in the ends will be taken up later.

Amount of Offset

The amount of taper given a piece depends upon the length of the piece, and the amount the dead center is brought forward. Let us assume that we have a piece 3 inches long, and that we wish to turn a taper which shall be 2 inches per foot. Now the piece is 3 inches long which is one quarter of a foot. If the difference in diameter is to be 2 inches for 12 inches, it will be $2 \div 4$ ($= \frac{1}{2}$) inch for 3 inches. We know that the distance from the dead center to the circumference is one-half the diameter; hence the dead center should be offset one-half of ½ inch, or ¼ inch. This is shown in Fig. 3.

Leaving the dead center offset ¼ inch, move tail-stock out so that a piece 6



inches long may be placed between the centers. The difference in radius will then be ¼ inch in 6 inches, and the difference in diameter will be ½ inch in 6 inches, or 1 inch per foot. Before, it was 2 inches per foot.

By following the same reasoning, it would be ½ inch per foot if the tail-stock were moved outward until a 12-inch piece could be inserted.

The above calculation was based on the assumption that the length was given and also the *amount of taper*. Now let us consider a case in which the length is given but the amount of taper is unknown. The piece is 8 inches long, and on one end a taper is to be turned. The tapered portion is to be 4 inches long, and the difference in diameters of this 4 inches is to be ½ inch. How much must the tail-stock be set over?

Let us first find that the taper would be 1½ inches per foot, because $3 \times \frac{1}{2} = 1\frac{1}{2}$. Then the tail-stock should be moved ½ of 1½ (=¾) inch if the piece were a foot long; but, as it is only 8 inches (or $\frac{2}{3}$ of a foot) long, it should be moved $\frac{2}{3} \times \frac{3}{4}$ (=½) inch. Had the piece been 18 inches long, the tail-stock should be moved $\frac{3}{4} \times \frac{3}{2}$ $(=1\frac{1}{8})$ inches.

The Lathe Centers

In these calculations, we assumed that the lathe centers merely touched the ends of the piece, thus making the length of the piece the same as the distance between centers. This assumption is not true in actual work; and if the calculation is to be accurate (and it should be as accurate as possible, to avoid continual changing of the tail-stock), the distance the centers enter the piece must be considered.

Fig. 4 shows (somewhat exaggerated) the effect of the lathe centers. If the piece is long, the error is slight; but if short, the actual taper will differ considerably from the calculated. Let us suppose each center enters ¼ inch; both would enter ½ inch, and the length to be used in the calculation should be reduced that much. To make a taper for a fit, the calculation should be made as accurately as possible; and while turning the taper, the calipers should be used frequently, so that the tail-stock may be correctly placed.

Some General Features of the 1905 Automobile

Trend of Improvements Exhibited at Recent Shows

By M. R. GREENE

THE very large attendance at the recent annual automobile shows in New York and Chicago, proves the extent to which the automobile, either as a pleasure vehicle or for business purposes, has found its way into general favor; and the character of the exhibits, from the standpoint of general appearance, seems to leave but little room for improvement, and is in strong contrast to the perambulating power plants which were so conspicuous only four or five years ago.

In fact, the most noticeable improvements in the 1905 types of automobiles, are in the remarkably handsome bodies, which are in many cases magnificent specimens of the carriage-builder's art. Canopy and limousine tops are much in evidence, not only adding to the appearance of the cars but providing a needed protection from the weather. In some of the closed carriages the upholstering is very handsome, and the whole tendency in body designing and finishing is toward more luxurious and higher-priced productions. It is also noticeable that the rear entrance car is rapidly giving way to those with side doors.

It is, however, with the mechanical details of the 1905 types, that our readers will be most interested; and mechanically these machines have improved almost as much as they have artistically, although improvements of a mechanical nature are naturally less obvious than those of the other class.

Gasoline machines constitute the great majority of automobiles in use at the present time, and it is in this class that the most notable improvements are found. Electric machines show but little change; and steam-engine-driven machines of the smaller sizes have practically disappeared, although this type still holds its own in the larger cars.

In the gasoline cars the engine is perhaps the most prominent feature, and in this year's models the use of vertical four-cylinder engines is very noticeable, being found in almost all the large cars of whatever manufacture. Next to this comes the two-cylinder opposed type of engine, which is still found in a number of makes of moderate-sized cars. The use of single-cylinder engines, judging from the recent exhibits, is being rapidly abandoned. The four-cylinder engine does not add any complications to the management of the cars, and, as the impulses are distributed between four cranks, there is a more uniform distribution of the force exerted upon the shafts, which results in fewer broken shafts. The engines are all four-cycle machines, with one exception, which is a two-cycle machine; and the latter, owing to its extreme simplicity of construction, may be regarded as a promising field for future improvement. It is understood that several new automobiles will be produced this year using this type of engine.

The sliding transmission gear and the bevel-gear drive are by far the most prominent, the chain being now found only on some of the lightest machines. Tubular frames have also practically disappeared, and pressed steel is almost universally used. The latter has the advantage of lending itself very readily to the many sharp bends and turns found in the frames.

Another noticeable feature which seems to be gaining in popularity is the use of ball-bearings, and these in many cases have been adopted for almost all the bearings on the car. In almost all of the exhibits, a complete chassis without the body was shown, and these were all characterized by excellent workmanship and careful design. In fact, it was generally remarked that the quality and finish of the American machines were fully as good as seen in the foreign-made machines of far higher cost. Within a comparatively short time the materials used in automobile manufacture have improved wonderfully, owing, no doubt, to the vast increase in the business which has warranted the manufacturers in turning out special grades of steel for this purpose.

Another feature which is noticeable in this year's models is the tendency toward air-cooling. In a number of the designs in which the cylinders are water-cooled, the radiators are made so as to present a very large area of cooling surface, and the draft is assisted by means of a fan placed in front of the radiators. One of the large cars exhibited had a four-cylinder motor which was cooled entirely by means of a draft of air from a blower, driven by a direct gearing from the engine shaft. The air blast thus created is carried in a large pipe to the cylinder-heads, and passes through the annular space between the outer walls of the cylinder and an aluminum jacket. At normal speed the air is forced through this space at a pressure of about two ounces per square inch, and the cooling effect thus produced has been found ample to keep the motor at a proper temperature under all conditions of speed. Various systems of air cooling are applied to the large cars of twenty to thirty horse-power, with the result of considerably decreasing the weights of the machines.

Wheels are almost universally of wood of the artillery type; and the wire bicycle wheel, which was at one time popular, seems to have entirely disappeared. There is a tendency to make tires larger and heavier; but, with the exception of one non-skidding tire, there was nothing exhibited especially new in this line. On the whole, the tire may perhaps be considered the weakest feature of the machines, and the difficulty with tires increases as the weight of the machines increases.

Ignition by jump spark with the usual double set of dry cells, is the rule with almost all of the cars, the cells being arranged with a convenient switch so that one set may be used while the other set is recuperating. The use of forced lubrication is also noticeable on many of the cars.

The exhibits as a whole showed that the manufacturers of automobiles have generally reduced their products to a number of standard types, and that the most important lines of improvement in view are the perfecting of small details of design, simplifying the machinery by dispensing as far as possible with complicated parts, and so locating the machinery that parts liable to need repairs are easily accessible. There is also a tendency to simplify the operating devices by reducing the number of wheels, levers, pedals, etc., to a minimum. The limited space at our command prohibits a detailed description of the different types of gasoline automobiles exhibited; but in a future issue an illustrated description of the principal features of the prominent machines will be given.

Outside of the gasoline type of car, the White steam car possesses a number of novel features which are of special interest. The steam generator is the important feature of this car, and is the feature which has made it a practical competitor of cars equipped with internal-combustion engines. This generator consists of a series of helical coils of seamless steel tubing, placed one above the other and separated sufficiently for heating space. These coils are surrounded by a casing and insulating material, and the heat is applied at the bottom by a burner. Water enters at the top of the coils, but cannot pass down to the bottom by gravity. It is held in the upper coils subject to the action of a water pump. In this way, water is forced into the top of the generator, and remains in the top coils, while the steam is in the lower coils directly over the fire, whence it passes directly to the engine. From this description it will be seen that the steam generator does not at all resemble the ordinary steam boiler. The upper coils of the generator act principally to heat up the water, and this hot water is converted into steam at some variable point in the coils, depending upon the rapidity of steam consumption in the engine. The water supply is automatically controlled by the steam pressure acting upon a diaphragm valve which opens a by-pass automatically when the steam pressure is above 375 pounds. The fuel supply is automatically controlled by a fire regulator in the steam pipe. This regulator shuts off the fuel supply when the steam reaches the temperature at which the regulator is set. With this system of regulation, the car can be run until the water supply is entirely exhausted, without damage to the coil, or danger of explosion. Should this condition occur, all that is necessary is to replenish the water.

The engine is of the compound type, and is arranged with a valve operated by a foot pedal so that high-pressure steam is admitted to both cylinders, thus running as a simple engine for starting and when a strong pull at a low speed is required. For ordinary running, the engine is always used compound, which is its condition of greatest efficiency. The engine cylinders are insulated and covered with an aluminum jacket, and the crank-case is of aluminum and entirely enclosed, making it thoroughly dirt-proof and providing an easy method of lubrication. A muffler is used for the exhaust steam, which makes the operation of the machine noiseless. The engine is lubricated by an automatic forced lubricating system, and its shaft runs in oil, as do also the driving and compensating gears.

The burner, which is placed directly beneath the lower coil of the steam generator, is of the Bunsen type, and fuel is fed to it under moderate pressure maintained by a pump attached to the engine. There is a pilot light used in connection with the burner, which heats the vaporizer and lights the burner. The main burner valve is turned on when the vaporizer has become heated, but this valve has no effect on the pilot light. It is claimed that steam can be gotten up within four minutes from the time the pilot light is lighted.

For a steam unit of such relatively small size, this generator and engine show remarkable results in water and fuel consumption. From a test made by Prof. C. H. Benjamin of the Case School of Applied Science, it was found that the steam consumption per indicated horse-power per hour varied from 11 to 14 pounds. An ordinary simple engine will consume from 25 to 36 pounds, and the triple-expansion condensing engine uses about 12 pounds. The consumption of gasoline for the burner is a little over a pound per horse-power per hour at full load. The results obtained from this generator emphasize the economy of the use of highly superheated steam.

The 1905 White car has been provided with a sliding gear which permits the engine to be run independently without moving the car. By means of this sliding gear, the gear ratio between the engine and the rear axle can be increased when the engine is running very slowly, and pulling very hard. This is, however, not a change speed gear, but merely an emergency gear, and is not normally in operation.

In Our Own Hands

WE shape ourselves the joy or fear
Of which the coming life is made.
And fill our future's atmosphere
With sunshine or with shade.

—John Greenleaf Whittier

Life Stories of Successful Men

Robert Gillespie Reid

By WILLIAM R. STEWART

Editorial Staff, *Cosmopolitan Magazine*

BY people who know Robert Gillespie Reid, the "Czar" of Newfoundland, as he became popularly called—which meant practically owner and manager of that seventh largest island of the world—the two qualities most generally associated with him are his prudence and his generosity. But by the great multitude, who knew only of him, the impression is strongly held of reckless daring and callous disregard of the rights of others.

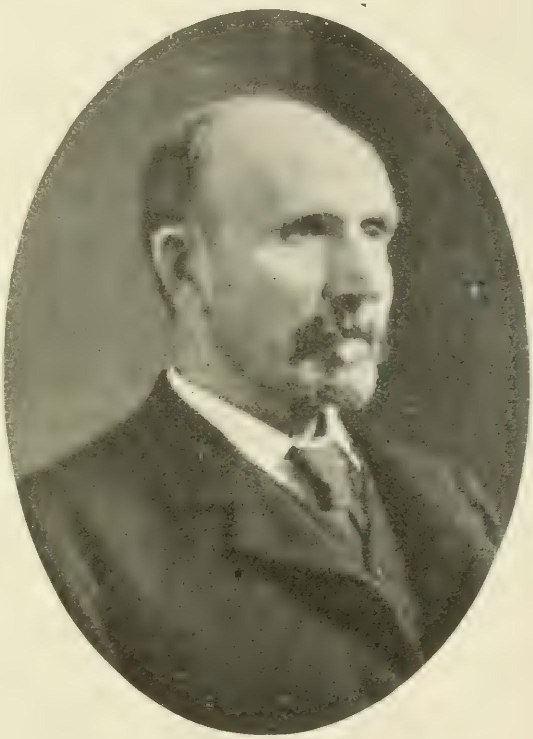
Perhaps there is reason for both. Certainly prudence and daring, antithetic as the qualities are, are not necessarily inconsistent in life. The resolution which is "sicklied o'er with the pale cast of thought," if it loses the name of action, is not real prudence. On the other hand, daring, when as its motive it has the logic of a correct appreciation of events and conditions, is not imprudent.

In the case of Mr. Reid, having amassed his fortune as a contractor, the characteristics which led to his success in that line are first sought. There, prudence in making tenders may properly be classed as the most important; and the rare ability of exciting enthusiasm among his employees, placed next. "Reid," said one who knows him well to the writer, "can do the impossible with a gang of men. They will work twenty-five hours a day for him, and like to do it." This last achievement implies, of course, such treatment of his men as attaches them to him with a strong personal loyalty.

But when we turn for a moment to the enterprise which gave him his great reputation, this supposed characteristic "prudence" must be taken largely on faith; and his "generosity" toward the people of Newfoundland was of a paternal order which this skeptical age instinctively suspects. Yet it will not do to disbelieve in either. Mr. Reid has never been accused of being reckless before, and—his friends being the witnesses—his increased wealth and age have multiplied his kindnesses. Much may be explained by that quality of long-sightedness—of seeing opportunities where others see impossibilities—which is probably his in common with most daring money-getters.

His dealings with Newfoundland have been such that one sometimes wonders whether it was he or the Government of that island that went temporarily mad. Newfoundland wanted a railroad. Its small population was largely centered about St. John's, and its chief industry was fishing. There were few places where there was any visible traffic for a railroad, and these were near together. So the Government, unable to find anyone willing to build it a road, started to build one itself, and, after years of effort, succeeded in getting some thirty miles done—and then could go no further. Yet it still wanted the road. There was no traffic for it; none of the capitalists who were approached would touch it; the whole power of the Government could not build it. So the "prudent" Mr. Reid undertook it. The Government had no money to pay him a subsidy; so he took government bonds. The first contract was for 260 miles from St. John's into the forest. There was no prospect that anybody would want to go from the city to the wilderness, or *vice versâ,* when the road was completed; but that did not seem to Mr. Reid to be a reason why he should not build it.

Close upon the inception of this enterprise, two disasters came to the already over-burdened island. A great fire swept the city of St. John's, and the banking institutions collapsed with a crash a little later. And a railroad from the capital to nowhere, for which the colony owed over four millions, did not seem a very valuable asset. But the Government decided on still more railroad; to the Newfoundlanders. They had the rails down, but they could not operate the line. This was a humiliating *denouement*. They had burdened themselves with a tremendous debt for a railroad they could not build themselves, giving away into the bargain 4,500,000 acres of land—one-tenth of the surface of the



ROBERT GILLESPIE REID.
The "Czar" of Newfoundland.

and Mr. Reid, despite the desperate financial straits of the island, undertook to supply it, taking government bonds and government lands for pay. Under the latter contract, the railroad was completed to Port-au-Basques, on the west coast, and the island thus given its wished-for line to a point where it could look across the Gulf to the civilization of the North American continent.

Still, even this did not bring happiness island—and now they had not the money to run cars on it. So they turned again to Mr. Reid. He was the "prudent" man who seemed willing to give them anything they asked for, and take their I. O. U.'s in exchange. And they did not turn in vain. Why, yes, he would operate the line for them, guarantee them a good and regular service, and let them have a million dollars in cash as a hostage for his keeping his agreement.

This was the arrangement which was finally reached. At first, Mr. Reid was to be paid in more government land for running the trains. He seemed willing to take anything the islanders were not using, and spend his money in providing them with railroad lines and regular trains and such things; and finally this veritable Santa Claus undertook to run the road without money and without price, letting the government hold a million of his money while he did it! He was to do this for fifty long years; and then the Government was actually to keep the million, as a little souvenir, and he was to keep the railroad. And, as the Newfoundlanders seemed to have difficulty in doing other trifling things for themselves, Mr. Reid undertook at the same time to establish and run a fleet of seven steamers from St. John's along the south coast. Later he took over the government telegraph lines for $125,000; bought the St. John's dock for $350,000; contracted to build an electric railway in St. John's and to pave the principal streets of the city; and arranged to carry the mails for a subsidy. He was to have the street railway franchise in perpetuity, and was granted the best water power near the city, with motor rights, etc.; then he was to build pulp mills and lumber mills, and develop the coal, copper, and iron mines, and assist in putting the fisheries on a better basis. How they came to let him out of the scavenging contract and the duty of keeping the city clock in order, is not clear.

What might have been the outcome of this Napoleonic stroke, however, was never put to the final test. The people became alarmed at the paternalism of the Reid *régime,* and voted out the Government which had bargained with him. Sir Robert Bond came into power, and he found out the weak spot in the agreement. Mr. Reid could turn his rights over to a third party only with the consent of the Government of Newfoundland; and Mr. Reid wanted to sell them to a stock company of $25,000,000 capital. So he was compelled to bargain with Bond, taking back his million dollars and giving up his reversionary claim to the railroad, selling back half his land, and handing the telegraph system over to the Government for nothing. Several other questions were in dispute between the new Government and Mr. Reid, but were recently settled by arbitration, the Reid Company being awarded a sum of $854,000 for unsettled construction expenses and improvements to the telegraph lines, etc. With all his "prudence," Mr. Reid had not foreseen the possibility and the consequences of the arising of a king "who knew not Joseph."

But Mr. Reid had a long and a successful career before he went to Newfoundland. He is a Perthshire man, born at Coupar Angus sixty years ago, and went through the Australian gold fever with many other daring sons of North Britain. While in Australia, he built some public works, acquiring a knowledge of contracting and construction, and so began the career which was to lead to wealth in America. In 1871 he came to this continent, and made his first "hit" while i charge of the building of the International bridge over the Niagara river. This exploit g ve him a continental reputation as a builder of difficult bridges, and it was not long afterwards before he was engaged in another international undertaking of a similar character—the construction of the railroad bridge between the United States and Mexico, over the Rio Grande.

With the advertising which the successful spanning of the Niagara and the Rio Grande gave him, Mr. Reid was well launched on the road to wealth. Work poured in on the vigorous contractor. He built a number of bridges across the Colorado river at Austin, Tex., in 1880, and a succession of others on the Southern Pacific Railroad, west of San Antonio. He also "crossed the Delaware" at Water Gap, Pa. It was in these enterprises that his power to get work out of his men, with their own good will, told, and he began to amass the riches with which he finally embarked on his audacious projects in Newfoundland.

From bridge builder he became a railroad contractor. The difficult section of the Canadian Pacific Railway, north of Lake Superior, was to be constructed, and Mr. Reid undertook the herculean task. The obstacles overcome there would make the subject for a railway epic; granite was to be tunneled, gaps to be leaped, an impossible country to be crossed with men and material. But the work was done, and the contractor who did it took rank with the masterful men who made the C. P. R.

It was but natural that when this latter company was faced with the problem of bridging the St. Lawrence river, at Lachine, in competition with the famous Victoria Bridge, at Montreal, Mr. Reid was the man first thought of for the task. Time was an important part of the contract; and the result was that this tremendous bridge, three-quarters of a mile long, was wholly completed within six months. Tourists to Canada will remember it as that airy structure under which the river steamers sweep just before they enter the Lachine rapids. Subsequently Mr. Reid built the "Soo" bridge, at Sault Ste. Marie, and another bridge across the Grand Narrows, in Cape Breton. The financial bridge which he endeavored to erect from the fishing Newfoundland of the past to the mining and industrial Newfoundland of the future, has already been described. The end of that enterprise is not yet, but it is Mr. Reid's last work.

Though in years not yet an old man, his health has been badly shattered by the strain of a life so filled with ambitious action, and the management of his affairs he has now consigned almost wholly to his two sons.

Dinner-Pail Philosophy

¶ Blessed is the man who has found his work.

¶ The best way to bury your sorrow is to dig up another's happiness.

¶ Opportunity makes the great difference between the greedy and the grafter.

¶ When you come to say good-by to old sins it is unwise to hold a farewell meeting.

¶ Speak today what you think is true, and contradict it all to-morrow if necessary.

¶ A goat's head is sufficient proof that a striking countenance doesn't always indicate brains.

¶ You can sell honor only once.

¶ The man who endures is the man who wins.

¶ Always be on time—and you will have to wait for the other fellow.

¶ The more you get into this world's pleasures the less you get out of them.

¶ If tombstone epitaphs were reliable his santanic majesty would have to look for another job.

¶ You have no right to complain that the sermon is thin if you are keeping the preacher on a water-gruel salary.

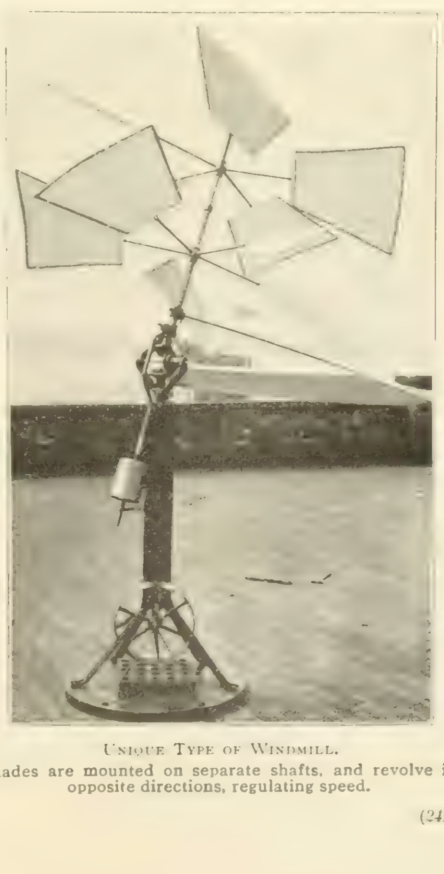
SCIENCE AND INVENTION

Lessens Dangers of Gasoline

GASOLINE, the explosive that has caused more accidental deaths in America than all others combined, is to be rendered less dangerous through an invention that has made its appearance in Europe, according to the statements of United States Consul Balstead, at Birmingham, England, who gives a lengthy description of the device in a late report. It is an application of the principle of the Davy lamp, supplemented with a fusible cap or plug. A 20-gallon tank, equipped with the device, was partly filled with gasoline, and placed upon a lighted bonfire. The fusible screw cap soon blew out, the solder having melted; and the ascending vapor caught fire immediately, but no explosion followed because of the Davy lamp device, whose metallic composition absorbed the heat and prevented it from reaching the interior of the tank. The flame was easily extinguished, and was then relighted and put out several times. Without the safety device the gasoline in the tank would have exploded with tremendous force.

New Type of Windmill

A WINDMILL consisting of two wind wheels, with sails oppositely inclined so that they will rotate in opposite directions—the invention of Alfred Fornander of New York—may mark a decided advance in this style of machine. The new mill, it is claimed, will transmit power not exceeding a predetermined limit no matter how strong the wind is blowing. As the velocity of the wind increases, the wind wheels are tilted upward, as illustrated in the diagram, thus modifying the force of the wind upon the sails. The shaft of the inner wheel is hollow, and revolves on the shaft of the outer wheel. The bracket in which these shafts are mounted, has a universal joint connection with the windmill standard, and an adjustable counterweight balances the weight of the wind wheels. The shafts carry bevel gears at their inner ends, and,



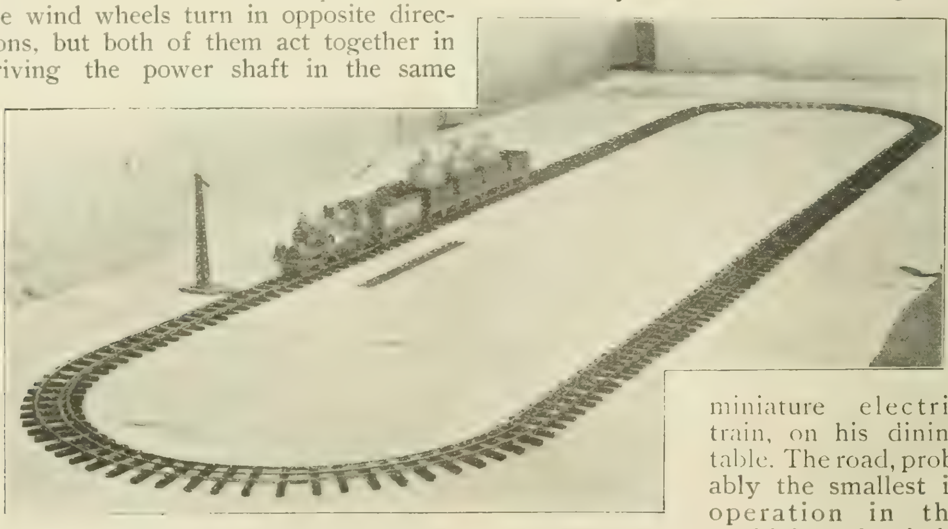
UNIQUE TYPE OF WINDMILL.
Blades are mounted on separate shafts, and revolve in opposite directions, regulating speed.

MINIATURE ELECTRIC TRAIN BEARING WINE TO GUESTS AT TABLE.
The fad of an English millionaire, Sir W. G. Armstrong, the great gunmaker.

by means of a pair of idlers on the horizontal hinge pin of the wind-wheel bracket, transmit power to a pair of concentric bevel gears turning on a vertical axis. At its lower end, the outer gear wheel, which is mounted on a hollow shaft, carries a bevel gear engaging the upper teeth of the gear wheel on the power shaft. The lower teeth of the power wheel are engaged by a bevel gear secured to a shaft which passes through the center of the hollow shaft and which carries at its upper end the inner bevel-gear wheel of the concentric pair. Thus the wind wheels turn in opposite directions, but both of them act together in driving the power shaft in the same direction. A blade or sail lying adjacent to and below the level of the wind wheels forms the vane of the windmill, which occupies a plane normally transverse to the direction of the wind. As the strength of the wind increases, the wind wheels rise because of the pressure against this vane, and the wheels then rotate at an acute angle to the direction of the wind. In this way the force of the wind upon the wheels is modified. It can readily be seen that any increase in the wind's velocity will be compensated for by an increase in the angle between the axis of the wind wheels and the direction of the wind.

Dinner-Table Novelty

THE newest fad of a certain English millionaire is the laying of a diminutive railway track and the running of a miniature electric train, on his dining table. The road, probably the smallest in operation in the world, is perfect in its minutest detail. It circles the dinner board prettily, perfectly, silently, every minute, laden with its load of wine and cigars; and the guests help themselves without in any way affecting the mechanism of this most expensive toy.



Miniature Electric Railway Installed on Dinner Table of Sir W. G. Armstrong, to Bear Wine to Guests.

The locomotive, with its tender seemingly full of coal comes first; but in reality the coal covers a little electric motor which is geared to the tender's wheels. Behind the tender there are three open freight cars which are coupled in regular railroad style. In each of these is a large, square decanter containing cordials, and behind these is a fourth, open car stocked with cigars. As the train rolls along, past each guest he can help himself to a cigar without affecting the train; but if he lifts one of the decanters out of its car, the train stops automatically. When the bottle has been returned to its place, the train instantly resumes its course and continues on its circuit.

The electricity is picked up from a third rail, and carried by the last of the decanter cars; it then passes under the bottles to the motor in the tender, and thence off through the wheels to the track. Under each decanter is a little piece of brass, which, when forced down by the weight of the glass and contents above, completes the circuit. When any of the decanters are removed, the circuit is broken and the train stops.

The train is constructed for a twenty-foot table and is more than five feet long. The locomotive is made of copper and is silver-plated; in its cab are two dolls dressed in overalls, which seem to be in charge of the precious freight. The track is carried in by a crew of waiters as the last course is cleared away, the train placed upon the rails and the current turned on by the touch of a button at the host's hand. The unique plaything cost about $5,000.

The Cart before the Horse

THE accompanying photograph illustrates the old adge of putting the cart before the horse. The buggy may be called a motor vehicle, although animal power is employed. The horse, as shown by the illustration, is placed between the shafts, which are fastened to the rear instead of the front of the vehicle. The animal is guided by a bridle fastened to the bit, and has been so trained that it

THE CART BEFORE THE HORSE.

will stop or start at the usual command. The steering, however, is done by means of a wagon wheel from which the rim has been removed, which is set in front of the box and bolted to the front axle. This nondescript "automobile" has been driven through nearly all the States east of the Mississippi river within the last two years.

Revolving Gasoline Engine

A REVOLVING gasoline engine, perfected after years of experiment, is announced as the invention of George E. Heaton, of Oakland, California. One of these engines has been repeatedly used in connection with a large airship, and was found to operate very successfully.

In all other gasoline engines hitherto

THE HEATON ENGINE.

invented, the bed and cylinders are stationary, and the mechanical movement is transmitted by the pistons to a revolving crank. In the Heaton engine, however, instead of an engine causing the revolution of a crank, we have a crank producing the revolution of an engine—something of a mechanical paradox.

The Heaton engine looks very much like an elongated barrel, about 3 feet long and 12 inches in diameter. This barrel revolves in its entirety upon a steel shaft or axle passing diametrically through it. Within this barrel, and on this shaft, is made fast that portion of the mechanism which, in other engines, would be termed the crank. Cylinders and pistons are to be found at either head of the barrel, the pistons being connected by the usual rods to the crank.

The introduction, into the cylinders, of the gasoline vapor which drives the pistons, causes a tendency to rotate, and a centrifugal movement is given the entire engine, which begins to revolve upon the shaft. The continued working of the pistons spins the entire mechanism around at a very high rate of speed—from 1,200 to 1,600 revolutions per minute being made. The two propeller blades (made of aluminum and strongly braced) are very firmly attached to the exterior of the barrel, and revolve with it.

Working at its maximum capacity, this revolving engine has 18 indicated horsepower. Including propeller, it weighs only 55 pounds.

The Heaton engine, it is claimed, has practically solved the problem of speed, power, weight, and temperature, so essential in the design of a successful airship. The fact that the entire engine revolves, does away with the necessity of a cumbersome balance-wheel, the engine itself acting in that capacity. The revolution of the engine, and its consequent contact at every point with the surrounding air, does away with the necessity of cooling coils, thus saving weight.

The cylinders are 4 by 4 inches, two-cycle, and so constructed as to obtain a gas explosion at every cycle, the engine differing in this regard from any known type. The gasoline is fed in from a small tank, and the explosions are produced by an ordinary sparking apparatus. There is, however, but the one sparking device for both cylinders—a feature which has been the wonder of all gas-engine experts who have inspected the invention.

Another notable feature is that the movement of the piston valves is regulated by the flow of the gas; there are no cams, no valve-fitting device of any sort.

Floral Auto Parade

THAT the automobile can be made a vehicle of ornament as well as use, is illustrated by the accompanying photograph of a floral parade held in the city of Cleveland, Ohio. Over twenty different types of automobiles were included in the procession, ranging from the ordinary runabout to the high-powered touring car. They were decorated with such flowers as roses, carnations, field daisies, pansies, and geraniums, not only forming an illustration of the decorative art, but representing the progress American manufacturers have made in automobile construction.

FLORAL AUTOMOBILE PARADE.
View taken in Cleveland, Ohio.

CONSULTING DEPARTMENT

Kiln Drying of Lumber

Question: What advantages are obtained from kiln drying of lumber?—*C. R. S.*

Answer: The temperature, circulation, and humidity must be regulated according to variations in atmospheric conditions and in the kind and condition of material to be dried, in order successfully to accomplish the removal of the moisture from the surface of the wood as fast as it is driven from the pores. In order to do this, the drying must commence at the heart of the board and work outwardly. The effect is produced by removing not only the volatile parts of the sap, but also such chemical parts as albumen, starch, sugar, etc., which if they are dried in, cause fermentation to set up, and as a result cause ultimate decay. It is advantageous to retain the resin in the pores of the wood. Heat does not drive out resin, which in its hardened state is only slowly soluble in water. As it contains a large proportion of carbon, which is the most stable form of matter, its retention in the pores of the wood is a great advantage.

Electric Locomotive Brakes

Question: I should like you to explain through THE TECHNICAL WORLD what kind of brakes electric locomotives and trains are equipped with, and how they are operated.—*Z. L. H.*

Answer: The common air-brake is used almost exclusively in electric traction work. The system and operation is practically the same as on steam railroads. The air-pump of course cannot be operated by steam, so an electric motor is used for this purpose.

Some cars for street railway work are equipped with an electric traction brake. By means of magnets, the coils of which are energized by current from the main line, the brakes are applied.

CONSULTING DEPARTMENT—(Continued)

Weight and Rating of Gasoline Marine Engines

Question: I am interested in gasoline engines for marine service, and should like to ask your opinion about the following:

One engine is catalogued as 4-cycle, each cylinder 4½ in. by 5½ in., and entire weight of engine and water-jacket 535 pounds. Do you consider that this engine will develop 34 H. P.? I do not know the number of revolutions per minute. It seems to me a very light engine.

Also, why are some gasoline engines spoken of as "12 to 16 H. P.," "20 to 24 H. P.," etc. A steam engine is rated at a fixed H. P.—*H. E. D.*

Answer: While it may be possible to develop 34 horse-power with the engine you describe, yet from the dimensions of the engine it is not apparent. The area of the cylinder is 15.9 square inches. Assuming an M. E. P. of 100 pounds, and solving for N, the number of impulse strokes per minute, we have:

$$34 \text{ H. P.} = \frac{4 \times 100 \times 5.5 \times 15.9 \times N}{33{,}000 \times 12},$$

from which

$$N = 384.$$

In a 4-cycle engine there will be two revolutions for each impulse, or the revolutions will have to be 768. This is rather a high speed, and the M. E. P. assumed was about 50 per cent greater than is obtained in ordinary practice. Also, the above calculations are on the basis of indicated power and not effective power. Unless there is some way of obtaining an especially high M. E. P., it does not appear probable that the engine can develop the power stated. The weight of the engine is a great deal less than other standard makes, as the following item from a manufacturer's catalogue will show:

"18 Horse-power 3-Cylinder Engine—1,500 pounds."

The reason why engines are rated 12 to 16, 20 to 24 horse-power, etc., is that the power varies with the mean pressure developed. The greater the mean effective pressure, the greater will be the horse-power, other conditions remaining the same.

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One 12-inch Triangular Boxwood Scale, engine divided; graduated 3-32, 3-16, 1-8, 1-4, 3-8, 3-4, 1-2, 1 1-2, and 3 inches to the foot, and one edge inches and 16ths, with case, -	1.00
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ARCHITECTS' AND ENGINEERS' SUPPLIES

CONSULTING DEPARTMENT—(Continued)

You are mistaken about the rating of steam engines, as the makers frequently rate them at certain horse-power for 90 pounds' steam pressure, and a little greater power for 100 pounds' pressure.

Chilled Shot

Question: What is chilled shot, and for what is it used?—*W. M. H.*

Answer: Chilled shot is made from iron or steel which has been atomized while in a molten state and then suddenly chilled. It comes in many sizes, from the very finest up to about the size of buck-shot. It is sufficiently hard to scratch glass, and has been in use for some time in sawing and polishing stone.

Compound Air-Compressors

Question: What is the advantage of compounding air compressors?—*F. S. W.*

Answer: The great advantage of compounding is the fact that more time is taken to compress a certain volume of air, and this air, while being compressed, is brought in contact with a larger percentage of jacketed surfaces. Water jackets do not thoroughly cool the hot air, but are practically the only method in use at the present time. Until something better is devised, compounding gives the best efficiency.

Engine Foundations

Question: What makes the best foundation for engines?—*A. F. W.*

Answer: Brick set in cement is the standard material for foundations, although concrete foundations are growing in favor and are being used in many places on account of their cheapness. A cement mortar—1 part cement, 2 parts sand, mixed with 6 parts broken stone—is good. The stones should be small, clean, and moist. With stone foundations it is usual to finish with three or four courses of brick, and it is best to use the brick under the pillow block.

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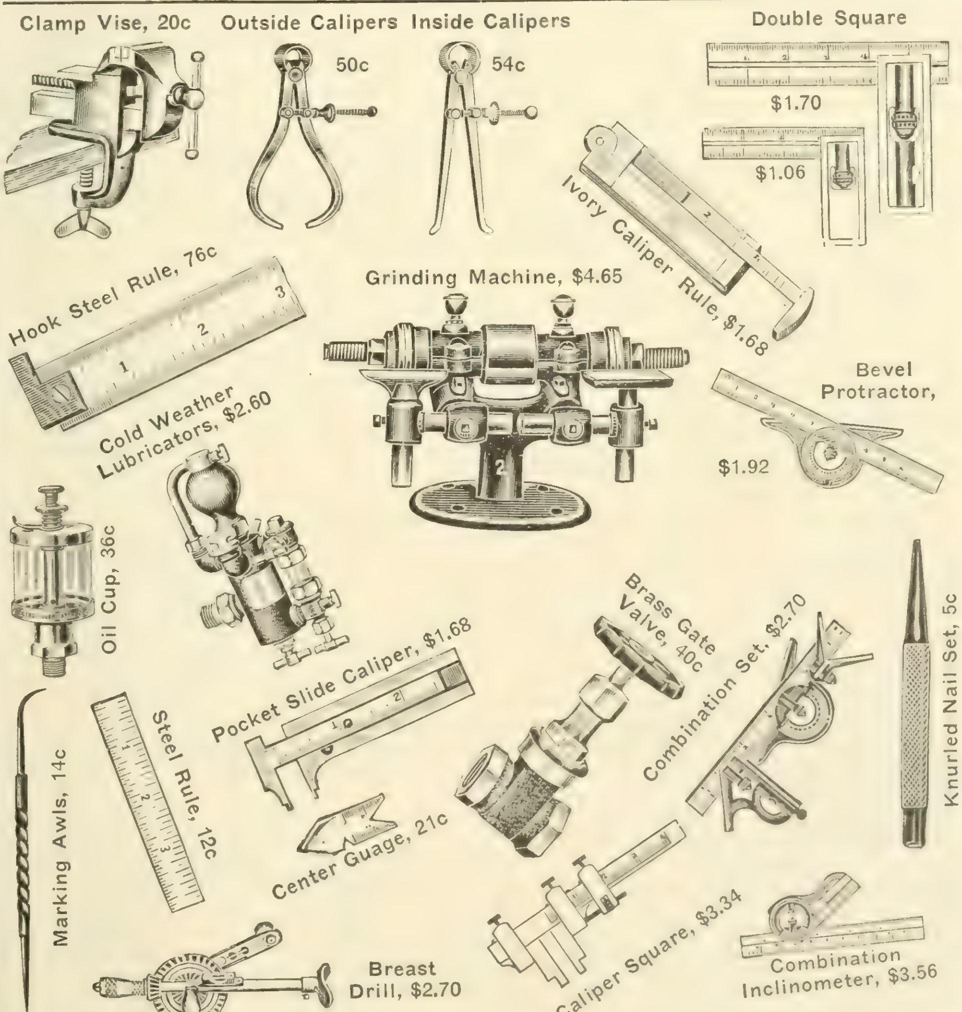

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CONSULTING DEPARTMENT—(Continued)

Mass—Unit of Mass

Question: What is mass, and what is its use in engineering and science? What are the units of mass?—*F. M. S.*

Answer: Mass may be briefly defined as the quantity of matter which a body contains. It is therefore a constant quantity. On the other hand, weight is the measure of the attraction of gravity for that body. The weight depends on the mass of the body and on the acceleration of gravity *g*, which varies inversely as the square of the distance from the center of the earth. Hence, the weight of a body depends upon the locality in which it is situated, being greater at the poles than at the equator. For all practical purposes, however, the acceleration of gravity can be assumed to be constant. Consequently it is customary to compare masses by their weights, inasmuch as at a given locality weight and mass are proportional.

Weight may be considered as a measure of force; and in absolute units, the Weight or Force (in poundals) is equal to the Mass (in pounds) *multiplied by* the Acceleration in feet per second. In other words,

$$W = M \times G; \text{ or } M = \frac{W}{G},$$

the latter being perhaps the more familiar form of this equation. The force of gravity upon a mass of one pound is equal to 1×32.16 (or 32.16) poundals. However, poundals are inconvenient units to use; and so we ordinarily adopt the pound, which is 32.16 times as great. Summing up, we have:

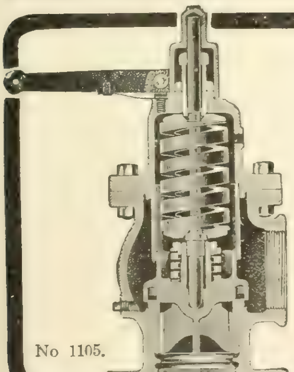
Weight = Mass × Acceleration of Gravity.
Force = Mass × Acceleration.

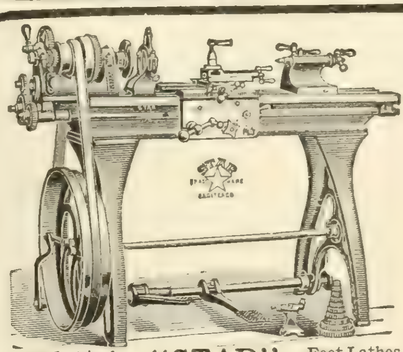
Horse-Power Available from a Lake

I RESPECTFULLY request that you answer the following questions based on accompanying data, in THE TECHNICAL WORLD, to which I am a subscriber:

Assuming (1) A lake 200 feet above sea-level; (2) Flow of water from lake, 1,200 cubic feet per minute; (3) Length of pipe line from power house, which is at sea-level, 5,000 feet;

Question 1: What sized pipe would be best adapted for installation, to get the best results,





CONSULTING DEPARTMENT—(Concluded)

or the greatest effective H. P. by using a Pelton water wheel?

Question 2: What would be the effective H. P. leaving the brushes of a generator of 90 per cent efficiency?—*R. B. T.*

Answer 1: In order to determine the best size of pipe in a case of this kind, it would require careful calculation of the total cost involved with each size of pipe figured on. Of course the greatest horse-power will be obtained by using the largest possible size of pipe. For instance, by using a 36-inch pipe, the frictional head for each 1,000 feet of length would be .04 foot, or a total of $5\times.04$ $(=.2$ ft.), for the length under consideration. A 14-inch pipe, however, while conveying the water at a little greater loss due to friction, would probably be the most economical in the end. The frictional head for each 1,000 feet for 14-inch pipe, is 2.02; and for 5,000 feet the loss would be 2.02×5 $(=10.1)$. The loss due to bends and valves would probably be as much more, or, in round numbers, the total loss in head would be 20 feet. This leaves an effective head of 180 feet.

Answer 2: The available horse-power is obtained by multiplying the volume of water (in pounds per minute) by the head (in feet) and by the efficiency of the apparatus. Assuming the efficiency of the water wheel to be .8, and that of the generator .9, we have for the effective horse-power:

$$\frac{180\times1{,}200\times62.4\times.8\times.9}{33{,}000}=300 \text{ H. P. approx'ly.}$$

Neighborly Love

MRS. BROWN—What do you think of your neighbor's boy Willie?

MRS. WHITE—You will have to ask my husband. No lady, you know, can be expected to use such language.

Never Touched Him

"My husband lost his hair before I married him."

"Well?"

"I only wanted you to know that I had no hand in it."

PERSONAL AND MISCELLANEOUS

Electricity in Warfare

THE wonderful successes that have attended the Japanese in their present titanic struggle with the Russians, are no doubt attributable to several causes. Not the least important of these is the intelligence and foresight which the Japs have displayed in applying the highest grade of technical skill to the engineering and dynamics of war. In future wars the electrical engineer will play a hitherto unwonted part, and the importance of having officers practically trained in the construction and use of electrical machinery and devices is becoming widely recognized. Even among the republics of South America we find evidence of this desire to keep abreast of the latest progress; and students from among the military classes are regularly enrolled in the engineering courses of the American School of Correspondence.

M. Charles de Neuter, of Lima, Peru, a Major attached to the staff of the "technical section" of the Peruvian Army, has just received his diploma as a graduate in the Mechanical-Electrical course of the American School. Few of our American or English-speaking students realize what difficulties have to be overcome by men of foreign tongue in mastering the details of such a training, but Major de Neuter has completed his course with eminent credit, and carries with him the best wishes of his instructors for his future promotion and success.

Recently Graduated

THE following students have been Graduated from the American School of Correspondence since the March number of THE TECHNICAL WORLD was issued:

Benbow, Burnie L., La Fayette, Ind.—Course: Electrical.

Brooks, G. W., Mullan, Idaho.—Course: Electrical.

Browne, Archie C., Avon, N. Y.—Course: Electrical.

Coubrough, Leslie, Tacoma, Wash.—Course: Mechanical.

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Mr. E. W. Pratt, author of the portion on Locomotive Engineering, is master mechanic of one of the large railroads, and has made the locomotive his life-study.

Mr. Albert Uhl, A. I. E. E., Instructor in Practical Electrical Engineering at the St. Louis School of Engineering, is a successful electrical contractor who has risen from the ranks, having worked as dynamo tender and wireman's helper in his younger days.

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4. Is heat a body?
5. What general qualities are due to a body?
6. What do you understand by the word: aggregate?
7. What are the general qualities of heat?
8. Are we able to transfer light into heat?
9. Would heat be developed by compression of aeriform bodies?
10. Can you give me examples showing that mechanical motion causes sensible heat?
11. What do you understand by combustion of a body?
12. What other causes of sensible heat do you know?
13. What is the unit of our length measure?

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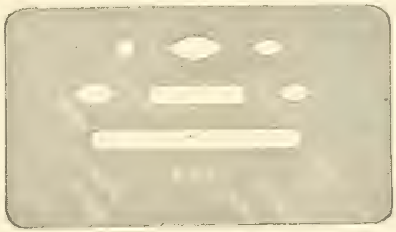

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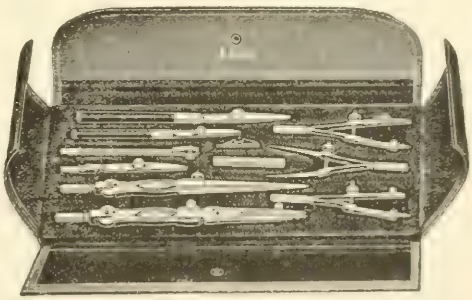

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LITERATVRE
REVIEWS · MAGAZINES · BOOKS

BOOKS RECEIVED

Elements of the Differential and Integral Calculus. With Applications. By W. A. Granville, Instructor in Mathematics in the Sheffield Scientific School, Yale University. Semi-Flexible cloth. Pages 463. 8vo. Illustrated. Indexed. Boston, Mass.: Ginn & Company, Publishers. Mailing price, $2.70.

THIS volume is announced as the first of a standard mathematical series to be published under the general editorship of Dr. Percey F. Smith, Professor of Mathematics in the Sheffield Scientific School. For an "elementary" text book, it is certainly formidable; but any student brave enough to attack the Calculus must look for that. While, however, the scope of the work includes all that is usually given in the more extended "first courses" in the Calculus, yet the arrangement of matter is such that any teacher can easily cut it down to meet the requirements of those who are pluming their wings for their first short flight in this ethereal region. The work is based on the Method of Limits, but intuitional methods have been freely employed to help the student over difficult places. The collection of figures, including drawings of all the standard curves usually employed, is the best to be found in any English text book on the Calculus. The work meets the demand for a Calculus at once thoroughly modern and teachable.

Elements of General Drawing for Mechanical Engineers. By C. E. Coolidge, Assistant Professor of Machine Design, and H. L. Freeman, Instructor in Machine Design, Sibley College, Cornell University. Cloth, oblong 4to. Pages 50; 21 folding plates. New York, N. Y.: John Wiley & Sons, Publishers. Price, $2.00.

THIS work embodies a complete practical course in the essentials of modern conventional drafting as practiced by the general profession of mechanical engineering. The book, naturally, follows closely the lines of work covered by students attending Sibley College of Cor-

LITERATURE—(Continued)

nell University, but is admirably adapted to the needs of students in manual training schools, trade schools, and technical colleges everywhere, as well as of the amateur draftsman who is serving his apprenticeship.

The work consists of two parts—a 200-hour Course in Drawing, and a Manual of Drawing. The exercises are progressive, the Course in Drawing being divided into five grades, through which the student is gradually advanced to a complete mastery of the principles, conventions, and technic essential to the well-equipped draftsman. In the Manual of Drawing, a standard drafting-room system, representative of the best practice of manufacturing concerns, is definitely formulated, the data for this purpose having been acquired from 130 of the largest concerns in the United States in various lines of business.

Line-cuts and half-tone illustrations in abundance, in addition to the folding plates accompanying the Course in Drawing, add to the clearness of the text. A pocket, 8 by 11 inches, is provided in the inside of the back cover, for holding loose sketches and any detached material that may be in use.

How to Mix Paints. A Simple Treatise Prepared to Meet the Wants of the Practical Painter. By C. Godfrey. Cloth, 12mo., Illustrated. Published by The Industrial Publication Company, New York, N. Y. Price, 50 cents.

THIS book is intended for those who have not had long experience in mixing colors.

Simple and clear directions are given, so that by a little practice the reader may be able to mix the various tints and shades. Notes are also given about use and care of brushes, hints on displaying colors to show customers, color harmony, etc. The book will be found an exceedingly handy companion for both amateur and practical painters. A complete index enables one instantly to find the directions for mixing any tint or shade, or to know if the color can be had in dry powder form without the necessity for mixing.

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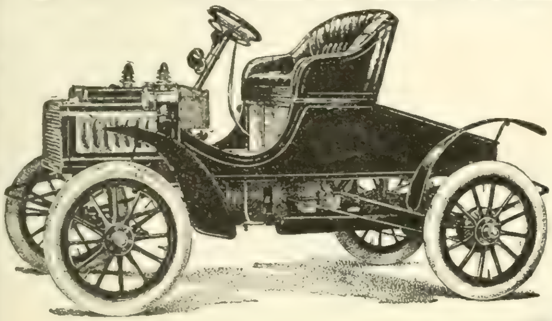

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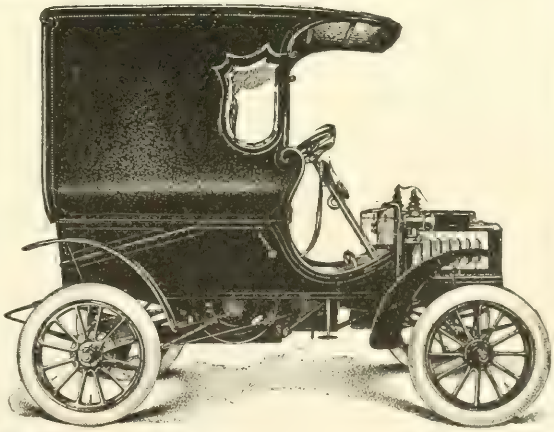

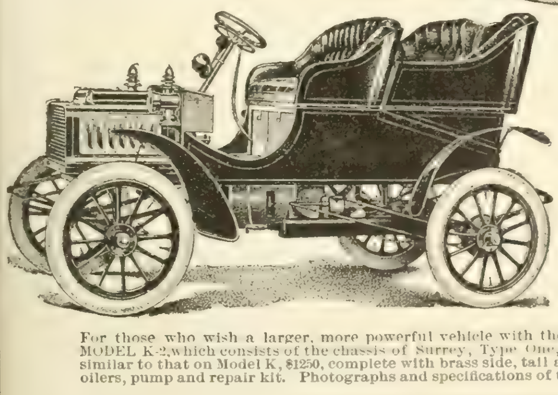

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Thomas B. Jeffery & Company, Kenosha, Wisconsin

LITERATURE—(Continued)

Radio Activity. By Charles R. Stevens. Pages 108. Cloth, 5 by 7 1-2 inches. Published by Broadway Publishing Company, New York, N. Y. Price 75 cents.

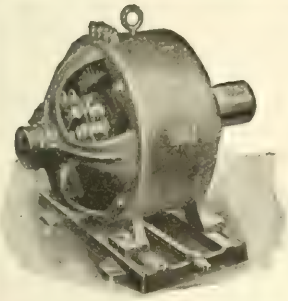
This book, as its title implies, treats of the laws of matter, and the various hypotheses in regard to the nature and constitution of matter. The latest steps towards the solution of these problems have been made in the field of radiation; and the study of radial energy has recently resulted in wonderful progress in scientific knowledge. The discovery of X-rays by Professor Röntgen, was the starting point in the re en. investigations in radio-activity; and the later discovery and separation of radium promises to be of the greatest value in tracing the laws of atomic activity. This book covers the subjects of force, permanence of matter, motion, energy, etc., and is written in plain language, which can be readily comprehended by the lay reader. It will be found of value to all students of nature in giving an idea of the constitution of matter and the causes of various phenomena of nature.

CATALOGUES

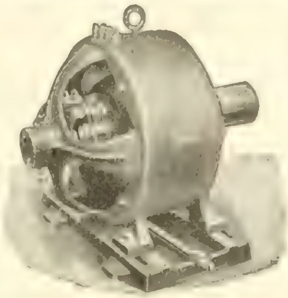
The Norwalk Iron Works Company, South Norwalk, Conn. Folder on Air Compressors.

This folder treats especially of air-compressors by which two pressures are furnished without the use of a reducing valve. In most establishments there is a demand for air of different pressures, the higher pressure for the operation of tools, etc., and the lower pressure for cleaning, painting, and similar work. The usual plan is to secure the lower pressure by throttling down the high-pressure air to the required amount; but this method is inefficient, as the power used in raising the air pressure from the lower to the higher figure is of course lost. In some of the compressors introduced by this company, what is known as a "skip valve" has been introduced, by means of which the air can be drawn out of the compressor at two pressures if desired, and any proportion of high- or low-pressure air can be used. Within

HOW ONE THING LEADS TO ANOTHER

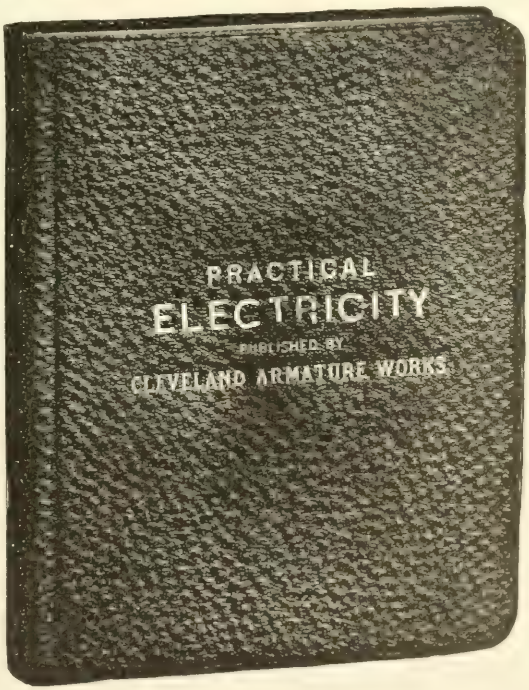


From our paper, THE ARMATURE WINDER, issued for the purpose of advertising our facilities for repairing electrical machinery, originated our book, PRACTICAL ELECTRICITY, which has proven to be the most popular book devoted to the study of electricity; 12,000 copies have found buyers, and the Fourth Edition is now ready. From PRACTICAL ELECTRICITY has sprung the manufacture of Dynamos and Motors.



By buying a copy of this book and becoming familiar with the art of electricity you don't know what it may lead up to.

There are XX chapters or subjects carrying you from the fundamental principles of electricity on through the various branches to a point where the careful student comprehends the complete designing, care and operation of a dynamo or a motor. Each subject is carefully written and to the point. After a student studies a subject, he is questioned on that subject in such a manner as to bring clearly to his mind the points he needs to know regarding same. A DICTIONARY in back of book will enable him to learn the meaning of any electrical word, term or phrase used in this book as well as hundreds of others in common use. All required tables necessary in the study are in it.



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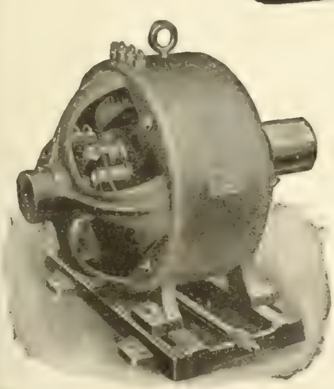

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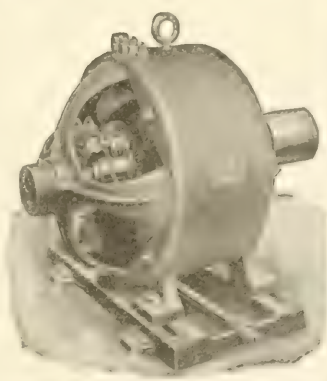

LITERATURE—(Continued)

the capacity of the machine, any quantity of air can be drawn off at any time and the speed is automatically adjusted. This is an entirely new method and, it is claimed, will result in considerable economy when different pressures of air are required.

The A. H. Andrews Company, Chicago, Ill. Catalogue on Metal Furniture. Fifth Edition. Paper, 8 by 6 1-2 inches.

THIS CATALOGUE describes an extensive line of metal chairs, tables, stools, etc., the metal work of which is constructed of Bessemer steel spring rods. The supports for this furniture are twisted and interwoven, making it solid and substantial. This furniture is made up in a large variety of patterns some of which are adapted to dental and medical work, piano stools, typewriter tables, chairs, etc. It is claimed that this style of furniture is practically indestructible; and it is built so that it can be taken apart and shipped in small packages, and reassembled again with the use of a hammer only.

International Acheson Graphite Company, Niagara Falls, N. Y. Catalogue on Graphite Paint Paper 4 1-2 by 7 1-2 inches

THIS CATALOGUE treats of the protection afforded by the use of graphite paint, and the resistance and durability of this material. The graphite used is not a natural product, but an artificially produced material made in the electrical furnace. In the process of manufacture, involving intense heat, all impurities are eliminated. The catalogue contains a brief but interesting account of the method by which this graphite is manufactured, and also contains an interesting treatise on the subject of paints, and a report of some tests made with the Acheson graphite paint.

Gilbert & Barker Manufacturing Company, Springfield, Mass. How best to Light our Country Homes and Resorts. Pages 82. Paper, 6 1-4 by 8 inches.

CATALOGUE, beautifully illustrated with half-tone plates, descriptive of the gas

LITERATURE—(Continued)

machine and its accessories. It also sets forth the advantages of air gas, as regards its safety, utility, and use.

The Derry-Collard Company, New York City, N. Y. Books and Things. Pages 16. Paper, 4 by 8 1-2 inches.

BOOKLET describing the D. C. method of sending books on approval, the D. C. Book Club, and other specialties. The above company will send any mechanical book costing a dollar or more, on approval, anywhere in North America.

The L. S. Starrett Company, Athol, Mass. More Starrett Tools. Pages 16. Paper, 5 1-2 by 7 1-2 inches.

CATALOGUE No. 17, SUPPLEMENT, which contains descriptions and illustrations of key-seat clamps, tap wrench, new desk rule, new universal surface gauge, cut-nipper, pocket screw-drivers, etc., as manufactured by the above company.

The Jeffrey Manufacturing Company, Columbus, Ohio. Bulletin A. Pages 8. Paper, 6 by 9 inches.

ILLUSTRATED BULLETIN giving a complete description of the Scioto Valley Traction Company's power plant, which is situated at Reese's Station, Ohio. The novel method of distribution of coal and ashes in this plant is attracting much attention.

Nernst Lamp Company, Pittsburg, Pa. The Nernst Lamp. Pages 32. Paper, 3 1-2 by 6 inches.

BOOKLET containing descriptions, illustrations, and price lists of the Nernst lamp, which is a comparatively new form of incandescent lamp. The distinguishing features of the Nernst lamp are its filament or glower, and the means for making the glower conductive.

Newhall Chain Forge & Iron Company, New York, N. Y. Forgings and Castings. Pages 32. Paper, 6 by 9 inches

CATALOGUE, illustrative and descriptive, of the different kinds of chains manufactured by the above company. Their chains are tested to United States Government, American Bureau of Shipping, Lloyd's Association, and *Bureau Veritas*

LITERATURE—(Concluded)

requirements. The testing machine capacity is 600,000 pounds.

The Frederick Post Company, New York City, N. Y. Post's Extra Waterproof Drawing Inks Pages 8. Paper, 4 by 7 inches.

BOOKLET of information regarding the chemical composition and durability of Post's drawing inks.

Stately Verse

IF Mary goes far out to sea,
  By wayward breezes fanned,
I'd like to know—can you tell me?—
  Just where would Maryland.

If Tenny went high up in air
  And looked o'er land and lea,
Looked here and there and everywhere,
  Pray, what would Tennessee?

I looked out of the window, and
  Saw Orry on the lawn;
He's not there now, and who can tell
  Just where has Oregon?

Two girls were quarreling one day
  With garden tools, and so
I said, "My dears, let Mary rake,
  And just let Idaho."

A friend of mine lived in a flat
  With half a dozen boys;
When he fell ill, I asked him why,
  He said: "I'm Illinois."

An English lady had a steed,
  She called him 'Ighland Bay.
She rode for exercise, and thus
  Rhode Island every day.

—*Life.*

Clear as Mud

"I WAS going over Westminster Bridge the other day, and I met Patsy Hewins. 'Hewins,' says I, 'how are ye?' 'Purty well, thank ye, Donnelly,' says he. 'Donnelly?' says I; 'that's not my name.' 'Sure an' mine isn't Hewins,' says he. An' so we looked at each other again, an' faith it turned out to be neither of us."

EMPLOYMENT DEPARTMENT

TO EMPLOYERS—The Technical World offers its services in bringing employers of skilled labor into communication with trained and efficient men. Write the Employment Department full particulars as to the qualifications necessary.

SITUATIONS VACANT

Wanted—For Textile plant in New York State, young man to take charge of Steam and Water-power plant. Must be experienced machinist and have technical knowledge of steam and mechanics. Would give preference to man having had practical experience in Woolen, Worsted, or Cotton Cloth mill. Address *The Technical World*, No. 338.

Wanted—Traveling salesman calling upon electrical trade and Electric Street Railway Cos., to handle our goods as a side line. Liberal commission. Address Sills-Eddy Mica Co., Newark, N. J.

Wanted—The application of every competent technical man desirous of securing a position or bettering his present one, is wanted at once. We are constantly searching for high-class vacancies, and always have from 100 to 300 places open for the highest-grade men. Write to-day. The Engineering Agency, 1218 Monadnock Bldg., Chicago, Ill.

SITUATIONS WANTED

Wanted—A student of the American School of Correspondence wants a position with a Surveyor or Engineering Corps, where he can gain a knowledge of instruments and practical work. Locality preferred, Northwestern States. Address *The Technical World*, No. 332.

Wanted—Position as Helper in electric light plant or power house is wanted by a student of the American School of Correspondence. Address *The Technical World*, No. 333.

Wanted—Position by young man of experience in mechanical lines in an Electrical plant where technical training will receive recognition. References. Address *The Technical World*, No. 336.

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EMPLOYMENT DEPARTMENT—(Concluded)

tical experience, wants to take charge of an exhibit at the Portland Exposition, or engage in some kind of engineering work on the Pacific Coast. Address *The Technical World*, No. 337.

WANTED—Position as Oiler or Engineer's Helper in some steam plant, light or power preferred, is wanted by a student of the American School of Correspondence. Two years' practical experience. Address *The Technical World*, No. 339.

WANTED—A student in Electrical Engineering desires a position as Oiler or Helper in electric light plant or power house. Has had experience with traction engine. References. Address *The Technical World*, No. 334.

WANTED—Position as Draftsman or Foreman is wanted by a man experienced in rigging, drawing, and construction work. Address *The Technical World*, No. 335.

FOR SALE

PLATINUM prints from original negatives. Duplicates of reproductions used in the "Historical pages" of THE TECHNICAL WORLD can be obtained by addressing Room 401, 170 Summer St., Boston, Mass. Price list on request.

To Everybody
WARNING!

A copartnership has just been formed between B. Munchausen and John Ananias.

We propose to tell the American people a few things they have been aware of for some time.

If this shall influence them to buy and sell some of our gilt-edged insecurities, we shall not have lived in vain.

We are going to make some terrible statements. This is one of them.

Six months ago we discovered that we were stuck on ourselves. Last week some malicious liar, whose name will be divulged later on, spread the awful news that we were telling the truth.

If you'll stop and think for a moment, you'll see what this means to us.

Yesterday President Roosevelt, all the members of the Cabinet, and all the crowned heads of Europe got down on their knees to us and begged and prayed us to stop. But we gave them the merry Ha! Ha! We have the American people in front of us, with all their good coin, and we dare anyone to say that we are not making anything out of this deal. Liar! Cutthroat! Villain! Murderer! Whoop! Hip, Hurrah! Zounds! Gadzooks! And likewise Pish and Tush!

Just cut these terms out and apply them to Everybody. We don't care, because they are true. They must be so, if we say so.

HOT AIR

Last week we publicly said that Hot Air would go to par and drop to 40 below zero. Were we right? We guess yes. Sell Hot Air if you value your System. There is nothing in it. We sold ours in the Good Old Summertime, and are now dealing in

BLIZZARDS

Buy our Blizzards at any price. Spring won't be here for months. We recommend Snow-drifts, Icicles, and Frost Banks.

Munchausen's Magazine
OUT TO-DAY.

Remember that we have no interest in this periodical except to write for it and go the System one better, and keep Wall Street guessing. Have you been stung in the market? We thought so. Buy the next number, and if you don't believe what we say, bear in mind that there's millions in it. That's what we are here for.

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During the five weeks I was in the United States on the occasion of the visit of The British Institution of Electrical Engineers, I traveled about six thousand miles over your country. I learned many things and I am grateful. I intend to show my gratitude in a practical manner, therefore, to everyone who becomes a subscriber to **The Electrical Magazine** for twelve months I will present the whole of the issues for 1904 (Vols. 1 and 2) for simply the cost of carriage ($1.00). Binding cases for these vols. are now ready and will be supplied to you post free for 50 cents each.

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The Cover which sold out two editions and gave
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