ges which are missing were removed
e they are advertisements

The tracks of the mountain district of the Chicago, Milwaukee & St. Paul Railway, in surmounting the obstacles imposed by the Rocky Mountain and coastwise ranges, represent the solution of one of the most difficult problems ever mastered by railway engineers. To provide adequate motive-power for the economical movement of freight and passenger trains over this section of rugged mountain railway, including many long grades and short-radius curves, has taxed the ingenuity of both railway men and locomotive designers. As nearly all trains cross the mountains intact, the longer they are the less is the labor-cost for moving them. The demand for larger and ever-larger engine-units led to the adoption of Mallet articulated locomotives, having a weight on driving-wheels of 325,500 lbs. In cold weather the difficulty of making steam prevented the use of the full power of the locomotives and stalled trains were a frequent occurrence. Induced by the growing traffic and the presence of many sources of hydro-electric power, officials of the railroad began to study the possibilities of electrification. Decision was finally made in favor of a trolley-voltage of 3,000, direct current, generated by synchronous motor-generator sets and converted into mechanical power by 1500-volt geared motors. The contract for the entire electrical equipment was let to the General Electric Company.

General Outlines

Four steam engine divisions were selected for electrification, aggregating 440 miles in length. Steam engines were first abandoned on the Three Forks-Deer Lodge Division, 115 miles long, and crossing the main Continental Divide, thus giving the electrical equipment its initial tryout under the severest service conditions of the entire system. The first electric locomotives were placed in regular service on December 9, 1915, and during the month of April, 1916, service was extended to Harlowton, making a total of 220 miles of electrically operated road. By the first of November, 1916, is is expected that steam engines will be superseded over the entire distance of 440 miles from Harlowton, Montana, to Avery, Idaho.

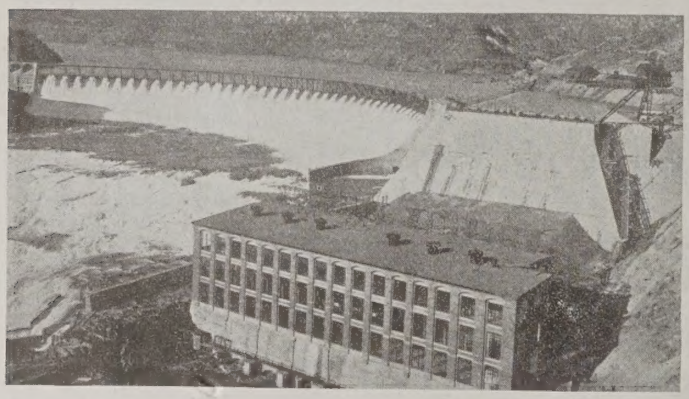
This project is the most extensive steam railway electrification in the world, the length of haul being nearly six times as great as any trunk line now operating with electric locomotives. In crossing the three mountain ranges included in the electric zone, there are several grades of one per cent. or more, the most difficult of which is the 21 mile two per cent. grade between Piedmont and Donald, and the longest the 49 mile one per cent. grade on the west slope of the Belt Mountains. The curvature is necessarily heavy, the maximum being 10 degrees. There are also numerous tunnels in the electric zone, 36 in all, of which the longest is the St. Paul Pass tunnel, over a mile and a half in length, through the ridge of the Bitter Root Mountains.

The passenger service consists of two all-steel finely equipped transcontinental trains in each direction, the "Olympian" and "Columbian," and a local passenger train in each direction daily between Deer Lodge and Harlowton. Freight traffic through the electric zone comprises from four to six trains daily in each direction. Westbound, the tonnage is made up of manufactured products and merchandise for Pacific Coast points and foreign shipment. Eastbound tonnage includes grain, lumber, products of the mines and some live stock. As a larger part of the traffic is through freight, trains are made up of an assortment of foreign cars, including box and flat cars, coal and ore hoppers, stock cars, refrigerators, etc., varying in weight from 11 to 25 tons empty and as high as 70 tons loaded. These cars being owned by many different railway systems are equipped with air brakes adjusted for different conditions of operation, and in accordance with different standards as to braking power and type of equipment, thus making the problem of holding the long trains on the heavy down grades by air brakes, a most difficult one.

Electrical Operation

Electrification promises a material reduction in running time. It has ben found, for example, that on the 21 mile two per cent. grade from Piedmont to Donald, the electric locomotive can reduce the running time of

passenger trains from an hour and five minutes to approximately 40 minutes. On the run from Deer Lodge to Butte which, under the steam locomotive schedule, required an hour and 20 minutes, a saving of approximately 30 minutes can be made. In the freight service, it has been found that on the first division where the steam locomotives have required 10 to 12 hours to make 115 miles, electric locomotives can meet a schedule of from seven to eight hours for the same distance. The heavy grades and frequent curves at certain points offer serious obstacles



Great Falls Dam and Power House

to steam locomotive operation even in the summer time and with winter temperatures as low as 40 deg. F. and heavy snowfalls in the Bitter Root Mountains, serious delays have occurred, owing to engine failures or to inability to make steam.

During a series of record-breaking temperatures in December, 1915, Mallet engines were frozen up at different points on the system and the new electric equipment was rapidly pressed into service to replace them. On several occasions electric locomotives hauled in disabled steam engines and trains which would otherwise have tied up the line.

During the initial operation on the Rocky Mountain Division, the capacity of the new locomotives has been thoroughly tested. Trains of 3,000 tons trailing have been hauled east and 2,800 tons west, using a helper on the heavy grades. From the operating data obtained on the first division, it is evident that much heavier trains can be hauled with the electric locomotives than with steam engines, and all passing tracks are being lengthened to take advantage of longer trains. On some of the runs where the grades are less than one per cent. trains of as many as 130 cars and as heavy as 4000 tons have been hauled with a single locomotive.

The four through passenger trains, "Olympian" and "Columbian," are taken across the two mountain ranges by a single passenger locomotive. These trains at present consist of eight full vestibuled steel coaches, weighing approximately 650 tons. Instead of changing locomotives at Three Forks, as has been the practice under steam operation, the same locomotive is run through the 220 miles from Deer Lodge to Harlowton, changing crews midway. Passenger trains will travel over the entire electrified division in approximately 15 hours, including all stops, and the tourist thus will have an opportunity of traversing by daylight some of the most beautiful scenic regions in the United States and without suffering the annoyance of cinders and smoke incident to the use of steam locomotives. The local passenger train operating in the electric zone between Deer Lodge and Harlowton is handled by a half unit weighing about 150 tons with equipment similar to the main line locomotives.

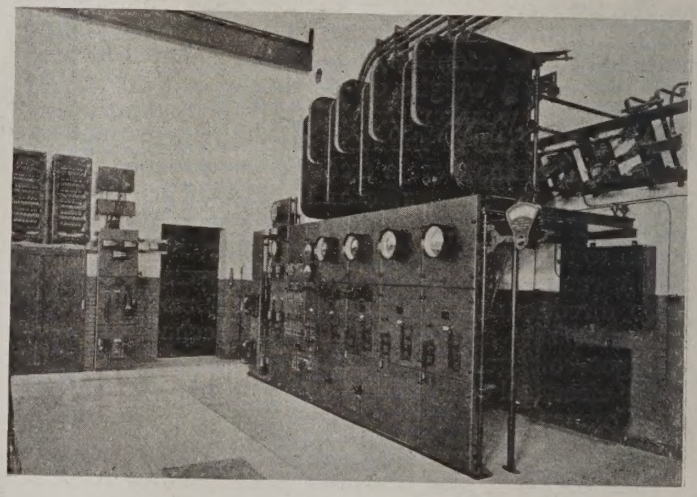
The Electrical Equipment: Power Supply

The scheme of electrification includes the generation of electricity from the several water power plants of the Montana Power Company; transmission at 100,000 volts, three-phase, 60 cycles; conversion in substations to 3,000 volts direct current and distribution over catenary overhead construction to electric locomotives.

Utmost precautions were taken by the Railway Company in making plans for this electrification to insure a reliable source of power. The Montana Power Company, with whom the contract was closed for electric power, operates a network of transmission lines covering a large part of Montana, which are fed from a main plant at Great Falls, and a number of other widely separated water power plants of adequate capacity at all seasons of the year.

The plants now in operation are:

	Capacity K. W.
Great Falls, on Missouri River	60,000
Rainbow Falls, on Missouri River near Great Falls	27,000
Black Eagle Falls, on Missouri River near Great Falls	3,000
Hauser Lake, on Missouri River, northeast of Helena	18,000
Canyon Ferry, on Missouri River, northeast of Helena	7,500
Madison No. 1, on Madison River, 60 miles southeast of Butte	2,000
Madison No. 2, on Madison River, 60 miles southeast of Butte	10,000
Big Hole, on Big Hole River, 22 miles southwest of Butte	3,000
Livingston, on Yellowstone River	1,500
Billings No. 1, on Yellowstone River	1,080
Lewistown, on Spring Creek	450
Steam Plants	5,920
Thompson Falls, on Clark's Fork of Columbia River	20,000
	159,450



Switchboard of Morel Substation

The available capacity of the storage reservoirs now in service is 447,150 acre-feet. Of this, more than 325,000 feet is in the Hebgen reservoir on Madison River which is so located that it supplies in turn the installations on both the Madison and Missouri Rivers.

As provisions for future need, there are available:

Hydro-electric powers in course of development or definitely projected	50,000
Power-sites undeveloped	121,500
Total horsepower	171,500

Transmission Lines

The Montana Power Company's transmission lines, which are carried in some cases on steel towers and in others on wooden poles, tap into the railway system at seven different points where the power is most needed. The Railway Company's transmission line extends the entire length of the system on wood poles. In most cases this line is built on the company's right-of-way, although at several points there are cutoffs which make a considerable saving in the length of line. On January 1, 1916, there were in service:

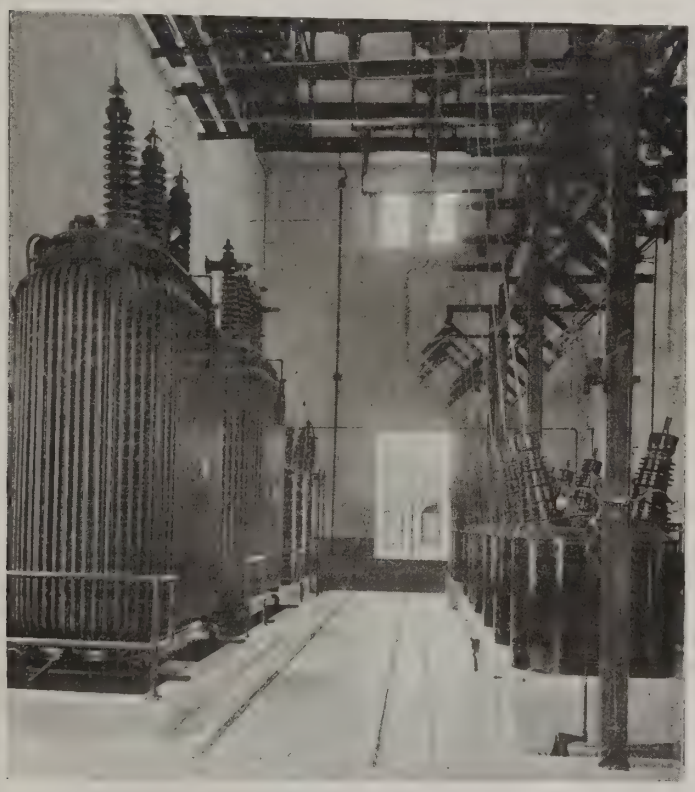
Steel tower lines, 100,000 volts	305 miles
Steel tower lines, 50,000 volts	35 miles
Pole lines, pin type, 11,000 to 60,000 volts	635 miles
Pole lines, suspension insulator type, 50,000 to 100,000	512 miles
Bridge type, 100,000 volts	341 miles
Total	1,828 miles

The Railway Company will pay 0.536 cents per kw.-hr., this very low rate being justified by the ample hydro-electric facilities available and the low cost of line-construction. Energy will be metered on the alternating-current side of the substations. It is expected that the power-cost will be lower for electricity than for coal for the former steam-locomotives.

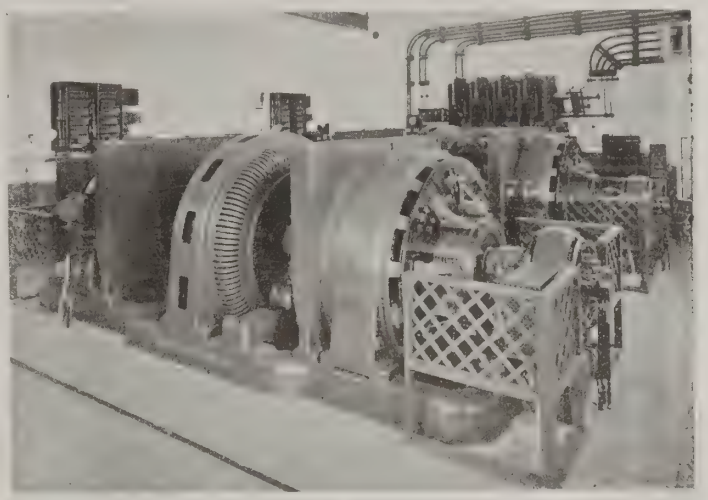
With this completely inter-connected transmission system, each substation may be fed from either direction and also at the tie-in points from a third source of power.

Railway Substations

Fourteen substations are equipped for converting the 100,000-volt alternating current to 3,000 volts direct current. They are distributed along the route at average intervals of 32 miles. Each station contains step-down transformers, motor-generator sets, switchboard and the necessary controlling and switching equipment. The transformers receive the line current at 100,000 volts and supply the synchronous motors at 2,300 volts. Each synchronous motor drives two 1,500-volt, direct current generators connected permanently in series, thus supplying 3,000-volt current for the locomotives. These generators are compound wound to maintain constant voltage up to 150 per cent.



2 2500 kv.-a. 3-phase 100,000 to 2300v. Transformers and Oil Switches in Morel Substation



2—2000 kw. Motor Generator Sets in Morel Substation

load and will stand momentary loads of 300 per cent. They are equipped with commutating poles and compensating pole-face windings. The fields of both the synchronous motors and the direct current generators are separately excited by small direct current generators direct connected to each end of the motor-generator shafts.

Overhead Construction

The overhead construction is of the modified flexible catenary type designed by the General Electric Company and installed under the direction of the Railway Company's engineers.

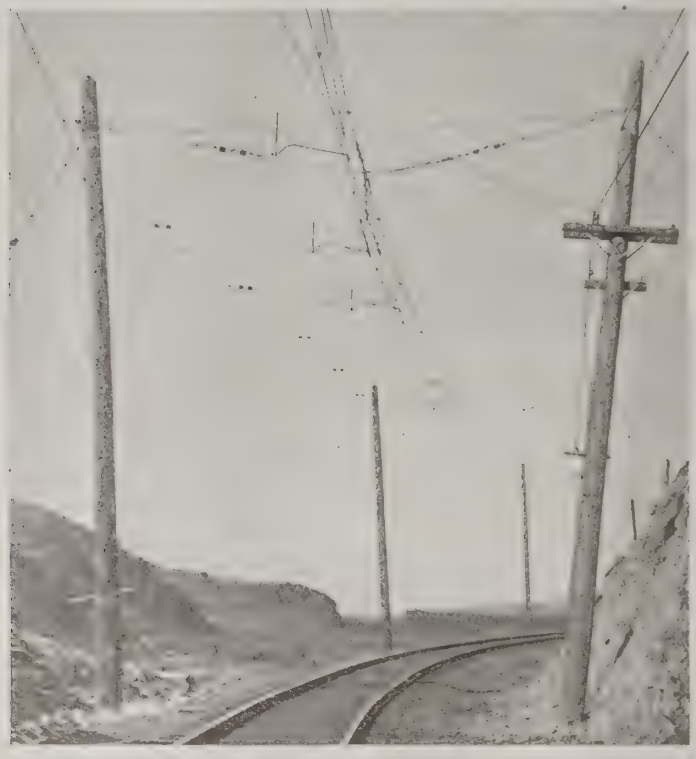
As may be seen from the illustrations, the construction comprises two 4-0 copper wires flexibly suspended side by side from the same steel messenger by independent hangers alternately connected to each wire. This is equally suitable to the collection of large currents at low speed, and smaller currents at speeds up to 60 miles per hour. Bracket construction is used wherever the track alignment will permit, and cross span construction on passing tracks and in the switching yards. All of this work is supported on 40-foot wooden poles suitably guyed and spaced.

A 500,000 c.m. feeder is installed the entire length of the electrification and a supplementary feeder on heavy grades. The feeder is tapped to the trolley wire at every seventh pole, or approximately every 1,000 feet. On top of the poles is carried a supplementary 4-0 negative feeder which is tapped to the middle point of every second reactance bond. These bonds are used for insulating the 60-cycle signal circuits and are installed at points averaging from 5,000 to 6,000 feet apart. Each track is bonded with a 250,000 c.m. bond on each joint and double bonded on the heavier grades.

Locomotive Equipment

The main line Chicago, Milwaukee & St. Paul electric locomotives are constructed in two units permanently coupled together, the halves being duplicates and each capable of independent operation. There are 42 of these main line locomotives (30 freight and 12 passenger) and two switching locomotives. The locomotives are the first to be used for railroad service with direct current motors operating at a potential as

high as 3,000 volts and the first to use direct current regeneration. The passenger locomotives are equipped with a gear ratio permitting the operation of 800 ton trailing trains at speeds of approximately 60 miles per hour on tangent level track. The average passenger train weighs from 650 to 700 tons and is hauled over the two per cent. grade without a helper. The freight locomotives are designed to haul a 2,500 ton trailing train at approximately 16 miles per hour on all grades up to and including one per cent. On two per cent. grades the trailing load was limited to 1,250 tons, although this figure has been exceeded in actual operation.



Typical Overhead Construction on a Curve

Each locomotive is equipped with eight Type GE-253-A, 1,500-volt motors, insulated for 3,000 volts to ground. This motor has a normal one hour rating of 430 h.p. and a continuous rating of 375 h.p., so that the locomotive power plant has a normal one hour rating of 3,440 h.p. and a continuous rating of 3,000 h.p. Each motor is twin geared to its driving axle in the same manner as on the Butte, Ananconda & Pacific, the Detroit River Tunnel, and the Baltimore & Ohio locomotives, a pinion being mounted on each end of the armature shaft. Additional flexibility is obtained by the use of a spring gear and a spring nose suspension which minimize the effect of all shocks and also reduce gear wear to a minimum. The motor is of the commutating-pole type and is constructed with longitudinal ventilating ducts in the armature for forced ventilation from a blower in the cab.

The control equipment is the well-known Sprague General Electric Type M arranged for multiple unit operation. The main control switches are mounted in steel compartments inside the locomotive cab with convenient aisles for inspection and repairs. A motor-generator set in each half of the locomotive furnishes low-voltage current for the control circuits, headlights, cab lighting and for charging the storage batteries on the passenger coaches. Under steam operation, the charging current for these batteries is furnished by a steam turbo-generator set located on the locomotive. The blower for ventilating the traction motors is also direct connected to one end of this set.

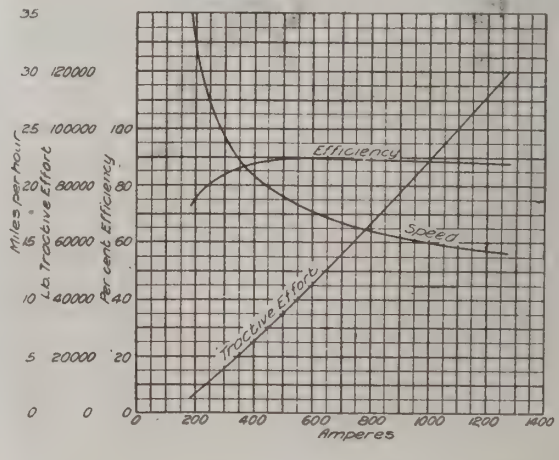
The pantograph collectors, one of which is mounted on each half of the locomotive, are of the double pan type with a working range of from 17 feet to 25 feet above the rail. The contact elements are of the same metal as the trolley wires, so that current passes from copper to copper.

The air brake equipment is practically the same as that used on steam locomotives except that motor driven air compressors are used to furnish compressed air. Aside from the air brakes, compressed air is also used for signals, whistles, bell-ringers, sanders, flange oilers, pantograph trolleys, part of the control equipment, and on the passenger locomotives for the oil-fired steam boilers.

Data on the main line locomotives follows:

Length overall	112 ft.
Total wheel base	102 ft. 8 in.
Rigid wheel base	10 ft. 6 in.
Total weight	564,000 lb.
Weight on drivers	448,000 lb.
Weight per driving axle	56,000 lb.
Weight per guiding axle	29,000 lb.
Diameter of driving wheel	52 in.
Diameter of guiding wheel	36 in.
Number of driving motors	8
Gear ratio, freight service	4.56
Gear ratio, passenger service	2.45
Total output (continuous rating)	3000 h.p.
Total output (1 hour rating)	3440 h.p.
Tractive effort (continuous rating)	71,000 lb.
Per cent. of weight on drivers (trac. coef.)	15.83
Speed at this tractive effort at 3000 volts	15.75 m.p.h.
Tractive effort (1 hour rating)	85,000 lb.
Per cent. of weight on drivers (trac. coef.)	19.00
Speed at this tractive effort at 3000 volts	15.25 m. p. h.
Tractive effort available for starting 30% coef.	136,000 lb.

Passenger and freight locomotives are identical, with the exception of gear ratio and the adoption of an oil-fired steam boiler in each half of the passenger locomotives for heating the trailing coaches. The two boilers are capable of evaporating 4,000 pounds of



Characteristics of a Main Line Freight Locomotive
Diameter of Drivers 62 in. Gear Ratio 4.56

water per hour and this equipment with tanks for oil and water brings the weight of the locomotive up to approximately 300 tons. The interchangeability of all electrical and mechanical parts of the locomotives is considered of great importance from the standpoint of operation and maintenance.

(*Continued on page 64*)

Electrical Equipment of the William Penn Hotel

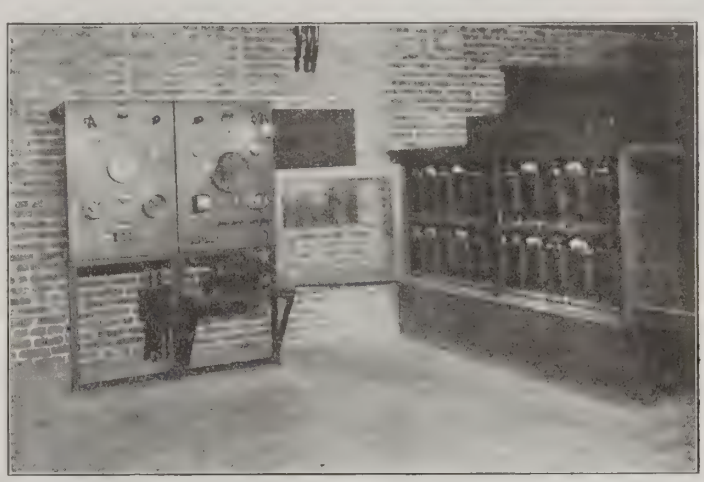
(*Continued from the June Issue*)

Quick communication is the essence of modern life. It goes without saying that every room has a telephone, but in addition to the thousand of these there are 150 more used in the various offices and departments of the hotel. They are served by a nine-position switchboard which requires the services of 27 operators. The equipment is installed and maintained by the Central District Telephone Co,, the local operating company of the Bell System. Fifty-five trunks connect the hotel with the nearby "Grant" central office.

In many cases in hotel service a record must be made. For this the telautograph is used. There are 30 sending instruments and seventy receiving instruments installed. Switching keys allow each sender to communicate with many receivers, either singly or in groups as needed. Thus the room clerk may tell both the telephone information operator, the nearest service station, and the credit clerk whenever a guest registers or "checks out," and orders for food and drink are transmitted from the service station directly to kitchen and bar.

Electric Clocks

The guest who forgets to wind his watch on retiring is not under the embarrassing necessity of asking "Central" for the time next day. Every bedroom contains a clock, operated electrically from a central station in the basement lobby. This system, which was furnished by Walker Brothers and Haviland, consists of two weight-driven master clocks which step the controlled clocks ahead by an impulse of current each minute. There are six circuits carrying 925 clocks operated by 24 volts through a relay for each circuit, and two circuits carrying 35 time-stamps operated by 110 volts. One spare clock relay and one spare time-stamp relay are installed; each have contacts sufficient to operate all circuits. On each circuit there is a clock on the control panel; a glance will show whether any circuit is out of service. If master clock No. 1 should fail, its mate automatically takes up its work; this, together with any failure of current automatically rings a bell in the engine room.

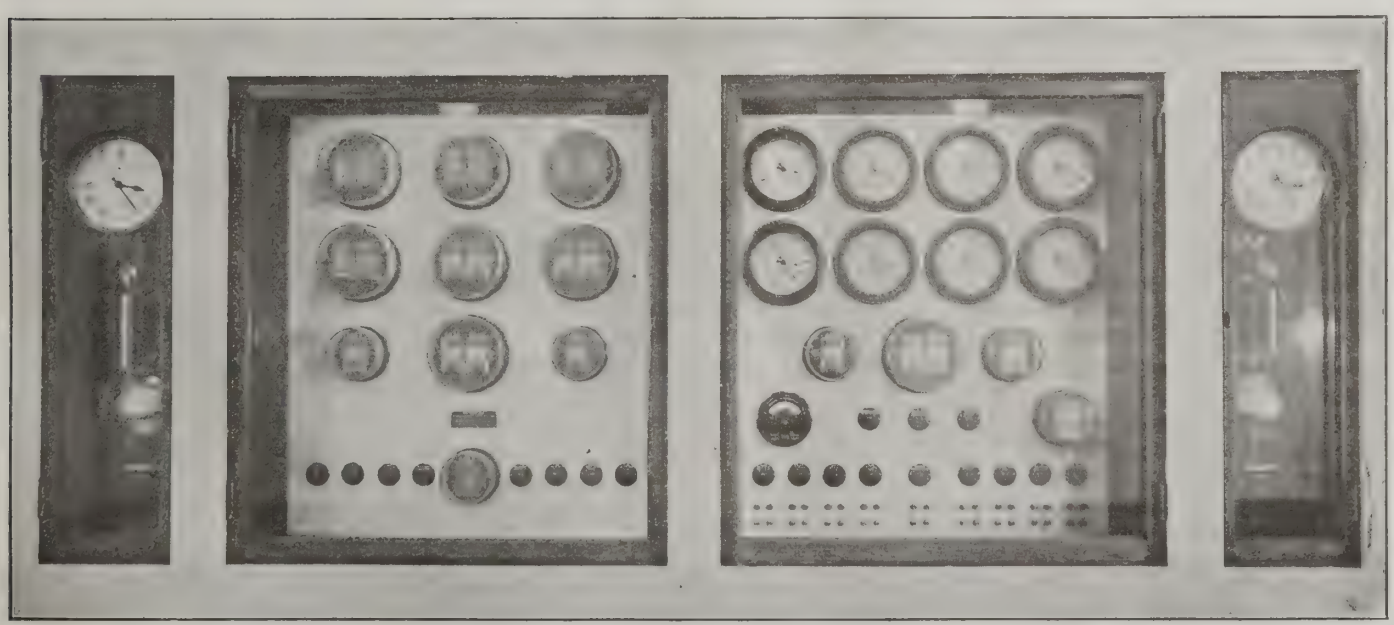


Low-voltage Switchboard and Battery

Low-Voltage Supply

Current for the electric clock system and for other low voltage apparatus is furnished by two Potentiostats, built by the U. S. E. M. Co., of N. Y. Each of these Potentiostats, which are mounted side by side on slate panels, controls a set of 12 "Chloride" storage cells of 80 ampere hour capacity. The clocks are operated from one set, and the other low voltage apparatus in the hotel from the other set. The set for the clocks is charged from the 120 volt d-c supply, and the other set is charged by means of an automatically controlled motor generator driven from the 110 volt alternating current supply. These two sets are linked to-

(*Continued on page 67*)



N. E. L. A. Convention Papers

Extracts from Report of Committee on Underground Construction

A New Service Box

Methods of serving consumers from distribution lines are always changing to suit developments in building construction. Central-station men are always on the lookout for devices which if not exatly suited to their conditions, may yet suggest the solution to some perplexing problem.

Underground construction when employed for service connections of small capacity, usually requires an abnormal investment in comparison with the business to be served. Where a number of customers in a single building are to be served by a single service, local municipal regulations usually require that the main service switch be placed in a location accessible at all times for the replacement of fuses, etc. This is usually accomplished easily in a building one or more stories in height,

Two Views of the New Box

where there are no partitions or dividing walls to cut the building vertically into several parts, by placing the service in the main entrance or in some position in the basement which is used in common by all tenants.

In the case of a block of one-story buildings, constructed with or without basements and each having its own entrance, recourse must be had to a separate service connections for each subdivision of the block. In many cases such services may have a load of only one-half kilowatt or less, thus involving a heavy and unwarranted expenditure for the business served.

In an effort to reduce the cost of this form of construction, the Edison Electric Illuminating Co. of Boston has effected a material saving by the introduction of a service box adapted for the supply of an entire block or group of customers of the character last described. This consists of a suitable weatherproof iron box built into the wall of the building at the street level in a manner to conform to the general architecture of the building and in no way detract from its appearance. The company terminates its service in this box, installing a main switch properly fused for the supply of the entire premises to be served. The owner of the building installs a common main from the service box, running this horizontally to connect with all the separate premises to be served.

This main when installed in conduit, in strict accordance with the rules of the National Board of Fire Underwriters, introduces no hazard of any character, and simply duplicates the conditions under which vertical mains or risers are installed to serve tenants in buildings of one or more stories in height. In both cases branch connections are taken from the main on each tenant's premises, thus giving the tenant access at all times to the devices controlling his service.

The main service box, placed in the outside wall of the building, is accessible at all times to the company's employees for refusing, inspection, etc., and also to firemen of other municipal agents who might desire to discontinue the service in the building in emergencies. While the box is ordinarily locked, provision is made for forcing the door without damage to the box itself.

This form of construction, requiring but one service for a number of customers under the conditions described, has effected a reduction of at least 50 per cent. in the cost of service connections for each customer when compared with the methods formerly employed. Aside from the saving thus affected, this form of construction has had the unqualified approval of municipal authorities wherever it has been introduced.

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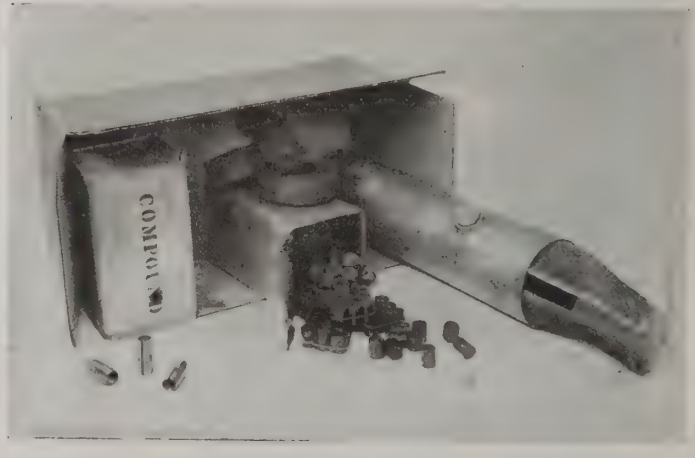
Unit Packages for Cable Joint Material

This method is in line with the tendency to prepare material as fully as possible for installation before it leaves the store-room. Every company can use it to some extent as a "spare-time" activity for the store-room men which will obviate waste of time and material later.

The New York Edison Company has used this method in the construction of joints for 3-conductor, 350,000-cm sector type 25,000-volt cable feeders. The necessary material was delivered on the job in cans or packages, two cans being used, one for the filling compound and one for the paper tape and other miscellaneous insulating material.

All of this insulating material was prepared at the cable factory, submitted to 29 inch vacuum and impregnated with the same compound which was to be used in filling the joint. The



insulating material is placed in the can in layers in the order required to make up the joint, so that all of the material in each layer has to be used in its entirety in each successive operation. The illustration shows all the material used to make one complete joint of this type.

The Commonwealth Edison Company of Chicago reports the following practice:

When the lead sleeve is three inches or larger in diameter, this sleeving is cut to the exact length required for the joint, wooden end-plugs and through bolts are used to seal the ends, and the tape, solder, copper sleeves and soldering paste are placed within the sleeve. If the package is sent out in advance of the work, the ends are sealed by dipping in melted paraffine.

When the sleeve is smaller than three inches in diameter, a pasteboard or sheet metal container is used to hold the lead sleeve and other material. The material is placed in the pasteboard container if it is to be used immediately, and in the sheet metal container if it is to remain on the job a day or two before being utilized. The latter is necessary in order to keep the tape dry. Each package made up for No. 6 and No. 0 single conductor cable contains material for four joints.

As the exact quantity of material required is sent out in each package, joints that are uniform are secured. Less time is required on the job to get material ready for the joints, because the lead sleeve is cut to the proper length and all material is in a form convenient to handle. There is also considerable saving in the storeroom, as these packages can be made up during slack time and are more quickly and easily handled when delivered.

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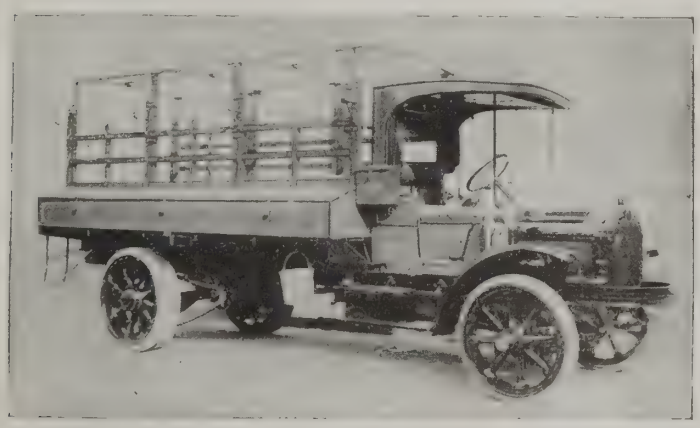
Use of Power Trucks in Underground Work

Where there is enough heavy outside work to keep it busy hauling supplies, a power truck is an excellent investment. At a moderate cost it can be equipped with a winch which will speed up heavy work to a remarkable extent. Relieved of the most fatiguing of their labors, the crews are encouraged to put all their energy into quicker and better work. This extract shows how several of the large companies make use of such trucks.

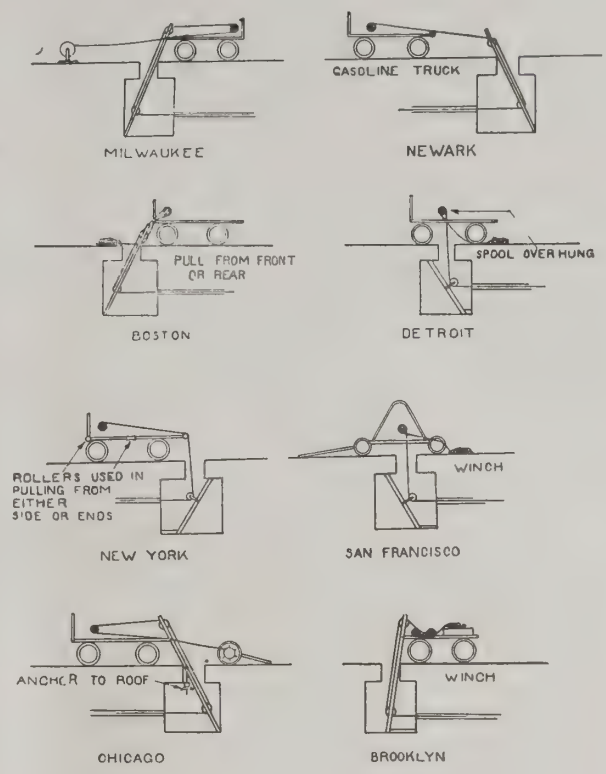
Nearly all of the twelve large operating reporting companies use power trucks for hauling reels of cable to the job, delivering material, pulling cable, and emergency work. One large member company is considering the replacing of horse-drawn vehicles with power trucks for the purpose of testing junction boxes, as the same men are used for emergency work, and a saving in time would be effected by the use of power vehicles. Nearly all use electric trucks; three use both electric and gasoline and one company uses gasoline engine driven trucks only.



Truck Used by Public Service Electric Co., Newark, N. J.

The truck most suitable for underground work should have a speed of ten to twelve miles an hour and be designed to run at least thirty-five miles on one charge.

Of the twelve companies reporting only two have trucks with bodies specially designed with compartments for tools. The others place tool boxes under the seat or in some convenient place on the truck. One large company has a truck with a body specially designed for emergency work. Compartments are built along both sides of the truck to hold tools, fire extinguishers, sand buckets, etc. One pocket holds the records of the distribution system and the cover to the pocket forms a desk on which the records rest while being used by the emergency-man. This company also has a three and one-half ton cable-pulling truck designed with compartments along the side for holding underground tools used for installing cable. A reel of cable can also be hauled to the job on this same truck.



METHODS OF PULLING CABLE
ALL TRUCKS ARE ELECTRIC UNLESS OTHERWISE SPECIFIED
MOTOR WINCH SHOWN SOLID

Seven different methods of pulling cable have been described. These methods, however, fall into two classes:

(1) By means of pulleys set on I-beam uprights.

(2) By means of a pulley or snatch-block anchored in some manner in the manhole.

An outline sketch is given of the various methods used by member companies.

When manholes are near car tracks it is sometimes impossible to use the I-beam upright method of pulling cable without interfering with street car traffic. For this reason it is a good plan to have the truck equipped with facilities for pulling cable with a rope leading from the rear or from the front. A New York Company has its trucks provided with facilities for pulling from either side as well.

Some difficulty has been encountered in maintaining the I-beam uprights in position when pulling heavy cable on account of the enormous strain. In order to obviate this difficulty the Chicago company has devised an anchor with wing bolts that may be adjusted to any manhole. This anchor holds the uprights in position by a strain on the roof of the hole, as illustrated.

When the rope is passed through the hole in the floor of the truck the strain on the truck as well as on the winch is downward, and very little difficulty is experienced in holding the winch to its fastenings. When this method is used the truck is placed over the manhole, a position which takes up less working space in the street and eliminates the hazard of an unprotected open manhole. It may be difficult to design the truck so that the rope leading directly downward through the trap door will not interfere with the battery or running gear. A rolling spool for the rope on the side of the truck and an eye-bolt for a snatch-block in the center of the floor, a method which the New York company uses, accomplishes the same results as the trap-door method without introducing its objectionable features.

A number of the member companies report that their electric trucks are not equipped with facilities for lighting manholes at night. It is recommended that trucks for underground work be wired with sockets for extension cords to both the front and rear. This will greatly facilitate trouble-hunting at night. For splicing cable at night however a portable storage battery outfit is more suitable and more efficient. The use of an outfit of this kind eliminates the hazard of candles or lanterns in gassy manholes, besides providing the better light needed for good jointing work.

* * *

Economics of Central Station Power for Railways

This extract from the report of the Committee on Central Station Power for Railroads is of especial interest in connection with the account of the Chicago, Milwaukee & St. Paul electrification which appears elsewhere in this issue.

The underlying economic reason why central power companies have been successful in the supplying of power to railway companies is due to concentration of production in the hands of specialists in that line. The diversity in peak requirements for power and resulting improved load-factor; the large quantity production; and the rapid aggregate annual increase in requirements on one system, making possible the purchase of one or two very large, and very economical units each year, all have permitted the central power company to sell power for less money than it cost the railway companies to manufacture it for themselves. Not only has more intensive use of generating, distributing and substation facilities resulted, but more frequent substations, better transmission and more adequate facilities in every way have resulted. In other words, since less money has been wasted more has been available for improving the service, both of the railway company and the central power company.

In the smaller communities concentration of production has naturally existed from the early days of the electric railway business. It was obvious to the operators in some of the smaller towns that the requirements of the community did not necessitate the building of two power houses and hence only one was built. Another case of concentration of production resulted naturally enough in localities where larger water powers exist. In such cases the power company supplied the demands of all sorts of users. However, athough concentration worked well in the case of the small town and in the case of the large water power, it did not seem to occur to the operators that the same economic principles should govern the problem in larger cities, or in a group of cities and towns where steam plants supplied the power. It was brought forcibly home to railway operators in some places when their original power houses, for one reason or another, become inadequate and oboslete and these railways were face to face with the problem of raising sufficient capital to build new plants. In some cases the lean earnings of the earlier years of electric railroading had not been conducive to the setting aside of proper reserve accounts to keep the power house abreast of the state of the industry. Hence the railroads logically turned to the central power company for power.

Along the Electrified Section of the Pennsylvania Railroad, West of Philadelphia

This brought about a still closer analysis of the load conditions, which showed that there was usually considerable diversity in the peak requirements of the railway company as compared with the light and power demand. Obviously this resulted

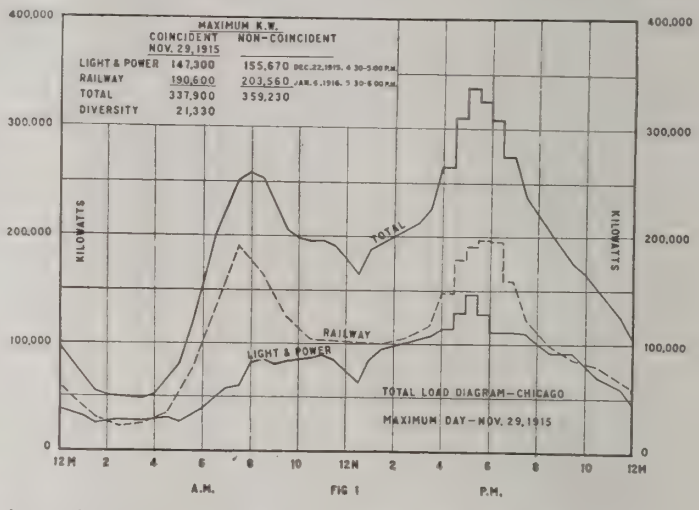


FIG 1

in a decreased aggregate investment and furthermore in reduced operating costs.

One of the results of the concentration of railway and light and power load in Chicago so far as diversity is concerned, is best shown by the curve in Fig. 1. The railway peak for the winter of 1915-1916 was 203,560 kw. and occurred between 5:30 and 6:00 p. m. on January 6, 1916. The light and power peak amounted to 155,670 kw. and occurred between 4:30 and 5:00 P. M. on December 22, 1915. The total of these two peaks, if at the same hour, would have been 359,230 kw. but the greatest load on the combined system amounted to only 337,900 kw. and occurred on the 29th of November, 1915.

This shows a diversity of 21,330 kw. or nearly 6 per cent. If the two systems were operated separately, and allowing reasonable reserve on this diversity the total would be approximately 26,000 kw. The result therefore of the combination is that the investment necessary to provide 26,000 kw. has been saved.

The economics of this matter are fully treated in a paper by Mr. Samuel Insull before the American Institute of Electrical Engineers on April 5, 1912, entitled "The Relation of Central Station Generation to Railway Electrification."

Another curve (Fig. 2) shows the effect of applying the estimated ower requirements for the electrification of the Chicago steam roads to the present output of the central power station company. These estimated requirements have been very carefully prepared by the Chicago Association of Commerce, Committee on Smoke Abatement and Electrification of Railway Terminals, and presented in its report recently published.

The load curve of the central power company has been taken for a typical October day, because of the fact, that such a day was chosen by the above mentioned committee for the plotting of power requirements for electrified steam railroads. The railroad peak amounts to not only about 30 per cent. of even the present combined peak. By the time such railroad terminals could possibly be electrified the combined peak would be much larger and this percentage much smaller. This railroad maximum load occurs in the morning and we find a diversity as compared with the combined peak of 10,000 kw. The load-factor for the day based on the one-hour peak is 62½ per cent. for the steam railroad requirements only, whereas the light and power and street and elevated railway requirements show a load-factor for the day of 59.3 per cent. and the combined sys-

tems a load-factor of 62 per cent. This distinctly shows what the beneficial effect of the electrified steam railroad requirements would be upon the present central power company load.

It is interesting to note that the steam railroads, if electrified, would have considerably less peak load demand than the elevated and surface railways. The suburban service of the electrified

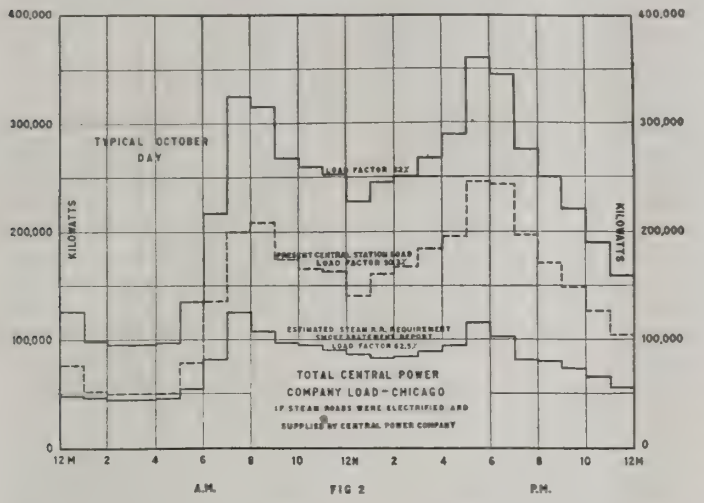


FIG 2

steam railroads in the Chicago district makes the annual load-factor less than would be the case in some smaller sized cities where the steam railroads do not have such a pronounced morning and evening peak in suburban service. This pronounced suburban peak will of course be found in ten or twelve of the large cities in the country.

* * *

Public Utility Employees' Savings and Loan Plan

An interesting and highly successful savings and loan organization is being operated by the employes of the Postal Telegraph Cable Company, New York, under the name of the Mutual Investment Association. Organized seven years ago, this association is essentially a voluntary club for systematic saving and thrift, having a limited charter membership of 150; all members must be employes of the company or its associated interests.

The primary purpose of the organization, as explained by Mr. Edward Reynolds, treasurer, is to employ its funds, derived through monthly contributions, for investments in real estate, stock, bonds or other securities, affording conservative returns with utmost safety. To encourage methodical saving, dividends declared from the proceeds of installments are placed to the credit of members instead of any immediate cash disbursement.

A Mutual Stock Company

The management of the funds of the association is under the jurisdiction of a finance committee of five members. Mutual benefit accures to members in proportion to the amount contributed by each one individually, a regular payment of five dollars a month entitling the member to one share of stock, and upon which there is no fixed limit of value. Stock is now worth close to $500 per share, representing paid up installments and interest earnings. It is interesting to note that employes have purchased stock to an amount of over $50,000, bearing a guaranteed annual dividend. These dividends with installments of members effect a total saving to date of about $80,000.

Not only does the association inspire its members to save, but through operation in foreign investments affords an added value of membership, rendering this additional service without compensation. Thousands of dollars have been placed for members in worthy, interest-bearing securities; during the first fifteen months' activity of this feature, outside investments to an amount of $50,000 were made. The acquirement of homes is still another extension of the habit of thrift in this organization. Desirable arrangements have been made with a building and loan association for the purchase of individual shares by members interested, in order that they may obtain property and build homes on an attractive payment plan. Company employes are not required to be members or shareholders to enjoy this privilage, and many "Postal" workers are now living in their own homes derived through the features of this idea.

Loans

The benefits of the regular loan department also are extended to all employes of the company, whether or not members of the association. All borrowers are placed upon their honor, loans being made solely upon personal notes and no other security requested or assignment of wages allowed. Accommodation is made at the rate of 6 per cent. a year, the borrower agreeing to repay the loan in weekly or monthly installments, as may be desired. For example, an employe obtaining a loan of $25 and paying back on the basis of one dollar a week, is charged a total interest for the accommodation of seventy-five cents. Practically no losses have been incurred through loaning money to employes on personal notes; even those who leave the company before fully repaying their indebtedness and over whom no control is exercised have, with a few minor exceptions and negligible resulting losses, paid their delinquencies in full.

Merchandise Purchases

Still another interesting feature of the association's operations is the plan devised for the assistance of employes in the purchase of merchandise at the lowest price obtainable. Investigations revealed the fact that many employes were purchasing necessities upon the installment plan, usually a very costly practice, while it was shown also that many stores were loaning money to employes and entering it upon the books as merchandise purchased. In the operating department, where each employe must furnish his own typewriter, it was found that loans were being made for the purchase of these machines, and that many were renting them at an exorbitant rate from different typewriter dealers.

To correct these conditions became part of the work of the association. Arrangements were made with various stores to furnish members and other employes of the company with merchandise at cash prices, charging to the account of the Mutual Investment Association. The organization in turn, derives a profit from the cash discount obtainable and, in certain cases, a commission from the retail establishment. The borrower and intending purchaser is supplied with a card of introduction to the store handling the particular goods desired, which sets forth that his bill is to be charged to the association to an amount not exceeding the total of his loan, as stipulated. It is not necessary for the buyer to show his card until after prices have been quoted and the purchase made, thus assuring the lowest cash price as would be obtained by any other individual.

Typewriters

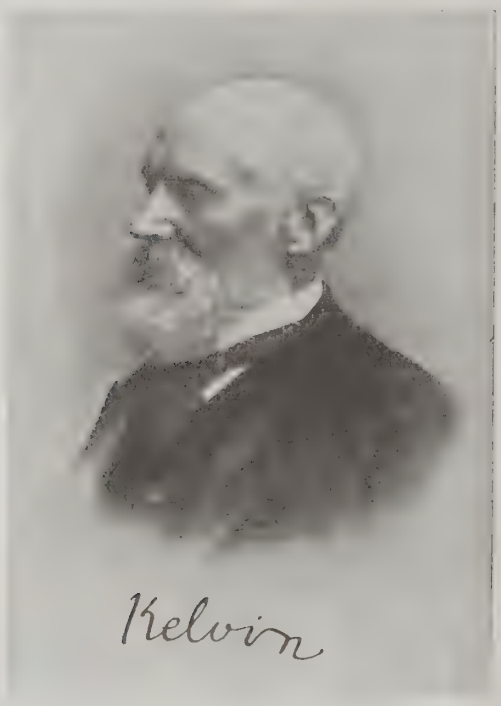
In the case of typewriters, a particular departure has been made. The association now sells machines direct to company operators on the installment plan, with the same charge as on the regular cash price basis. Not only does the purchaser directly benefit but the advantage is reciprocal, the club deriving the profit both on the sale of the machine and the loan, and which in turn accrues to the association fund for members.

The operations of the Mutual Investment Association have proved so successful that similar organizations have been established by company employes in other large cities. All of these engage upon the same co-operative principles and are bringing equally notable attainments.

Electrical Fathers

Lord Kelvin

From time to time at technical gatherings or in scientific journals there is talk of what should fix the dividing line between pure research and engineering analysis. Always the discussion is tinged by the prejudices of those who take part. The men of science are prone to sneer at anything which has a "practical" aspect, while the engineers contend that what has not the prospect of financial worth is a waste of time. Fortunately, the development of research organizations in the great industrial companies has brought men of both schools together in the search for common ends; the scientists to determine the fundamental relations, the engineers to make the economic applications to working conditions. It is therefore of much interest to turn to one of those pioneers who at the time of need showed the practical electricians how the mathematical theory of electricity could solve their problems.



William Thomson was born in Belfast, Ireland, on June 26, 1824. At the age of ten years, he entered the University of Glasgow, in which his father held the chair of Mathematics. In 1841 William entered Cambridge University, from which he obtained his bachelor's degree four years later. After a year's study in Paris under Regnault, the famous physicist, the University of Glasgow called him back in 1846 to take the chair of Natural Philosophy, a title which included both Physics and Chemistry. This post he retained until his death, which occurred on December 17, 1907.

While Thomson had a profound influence on his pupils during his sixty years of teaching yet in other fields are his chief contributions to our civilization. We seldom think nowadays as we read long cable-dispatches from across the seas, of the days when the calculations were being made for the first transatlantic cable and of how little was known of the propagation of electric waves along wires. William Thomson demonstrated that the speed of signalling varied inversely as the square of the length of the cable and showed that it would be useless to try to help matters by increasing the impressed potential. So favorably did his theoretical work impress the directors of the transatlantic cable enterprise that they made him their chief engineer. During the trying years which saw one failure after another pave the road to success, Thomson's scientific ability was of great value; the mirror galvanometer, by which signals were at first received was his invention, and later he developed the syphon recorder which is in use to this day. "Sir William," we must call him now, for his services won the recognition of knighthood at the hand of Queen Victoria.

A characteristic trait of Sir William Thomson is shown in connection with his work on the mariner's compass. It had been the custom to use large heavily magnetized needles to actuate the card and correction against the effects of nearby iron was a difficult matter. In 1874 Sir William was asked by the editor of a popular monthly to contribute an article on the compass. The preparation of this drew his attention to the deficiencies of the instrument, and when, five years later, a second article appeared, the author had re-designed the compass. His model, now in universal use, employs a light ring instead of the old card, and a number of small magnets fastened near the point of suspension. Correction against external fields is accomplished by a few permanent magnets, instead of by the huge iron spheres formerly used.

In theoretical electricity, Sir William was the pioneer in the development of the theory of the ether. He laid down the hypothesis that all space is permeated by a weightless, perfectly elastic medium through which are transmitted electric and magnetic forces. As opposed to the former theory of "action at a distance" this gave men a means of applying mechanical analogies to electrical wave-phenomena, and later others developed the equations which relate all forms of wave-motion, whether of sound, of water, or of electro-magnetic forces.

We little think when we refer to the units of our profession that there was once a time when there were no standards of electrical measurement which were definitely related to the fundamental units of mass, length and time. Proposed first by Weber and Gauss, the absolute system of electrical units owes its adoption to the enthusiasm and interest of leaders such as Helmholtz and Thomson. The latter served on the committee of the British Association, which fixed the values of the electrical standards we now use.

One of Thomson's inventions was the quadrant electrometer. This instrument is particularly well suited to voltage measurements where current to operate a galvanometer is not available. Such a case would be the measurement of the no-load secondary e.m.f. of a transformer when the current drawn by a voltmeter would be comparatively so great as to be an appreciable load. With it Thomson made important determinations of the dielectric strength of air, and of the insulation of cables. Later the need of accurate standard instruments for measuring heavy currents led Thomson to invent his famous ampere-balance. This consists of a light metal frame, usually about fifteen inches long, balanced upon knife-edges at its center, and carrying at each end a flat coiled conductor. Similar flat stationary coils are arranged above and below each moving coil and all are so connected that the current to be measured flows through all in series. The fields produced tend to lift one moving coil and depress the other. This force is counter-balanced by the addition of weights until the beam is again in its no-load position. The device is sometimes called a "current-weigher" and its utility lies in the fact that its calibration may be determined by calculation from its physical dimensions instead of by comparison with another standard. By the substitution of high-resistance coils on the balance-arms, and connecting them across the supply line, the instrument becomes a wattmeter whose constant also may be calculated from its dimensions.

Nor did Thomson disdain the commercial side of invention.

(*Continued on page* 65)

EDITORIAL

As The Colors Pass

The President's call for the militia has set in motion the National Guard organizations of many states, and as we go to press trainloads of citizens, enthusiastic over the prospect of becoming real soldiers, are rolling toward the scene of action. Yet the daily traffic of our lines of communication goes on as usual; no schedules are suspended nor shipments delayed to take care of mobilization. Probably the most serious inconvenience is that suffered by the smaller business organizations, some of whom have lost a considerable percentage of their force. The large corporations are testing the value of "diversity factor" given by their large staffs; if one department is hard hit, it can call on the others for assistance. Moreover, the smaller concerns depend on this month's output for next month's income, while a cessation of activity in some departments to provide men to operate others would mean only a small loss to a big company. But large or small employers are responding as liberally as their means will allow in sharing the financial responsibilities of the men who represent them in the ranks. Almost every important central station and manufacturing company has offered to continue full pay to its employees who are called out, and to give them their former positions on their return. A notable and a wise exception has been that of a telegraph company which, realizing the special value of expert operators, has discouraged the enlistment of its men in the ranks.

Electrical men should make good soldiers. All of them have been trained to deal with things as they are, to accept the facts and make available facilities serve their needs. Construction men will find the transition an easy one; a soldier's field equipment is, to be sure, somewhat heavier than a belt full of tools, but use will soon make the burden but a part of the day's work. When it comes to making or breaking camp in a hurry, or throwing up some sort of cover from the enemy's fire, we are willing to back the electrical man against all comers.

There is, of course, the possibility that the Constitutionalist government of Mexico may recognize the error of its ways and come to terms, but the Mexican genius for political blunders may be counted against it. Whatever may be the event, we are going to see it through. The service of every man of us—at the desk, in the shop, before the switchboard, or along the transmission line—is at his country's call. While "the boys" march by, our throats are husky with something more than the cheering and as the colors pass, our hats are off.

Rental of Motors by Central Stations

One of the slogans of modern business is "Service." The whole spirit of commercial life is being changed to conform with the ideal of selling the customer satisfaction rather than a mere product. That has been the guiding principle of the telephone industry, so that now everyone has come to think of the instrument on his desk as only his point of contact with a vast system. Power companies have been slow, however, to recognize the fact that what most of their customers want is mechanical power rather than electrical and that the user should be, and usually is, indifferent to the means whereby power reaches his shafting.

One of the reasons for the phenomenal growth of the telephone systems has been the ease with which new subscribers can take on the service. No initial outlay is necessary on the part of the "prospect." Provided his credit rating is satisfactory the signing of a contract is enough and each month's bill is paid as part of his current expenses. On the other hand, the prospective user of electric drive has to be "sold" a wiring and motor installation for which he must pay out of capital. Few concerns there are which cannot at any time find a use for spare cash which will bring them ten per cent. When that and other fixed charges were added to the cost of electricity the proposition looks much less inviting. It is very likely that if central stations would make a practice of renting motor equipment complete to their customers, the extension of motor drive would be much easier.

It is of interest in this connection to note the results secured from renting motors by the Hawick, England, central station. The community chief industry is the manufacture of tweeds and hosiery, and as might be expected the horsepower of individual motors is small, being on the average six and three tenths. Of the 300 installed at the end of 1915, customers owned 174, ten were on a time-purchase plan and 116 were rented by the company. The rental rates range from $8.75 per year for one-fourth to $121.50 per year for 50 horsepower. On the signing of a contract the company installs the motor complete with all accessories. The customer pays for the labor, and for the necessary belting. Thereafter the company maintains the motor in good condition, replaces worn-out brushes and makes any repairs necessary, even though these may be due to a fault of the user. The inevitable delay incident to a breakdown makes the user careful not to abuse the motor. When trouble occurs, the company sends a man, who reports the extent of the damage by telephone and starts the work while the shop crew are

preparing the materials or a substitute motor. That the plan is profitable is evident from these figures:

Gross Rentals	$3,900 per annum
Less Maintenance	1,182
Net Rentals	$2,718

This represents 14.4% on the capital invested, and if 6% be deducted for depreciation, the balance, 8.4% is a satisfactory return. To this should be added, of course, the indirect return from the electricity which might otherwise go unsold.

Every central-station man is familiar with the arguments in favor of his service as against that of an isolated plant. Most of these will apply equally well in superseding other power sources with electricity, if the central station accepts its whole duty of supplying mechanical power rather than electrical. A large organization is better equipped to make repairs quickly and cheaply, and hence to give the sort of real power service which will allow the manufacturer to concentrate on that which he can do best—the turning out of his product.

* * *

The Midsummer Slump

All through the month of June, the fan salesmen have been "on edge." No sooner had a day or two of warm weather gladdened their hearts than along would come a spell of cold, dismal dampness, during which the mention of fans was as an offer of a refrigerating system to an Esquimaux. But now the luck has turned and we may expect real summer weather from now on.

From time immemorial "the summer slump" has been anticipated by a slowing down in merchandising activity. The curve of sales in most lines shows a falling off during July and August which amounts in some cases to a practical cessation of activity. Particularly is this true in the retail field; with regular customers out of town, with business slack in other lines, what wonder that the salesman yields readily to his own lassitude and cuts the working day short at both ends, and a good-sized chunk out of the middle?

True it may be but it is none the less inconsistent. Every man in the power-supply field knows that the "valley" of his production-curve holds a sink-hole into which profits disappear. The filling of that valley is his job, and it is up to the appliance man to learn wisdom and do likewise. It has been said by a noted statistician that the time to push sales hardest is when there is the least business coming in; when business is good, there is less need of exertion, in other words, raise your "valleys" and let the "peaks" take care of themselves.

Like a good general, the merchandiser who plans a summer campaign will take advantage of every point which he can command. If he has the choice, he will feature seasonable merchandise, such as electric cooking devices for coolness; a sewing-machine motor to get the work done earlier; an electric iron to take along when travelling; a flashlight for the wind-up of the twilight excursion; or an electric fan for half a dozen reasons. The locality will influence his choice; in a "summer colony" the less expensive devices or rental propositions will likely be most successful, while in the city a hot July morning would be just the time to "close" Mrs. Housewife on that electric washing machine that she had long wanted and managed to do without. For travellers, motor-driven devices should be equipped with "universal" motors for while city supply lines are generally alternating-current, the isolated plants and small central-stations at resorts are more often for direct-current.

When the device is one which can be sold in the home by a demonstrator, the summer is one of the very best times to make the attempt. Almost all such devices have at bottom the purpose of lightening domestic labors, hence they are inherently timely. Many home-dwellers have more leisure in the summer, and hence often that ennui which makes them the more willing to listen to a demonstration. College vacations set free many young men and women who want employment. They are ideally suited to the work, learn it quickly, and make a favorable impression on those whom they approach. As they are willing to work on a commission basis, the expense can be more readily borne than where a regular salary must be paid.

For the wiring of existing houses there is no time like the summer. Most "prospects" will be away from home for at least two weeks and by a careful scheduling of work it is possible to have one job follow another without a break. To get this class of business, it is absolutely essential that the contractor should have a reputation for the honesty of himself and of his men and that he should give special attention to seeing that every article of furniture is left exactly as he found it. Reputations grow slowly and it is good policy to feature reliability in all advertising, in order to forestall any objection to placing a house and its contents in the hands of an outsider during the owner's absence.

But after all, the obstacles we have touched upon have been secondary ones. The big one lies so near home that it is sometimes overlooked in the first flush of enthusiasm. The lack of "staying power" to fight along in the face of heat and humidity to keep on "plugging" when the outdoors is calling is what kills many a campaign. Most men do routine work ninety per cent. of the time. The quick shifts necessary to a real "campaign"—the throwing of a flying squadron into the office district with fans on a hot day—the quick shifting of a wiring gang because Mrs. Smith is coming home a week earlier than she—and you—had planned—is what tries your generalship. But there's real money to be made, and that, to an American business man, means a quick start, a hard pull and a strong finish.

Installation, Operation
Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Lightning Protection For Transformers

By D. W. Roper

Mr. Roper is superintendent of the Street Department of the Commonwealth Edison Company of Chicago. In this paper presented at the recent N. E. L. A. Convention he tells of two ways of protecting distribution transformers from lightning—by removing the exposed high-tension terminal boards of the transformers, and by installing lightning arresters on the same poles as the transformers.

At the time of starting the investigations which form the basis of this paper, the distributing system of the Commonwealth Edison Company, with which the writer is connected, included about 9,500 transformers and supplied service to about 100,000 customers. The maximum load on this system of distribution at that time was about 28,500 kilowatts. Since that time this system has been growing very rapidly, so that at the present time there are over 16,000 transformers supplying service to more than 240,000 customers, and the maximum load during the past winter was about 74,000 kilowatts. The transformer burn-outs due to lightning then amounted to about 1.2 per cent. per year, and the transformer fuses blown by lightning averaged about 12 or 15 per cent. of the number of transformers.

The practice of the company, in matters regarding lightning protection at the time of beginning this investigation, was briefly as follows:

(a) Transformers were purchased and installed with primary terminal boards above the oil.

(b) Lightning arresters were installed on the line poles, i. e., poles supporting wires only, and placed so that there was one arrester for about 2,000 feet of primary line.

(c) Different types of arresters were purchased in succeeding years and were placed on the lines so as to protect the additional primary wire installed during the preceding year, without any reference to the types of arresters installed in the same vicinity in other years.

(d) No systematic detailed records were kept of all the troubles caused by lightning as such records were quite impossible with the methods of installation in use at that time. Occasional records were kept of the lightning troubles on a few selected primary circuits.

Our first step in the investigation of the causes of lightning troubles consisted in making a careful examination of all transformers whose fuses blew in several lightning storms. In about 80 per cent. of these we were able to find marks on the transformer case or on the primary board where the arc had jumped across between primary terminals or from primary terminals to the cover, or around the primary bushings. We therefore selected an area which included several hundred transformers, removed all transformers within this area in which the primary terminal boards were above oil and substituted tansformers which had their primary terminal boards removed or submerged below the oil. The result of this investigation indicated a considerable improvement in the service, so that we therefore specified that all new transformers should have their primary terminal boards either removed or submerged. In addition we arranged that all transformers which were for any reason returned to the storeroom from the line, should have their primary terminal boards removed before being again sent out to be reinstalled.

Simultaneously with the above investigation we started to segregate the various types of arresters. For convenience we selected the primary circuit as our unit with the idea that this would be the simplest way of keeping the records. The arresters were installed so that there was only one type of arrester on any single primary circuit.

About this time the theory was advanced that in order to be most effective, lightning arresters for the protection of transformers should be installed on the same pole with the transformer. Several additional areas were then selected for the purpose of giving this theory a trial, and in those areas a lightning arrester was installed on the same pole with each transformer. For convenience we called these areas "100 per cent. protection areas."

Lightning arresters had been considered a necessary evil by some line foremen as well as engineers, and had therefore been relegated to the line poles where they would be out of the way. The problem of devising a method of construction with arresters on the transformer poles, while offering some difficulties was not insurmountable. Photographs of several typical installations are shown in Figs. 1 and 2. The results of these two steps in the investigation

were presented in a paper before the Pittsfield meeting of the A. I. E. E. May 28 and 29, 1914. The results of the latter investigation, while indicating a considerable improvement, were not considered conclusive; so that in the following year the 100 per cent. areas were considerably enlarged. Again careful records were kept of the results in these areas and in the rest of the city, and as these indicated a considerable advantage in placing the arrester on the same pole with the transformer, we next moved all lightning arresters from line poles to transformer poles.

About this time we began to find serious difficulties in using the circuit as our unit for the various types of arresters. As the load increased and additional circuits were

Cross-arm Construction

necessary, it was quite impossible to make an economical lay-out of the additional circuits without moving a large number of arresters each year. For this reason we abandoned the primary circuit as the unit and adopted certain streets as definite boundaries of the various areas in which the several types of arresters were segregated. Stated in another way, we abandoned the theory that a lightning arrester protected the transformers on any considerable amount of line, and instead adopted as our working theory, that the protection accorded to any transformer depended upon the arrester which was alongside of it and not on the arrester that was 1,000 feet or more distant. This scheme of separating the various types of arresters by definite boundary lines greatly simplified the keeping of the records. After having once made certain that the proper type of arrester is installed at each location the type of arrester at any particular point can thereafter be determined by referring to an index map of the city which shows the districts assigned to the various types of arresters.

At the time when we moved the lightning arresters from the line poles to the transformer poles and placed them within certain definite areas, it was also thought that some protection should be accorded to the more important customers outside these areas. A rule was therefore adopted calling for the installation of a lightning arrester on the same pole with each lightning transformer of 4-kw. capacity or larger, and on all power transformers regardless of size. Again careful records were kept of all of the transformer burn-outs and primary fuses blown by lightning, the results of which are shown in Table 1.

Table 1 indicates that, other conditions being the same, the installation of lightning arresters on the transformer poles instead of on the line poles, reduces the number of transformer troubles due to lightning by about 75 per cent. This means that the value of a lightning arrester, as a device for protecting a transformer, is very considerably increased by installing it on the same pole with the transformer.

Having determined the most favorable conditions for installing lightning arresters, it then becomes pertinent to inquire whether or not the reduction in the cost of repairing transformers which will follow the installation of the lightning arresters is sufficient to warrant their use. An answer to this question can be secured by assuming, first, that none of the transformers in Chicago have an arrester on the same pole; and second, that all the transformers are protected by a lightning arrester on the same pole; and from the percentages given in the last column of Table 1 calculate the number of cases of trouble that would have occurred for each of these two conditions.

These calculations are given in Table II, which shows in the last column the reduction in transformer troubles that, according to the experience in Chicago in 1915, should follow such an installation of lightning arresters. Based on these figures, the saving in the cost of repairs and maintenance of transformers due to the installation of lightning arresters is estimated as follows:

Replacing and repairing 201 burned out transformers @ $50.00	$10,050
Replacing 485 primary fuses @ $2.00	970
Expense of replacing damaged primary cut-outs	300
Supervision and use of tools, 15% of the above items	1,700
Loss of revenue due to burn-outs, assumed at 5 kilowatts for six hours @ 5 cents per kw-hr	302
Loss of revenue due to blown primary fuses, assumed at 5 kilowatts for two hours at 5 cents per kw-hr.	243
Total	$13,575
Assuming that the total cost of labor and material of the lightning arrester installations would average about $7.50 for each transformer, the total cost of the installation would be 15,600 (transformers) @ $7.50	$116,500
Assuming that the total annual charges for interest depreciation, maintenance, taxes, etc., would be 18% of the cost, then the total annual charges would be 18% of $116,500	$21,000
Net loss due to installation of arresters	$7,425

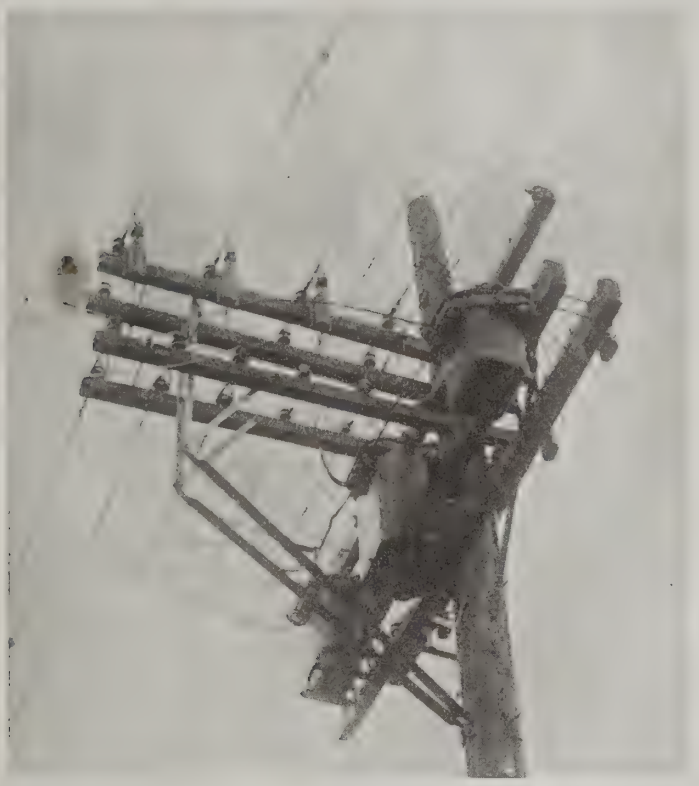
These figures show that, based on the experience in Chicago in 1915, an installation of lightning arresters for the protection of transformers is not warranted by the saving in the cost of repairs alone, but that, instead, the total annual charges of a lightning arrester for each transformer are about 50 per cent. more than the savings that can reasonably be anticipated.

In making the above calculations it has been assumed that the installation of lightning arresters on the line poles amounted to practically no protection. While this statement is probably not quite in accord with the facts, the indications are that the protection accorded to transformers by arresters placed several hundred feet distant is very small. The error made in this assumption is probably more than offset by the fact that in the year 1915, during which these records were obtained, the lighning storms were somewhat more severe than the average during the past ten years.

We have still to consider the question of the effect of lightning arresters on the quality of the service. The installation of a lightning arrester on the same pole with each transformer will increase the total cost of the transformer installation about 10 per cent. and will increase the total annual charges for each transformer installation about 53 cents per year. The question then to be determined is, whether this additional expense is warranted for the purpose of eliminating about 75 per cent of the interruptions to service that are caused by lightning.

There are several factors that enter into this question, such as the financial condition of the company, the standard of quality of service that it has established, and the effect of the quality of the service upon securing new and retaining old business. In Chicago, where the demands for continuous service are quite exacting and constantly increasing, it is thought that this expense is well warranted and it is now

our rule that a lightning arrester must be installed on the same pole with each transformer, regardless of its size or use. A general answer that will apply to other cities is not possible, but it is thought that many companies are installing in their stations and substations various devices or apparatus, for the sole purpose of improving their service, which do not result in as great an improvement in the quality of the service in proportion to the money expended as would the installation of a lightning arrester for each transformer.



Side-arm Construction

Statements are sometimes made that a trial installation of lightning arresters on comparatively few transformers has demonstrated that the arresters would save their cost in transformer repairs within a few years. The experience in Chicago indicates that while it is perfectly possible to select a single circuit or a certan small district and secure results which would amply justify such a statement, it would also be possible, and just as easy, to select a circuit or a small district entirely without arresters in which the difference in results in two succeeding years would be just as pronounced. Persons making such statements must assume that lightning storms are quite uniformly distributed and that they are very much the same year after year, both of which assumptions are very far from the truth.

For the information and guidance of companies that may be intending to install lightning arresters for protecting their distributing transformers, the following suggestions, based on the experience in Chicago, are offered:

(1) If the financial condition of the company does not permit the installation of lightning arresters on all transformers, indicate on a map the boundaries of the territory within which continuity of service is most important, and which includes such percentage of your transformers as you can afford to protect at one time. Install lightning arresters on these transformers and also on any additional transformers that are thereafter installed within the same area.

(2) In the area outside of this boundary line, move all lightning arresters from the line poles to the transformer poles, selecting for this purpose the transformers which supply the most important service.

(3) Select some dividing line that will determine the size of the transformer on which the service, whatever its character, is of sufficient importance to warrant the extra cost of an arrester for the improvement of the service.

(4) Each succeeding year increases the area within which all transformers are protected by lightning arresters, and at the same time reduce the size of the transformers above which all are protected by arresters regardless of location.

(5) Keep careful records of the transformer troubles due to lightning, segregating the transformers that are protected by arresters on the same pole, so as to learn from your own experience how much improvement in the service is being secured by the installation of the arresters, and at what cost.

(6) Make use of the information obtained from the records each year in determining the increase in the amount of lightning arrester protection that will be warranted during the following year.

Table I

SUMMARY OF RESULTS FOR 1915

	Transformers protected by lightning arrester on same pole	Transformers not protected
Number of transformers	9307	6298
Transformers burned out, Number	25	98
Transformers burned out, Percent.	0.27	1.56
Primary fuses blown only, Number	111	271
Primary fuses blown only, Percent.	1.19	4.30

Table II

RESULTS OBTAINED BY APPLYING THE PERCENTAGE FIGURES FROM TABLE I TO THE ENTIRE INSTALLATION OF DISTRIBUTING TRANSFORMERS IN CHICAGO

Assumed Location of Lightning Arresters	Number of Cases On Line Poles	Number of Cases On Each Transformer Pole	Reduction
Transformers burned out.....	243	42	201
Primary fuses blown.....	671	186	485
Total cases of trouble...	914	228	686

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A Word For The Station Operator

By An "Ex-Operator"

The switchboard operator is one of the most important factors in the satisfactory and efficient running of an electrical power supplying system. In some of our early plants, in which the station equipment was both complicated and bulky, the operator had sole control over the kind of power supplied to the customers. Only his steady eye on the voltmeter, the ammeter, on the brushes or on some other part of the equipment, kept the station running at the required notch. Even at the present time, when complicated hand operated mechanisms are being replaced with automatic controls, the operator has much to do with supplying satisfactory power. Several stations within my acquaintance rely almost entirely on their operators for satisfactory operation. In some of these stations the operator does anything from watching the switchboard to ordering supplies and cleaning station equipment. He must be always on the job, for a little oversight on his part might result in damage to equipment and consequently, interruptions to service. Coolness, steady eye, good head, and a good working knowledge of the business should be constituents of every operator. These are the main points that the electrical engineer should look for, before employing an operator, for they are positively essential to the good running of all plants of any size. F. Ed. Stier.

A Modern Street Lighting System

By J. H. Ross

The gas filled lamp has been widely exploited, and justly so but there has been little or no date available as to how to install a practical, satisfactory, system, at least cost both for installation and operation.

The system at Freeport, Texas, at the mouth of the historic Brazos River, has been in operation over one year. The equipment installed makes the little town the best lighted for its size, in the Southwest.

The lighting system consists of 20 two hundred and fifty c.p., 6.6 ampere series gas filled lamps, and 14 pedestal lights consisting of two 110 volt, 60 watt Mazda lamps in series

Fig. 1

across 220 volt underground mains. The series lights are used for lighting the residence portion of the town and the pedestal lights are placed in the business district. The lighting system is fed from the primaries of the Freeport Light Water & Ice Co., the central station company of the town. They in turn, purchase their power from the Freeport Sulphur Company. The current for the street lights is put through a Westinghouse constant current transformer, of sufficient size to take care of future needs, delivering current at 6.6 amperes. This transformer, and consequently the street lights, is controlled by a Campbell high voltage time switch.

The pedestal lights are fed from two General Electric type SL constant current transformers of 1 k.w. capacity each, one feeding a network of six and the other a network of eight pedestal lights. The current is taken from the street series circuit through protective devices similar to film socket cutout, shown in Feg. 1, just to the left of series lighting transformer. The transformers are located on pole nearest the underground network they feed, the conduit being run up the pole to a point just below the transformer and the leads brought out through a Type "F" condulet, as shown in Fig. 1. The usual method of connecting these pedestal lights in series was not carried out because it was desired to have the pedestal light circuit so that it could be connected on the secondary distribution system, should the series circuit become inoperative for any reason, for any length of time. Switch for this purpose can be seen in Fig. 1, on lower crossarm between transformer and end of conduit line. Each pedestal was connected in series-parallel and the secondary of the series lighting transformer, Fig. 1, connected in parallel and then the circuit from the SL transformer on the secondary side, so loaded as to give a voltage of 220 at the lamp, thus allowing two standard lamps to be used in series. Theoretically approximately 3.33 amperes load should produce the 220 volts with 6.6 amperes on the primary side but experience showed that it was better to use a slightly heavier load and thus secure lower voltage with consequent longer life of lamps in pedestal, since ample light was furnished at the lower voltage. This also would tend to eliminate excessive voltage should one pedestal light burn out while in operation. Ordinary 60 watt, 110 volt Mazda lamps were used, two to each lamp. It was also found by experience that the difference of one pedestal light on the load made but little difference in voltage, not enough to burn out the remainder from excessive voltage, but where two pedestals on the same circuit were out the voltage began to rise sufficient to materially shorten lamp life of remainder.

The pedestals themselves, Fig. 2, were strictly a home product. They had to be cheap and at the same time extra strong to withstand the gulf storms which often sweep the gulf coast. They were made of nine foot lengths of 6 in. second hand iron pipe secured from the Freeport Sulphur Company at the cost of cutting plus their scrap value. The pipe was threaded on one end and a 6 in. to 2 in. reducer screwed on, then a 2 in. close nipple screwed in this reducer and the 2 in. fitter for holding the 12 in. C.R.I. ball screwed on to this nipple. The fitter was tapped on the inside for ¾ in. pipe for holding the socket fitting. This was utilized as such and a ¾ in by 3 in. nipple screwed in making a watertight joint. Then the fitter was drilled at the lowest point to allow the water being blown into the fitter from the surface of the ball, to escape to the outside instead of going down the inside of the shaft. This made the shaft waterproof from above. A foundation of 2-3-5 concrete was made 18 ins. deep by 36 ins. square. Old 1 in. line pipe discarded for slight rust spots which made it unsafe to use in sulphur wells, was laid in a trench along the curb line, inside the curb, from one pedestal to the next, extending in a continuous piece to within 6 in. of the top of the pedestal shaft. This made each wireway independent and easily accessible by removing the fitter on top of pedestal shaft. Iron wire was "fished in" at the same time for ease in installing the copper circuit. After this was done and before the concrete had time to "set" the 6 in. pedestal shaft was slipped over the 1 in. conduit lines are embedded in the concrete at the proper height above sidewalk. It was lined up with a transit each way at the same time. After the foundation had set a concrete base, composed of one part cement and thre parts sand, 18 in. square and 12 in. high was placed thereon, and on top of this base was placed a smaller base 12 in. square and 10 in. high. The lower base is not shown in Fig. 2 because of height of sidewalk at that point, the smaller upper base only being shown. The foundation came flush with the top of the sidewalk making the base extent for a height of 22 ins. above the sidewalk and the height of the pedestal 9 ft. 6 in. over all.

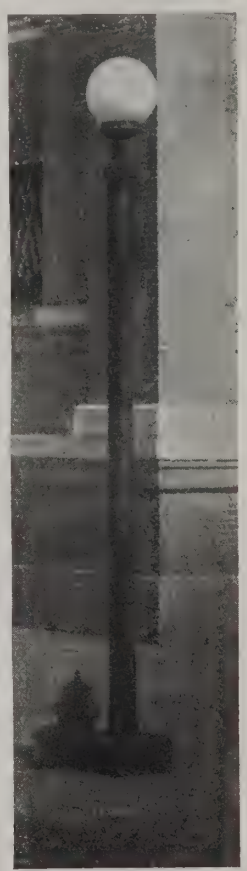

Fig. 2

After all the concrete was firmly set the copper wire was pulled in with the leading in wire mentioned above. This wire was commercial, double braid, rubber covered, solid wire No. 14 new code. One reason for the 220 voltage used was to cut the size of this wire and still provide good distribution, since the distance from supply to farthest lamp was a distance of about 800 ft. It was thought that lead-covered wire would have to be used eventually but during the August 16-19, 1915, West Indian hurricane, water stood over the ground to a depth of 3 feet for two days and absolutely no damage was done to any of the underground circuits. The pedestal light system has given no trouble whatever other than the necessary maintenance of burned out lamps and globes broken by mischievous boys. The entire maintenance has not been over $1.00 per pedestal, per year.

The resident lights consist of a Cutter porcelain body, Regent film socket, and 24 in. radial bowl reflector arranged for attaching diffuser, although the diffusers are not now attached on account of expense and lack of revenue from lighting circuit. These lights are placed on pole set just within curb line at each street intersection and at a height of 20 ft. above and 3 ft. out from the curb. They are supported by a ¾ in. pipe gooseneck which is, in turn, partially supported by the feeder wires of No. 8 weatherproof copper from the 2-pin standard arm at top of pole. The main lighting and secondary leads are in the alley and break arms are used to "take off" the street lighting circuit at each intersection. The street lighting leads are kept above the secondary leads as much as possible.

Data was available to cover the connection and use of the series lighting circuit but nothing could be secured on construction of pedestal lights other than the manufactured ones which were too expensive to be considered. The pedestals, as outlined, Fig. 2, cost approximately $8.50 each, complete, including the installation of conduit and wire. There was but little data to be had on the use of the series lighting transformers in just this way so as to make available additional source of supply should the series circuit be out of order.

While this system could be much better and several constructions are not in strict accordance with the very best practice, the system has been working perfectly for almost two years and has never given the least trouble except during the West Indian hurricane when the 110 mile wind broke the overhead lines in one or two places. Often no attention is given for months at a time other than to wind and set the time clock once per week. For a system from which no revenue is obtained and much is expected in the way of light, it has proven entirely satisfactory, both to the management and the townspeople. It would lend itself admirably to industrial lighting.

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Bare Grounded Return Wiring System to be Investigated

The Committee on Electric Wiring Systems of the Electrical Industry has appointed the following sub-committee to investigate bare grounded return wiring systems:

Chairman, C. E. Corrigan, Associated Manufacturers of Electrical Supplies, Pittsburgh, Pa.

W. H. Flandreau, International Association of Municipal Electricians, Mt. Vernon, N. Y.

J. C. Forsyth, American Institute of Electrical Engineers, New York, N. Y.

G. S. Lawler, Associated Factory Mutual Fire Insurance Companies, Boston, Mass.

C. Renshaw, Westinghouse Electric and Manufacturing Company, East Pittsburgh, Pa.

Secretary, Wm. S. Boyd, Western Association of Electrical Inspectors, 175 West Jackson Boulevard, Chicago.

The committee desires the co-operation of the entire electrical industry in this work, and to that end requests that all information and data on wiring systems having a bare grounded conductor, be sent to the secretary.

The committee will especially appreciate the following information:

(1) Safety, cost and reliability data based upon practical experience with concentric wiring, or any other type of wiring having one or more bare or partially covered conductors which are permanently connected to earth;

(2) Theoretical or tested installation details or protective features which will safeguard concentric wiring or other wiring systems having bare grounded conductors;

(3) Reliable methods of preventing meter setters or linemen from reversing the polarities of a two-wire system;

(4) A suitable definition of "ground" or "earth" as these words relate to electric wiring;

(5) Practical experience with ground or earth connections:
(a) Whether they have been found reliable, or unreliable;
(b) The proportion found to be unreliable, if any;

(6) Adequate methods of establishing and maintaining a reliable ground or earth connection for safety purposes;

(7) A simple method of test which will insure the detection of unreliable ground or earth connections;

(8) Economies which may be practiced with safety in connection with any of the existing wiring methods;

(9) Estimates or actual figures as to the cost of any protective features reported upon in response to the foregoing requests; and

(10) Any data or experience calculated to assist the committee in reaching an accurate conclusion relative to the practicability of bare grounded return wiring systems.

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Electric Power For Seattle Bridges

Contracts for the complete electrical equipment of three large double-leaf bascule lift bridge for the City of Seattle, have been awarded to the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa. These bridges will span the Lake Washington Canal and will be among the largest of their type yet built. Each bridge will have a total overall length of 291 feet, with a 200-foot span, and will be 60 feet above the water. Each bridge will be made to carry both vehicle traffic and a double track street railway, and will be constructed of concrete piers with structural steel for the span. The electrical equipment for each bridge will consist of four, 100 hp., main operating motors together with a smaller motor for operating the centerlock. Two main operating motors will be connected permanently in series on each leaf and will have switches so that if one motor fails it may be cut out and the other motor left to operate the bridge. Either motor alone will be capable of raising the leaf at reduced speed. The motors on each leaf will be controlled by a magnet switch controller regulated by a master switch located in an operating house on the leaf. There will be an operating house on each leaf, designated as "north" and "south" operating house. Control panels and master switches will be installed in each. Each main operating motor will have a weatherproof brake mounted on it. For the centerlock, a varying speed, series wound, direct current motor will be used, operated by a drum controller located in the "south" operating house. The installation and erection work will be done by local sub-contractors in Seattle.

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Among prominent electrical men in Chicago during the Republican National Convention, June 7-10, were Mr. Theodore N. Vail, president of the American Telephone & Telegraph Company, who was a delegate from Vermont; Mr. N. C. Kingsbury, vice-president of the same company; Newcomb Carlton, vice-president of the Western Union Telegraph Company, and C. C. Adams, vice-president of the Postal Telegraph Company.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Practical Calculation and Construction of Rheostats

By Norman G. Meade

II. Motor-Starting Rheostats*

Motor-starting rheostats must be constructed so that the starting current will not exceed predetermined limits, or a value that would be liable to injure the motor. Current sufficient to produce the necessary starting torque is designated as the minimum current, $I_{min.}$, and the maximum current, $I_{max.}$, is generally about 50 per cent. greater than the minimum current. When the rheostat arm is on the first point the total resistance, including that of the armature, should be proportioned so that about 50 per cent. normal starting current can be established. At the second point the resistance should be reduced sufficiently to allow normal starting current, $I_{min.}$, to flow, and the motor should start from the third point and increase in speed for each succeeding step, generating a counter-electromotive force which will assist the ohmic resistance in reducing the current peaks to $I_{min.}$

In rheostat calculations the first unit is determined by Ohm's law and the succeeding units are so designed that the rush of the current will not exceed $I_{max.}$ Fig. 1 illustrates graphically an 8-point rheostat designed for use in connection with a shunt- or a compound-wound direct-current motor having a constant field

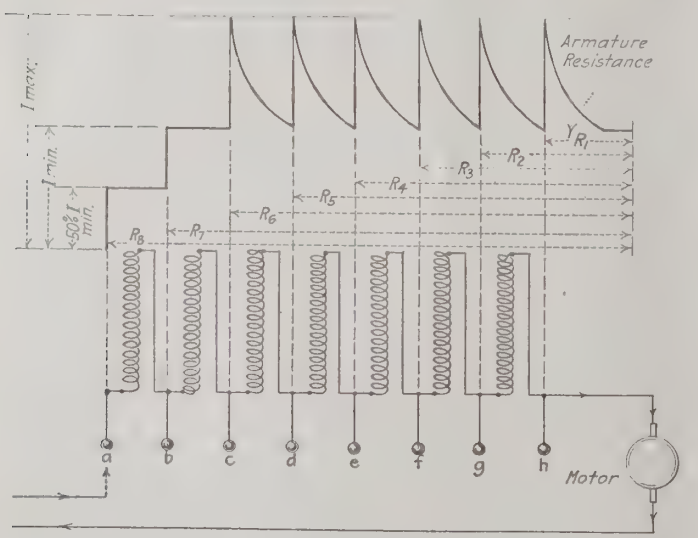

Fig. 1

flux. At the first point of the rheostat a current of 50 per cent. normal, or one half $I_{min.}$ is established, at the second point the current increases to $I_{min.}$ and at the third point to $I_{max.}$, falling back to $I_{min.}$ and again increasing and decreasing at each successive step. In the illustration, 8, 7, 6.....1 represent different resistance units connected to the contacts, *a*, *b*, *c*, etc. The unit R_1 represents the armature resistance, and the succeeding units should form a geometrical progression and have a constant multiplier, k, equal to $I_{max.} \div I_{min.}$, therefore $R_2 = kR_1$, $R_3 = kR_2$, $R_4 = kR_3$, and $n = kR\ (n - 1)$. The calculations are simple if the armature resistance is known and the minimum and maximum currents determined. It is possible to determine the proper number of steps in the rheostat mathematically, but this involves considerable time and it is safe to adopt a number corresponding to standard starting rheostats which generally run from 7 to 12 points. Fig. 2 shows the rheostat connections with the no-load release magnet.

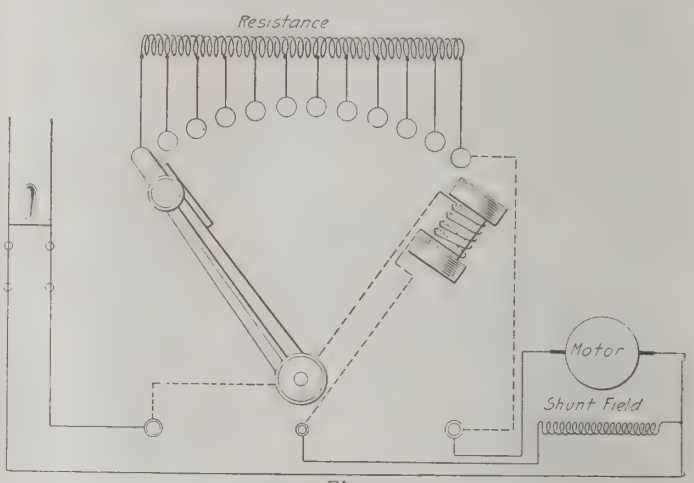

Fig. 2

Assume that it is desired to design a starter with seven points for a 10-horsepower, 220-volt, shunt-wound motor, having an efficiency of 80 per cent., then the watts input will be $10 \times 746 + (.20 \times 7460) = 8952$ watts. The full-load current is found by dividing the watts imput by the voltage, $8952/220 = 40 +$ amperes, $= I_{min.}$ Then $I_{max.} = 40 \times 1.5 = 60$ amperes and $k = I_{max.} \div I_{min.} = 60 \div 40 = 1.5$. Assuming that the armature resistance is 0.20 ohms, then,

R_1 = Armature resistance =	0.20	ohms,
$R_2 = kR_1 = 1.5 \times .2 =$	0.30	"
$R_3 = kR_2 = 1.5 \times .3 =$	0.45	"
$R_4 = kR_3 = 1.5 \times .45 =$	0.675	"
$R_5 = kR_4 = 1.5 \times .675 =$	1.00	"
$R_6 = kR_5 = 1.5 \times .1 =$	1.50	"
$R_7 = kR_6 = 1.5 \times 1.5 =$	2.25	"

Steps 1 to 5 inclusive must have a carrying capacity of 60 amperes and from the curve, Fig. 3, it is found that No 12 wire has a carrying capacity a little in excess of this figure. Both Figs. 3 and 4 relate to German silver resistance wire. From Fig. 4 it is found that the resistance of No. 12 wire is 35 ohms per thousand feet or .035 ohms per foot. The sixth

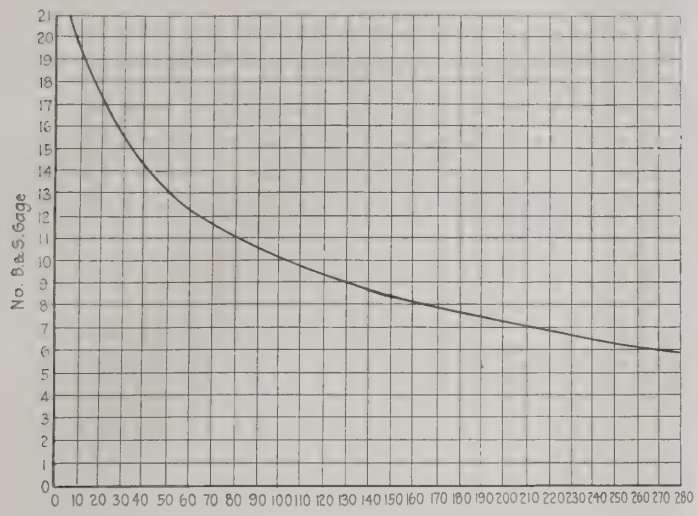

Fig. 3

step must have a carrying capacity of $I_{min.}$ or 40 amperes, and by reference to Fig. 3 it will be found that No. 14 wire is required, which has a resistance, by Fig. 4, of 55 ohms per thousand feet or 0.055 ohms per foot. Unit 7 must carry 20 amperes, and from curve Fig. 3, it is found that No. 17 wire is required, which has a resistance of 115 ohms a thousand feet, or .115 ohms per foot. Dividing the required resistance of each unit by the resistance per foot of its respective size of wire will give the number of feet required for each unit.

Then,

No. 2—	0.300/0.035	8.5 feet,
" 3—	0.450/0.035	12.8 "
" 4—	0.675/0.035	19.2 "
" 5—	1.00/0.035	27.6 "
" 6—	1.50/0.055	27.2 "
" 7—	2.25/0.115	19.5 "

Figure 5 gives coil winding data. It shows that with a ¾-inch mandrel there are 0.23 feet of wire per turn and seven turns to the inch, or there will be 0.23 × 7 = 1.61 feet of wire

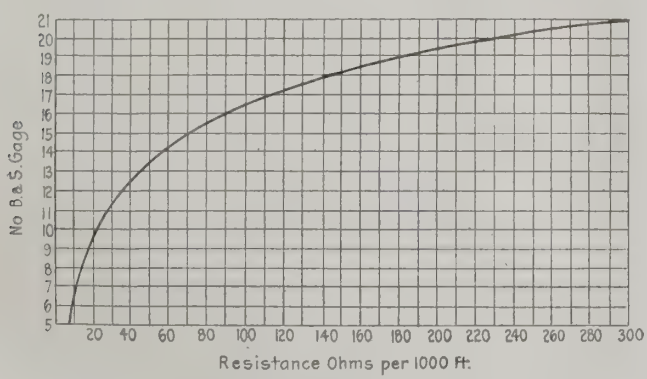

Fig. 4

per inch of coil. Now by dividing the length of wire required for each unit using No. 12 wire by the number of feet per inch in length of coil, the length of the coil in inches will be found. For example, No. 2 unit requires 8.5 feet of wire and 8.5/1.61 = 5.27 inches. In a similar manner the other coils can be calculated. It will be seen that the maximum length of the coils is given in Fig. 5 for each size of wire, and if the length of wire required for any unit forms a coil in excess of the figure it must be divided. The manner of constructing resistances and frames was discussed in a previous article on the subject.

It frequently occurs that to obtain the desired carrying capacity, two or more wires have to be connected in multiple and for determining the equivalent areas of wires, B. & S. gague,

No. B & S Gauge	*Diameter of mandel in inches*	*Feet per turn*	*Turns per inch*	*Max. length of coil in inches*
6- 8	1.25	0.38	4	18
9-11	1.00	0.30	4.5	12
12-14	0.75	0.23	7	12
15-18	0.50	0.16	9	12
19-21	0.25	0.082	14	6

Fig. 5

the table, Fig. 6 is given. It indicates the number of smaller wires required to give a sectional area equal to one larger wire, the figures between the horizontal line corresponding to each other. For example: It requires two wires, No. 0, or four wires No. 3, etc., to give a sectional area equal to one wire, No. 0000. It requires two wires No. 13, or four wires No. 16; or two wires, one No. 12 plus one No. 14, to give a sectional area equal to one No. 10 wire.

Gauge. No.	*No. of Wires.*	*Gauge. No.*	*No. of Wires.*	*Gauge. No.*	*No. of Wires.*	*Gauge. No.*	*No. of Wires.*	*Gauge. No.*	*No. of Wires.*	*Gauge. No.*		*Gauge. No.*
0000	2- 0	4- 3	8- 6	16- 9	32-12	64-15						
000	2- 1	4- 4	8- 7	16-10	32-13	64-16						
00	2- 2	4- 5	8- 8	16-11	32-14	64-17	1	and	3			
0	2- 3	4- 6	8- 9	16-12	32-15	64-18	2	"	4			
1	2- 4	4- 7	8-10	16-13	32-16		3	"	5			
2	2- 5	4- 8	8-11	16-14	32-17		4	"	6			
3	2- 6	4- 9	8-12	16-15	32-18		5	"	7			
4	2- 7	4-10	8-13	16-16			6	"	8			
5	2- 8	4-11	8-14	16-17			7	"	9			
6	2- 9	4-12	8-15	16-18			8	"	10			
7	2-10	4-13	8-16				9	"	11			
8	2-11	4-14	8-17				10	"	12			
9	2-12	4-15	8-18				11	"	13			
10	2-13	4-16					12	"	14			
11	2-14	4-17					13	"	15			
12	2-15	4-18					14	"	16			
13	2-16						15	"	17			
14	2-17						16	"	18			
15	2-18											

Fig. 6

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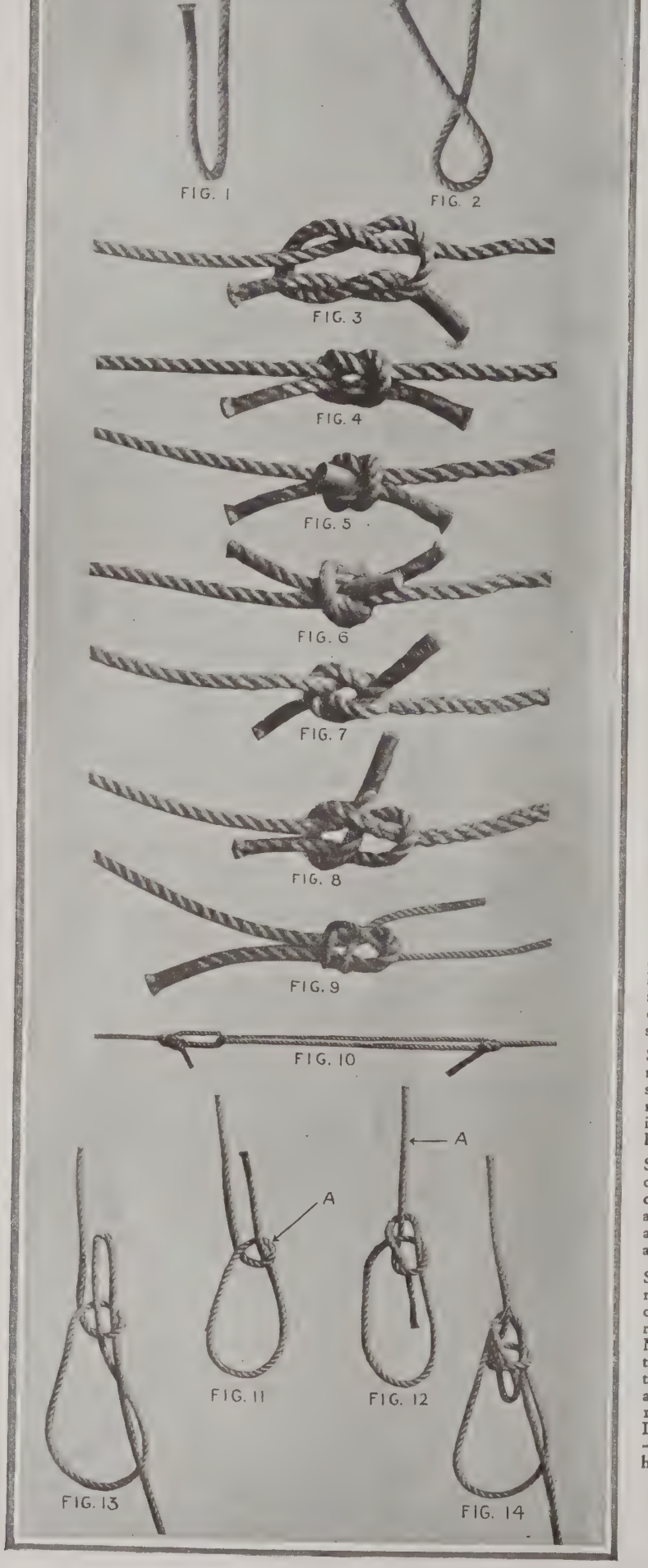
Braking an Induction Motor with Direct Current

In a certain instance where it was desired to stop a two-phase, 440-volt induction motor as quickly as possible, it was found that it could be done by the use of a 220-volt, direct-current circuit with a resistance and a double-throw switch. The method of connection was as shown in the diagram.

When the switch is thrown over to the direct-current side, the motor comes to a stop almost instantly, the current being applied for only the fraction of a second.

The question has arisen as to the exact nature of the electrical action that takes place in this case. Also, as to whether the action is injurious to the motor, and whether a 12-volt direct-current circuit could be advantageously used to brake a 110-volt direct-current motor and if not, what would be the proper direct-current voltage.

(*Continued on page* 46)



BEFORE describing those loops, knots or ties most frequently used, the definition of certain technical terms, which are applied in explaining them, is in order.

"Bight"—A section of rope turned back on itself to form a loop. Figs. 1 and 2.

"Cucold's Neck"—A second bight turned above the first as in making a bow-line knot. Fig. 11-a.

"Loop" or "Turn"—A rope passed once around a pole and the ends brought together.

"Round Turn"—A rope passed twice around a pole and the ends brought together. Fig. 23.

"Standing Part"—The section of rope leading away, which the round turn or hitch is made to hold; the part which takes the strain, as in Figs. 12, 20, 22 and 24.

TYING ROPE ENDS TOGETHER

Flat Knot—The most common knot in use for tying together the ends of two ropes or cords is the flat knot. Figure 3 shows the knot before pulling tight, and clearly indicates its make-up. Figure 4 shows the finished knot. While this knot is safe and excellent for ordinary use, it will jam under a strain, so that it cannot readily be undone.

Flat Knot Over a Plug—When it is desirable to use the knot just described, jamming under a heavy strain can be prevented by making the knot over a tapered wood plug, Figures 5 and 6. When the strain is released and the plug driven out, the knot is easily undone. A second tie over the plug is a good "safety first" precaution.

Granny Knot—This knot results from the failure to tie a flat knot properly. It should never be used, but is shown in Figure 7 so that this incorrect way of making a flat knot may be avoided.

Weaver's Hitch or Knot—Through the loop of a bight turned in the end of one rope, pass the end of the other rope. Then take a half hitch (first paragraph under Hitches) with the latter about both parts of the bight, Figure 8.

If one of the two ropes to be joined is smaller than the other, the bight should be turned in the large rope, the small rope passed through the loop and two or more turns taken in the half hitch. Figure 9 shows this knot with two turns in the half hitch. This tie is preferable to the flat knot, as it will not jam, and can easily be undone by pushing back the loop of the bight.

Linked Bow-Line Knots—A safe connection between two ropes, which will not jam under strain, is obtained by making a bow-line knot (Figure 12) in the end of one rope, passing the end of the other rope through this loop and tying it in the same way (Figure 10). One or both knots may be run out to take up any surplus rope. This method is especially adapted for use with heavy ropes.

LOOPS, EYES OR SLINGS

Bow-Line Knots—For forming a temporary loop or eye at the end of a rope or in a bight at any point on a rope, the bow-line knot is the best. There are three forms of bow-line knots, and if the workmen are taught only these forms they will more quickly become proficient in making safe loops which will not slip, jam or injure the ropes and which can easily be untied.

Single Loop Bow-Line Knot—Take the end of the rope in the right hand and form a long bight by laying the end across the standing part, Figure 2. Then with the left hand turn a cucold's neck (Figure 11-a) over the end. Lead the end around the standing part and back through the cucold's neck and pull tight, Figure 12.

Single Loop Bow-Line Knot on a Bight—Using a bight instead of an end, lay the bight across the standing part and turn a cucold's neck over it, Figure 13. Lead the loop of the bight around the standing part and back through the cucold's neck and pull tight, Figure 14. The idle standing part may be used as a snub to hold the strain taken up by the loop.

Safety Sling—(See illustrations in center of page). This is a modification of the knot described in Figures 15 and 16, and is of great use where it becomes necessary to send a man aloft to remove a helpless man or for similar emergency purposes.

Make a double loop bow-line knot on a bight, but before pulling tight slip the loop of one of the large bights through the knot, thus forming one large and one small loop—the former to sit in and the latter to pass around the body under the arms, Figures 17 and 18.

In cases of emergency, where it is necessary to send a man aloft—e.g., to remove a helpless man from a pole—a knowledge of how to make this sling quickly will be found useful.

Double Loop Bow-Line Knot on a Bight—Using a bight of rope, as before, lay it across the two standing parts and turn a cucold's neck in both parts over the bight, Figure 15. This forms two large bights below and one small bight above the cucold's neck. Loop the small bight over the two large bights and pull tight, Figure 16. One or both standing parts may be used against the double loop, but not in different directions, as with the single loop bow-line knot on a bight.

HITCHES

Half Hitch—To make this hitch bend the end of the rope up and across the standing part, forming a bight. Lead the end around the standing part and through the bight, Figure 19. A half hitch in itself does not form a complete tie, but in conjunction with other forms of securing rope it is the one most generally used.

Clove Hitch—Form a half hitch and then lead the end of the rope again around the standing part and under its own loop, Figure 20. The two half hitches thus formed are commonly known as a clove hitch.
In general practice two half hitches are designated in this way. However, an additional half hitch would result in a tie which would be called three half hitches.

Clove Hitch with a Half Hitch on the Standing Part—Take two half hitches about a pole, etc.—a clove hitch, Figure 21. Then take a half hitch about the standing part and the resulting tie will appear as in Figure 22. This is one of the best hitches. It is easily made and does not jam; nor will it injure the rope. It is adapted for tying to toggle blocks or any anchorage which would tend to roll out of a round turn under a strain. The ends of temporary rope guys may be secured with this hitch.

Round Turn and Two Half Hitches—When it is desired to hold the slack as it is pulled, the rope is given two turns around a pole, forming a round turn, Figure 23. When the rope has been pulled up tight enough and it is desired to hold it this way for a time, lead the end under and around the standing part and down through the loop. Repeat this, pulling tight each time. Two half hitches are thus formed and the complete tie will appear as shown in Figure 24. This hitch is equal to the clove hitch for attaching to any rigid support.

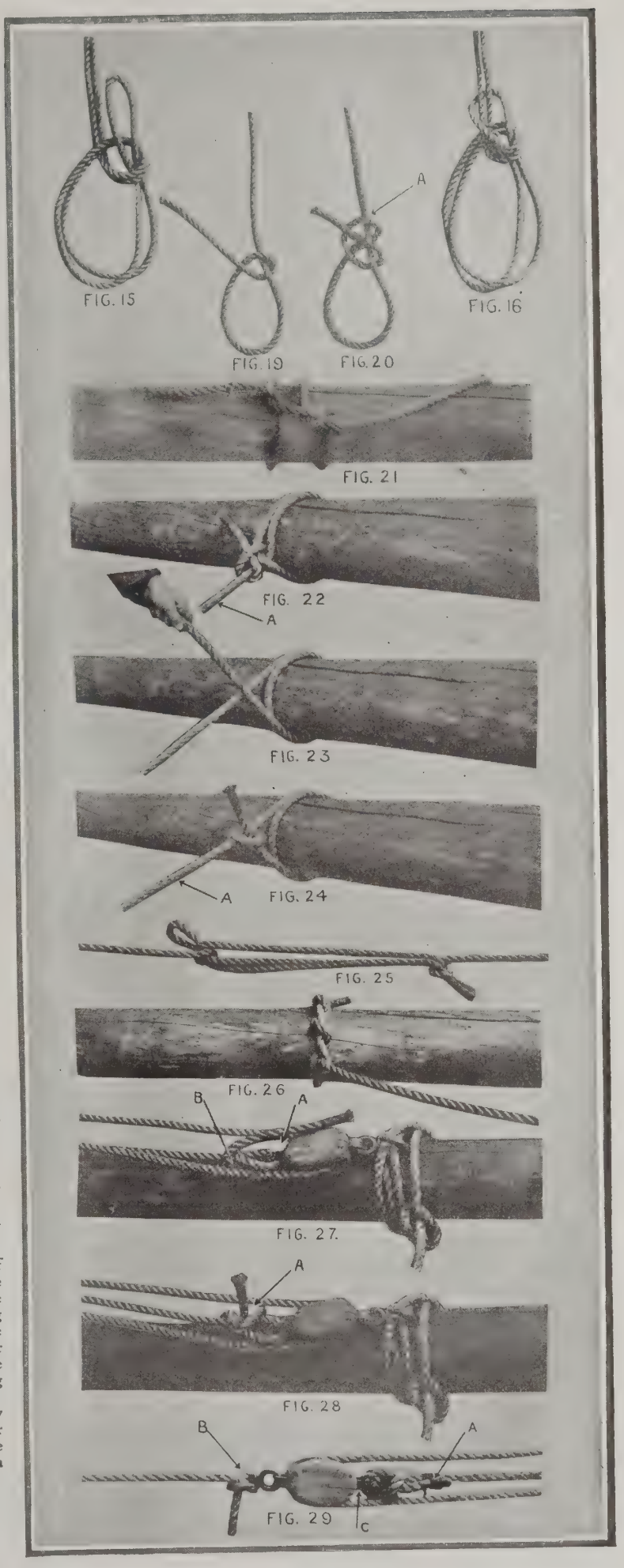
Half Hitch on the Bight of a Rope—In laying out a pennant or guy rope, any surplus or slack rope, which it is inconvenient to take out at the ends, may be taken up by bending a bight in a section of the rope and throwing a half hitch over each end of it, Figure 25. Although, if properly made, this hitch is perfectly safe, it is well to have those, not familiar with it, place two half hitches on each end.

Timber Hitch—Take a turn around a pole or log, bend the end back over the standing part and pass two to four turns around its own part. Then slip up tight, Figure 26.
This hitch is used principally in logging on the water, where the heavy wet ropes are difficult to secure. It should not be used for snaking poles on the ground, except in emergencies when a log chain cannot be obtained, as the dragging on the ground destroys the rope.

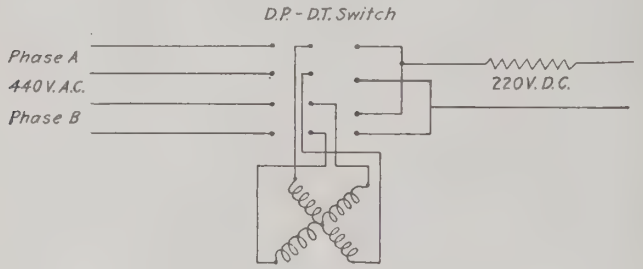
Inverted Half Hitch on a Becket Thimble—After reaving off, pass the idle end of the fall rope through the becket—"a" in Figure 27 and "c" in Figure 29—and around the thimble. Then bend it about the standing part—"b" in Figure 27—and over itself towards the thimble. Bend it again around the standing part and through the loop thus formed. It will be seen that this forms two half hitches, but the end or last hitch is on the inside, Figure 28. Pull the hitches tight and slip them snug against the thimble. If the hitch is to remain for some time, seize the end of the standing part—"a" in Figure 29. This is a standard method of attaching the idle end of a fall rope to a block.

Blackwall Hitch on a Hook—Give one turn around the point of the hook, crossing the rope inside with the end on top. Slide the loop around to the back of the hook. This will bring the end beneath, where it will be held by the pressure of the standing part on it—"b" in Figure 29. This hitch should not be made with a small rope in a large hook, as there would be room for the hitch to upset and slip. Unless the crossed rope fills the hook fairly well, two half hitches should be taken on the standing part.

This hitch should never be used for hoisting or for any work where the slipping of the hitch would result in damage or injury. For hauling a rope along the ground and the like, the quickness with which it can be made and undone makes it a very desirable method.



A study of the connection diagram shows that, on the direct-current side, the phase windings of the motor are connected in multiple with a resistance in series with both windings. Therefore, the amount of direct current that will flow throught the motor windings, after the first instant, or so, will depend on the resistance of the motor windings and on the amount of resistance in series with them. Neither of these are given, but from the effect noted it is safe to say that the amount of direct current flowing is many times as great as the full load alternating current, for the ohmic resistance of the windings of an induction motor is usually quite small.



2-Phase Induction Motor

The braking action produced is due to the formation of a set of intense fixed magnetic poles around the field of the motor by the heavy direct current in the stator windings. The braking effect is increased by the circulation of heavy induced currents in the rotor winding as long as the rotor continues to move. The amount of the braking effect depends entirely on how much direct current is admitted into the windings and it will be seen that with heavy currents it can become extremely powerful. In fact if the direct-current is twice as great as the starting current, under a constant resistance to rotation, the retarding effect will also be at least twice as great and the motor if the load is the same in both cases will come to a stop in half the time it takes it to start up. So by adjusting the direct current, any desired rapidity of stopping can be attained.

Whether this procedure does any damage to the motor can hardly be stated without knowing definitely the amount of the currents in the windings and their resulting magnetic effect. If there is no considerable overheating and no distortion of the end turns of the windings, it would be hard to injure the motor in any other way.

As to the effect of throwing 12-volt direct-current on to a 120-volt alternating-current motor, while the time to stop cannot be predicted without knowing the data of the motor windings, it is safe to say that it will bring it to a stop more or less rapidly, provided there is plenty of current capacity behind the 12-volts to produce the necessary magnetizing effect.

Calculation of the d.c. voltage to be applied to stop the motor in a given time would be difficult, as so many constants of the system would have to be determined. The best way to find out would be to vary the resistance R, using 110-volt supply and find the value of the direct current which if applied continously would bring the motor and its load to a standstill in say three seconds. The voltage drop across the stator windings would be the voltage to apply without the resistance R in circuit. The low-voltage supply must of course have a capacity great enough to furnish the necessary current.

W. K.—P. B. F.

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The Westinghouse Electric & Mfg. Company, of East Pittsburgh, Pa., has sold to the Rochester Railway and Light Company, of Rochester, N. Y., for its new hydroelectric plant in that city, two, 12,500 k.v.a., 11,000 volt, 3 phase, 60 cycle, 180 r.p.m., vertical alternating current generators with direct connected exciters.

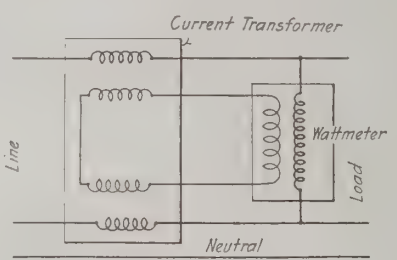
A Wattmeter Reversal

In our March issue, in answer to a question, the statement was made that on a single-phase circuit a wattmeter would always indicate the true power. One of our readers calls attention to the fact that a watthour meter will sometimes reverse on low power-factor, even on a single-phase circuit: A large office and college building was supplied with lighting current from a-c. primaries 2300-volt, single-phase, three step-down transformer of 30-kw. capacity over 230-volt, 3-wire secondaries. The distribution was metered through two current transformers, ratio 60—1, to a 5-amp. s.p., a-c. wattmeter with the higher voltage in the shunt, or potential circuit. Although wired for a large lighting load, the actual lighting demand was normally extremely small except on dark and cloudy days, very little lighting being required normally at night. There was, however, a very large installation of single-phase desk and ceiling fans.

The meter readings in this building were suspiciously low, and it became the duty of the writer to determine the reason therefor. For some time the problem was without apparent solution, first one likely clue and then another being run to cover without result. One bright, warm day, the writer having been called to the building for some reason, upon going out passed by the meter and glanced at it. His surprise was great when he saw the disc rotating backward.

He knew that this wattmeter had been but a short time previously calibrated to less than one per cent. error at fifty per cent. and ½ of one per cent. at full load. As he was young in the work then, he decided that he had inadvertently connected the meter wrongly after the calibration. A most painstaking investigation determined that such was not the case.

He, therefore, delibrately sat down before the meter and started on the reasoning out operations. For some time he failed to take notice of the fans, some fifty or more, being operated at the time; but the fact finally filtered through, and investigation proved that a condition of almost no lighting service but large



Connections for One Transformer and Meter on 3-Wire Circuit

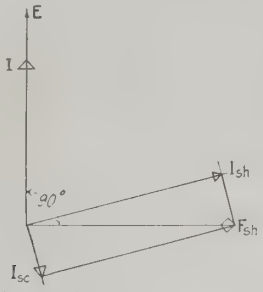
fan service existed. On experimenting, it was found that with the fans working and no lighting at all, the metter cheated unconscionably; that but few lights turned on simultaneously with the fans in operation served to cause the meter to "wobble" first forward, then backward; that by cutting off all fans and light, it stood quiet, and only a few lights alone set it going to work honestly. Only one conclusion was possible—that the abnormally large fan operation with its consequent known heavy wattless component in the system was sufficient to reverse the wattmeter, or if but few lights were burning at the same time, to cause it to stand still or "wobble."

The experience gained in the above instance was amplified by later observations with polyphase wattmeters. In the first instance a three-phase wattmeter was used to check the power used by the motor of a railway motor-generator set, and was observed to frequently reverse. The writer, after carefully checking the connections, was forced to the only possible conclusion, that the reversal was due to momentary conditions of low power factor. As before, no power factor indicator was at hand. This same motor-generator set, temporarily installed in the above instance, was later permanently installed in the plant of a lighting

and power company, where a power-factor indicator was permanently connected to the buses. Here the same reversal of the wattmeter was observed, and as could now be determined, took place at times of power factor indications of less than fifty per cent., and at times of small lighting load.

Junior Parrish.

A probable explanation of the first case seems to be that the shading coil of the wattmeter was defective. The induction wattmeter consists of an aluminum disc which passes through fields generated by coils in series with the line and across it. In order that the meter may operate correctly, these fields must be 90° out of phase at no-load. The shunt coil is highly inductive and therefore its current I_{sh} lags by nearly 90°, but not quite,



on account of the losses in the coil. Around the pole-top of the shunt-field magnet is a coil of wire called the shading coil which has a current I_{sc} induced in it. The resultant magnetic flux from the main and shading coils is F_{sh}, the resistance of the shading coil being so adjusted that F_{sh} is exactly at 90° lag from E. If with the same line current the power-factor of the load becomes less, the vector I rotates toward F_{sh}, thereby slowing the rotation. When the two coincide, at zero power-factor, there is no rotation. If now the shading-coil be open, F_{sh} would lie along I_{sh} and I would coincide with F_{sh} at a higher power-factor than zero. Data is not available to determine whether the power-factor of an induction motor load would be low enough to produce this effect; perhaps some of our readers may know.

Concerning the reversal of the three-phase wattmeter, as no connection-diagram is given, it is impossible to say what might be the cause. Anyone who has had a similar experience is invited to contribute his explanation. P. B. F.

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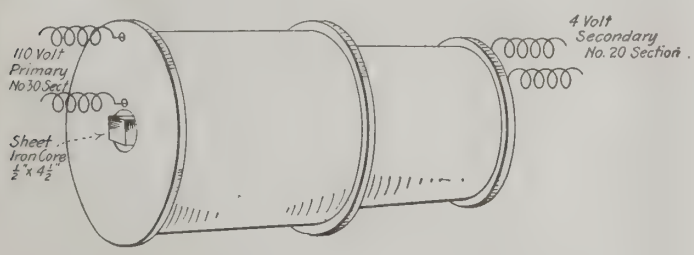
Unsatisfactory Bell Ringing Transformer

A transformer for ringing bells, fed from 110-volt, 60-cycle alternating-current and designed to give four volts on secondary side has been made according to sketch given below.

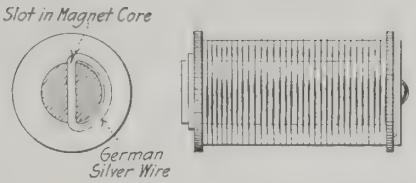


Bell Ringing Transformer

When in operation, however, there is an annoying variation in the sound of the buzzer which is quite different to the effect given when operating the same buzzer with a 4-volt dry cell. Can you suggest what the trouble is and how it can be remedied? C. K.

(Note: One answer to this question was given in our June issue. Those given below are also of interest.)

One way of making a buzzer operate more smoothly on alternating current is to adjust the tension of the buzzer vibrator till the natural period of the buzzer is thrown out of time with the alternations in the current. If adjusting the tension does not give the desired result it will help matters to saw a slot



across the face of each of the buzzer magnets and enclose half the magnet face by a piece of german silver wire about No. 18 soldered into a ring. This forms a shading coil on the magnet cores and gives a smoother pull. R. H. W.

The current supplied by the dry cell is direct current, whereas, the current of the transformer is alternating. To make the buzzer operative with alternating current the vibrator screw must be screwed in until the spring does not break contact, or the contact device must be shunted. The buzzer will then operate at the frequency of the alternations of the current nearly. The vibrator is necessary with direct current in order to allow the armature to recede from the pole after being drawn up by the current flow. The reason for the variation in tone on alternating current is that the vibrator and the alternating current do not operate with a synchronous action. H. E. W.

(With a frequency of vibration as high as 60 cycles per second, we fear that the motion of the comparatively heavy armature might be so small as not to give a loud enough sound. However, the method is worth trying.—Ed.)

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Slotting Commutators

By Kennedy G. Rockworth

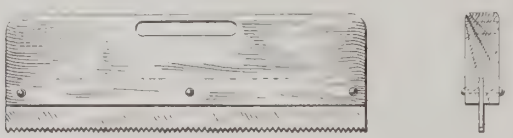
Slotting commutators has become quite a general practice in the last few years. Those who have tried slotting their commutators like it, and do so thereafter wherever possible. Often slotting is done just for convenience, sometimes because operating conditions necessitated doing so. Slotted commutators prevent high mica, which is usually accompanied by sparking of the brushes; enable longer life of the commutator since it is not necessary to turn down or grind the commutator merely to remove the high mica; longer life of the brushes; and increased output of the machine, in many cases, and always where commutation imposes the limitation. It can be seen therefore that slotting of commutators is well worth while, the more so since it may be done with little trouble and practically no additional cost.

Improvements in operation always accompanies slotting of commutators, that is to say in almost all cases. It matters not what is the size of the machine whose commutator it is proposed to slot, and whether it have high or low voltage or be of small or large capacity. The only factors requiring attention is that the commutator rotates at sufficiently high peripheral speed. If the commutator of a slow speed machine, such as a direct connected engine or gas engine machine be slotted the peripheral speed of the commutator is so low that dirt and other foreign matter that has chanced to become lodged in between segments cannot be dislodged, and short circuits, sparking and other troubles are liable to develop. Any machine may have its commutator slotted to advantage therefore provided that the peripheral speed of the commutator is high enough to exert sufficient centrifugal force throw out foreign substances that have gotten in between commutator bars.

On the other hand there are several instances where it is almost necessary to slot commutators whether or not one cares to do so. One of these is in those machines using graphite brushes. These brushes are very soft and if the mica is not cut down there will soon be high mica all round the commutator. Another case where undercutting the mica is necessary is the large 60-cycle railway rotary converters. In the 60 cycle rotary converter the peripheral speed is far higher than in the 25 cycle unit, and the percentage of mica

to copper is greater. If the mica is not undercut or the commutator slotted commutation will surely soffer.

Slotting may be done by the various machines upon the market, designed especially for this purpose, or it may be done by adopting tools that are already at hand. The sketch shows a simple, easily made tool that has been used in many stations for doing the initial cutting and for keeping the slots clear of dirt, etc. All that is needed is a hack saw blade, which is fixed in a wooded handle by means of two or three screws or bolts. The hack saw blade should be set so that it is impossible to cut down the mica more than is required, namely from 1-16 to 1-8 of an inch. When first starting to undercut a commutator with this tool it will be found best to lay a piece of wood or other substance alongside the slot to be cut to act as a guide for the cutting tool. In starting press gently and evenly over the entire length of the tool with a smooth steady motion. After the tool has cut a path for itself the piece of wood that is being used as a guide may be removed. In cleaning commutators that have been slotted it is usually sufficient to merely blow them out with compressed air under pressure of from 40 to 80 pounds per square inch. The slots should be inspected from time to time to see that dirt is not collecting. It is not advisable to clean the slots too often, only when necessary. Oil should be kept away from all commutators because it has a very deleterious effect upon the mica. This is particularly true of commutators that have been slotted, for damage can go on unseen. Slotted commutators need less work upon them than commutators that have not been slotted. On the other hand they should receive careful attention at all times.



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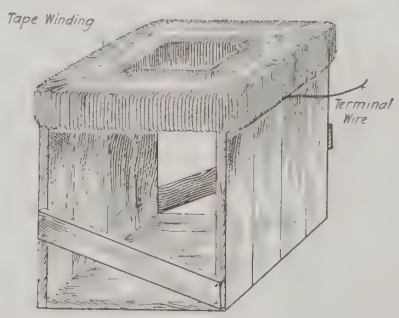
A Coil Taping Frame



When taping field coil it is often difficult to hold the coil in a convenient position so that the tape can be passed through the center opening. The wooden frame, shown in the sketch, fills the requirements for this job very satisfactorily. It has but a base and two sides to support the coil.—R. L. Hervey.

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A Commutator Repair

Here is a "kink" for someone who has to fill up a commutator slot without taking the commutator apart. A short circuit between bars of one of our machines burned the mica so badly that the armature was grounded. I cleaned the slot out, making sure that all burned particles were removed. I made a paste of plaster of paris, shellac and powdered mica with which I filled the hole, ramming it firmly into all cavities. As soon as it was hard, I cleaned the surface, sand-papered the commutator and put the machine back into service. The filling is still holding perfectly. Of course the mica is not essential, but it adds to the insulating qualities of the cement.

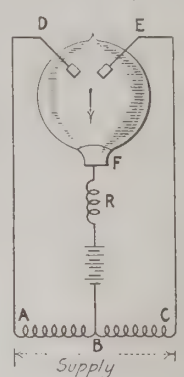
Questions and Answers

Q.—What is the function of reactance in a mercury rectifier circuit?

A.—Reactance is used to store energy during part of the cycle which later is used to keep the arc alight while the line voltage is passing through the zero point. To get a better idea of what happens, consider the various events in a cycle.

Bearing in mind the fact that current can flow through the tube in a downward direction only, then during one-half of the a-c. wave *A* will be positive to *B* and current will flow through this half of the winding, the tube, the reactance *R*, and the load *L*. On account of the reactance, this current will lag behind the empressed e.m.f. so that when the latter has reached zero the curent is still flowing. In other words, *R* is giving out a current which flows in the same direction as before, as long as any energy is left in the magnetic circuit of *R*.

When the line e.m.f. is at its zero point, there is obviously no difference of potential between *A*, *B*, and *C*. The current from *R* then divides at *B*, part flowing through *A* and part through *C*. As the line voltage increases negatively, the voltage across *BC* helps to continue this current, and it rapidly increases. The voltage across *AB*, however, is opposed to this current and it rapidly decreases to zero. Immediately the resistance to currents in an "upward" direction through the tube is set up, and no more current flows through the wire until the line e.m.f. again changes its direction.



It is customary to provide reactance by so designing the auto-transformer *ABC* that there will be leakage between the windings. This leakage flux acts as a reservoir of energy, for when the current in the coil begins to diminish, the flux diminishes also, and in so doing returns to the coil the current which created it.

Q.—Somewhere I have seen a table giving the wave-lengths of electric waves which make light, and which are used in wireless telegraphy. Will you please publish it in your columns?

A.—The waves produced by electrical means, which are used in radio-telegraphy are identical in nature with those produced by luminous bodies, the only difference being in their length.

Some of the more important wave-lengths are:

Violet	.000000004 cm.
Yellow	.0000000059 cm.
Deep Red	.0000000075 cm.
Shortest waves observable by electrical means	about 1 cm.
Waves for amateur radio stations	up to 200 cm.
Longest waves generally used	2,000 cm.

Between the two groups there is a great field for which we have no means of detection. J. S. F.

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Not to be outdone by New York, Chicago electrical workers turned out in full force for the "Preparedness Parade" held on June 3. With Samuel Insull, president of the Commonwealth Edison Company at its head, the Utilities' Division included 20,000 marchers, of whom 7,900 were from the electric and gas companies and the city railway lines, and 7,400 from the telephone company (including operators).

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Municipal Ownership and the Contractor

By Glenn Marston

Mr. Marston is a specialist in public relations of central stations. For several years he has given much attention to the question of municipal ownership of public utilities, and has directed numerous campaigns of publicity. The conclusions of this article are drawn from investigations of the conditions in municipally operated plants here and abroad.

That municipal ownership is detrimental to privately owned central stations is self-evident. That it is detrimental to the taxpayer at large has bene proven hundreds of times. But there are certain classes of people who believe that municipal ownership will benefit them more than it will hurt them. Among these are frequently men who are familiar with the electrical industry and believe that municipal ownership offers opportunities for advancement.

On first thought the electrical contractor might be expected to advocate the erection of municipal plants on the ground that it would bring him more business. With the customers of two plants to cater to it would appear that business might be doubled. In the long run this benefit disappears and is replaced by disadvantages which far outweight it.

In the first place there is never any doubling of business through the entrance of competition in the central station business. Sometimes there is a slight increase in the rate of growth of new customers, but frequently the chief activities of a municipal plant consist in taking over such customers of the old plant as we are willing to make a change. The creation of new customers is nearly always left to the private company. It is self-evident that the private company would try to get new customers anyway. But this municipal competition, on account of the false economics of the situation, where the municipal plant has the ever-ready taxpayer to foot the bills and the company can only spend what it makes, forces the company to retrench. This retrenchment usually makes itself first felt in the new business department, and the solicitation of new customers diminishes. Since the municipal plant has not any new business department (not ten of the 1500 municipal plants in America have new business solicitors) the rate of increase in new customers for the two plants has a tendency to decrease. If the competition is so severe as to wipe out profit or surplus the quality of service deteriorates and the advantages of electricity do not make as quick an appeal to the possible new customer. The contractor should take a leaf out of the book of the large manufacturers, all of whom, while they sell equipment to municipal plants, do not encourage the erection of such plants.

Private Ownership Stimulates Sales of Current

This is not due, as many think, to the fact that the bulk of the business is done with private companies. The last census figures show us that the proportion of municipal plants was 29 per cent. of the total in this country, while the private plants were 71 per cent. The amount of energy sold, however, shows an entirely different condition. The private companies sold 96 per cent., while the municipal plants sold only 4 per cent. of the distributed energy. It is due to the fact that the manufacturers of electrical machinery and equipment are far-seeing enough to realize that any influence which interferes with the stability of the central station industry will have, in the long run, an adverse effect on the expansion of that industry. What is the gain in selling a few hundred thousand dollars worth of generators this year if the sentiment for municipal ownership keeps investors from expanding or improving existing plants to the extent of a million next year?

The same question holds equally with the contractor—why favor competition in the central station business of your city, when it will cripple both competitors to a point where electricity will not be popular because of its poor quality, and the contractor's business therefore suffer? In places where I have been called upon to deal with municipal ownership agitations I have always had the unqualified support of the electrical contractors, because they have realized that municipal ownership made for confusion in the industry, and was more than likely to injure them. Experience has also shown that it is easier for a contractor to deal with one central station, and that a private company, than to try to please two masters. Frequently where there is competition between central stations a contractor is likely to incur the enmity of one and therefore be dependent on the other for his business, thus cutting his prospects in two.

The Attitude of Isolated-Plant Employees

Frequently the employees of isolated plants are on the municipal ownership bandwagon, from a variety of reasons. One of the most frequent is also the most indefensible. The employee knows that the central station is trying to get the load of his plant, which may throw him out of work. This means that the employee of the isolated plant is not friendly to the central station. He knows a municipal plant will be injurious to the central station, and is sometimes

small enough to advocate municipal ownership out of spite. He forgets, of course, that with two central stations in the field, the chances are increased that one or the other will get the load he is handling. Another reason is that officials who advocate ownership are addicted to dropping hints that the proposed municipal plant cannot recruit its force from the employees of the enemy central station and must therefore look to other local electrical men or go out of town for its staff. Too often the employee of the isolated plant lets his ambition get the better of his judgment in this way, for even if a municipal plant is put up, the politicians do not confine their appointments to men who have had experience in the electrical business, but take the men who have the strongest political pull. In a municipal plant in the middle west where the Socialists came into power they put a young man in as superintendent of the gas works who had no experience whatever in the gas business. It took him a considerable time to learn, and his education was at the expense of the taxpayers. The Socialists have been expected to follow their declared principle of employing the people best fitted to do the work at hand, but they seem to be as much influenced by political considerations as are the leaders of the parties they wish to replace. There are a surprising number of municipal plants where the superintendent or manager has had no previous experience whatever with electricity in any form. That there are a few municipal plants where employees are hired and fired on their merits only serves to emphasize the fact that most of them are subject to spoils system politics.

Municipal Employees Often Dissatisfied

I have inspected several hundred municipal plants during the past few years, and have been very much surprised by the number of superintendents who have asked me if there was not an opportunity for them to tie up with some private company. I kept no record of the number, but in looking over some of my field notes I find that the proposition seems to be at least 50 per cent. They tell the same story of aldermanic interference to such an extent that their jobs ar next to unbearable. Councilmen who have never had any knowledge of electricity offer and vote for resolutions which are directly against the interests of their own plant, and will not listen to the advice of the superintendent they have employed. And of course these plants are always the poor ones.

The lot of the municipal superintendent is not a happy one. He not only has to do his work well enough so that he will not be dismissed for inefficiency, but he must keep his political fences strong enough so that some rival will not get influence enough to have him ousted. Besides looking after his own political welfare, he is at the beck and call of his political superiors to do such political errands as they force upon him in their own interest. While the manner of a private plant must also mind his p's and q's in order to hold his job, his chief means of doing it consists in taking care of the electrical business; but the municipal man has to make his real job a secondary consideration, and devote time, labor, and money to the kind of outside work which will keep him his job.

Reasons Back of M. O. Agitation

Contrary to general belief, municipal ownership agitations are not started because of anit-corporation spirit, though the advocates of municipal ownership usually, in the course of a campaign, take full advantage of the opportunity to cuss the corporation. Nor is an agitation for municipal ownership started because it is felt that municipal ownership will be good for the community. Municipal ownership agitations are invariably traceable to motives which are far removed from the broad principles of municipal vs. private ownership. Frequently it is due to some shortcoming of the local company. Of all the cases with which I have been associated only one was started because its instigators truly believed in the principle of municipal ownership, and when the people at large voted on the question they defeated it by four to one. This indicates rather clearly that the well-behaved private company has little to fear from municipal ownership. It is only when rates seem high, service is poor, or there is indifference to public needs on the part of the company, that there is cause for real fear of municipal ownership.

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The Club Idea in Appliance Sales

By G. D. Crain, Jr.

The instalment idea has been responsible for a tremendous increase in sales of all classes of goods. The divided-payment plan has increased the market for practically everything on the list, from clothing and furniture to automobiles and houses. Even jewelers have found that it is a good plan to place their merchandise in the hands of users while the latter are completing their payments.

To buy "on the instalment plan," however, does not appeal to a good many people. It suggests the collector from the furniture store, who makes his calls among the poorer classes of people. Hence dealers who cater to those in better circumstances have found it necessary, in order to bring this business-creating idea into play, to call it something else. The "something else" is known as the club plan, and it is not essentially different from the old-fashioned instalment method, though the details are changed to suit the conditions.

The electrical dealers of the country have been rather slow to see the advantage of selling "on time," because of the obvious necessity of carrying the business on their books for a longer period. This is not an ideal situation, it is true, for the reason that it takes more capital to run a business of this kind, and the turn-over is not so rapid.

Success Requires Adaptability

But the big successes in business have been won by adapting methods to the requirements of the market, and in order to increase the volume of appliance business, the dealer must arrange the terms so as to attract as many as possible of those who are in a position to use his goods to advantage. If he does not do this, the chances are that while he will get some business, he will lose a lot which he ought to have.

The central stations have led the way in the direction of instalment selling by arranging to do house-wiring, the cost to be divided into small amounts and paid with the bills for current. This has put the use of electricity into the homes of thousands who would not have been able to pay for wiring installations in a lump sum. And after the wiring was completed, all of these people became prospects for electric fans, sewing machine motors, washing-machines, vacuum cleaners and all of the other appliances which are to be found in the stock of the up-to-date electrical store.

The Installment Plan's Appeal

It is an interesting fact, also, that the people to whom the electrical appliances appeal most strongly are those who belong to what, for want of a better term, is generally called the middle class. They are those who though not held down by poverty, do not live in houses maintained by servants, and who ride not in limousines but in the lowly Ford.

The woman who does her own sewing, for instance, can appreciate the value of a motor for her machine more than one who calls in a seamstress when she wants any work of this kind done. And the former would find it more difficult to lay down on the dealer's counter the $15 which he may be asking for the motor than the latter, and inasmuch as it is the first who is the potential customer of the electrical concern, it should proceed to study her financial arrangements and put forward a proposition that will appeal to her from every angle.

The woman of the type referred to is often "sold" on an article long before she actually gets it. This is a fact which should not be lost sight of. Much stress is laid in selling discussions on the necessity of getting the interest of the customer, creating the desire for the goods, etc., but what about making a sale when the customer would like to buy but feels that she can't afford it? Here all the clever salesmanship in the world is worthless—unless the sort of terms which will enable the customer to convert desire into action is being offered.

The wife of a prosperous mechanic, who owns his own home and is comfortably fixed, may pass the store of the electrical man. She sees a sewing machine, driven by a motor, in operation, and when she thinks of the labor which is required in operating the machine at home, she promptly decides that the motor is just what she wants. But when she sees the price card, "$15," she shakes her head and tells herself that she can't afford it.

But just then she sees another card in the window—"Take this motor home with you for $1.50," with the further explanation that the machine is being sold on monthly payments of equal amount.

"I can surely afford that," she tells herself, "and I'll have the motor paid for before I know it."

She goes into the store, gets a further demonstration of the motor, and has it sent out to her house. She leaves proud of the possession of the appliance, and without feeling that she has been extravagant. The earning power of the future has simply been called on to provide something which is going to be used in the future, as well as in the present.

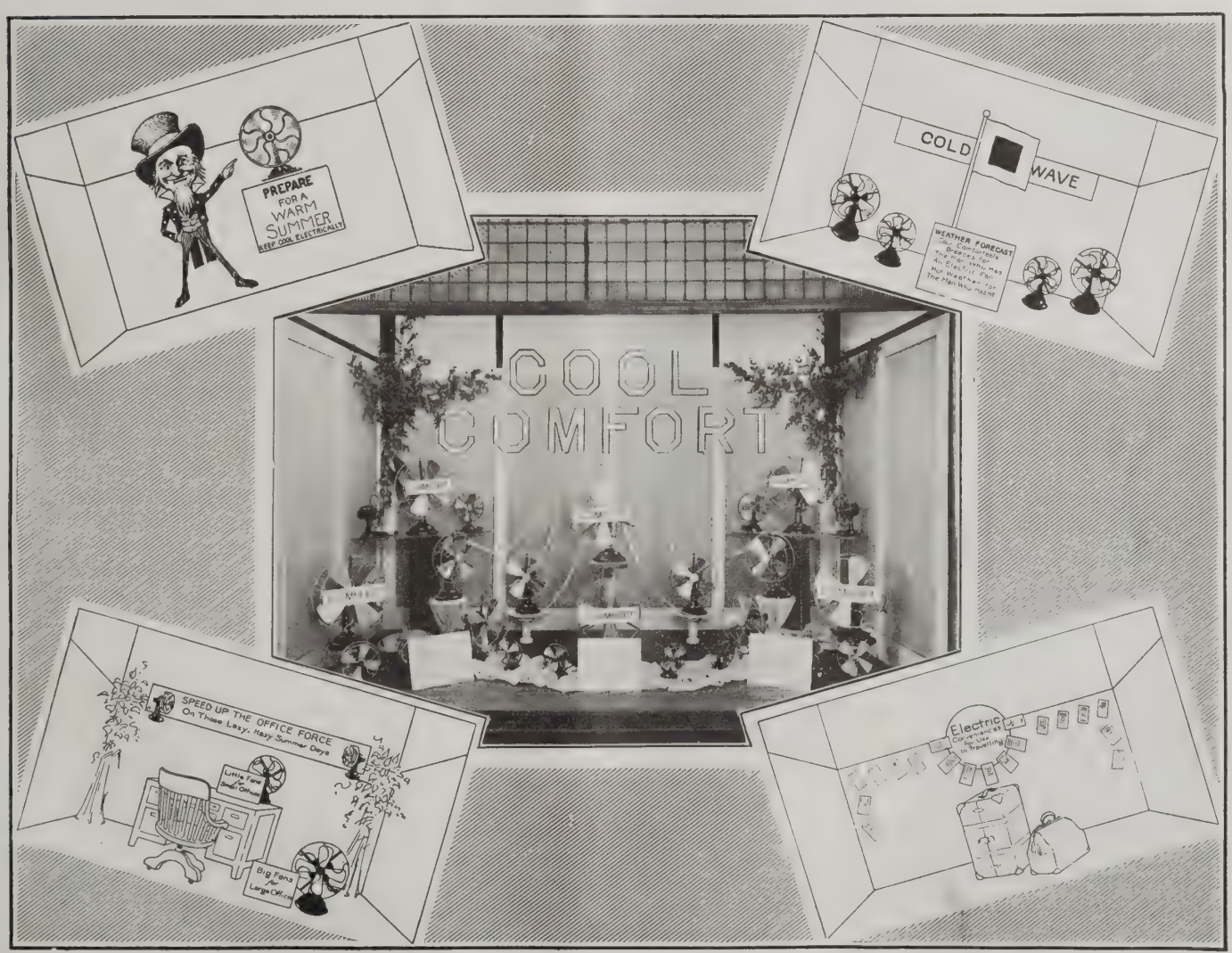
One Sale Makes Another

And this suggests another idea. A woman of this kind, who is a good housekeeper and is industrious in her household work, likes her friends to know of her acquisitions in the line of home equipment. You may be sure that any woman who adds a motor-driven sewing machine to her possessions is going to let her neighbors know all about it, and when they come in to see her in the afternoon, she is going to give demonstrations of the ease with which the machine may be operated. Driving a sewing-machine, while a great improvement over the old days of hand-sewing, is nevertheless back-breaking work for a woman, and the addition of a motor makes it child's play to most of them. Those who hear about the easy terms on which the Blank Electric Company has sold the motor will be interested, and every sale of this kind will cause a regular procession of interested inquiries to start in the direction of the store. This is the only "chain" proposition the writer knows anything about that really gets results.

An electric washing-machine appeals to the same class of customers. The woman who is a little further up in the world has servants to take care of her laundry work, and while the

Our Monthly Window-Display Suggestion

Hot Weather and Vacations Make These Pieces of "Copy" Timely



(Courtesy of The Society for Electrical Development)

servant who has influence with her mistress may be able to secure the purchase of labor-saving machinery of this kind, it is the house-wife herself, who has to wrestle with Blue Monday, to whom the idea of installing an electric washing-machine is going to make the strongest appeal.

All of these facts simply emphasize the proposition that unless the dealer has made an arrangement providing for divided payments he is not going to get the business of the people to whom he ought to be able to sell the largest number of appliances He is cutting himself off from his biggest and surest mark if he decides that he will sell for cash, or on open account to those who are known to be able to take care of their obligations, even to a substantial amount.

As a straight business proposition, therefore, the electrical concern which is endeavoring to work up appliance business should study the club plan, which has proven so successful in other lines. One feature of this idea, which distinguishes it from the instalment plan, is that while the latter involves an increase in the price as compared with the cash question, to cover the cost of bookkeeping and collection, the club price is usually the same, but a small percentage of the price, usually 6 per cent., is charged when the account is opened. The customer would rather pay this in the form of a club fee, it has been found, than to feel that she is being asked to pay more than the cash customer. She feels that under the latter plan she is being discriminated against, while the club idea is rather attractive than otherwise.

A book is usually issued to the club member, who is informed regarding the dates of payments, and in practically all cases these are made without effort on the part of the dealer. The sort of people who are appealed to by the club plan do not need to have collectors sent after them, but mailing a notice that the payment is due will usually result either in a personal call with the book and the amount due, or the book is mailed in and the payment made by check.

It should be added that many young married people buy most of their house furnishings in this way, and their purchasing capacity is immensely increased by the convenience with which good merchandise may be acquired through the use of the club plan. If they have to pay cash, they buy little, and the little they buy is generally of inferior quality, whereas on the club plan they get good stuff at corresponding prices. Mrs. Newlywed is thus a good prospect for an electric toaster, electric percolator, electric curling-iron, electric vacuum cleaner and other goods—including electric fans—which she might hesitate to purchase if she had to pay cash.

All in all, the club plan is the dealer's best bet, and it is up to him to make use of it.

Above—New York Harbor
At Left—Athens, Georgia
(Courtesy The Doherty News)

Rivals

Great interest throughout the country is being taken in the project of flood-lighting the Statue of Liberty in New York Harbor. On a recent evening Miss Lil. Hodgson, said to be the most beautiful girl in Athens, Georgia, posed in costume on the top of the Court House in her home city. Spot-lighting effects were produced by projectors installed on the roof.

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Causes of Failure in Electrical Business

By a Jobber

There never has been a gathering of electrical men in which the subject of the remarkable "death rate" in the business has not been discussed. Many reasons have been advanced for this mortality, but as yet no remedy which will lessen it to any appreciable extent has been found.

Having handled dealers' lists for some time and having been on the "firing line" myself, I have had occasion to investigate the subject rather thoroughly. In my opinion the more important reasons for the disappearance of so many new ones are:

1.—The electrician's lack of knowledge of the fundamentals of the business.

2.—The presence of so many "floaters."

3.—Unintelligent competition on the part of the electrical contractors.

4.—Unfair competition between central stations and contractors.

The lack of practical knowledge on the part of the man in the field is almost appalling. This is evident from the results of license-board examinations which under the new building code of New York City, every contractor and electrician who does electrical wiring work must pass. In order to qualify for licenses the applicants must obtain a mark of 70 or over on their answers to the questions asked. Unlike the provisions of other state and city electrical license laws, the New York ordinance allows no exemptions from examinations on the point of mere experience in electrical work. Since this ordinance went into effect last October, the board has received over 3,000 applications for examination and has granted a trifle over 1,700 licenses. Over 40 per cent. of the men taking the examinations, therefore, were found unfit.

Not being permitted to practice in New York, the man who fails there often drifts to another city where the rules

are not so strict and opens a small shop where he immediately commences to cut prices right and left in order to secure work. This is, of course, in direct competition with the established firms who have, after consistent and modern business methods, brought prices up to a good average. Though he gets along for a while at the expense of the first-class contractors, he soon realizes that with material high in price, work not too plentiful at the start, and not enough capital, he cannot withstand a period of temporary idleness, the journeyman-contractor is soon forced to give up his shop and to become a job hunter. That is one of the kinds that makes up the class familiarly known as "floaters."

Another is the electrician's helper who is anxious to go into business for himself. While talking with a well-known electrical contractor the other day, he said that "almost every ten-dollar-a-week helper with enough pride in him who can afford to have 500 letterheads and cards printed, adds the words "electric company" to his name and solicits business." These helpers in most cases find the cost of carrying on their business much higher than they had anticipated, and it isn't very long before they are again looking over the "help wanted" columns of the newspapers in search of positions.

"Knifing" by Competitors

Another reason for the great number of contractors going out of business, which, to a certain extent is an outgrowth of the two cases mentioned above, is unintelligent competition among the dealers.

When a man is ready to have his house wired, he calls in an electrician and asks for an estimate. Several days later he calls another one and says, "John Jones will wire my home for $75.00." Then Bill Smith, the man he has just called in, says, "well, if John Jones can do it for $75.00, I'll do it for $60.00." And so whoever the electrician is who puts in the lowest bid, gets the contract and does the work, although he didn't even figure out what his cost might be. After the job is completed and his bills are settled, the contractor finds that instead of making the profit he had counted on, he has made barely enough to pay for the fixtures, the other material, and the help, and is indeed lucky if he hasn't lost money on the transaction.

When Bill Smith "estimated" on the job he didn't take into consideration the fact that in figuring, John Jones realized that the work could not be done at a profit for less than $75.00. And so the man who got the job came out on the wrong side of the ledger. This is true even in cases where large contracts are given out.—I have often heard an electrician say, "it was a big job, but it didn't pay."

Central-Station Competition

Another thing which contributes to the fact that so many contractors go out of business is the unfair competition of the electric service companies with them. The main idea of the electric company in any locality is to sell current. In order to get the people of the city to use more current, the company offers for sale, at practically cost prices, electrical appliances—toasters, vacuum cleaners, irons, etc., all of which aid in running up the monthly bill. When the service station heavily advertises and sell a $4.25 toaster at $3.19, the contractor who handles this article has little chance to get the public to trade at his store for such merchandise. There is an illuminating company in the east which offers each month as a "special" some appliance at a trifle more than half the retail price. The electrical dealers in this city have all suffered considerably on this account, in their business not only on appliances, but on fixtures, wiring, and other branches of their work. In the face of such competition, which ranges especially in the smaller towns, the electrician has little opportunity to get the "extras" which follow a wiring job. This added to the other causes does its share in forcing the contractor to the wall.

From experience in the field and conversations with electricians, I believe that the most logical remedies would be first, the passage of a law somewhat similar to the New York City ordinance, making the qualifications for an electrician's license the same throughout the country.

Under such a regulation, every man practicing as an electrician would be qualified to take on responsible electrical work, and this would aid considerably in doing away with the first two causes mentioned in this article. Practically all the men who have passed the New York examination are making good progress as electrical contractors, because they came up to certain high standards.

We would recommend, secondly, the organization of associations of the smaller dealers. There are some associations in the country now but they do not really benefit the electrical contractors. They benefit the central stations, for they are practically run by them. With the coming of community organizations the associations could take up matters intelligently for the betterment of "the man in the overalls," and could force the appliance manufacturers to give the small electrical man protection in regard to prices on their material—something which has up to this time enabled the service stations to greatly undersell the contractors. Such associations would also aid in ridding the field of unprofitable competition, for they would show the electricians the folly of underbidding to get a job.

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Business Office For Charity Sales

Following the successful work of Manager Coffy of the Everett, Washington, Gas Company, in inducing benevolent organizations to hold sales in the company's business office, the Louisville Gas & Electric Company, of Louisville, Ky., has sent out circulars to many local churches, hospitals, societies, etc. The company offers to install in its office a gas range and any other gas or electric appliances which may be necessary, and to furnish the use of the space and facilities, and the services of a porter without charge.

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Leaves Independent Telephone Field

The Western Electric Company has withdrawn its salesmen from the Independent telephone field. Shortage in raw materials is given as the reason for the company's unwillingness to seek new telephone business; orders received from Bell and Independent customers will have the same attention as formerly. The Western Electric's activity as a jobber of other lines of electrical merchandise will, of course be unaffected.

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A contract for fifty-four ranges to be installed in the Imperial Arms Apartment at Portland, Ore., has just been secured by the Hughes Electric Heating Company, Chicago, Ill. The ranges sold are of two types, namely, forty-two of the C-4 type and twelve of the No. 50 type, the latter being placed in the higher-priced apartments and the plainer ranges being used for the others. These ranges will represent a connected load of 317 kw. This is to be one of the largest apartment houses in Portland to be equipped for electric cooking, taking service from the lines of the Portland Railway, Light & Power Company.

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A motion picture devoted to the electric washing machine and iron has made its appearance under the attractive title "The Education of Mrs. Drudge." This film devotes its 1,000 feet to show how a woman shackled to the old fashioned wash tub is emancipated and made happy by the purchase of an electric washing machine and iron. The picture has been produced by the Western Electric Company and is furnished to central stations and electrical dealers to further their sales of the commodities shown. The reels are in big demand and are well received wherever shown. Western electric offices are booking them for advance production.

Commercial Exploitation of Electric Current for Cooking and Heating

By J. A. Dupree

This paper was presented at the recent Convention of the Southwestern Gas & Electric Association. Mr. Dupree is manager of the Electric Appliance Department of the Corpus Christi, Texas, Railway and Light Company.

The first move in utilizing electric current for cooking and heating is to induce the public to realize the advantages of electricity over all other methods. This has to be accomplished by much "missionary work," demonstrations and judicious advertising.

When the writer began to introduce electric ranges to the customers of the Corpus Christi Railway and Light Company, among the first questions asked was, "Does electricity actually cook as well as other fuels?" It was no small task to establish the fact that it does. We answered that question by making a proposition of a thirty-day trial, stating that if, at the end of that period, cooking electrically had proven unsuccessful, we would remove the range. This plan sold several ranges. After a number had been in use for one or two months, interest in electric cooking began to increase, and then we were confronted with the greatest problem with which all central stations engaged in selling electric ranges will have to deal, that is, the question of rates. When approached on the subject of cooking with electricity, the prospect would say, "Yes, I know electric cooking in clean and safe; but isn't it very expensive?"

When we began our cooking campaign, we made a rate of 5½ cents per K. W. H., with a minimum monthly bill of $4.00, which was perhaps "discriminatory," as our initial power rate is 6 cents per K. W. H.

We found that some families were able to cook for an amount very near the minimum, while others used as much as 400 K. W. H. per month, and the big users were the most extensive advertisers of electric cooking; but, unfortunately, the advertising they did was not the kind we wanted.

Not Expensive if Carefully Operated

As an illustration of this: Two next-door neighbors were each sold a range on thirty days' trial. After the ranges were installed we instructed both housewives in their use, and endeavored to make clear to them the economical way of operating the ranges. Both users were enthusiastic over the way cooking could be done on the electric range, and told us of the perfection accomplished in making fruit cake, roasting turkey, etc. Both employed servants to do the cooking, but one housewife gave her personal attention to the preparation of all meals. These respective servants were both Mexican girls. This, in passing, is of particular interest in this locality, for the reason that some have been doubtful of the possibility of training servants to efficiently operate electric ranges. We found, in watching these installations, that after the food was removed from the range, in one household the residual heat was utilized for heating water for the dishwashing, and in the other case a kettle of water was kept boiling on the range at all times during any cooking operation. Attention was tactfully called to this, and the method of making use of residual heat was suggested, but notwithstanding, at the expiration of the thirty days the meter reading in this case was 345 K. W. H., and the other meter for the same period read 131 K. W. H. Attention is called to the fact that these ranges were both of the same make and size.

Needless to state, the customer whose current consumption was the lower accepted the range and sent his check covering the purchase price of same, together with the amount for current used, expressing himself as being well satisfied in every way regarding the excellent performance of the range, and also with the amount of his bill for current consumed. The other man wrote a letter asking us to remove the range, stating that they could not keep it because the current consumption was too great; outside of that they thought the stove was very "nice." We then offered to extend the trial for another thirty days, with the services of our demonstrator, stating that considerable current had undoubtedly been used in becoming acquainted with the working of the range, and that we were thoroughly convinced that cooking with electricity was by no means extravagant when the range was properly operated. He replied that no amount of argument could convince him that electricity was a practical fuel, and that if he or his wife should have to watch the cooking and resort to all sorts of devices to economize current, that the electric range ceased to be a convenience and defeated the very object for which it was installed.

This case, we believe, is an exception, however, for we have found that in most instances users of electric ranges are willing and eager to follow instructions enabling them to produce the best results with the minimum amount of current consumption.

Ordinary cooking usually in itself requires comparatively small current consumption. In our experience, the current wasted in water heating is a large portion of the total amount used by the consumer. This suggested the installation of an auxiliary water heater. In one instance where this was done, the customer's consumption dropped from 103 kw-hr. to 65 kw.hr. for the succeeding month.

Consumers Give Data on Usage

Several of our customers have given us the benefit of their experience in cooking certain foods, even calling us over the telephone to tell of some particular success and how it was accomplished. One customer found that cooking rice and other cereals in the oven rendered the food more palatable than when cooked by the ordinary use of the hot plate burners. Another found that bread could be baked in the oven with the current turned on at full heat for only fifteen minutes, the cooking being continued by stored heat after the current was turned off altogether.

Tests of cooking various foods made in a laboratory, comparing the amount of electricity in watt hours to units required of other fuels, have not the same practical value afforded by actual experience. However, these laboratory tests should not be discredited, for they furnish a working basis which can govern the practical operation of nearly all types of electric ranges.

Different makes of ranges, in actual practice, will not give the same absolute results, hence no arbitrary rule can apply, determining in exact watt hours the amount of current to be expended in cooking certain articles of food, which will hold true for every type of range. The General Manager of our Company has determined that for every pound of roast beef cooked in a certain make and type of range, it requires the expenditure of .25 kilowatt hours; nevertheless, this need not be an exact rule in operating other types of electric ovens.

The writer has found by actual test in his own home that four large loaves of bread can be baked in one make of elec-

tric fireless cooker, with an expenditure of 450 watt hours, but this does not imply that the same results can be produced with a like expenditure of current in every type of electric fireless cooker.

Therefore, practice is necessary to acquaint the customer with his particular installation of electric cooking apparatus, and no set code of rules regarding length of time for every cooking operation should he be expected to follow.

Schedules for Cooking and Water Heating

Not without experience dearly bought, and with undoubtedly a great deal more yet to be gained, have we advanced thus far in the use of electricity for cooking. After exhaustive experiments in selling ranges and in an effort to obtain a rate which would be both satisfactory to the company and to the consumer alike, we finally adopted a plan of selling ranges at list prices, making no additional charge for wiring and connecting same, and the rate we have finally adopted for electric cooking has been successfully employed in the Eastern States. It is termed a flat demand rate. Consumer is charged at the rate of $2.00 per kilowatt, according to his "active load," or "rate of taking." Sixty per cent. of the connected load, we find, is sufficient under ordinary conditions to operate an electric range for an average size family. We contract to supply current for a year for cooking and heating water, holding ourselves in readiness to serve an amount equivalent to or above his active load, making the charge for service according to his rate of taking. For example, should his active demand be 2 kilowatts, he pays a flat rate of $4.00 per month. Should he use current in excess of his rate of taking, this current is charged to consumer in addition to his amount of flat rate. This plan does not conflict with our power rate, hence no cause for complaint from a motor user that discrimination is being made in the sale of electricity for cooking and water heating. A number of water heaters have been installed by consumers who have ranges. Formerly current supplied for water heating was sold at a rate per kilowatt hour; we are now allowing the use of a 2 kilowatt water heater in conjunction with a range, for $1.000 per month, in addition to the demand rate on the range, installing a double throw switch which allows the use of either the range or the water heater separately as desired, meaning that both cannot be operated at the same time.

Types of Water Heaters

We have found the immersion type water heater very efficient when installed according to our specifications, which comprise a 10 or 15-gallon tank, usually covered with asbestos insulation and the water connection made in a manner which permits a limited quantity of hot water being drawn within one minute after current is turned on. By this method enough water for a bath can be heated in less than fifteen minutes.

We encourage the use of the immersion type water heater for the reason that it is more direct in its action than other types and quicker results are obtained. For a like reason we encourage the use of the open-coil type range, believing that it is best suited to the use of a people who have long been accustomed to seeing evidence of the heat used in cooking, and as the burners of this type are, so to speak, "self-indicating," this inherent quality facilitates any cooking operations, eliminating the necessity of having to notice the indications of the three-heat snap switch which is generally supplied on all ranges, reading, "Full," "Medium," "Low" and "Off." This self-indicating feature of the heating elements also renders the range especially adapted to the use of illiterate servants.

We are of the opinion that a demand rate cannot successfully be applied to current used for air-heating. White current so utilized is in a large measure an off-peak load, the demand is practically constant during all hours of the day; whereas, the time demand for current used in cooking and water heating is limited. Our cooking rate is based on the fact that during off-peak hours there is available a surplus amount of current, necessitating no appreciable increase in fuel consumption under our boilers. In fact, a slight variation in load will not require the readjustment of the oil burners. This surplus is, of course, greater or smaller according to the capacity of the central station's generating units. This enables us to proportion to each consumer, for cooking purposes, a relatively small part of the surplus, pro-rating the charge accordingly.

A Drug-Store User

One drug store makes its hot drinks with electricity, cooking chocolate on an electric hot plate rated at 880 watts keeping it hot in an urn such as is used by restaurants and soda fountains, to which has been attached a 660-watt immersion water heater arranged in a manner causing the water to circulate, bringing the three quarts of water, which is the content of the water jacket, from ordinary faucet temperature of around 60 degrees, to the boiling point, within about thirty minutes, the current being turned on and off from time to time, maintaining a temperature near 212 degrees Fahr. The proprietor states that electricity in this case is cheaper than any fuel formerly used for this purpose.

Heating the Store Electrically

This store has two radiators which take current through the same meter, and which together are rated at 2,100 watts. One is a luminous and the other a radiant type. These are used without auxiliary means for heating the store. The following shows the current consumption of this installation:

Month:	K. W. H.
December	219
January	326
February	293
March	100

From this it is evident that a flat rate for current used for air heating, however remunerative to the company, would not satisfy the consumer. A flat rate charge for air heating could not in our opinion prove satisfactory, particularly in this climate, where the consumer would be averse to signing a year's contract for current supply. The period of cold weather here is of such short duration that the charge for current furnished for air heating service, made on a flat rate basis, would be impracticable. We have a few customers who use electricity as their only means for air heating; this current is registered in kilowatt hours and sold at the power rate.

The stage of electric cooking of to-day may be compared with the stage of telephone of twenty-five years ago, when the business was obtained by much hard work and in the face of many difficulties. The telephone, to-day, is ranked as a necessity, and just so do we believe electric cooking will be considered within the near future.

A big field is being opened to the central station for the sale of its product, and the prospects seem inviting. Let us work to make cooking with electricity the method housewives will recognize as the accepted standard.

* * *

Movement to Honor Inventor of Electro-magnet

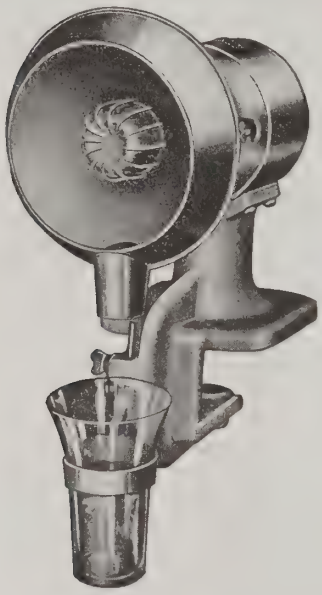
Progress is being made in the effort to raise $30,000 with which to erect a granite and bronze monument to Prof. Joseph Henry, inventor of the electro-magnet. The monument will grace the little swarded and shaded park fronting the Albany (N. Y.) Academy where Professor Henry taught during the years of his experiments, 1827-1831. A general committee of which Prof. Henry P. Warren, headmaster of the Albany Academy, is chairman, is engaged in interesting local professional and business men to the extent of making contributions to the extent of $15,000; Prof. M. I. Pupin has volunteered to raise the balance.

New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Electric Lemon Squeezer

The electrically operated fruit juice extractor illustrated, has recently bee developed by Thomas Mills & Bros. Company, of Philadelphia, Pa. This outfit is suitable for restaurants, soda fountains and other places where it is necessary to extract the juice from large numbers of lemons or oranges.



It consists of a motor driven hemisphere provided with ribs similar to the ordinary hand operated glass extractor. The lemon or orange is halved and held against this semispherical part. The juice is caught in a reflector at the back and runs down through a spout at the bottom. A clamp is provided for attaching the outfit to a table or counter and a ring is attached below the spout to support the glass. The outfit is equipped with a 1/10 horsepower universal A.C.-D.C., 3,000 r. p. m. motor made by The Robbins & Myers Company, Springfield, Ohio.

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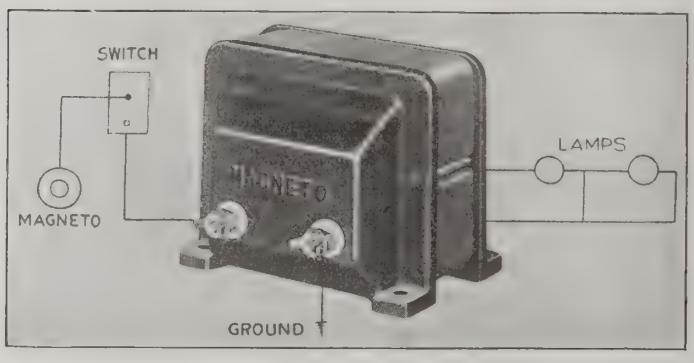
Waynelite Steadies Ford Lights

The steady headlight illumination that Ford drivers always have wanted is available now at low cost by the use of a specially designed transformer, the "Waynelite." It has been impossible to get this kind of light on the Fords as electrically equipped at the Factory because the current supplied by the magneto naturally varies with the motor speed. The revolutions of the motor are influenced by every factor of the constantly shifting motor load and the driver's manipulation of the control levers. At low speeds on high gear when bad roads, danger or congested traffic emphasized the need of a bright light it was not to be had. The magneto did not turn over fast enough to supply the necessary current. Not until the motor speed approximated 12 miles per hour was the light really useful. With the higher speeds the illumination was unnecessarily bright, lamps were frequently burned out and their lives shortened in any event.



The "Waynelite" is a small transformer, perfected by the General Electric Company. It receives current from the magneto included in the motor and delivers current to the headlight lamps which are wired in multiple instead of in series as is the Ford factory practice. With the series wiring if either lamp fails, both go out, to the driver's annoyance and perhaps peril. This is prevented by the multiple wiring of the new method. Installation is simple. The only changes from "standard equipment" of the Ford are adding the transformer, partial rewiring and substitution of 6 volt lamps for those of 9 volts supplied on the Ford. From magneto to switch the wiring is unchanged. At the switch the present headlight wire is attached to one of the "magneto terminals of the transformer while the other "magneto terminal" is grounded to the engine frame. A pair of wires lead from the two terminals on the "lamp side" of the "Waynelight." Each wire is connected to one side of each headlight. The replacement of lamps should be made with the Mazda B, G 16½, 6-8 volt 15 candle power double contact bayonet base lamp or the Mazda C, G 12, 6-8 volts 21 candle power lamps. This recommendation is made because the G 16½ conforms with the present size Ford lamp. The over all dimensions of the transformer are: 3¾ inches wide, 3¼ inches high and 4¼ inches deep. As it is practically water-proof it may be placed on the dash or under the hood or floor boards with perfect assurance that it will operate at all time desired. "Waynelite" transformers to be sold at retail for $4.00.

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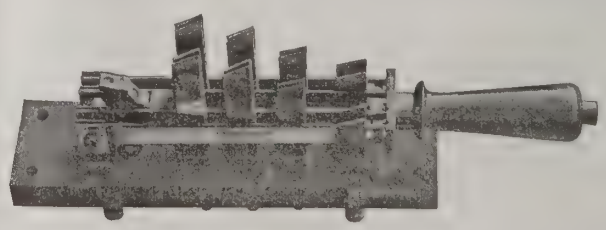
Motor-Starting Knife Switches

For use as a simple and inexpensive method of starting rotary converters from the direct-current end and direct-current motors of large capacity having starting conditions that will permit cutting out the starting resistance in four steps, the Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa., has developed a line



of motor starting knife switches of which the one illustrated is typical. These switches are for use on circuits up to 600 volts, and are made in two types for starting capacities from 300 to 3600 amperes. They are intended for starting conditions only, being rated in terms of the starting current. They will, however, carry one-fourth their rated current continuously. Unless the full-load current is only one-fourth of the starting current rating, a short-circuiting line switch or circuit-breaker should be used to carry the running load.

These motor-starting switches have four sets of contacts of such length that the switch blade makes contact with each set

in succession. Each switch has four blades, a construction that allows of ample ventilation and reduces the depth of the switch from the switchboard.

To prevent large machines from being started too quickly by throwing the switch through allthe positions without stopping on any one position, a ratchet device is provided on the switches for starting capacities of from 1200 to 3600 amperes. This device has a stop for each position, and it is necessary to release this stop before passing to the next position, thus insuring that the machine being started has time to accelerate as the resistance is cut out.

These switches are furnished with terminal lugs and are arranged for mounting on panels of from 1¼ to 2 inches thick.

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The Writerpress

The only practicable method of reaching a large number of prospective customers at a reasonable cost is through form letters. It has long been well known that the principal difficulty encountered in making these pass as personal is in putting on the names and addresses. Formerly two operations were necessary and if a personal signature was to be added, a third operation was required.

In any process requiring two operations, variations almost insurmountable are encountered. These variations are in color and shade of machine and matching ribbons—pressure of machine and touch of operator filling in—difference in exhaustion of ribbons, and in copying from lists of cards, errors in spelling or addressing occur and at least half of the labor cost is in filling in and addressing envelopes. A new machine has been designed to provide for these things. The body or form portion of the letter is set up in type made to exactly reproduce typewriting, in interchangeable chases or forms.

Name plates or address plates containing card indexes are set up in type having exactly the same face as the type in the set form—for convenience this type is cast on a short body to save space and to permit assembling in the name plates but it is cast in the same face molds as the body type.

In action, the name plates are successively fed by the movement of the machine into position in the bed of the machine and one letter after another is printed, each containing a different name and address. Inasmuch as the form and the name and address are absolutely the same, both printed at one stroke through the same ribbon and by the same pressure, all variation is eliminated and as one operator can turn out 600 to 800 letters per hour, practically all of the expense of filling in is saved. All chance of error in spelling or addressing is eliminated and form letters that receive the same attention as letters typed one at a time are obtained.

The model illustrated is motor-driven and has automatic feed for address plates. This makes it suitable for addressing customers' bills. The name-plates are of sheet-metal, with slots which hold the type. It is thus a simple matter to change names or addresses without re-making the plate. Enough space on the plate is provided for a card on which the name is printed, and which may carry other information of use either for follow-up work or concerning the customer's account.

The chase which holds the type for the body of the letter will also take ordinary type, so that forms, letter-heads, diagrams, handbook sheets, etc. Thus the owner of one of these devices has practically a complete printing-plant at his disposal.

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A Strain Insulator for High Voltages

Identical metal electrodes at the top and bottom of a new strain insulator are claimed to produce a very desirable balancing of the electrostatic fields through and over the dielectric. The dielectric thickness is 2¼ in., which is claimed to be much greater than that of any other single-piece unit now in use and the stress on the porcelain under all operating conditions is said to be correspondingly lower than on the thinner types. The usual rigid malleable-iron caps and solid pins are replaced by two spider-shaped caps, the legs of which are set into the porcelain

to a depth of 1 in. on the upper and lower sides of the insulator. Each leg is cast with a foot; by giving the cap a slight turn after placing in the holes provided in the insulator, these feet clamp into the porcelain and the space around the legs is filled with a special alloy similar to that used in die casting. No cement is used on the insulator. This alloy, as applied, does not shrink away from the porcelain, and has a very low coefficient of expansion. It is asserted that the insulator can be plunged from boiling to ice water without harm. The flexibility of the legs prevents expansion and contraction strains on the porcelain, and this construction is intended to absorb shocks and distribute the tensile strain uniformly.

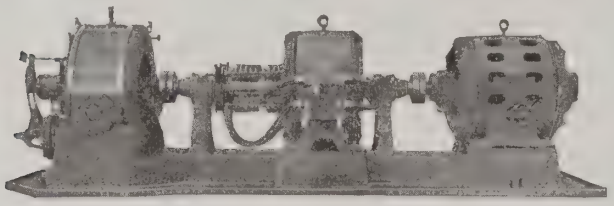
The ultimate mechanical strength of the insulators is claimed to be from 8,000 to 10,000 lbs., and the electrical properties are said not to be affected in the least up to the full breaking strain, the electrical and mechanical strains occurring at entirely different parts of the porcelain.

Authorities have proved that insulating materials gradually fail under stresses which cause corona. The critical stress varies with the specific inductive capacity of the material, and for porcelain, the safe potential gradient is about 40,000 volts per inch of thickness. Tests of this insulator have shown that on both normal and high frequency, corona is avoided up to 90,000 volts and even 110,000 volts, due to the unusual thickness of dielectric. It is also claimed that the balanced field is very important in securing the full value of the insulating material.

Duplex Exciter Sets

One of the most important pieces of apparatus in the power plant is the exciter. The exciter bears to the main generator the same relation that the boiler feed pump does to the boiler. A failure of exciting current means immediate failure of the main units, so that reliability in this piece of apparatus is of paramount importance. From the standpoint of reliability, the ideal exciter drive is a steam drive, as the boiler is usually the last piece of apparatus in a power house to go out of commission.

For steam-driven exciters the turbine has proved to be much more reliable and flexible than the reciprocating engine. Furthermore, the maintenance cost is very much less. For obvious reasons small turbine exciter sets are run non-condensing and where the load characteristics of the station are such that all



the exhaust steam can be used in the heater, this makes a most economical proposition. There are many stations, however, where the load-factor is low and all the exhaust steam from the exciter cannot be used. This results in a direct loss by blowing off steam from the heater.

From an economical standpoint, therefore, the motor driven exciter is well often more efficient than a steam-drive. The serious objection to this type of auxiliary, however, is that when anything happens to interrupt the current supply to the exciter motor, the excitation is immediately lost, and the main unit is out of commission until some auxiliary exciter can be started up.

Duplex exciter sets, combine all advantages of a motor-driven exciter with the reliability of the steam-driven exciter. These sets consist of an exciter-generator coupled to a motor at one end, and to a steam turbine at the other end. For normal operation the set runs as a motor-generator set. Should anything happen to interrupt the supply of current to the motor, or should anything happen to the motor itself, the seed will drop slightly, the governor of the turbine will immediately take hold, and the machine from then on runs as a direct-connected turbo-exciter set. The action of the special governor that is fitted to these sets is so sensitive that when the switch controlling the motor is pulled, the turbine will instantly take hold of the load without any appreciable fluctuation in voltage.

The turbine governor is also fitted with a speed-changing device that is used during normal operation to divide the load between the turbine and the motor, so that the unit can be operated at its maximum efficiency at all times. With this device, as the station load increased and with it the demand for exhaust steam for the feed water heater, the load can be gradually shifted from the motor end to the turbine end. The proportion of the load carried by the turbine can be varied at will from zero to 100 per cent., to supply exactly the amount of exhaust steam needed to maintain proper heat balance in the heater.

This device does not affect the operation of the unit under emergency conditions.

The advantages of the duplex exciter are:

1. It obviates the need for both motor-driven and steam-driven exciter sets, such as are now installed in many stations, and thereby saves both in first cost and in floor space.

2. It gives absolute certainty that excitation will not be lost as long as there is steam at the turbine.

3. When anything goes wrong in the station, all available help can be used elsewhere, as the exciter set can be depended upon to take care of itself.

4. The set can be driven economically from the turbine end when exhaust steam is needed at the heater, and the switchboard operator can, without leaving the switchboard, instantly shift the drive from motor to turbine.

5. In normal operation a better all-day efficiency can be obtained (by shifting the exciter load from the motor-end to the turbine-end of the unit as the demand for exhaust steam increases), than can be attained with either a straight motor drive or a straight turbine drive.

6. The main generating units are relieved from carrying the exciter load during peak periods, because during these periods turbine drive for the exciter unit is much more efficient than motor drive.

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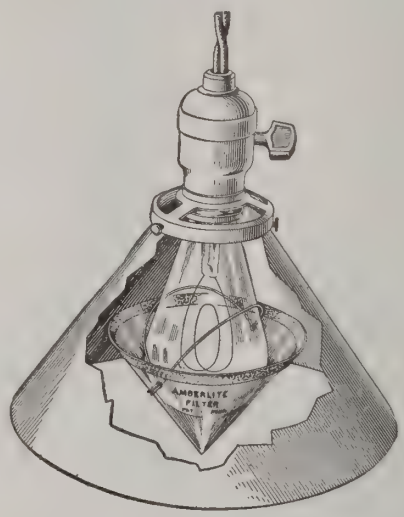
Diffuser for Pendant Lamps

Those whose eyes are troubled by the white light of electric incandescent lamps will be glad to know that a diffuser and softener has been placed on the market for their benefit. This is made of pyralin, tinted amber, so as to remove the irritating rays at the violet end of the spectrum. The device is conical in shape, and is held below the lamp by two wires, as shown in the accompanying illustration. The price is 25 cents, and the trade-name is "Amberlite."



The same company manufactures two diffusers for electric headlights. The "Simplex" is similar to the "Amberlite," having in addition a sheet of pyralin which nearly fills the front of the reflector-opening. Another form, the "Melolite," has either a green or an orange center, the remainder being a disk of frosted pyralin. The price of these devices ranges from 50c to $1.50 per pair.

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Multiple Spindle Drilling Machine

For drilling all the holes in an automobile transmission case at one setting the Baush Machine Tool Company, of Springfield, Mass., has perfected the multiple spindle drilling machine shown in the accompanying illustration. This machine is unique in that there are 46 holes in each transmission case and the drilling is done regardless of the fact that some of the holes are on an angle and vary in size from 3-16 to 1 11-16 inch. Each drill runs at the same speed and each group of drills has independent feed.

The machine is operated by a 25-horsepower, 230-volt, 1400 r.p.m., commutating pole, direct-current, Westinghouse motor, through a main driving shaft placed at the rear of the machine, connected to the horizontal heads by steel gears and cloth pinions, and connected to the vertical head by bevel gears. The motor operates equally as well in either direction of rotation and can be reversed without changing the position of the brushes.

The bed of the machine is supported on feet, providing ample space for cleaning under the machine and preventing the floor from becoming water soaked if drilling compound is used. All reciprocating parts are enclosed in cast guards, effectually protecting the operator from injury. Various spindle speeds are obtained through gear reductions encased in oil tight boxes on the heads. The spindles are equipped with ball thrust bearings

and Baush universal ball joints. An improved type of arm allows a center distance between holes equal to the diameter of spindle. Spindles may be adjusted for different lengths of drills by operating but one screw at the outer end of arm. The horizontal heads have standard belt driven feed with automatic control and quick traverse by hand wheel. Vertical head and cluster box slides are automatically controlled by left hand head through trip rod and bell crank which operate jaw clutch on reversing gears in gear box. These gears control shaft operating pinion and racks attached to vertical head and slide.

In operation the left hand head is brought forward, automatically engaging feed of vertical head and cluster box slide, which travel the required distance and automatically return to neutral position. The feed for right and left hand head is now engaged by levers. At the same time a spindle on the box jig drills the hole. Feed is automatically tripped by stops and heads return to neutral position, completing operation.

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An Automatic Lighting Switch for Automobiles

This Automatic Lighting Switch combines the functions of a switch and overload circuit breaker and in the latter capacity takes the place of the usual fuse block. As a protective device it is far more reliable than the fuse and it gives this protection to the electrical system with minimum inconvenience to the motorist. The blowing of a fuse always causes a certain amount of annoyance and inconvenience. Generally the fuse blows as a result of a momentary, accidental ground, occurring while some repair or adjustment is being made. It is then necessary to hunt around for the fuse block, which is often placed where it is hard to get at, locate the fuse which has blown (which is not always an easy matter) and put in a new fuse, providing one is available. With the automatic switch installed, all that is necessary in order to re-establish the circuit is to push a button. In a new line of these switches we have incorporated the device with the lighting switch, the combination requiring no more space on the instrument board than the usual lighting switch. The circuit breaker is operated by means of a push button which normally is flush with the face plate, but when the circuit breaker opens, the button projects slightly, as shown in the figure and thus positively indicates the open circuit condition.

The lighting switch is operated by means of a key. Where double bulb headlamps are used, a turn to the left lights the small bulbs and tail lamp. A turn to the right lights the large bulbs and tail lamp. In like manner where a dimmer is used, a turn to the left connects through the dimmer coil, which is mounted on the switch base. Turning the key to the right gives the full candle power of the headlamp bulbs. The key can be withdrawn in either of these positions, thereby preventing any tampering with the lights in the owner's absence. This switch lists at $3.00 without the dimmer-coil.

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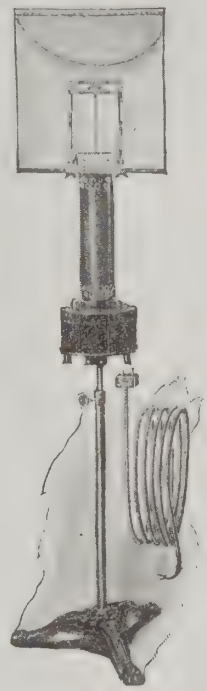
The Liliput Arc Lamp

This portable lighting unit for motion picture work has recently been brought out by a New York firm. It is designed for use in the studio, or away from the studio, wherever an artificial light is required for motion picture photography. The light is said to be identical in quality to daylight. The lamp works on either alternating or direct-current, and at pressures from 110 to 125 volts. The arm lamp, rheostat, and hood are combined into a complete unit.



The lamp is 33 inches high with the stand. It can be adjusted for any normal working height. It has two pairs of carbons with automatic feed, and consumes 15 amperes at 110 volts. A groove or slide is provided on the front of the reflector for a diffusing screen.

The top carbon holder has a swinging joint which permits the carbons to take the correct position as soon as the current is applied. All live parts are enclosed in the hood. The rheostat is fastened at the bottom of the lamp, and acts as a base for the lamp when it is used without the adjustable stand. Twenty-five feet of No. 1 flexible stage cable is supplied with the lamp. The total weight of the lamp with stand and 25 ft of cable is 30 lbs.

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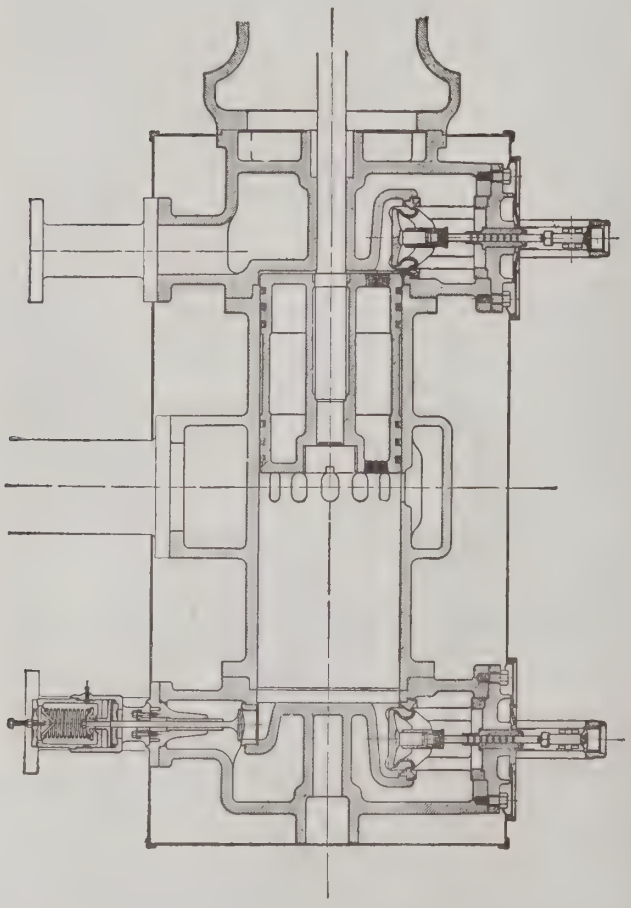
Large Uniflow Engines for Youngstown Sheet and Tube Company

The uniflow engine, as is now generally appreciated, owes its efficiency to the reduction of the loss by initial steam condensation. The ends of the cylinder are not cooled by the rush of exhausting steam since this flow occurs at the farthest point from the ends, through the ports in the centre of the cylinder, which are uncovered by the piston. The uniflow engine is, therefore, suitable for wide temperature ranges. Expansion from boiler pressure down to condenser pressure may be carried out in one cylinder and the engine is found to be equivalent in steam economy to a tandem compound engine.

Although the increase in efficiency is of importance, the predominant advantage of the uniflow engine, which is often overlooked, is its capacity for extreme overloads with a flat steam consumption curve. Tests have shown that 200 per cent. load can be carried with only 10 per cent. increase in steam consumption. The uniflow engine is therefore pre-eminently fitted for severely fluctuating loads with high peaks, such as driving a rolling mill and similar power services or for electrical loads of a fluctuating nature.

In this country the first uniflow engines for rolling mill

work are those now under construction by the Nordberg Manufacturing Company, Milwaukee, Wisconsin, for the Youngstown Sheet & Tube Company, Youngstown, Ohio, the larger to drive a 12-inch rod mill, the smaller a 9-inch rod mill. The general design of the cylinders is shown by the longitudinal section in the figure. The cylinder is a plain cylindrical casting, all valve chambers and steam passages being contained in the heads, bolted to the ends of the cylinder. This prevents distortion and strains due to expansion and contraction with the use of high pressures and superheats. The steam valves are of the poppet type, the valve cages being separate castings which are ground into the heads with a steam tight joint. The valves are of the double heat, balanced poppet type and no packing is required for the valve stems, which are accurately ground and polished and work in ground and lapped bushings. The valves are operated from lay shaft by a releasing valve gear with spring dashpots, the cut-off being under control of the governor through the wide range of loads. The steam enters the cylinder at the bottom, sweeping up over the heads and jacketing them before entering the valve at the top. The exhaust is through the ports in the center of the cylinder uncovered by the piston near the end of its stroke. Relief valves of the poppet type with cataract dampening device are located near the bottom of the heads. In case of loss of vacuum and over-compression these valves automatically open and connect the clearance space of the cylinder with the steam space in the head and the communicating steam piping. The steam conditions will be approximately 170 lbs. pressure, 75 deg. superheat, and 20 in. vacuum, steam being condensed by barometric jet condensers. The larger engine is 44 by 50 in., 110 rev. and will have a capacity from 700 hp. to between 3,000 and 4,000 hp. The weight, including 110,000 lbs., 10 ft. flywheel, will be 480,000 lbs. The second engine is a 37 by 48 in. at 110 rev. and its weight, including a 90,000-lb. flywheel, will be 360,000 lbs.



The "Electralogue"

A syndicated house organ for central stations known as "The Electralogue," in which each company maintains its individuality to such an extent that it may be said to be issuing its own house organ, has resulted from the general demand among lighting companies for this most effective and dignified form of advertising. The Electralogue aggregates, with cover, forty pages. Twenty-four of these are devoted to syndicated reading matter consisting of articles gathered from every field of the electrical industry and presented in a popular and attractive style. They tell what is being done with electric light, heat and power, in both the industrial nad domestic fields. The text is primarily sales-stimulating, and presented with the human interest element emphasized, thus making a strong appeal to consumers and prospective consumers of central station service.

Bound in with these pages are four devoted exclusively to reading matter of the subscribing company. Here the central station can conduct its own selling campaigns as it sees fit, or it can tell in detail the news of the local field.

Added to this, a separate cover and an inside cover page advertisement is reserved to the subscribing company, completing the individual features of the magazine. The remaining ten pages are devoted to advertisements of appliance companies, who thus canvass the local field for business that is bound to add current consuming devices to the central station's lines.

The same syndicate is planning the issuance of a miniature edition of The Electralogue to be used by central stations in small communities. In this, too, the subscribing companies may maintain their individuality by utilizing special pages for sales campaigns and news of interest to the community which they serve. The miniature "Electralogue" will make its initial appearance with an October issue, and will serve, in every respect, the same purposes, as the house organ of the larger companies. For this edition, the price will be $7.75 for 250 copies or $25.00 per thousand completely printed.

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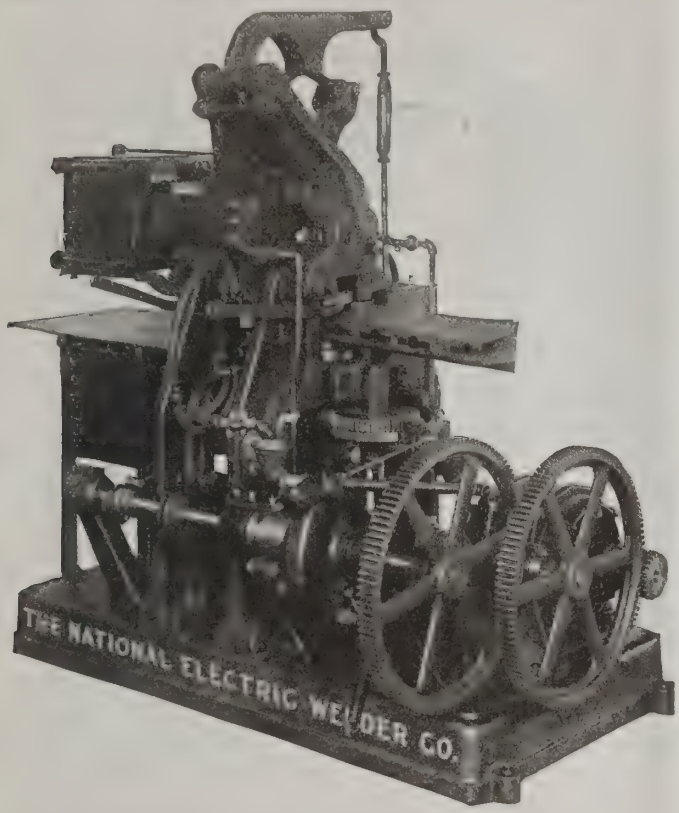
An Electric Welding Machine

As an instance of the extent to which electric welding can be developed, the accompanying illustration of a special spot welder is of considerable interest. This welder is used in assembling a V-1 Section in an Eastern plant which makes a specialty of pressed steel forms. The fact that the machine is wholly automatic in its operation will convey some idea of the high degree of mechanical and electrical skill involved in its construction.

Power is delivered through a train of gears from a 2-hp. motor mounted on the machine base and operating at 1200 r.p.m. The work is run through the machine in 12 ft. lengths, the spot welds on each side being automatically made at the same time

and at the rate of 40 per minute. A cam (shown just to the left side of the second large gear) operates a ratchet gear (shown to the left of the top of the second large gear) which in turn operates the friction rollers which carry the section through the machine. During the intervals between the ratchet gear move-



ments, the welding points are brought into contact with the work by means of the cam shown between the uprights of the frame just below the water hose. The welding points are water-cooled, the temperature and flow of the water being indicated in the drip cup through which the water passes as it flows from the cooling system into the waste pipe. Despite the seeming complication of parts the machine is exceedingly simple in working principle, so much so in fact that it would require actual abuse to impair its efficiency. The possibility of such abuse is provided for by unusual sturdiness of construction and liberal provision for emergency overloads. This special machine will take the place of several riveting machines which will be utilized for work on which electric welding is not economically practical.

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New Inexpensive Types of Electric Ranges

In many localities the central stations and electric range salesmen found that the cost of their standard line was too high for certain classes of the inhabitants and that there were great sales possibilities in a lower priced range. In accordance with this waiting business, a Chicago company is now manufacturing a new line of all black enameled ranges which are much lower in cost owing to the omission of fancy nickel plated legs and trimmings white enameled splashers and others costly features. Another reason why these ranges can be priced so much lower is because their legs are not cast but formed from angle iron.

The lowest priced range of this new line is the "C 18" which sells for $39.50. This range has a two-burner cooking surface, one unit with a maximum of 1500 watts, the other 880; also a two-burner oven, each unit having a maximum of 880 watts.

The highest priced stove of this group is the "C 4" which is of the cabinet type and sells for $70.00. It has a three burner cooking surface, two burner oven, outside elevated warming shelf and outside lower shelf. The maximums of the cooking burners are: 1500, 1100 and 880 watts. Of the oven burners: 1100 watts each. The other types vary in design and capacity between the small "C 18" and this larger "C 4."

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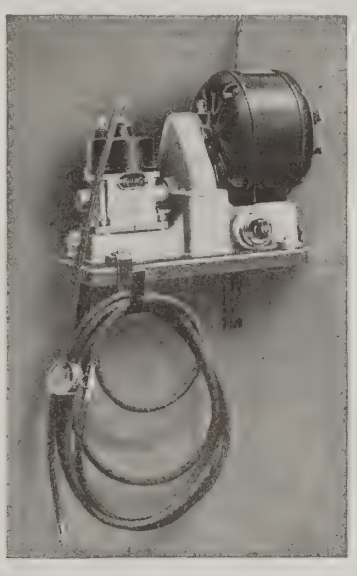
Motor-Driven Air Compressor

For the private or small garage an electrically driven tire-pump is so convenient that it has become almost an essential part of the accessory equipment. One model which on account of its many good points has been much in demand is illustrated herewith. Being small and compact it may readily be installed on brackets fastened to the wall, where it will be out of the way. The motor, of 1-6 hp., for alternating or direct-current as specified, drives the pump through spur gears which are fully enclosed and run in an oil bath. This forms a reservoir containing enough oil to last for several months. The makers guarantee that no oil vapor is included in the discharge of compressed air.



Included in the equipment is an 8 ft. lamp cord with attachment plug, a two-pole snap switch, 15 feet of special hose and a gauge to show the pressure in the tire while it is being inflated. The price is $50.00 with direct-current motor and $55.00 with alternating-current motor.

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Spot-Lamp Dimmer

The tungsten spot or lens lamp is rapidly replacing the ordinary hand-fed arc lamp as a means for portable stage light-

Fig. 1

ing. To increase the value of this lamp for this work, the Ward Leonard Electric Company of Mount Vernon, N. Y., has recently brought out a device called a spot-lamp dimmer. In the accompanying illustrations is shown a dimmer designed for

use with 1000-watt tungsten lamps and so constructed that it can be mounted on the upright lamp support. All energy-carrying parts of the device are inclosed. The dimmer is comparatively light in weight, has fifty steps of control and will dim a 1000-watt gas-filled lamp from its full candlepower to blackness. In Fig. 1 is shown the inclosing box to which the terminal leads are carried. The dimmer or rheostat is mounted upright on the standard as already noted and the handle moves up and down in the slot as shown in Fig. 2.

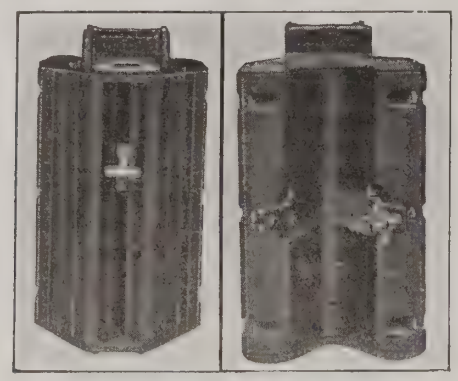

Fig. 2

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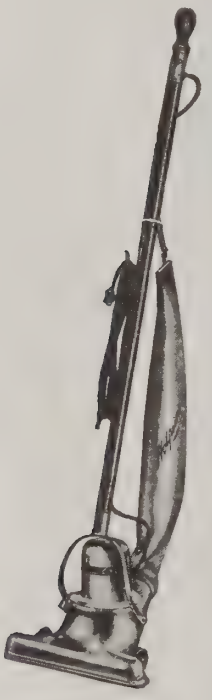
A Pressed-Steel Vacuum Cleaner

An all-steel case vacuum cleaner which has recently been placed on the market though made of pressed steel loses none of the flowing lines typical of the ordinary cast aluminum case. Its nickel finish absolutely does not discolor light colored rugs or fabrics—a decided advantage over the aluminum case. The pressed steel case permits interior surfaces being made absolutely smooth, thus doing away with any possibility of lint or dirt clinging to these surfaces.



The vacuum cleaner is equipped with an air-cooled motor whose air-cooling system is unique. The air is drawn in through the top of the motor housing, passes through the armature and out at the lower edge of housing; this keeps the contact brushes free from dirt, eliminates lubricating troubles, assures ease of operation, and lengthens life of the cleaner.

Other notable features mentioned are; large fan made of pressed steel; pear-shaped handle grip fits palm of hand, and locking device on handle keeps it in any desired position; self-adjusting, stationary brush; and adjustable rear roller make it an easy matter to keep suction nozzle at proper distance from nap of carpet or bare floor. The floor wheels, being all rubber tired, can not mar the highest polished surfaces. The double-lined dust-bag is quickly and easily removable for emptying. A set of extra attachments is furnished at slight additional cost, making the cleaner adaptable to practically every house-cleaning operation.

The new cleaner received a great deal of National and local newspaper publicity during the week of July 3rd to 8th, when housewives were given an opportunity to purchase at a saving of $5.50. The cleaner regularly retails at $25.00.

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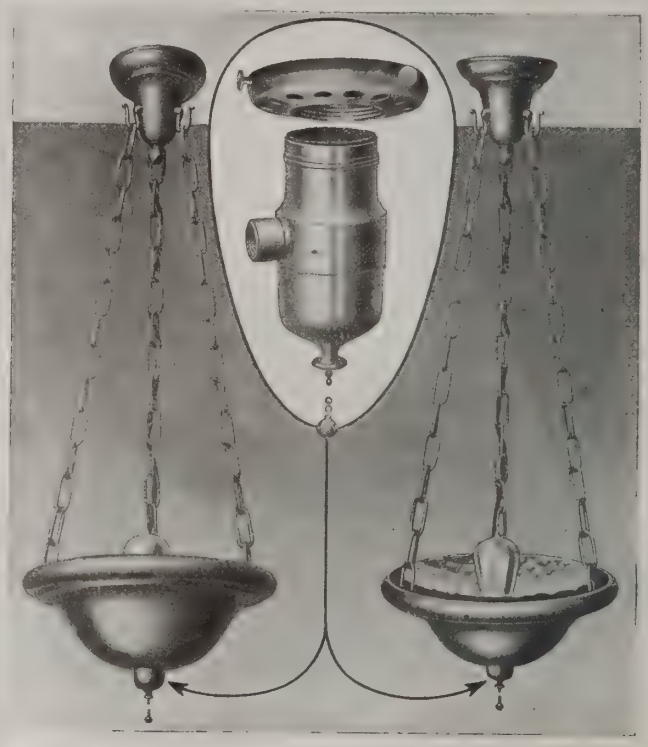
Pull-Chain Socket for Indirect Fixtures

The advantages of indirect lighting for certain places are generally conceded—in fact this method of illumination has become so desirable that many fixtures of other and older types are being discarded. It often happens, however, that the wiring as originally done has not provided for wall switches and heretofore most indirect fixtures did not permit of pull-socket or button switches. In this connection an interesting innovation is the new socket illustrated herewith.



As will be noted from the illustration, this socket fits snugly into the bottom of the bowl and protrudes through it just enough to enhance the artistic effect. The socket has the threaded bead upon which any diameter of Uno shade holder can be readily mounted. The pull chain hanging only the necessary length below the fixture provides a most convenient form of local control and at the same time does not mar the general artistic effect of the design of the fixture.

This same style of socket can also be used on a side wall fixture by attaching it directly to a brass nipple extending from the outlet—the length of this nipple being governed entirely by the dimensions of the canopy and shade holder used.

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A revised discount sheet applying to prices given in their catalog has been sent out by the Cutler Hammer Manufacturing Company, Milwaukee, Wis., owing to the increase in the cost of materials This discount sheet shows a general rise in prices of approximately 10 per cent. For a period of thirty days from June 12, 1916, however, bonafide outstanding quotations which have been made prior to that date will be protected.

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New offices have been established in the Woolworth Building, New York City, by the United Battery Corporation. The executive offices have been separated from the factory and the manufacturing facilities have been materially increased, it was announced by the company.

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The executive departments of the Western Electric Company at New York were recently moved from 463 West Street to new offices in the Telephone & Telegraph Building at 195 Broadway. The move was made necessary by the steady growth of the company's engineering departments, which will occupy the space that has been vacated. The local New York distributing department and the engineering and patent departments remain at 463 West Street.

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

"No Spark" Carbon Brushes manufactured by the Calebaugh Self-Lubricating Carbon Co., of Philadelphia, are receiving very complimentary opinions from their users.

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"One Hundred Condulet Suggestions" is the title of the 112 page catalog recently published to which attention is directed by a folder issued by the Crouse Hinds Company, Syracuse, N. Y.

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Various types of **air compressors and stationary type vacuum-cleaning systems** are described in a large general catalog which has just been issued by the Blaisdell Machinery Company, Bradford, Pa.

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The Crocker-Wheeler Company, of Ampere, N. J., have prepared a four-page folder descriptive of their nine-inch fans. Space is provided on the first page for the dealer's imprint.

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One-half and one-ton hoists are described in Bulletin 48906 issued by Sprague Electric Works, New York City. These hoists run on a single girder-rail, and make a valuable auxiliary for traveling cranes. Numerous other uses are also illustrated.

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"Chelten" Electric Specialties are described in a booklet issued by the Chelten Electric Company, of Philadelphia. Push-button switches, standard and special switch plates, receptacles, plugs, indicating receptacles and fuses are described.

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Treveling Water Screens are described in a booklet just issued by the manufacturers, the Chain Belt Company of Milwaukee, Wis. These screens are used for removing refuse from intake-water, or from factory-waste water. An installation at the Northwest Station of the Commonwealth Edison Co., Chicago, is illustrated.

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Portable direct-reading bond testers for electric railways and other places are shown in a circular just issued by Roller-Smith Company, New York City. A new contact device, shown in the accompanying cut, is for making contact with grooved rails. The contacts are broken bits of hacksaw blade, which cut through the film of oxide on the surface of the rail. Portable direct-reading ohmmeters made by the same company are described in another folder. These instruments, on account of their low price and ease of manipulation, are particularly suitable for the use of smaller power plants for fault-location work.

"Duro" Systems for Residence Water Supply where electric power is available are described in Bulletins 6 and 7 by the Burnett-Larsh Mfg. Co., of Dayton, Ohio.

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"Beaver" Die Stocks and Pipe Cutters are shown in a booklet issued by the Borden Company of Warren, Ohio. The operation of the company's "square-end" cutters is illustrated.

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Pivot Bucket Conveyors are illustrated in Catalogue 15-4 of the C. W. Hunt Company, 61 Broadway, New York City. The same firm has also issued recently Catalogue 15-3 describing coal and ash gates.

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Information on the **Model No. 5 cylinder type electric washing machine** is contained in an illustrated catalog recently issued by the Crystal Washing Machine Company, Detroit, Mich.

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"How to Design Effective Lighting" is Number 6 in the Westinghouse Lamp Company's Salesman's Handbook Series. It gives a number of practical points in what to seek and what to avoid in the design of illumination installations.

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Exempler Campaign Fixture Sets is the title of a catalog issued by Pettingell Andrews Company, Pearl Street and Atlantic Avenue, Boston, Mass., which contains information on ornamental lighting fixtures.

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Solderless Electrical Connectors made by the Frankel Connector Co., 117 Hudson St., New York, are shown in great variety in a booklet sent out by the makers. Included are Frankel sparkplugs and the well-known Frankel test-connectors.

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The George Cutter Co., of South Bend, Ind., has issued is General Catalogue No. 14, listing its line of lighting fixtures and wiring devices. These include street lighting equipment, pole line material, panel boards and cabinets, switchboards, cut-out boxes and "Cutter" toggle bolts.

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The Wm. B. Scaife & Sons Company, Pittsburgh, Pa., have issued catalogues of their high-pressure tanks, copper-brazed, pneumatic water-supply tanks, hot-water storage tanks, gasoline storage outfits, the various parts of which are included in the approved list of fire appliances issued by the National Board of Fire Underwriters; motor boat tanks and horizontal and vertical galvanized range boilers.

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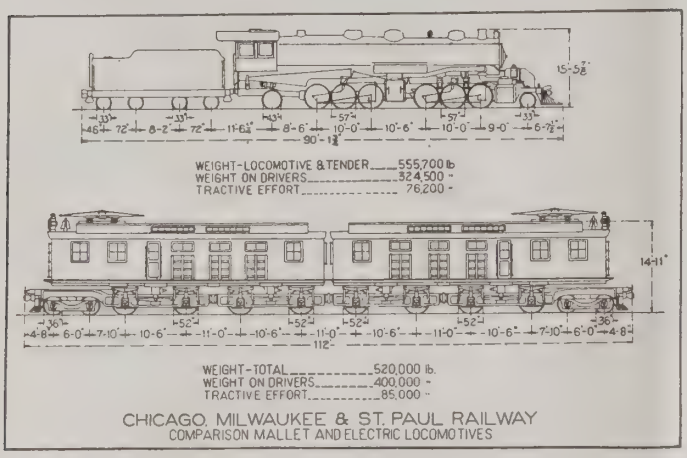
Lightning arresters of various types designed for particular classes of service are covered in quite a complete manner in the recent publication, Catalogue I-A, issued by the Westinghouse Electric & Mfg. Company, entitled "Westinghouse Lightning Arresters." A discussion of lightning and its effects is given, followed by a discussion of the application of lightning arresters for the protection of various classes of apparatus, and types to be used with each. Following this is given a general description, accompanied by illustrations of the different types of lightning arresters and accessories manufactured by this company.

Electrification of the Chicago, Milwaukee and St. Paul Railway

(*Continued from page 28*)

Switching Locomotives

The switching locomotives are of the swivel truck type, weighing 70 tons each, and equipped with four geared motors. A single pantograph of construction similar to that used on the main line locomotives is mounted on the cab and in other ways the locomotives represent the standard construction commonly used with the steeple cab type of switcher. The motors (known as Type GE-255) are of box frame, commutating-pole, single-geared type designed for 1500 volts with an insulation of 3,000 volts to the ground. Many of the switching locomotive parts are interchangeable with those used on the main line locomotives; for example, the air compressors, small switches, headlights and cab heaters.



Other data on the switching locomotives are:

Length inside knuckles	40 ft.
Height over cab	13 ft. 10 in.
Height—trolley down	16 ft. 8 in.
Width overall	10 ft.
Total wheel base	29 ft. 4 in.
Rigid wheel base	8 ft.
Diameter of wheels	40 in.
Weight—locomotive complete	140,000 lb.
Weight per driving axle	35,000 lb.
One hour rating of locomotive	542 h.p.
Tractive effort at one hour rating	18,400 lb.
Speed at this rating	12 m.p.h.
Continuous tractive effort	13,480 lb.
Speed at continuous rating	13.2 m.p.h.
Tractive effort 30%	42,000 lb.

Regeneration

Regeneration, or the recovery of energy on the descending grades, by reversing the function of the electric motors reduces the cost of operation and furnishes a ready solution of the difficult braking problem. On the long sustained grades encountered in crossing the three mountain ranges, great skill is required to handle either the heavy and varied freight or the high speed passenger trains with the usual air brakes. The entire energy of the descending train must be dissipated by the friction of the brake shoes on the wheels, and it approximates 3500 kw. or 4700 h.p. for a 2500 ton train running at 17 miles per hour on a two per cent. grade, thus explaining why brake shoes frequently become red-hot and other serious damage is done.

With regenerative braking, the motors become generators which absorb the energy of the descending train and convert it into electricity, thus restricting the train to a safe speed down the grade and at the same time returning electric power to the trolley for use by other trains. The strain on draw bars and couplings is reduced to a minimum since the entire train is bunched behind the locomotive and held to a uniform speed. The electric-braking mechanism automatically controls the speed by regulating the amount to the periodical slowing down and speeding up of a train controlled by air brakes.

The usual speed of the electrically hauled train is 15 miles per hour ascending and 17 miles per hour descending the maximum grade, but half these speeds can easily be maintained with series connections of the motors should conditions require it.

An 82-car Freight Train Weighing 2680 tons

In case there are no other trains between the substations to absorb the power generated by a descending train, this power passes through the substation machinery, is converted from direct to alternating current and fed into the distribution system connecting all substations. The Power Company's lines are so extensive and the load of such a diversified character that any surplus power returned by regenerating locomotives can readily be absorbed by the system; credit is given for all energy returned.

Electric locomotion has been adopted by the Chicago Milwaukee & St. Paul Railway as " a newer. better foundation on which builders shall rear the structure of railroading to undreamed-of-efficiency and comfort." The enterprise has been undertaken with the expectation of effecting a sufficient reduction in the cost of operation to return an attractive percentage on the investment required, as well as to benefit by all the operating advantages of electric locomotives. According to statements made by the railroad officials, about $12,000,000.00 will be expended, and with the work more than half completed there is every reason to believe that the cost of construction will come inside the estimates.

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Electrical Fathers---Lord Kelvin

(*Continued from page 34*)

The demand for his apparatus led to the formation of a partnership with the university instrument-maker, under the name of Kelvin & James White, Ltd. Much excellent material was turned out by this firm, among its products being some of the very earliest recording volt-meters and watt-meters.

We have seen in earlier papers of this series how versatile were many of the men of science of an older generation. Sir William Thomson showed in himself a fine example of this ability to engage in widely different fields of endeavor and always with distinction. One of his earliest interests was in the subject of heat, and here he showed that wish to consider problems from the viewpoint of energy. There was no absolute scale of temperature, and to create one Thomson started from the theory that the heat reected in a perfect engine in inversely proportional to the absolute internal temperature of the working agent. From this he deduced the location of the absolute zero, with reference to such a point as the temperature of melting ice. His value coincides very nearly with other values determined in many different ways.

Lately it has been proposed to recognize this work by naming the scale which has its beginning that absolute zero the "Kelvin" scale.

To an unusual degree Thomson had the happy ability of being able to put scientific concepts into popular language. One famous expression of this sort was that if a mass of water the size of a (British) football should be magnified into a sphere the size of the earth, the molecules would be larger than cricket-balls, though probably not so large as foot-balls. His interest in geology led him to formulate a theory as to the age of the earth, and to predict the probable amount of coal which might be available for future generations. Toward the end of his life he withdrew from the earlier position in which he had attempted to explain by means of kinetics the fundamental problems of matter and force. No conclusion in these matters has yet been reached by scientists, but we may be very sure that his work will always command respect.

The honors which were heaped upon Sir William Thomson have been without parallel in the history of science. In 1892 he was created a Peer of the Realm, with the title of Baron Kelvin. His own sovereign conferred on him as well a Privy Councellorship, the Grand Cross of the victorian Order of Merit. He was also an officer of the Legion of Honor of France and a Knight of the Prussian "Ordre Pour Le Mérite." Three times he was elected president of the Institution of Electrical Engineers and the other offices he held, and the degrees conferred on him would fill a column. Best of all, his lovable personality and warm heart brought him troops of friends and when on December 17, 1907, the cables carried the news of their master's death, all the world of science mourned.

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Book Reviews

THE ENGINEER IN WAR, by P. S. Bond. 187 pp. New York: McGraw-Hill Book Co.: $1.50.

With the National Guards of many States being mobilized, there is unusual interest in all things pertaining to the military art. Major Bond's book, while addressed primarily to civil engineers and contractors, will be of value to any man whose inclination is toward the engineering side of military operations. While it does not pretend to be exhaustive, it covers the field in a very complete manner, being thus of value to the busy man who wants a comprehensive survey of what is to be known concerning military engineering. Every man who expects to fight for his country at some time should read this volume with care; if his inclination is to become more fully informed, the bibliography at the end will guide him to the best sources for what he seeks.

Technical readers cannot but be impressed with the often-emphasized need for speed, above all other considerations. The conscientious constructor in peaceful life cannot tolerate "short-cuts" which may weaken the finished work. Major Bond makes it clear that military works are of the most ephemeral character, and that in the presence of the enemy, time is of the essence. War moves are made rapidly, and the volunteer engineer must adapt his "rules of practice" with that in view.

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EXPORTERS' ENCYCLOPEDIA, 1916 Edition. New York: Exporters' Encyclopedia Company: $7.50.

This volume is full of information for the exporter. Its principal section contains a brief description of the area, population, commerce, etc., of each country in the world, with a list of the points to which through bills of lading are issued, the banks which collect shippers' drafts the shiping routes from New York, and their regulations. There is also information on postal rates and regulations, the preparation of shipping papers, cable rates, tables for the conversion of foreign money, weights, and measures and many other items make this book well-nigh invaluable. The subscription price includes a monthly bulletin of corrections and the *"Exporters' Review"* for one year.

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A HANDBOOK ON INCANDESCENT LAMP ILLUMINATION. Harrison, N. J.: Edison Lamp Works of General Electric Co.: 75 cents.

For so small a book (2¾ by 5⅝ inches), the amount of information which this handbook holds is surprising. In 211 pages it covers the incandescent lighting field so explicitly that any one can find the solution for his particular problem, or hints from which he can readily work it out. Section 1 treats of lamps and their characteristics; Section 2 of illumination terms and calculations; Section 3 of lighting practice, and Section 4 of electric circuits and apparatus. The book should be the pocket companion of everyone who has to do with the design or selection of illuminants.

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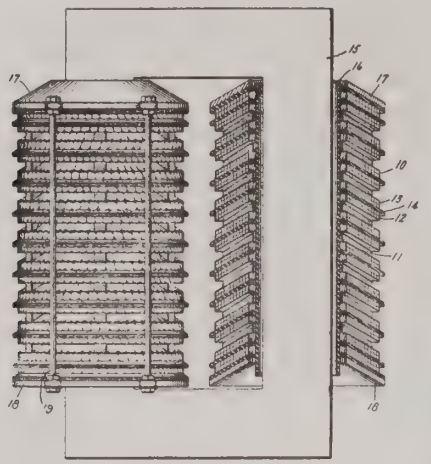
The Utah Copper Company and its allied interests have placed orders with the Westinghouse Electric & Mfg. Co., of East Pittsburgh, Pa., for 211 vertical agitator motors for separating copper from low grade ore and trailings by the use of the flotation system.

Recent Electrical Patents of Interest

Compiled by Thomas Howe

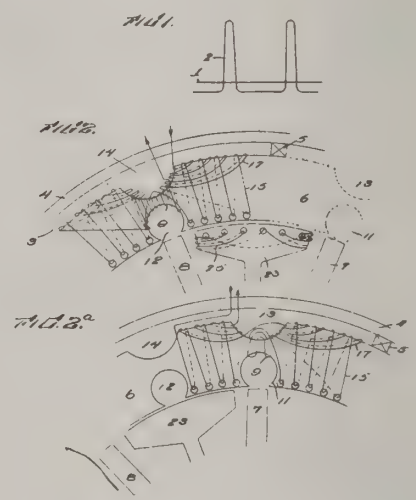
Electrical Winding.—Heating is one of the most difficult problems to be dealt with in connection with windings of transformers, etc. Every advance which facilitates ventilation of such windings is of great practical importance. A common form of winding is one built up of disk coils, and to aid in keeping them cool, they are separated to provide spaces between them for ventilation. The cooling fluid flows

Fig 1.



over the outer surface and through a central axial ventilating space. Previously the common practice was to make the coils flat so that the spaces between them were perpendicular to the axis. In such a construction there is a tendency of the air between the coils to remain stationary. According to an invention to William J. Wooldridge, of Pittsfield, Mass, these coils are dished and then assembled substantially like the flat disk coils. A central space is provided through the winding in the direction of the axis so that the cooling fluid may circulate over both the inside and outside surfaces of the winding. The inclination of the spaces between the coils induces a circulation of fluid so that the coils are on all sides subjected to moving currents of air and the apparatus is satisfactorily ventilated. The arrangement in detail is clearly shown in the cut. Patent No. 1,183,616.

Dynamo Electric Machine.—In the modern applications of electricity it is in many cases desirable to generate alternating currents having unequal positive and negative values. Currents of this type have found many useful applications. For instance, when applied to a circuit containing apparatus for striking an arc, the arc electrodes may be so arranged that the high voltage positive waves will be permitted to pass while preventing the passage of the low voltage negative waves so that an intermittent current is obtained. Unidirectional currents are readily obtained from such unequal current waves by the use of asymmetric cells, vapor tubes, etc. In Fig. 1 is shown a current of this character in which abscissae represent intervals of time and ordinates instantaneous voltage values. It will be seen that the positive values are much greater than the negative but of shorter duration, In a patent recently granted to Mr. Jean L. Farney, Zevrich, Switzerland, is described a generator for producing currents of the character indicated very efficiently. The windings of the machine are so related that the portions thereof mutually react to nullify the reactance so that a larger output than otherwise is produced. The general scheme of the generator may be understood from Fig. 2, which shows a portion of a laminated ring armature core 6 in a frame 4, being spaced therefrom by non-magnetic blocks 5, leaving an air gap 3. The core is provided with radially extending grooves 11-13, 12-14, equal to or a multiple of the narrow poles 7 and 8 and equally spaced around the armature core. The poles 7 and 8 are one polarity and the intermediate broad poles 23 and 24 are of the opposite polarity. The passage of the narrow poles 7 and 8 past the grooves containing coils 9, causes a sudden rise in the current wave, however, unless the reactance of the coils were nullified because the choking affect would very materially limit the current. On each side of coil 9 therefore are coils 15 which nullify the reactance of the coil 9. Either of the coils 9 or 15 may be short circuited, the coil 9 being so shown in Fig. 2a. In operation, suppose the coil 9 to be tranversed by the maximum flux. Then if the rotor is moved to a no-flux position, a current will be generated in coil 9 which will so affect the flux in the two sections of coil 15 as to cause to be generated therein a voltage corresponding to the first half of the part 2 of the wave shown in Fig. 1. During the next period of movement



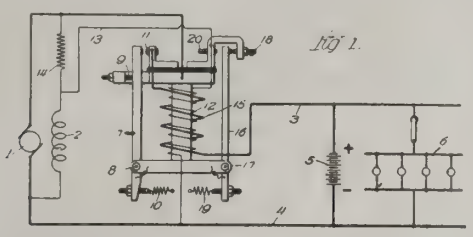
of the rotor to the position where maximum flux traverses the coil 9 in the opposite direction, the second half of part 2 of the wave is similarly generted. Subsequently the flux emanating from the rotor and traversing the coil 9 generates the current therein which affects the coil 15 to generate the current corresponding to that below the base line in Fig. 1.

To oppose the tendency of any inductive flux to close through the pole face, short circuited coils 25 carried by the broad poles 23 may by provided as shown in Fig. 2.

The patent shows various modifications of the scheme. Patent No. 1,183,286.

Automatic Electric Regulator.—In numerous systems such as in lighting and ignition systems of automobiles and axle driven car lighting systems, a variable speed generator is employed in conjunction with a storage battery and suitable switch apparatus to prevent the storage battery from discharging back into the generator, to regulate the voltage of the generator, etc. In the voltage regulation of generators the vibratory contact in shunt with the field resistance has been found to be very satisfactory. In a recent patent granted to William A. Turbayne, of Buffalo, N. Y., a compact regulator is provided comprising a unitary structure having an automatic electromagnetic switch for disconnecting the generator from the system, and also a vibratory contact regulator for the generator voltage.

The arrangement is shown quite clearly in the cut. The generator shunt field 2 has in series with it the resistance 14. The unitary structure comprising the automatic disconnecting switch and the vibratory contact includes a current coil 15 and a voltage coil 12. These are comulative so long as current flows from the generator to line, but when the current is reversed it tends to decrease the predominating influnce of the voltage coil. The spring 10 tends to hold the contacts 11 open. Upon sufficient decrease in magnetism



these contacts open, disconnecting the generator from line. Obviously this will occur when the voltage of the generator is very low so that there is a decrease in the holding power of the voltage coil and this is still further decreased by the opposition of the current coil. The vibratory contact 16 normally closes the shunt about the field resistance 14 under the influence of the spring 19. When, however, the voltage of the generator rises abnormally this contact is opened and by its vibration maintains the generator voltage at a proper value. Patent No. 1,183,411.

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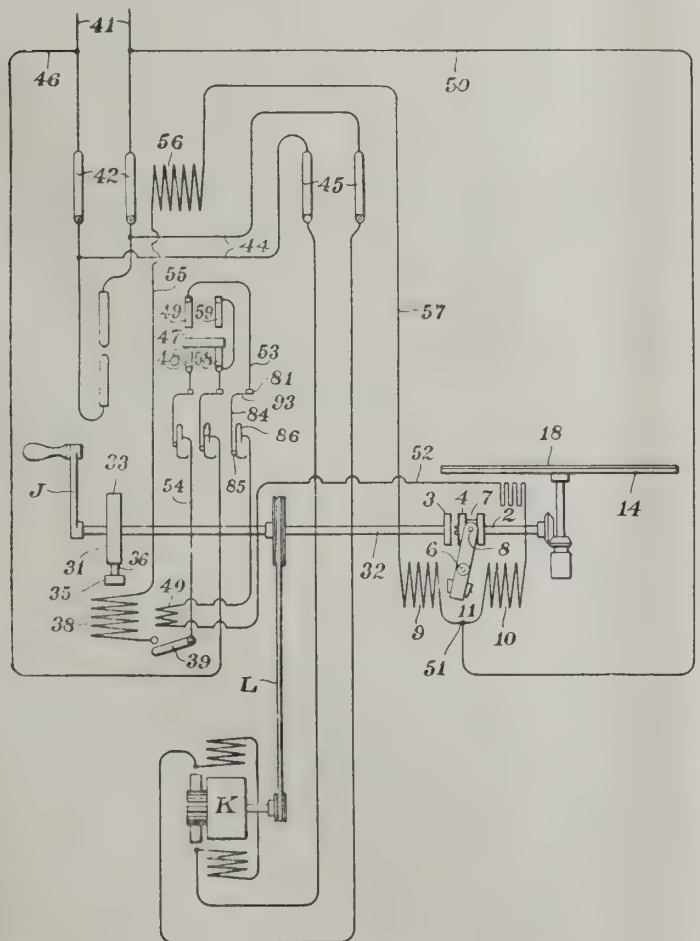
A patent has been issued to S. W. Greene, 135 Welham St., New York City, for a means of coupling a talking-machine with a moving-picture machine for the synchronizing of the pictures and the sound-record. Referring to the diagram, the method of operation is as follows:

When the main switch 42 is closed, the projecting arc is start-



ed and the motor K of the projection machine begins to draw the film through the guides in the usual way. The talking-machine needle has been set on a point marked on the record.

At the exact point on the film which corresponds to this spot there is an opening when a finger on 47 enters. The film pulls the finger downward about 45 degrees, shifting the bridging member 47 from contact 48-58 to 49-59, thereafter the finger trails against the film in a downward position. This closes a return circuit for the record shunt supply wire 46 through contact 59, bridge 47, contact 49 wire 53, brake switch magnet 40, wire 52, to branch point 51, and back to line by 50. This throws the clutch and starts the phonograph into instant operation in synchronism with the pictures.

The closing of the switch 39, as a result of the energizing of magnet 40, has completed another return circuit to branch point 51 except for the break between contacts 48-58 left open by the shifting of switch 47. If the film breaks or runs out, the finger on 47 is no longer held down by it, and swings bridge 47, back to contacts 48-58. This breaks the circuit through clutch closing magnet 10, and completes the other section circuit from contact 58, through bridging switch 47, contact 48, wire 54, switch 39, brake magnet 38 main switch throughout magnet 56, wire 57 and clutch opening magnet 9. This accomplishes three results. It applies the brake to stop the projector, disconnects the drive power from the phonograph, and opens the main switch 42, putting out arc light and deenergizing all magnets and circuits, including those of motor K.

The apparatus is readily attached to any standard projecting machine without cutting or drilling, and does not interfere with its operation for regular moving pictures. The automatic safety stop feature applies equally to any kind of film.

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Electrical Equipment of the William Penn Hotel

(*Concluded from page 29*)

gether by cross connecting switches so that either set may be charged from either alternating or direct current systems, and so that the load may be carried by either set alone, thereby insuring, in a high degree, the continuity of service so necessary in an installation of this kind.

William Penn Power Consumption

The total connected load of the hotel is over 1550 kw. Included in this are more than 20,000 Mayda lamps of from 10 to 250 watts; together with miscellaneous small motors they make a connected load on the alternating current mains of 800 k. w. The direct current system serves about 1000 h-p. of motors at 220 volts. The normal "five-minute maximum demand" is 560 kw. for power and 600 kw. for lighting; the maximum coincident demand is about 1100 kw. If the first two months of operation are a fair indication of what may be expected, the annual consumption will be 2,700,000 kw.hr. for power and 900,000 kw.hr. for lighting. About 75,000,000 pounds of steam will be required per annum.

What the William Penn Hotel Cost

As it stands to-day, the William Penn Hotel represents an investment of $6,500,000. The ground alone is valued at $2,700,000; th ebuilding and machinery cost $3,000,000 and the furnishings added $800,000. The architects were Janssen & Abbott, of Pittsburgh, and the mechanical engineering was done by Clyde R. Place, of New York City. Wiring throughout the building, save for

telephones was installed by J. Livingston & Company, of New York. Wire for light and power was furnished by the Standard Underground Cable Company.

Acknowledgement is made to J. Irvin Alexander of the Duquesne Light Company for detailed figures and photographs of power applications.—The Author.

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Among the Associations

At a recent meeting of the Radio Club of America held at Columbia University, New York City, Mr. Paul F. Godley presented a paper on "Applications of the Audion" in which were discussed important considerations in design, construction and operation of apparatus used with the audion as a detector for short or long wave reception, as an amplifier, and as a generator of high-frequency oscillations to be used both in the reception of undamped waves, and as a source of power for radiotelegraphic and radiotelephonic transmission. Complete diagrams, data and specifications were given.

The principal subject of discussion at the meeting of the Electrical Supply Jobbers' Association held June 7-9 at Hot Springs, Va, was the cost of doing business and the need for accurate knowledge, not only of the costs for the business as a whole, but for particular lines, in order to eliminate unprofitable ones and secure better treatment from manufacturers. The consensus of opinion was that nothing need be feared from concentric wiring as the increase in "prospects" for wiring of old houses and the resultant sale of appliances would more than offset any possible loss.

The following offiecrs were elected at the annual meeting of the New York Electrical Society, held at the Hotel McAlpin, on June 14: President, Putnam A. Bates; vice-presidents, C. E. Scribner, Edwin B. Katte, and W. C. Whiston; secretary, George H. Guy; treasurer, Thomas F. Honahan. A paper by Theodore W. Case, "A New Way of Converting Light into Electrical Energy" was presented. The society, one of the oldest in the country, has a membership of more than 700.

The Advancement Club of the Red River Power Company, one of the Northern States Power Company subsidiaries, located at Grand Forks, N. D., has organized a class for electrical work composed of twelve employes which will be taught by Mr. Radsliff, chief engineer of the company. Each member has purchased his own books and the enthusiastic reception which has greeted this educational effort has led to the formation of classes in other departments of the work.

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Coming Conventions

Public Utilities Association of West Virginia. Annual convention, Parkersburg, W. Va., July 12-14. Secretary, W. C. Davisson, Charleston, W. Va.

Ohio Electric Light Association. Annual convention, Cedar Point, O., July 18-21. Secretary, D. L. Gaskill, Greenville, O.

National Electrical Contractors' Association of the United States. Annual convention, Hotel McAlpin, New York City, July 19-22. Secretary, G. H. Duffield, 41 Martin Building, Utica, N. Y.

International Association of Municipal Electricians. Annual convention, Baltimore, Md., August 22-25. Secretary, C. R. George, Houston, Tex.

Pennsylvania Electric Association. Annual convention, Eagles Mere, Pa., September 5-8. Secretary, H. N. Muller, Duquesne Light Company, Pittsburgh, Pa.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., September 18-21. Secretary, C. A. Littlefield, Irving Place and Fifteenth street, New York City.

Association of Iron and Steel Electrical Engineers. Annual convention, Chicago, Ill., September 18-22. Secretary, W. O. Oschmann, Oliver Steel & Foundry Company, Pittsburgh, Pa.

Personals

Mr. C. D. Fawcett, formerly instructor in the Electrical Engineering Department of the University of Pennsylvania, has been appointed assistant secretary of the Illuminating Engineering Society, vice Mr. Joseph Langan, resigned.

Mr. H. E. Dawson, who for the past five years has been with the Edison Lamp Works of General Electric Company, Harrison, N. J., in advertising and general campaign work, has recently accepted the position of contract agent for the Metropolitan Electric Company, Reading, Pa.

Mr. George H. Graves has been appointed head of the electrical department of the Sanitary District of Chicago, following the resignation of Edward B. Ellicott. Mr. Graves was formerly assistant electrical engineer.

James A. Green has been appointed vice-president and general manager of the Northern Idaho & Montana Power Co., and in this capacity will co-operate with Elmer Dover, vice-president of H. M. Byllesby & Co., in charge of Pacific Coast properties and president of the Northern Idaho & Montana Power and Oregon Power companies, in the operation of the Byllesby properties in Montana, Idaho, Oregon and Washington.

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Obituary

William Tell La Roche, formerly general superintendent of plant of the Bell Telephone Company of Pennsylvania, died on June 8th after an illness of several weeks. Mr. La Roche entered the telephone field in 1887, at the age of 21, serving first as switchboard operator, lineman and manager of small exchanges in central Pennsylvania. Coming to Philadelphia in 1891, Mr. La Roche assisted in the development of the first private branch exchange and the initial installation of common-battery service. In 1898 he was appointed district inspector, with charge of maintenance through the city. Later his territory was extended to include the southern half of New Jersey. His work here included the development of routine maintenance tests in order to anticipate trouble. With his appointment as division plant superintendent in 1906, Mr. La Roche took charge of outside construction and maintenance as well as of subscribers' and central-office equipment. Many of the present supervisory cost-reports, which now tell so much about the efficiency of various districts, were originated by him.

The exceptional ability evidenced by Mr. La Roche in each position held by him from inspector to plant superintendent resulted in his appointment as general superintendent of plant in March of 1913, he thus becoming head of a department which he has been so instrumental in building up to its high standard of efficiency and personnel. One of the most typical episodes in his life was Mr. La Roche's comment—made to a friend—upon the announcement of his appointment to this high office, when he said: "You know, I am glad to have this promotion, not so much for myself as for the men down the line, because it shows them how a fellow may climb up from the bottom."

Silvanus P. Thompson, electrical engineer, teacher and author, died in London on June 13. He was born in 1851 and received his B. Sc. from London University in 1875. Since 1885 he was Professor of Physics in the City and Guilds Technical College at Finsbury. He was well known as a writer on electrical and scientific subjects, being author of the classical "Dynamo-electric Machinery;" The Electromagnet," "Polyphase Electric Currents and Motors," and other works. His affiliations with scientific societies were numerous and included honorary membership in the American Institute of Electrical Engineers.

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The Hamilton, Mo., Electric Light Co contemplates the extension of its system to Breckinridge.

Review of the Month

A Complete Record of Important News Edited for Busy Readers

Improvements and extensions to the Dale Light, Heat & Power Company plant, of Johnstown, Pa., are contemplated.

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Work has begun on the installation of an electric-lighting system in Falmouth, Pa. Energy will be supplied by the York Haven Water & Power Company.

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Extensions in the Fresno District that will cost approximately $75,000 will be under way in a short time, it was announced by the San Joaquin Light & Power Company, Fresno, Cal. About 65 miles of new lines will be put in.

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The Otter Tail Power Company, of Fergus Falls, Minn., is planning to erect transmission lines to Perham and Deer Creek, Minn., through Underwood, Battle Creek, Clitherall and Henning, and is negotiating for the purchase of the municipal electric lighting plant at Perham, Minn.

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The Nashua Light, Heat & Power Company is to receive a contract by the Central Maine Power Company, of Augusta, to erect an electric transmission from Bath to Gardiner, a distance of 30 miles.

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Plans for the installation of an electric lighting system in Palco, Kan., are being considered. Electricity to operate the system will probably be secured from Plainville. The cost will be from $10,000 to $15,000.

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The Rahway Valley Railroad Company, Summit, N. J., which operates a railroad from Summit to Aldene, plans to equip its line for electrical operation. J. S. Caldwell, of Kenilworth, N. J., is general manager.

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To care for the largely increased demands for current, the Trumbull Public Service Co. of Warren, Ohio, one of the Doherty properties, will install a 6,000-kw. units mechanical coal-handling apparatus and automatic stokers for burning slack coal.

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The National Tube Company, of Lorain, Ohio, has announced that a new power house will be built and coal gas will be used to furnish power for the plant. The company is erecting a battery of by-product coke ovens for the production of coke for the blast furnaces.

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A high tension transmission line will be erected from the plant of the American Gas & Electric Company at Beech Bottom, W. Va., to Washington, Pa., by the Brooke Electric Company, of Warwood, W. Va., who have been granted a permit by the County Commissioners.

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In addition to the new power plant of the Holton Power Company, Calexico, Cal., near Holtville, which will be completed in 30 days, the company will have its gas and electric reserve plants at El Contro completely renovated and remodeled, greatly improving its equipment and service in the valley.

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A new set of public utility safety bulletins will be issued by the National Safety Council. Fourteen of the sixteen bulletins which constitute the advance set, show probable causes of electrial accidents. These bulletins will be issued at the rate of one a week.

All employes of H. M. Byllesby & Company who are members of the National Guard will receive full pay during their absence and their positions will be held for them.

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The capacity of the Municipal Electric Lighting Plant, Kinston, N. C., has been quadrupled and considerable reserve power for manufacturing purposes is now available—extensions and improvements costing approximately $40,000.

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A laundry plant across the river from the Grand Trunk Railway Station is under consideration by the Trojan Laundry Company, of Flint, Mich., recently incorporated with a capital stock of $100,000. Electrically operated machinery will be used.

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Mr. Andrew S. Merrill, of Bath, Me., has been awarded a contract by the Central Maine Power Company, of Augusta, to erect an electric transmission from Bath to Gardiner, a distance of 30 miles.

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The Fiscal Court of Louisville, Ky., has appropriated $3,000 for limited repairs to the light and heating plant located at the county jail. A new plant, it is stated, will be necessary next year. Brinton B. Davis is county architect.

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The Electric Storage Battery Company, of Philadelphia, Pa., will erect a brick and concrete manufacturing building, 146 ft. by 115 ft. and seven stories high on Nineteenth Street south of Allegheny Ave.

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The transmission line of the Appalachian Power Company, of Bluefield, W. Va., is being extended to the mines of the Clinchfield Coal Corporation at Dante, Va., a distance of 80 miles and to points intermediate.

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For the construction of the proposed electric interurban railway between Houston and San Antonio, Texas, the Houston, Richmond & Western Traction Company are placing contracts for material. The contract for electric power station will be awarded soon. E. Kennedy is president.

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An option on the plant of the Harlowton Light & Water Company, of Harlowton, Mont., is reported to have been obtained by the Montana Power Company of Butte, Mont. If the deal goes through the power company will build a substation here and will establish a 24-hr. service.

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$12,300 will be expended by the City Council of Moose Jaw, Sask., for improvements to the Municipal Electric Light Plant which will include extension of transmission lines, replacing old lines with heavier wire and improvements to equipment in power house.

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In order to construct an electrical transmission line from a point in Inyo County to a point in Los Angeles County, Cal., the city attorney of Los Angeles has been authorized to institute proceedings in the Superior Court to acquire by condemnation a right of way over certain property.

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A high tension transmission line to the Irondyke and Homestead mines at Baker, Ore., is being erected by the Idaho-Oregon Power Company, of Boise, Ore., in order to supply electricity to operate machinery in the mines.

The large power plant for the National Tube Company, of Lorain, O., will be equipped with gas engines which will be supplied with gas from coke ovens now under construction. Construction work on the plant is now well underway.

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The Jefferson Construction Company, of Birmingham, Ala., has secured the contract for the foundation work for the new steam-power generating station at Lock 12. This plant will have a capacity of 20,000 kw.

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A direct-current plant will be constructed by the Village of Trenton Mo. An oil-engine direct-connected to a 25-kw. generator with a storage battery for reserve. Pole lines and a street lighting system will be installed. The engineers are Fairbanks, Morse & Co., of Omaha, Neb.

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According to H. D. Pattee, the promoter of the project, the Tulsa Interurban Railroad Company, Tulsa, Okla, has financed its proposed interurban electric railway that is to be built between Tulsa and Wagoner. The line will be 37 miles long and will run via Broken Arrow. The project involves the construction of an electric power station.

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The construction of an electric railway from St. Cloud, Fla., to Sanford, Dunnellon and Tampa, also through Volusia County to a point on the Atlantic Coast, covering a distance of about 300 miles, is contemplated by the Central Florida Interurban Railway Company which has applied for a charter. Carl E. Carlton and William S. Alyea are among the incorporators.

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Contracts for materials for the construction of the proposed interurban electric railway that is to run between San Antonio and Houston, Tex., are being placed by the Houston, Richmond & Western Traction Company, San Antonio, Tex. The contract for the construction of the electric power station will be awarded soon.

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The consolidation of the Bucks County Electric Company, of Newton, Pa., and the Doylestown, Pa., Electric Company into the Pennsylvania-New Jersey Power & Light Company with a capital stock of $100,000 has been approved by Governor Brumbaugh. Sidney L. Wright, of Philadelphia, Pa., is president of the new company and Gaylord Thompson, of Trenton, N. J., vice-president.

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The Nashua Light, Heat & Power Company is to receive a contract from the Mayor and Lighting Committee, of Nashua, N. H., for lighting the streets of the city, exclusive of the ornamental lighting system for a period of seven years. The 215 arc lamps now in use will be replaced with new lamps under the terms of the new contract and 140 additional lamps will be installed.

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As a result of the war, Ocos, Guatemala will lose its electric-lighting plant. About nine years ago the Kosmos liner "Sesostris" was beached near there, and the chief engineer arranged to supply the town with electricity, after it was decided not to refloat the ship. Now the demand for vessels has reached a point where it appears profitable to dig a canal and float the ship back to sea, says the *"Electrical Review"* (London).

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A bond of issue of $3,750,000 was authorized by the voters of Chicago for extensions to the city's street-lighting system, to include 5,800 new 600-c.p. and 25,400 new 100-c.p. incandescent lamps, a new 2,000-kw. generating station and three new substations. This is thought to provide for five years' growth.

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Work on the erection of a 33,000-volt electric transmission line by the Shirley Electric Company, Shirley, Mass., to Pepperell, a distance of 10 miles has begun. The company will soon start work on the construction of a transmission line from Pepperell to Hollis, N. H.

The system of the Lewisburg, Tenn., Light & Power Co. has been purchased by the Public Light & Power Co., of Chattanooga, Tenn., which will build a transmission line to connect Lewisburg with its system.

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Surveys are being made by the Fort Smith (Ark.) Light & Traction Co. for the extension of its Van Buren transmission system to the smelter of the Arkansas Zinc Co. and probably to Alma, Ark.

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The E. J. Cross Company, of Worcester, Mass., has been awarded the contract for the construction of a four story reinforced concrete building, 80 ft. by 100 ft. at Norwich, Conn., with a power house adjoining by the Winchester Woolen Company. The cost of the building is estimated at $90,000.

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The McMyler Interstate Company, of Cleveland, Ohio, has been awarded the contract for construction of a steam and electrically-controlled car-dumping machine and appurtenances at the yards of the Port Reading Company, Port Reading, N. J. The work includes a 100 ton car dumper, 600 hp. steam power plant and a vessel hauling machine.

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The Alabama Power Company, of Birmingham, Ala., has purchased the property of the Jasper Water, Light & Power Company, Jasper, Ala. The local plant will be closed down and power will be supplied from the substation at Magella, near Birmingham, and in case of emergency, from the steam plant to be built on Baker's Creek.

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Plans for a new office building for the Franklin Trust Company, Philadelphia, Pa., are being prepared by the Scofield Engineering Company, Commercial Trust Building, Philadelphia and De Armond, Ashmead & Bickley, architects, Philadelphia. There will be a twelve story office building with a power house across the alley in a separate building.

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The board of water commissioners of Dunkirk, N. Y., have retained Mr. Roy Husselman, an electrical engineer representing F. W. Ballard, of Cleveland, Ohio, to make a survey of the local electrical situation in order to find out whether or not it would be advisable for the city of Dunkirk to install new generating machinery in the municipal power plant or to buy power from the Niagara & Erie Power Company.

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The construction of a large manufacturing building 212 ft. by 105 ft. at Summer and C streets, South Boston, Mass., for the Western Electric Company is now under way. The building will be equipped with elevators, conveyors, electric light and power and mechanical appliances. The W. K. Kearns Company, of Boston, has the contract for the work, and George F. Shepard is architect.

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In order to connect the lines of the Bridgeton Electric Co., Bridgeton, N. J., and the Electric Company of New Jersey, a transmission line is being constructed. The new line will be 18 miles long, running from Bridgeton to Woodston via Deerfield, Shirley and Pittsgrove, and will supply electricity to residents along the lines as well as to the cities of Salem, Glassboro, Pitman, Woodbury, Woodstown and Mullica Hill.

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The expenditure of $42,000 for an electric light, water, and heating system has been authorized by the trustees of the University of North Carolina. Light and power will be furnished to the town of Chapel Hill also.

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The property of the old Iroquois Salt Company in Perry, N. Y., has been purchased by the Perry Electric Company. In order to supply electricity in Perry, Warsaw, Castile, Silver Springs and Gainesville, the two buildings on the site will be remodeled and used as a central power plant.

A new generating station near the present L Street Station is under consideration by the Boston Edison Company, Boston, Mass. The first unit will be a 30,000 kilovolt-ampere General Electric turbogenerator, 14,000 volts and running at 1,800 revolutions per minute. Excitation will be at 250 volts. This will be the first generator installed by the Edison Company for 14,000 volts and it will be its first horizontal machine. Four 1,230-horsepower Babcock & Wilcox cross-drum boilers, designed for 350 pounds working pressure, will be installed in connection. The plant is expected to be ready for operation in the fall of 1917.

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All steam consumers in Cleveland, Ohio, have been notified by the East Ohio Gas Company that arrangements must be made for fuel other than gas by Oct. 1, when their gas supply will be turned off. No explanation was made for this step other than that the first duty of the gas company is to the domestic consumers. About 2,000 shops of various kinds will be affected by this change.

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It is reported that H. E. Huntington, president of the Pacific Light and Power Corporation, of Los Angeles, has purchased the system of the Mount Whitney Power & Electric Company of Visalia, California. The territory served is a rich farming country, in which electricity is used liberally for irrigation pumps. The Mount Whitney Co. has four hydro-electric stations in the Sierras with a combined rating of 13,000 hp. and a steam plant of 10,000 hp. The property will be a particularly desirable acquisition for the Pacific Co., as its 150,000 volt transmission line crosses the territory served.

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An interesting application of electrolysis has been made to the destruction of insect life by Isadore Kitsee, of Philadelphia. Where the soil is to be treated, it is moistened with a saline solution, and a current of electricity is passed through it from buried electrodes. The gas generated will rid the soil of germs, uarvae and insects without injury to vegetation. When plants are to be treated, the solution is subjected to electrolysis, and while the gases are still in solution, it is sprayed in the usual manner.

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The maximum rate to residence customers has been reduced from 9 to 8.5 cents per kilowatt-hour by the Union Electric Light & Power Company, of St. Louis, Mo. The company announced last August that the maximum rate would be reduced from 10 to 9 cents a kilowatt-hour when the number of its customers reached 65,000, and a further reduction from 9 to 8.5 was promised when the number reached 70,000. When the number of customers reaches 75,000 the company promises a reduction to 8 cents. The company reduced its minimum rate last August from 6 to 3 cents per kilowatt-hour.

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In order to bring the Southern Power Company's lines into Gaffney, S. C., a representative of the company has been engaged in securing right of way. A site for a substation and right of way from Gaffney to Rutherford, N. C., has been secured. The transmission line will be erected by way of Forest City, Caroleen and Rutherfordton, and will furnish the mills at those placed with electrical energy for power and lighting. The Electric Manufacturing & Power Company at Gaston Shoals on Broad River has been furnished power to Gaffney for several years and the Southern Power Company's plant is located at the Ninety Nine Islands on Broad River, but several miles farther from Gaffney.

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A transmission line from Central City to Clarks, Nebraska, is being erected by the Central Power Company of Grand Island, which has been granted a 25 year franchise and awarded a contract for lighting the streets of the village and for furnishing electricity for pumping water for a period of ten years. The company is now installing a new distributing system in the village. When the new system is completed the municipal plant will be closed down and the generating equipment and material for distributing system disposed of by the village of Clarks. T. H. Fritts, of Grand Island, is vice-president of the company.

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The reservoir site, ditches and water rights of the Oro Electric Corporation in Humbug Valley, California, and along Yellow Creek to the north fork of the Feather River where the Oro company had acquired a site for a power plant, are said to have been purchased by the Great Western Power Company, Quincy, Cal. It is understood that the Great Western will develop a series of power plants, the ultimate construction cost of which will be approximately $25,000,000.

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The substitution of incandescent lamps for the present arch lamps and gas lamps now in use, is advocated by William F. Schwartz, street commissioner of Buffalo, N. Y. His plan is to make the change in the principal business streets, next the main arteries and then gradually to extend the zone of new lamps, the entire change to be made in perhaps five years.

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A new 2500-kw. General Electric turbo-generator with condenser, and a new ventilation system will be added to the equipment of the power plant of the Houghton Electric Light Company, of Houghton, Mich. The proposed improvements to the plant will include an addition 25 ft. by 48 ft. to the boiler house and installation of a 600-hp. boiler; the erection of a new smoke stack; the roof of the present boiler house will also be raised. The Stone & Webster Engineering Corporation, of Boston, Mass., has the contract for the work.

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A new $75,000,000 corporation, the Civic Investment & Industrial Company, has been formed to hold the stocks of the Montreal Light, Heat & Power Co. and the Cedar Rapids Power Co. The Montreal Co. operates, through subsidiaries, the central station electric and gas service of Montreal. Its capital obligations are $18,700,000 of stock and $10,713,000 of bonds. The Cedar Rapids Co. is principally engaged in hydro-electric power supply and has a capacity of 100,000 hp. The new corporation will be one of the largest of its kind in the world.

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Substantial increases in Minnesota manufacturing are shown by a preliminary statement of results of the census issued by the department of commerce. The report compares statistics for the year 1914 with 1909, and the various items show increases as follows:

Salaries, 42.9 per cent.; salaried employes, 23.6 per cent.; capital, 28.7 per cent.; wages, 23.2 per cent.; wage earners, 9.5 per cent.; value added by manufacture, 22.5 per cent.; value of products, 20.5 per cent.; materials, 19.6 per cent.; number of establishments, 7.4 per cent.

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A statement of earnings of the Utah Power & Light Company for the twelve months ended March 31, 1916, with a comparison for the previous twelve months' period, is as follows:

	1916	1915
Gross Earnings	$3,772,852	$2,392,619
Operating Expenses and Taxes	1,895,342	1,208,713
Net Earnings	1,877,510	1,183,906
Bond Interest and Discount	714,782	542,932
Other Interest (Net)	297,848	242,566
Balance	864,880	398,408

The above statement shows the earnings for the entire period of all properties now owned by Utah Power & Light Company and The Western Colorado Power Company, irrespective of the dates of their acquisition, and the earnings since January 1, 1915, of the electric light and power and gas properties owned by the Utah Light and Traction Company and now leased to the Utah Power & Light Company.

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The Metropolitan Water & Sewerage Board of Boston, Mass., proposes to construct a transmission line to connect

the Connecticut River Transmission Company with another generating station at the Ludbury dam which is nearing completion. The board operates a hydroelectric station at the Wachusett dam where the runoff is utilized to produce electrical energy which hitherto has been sold to the Connecticut River Transmission Company. The distance is 15.5 miles and the plan is to construct a two-circuit underground cable line 700 feet from the Wachusett station and a one-circuit overhead line on expanded steel truss poles the remainder of the distance. The estimated cost is $60,000. The object of th connection is to increase the reliability of the service and to enable energy to be delivered from either station, as most desirable.

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A 6,000-kilowatt Westinghouse unit, including steam turbine, generators, condenser and pump equipment, is being installed by the Richmond Light & Railroad Company, New Brighton, N. Y., in its power house at Livingston, Staten Island. The new generator will be air cooled by means of an air washer and pump outfit manufactured by the American Spray Company, 201 Devonshire Street, Boston, Mass., which will have a capacity of 37,000 cubic feet of air per minute.

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The Arkansas Hydroelectric Development Company has undertaken the development of a water power site on the Little Red River, and A. B. Amos, of Little Rock, Ark., president of the company is in Memphis, Tenn., in order to study the problem of transmitting electrical energy to Memphis and West Memphis. It is expected that enough power will be developed to supply a number of municipalities near Little Rock.

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New York Metal Prices

June 27, 1916

Copper, prime Lake*	26.62½	@	26.87½
Electrolytic*	26.62½	@	26.87½
Casting*	24.00	@	24.25
Wire, base*	29.00	@	31.00
London std. spot	102—0/0		
Lead	7.00		
Nickel	45.00	@	50.00
Zinc, sheet, f. o. b. smelter*			19.00
Tin, straits			39.00
Aluminum 98 @ 99%	60.00	@	62.00
Spelter	11.67½	@	11.92½

Old Metals

Copper, heavy*	19.00	@	20.00
Brass, heavy*	11.00	@	11.25
Brass, light*	9.00	@	9.50
Lead, heavy*	5.25	@	5.50
Zinc, new scrap*	9.00	@	9.50

*Nominal.

ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

Vol. 49 **AUGUST, 1916** **No. 2**

Electrical Wiring of a Steamship Pier

By Benjamin Gross

The new terminal pier for the Ocean Steamship Company at Savannah, Georgia, is the largest south of Baltimore. It is approximately twelve hundred feet long, six hundred feet wide; the slip between the two sheds being over one thousand feet long and over two hundred and twenty-five feet wide, the sheds themselves being about two hundred feet wide each. It is one of the finest terminal piers ever constructed, being practically all steel and corrugated sheet metal, except the roof, which is of wood, and the floors, which are of asphalt blocks set on concrete. Wire is rubber covered and braided, in accordance with National Electric Code and local regulations. All conduit used is loricated, as are also the various outlet boxes, etc.

Power Service

The service to the building is 110-220 volts, three-wire, sixty cycle, alternating current, for lighting; and 500 volts, two-wire direct current for power. There is very little power used in the building, provision being made for only a few small portable hoisting motors. Figure 3 shows a plan and general wiring diagram of the whole pier. The power line is shown running down each shed. At every column is located a junction box, having mounted therein a small panel with copper bar straps, and easily adjustable terminal posts. The portable outfits are provided with long extra flexible cables, which are connected permanently at one end to the motor starters and can be attached very readily to any junction box temporarily. These junction boxes are installed high up, being accessible from the gallery only, so that the flexible leads can provide quite a large radius, about which the motors may travel, without any of the conductors lying on th floor or interfering with stock or traffic. A fused knife switch, quick break type, with N. E.C. enclosed cartridge fuses, all in a cabinet, is installed on each column, accessible from the floor. This switch and fuses is connected in the line between the mains and the junction panels, so that control can be had from below, where the motor is operated. The four wires required for the switch, i.e., the mains and leads to the motors, are all run in one conduit between the junction panelbox and the switchboard. This is clearly illustrated in the sectional elevation on the plan, Figure 3. The services are split in halves, one for each shed.

Ocean Steamship Co.'s. Pier at Savannah

Method of Running Main Lines

All wiring is run exposed on porcelain cleats, except from a point 25 ft. above the floor level down to panels or switches. Figs. 1 and 2 illustrate the type of construction and installation of the wiring typically. Each conduit running up from the panels or switches ends in an appropriate terminal fitting, having a separate hole for each wire. These conduits were installed as a protection against mechanical injury to the wires and cables. The cleats are fastened by screws to wood strips which are supported from the roof channels. Wires are installed on 2.5 in. centres and 1 in. away from the surface wired over. Figure 1 shows the difficulties met with in the installation of feeders and circuits to the panelboards. This view shows the typical condition occurring at panels B, C, E, F and G, in exactly similar manner. Panel F can be seen in the distance. The panels had to be installed where shown, due to the value of the space at the side of the locker rooms, which meant bending the conduits at the panel end. This further necessitated some careful "juggling" of the wires at the ceiling, to have a minimum of crossing. Due to the large strain on the insulators at this point, reinforcements were necessary for the wood strips.

Cleat Work on Ceiling

Figure 2 shows a fine example of cleat work. The wires are installed in two tiers and the wood supports for cleats heavily braced to the structure. The main feeders are easily distinguished among the circuit work. A pair of six wire terminals are shown near the ceiling line, through which the cicuits pass to the adjoining room. A conduit sleeve is installed through the fire wall, with a terminal fitting on each end;

this arrangement provides the best possible protection to the wires.

The wiring running parallel with the channels, is installed on cleats secured directly to the wood roof. This means that the wires run between the tops of the trusses and the under side of the roofing, where they cross the trusses. At various points, viz: at bents No. 13, 25, 36 and 48 in the northbound shed; 62 and 70 in the head-house, and No. 84, 96, 108 and 120 in the southbound shed, there is a concrete fire stop or partition installed from the lowest member of the truss clear to the roof, completely enclosing the truss work and running from wall to wall. These are to limit the spread of fire as much as possible by dividing off, in a way, the portions near the roof into sections. Tight-fitting tubes are installed through these fire stops, through which the wires are run. One of these fire stops can be seen in the distance in Fig. 1, immediately near Panel F. Fires on the southern piers are very dangerous, due to the thousands of bales of cotton often stored thereon. Large and glaring "No Smoking" signs attract the attention of the newcomer.

Lighting Fixtures

Practically all of the lighting fixtures occur at the under side of trusses, which is shown by the outlet symbols on the plan in Figure 3, the dotted cross lines representing the trusses. These fixtures are made up of conduit stems, hung on a hook and link, with an open hickey at the top. The link is used to allow the fixture to swing, as high winds often sweep the pier. The fixtures are each fitted with suitable sockets and reflectors, of types best adapted for the various cases A solid tap is made to the circuit wires at the ceiling, to a flexible reinforced cord which is looped down to and into the fixture stem. This can be seen at the truss immediately beyond the gallerry in Fig 1. The method proves very satisfactory, and makes a neat appearance.

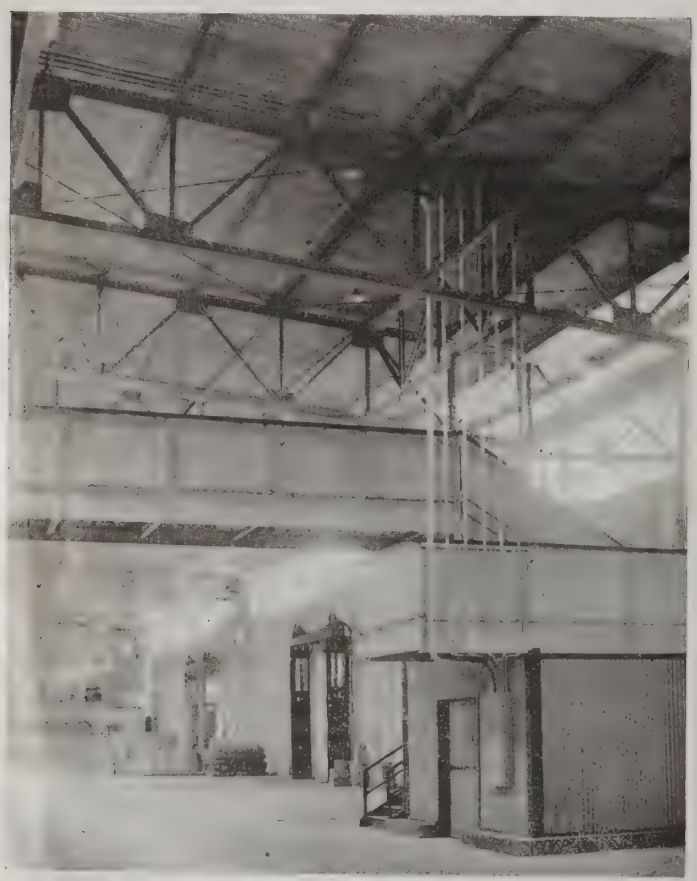


Fig. 1. Interior of Pier

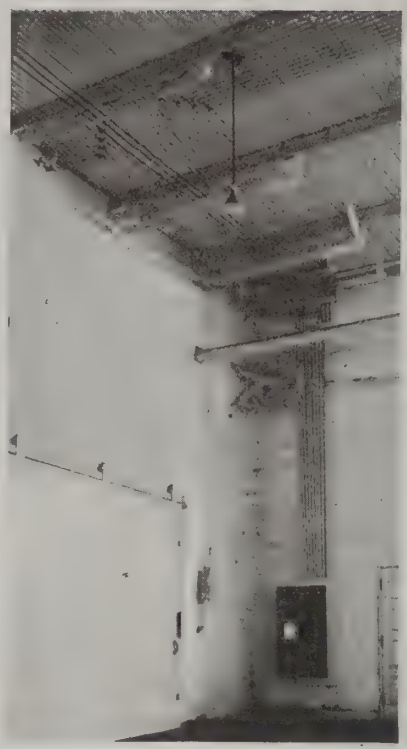


Fig. 2. Distributing Panel

Control of Lighting Circuits

The lighting is generally controlled from the panelboards, except for the 1,000-w. outlets, which are controlled locally by lock switches. By referring to the plan (Fig 3), thtese can be easily distinguished with the aid of the list of symbols, the fused lock switches being clearly shown at the column nearest each such outlet. A pair of N.E.C. enclosed fuse cutouts are installed in a box at the points designated. Each of the cutouts is equipped with rotary snap switch and fuses, the switches having a lock and key attachment. The outfit is so mounted in the box as to have the lock attachment set flush with the outer face of the door when closed. Two small apertures in the door expose the operating attachments so that the lights can be thrown on or off with the use of the key, without opening the door. The door, when opened, exposes the cutouts for re-fusing purposes. The various wires to the switches are installed in one conduit, there being seven where two switches are located in one box, i.e., three for the feeds (one switch being connected on each side of the three-wire circuit, balancing the same), and two returning to the ceiling from each switch to its fixture. Where one switch only is located in the box, there are but four wires run down. The typical sectional elevation on plan (Fig 3) shows this very clearly.

Electric air heaters, manufactured by the Westinghouse Electric & Manufacturing Company, are installed in the various booths, as shown on the plan. These booths are each about 11 ft. square and 10 ft. high, each being equipped with two 2250 watt heaters, having three-heat snap switches.

It may be noted, as a point of interest, how the railroad tracks and loading platforms in the northbound shed, are arranged. This arrangement allows the handling of quite a few more cars than on the other shed, where the usual scheme is applied. There is a gallery platform running all around the entire pier for the use of passengers, as shown in Figure 3.

Panelboards

The panelboards are distributed about the pier at points indicated on the plan. They are of high grade construction, of slate, each circuit being provided with a two-pole knife switch, the hinges and jaws being forged from solid copper, sweated and pinned in their blocks; and a pair of enclosed type N.E.C. fuses. Each panel has also a main fused switch and pilot lamp. The panels are each provided with slate barriers, partitioning them from the wiring spaces between the panel and the cabinets they are mounted in. These cabinets are built of sheet steel, 1/8 in. thick, substantially braced, and provided with hinged doors, vault handles and lock. The trims are fixed in position, forming a permanent cover over the gutters or wiring spaces; the doors being hinged and exposing the panels proper only. Feeder cables are sweated into lugs, and circuit wires No. 10 and smaller fastened under U-shaped washers and knurled thumb-nuts, slotted for a screwdriver and fastened to their respective terminals. Main switches and fuses, as well as circuit switches and fuses, are all so arranged that with the switch open the fuses and the switch blades are "dead."

Service Connections

The services are brought to the main panels at the entrances from the Lighting Company's overhead lines, from which the feeders distribute to the various panelboards. These feeder cables are all run exposed on the cleats, as above described.

Figure 4 shows the service entrance point A in the northbound shed. As this panel occurs immediately above the main entrance door, it was necessary to install the same high up on a platform about twenty feet above the floor so as to clear the door when sliding open. The incoming line enters a service switch and fuses, then runs to the meter and its current transformers, and thence into a main switch for the entire shed. This panel contains a fused switch controlling

Fig. 4. Main Service Entrance

the feeder to each individual panelboard. A fused switch and meter is similarly arranged for power. The arrangements made for the other shed are practically identical with this one. The feeder layout in Figure 3 shows the entire system and service from the main panels out.

Calculation of Feeders

An interesting feature is the exactness with which the side of feeder cables and circuit lines had to be de-

Continued on Page 61

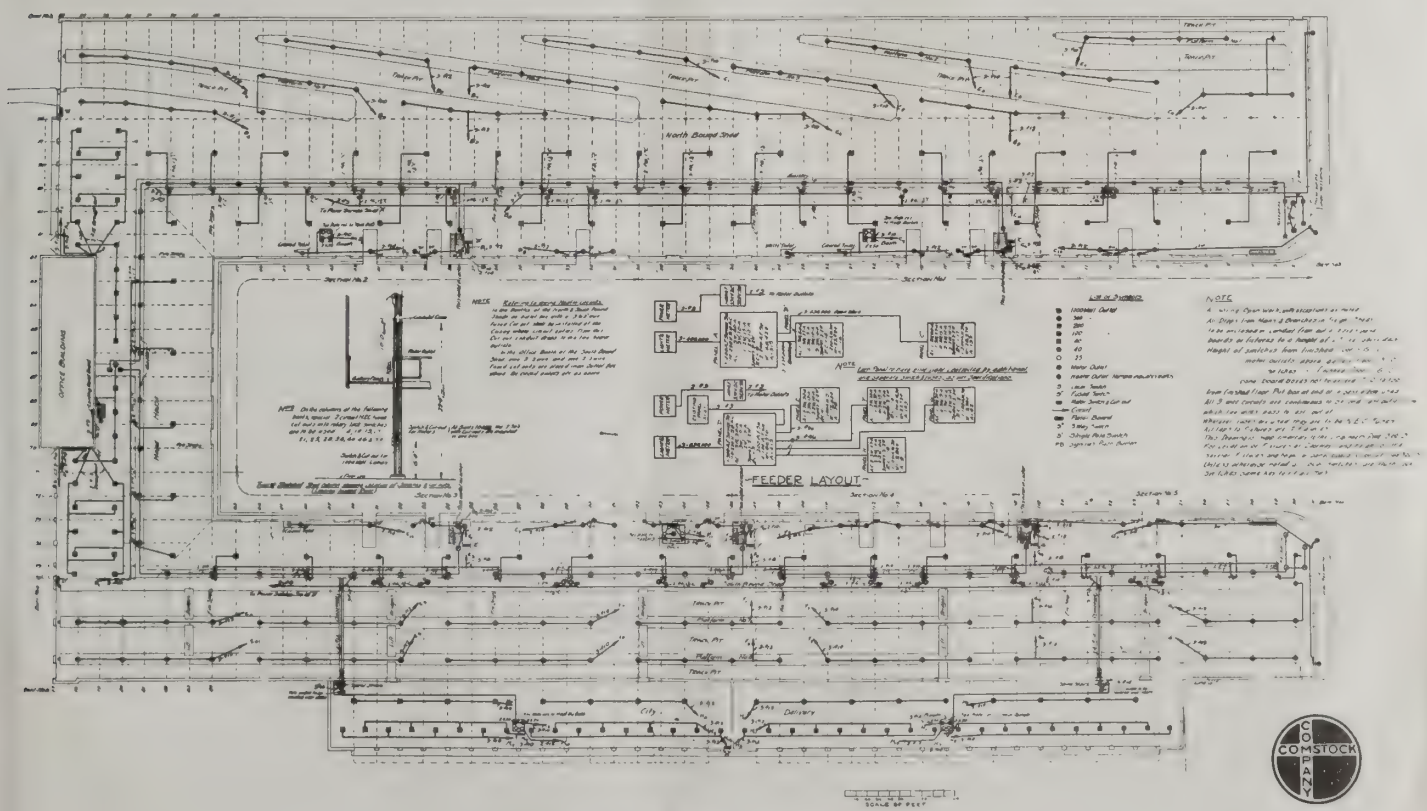


Fig. 3. Wiring Diagram

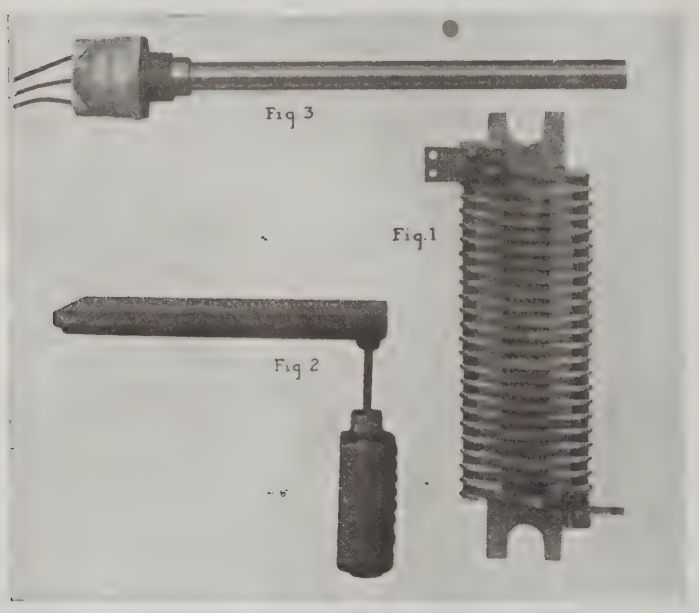
The Resistance Heater as a Load Builder

By Edgar F. Collins

Engineer Industrial Heating Department, General Electric Company

During the past two years the industrial heating engineer has used electric heat as a medium for accomplishing many industrial processes in a more economical and satisfactory manner than was possible with the older modes of heating, such as steam, coal or coke and gas. Not only have these applications been of value in promoting quality of product, but they have in many cases increased production as well and a lower cost has resulted.

A consideration of what has been accomplished in this short time, and a careful study of the possibilities for the future are rapidly convincing central-station men that this field offers such promise of increasing their load that they are already organizing special industrial heating forces to co-operate with the manufacturers and bring about the greatest results from the use of electric heat.



Economies of Electric Heat

Not only does the resistance heater offer a large output in kilowatt-hours to the central station, but the load comes largely at such times that it modifies the load curve in a very acceptable manner by filling in the off-peak periods with balanced non-inductive loads. In many cases factories operate on a 24-hour basis and the central station can materially increase its night load. The customer also frequently profits through his taking on electric heating loads merely from the fact that he increases his total power consumption and gets the advantage of a corresponding decrease in rate for his whole electric power load. Again in many cases he is operating an expensive steam plant and long steam mains in order to do a comparatively small amount of low-temperature steam heating; such satisfactory conditions can usually be remedied through the use of electric heat.

There are many cases where central stations may, in the future, employ electric heat as a part of their generating and distributing system and make a saving internally. I refer to stations which are combined steam and water-power plants, and which do a considerable amount of steam heating. Through the use of auxiliary electrically-heated boilers, to be used independently or in multiple with fuel fired boilers, the maximum load on a water-power plant may be kept practically constant or at any rate may be increased to the extent of its steam-heat load during off-peak periods, using the fuel heated boiler only for peak periods of load.

Many paper mills located where there is an abundance of water power should be able to generate steam electrically for their heating needs more economically than through the use of fuel fired boilers.

Necessary Analysis of Each Case

From the foregoing, it is evident that a decision as to whether electric heat may be employed to replace other means of heating cannot safely be determined by comparison, simply on a B.t.u. basis of cost of electric heat as against heat for fuel. The applications must be carefully analyzed and due allowance made for all advantages accruing from the use of electric heat. The heating engineer must consider the advantages, control of temperature, ease and directness of application, increase of production, reduction in fire risks, decrease of labor of attendance, decreased cost of up-keep, freedom from smoke, gases and excessive heat lost to the room creating discomfort to the operators in hot weather, saving in floor space increased quality of production and saving of lost heat due to fuel being burned uneconomically through the carelessness of operators in adjusting fires, burners, etc. This last point is not always given the consideration it merits. A kilowatt-hour in an electric heater must create 3412 B.t.u.; on the other hand the writer has seen cases where the operator used double the fuel oil that was required for certain heating, simply because he did not have the skill or care to tdjust his mixtures at the burner for perfect combustion. This cannot happen with electric heat, especially when automatically controlled, and hence its use serves to safeguard against needless waste of heat.

Fig. 4. Electric Japanning Oven

Much waste occurs in fuel fired apparatus due to the impossibility of applying heat directly at the point where it is wanted. Compare the immersion electric heater which puts the heat directly in the body of liquid to be heated with the fuel

Delivered before the recent convention of the National Electric Light Association.

fire where only a part of the heat of combustion is transferred by convection currents of heated gas first to the container surface and thence to the liquid which is being heated, the remaining and perhaps major part of the heat of combustion escaping with the flue gases. This is heat lost and results in slow and inefficient application as compared with the electric way.

It is intended in this paper to deal only with the application of electric heat in industrial processes that require 50 degrees fahr. or less. A few of these processes only will be discussed in detail, but a more extensive tabulation of the practical possibilities of the use of electric heat demanding the attention of the heating engineer is here outlined.

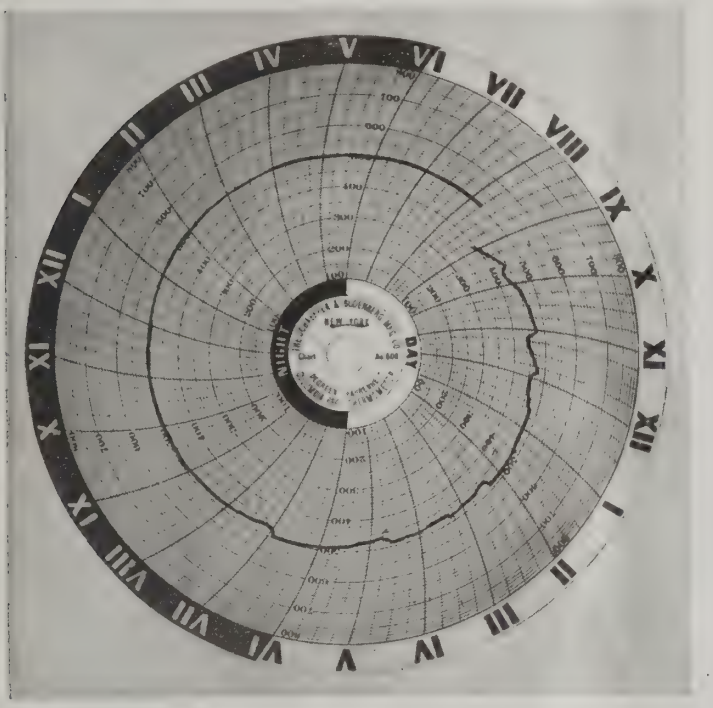


Fig. 5

general three types of heating units have been developed by the manufacturer to cover industrial heating devices not requiring more than 950 degrees fahr. These units are (1) the air heater unit (Fig. 1) the hot plate or cast-in or embedded unit (Fig. 2) and the immersion type unit (Fig. 3). These units are generally of the metallic resistor type, this resistor being of the nicklechrome combination which is free from corrosion in the air at temperatures much in excess of their normal operating temperatures. These units are designed so that they may be used singly or in combination to take care of standard voltage such as 550, 440, 200, 110 alternating or direct current.

Air Heaters

The air-heater type of unit consists in general of a frame work of steel or cast iron carrying insulators made from mineral compounds such that they afford high insulation resistance even at the fusing point of the metallic resistor which they carry. This resistor, in the best designs, is of the nicklechrome-type alloy and is non-corrosive in air at a temperature of 800 degrees cent. or higher. Where a number of these heaters are connected together in air, oven or other heating chamber, it has been found best to use steel busbars and connections mounted upon insulators having the same characteristics as the heater insulators. In addition to high insulation and refractoriness at high temperatures this compound has practically no expansion and contraction and is not affected by moisture even at high temperature.

Air heaters have a very wide application. When used in heating ovens they are usually units of capacity ranging from three to ten kilowatt units, which may be distributed to give uniform heating results and the desired oven temperature. Standard control panels both for hand and automatic control through the medium of an oven thermostat are available, and are in fact a necessity for most installations. Fig. 5 shows a chart taken from automatic control adapted to the heating of an oven for japanning at 500 deg. Fahr.

Hot-Plate Heaters

The hot-plate cast-in, or embedded type of unit consists generally of a metallic resistor properly insulated and clamped between metal plates, or it may have the resistor wire suitably insulated and cast in a metal plate or container as an integral part of such, or the same type of resistor wire may be embedded by rolling, swaging, welding or other method in metal plates or resistor carrying parts. Such units are usually employed by clamping them in contact with the parts to be heated and are suitably lagged to pevent loss of heat from external surfaces in contact with the room. These units are likewise designed for use in standard voltage circuits either individually or in combination and in many cases are wound to give three heats through the use of a 3-point snap switch.

The immersion type of unit is in general of such form that the resistor itself may be immersed in the body of fluid it is to heat or it may be protected from direct contact with the fluid by an intervening insulated and protecting sheath. One end of the sheath protrudes from the fluid and carries the heater terminals. In the application of the immersion heater to industrial uses, the writer favors automatic regulation of temperatures, and to this end recommends the use of a thermostat and automatic switch (Fig. 8) to control and prevent overheating and yet allow the most rapid heating.

Table of Uses

The following table shows some of the more common industrial applications of the foregoing heating units and the particular type of unit usually employed: Figs. 9, 10 and 11 shows equipment heated by resistance units.

Process of Device	Temperature Range	Type of Heating Unit	Method of Heat Control
Baking of japan	300- 600 deg F.	Air	Hand or automatic
Baking of varnish & paints	100- 300 "	"	Automatic
Baking color enamels	100- 300 "	"	"
Baking bread & pastry	150- 600 "	"	"
Baking foundry cores	350- 500 "	"	"
Baking insulations	200- 500 "	"	"
Annealing copper	350- 700 "	"	"
Annealing aluminum	500- 800 "	"	"
Annealing glass	900-1000 "	"	"
Tempering steel	200-1000 "	Air & hot plate	"
Melting lead	620- 700 "	" " "	"
Melting tin	450- 500 "	" " "	"
Melting babbitt	450- 700 "	" " "	"
Wax & compounds	150- 500 "	Air, plate & immersion	"
Heating coils	100-1000 "	Plate & immersion	"
Heating water	32- 212 "	Air, plate & immersion	Hand or automatic
Making steam	212- 500 "	Air & immersion	Automatic
Heating metal molds	200-1000 "	Air & plate	Hand or automatic
Lumber drying kilns	100- 200 "	Air	Automatic
Boiling varnishes	100(?)-500 "	"	Hand or automatic
Heating buildings	0- 80 "	"	Hand
Soldering	400- 650 "	Plate	"
Glue pots	100- 200 "	Cartridge	Hand or automatic
Melting type-metal, linotype machines	625- 700 "	"	" " "
Sherardizing	650- 700 "	"	Hand

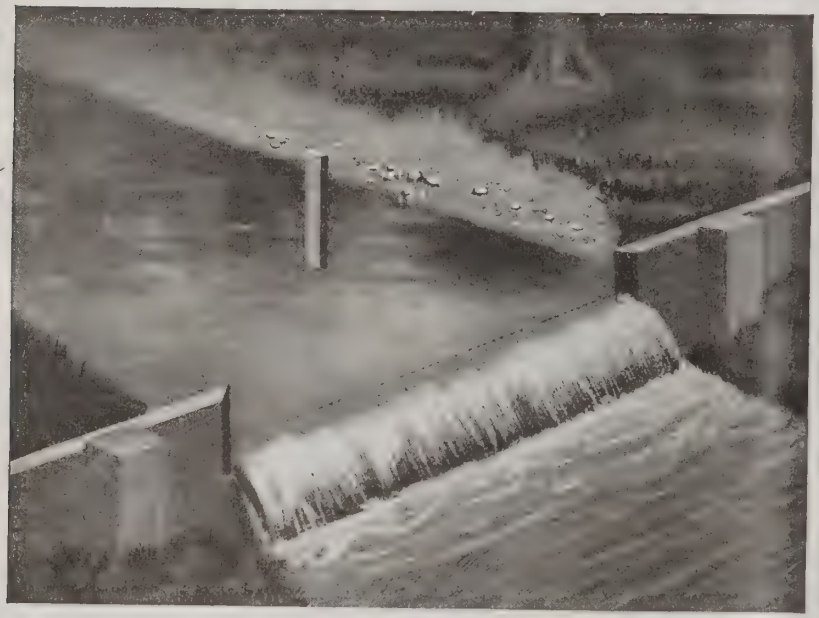
Those heating processes employing the air heater have during the past two years yielded the control stations a large kilowatt-hour output. Very great success has attended the use of the air heater in baking ovens whose temperatures range from 300 to 500 deg. Fahr. A specific use is that of japan baking. It may be said that already more than 40,000 kilowatts of connected load in air heaters have been installed for this purpose. The writer does not know of a single installation changed to electric heat which has not been so satisfactory that it has worked to extend the use of electric heat for baking purposes.

Much could be said in detail concerning other processes in favor of electric heat as against fuel fired equipment. It is hoped that these few comments may be sufficient to enlist the energies of the central station man not already conversant with and enthusiastically at work in this promising field if industrial heating.

Water Power for the Farm

Natural resources are conserved just as much by the little economies as by the big ones. Power from a small stream may replace much human labor.

The ideal source of power for the farm or country home is one which requires minimum maintenance, even at the expense of a slightly greater first cost. Installed in out-of-the-way places, such power-plants are seldom inspected by expert electricians, but must depend for upkeep on the few minutes' casual looking-over and filling of oil-cups which the owner or the "hired man" may be inclined to give. The further the plant is from a repair-shop, the more important is its ruggedness, for much time must of necessity elapse before assistance can be secured in time of need.



View of a typical weir. It is better practice, however, to have the pond about three times as wide. Graduations on the stick begin at the level of the weir crest.

While the modern gas-engine is a remarkably sturdy device, yet its unavoidable complications and the necessity of a constant supply of fuel are drawbacks which are not presented by the use of Nature's "white coal"—water power. The man who can utilize a stream of water to drive a generator has at hand a source of power which costs him next to nothing for operation, maintenance and depreciation. For its harnessing the capital outlay need not be large, since "spare-time" labor of the owner and his regular employees will ordinarily suffice.

The Preliminary Survey

In prospecting for water-power site that is worth development there are several points to be kept in mind. A preliminary reconnoissance will show whether within economical transmitting distance there is a sufficient fall in a stream whose minimum flow is enough to generate the required power. Assume that the peak load is 1 kw. and that the total output in 24 hours is 12 kw-hr. With 80 per cent. generator efficiency there must be a mechanical input of 15 kw-hr. The efficiency of the turbine or wheel will be about 80 per cent., so that there will be required 39,670 cu. ft. of water falling through a height of 20 ft. from the level of the head-race to that of the tail-race. Therefore the total flow of the stream per day during the dry season should not be less than about 40,000 cubic feet. If the stream has an average velocity of flow of 1.5 ft. per sec., it must have a cross-section of 44.5 sq. in. in order to pass 40,000 cu. ft. in 24 hours.

The foregoing example has been worked out to show a typical case and to give an idea of the relative magnitudes encountered. If the reconnoissance indicates the probability of sufficient power, a careful study should be made in which all the elements are carefully determined and the probable cost and amount of power to be secured are estimated.

Measuring Stream-Flow

There are two methods of measuring the flow of a stream, which are almost equally accurate. If the bed is of fairly uniform cross-section for fifteen feet or so, the velocity of flow may be measured by timing the movement of a stick floating down the current. This should be weighted at one end so as to float vertically with one end near the bottom. Multiplying this by the sectional area of the water, measured in square feet, gives the flow in cubic feet per second, and this value multiplied by 86,400 gives the cubic feet per day. The weir method is more generally applicable, for a dam can be constructed almost anywhere. The "spillway" through which the water escapes should be formed of boards with sharpened edges, the bevel opening down-stream. Thin metal edges may also be used. The location should be chosen so as to form a pond of such size above the weir that the water has practically no velocity when it reaches the vicinity of the weir. The width B of the weir should be not more than $1/6\ W \div H$; B is the width of the pond immediately above the weir and H is the head over the weir. A stake is driven in the pond at some distance above the weir and so that its top is level with the crest C of the weir. The formula for the flow of water over the weir is then

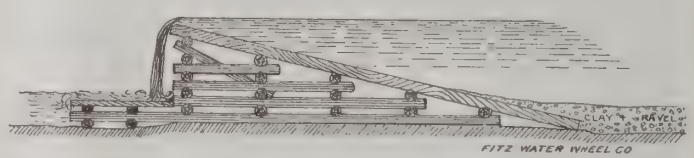
$Q = 3.33\ B\sqrt{H^3}$ where

Q = flow in cu. ft. per sec.

H = depth of water above crest of weir, i. e., above top of stake.

B = breadth of weir.

When a large hydro-electric development is projected it is usual to take measurements during several months, but for plants such as we are considering it will be sufficient to take daily readings for about a month during the dryest season of the year.



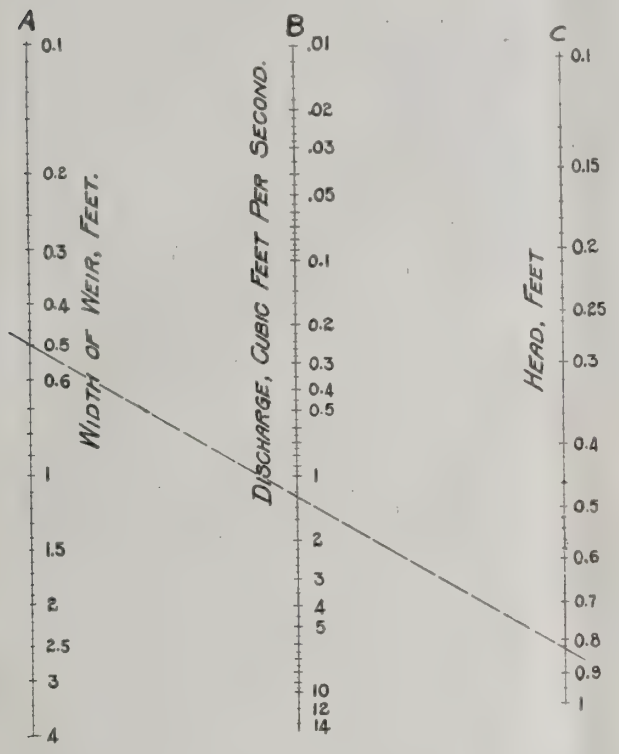
LOG DAM

Where timber is easily obtainable, this is an inexpensive dam to build. It is easy to put together and is quite satisfactory where only a small dam is required.

Necessity for Water-Storage

The question of whether or not to build a dam for water-storage depends on whether the minimum flow of the stream is

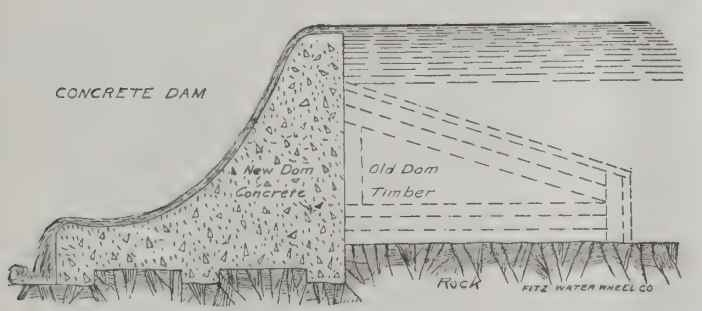
sufficient to provide adequate power. Returning to the typical case mentioned, in which the peak load was 1 kw., there would be required at that time an input of $\frac{1{,}000}{760 \times .80 \times .80} = 2.1$



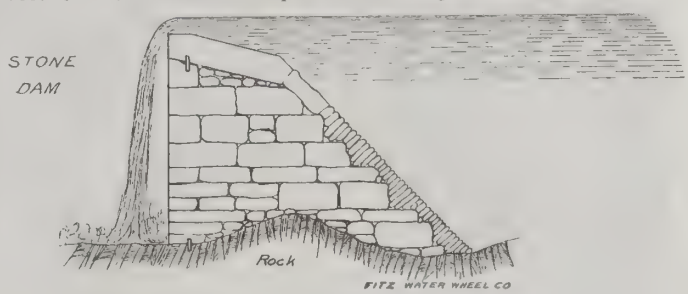
To find the flow of water over a weir, lay a straightedge on the diagram so that it crosses columns A and C at points indicated by the head and the width of weir respectively. The discharge may then be read at the point where the line cuts column B. Thus in the example shown by the broken line, with a width of 0.5 ft. and a head of 0.83 ft., the discharge will be 1.25 cu. ft. per sec. The formula is the same as that given in the text.

water hp. This would require a flow of $Q = \frac{P}{.114h}$ cubic feet per second where P = water horsepower and h = useful head from head-race level to tail-race level. Assuming $h = 20$ ft., we find that $Q = .918$ cu. ft. per sec. In this case, the stream has a flow of .46 cu. ft. per sec. or only half enough for the peak load, so that a dam is essential.

While for large projects storage capacity for several weeks' supply of water is often provided yet private plants can seldom afford to build a dam or set aside ground sufficient for more than one or two days' exclusive supply. In our typical case we found that a total flow of 40,000 cu. ft. per day was necessary. This amounts to .918 acre-feet (1 acre-ft. = 1 acre covered to 1 ft. depth = 43,560 cu. ft.) Assuming sufficient capacity for three days' normal service, we should require 2.75 acre-feet or the contents of a pond 10 ft. × 50 ft. × 240 ft.



If, later, a concrete dam is desired, this form can be built without removing the old timber dam. For anyone familiar with its use, concrete is the best material for dams.

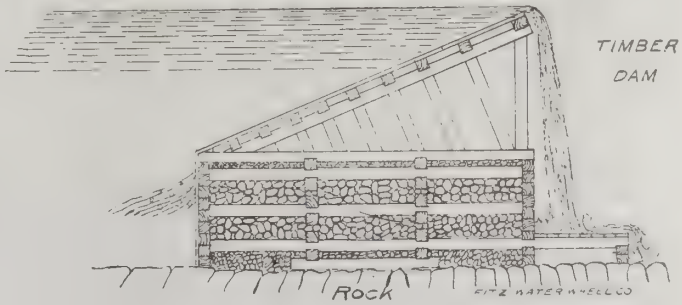


A very good dam made from stone. The outer layers should be bound with cement mortar or concrete to render them perfectly watertight.

One of the devices by which an owner can eke out his supply of water is well illustrated here. The assumed load-factor is 50 per cent., which means a large day load. In times of low water this can be reduced by deferring power-using tasks, thus reducing the load-factor to 20 per cent. without restricting the use of light, which forms the peak-load. By this means the consumption of water can be reduced to 40 per cent. of the maximum, or 16,000 cu. ft. per day.

Types of Dams

The details of dam-construction vary so with the location, and are generally so well understood that no extensive account is necessary. Sketches of several types are given which may be suggestive. The versatility of the American farmer can be counted on to construct the form best adapted to his conditions of labor, material, site and size. Where concrete is used, care should be taken to secure the best of cement, clean, sharp sand and good stone.



Where greater height is wanted, this form of timber dam may be used.

Types of Wheels

In choosing the type of wheel, the available head and the amount of power to be developed are the determining factors. While it is always best to consult with the manufacturers concerning the exact type and the setting of it, yet for the preliminary work the following information may be of service:

The *impulse-wheel* is suitable for high heads and small quantities of water. It gives considerable latitude in the selection of a power house site, for the water is conducted in pipes of moderate size and the wheel with its associated generator forms a compact unit. The *overshot wheel* will care for moderate volumes of water, but as its diameter must be the height of the fall, it is limited as to head. It must be set in the line of flow and needs careful alignment. On account of its low speed, two sets of gears are used between it and the generator.

Continued on Page 48

Industrial Leadership

By H. L. Gantt

Mr. Gantt has done notable work in the development of machine-shop planning systems, and scientific piece-rate methods. For the past few years he has been engaged in perfecting a system of management which would lead employees of all grades to become interested in their work. .One result has been the development of a strong spirit of harmony and co-operation among employees working under his instructions but which is so strong as almost to eliminate jealously among those engaged in the work.. The most striking effect apart from the improvement in quality and increase in quantity of product has been the development and training of men. It is seldom now in plants working under these methods that a trained man promoted to a higher position does not fill it better than his predecessor did.

This address was delivered before the Baltimore Section of the A. I. E. E.

ALL great movements, whether for good or for evil, originate in the mind of some leader. So important is this man that his movement is often known for thousands of years by his name. Christianity, Mohammedanism, and the other religions of the world bear testimony to this fact.

All great inventions and enterprises not only have their origin in the mind of some leader, but they must be carried out under competent leadership. There is no factor that comes to the front at so many points as leadership; for it is not only the man who conceives the idea of an enterprise who must be a leader, but so must be all of those under him who have to direct the activities of other men The manager, the superintendent, and the foreman must all be leaders if they would get results. This is true all over the world, but more especially in America, where every man has a right, so long as he conforms to the laws of the state, to do that which serves his interest best.

If, therefore, we would stand at the head in industry, we must develop such methods of training our leaders as will enable them to command the confidence and suport of the men with whom they have to deal. This subject has been given but little attention in the past, and in consequence our leaders have been largely selected at random, with the result that there are in this country no generally accepted principles of industrialism along the lines of which advancement can best be made. Not until we have determined these principles, and then accepted the lines along which our leaders must be trained, can we expect any harmonious development.

Lessons From the War

The great war now being waged in Europe has enabled us to contrast a great nation where industries were thus harmoniously developed with one whose industries have been developed in the haphazard manner which seem to cherish so highly. This war is destined to be the most far reaching event that has taken place since the fall of the Roman Empire, and many methods which were in vogue when it began, will be as obsolete when it ends as the dodo. If we would keep our place in the new world, which is to be created by this war, we must learn our lesson as it progresses, and train our people accordingly. In order to do this, we must ask ourselves, "Why is it that Germany has shown so much greater efficiency, both from a military and an industrial standpoint, than have the Allies?"

It is becoming perfectly clear that the principles underlying industrial and military efficiency are the same and that, if a nation is to be efficient in a military sense, it must first be efficient industrially.

We have talked efficiency in this country for several years, and many books have been written on the subject, but many of us feel that the actual results so far have been lamentably small; and that we should be much more nearly in the class with England than with Germany if we were suddenly confronted with her problems. It would seem, therefore, that we should find the fundamental reasons why England presented such a strong contrast to Germany, and see if we cannot learn something therefrom.

Wealth Versus Productive Capacity

It is only a short time since England led the world in the arts, but recently Germany has demonstrated her superiority to both England and France. We must ask ourselves how this happened. It would seem to be something on this wise: The financiers of England, feeling that wealth could purchase whatever was needed for themselves and their national life, have devoted their energies for a number of years to securing the wealth which was produced by others rather than making strenuous efforts to produce it themselves. In this attempt they have sent abroad millions of dollars to develop industries in foreign lands which brought them great returns. The leaders of Germany, on the other hand, not being able to exploit foreign peoples to the extent which was possible in England, turned their attention to developing their own resources, and the ability of their own people. When the supreme test came, Germany was found to be a nation of people who, in general, knew what to do and how to do it; while the industries of Englaand were, in too many cases, controlled by people who understood only their commercial side.

We, following the footsteps of England, have regarded financial strength as the most important strength; forgetting the comment which the ancient philosopher made to the rich man who boasted of his possessions, when he said: "What availeth all thy wealth? He that hath better iron than thou will come and take away all thy gold." In those days *iron* meant weapons. To-day iron may be taken as the symbol of both weapons, and tools of industry; and the statement is just as true to-day as it was two thousand years ago, that he that hath the better tools is more powerful than he hath wealth only.

The move of the Secretary of the Navy to get engineers of the country working together for industrial preparation is a most hopeful sign, for in the critical times in which we are living, wealth may become of little more value to us than it would have been to Great Britain, if twenty miles of water had not separated her from the Continent of Europe.

The Power to Create

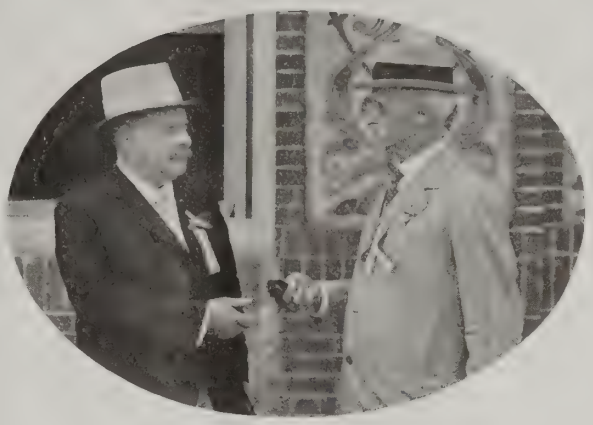
On the other hand, the power to *do* things cannot be taken away from us. Whether in peace or in war, the nation and its citizens who can produce are always masters of their destiny. The greater his creative power, the more important will a man become, as we realize the real meaning of the titanic contest which is now going on in the world.

The man who knows what to do and how to do it is preeminently the engineer. The new world, which is being ushered in by the great struggle now taking place is one in which the engineer is destined to be the supreme power, for it is becoming

Continued on Page 54

New York Convention, N. E. C. A.

Co-operation between contractor, central station, and manufacturer was the keynote of the sixteenth annual convention of the National Electrical Contractors' Association at the Hotel McAlpin, New York City .The week of July 17-22 was a period of "getting together" for electrical men in which the social side was by no means neglected.



Presidents, Past and Future:
R. S. Stearnes *J. R. Galloway*

At the first session, Mr. T. Commerford Martin, executive secretary of the N. E. L. A. showed how much the electrical industry owes to the co-operation between central stations and contractors in producing the present growth of the industry. As tillage of the great field of electricity supply, T. Martin cited the sum of $3,000,000 spent annually for publicity by the generating companies—the harvest of which will be reaped by the contractors as well as the central station.

The responsibility of the contractor for the good name of the industry, due to the fact that it is he who comes into personal contact with the public, was brought out by Mr. Arthur Williams, of the New York Edison Company. More adequate repersentation of electrical men before the law making bodies was urged by Mr. Edward Trefz, secretary of the Chamber of Commerce of the United States. Plans for "America's Electrical Week" were explained by Mr. H. W. Alexander of the Society for Electrical Development.

Wednesday afternoon's meeting was behind closed doors. On Thursday morning there were presented reports of the insurance and national code committees, followed by a discussion of concentric wiring. One speaker gave as his opinion that the safety and superior economy of the method were doubtful. Others suggested that improvements and changes would make the method a real business-getter for the contractor. Elimination of the minimum monthly bill was proposed as a method of interesting many who otherwise were hanging back from taking on electric service.

Progress was reported in the Association's efforts to discourage the sale of electrical goods to five and ten cent stores, a number of manufacturers having already ceased this practice.

The following officers were placed in nomination by the Nominating Committee, and elected by the Convention on Friday:

President, Robley S. Stearnes, New Orleans, La.; first vice-president, W. K. Tuohey, Springfield, Mass.; second vice-president, J. C. Rendler, Los Angeles, Cal.; third vice-pre ident, J. T. Hilton, Syracuse, N. Y.; secretary, George H. Duffield, Utica, N. Y.; sergant-at arms, James F. Burns, Schenectady, N. Y.

The next convention will be held at New Orleans during the week of October 10,1917.

Social features of the convention included a reception and dance in the green and blue rooms of the McAplin on Wednesday night; an inspection of the department store of B. Altman & Company, for the ladies, on Thursday morning; a concert tendered by the Aeolian Company on Thursday afternoon, for ladies and guests, and an automoble ride for all to Coney Island that evening. The big affair, however, was the trip to Long Beach on Friday afternoon, in a special train on the Long Island Railroad. Surf bathing, undisturbed by sharks, was enjoyed by many, and after dinner both younger and older members danced until a late hour. On Saturday morning there was a boat-excursion around the Manhattan water front, during which those present were guests of the New York central stations and the local Association at lunch.

All of the leading electrical manufacturers had well-planned exhibits in the show held in the McAlpin grill. There was no exception to the rule that as much profit is derived from the exhibition of new products as from attendance at the convention sessions.

The Convention Party at Long Beach

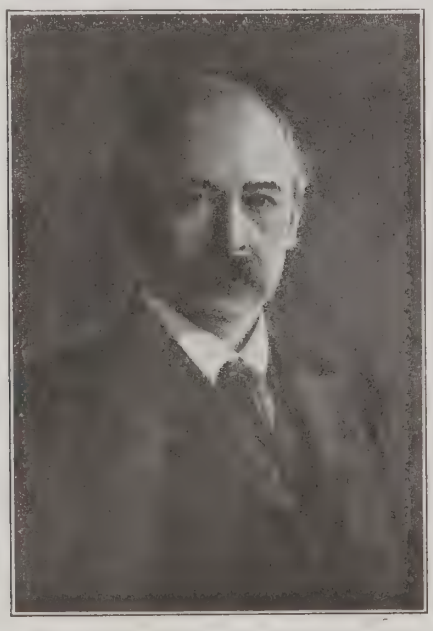
Electrical Fathers

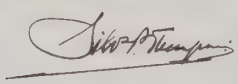
S. P. Thompson

For the paths of progress we are indebted to men of two types. There must be not only pioneers to blaze the trail, but sturdy workmen to clear the way of obstacles and prepare it for the feet of thousands who follow. Such a pioneer was Lord Kelvin, whose name designates so many landmarks in electrical engineering, and such a roadmaker was Silvanus Thompson, through whose works so many of the older generation of electrical engineers entered upon the knowledge of their profession.

Versatility and charming personality won him an honored place among that group of which Lord Kelvin was the shining light. His death, which occurred on June 12, makes it fitting that we give at this time some account of his life and work.

Silvanus Phillips Thompson was born at York, England, in 1851. At London University in 1869 he took his B. A. and in 1878 his D. Sc. Having lectured on science at Bristol for some time he was at once given the rank of professor,





which he held until in 1885 he was elected Professor of Physics at the City and Guilds Technical College at Finsbury, London. Later he became principal of that institution, a position which he held until his death.

The opportunity which was opened to Professor Thompson at the very outset of his career was unique. From being a pure science, electricity was just becoming a technology, and the rapid growth of the industry required that more and more men be trained in its knowledge. The newcomers, if students, attracted by the possibilities of the field, sat in Professor Thompson's classes and if men trained in the older branches of engineering gained from his writings a knowledge of exact methods so unlike those rules of thumb to which they had been accustomed. For this work he was particularly suited, since he had the gift of explaining new ideas in terms which might readily be grasped by his hearers. Among technical works, popularity is a good test of merit; judged by this the sale of 100,000 copies of the English edition of "Electricity and Magnetism" and its translation into German, French, Italian, Polish and Japanese, gives it a high rank shared by "Dynamo-Electric Machinery" and "Polyphase Electric Currents."

Just as Lord Kelvin's talents were of great service to the promotors of the Trans-Atlantic Cable so the service of Dr. Thompson were in constant demand in the early days of the electrical industry. Systems, machines and processes of manufacture were offered to the public backed by the wildest claims. Dr. Thompson's sound judgment and professional knowledge enabled him to sift the wheat from the chaff and save many a pound sterling for its owner. In electrical design and especially in patent work his knowledge of what had been attempted made valuable his opinion of the feasibility of a project. The mile-post of scientific progress in England is the annual series of Cantor lectures. Professor Thompson was twice honored by being chosen as lecturer, choosing as his subject in 1883 the theory of construction and operation of dynamo-electric machines. These lectures may even now be read with profit, and when it is remembered that they formed the first concise expose of the subject, the widespread interest which they excited may be realized. The Electro-magnet was the subject of the second series, delivered in 1893. Magnetism had always been a hobby with Prof. Thompson; he had studied all the early works on electricity and magnetism and these researches were embodied in his lectures.

Like many other men of science, Professor Thompson's interest were as broad as they were deep. In music he was well versed; with artists he could talk with the confidence given by his skill in water colors and the fact that some of his pictures had been hung in the Royal Academy; he was an authority upon and a discriminating collector of first editions, jewels and rare stones; and he was always in touch with the latest discoveries in every science, particularly in astronomy. Outside of electricity, the study of optics, chiefly engaged his attention, and he made a number of contributions to its theory, both mathematical and physical. A useful volume of optical tables is also of his compiling.

As a public speaker, Professor Thompson was often in demand. Reference has been made to his Cantor lectures; he also delivered similar lectures on many notable occasions. During his long and active membership in the Institution of Electrical Engineers he frequently took part in discussions, though contributing but few original papers. His proficiency in foreign languages made him the spokesman of the Institution on the Continent, and in the discussions of the International Electrotechnical Commission he was often able to avert misunderstandings by some of the foreign members.

Men who unite agreeable personality with engineering attainments are always in demand for executive posts in technical and scientific societies. Many honors of this sort were given to Professor Thompson; he was at some time president of the Institution of Electrical Engineers, the Institute of Junior Engineers, the Physical Society, the Optical Society, the Illuminating Engineering Society and "The Sette of Odd Volumes." The leading scientific societies of other countries numbered him as a member; among these were the American Philosphical Society and the American Institute of Electrical Engineers.

In his private life Dr. Thompson exhibited the simplicity and kindliness characteristic of the Society of Friends of which he was a sincere and devout member. The affection which he inspired was due not only to the practical aid which he quietly extended to many persons in need, but to the sympathy and sound counsel which were ready for any who came to him in trouble. Such qualities even more than his scientific attainments have made the loss of Dr. Thompson sincerely mourned.

EDITORIAL

Industrial Leadership

One of the most characteristic traits of the American people is their belief in the sovereign power of education as a means of advancement. Starting with the common school to prepare men for the simple intellectual needs of out-door life, and the college to train them for the law and the ministry, our educational system has branched out into fields the most diverse. Even in electricity there are courses for dynamo-tenders, motormen, meter-readers, salesmen and so on for every grade up to the top. For the less complex positions, all a man needs to know may be included between the covers of a text-book. Faithful study will fit a man to do his work better and better, until his advancement finally brings him to the place at which the text-books stop. There, he has mastered the technique of his calling; the problems that now confront him are those concerning, not materials and machines, but men.

Bradley, these problems may be grouped under the caption, "Problems of Leadership." The man who does his own work well is sure to be given the chance to direct other men, because the vacancies in this field are so many. And yet though he has a dozen handbooks on technology he has not one on leadership, nor is there anyone to tell him what he should or should not do. He is brought out of the ranks to succeed or fail largely as chance may determine.

An able address by Mr. Henry L. Gantt, published elsewhere in this issue, brings out forcefully the need of industrial leaders in the immediate future and the desirability of training them ere that need becomes pressing. With his opinions we are inhearty accord. Any contractor or manufacturer will say that his foremen are the most essential part of his organization. Yet no effort is made to train men, by conscientious schooling, to fill their places, vacancies will occur by resignations, promotions, enlargements of the business, yet there is seldom an "understudy" waiting to step into the vacant shoes.

It must be admitted that instruction of this sort is the hardest in the world to give. As in any case where personalities are involved, the values to be recognized are most intangible. Anyone may know how much load a motor will carry—but how much praise does Bill Jones have to have to keep him contented, and how much more would make him self-conceited? Yet there are many things a wise foreman knows which he can tell to others for their good in instructing them how best to deal with their fellow-men.

Systems there are for choosing employees—but for developing leaders—how great is the need!

* * *

Idle Tongues

That no employee in possession of his senses will criticise his employer to an outsider has become one of the unwritten rules which is generally obeyed. Too many men, however, while acknowledging their obligation to refrain from doing anything which might injure their employer's business, are not as careful as they might be in considering the effects of their words upon people who know little or nothing about electricity. A customer inquires: "How did you know what my meter read last month? Your man didn't get into the house to read it."

The desk-man answers: "Oh, he just guessed at it." Perhaps the bill was small and the customer did not care to follow the inquiry. But he would carry away an impression of slipshod accounting methods which would cast a shade of doubt over all his subsequent bills. By a word of explanation the employee might have assured him that the meter would be read the next month and that any error in the previous reading would then be corrected automatically.

Remarks as to the danger of electric shocks are quite frequently heard. Where a high-tension distributing network is used, timid people may well hesitate to use the safest kind of secondary service because of some lurid tale they may have heard of a fatal shock being received from inside wiring. Prospects for house-wiring frequently interpose the objection of fire-risk—a fear inspired by oft-repeated and usually wrongly-placed blame for fires of really unknown origin. There has come to our attention recently a case in which a salesman mentioned as a particular merit for his fire extinguisher the fact that it was especially suited for putting out fires in partition-walls due to crossed electric wires. Questioning developed the fact that a central-station man had given him this "talking-point."

It seems strange that after all the efforts of electrical men to convince the public of the safety of electric wiring, one of their own number should recommend an extinguisher for electrical fires. As an actual fact, the chance of an extinguisher being used for that purpose is negligibly small. Further, ordinary commonsense should make a man hold his tongue concerning any defect in his goods or services unless that defect rendered them really unfit for the customer's use. The

public assumes that he is doing that, and hence multiplies his criticism many fold.

It may be asked what reply should be made to a question which touches one a delicate subject. There are two methods, the choice depending on circumstances. If the query is a casual one, it may be turned off by a mere assurance in a positive manner. Should the questioner be in genuine uncertainty, the only way is to explain just as clearly as possible the exact status of the matter. If this is not done the customer will think something is being concealed and his suspicion will be greater than ever. Even if the explanation does not result in a sale, the customer will feel that his interests are being cared for and the good-will thus established will be a permanent asset.

* * *

The Future of Copper

When purchasing agents get together, the one favorite topic of discussion is sure to be the price of copper. On the stability of the present level until the end of the European war, there is no difference of opinion. Munitions-manufacture to fill orders for the Entente Allies will continue at a slightly increasing rate until peace is actually in sight. The stimulus which this large volume of business brings to associated and contributory manufacturers will continue to call for copper on the same scale as in the past for increases to all sorts of electrical plant. Generating companies must supply power no matter what the cost of conductors and the needs of the telephone and telegraph systerms for additional circuits can now be met only by stringing more copper. We are not likely to come to the use of iron conductors, save in a few cases for telegraph lines, nor is there any prospect that the price of aluminum will be lowered to a point at which it can compete with copper.

Concerning the price of copper after the war, however, there is a sharp difference of opinion. Some hold that when existing consumers come again into normal conditions, their demand will be so much curtailed that producers will lower the price to a figure below what it was early in 1914. This is, of course on the assumption that producers will feel the need of keeping their net revenues somewhere near the figure at which they stood in the heyday of their present prosperity. That this assumption is unfounded can readily be shown, but we shall first consider the question of the demand for copper when peace shall have come.

Reference to copper statistics for the normal years up to and including 1913, enable us to say with fair accuracy that had there been no war, the Teutonic Allies would have imported 1,200,000,000 lbs. of copper during the two years ending July 31, 1916. During that time, however, they have been able to import only a very small amount, so small indeed, as to be negligible.

As far as we can tell, the industrial expansion of the Central Powers, while great in a few lines has on the whole been largely curtailed. There is no reason to think that the war will leave them economically prostrate; large as their losses have been, they will still have men and money to turn to the pressing needs of rehabilitation. Large as may be the supply of swords and spears for the manufacture of ploughshares and pruning hooks, there will be a tremendous amount of new material required at once to build up the industries of peace. Not only have additions to industrial plant been small, but over 1,000,000,000 lbs. of copper have been reclaimed—from idle traction lines, less necessary motors and generators, and copper bus-bars, from the humble kettle of the housewife and the roofs of dwellings. Many of these sacrifices must be made good by replacement when peace comes.

On the whole then, we find that not only have Germany and Austria done without more than a million pounds of imported copper, but they have diverted to military use another million pounds. The vacuum created must be filled, and the filling of it will require imports in addition to their regular demand. One estimate of the needs of these two countries is 40 per cent. of the world's entire production during the five years after the war.

The effect of this on our domestic market can easily be seen. In 1913, 161,000 tons or 41.5 per cent. of our copper exports went to the Central Powers. In 1915, with this market entirely shut off, our copper exports dropped by 112,000 tons—that is, the total of our exports to all other countries increased but 49,000 tons, or 12 per cent. of a normal year's shipments. Even assuming that all this increase was due to war conditions, we should have at its close only a loss of 12 per cent. as against an immediate gain of 41.5 per cent. to supply current demand, and a much greater gain to supply the copper-vacuum.

So much for conditions of demand. On the "supply" side of the balance, there is little real evidence in favor of a movement toward lower prices. Continuous iteration of the phrase "conservation of natural resources" and growing understanding of the sound logic which lies behind it, has convinced copper producers of the wisdom of holding on to their stock until it can be disposed of at a good profit. The margin at the former average price of fifteen cents is not so large that there is anything to be gained by sacrificing prices to gain volume. Nor is there need to cut prices to keep the mines running. Experience in 1914 taught executives ways of maintaining practically full efficiency while producing to but 50 per cent. of capacity. With operating expenses fixed at about 10 cents per pound, the return on the investment will be just as great on 50 per cent output at 16 cents as on full output at 13 cents, and the unworked ore remains in the ground against the day of still higher prices. Restriction of sales will be still further aided by the large financial resources which have been laid by out of the enormous profits of the past eighteen months. By their aid it will be possible to put in stock quantities of metal, thus holding up the price and smoothing out the market-flurries which have formerly been so common.

Installation, Operation
Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Ocoee Power Station No. 2

By M. M. Samuels

The great advance in the design of large transformers of very high voltage and the remarkable progress in the evolution of high-tension switching apparatus has made it possible to build power plants and transmission lines for 120,000 volt and even higher. However, very few of these power plants built within the last few years show particular features which would be of much interest to the designing engineer. A great many of them have awkward wiring schemes, complicated high tension runs and unnecessary back and forth running of conductors. The reason for this is that in many cases little attention is paid to the electrical wiring when the preliminary building design is made up. It will therefore be of some interest to review a power plant which shows careful planning and construction from the electrical point of view, and which, as an electrical proposition may be put down as one of the simplest high tension layouts in this country. A first glance at the plan and cross section in Figs. 1 and 2 will show that all high tension runs are straight, short and direct, and that the arrangement of apparatus is actually as shown in the wiring diagram, Fig. 3, i. e., the energy goes in a straight line from the generators, through the low tension switches, transformers and high tension switches, to the line and no cable or wire runs backwards. It will also be seen that there is a maximum utilization of space and at the same time plenty of working space and clearance about conductors.

Location

The first hydro electric power house on the Ocoee River is located at Parksville, Tennessee, about forty miles northeast of Chattanooga, and about seven miles upstream from where the Ocoee River flows into Hiawassee River.

The second development which is herewith described, is located on the Ocoee River about 2 miles above the backwater of the lake of the first development.

Hydraulic Features

At the top of the development, 5 miles up the river from the power house, there is a timber crib diversion dam, and the flume which carries the water from the dam to the equalizing basin is about 25,000 ft. long supported by a bench, cut in the hillside. The flume and its appurtenances

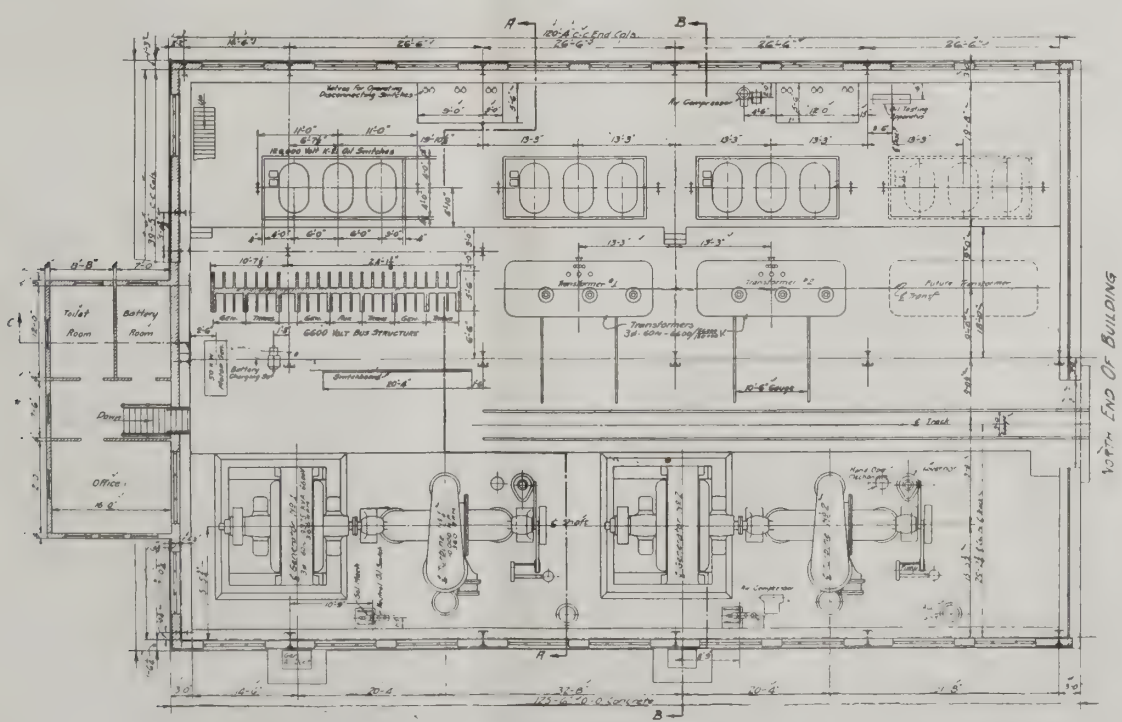


Fig. 1 Main Floor Plan, Ocoee Plant No. 2

deliver the water into a concrete intake built on the side of the mountain, 254 ft. above the water in the river at the power house site. The water is carried from the intake through two steel penstocks, eight feet in diameter down the side of the mountain to the turbines.

Apparatus

There are two horizontal shaft, spiral base I. P. Morris turbines driving General Electric generators, each 9725 kw. 3 phase, 60 cycle, 6600 volts, 3600 r.p.m., with direct connect-

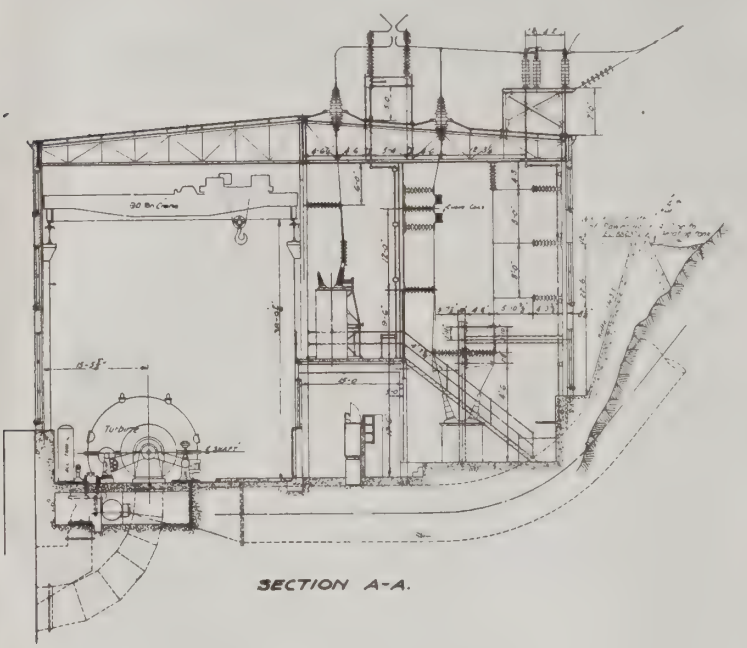


Fig. 2

ed 125 volt exciters and two G. E. transformers, each 9725 kw., 3 phase, 60 cycle, 6600-66000-120000 volts. The transformers are 20 ft. 4¾ in. long, 7 ft. 6¾ in wide, 18 ft. 7¼ in high over the high-tension terminals and weigh 200.000 lbs. each. Each transformer requires 47 gals. of cooling water per minute at full load.

There is also a 75 kw. 3 phase 6600-200-110 volt transformer, a 50 kw. motor generator set for auxilaries and a 3½ kw. motor generator set for charging the control storage battery. A compressor furnishes air for pneumatically-operated disconnecting switches and other purposes and an oil filtering outfit takes care of the oil for transformers and switches. The switchboard is of General Electric Company's practically standard design with mimic buses, between control switches. The high tension oil switches are G. E. Co. type K 21 and the low tension oil switches G. E. Co. type H 3.

General Arrangement of Apparatus

As mentioned before, the actual arrangement of apparatus follows remarkably close to the wiring diagram, a feature which will be found in very few large stations and to which the simplicity of wiring and conduit runs is largely due. The generators are arranged on the down-stream side of the station, which is the east side. The current and potential transformers are located in the generator pits, which are made large enough to provide ample working space and clearance. the air ducts run under the floor and turn up outdoors where suitable provision is made to prevent dirt from getting into the pits. Two generators were installed and provision made for a third one.

Further west are located the transformers. Each stands on a track whereon it can be moved and transferred by a special truck to another track which runs parallel to the transformers and at right angles to the individual tracks. There the transformer can be moved outdoors or the core can be lifted out by means of the 30 ton crane which runs the length of the turbine room.

South of the transformers is the switchboard and west of the switchboard is located the 6600 volt bus and oil switch structure. There is a gallery over this space where the 120,000-volt lighting arrester is located behind a suitable partition. Here also are the generator - field rheostats, which are electrically operated and the auxiliary station transformers. West of the transformers and bus structure the floor rises two feet on account of the slope in the penstocks. On this elevated part of the floor is arranged all the 120,000 volt switching apparatus.

Conduit System

The conduit system is remarkably simple. Nearly all the ducts in the floor are of fiber, and except for the control ducts coming up at the high tension oil switches, no bends or offsets exist. A series of manholes—or better, pull holes, as they are only one foot deep and can hardly be called manholes—is installed, and all the conduits run from manhole to manhole in straight lines. Cables for direct and alternating currents have separate manholes and 6600-volt cables do not come into the same manhole with 220 or 110 volt cables.

Concrete covers are provided for all manholes. Pipe couplings are installed in each cover and it can so be raised by means of a lifter made up of standard iron pipe.

A continuous pit is provided under the switchboard, which is partitioned off every 3 ft. All the conduits coming to the switchboard end in the pit and the cables are brought up through small pieces of pipe installed in the cover plate, which is part of the switchboard base. These small pipes are arranged in uniform sizes, spacing and height, and are located

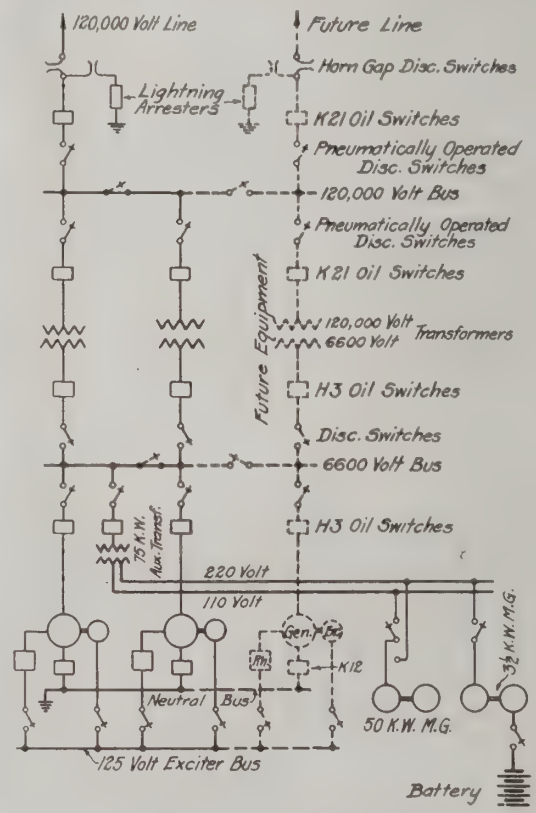


DIAGRAM OF CONNECTIONS

Fig. 3

opposite the terminals which they serve. All bending of cables back of the switchboard is thus avoided and an exceptionally neat switchboard arrangement of wiring is the consequence. A few short pipes are installed through the partitions in the pit to provide for interconnections.

Another similar pit is provided under the 6600 volt bus structure with ample space to accommodate potential beads and to allow for pulling of cables. All pits are provided with drainage outlets.

6600 Volt Bus Structure

The structure for the 6600 volt type H-3 oil switches and buses is built of concrete, for the reason that it was necessary to install most of the control conduits in the rear wall of the structure. A typical cross section of this bus structure is shown in Fig. 4, which is self explanatory.

High Tension Arrangement and Wiring

The most interesting feature of this station is the high-tension part. It may be said without fear of contradiction that there is hardly another station which shows an arrangement equal to this one, both as regards simplicity and economy of space. There is not one bend or offset in the whole installation; all leads run straight and direct.

The indoor disconnecting switches between the bus and the oil switches are pneumatically operated, and the valves are arranged on a platform which is built over the penstocks where they slope into the power house, which is another instance of utilization of space. The valves are solenoid operated and controlled from the switchboard. The high-tension insulators are post type, made up of strain disc units which are cemented together into one solid pillar. The outdoor disconnecting switches, which are located on steel work on the roof are of the horn gap type and are operated from inside the station by means of a simple pipe mechanism, three switches being operated by a single lever.

The lightning arrester is located indoors on a galley as mentioned above, as it was not considered advisable to use outdoor type arresters of such high voltage in the hot climate. However the horn gaps are on the roof and are operated from indoors by a simple pipe mechanism. The lines as well as the arrester leads are brought in through roof by means of high tension porcelain bushings made by the Ohio Brass Co., which are set in specially ingeniously constructed steel framing through the roof.

It was not necessary to install foundations for the 120,000 volt K 21 oil switches, since the switches themselves are high enough to make it impossible for anyone to come into accidental contact with any energized part.

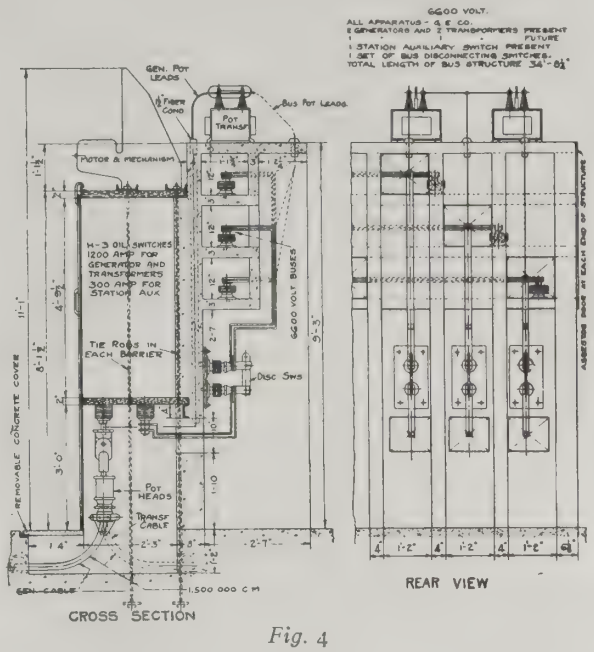
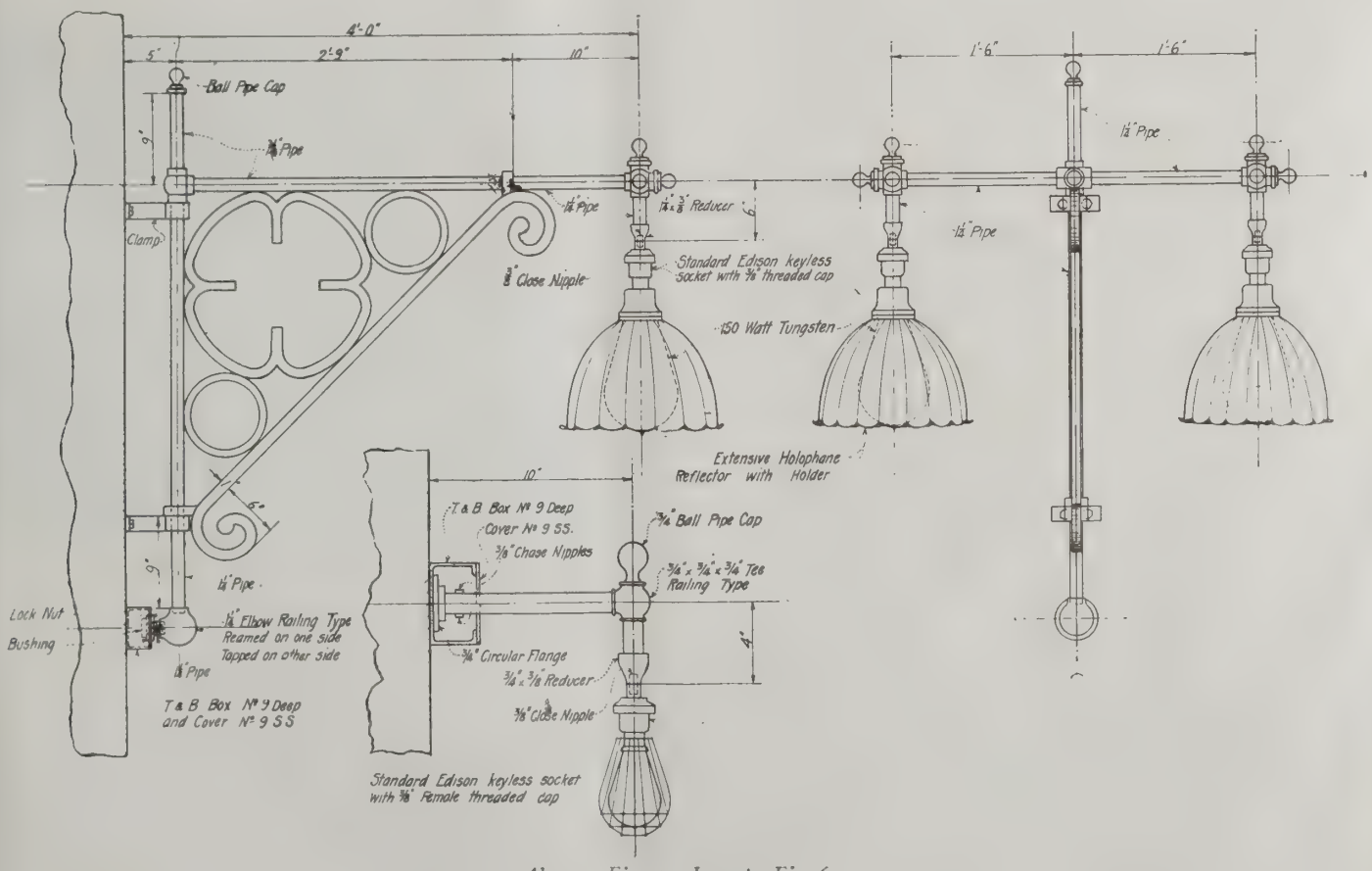


Fig. 4

A concrete drain is built around the oil switches as well as around the lighting arresters to prevent the oil from spreading in case of any accidental leak in the tanks.

The oil switches, as well as the arrester, are piped up to the oil piping system, so that they can be emptied or filled by opening the proper valves.



Above—Fig. 5. Insert—Fig. 6.

The generator neutral runs along the east wall and each generator is connected to it through a G. E. Co.'s type K-12 oil switch which is mounted on a steel bracket on the east wall and is electrically operated.

Penstock Control

The butterfly valves on top of the penstock are operated by direct current motors controlled from the main switchboard, where there are indicating lamps to show the position of the valves.

Lighting

A few short remarks about the lighting may be of some interest. The generator space is lighted by fixtures such as shown in Fig. 5. The fixtures can be turned out of the way to permit the crane to pass. Simple fixtures, such as are shown in Fig. No. 6 are used around the high-tension wiring. No shades are used there, as it was advisable to let the lamp throw its light in an upward direction, since for obvious reasons, no fixtures can be placed in places not easily accessible in high-tension rooms. Guards are provided over all lamps in the high-tension space to protect the filament from static influences.

Transmission Line

The transmission line from this plant to Parksville, a distance of about 8 miles, is a three-phase, double-circuit, 120,000 volt line on steel towers. Three 2-0 wires are used for power, a 5-16 in. copper-clad wire for ground. The towers will carry an additional circuit when the load demands one.

The design and construction of the power house as well as transmission line was done by the J. G. White Engineering Corporation, of 43 Exchange Place, New York City.

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Removing Moisture From Transit Oil

By Kennedy G. Rockworth

Transil oil or transiormer oil is known almost universally in the central station industry because it is used nearly everywhere, in high and low voltage transformers of large or small capacity, in circuit breakers for high voltage and heavy current, and in certain forms of cut out or fuses. Transil oil is used primarily as an insulating medium; secondly as a cooling medium, that is to say for carrying away heat from a warm to a cooler body as for example from the core and windings of a transformer to the case; and thirdly for the quenching of arcs by interposing a barrier of oil between two electrodes across which the arc is playing.

Transil oil is marketed in various grades, depending upon the dielectric strength, viscosity, flash point, freezing point, etc. Of all these the dielectric strength is the most important, although other factors must be taken into consideration according to the service for which the oil is to be utilized. In choosing an oil, beside the above characteristics, absence of impurities that will attack metals, promote sludging at high temperatures, throw down sediment under the influence of electrostatic stress, etc., must be guarded against. These are, however, problems with which the manufacturer is concerned to a greater extent than is the user.

Effect of Moisture

The dielectric strength of transil oil is the characteristic that concerns the user most, and one of the most important factors that enters into this phase of the matter is the presence of moisture. It is well known that the presence of moisture in oil lowers the dielectric although just to what extent this occurs is not very generally known. That only a very small amount of moisture has an exceedingly deleterious influence upon the dielectric strength is at once apparent from the curves shown. It will be noticed that these two curves give different actual values of dielectric strength although the shape of the curves is very similar. The difference is due to the use of different frequencies and electrodes of different shapes.

The dielectric strength test or breakdown test is the recognized method for testing oil for moisture because it is the criterion as to the fitness of the oil, it is most sensitive—it would be rather difficult and far more tedious to determine the presence

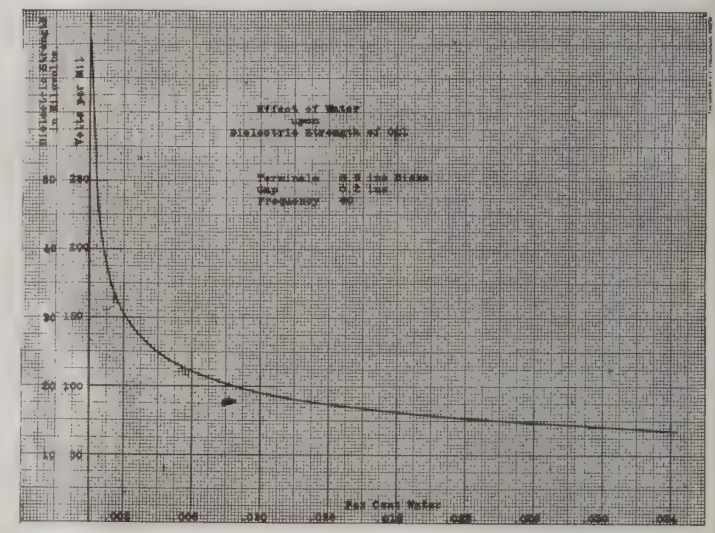

Fig. 1. Effect of Water at Frequency 60 Cycles

of two-thousandths per cent. of moisture by chemical means—and simple. Specifications are drawn up giving the dielectric strength, expressed in volts per mil. The manufacturers supply oil-testing apparatus for testing their oil, hence the desirability of standardizing the shape, spacing etc., of the electrodes must be apparent from the above curves. If electrodes of various shapes are to be used they should be calibrated and a curve plotted so that the relation between various breakdown voltages and different sizes and shapes of electrodes is known. It is however,

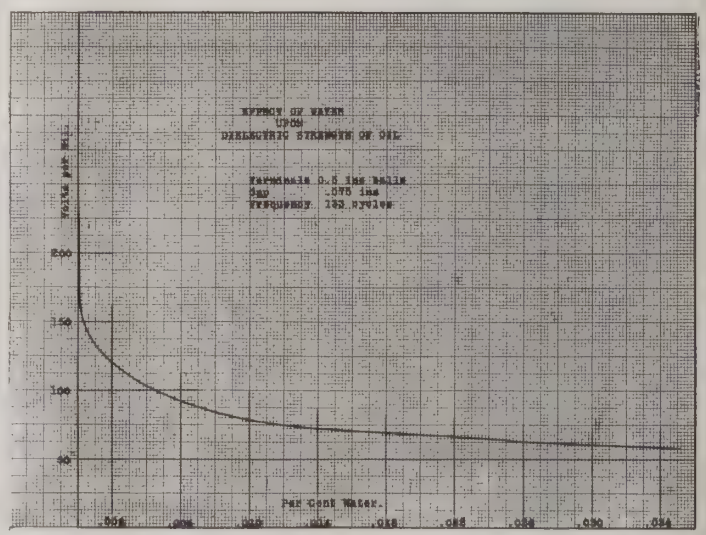

Fig. 2. Effect of Water at Frequency 133 Cycles

far simpler to adhere to electrodes as supplied by the manufacturer.

Rough Tests for Moisture

It often happens that oil is being used to fill transformers, circuit breakers, etc., far removed from a source of electric supply suitable for testing purposes. In this case it is impossible to apply a high potential or breakdown test to the oil although the need for knowing whether or not it is free of moisture is as important as ever. There are methods that are at once comparatively simple and reasonably accurate for determining the pres-

ence of moisture in oil. These methods, unlike the dielectric strength test, give only an indication of the presence of moisture and do not show just what amount is present. They are however, better than no test whatever.

One of the best-known methods for determining whether water is present or not is to take a sample of oil (always take the test sample from the bottom of the container because water having higher specific gravity than oil sinks to the bottom) and plunge a red-hot iron into it. If moisture is present there will be heard a hissing sound; if there is absence of moisture there will be no sound. Another method, and one that is more accurate than the one mentioned above, consists of obtaining a few lumps of calcium carbide which are to be dropped into the sample of transil

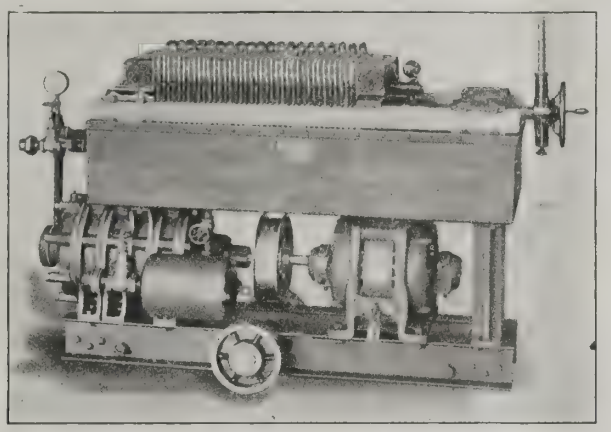

Fig. 3. Oil Filter and Pump

oil. When these lumps of calcium carbide reach the bottom of the vessel containing the oil, which should be preferably transparent, gas will be given off if moisture is present, and bubbles generated will immediately rise to the surface of the oil.

There is yet another method for determining the presence of moisture, which is probably more accurate and sensitive than either of those previously mentioned. Obtain some copper sulphate crystals and dehydrate them (dehydrate means to dry them by heating until all moisture is driven off). When the copper sulphate is properly de-hydrated the residue will be a white powder known as anhydrous copper sulphate. Now pour a little of the transil oil slowly and drop by drop upon the anhydrous copper sulphate. If moisture is present the white powder will revert to its original color of bluish green. This test is a very sensitive test, and is recommended where the dielectric strength test cannot be carried out.

Protection of Oil From Moisture

Transil oil is highly hygroscopic, that is to say it will take up moisture from the air very readily. The great importance therefor, of protecting it properly from the rain and the damp air, especially in view of the rapid deterioration in dielectric strength of even small amounts of moisture, is readily seen. Barrels should always be kept tightly closed, metal barrels containing oil should be stored so that the bung or outlet is not in such a position that rain will collect round it.

The best way to safeguard apparatus is to keep the oil free from moisture, the next best to test for moisture before using any oil whatsoever. If moisture exists the oil must be treated so that it is removed. There are several ways of removing moisture from oil.

Removing Moisture by Filtering

The most satisfactory, and the one most generally used consists of filtering the oil, which has the further advantage in its favor of also eliminating slime and sediment. The oil is pumped through a number of filter papers under a pressure of between 25 and 100 pounds per square inch. These filters, which are designed especially for this class of work are motor driven, and may be stationary or portable according to choice. The filter contains from 14 to 20 separate chambers partitioned off by iron plates between which are placed pieces of filter paper. An outfit having twenty chambers will utilize forty separate sets of filter papers of three to five thicknesses each.

Drying by Heating

Often a filtering apparatus is not available, and some other means must be taken advantage of for eliminating the mo' ture A favorite method consists of drying the moisture out of the oil by heating. Great care must be taken that the oil be not damaged on account of being heated to sufficiently high temperature to partially carbonize. Where possible the oil should be placed in a vacuum, as by this means the boiling point of water is lowered considerably. For example where a vacuum of 28 inches can be maintained the boiling point of water is approximately 40 degrees C instead of 100 degrees. Usually when on the road it is impossible to obtain a vacuum, and the oil must be raised to 100 C, care being taken that more than 110 be not exceeded This can best be done by gas or similar form of easily controlled heat. Three containers should be used, connected together by pipes, through which the oil may be circulated by a power-driven pump. The water-saturated oil is stored in one tank, the middle tank is set above the heater, and the third tank is situated beside the middle tank. The middle tank is heated until the desired temperature of 110 to 100 degrees is obtained, and the oil from the storage tank is gradually fed in, preferably by gravity and controlled by a valve so that the temperature of the oil is kept within safe limits. After the oil has been at 100 or 110 degrees a sufficient length of time it is pumped into the third tank. This process may be repeated several times if necessary. As transil oil is rather inflammable care must be taken in this respect. Heating the oil as described is undesirable because of the likeihood of damaging the oil due to excessive temperatures, and the possibility of fire. On the other hand it is very often the only solution out of the dilemma, where the oil contains a large amount of water, as differentiated from moisture.

Drying by Absorption

Yet another method, that is applicable where the oil is not only moist but so moist that it may be said to contain water, is to use calcium chloride or unslaked lime. The oil is poured over the lime, which absorbs the moisture, and the oil passes away to

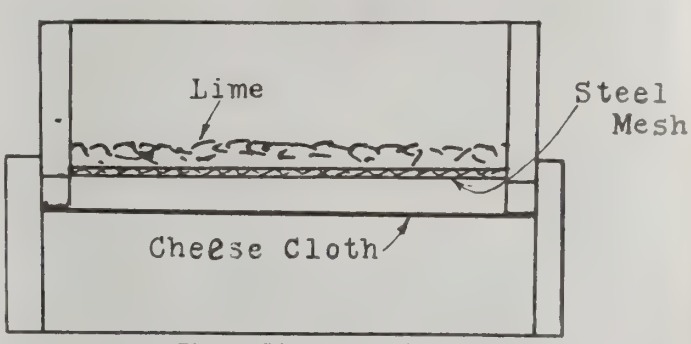

Fig. 4. Lime Absorption Method

the vessel below. One temporary method of utilizing this method when placing six oil-cooled 1000 kw transformers in service by the writer recently is shown in Fig. 4. Two wooden boxes of dried wood were built, the one fitting into the other. Pieces of wire mesh were fastened to each. On the upper one the mesh was covered to a thickness of about two to three inches with lime. The bottom mesh was covered with three layers of cheese cloth that had been previously thoroughly dried. The oil barrels were set up somewhat above the filter and the oil slowly passed through the lime, then through the cheese cloth where all sediment and foreign matter was retained. A barrel that had been previously dried was filled with oil and samples taken from time to time. All samples indicated that the moisture had been removed. The lime was changed several times during the operation, more as a precautionary measure than because of necessity.

In addition to the above methods, which may be modified in methods of performance, water may be separated from oil by electrostatic means or mechanically. The former method permits the dry oil of lighter or lower specific inductive capacity to pass into a comparatively weak electrostatic field, while the water which has greater specific inductive capacity to be held in the stronger field. The latter, or mechanical method, takes advantage of the fact that water has higher specific gravity than has oil, hence sinks to the bottom. Both methods are hardly applicable as temporary measures where there is little apparatus available and equipment must be placed in service with as little delay as possible.

Summary

All transil oil should be tested for the presence of moisture, the more so the higher the voltage. The best way to do this is by applying a high potential test, and where this is not possible by the reaction with copper ulphate. When oil must be dried the filter press is the best way to do it, and in its absence the lime offers the quickest, safest and most convenient way. Transil oil must be treated carefully in the presence of a bare flame, such as fire, and this must be borne in mind where heating is restorted to. The whole success of many electrical systems depends upon the oil used in the transformers, oil circuit breakers, etc., and every one whose duty it is to care for apparatus of this nature should familiarize himself with the methods of caring for the oil, because he will surely have to use his knowledge, and in a hurry, at some time.

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Motorcycle Helped Light a Town

When the town of St. Charles, Mo., was left in darkness at 9 o'clock one night several weeks ago by the breaking of the high pressure cable from the great Keokuk dam on the Mississippi an Indian motorcycle helped to save the situation in a unique manner and keep the town lighted. Before the town secured current from the Keokuk dam it was lighted by a steam power plant which drove a 150-kw. generator. When the engineers came to look up the abandone steam plant they found it possible to get up steam and run the big generator, but discovered at the same time that a very important auxiliary, the little exciter generator which is run in conjunction with the big one to excite the fields of the 150-kw. was out of commission. The sub-station of the Keokuk plant, however, is of the same general type except that the generators there are driven by motors which take currrent from the transmission line. The exciter at the substation was available and if power could be obtained to run it the current could be transmitted to the old steam plant and by a combination of the two units the town would be lighted. About that time it occurred to E. F. Waye, electrician and trouble man employed by the Electric Company of Missouri, that there was power enough in the engine of the Indian motorcycle which he rides, if it could be harnessed.

No sooner said than done. He set his motorcycle on the stand, took off the tire, slipped on a belt from the rear wheel to the pulley of the little exciter and started his gasolene engine. For an hour and a half he pulled the exciter and furnished the city with light while the wires to the Keokuk dam were repaired. The motor was run on wide open throttle the whole length of time that the emergency service was required.

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The Condenser Type Lightning Arrester

The best way to protect electrical apparatus from lightning when not in use is to disconnect it from the line. If this is not feasible, practically perfect protection can be obtained by grounding the line before it reaches the apparatus. Neither method, however, could be adopted to protect apparatus when in use until condenser type arrester made the latter method possible. Formerly it was thought that to ground a line as a protection agains lightning would necessarily result in a short circuit of the power current with disastrous results. It was not realized, however, that a direct-current line could be grounded so far as lightning was concerned yet be perfectly insulated with respect to the power current. This is possible due to the characteristics of an electric condenser which is an insulator so far as direct current is concerned, but an increasingly good conductor of alternating current the higher the frequency.

Thus a one microfarad condenser is an insulator on direct current and has an impedance of less than 3,000 ohms on 60 cycles. On 60,000 cycles, however, its impedance is less than 3 ohms, and on 600,000 cycles it is less than 0.3 ohm. Inasmuch as lightning surges are always of very high frequency, or what amounts to the same thing, of every steep wave front, it is evident that a condenser connected between line and ground affords almost a short circuit for the lightning and consequently most effective protection to the apparatus. On the other hand no power current can follow the discharge and there is no need therefore of special means such as circuit breakers, magnetic blowouts, etc., to insure that the arrester shall clear itself after a discharge.

The commercial arrester for street car protection consists of 1 microfarad condenser of high dielectric strength connected in series with an adjustable spark gap and shunted by a very high resistance. All are enclosed in a weatherproof cast iron box. The spark gap can be set very close to the operating voltage since it has no power arc to break, or it may be short circuited entirely if preferred. It affords a place to insert a tell-tale paper in case a record of discharge is desired. When a gap is used the resistance shunting the condenser keeps the latter discharged and gives the arrester slightly greater effectiveness. Where the motor insulation is known to be very weak so that no lightning arrester having a spark gap could give protection, it is usually still possible to operate reliably by protecting the motor with condenser arrester with the gap closed. Such an arrester gives protection against all abnormal surges without requiring any use of voltage to put it into operation.

Not the least advantage of the condenser arrester is the fact that it requires no maintenance expense whatever once it is installed. This is a great advantage over the electrolytic arrester which is its only competitor from a protective standpoint for this service.

The condenser arrester can be used equally well for the protection of station apparatus or as a line arrester. It has in certain cases been found very valuable on the alternating current side of rotary converters as a protection against electric disturbances coming in over the alternating current line and through the transformers. On the direct current side they have been found useful in protecting against commutator flashovers. The use of condensers in *shunt* to apparatus as a protection against high frequencies is only the natural corrollary of the use of choke coils in series for the same purpose.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Commutation of Direct-Current Motors

By Norman G. Meade

To fully understand the phenomenon of the commutation of direct current motors, it is necessary to comprehend the fundamental principals of direct-current machines. Generators and motors are essentially the same in design, but the wire range of motor applications requires modifications in the motor's design to meet special requirements, and commutation is one of the most important features.

In Fig. 1 the upper sketch represents an electro-magnet with lines of force passing from the north to the south pole as indicated by the fine parallel lines. The left-hand black disk represents a conductor in which there is no current flowing; the right-hand disk represents a conductor in which

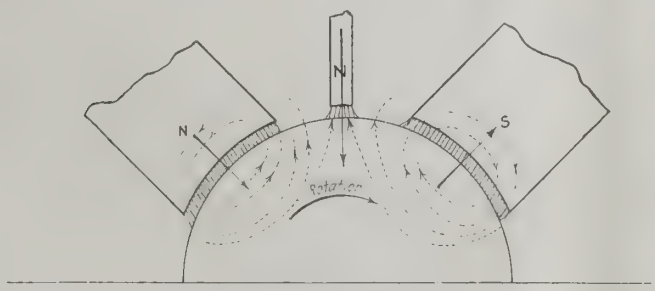

Fig. 1

current is assumed to be flowing in a direction away from the observer at right angles to the direction of the lines of force. A current flowing in a conductor causes lines of force to encircle it as indicated by the circles surrounding the conductor. If the current is flowing away from the observer as in the present case the direction of the lines will be clockwise as indicated. If the current flows towards the observer the direction of the lines of force will be counter clockwise. Now referring to the right sketch in Fig.1, it is assumed that the current in the conductor is flowing away from the observer, therefore the lines of force set up by the current in the conductor add to those of the field flux above the conductor and tend to repel those below the conductor. The lines above may be likened to rubber bands in tension that tend to force the conductor downwards as indicated by the arrow. Under the conditions set forth this would be the direction the conductor carrying a current would move. It will be seen that this is just the reverse of a generator as in the latter case the conductor would be forced in the opposite direction by mechanical power and voltage would be generated in the conductor.

From the foregoing it will be apparent that the armature winding sets up a magnetomotive force which acts at right angles to the field magnetomotive force. Evidently the effect of the armature current will be to shift the field so that the flux is greater at leading pole tips. It is necessary that the current be reversed in the coils short-circuited by the brushes so that it flows in a direction the same as that which it will flow when the short-circuited coils leave the particular brush in its rotation. This reversal is accomplished by generating in the conductors a counter-electromotive force which is opposed to the former current. The brushes therefore must have a backward lead in order to bring the short-circuited coils under the influence of the trailing pole pieces. The current set up by this connter-electromotive force flows in the same direction as that of the current in the armature conductors when the short-circuited coil leaves the brush. The direction of the impressed electromotive force, and in conseqence the current, is indicated in Fig. 2.

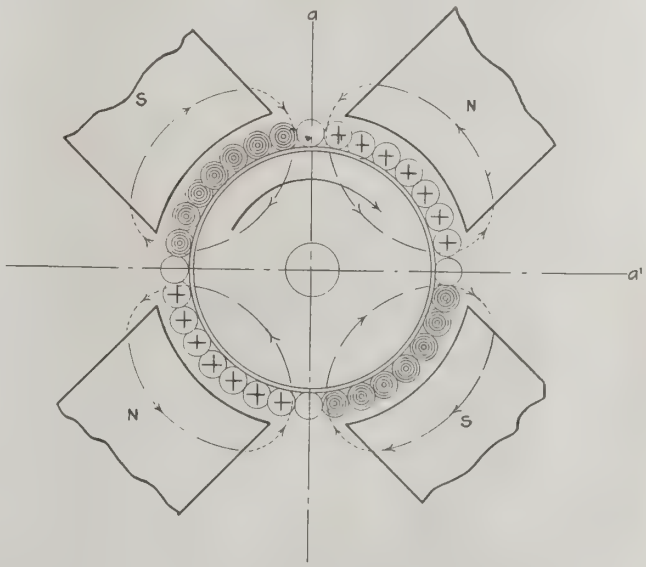

Fig. 2. "+" Indicates Current Flowing Away From Observer

Shifting of the brushes brings into play the armature conductors included between the double "angle of lead." The current flowing in these turns which produces "back ampere-turns" tends to demagnetize the field. In Fig. 3 a and á represent the brush positions and L the double angle of lead, here exaggerated for clearness. Let the conductors ly-

ing within the angle represent the back ampere turns and the balance of the armature conductors the "cross ampere turns." The latter produce the flux which acts at right angles to the field flux and tends to shift it. Let O-b and O-b' represent the back ampere-turn magnetomotive force and b-c and b'-c' the cross ampere-turn magneto—motive force. These act at right angles and when resolved into a parallelogram of forces have the resultant diagonals d-d' and e-e', which represents the center-line of the theoretical path of the distorted field flux.

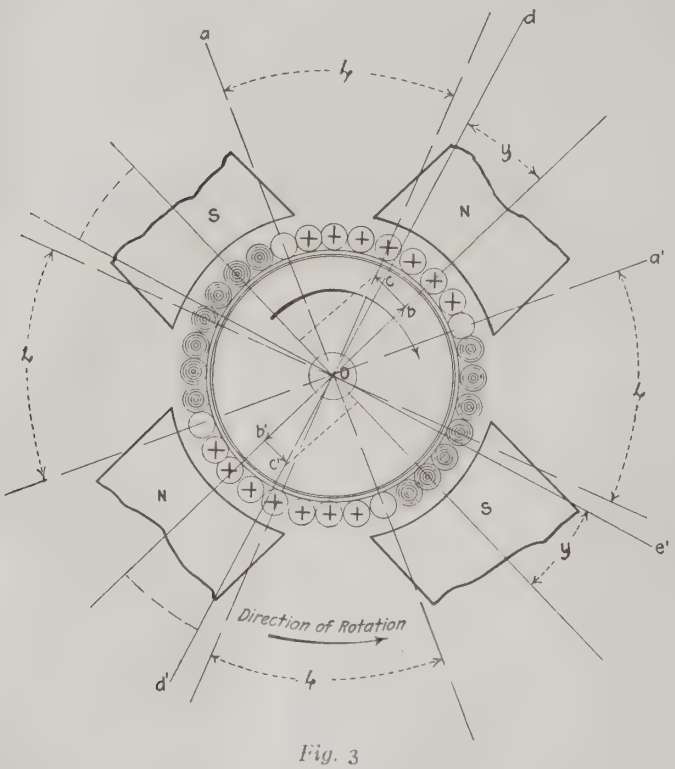

Fig. 3

Obviously the armature ampere-turns, and hence the distortion, well vary with the load, so that for perfect commutation the brushes have to be shifted as the load varies. In practice the brushes are set for full load conditions and the sparking at light loads is negligible.

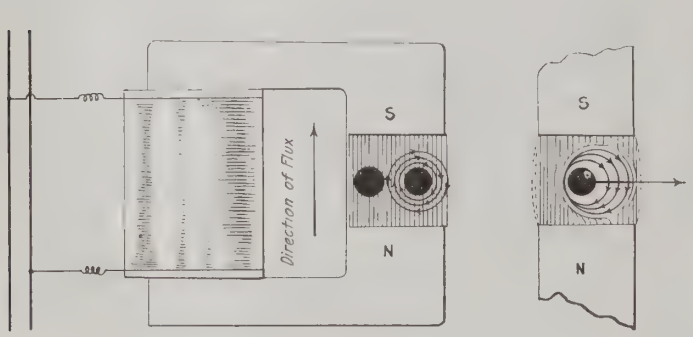

Fig. 4

To secure good commutation in direct-current motors under widely varying conditions of speed and service, the interpole, or commutating pole motor has been developed. This type of motor is equipped with small poles placed midway between the main poles as shown in Fig. 4. The winding of the auxiliary poles are connected in series with the armature and produce a flux that induces the desired electromotive force in the short-circuited coils and sparkless commutation is secured without shifting the position of the brushes for any load within the range of the motor.

Voltage Control of Rotary Converters

It is a well-known fact that the voltage across the direct-current brushes of a rotary converter depends on the method of connecting the armature coils and on the alternating-current voltage. Adjustment of the field excitation will not, therefore, change the delivered d. c. voltage, as it will on a direct-current generator. There are, however, quite a number of ways in which the voltage may be varied, either automatically or by hand. All are based on variation of the impressed alternating e.m.f. and are both interesting and ingenious.

The classical method for varying the continuous voltage of a rotary converter is known as the series reactance method. It is based on the fact that the alternating-current drawn by a rotary converter may be varied in phase by the adjustment of the field strength. When for a given load the field rheo-

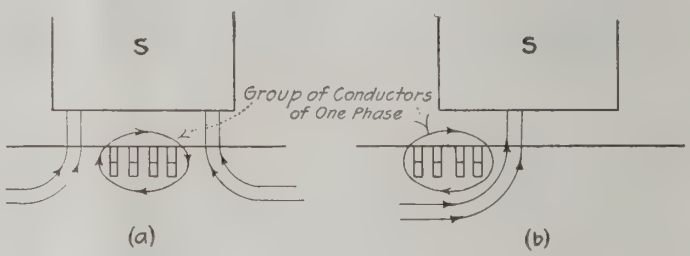

Fig. 1

stat is varied so that the alternating current input is a minimum, then the current is in phase with the voltage. If the field is weakened, the current will lag, and if it is strengthened the current will lead. The explanation of this is as follows:

From the a. c. side the rotary converter behaves like a synchronous motor. When a motor of any type is in operation a counter—e. m. f. is generated which is just enough less than the impressed e. m. f. to allow the necessary current to flow through the impedance of the windings. If the field of a synchronous motor produces a flux which is too great for this purpose, the armature currents automatically take such a value and phase relation as to keep the flux at the proper amount. If we consider the group of coils which constitute one phase we shall find that if the current they carry is in phase with the voltage, it will have no effect on the total flux (see Fig. 1, (a), for it will reduce the flux on one side by as much as it increases it on the other. If, on the other hand, the current leads the voltage it will tend to reduce the flux, as shown in Fig. 1, (b). Hence when the need arises, the current shifts its phase to lead the voltage by the proper amount.

If now we have a line between the generator and the rotary converter which contains inductive reactance, we have the condition shown in Fig. 2. If the load were a resistance

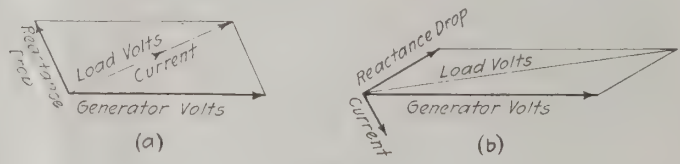

Fig. 2

only, the current would lag behind the voltage, due to the reactance of the lines and the voltage across the load would be less than across the generator. In this case, we can force the current to lead the voltage, and so the reactance drop is "swung" into such a position that it makes the load voltage greater than the generator voltage. When the "load" is a rotary converter, this means that the d. c. voltage will rise.

In actual practice this method is used to make the converted voltage rise from no load to full-load automatically. If a 10 per cent. increase is desired, the converter has suffi-

cient series turns on its poles to make it overcompounded 10 per cent. as a d. c. generator. Included in the circuit is reactance of such amount that from 12 to 15 per cent. of normal voltage is required to force full-load current through it. With the converter running at no-load the shunt field is so adjusted that about 30 per cent. of full-load current is flowing in the line. This current has only a small component (enough to supply losses) in phase with the generated voltage; the rest is lagging wattless current. This produces some line drop so that the voltage at the converter is slightly less than at the generator. As the converter output is brought up to full load the shunt field being left unchanged, the line current becomes leading so that the power-factor is about .90. Under this condition Fig. 2 (b) applies and the voltage at the converter becomes greater than at the generator. The percentage rise from no-load to full load is decreased through ohmic resistance of the line by practically the number of per cent that represent the ratio of line resistance drop to terminal voltage.

The d. c. voltage of a rotary converter may be varied also by varying the a. c. voltage applied to it through any of the familiar means. Feeder-regulators of the locked induction-motor type, in which the position of the rotor with respect to the stator may be varied, are controlled by a relay which may regulate for voltage either constant or increasing with the load. The Stillwell type of regulator, in which a varying number of turns of a transformer winding can be cut in by means of a rotating switch, is also suitable.

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The Split-Pole Rotary Converter

By Prof. William R. Bowker

Another means of varying the direct-current voltage of a rotary converter is through the use of auxiliary field-poles which affect the alternating e. m. f., but little while producing a considerable change in the direct-current voltage. The principle of operation of a regulating-pole converter will be clearly understood from the following description and explanation.

The machine has a field structure as shown in Fig. 6, somewhat resembling the field magnets of a direct current generator with commutating poles, but with the armature brushes so set that one of the regulating poles adds its field flux to that of one main pole, cutting the conductors be-

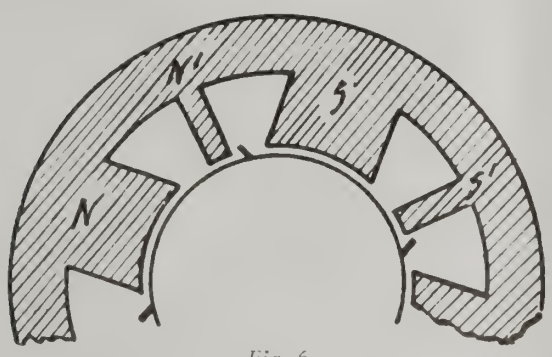


Fig. 6

tween two direct current brushes. N, S represent the main poles, and N^1 S^1 the regulating poles of the machine. The regulating pole is shown with a width equal to 20 per cent. of that of the main pole.

To obtain definite numerical values, it may be assumed that the machine at normal speed, with the main poles excited to normal flux density, but with no excitation on the regulating poles, gives 250 volts direct current. If each regulating pole is excited to the same flux density as the main poles; and with a polarity corresponding to that of the main pole in the same section between brushes, the d.c. voltage will rise to 300 volts, at the same speed, since the total magnetic flux cutting the conductors in one direction between brushes has been increased 20 per cent. If, on the other hand, the excitation of the regulating poles is reversed and increased to the same density as that of the main poles, the d.c. voltage will decrease to 200 volts, since in this case the regulating poles give an e. m. f. opposing that generated by the main poles. If the machine is equipped with collector rings; i. e., if it is a converter, this method of varying the d.c. voltage from 200 to 300 volts does not re-

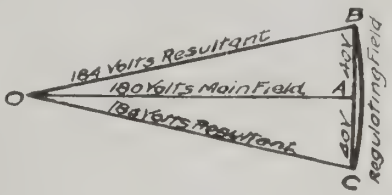


Fig. 7

sult in as great a variation of the a.c. voltage; in fact the a.c voltage will be approximately the same when delivering 200 volts as when delivering 300 volts d.c. if the main field excitation is the same. This is illustrated in Fig. 7, which is a diagram showing the a.c. voltage developed in the armature windings by the two sets of poles. The horizontal line O A represents the a.c. electromotive force generated by the main poles alone, with the regulating poles unexcited; that is, when delivering 250 volts direct current.

For a six-phase converter O A measures about 180 volts diametrical, that is, between electrically opposite collector slip rings. If now, the regulating poles are excited to full strength, to bring the d.c. pressure up to 300 volts, the a.c. voltage generated by the regulating poles will be 90 degrees out of phase with that generated by the main poles (since they are spaced midway between the main poles), and will be approximately 40 volts as shown by the line A B. The resultant a. c. voltage across the slip rings will be represented by the line O B with a value of 184 volts.

If, on the other hand, the regulating poles are operated at full flux strength in the reverse direction so as to cut the d.c. voltage down to 200 volts, the a.c. voltage of the main and regulating poles will be O A and O C respectively, giving the resultant O C equal to O B with a value of 184 volts.

It must be borne in mind always that the generated direct current e. m f. is due to the algebriac sum of the flux produced by the two sets of poles, while the generated alternating (counter—) e. m. f. is due to the vector sum of the fluxes. If then we desire to keep the a.c. voltage constant we may weaken the main field so that the voltage O A when added vectorially to that due to the regulating poles A C shall make O C equal the former value of O A— in this case 180

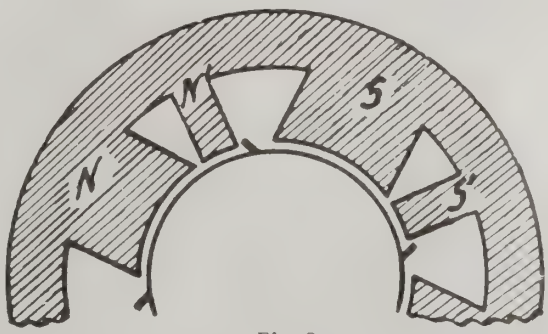
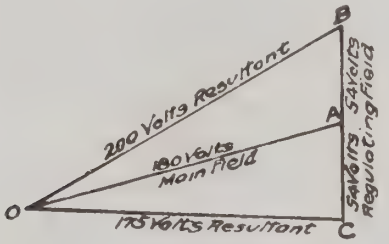


Fig. 8

volts. A constant total flux may thus be obtained equal to the radius of the circumference B A C (Fig. 7). In this instance, the line O A representing the main field strength, will equal O B when the regulating field is unexcited, and 250 volts can only be obtained at this adjustment. This method of operation gives unity power factor with a constant

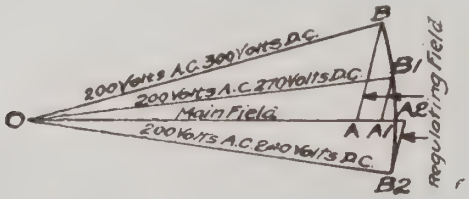
impressed alternating e.m.f. of 184 volts and a range of direct current voltage from 200 to 300 volts.

In practice the machines present a modified construction to that shown in Fig. 6; the regulating pole being located closer to its corresponding main pole as shown in Fig. 8. Except for a slight magnetic leakage that takes place between the main pole and auxiliary pole when the latter is opposed to the former, that is, when the d.c voltage is being decreased, the effect on the d.c. voltage is unchanged by the location of the regulating poles nearer the leading pole than the trailing pole.



The effect, however, on the a.c. voltage results in different numerical values being obtained as shown in Fig. 9, due to varying the regulating field strength of a machine proportioned according to Fig. 8 from a flux density equal to that in the main poles to the same density reversed; the flux density of the main pole field remaining constant. The d.c. voltage in this case varies from 30 per cent. above that produced by the main field alone to 30 per cent. below. or from 325 to 175 volts while the alternating current voltage varies only from 200 to 175 volts.

To maintain the a.c. voltage constant with such a machine the main field must be strengthened as the regulating field is weakened or reversed so as to reduce the d.c. voltage. This strengthening increases the core loss, particularly on low direct current voltages, which, however, are seldom required, hence a machine proportioned as in Fig. 8, would not be operated through so wide a range as 175 to 325 volts. Assuming therefore that the range is 240 to 300 volts, and at the highest voltage both main and regulating fields have the same field density, presenting to the armature practically one continuous pole face of uniform flux density.

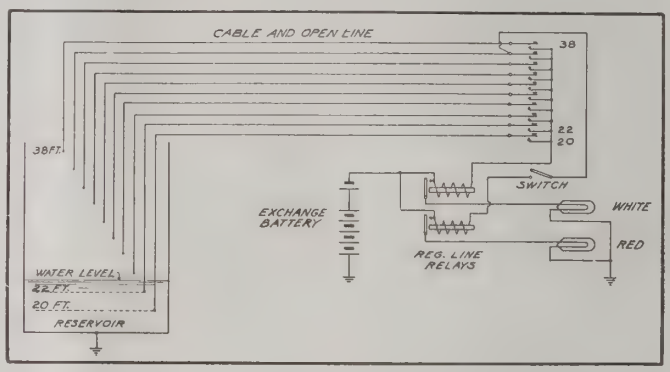


The diagram of a.c. component voltages to give constant a.c. resultant voltage across the slip rings for this case, is shown in Fig. 10. At 300 volts direct current the main field produces an a.c. voltage O A and the regulating field a voltage A B with a resultant O B equal to about 200 volts alternating current. At 270 volts direct current the main field produces an a.c. voltage O A^1, and a regulating-field voltage A^1 B^1, giving a resultant a.c. voltage O B^1, equal to 200 volts. Similarly, at 240 volts direct current, the main field produces an a.c. voltage O A_2, and the regulating field (now reversed) produces the counter or opposing voltage A_2 B_2, giving the resultant O B_2 again equal to 200 volts.

It will be noted that theoretically the main field strength must be increased about 15 per cent. above its value at 300 volts d.c. in order to keep the d.c. voltage at 250 volts.

Water-Level Indicator

An ingenious electrical water-level indicator is described by Henry C. Larrabee in a recent issue of *"Telephony."* A plank about 10 in. wide and 18 ft. long is fastened vertically to the side of the reservoir or tank. Ten bare No. 10 copper wires are stapled to the plank about an inch apart and cuts off so that the end of each will be 2 ft. above its neighbor to the left. Each wire is then connected through cable to the measuring station where a group of push-buttons are installed. These are numbered according to the level of the water when it is touching the respective wires to which they connect. Ordinary telephone line-relays were used as shown, and a 24-volt battery.



When the operator wishes to know the height of the water, he presses one button after another. If the water is above the end of any given wire, circuit is closed through, and the relay lights the white lamp. When at length on pressing a button the lamp fails to light, it indicates that the water has not reached that height. In order to give an alarm when the tank is nearly full, one of the wires is tapped off to a second relay, which automatically lights a second lamp. As soon as its indication has been noted, it is cut out by the switch.

An arrangement such as this can be used in a great variety of combinations. It has the advantage that a low-voltage battery can be used to operate the relays, which in turn may control 110-volt lighting and bell circuits.

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Questions and Answers

Operation of a Direct-Current Motor

Q. For the benefit of a class in elementary electricity will you please explain how current flowing in the armature conductors of a d.c. motor pulls them across the pole-face and makes the motor run?

F. C. N.

Around every current-carrying conductor there is a magnetic force which is commonly said to produce "lines of force." These lines form closed loops about the conductor and have two properties of importance here: (1) They are inseparable from the conductor and if pushed aside will exert a force on the conductor; (2) The presence of other lines will tend to push them in the direction which will make the concentration of lines less.

When a conductor carries a current *away* from the observer, the magnetic force acts in a clockwise direction. An easy way to remember this is to consider that a right-hand screw is turned in this direction when we want it to move away from us. Suppose now we have a field of lines produced by an electro magnet and in it a conductor carrying a current away from us. At first the conditions will be as in Fig. 1 (a) where the two lines *c, d,* separate and pass on either side of the conductor. But on the left side of the conductor the magnetic forces acting in opposite directions cancel each other, so that we have the condition shown in (b) where the circular line has united with the line *d,* and there are two lines on the right and none on the left. (The line due to the conductor still encircles it; but its path is now through the iron of the magnet). The lines *d* and *e* are now closer together than *c* and *d*, so that *d*

will be forced to the left, and as part of *d* is, so to speak, tied to the conductor, it too will be forced to the left.

If in the same field another conductor were carrying a current in the other direction the result would be reversed, i. e., that conductor would be forced to the right, and if the two conductors were mechanically connected they would tend to rotate. That is exactly what we have in the bipolar motor. The armature winding is so arranged that under each pole all conductors carry current in the same direction. The force in the case shown in Fig. 2 is such as to move the top conductors to the left and the bottom conductors to the right. As they are firmly fastened to the iron of the armature they cause the latter to rotate counter-clockwise. The arrangement of brushes and commutator is designed to make the current in the conductors flow always in the right direction. The truth of this will be easily seen by tracing the path of current through the armature from a positive to a negative brush. It will be found that the connections are made so that the current flows *down* in front of one pole, *back* in front of the next and so on, always flowing in the same direction under poles of the same sign. P. B. F.

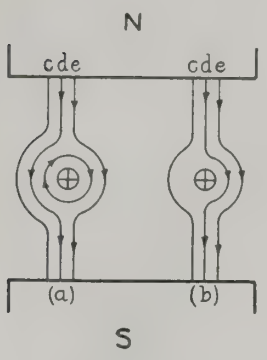

Fig. 1

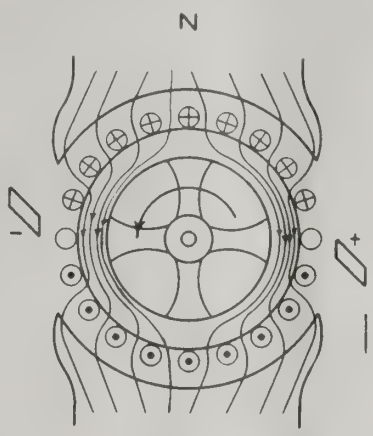

Fig. 2

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Change of Field Connections

Q. What determines the direction of rotation of a shunt wound generator, in order to make it generate, which it will do only when running in a certain direction? Why does a direct current dynamo generate only when running in one certain direction? I have a shunt wound generator counter-closed wire rotation, but wish to change same to clash-wire rotation, therefore would be pleased to have you inform me on this subject. The above generator is a 2-pole machine, 32 volts, 7.5 amperes. E. S.

A. Our correspondent is not quite correct in saying that a direct-current machine will generate only when running in one direction. It will generate in either direction but will "build up" its voltage only when rotating in the direction in which it was last run. There remains in the field a small amount of residual magnetism, and when the machine is started it induces voltage enough to send a small current through the field windings. If the connections and rotation have been unchanged, this current will add to the field magnetism and increase the generated voltage, which will in turn increase the current in the field. But if either the shunt field connections or the direction of rotation have been reversed, the first small induced current will subtract from the residual magnetism and speedily wipe it out. Then it may be impossible to get the machine to build up, even if matter be righted, until the field is remagnetized by connecting batteries to it. If, however, the direction of rotation and the shunt field connections are both reversed, the generator will "build up" as usual.

If the change of wiring is made in this way, the polarity of the generator terminals will be found to be reversed. As this is generally undesirable, it is customary to leave the field connections unchanged and interchange the leads to the brush-holders. Z. S. C.

Q. What is the couse of an a.c. fan motor failing to start when current is thrown on and what is the remedy? L. S. M.

A. The a.c. fan motor is either a series-wound commutator motor or a single-phase induction motor. If it is of the former type, as may be determined from the presence of a commutator and brushes, these should be inspected for good contact at the rubbing surfaces. If no trouble is found, and there is no current flowing through the motor when voltage is applied, there is an open circuit somewhere. To test for this connect the leads of a lamp of the same voltage as the circuit across one coil after another of the motor. The lamp will light when connected across the "open." If, however, current will flow through the motor but it will not run, the current flow for a time, watching for the development of any "hot-spots." These indicate a short-circuit which must be located and fixed.

However, the most common difficulty with fan motors occurs with the single-phase induction-motor type. Many of these are provided with a switch in the rotating element which closes when the speed reaches a certain value. If this switch fails to open as the motor slows down, the motor may fail to start when power is again thrown on. If, however, it is spun by hand, it will pick up after it reaches a certain speed. Should the rotor winding be open, the motor will not pick up at all; the hum of the current in the stationary windings will indicate whether or not current is flowing in them. "Hot spots" should be watched for here as before.

If our correspondent will tell us just how his motor behaves and also what data is on the name-plate, we shall be glad to advise him further. H. R. O.

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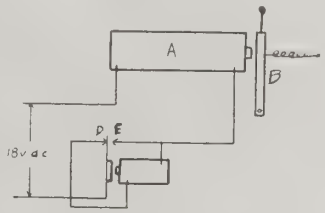
A Relay Problem

Q. I should like some help on a relay problem for which I cannot find a satisfactory solution. The magnet A has a core of solid Norway iron 0.25 in diameter and 2.5 in. long. Due to space limitations the diameter over the windings must not exceed 0.5 in. The armature B is of steel, 0.25 in. from the pole-tip when open and 0.0625 in. when attracted. A pull of 3 to 5 lb. is required to overcome the tension of the spring C. Armature B must vibrate at a frequency adjustable between 5 and 50 blows per second. Either alternating current at 125 cycles, any voltage, or direct current, any voltage up to 110 v. is available. Three such sets in parallel will have to work three hours a day for six months without requiring readjustment.



The diagram indicates a scheme of connections that was fairly satisfactory. Copper-carbon contacts at D and E were used but the current—6 amp.—was so large that the arc soon destroyed them. The wire on the coil A was No. 23. C. B.

A. The problem is a difficult one because with the small space available it is impossible to avoid using a large current to operate the magnet A. Connecting a 2 mf. condenser across contacts D and E would help; the contacts should be of platinum. Perhaps some of our readers who have had experience with similar problems will suggest the solution. Ed.

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Q. Will you please tell me how to wind 10 in. horseshoe magnets to increase their efficiency for catching iron particles in grain-spouts of a flour-mill. What size of wire and how much of it should be used? 220 volts d.c. is available. M. C. M.

Water Power on the Farm

(*Continued from Page 31*)

Turbines may be used where the volume of water is large, but as such cases require careful engineering it would be a waste of time to go into the matter in detail here.

Voltages

The voltages in common use are 115, 65 and 32. Where power must be transmitted for several hundred feet or where motors are to be used, the standard voltage of 115 should be used. If 24 hour service is desired, and there is not enough water to keep the wheel turning continuously, a storage battery must be installed. The cost in this case will be much less at

An overshoot wheel in a country estate. With flow of 0.35 cu. ft. per sec. in average weather, the "Fitz" wheel, 10 ft. in diameter and 1 ft. wide, generates enough power to supply 8 or 10 lamps at a time for several hours a day.

lower voltages, and when the distance is short 65 or 32 volts will answer. Complete outfits are made by a number of concerns; these comprise a generator, storage battery and switchboard mounted on a skid and with internal connections made.

Regulation

The governors furnished for water-wheels are usually actuated by revolving balls and hence regulate for constant speed. With increasing load the inlet-gates are opened gradually to their full width; when the maximum quantity of water is admitted an

An impulse-wheel outfit in course of installation. This wheel is made by the Pelton Water Wheel Co., New York and San Francisco.

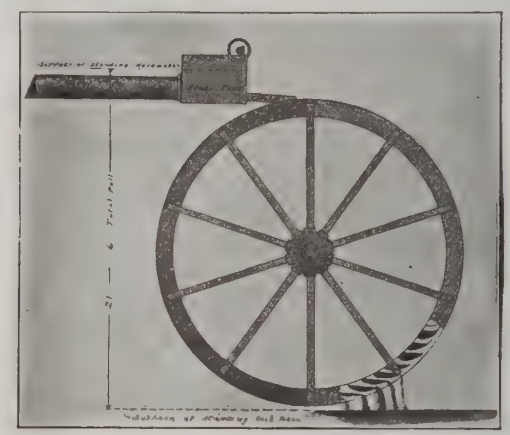
increase of load will reduce the speed and consequently the voltage and electrical output to a point at which the latter balances with the water input. Hence a water wheel cannot be stalled by overload. Where water is plentiful, the governor may be omitted and the wheel run at a fixed gate-opening. The voltage can then be kept approximately constant by connecting heating-devices to the line when the load is light. Air and water heaters lend themselves to this use.

Special Devices

The usual protective devices are of course installed and also lightning arresters when the length of line or its exposure suggests the necessity. Ingenuity will suggest many devices to save the trouble of visiting the plant, especially when water is used during certain hours only. Sometimes a wire or cable runs from plant to house by which the gate is opened or shut; where a storage battery is used a current relay may energize a gate-operating motor to open at, say, 30 per cent. load and close at 15 per cent.; while the gate is open the governor operates in the regular manner.

Care and Maintenance

The great advantage of water power lies in its freedom from maintenance difficulties. If well built the dam and water-ways



The Fitz "Overshoot" Wheel, manufactured by the Fitz Water-Wheel Co., Hanover, Pa.

should last a lifetime; and barring accidents the machinery will last as long. Generator and storage-batteries require a certain amount of care, the details of which are well known.* All bearings should be kept well oiled, and trash-racks in the forebay should be cleaned regularly. Such duties can be performed by any intelligent man, and unless rainfall ceases utterly the rural dweller may be as sure of continuous service as are his city brothers.

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A Correction

On page 48 of the July issue, under "Questions and Answers," it was stated that wave-lengths for amateur radio stations were up to 200 cm—and the longest waves generally used were 2,000 cm. These figures should have been 200 meters and 15,000 meters respectively.

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Three large motor-generator sets, each capable of delivering 10,000 amperes continually at 170 volts, and a completely equipped switchboard have recently been sold by the Westinghouse Electric & Mfg. Company, to the Cornelia Copper Company, for their leaching plant. The Cornelia Copper Company is an off-spring of the Calumet and Arizona Mining Company and was formed to handle the low grade ores from the parent company's claim near Ajo, Arizona.

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Within a very short time the town of Plumerville, Ark., will be supplied with electricity as the completion of the transmission line of the Arkansas Light & Power Co. from Morrilton is now in sight. The plant at the latter place will supply energy for the present but a line will shortly be built from there to the large hydroelectric plant at Russellville.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Selling Electrical Appliances by Telephone

By D. R. Dusenberry

The telephone as a sales ally is more and more claiming the attention of alert progressive dealers in electrical appliances. That this is true is only logical and appropriate for purveyors of things electrical should be the first to recognize the worth of electrical means of disposing of such goods. Furthmore everything from safety pins to railroads is being sold by telephone nowadays and the average electrical dealer is not one to let a sales agency of this calibre escape him.

RECENTLY a large wholesale drug house decided that the telephone selling idea was worth a trial. Two of its salesmen were assigned the job of calling customers and prospective buyers by telephone with the result that within a month, $15,000 worth of drugs had been sold and his without any inroads in the sales made other ways. In other words, this was "velvet" and of a good quality.

Three train loads of grain with forty-two cars to the train and worth about $75,000 were sold by clever sales talks and the wise investment of $1350 in telephone calls.

If thse things are true—and they are—it is not surprising that the telephone selling idea is being adopted to the electrical appliance business. The field for this sort of effort is a fertile one and with a little cultivation will produce results which will not only be gratifying but will show a handsome balance on the right side of the ledger.

There are several reasons why this is so. The list of telephone subscribers form probably the best prospect list for electrical dealers that can be secured because telephone subscribers are the "pick of the population" and can generally be considered as able to afford electrical appliances. Then too from the viewpoint of costs, selling by telephone seems to be an economical as well as an effective means of getting in touch with prospects and keeping in touch with them. It offords a quick way of determining and classifying the active and slow prospects and of following up these presumptive buyers as good judgment dictates.

How to Start a Telephone Campaign

In going out after new trade in this way it is undoubtedly best to feature a single article for sale. Something should be selected which is particularly adapted to the needs of the people in the neighborhood to be covered and of use to them in the season in which the campaign is promoted. If possible the price of the article should be "shaded" to make the proposition inviting and the difference charged against the advertising appropriation. The next step is to prepare a sales talk. This should be cordial, courteous, brief and to the point. It should go something like this. "Mrs. Jones, this is Mr. Blank, of the Blank & Dash Company, who you probably know are dealers in electrical appliances. We have just recently secured the agency for the Peerless Electrical Toasters. Heretofore these toasters have not been sold in this section but so many of our customers asked for the Peerless that we decided to place them on sale at our store. We have already sold a number of these toasters and we have heard so many nice things about them we felt sure you would be interested. The uses and advantages of this toaster are, etc., etc. If agreeable we should like to have you try one for a week without cost to you. This will not obligate you in any way but will give you a chance to see for yourself that our claims are true."

If this arrangement is agreeable to the party called, the

toaster should be delivered for trial by a representative who should carefully explain its operation. Even though the profit on the article may be small it will pay to be sure that the prospective buyer understands how it works. Furthermore an opening for bringing the buyer and seller together is gained. The salesman should make mental notes of the prospect's characteristics, electrical needs and apparent financial ability. Immediately after the interview the information secured should be recorded on a card provided for this purpose.

At the end of a week's time this same salesman, with the data secured on the first interview in front of him, should call the prospect by telephone to ascertain the results of the trial. The recorded information should make it possible for him to handle the case intelligently. If the toaster is to be kept arrangements for payment can be made. If for any reason the toaster has been unsatisfactory, difficulties should be determined and remedied and a further trial suggested. A little extra effort to make things satisfactory is appreciated and will in the end mean extra profit. It is more important to make a friend than to make a sale. By this time the prospect knows your concern and has had an actual demonstration of your desire and ability to "deliver the goods." The good will and card record gained will be useful for future followups.

Keeping the "Outside" Men Busy

The routine of a large public service corporation provides for the keeping of a comprehensive card record of subscribers to their service as well as prospects, showing their present equipment, also the equipment the salesman feels the customer or prospect should be. The salesmen indicate on the cards the dates for future personal and telephone calls and get in touch with prospects on these recall dates. On rainy days particularly the sales force can be kept busy 100 per cent. of the time and with good results if the telephone is brought into play, for in stormy weather the buying public is more apt to be found "in" than at other times.

The use of the telephone in selling enlarges the field and enables it to be covered more frequently. It means the establishing of a point of contact which, if carefully fostered, is reasonably certain to develop new and increased business.

The wise electrical dealer realizes the necessity for insuring himself against dissatisfied customers. He knows that there is more to the business of selling than merely disposing of goods. Care must be taken to see that articles sold are being used properly and that they are giving the satisfaction that can reasonably be expected of them. This can be done in an efficient manner by telephone follow-ups if a record of the sales made is kept.

Promoting Good-Will by Telephone Talks

One dealer realizing the difficulty in using electrical ranges to the best advantage, kept a record of the ranges sold and followed up these sales by telephone. Inquiries were made to determine whether the ranges were satisfactory and suggestions were tactfully offered as to the proper operation of the ranges in order to conserve electric current. This to the central-station man might seem like killing the goose that laid the golden egg, but satisfaction is what is demanded by the public to-day and satisfying customers, even at considerable trouble and expense, pays for it paves the way for further sales.

The chance of equipment getting out of order should also be taken into consideration in selling electrical goods and many friends and permanent customers can be made by mere telephone inquiries to determine whether articles recently purchased are in good working order. If there is any trouble, repairs should be made at once. This service idea appeals to customers and results in securing their good will, a most valuable asset to any concern.

"Quick Action" for Seasonal Sales

The telephone also proves its value in moving seasonal goods, especially when the season is fast slipping away and hold-overs are undesirable. A reduction in the prices of such articles equal to storage costs and an active telephone sales campaign form a combination which ought to prove a source of gratification to the dealer who is cramped for space. The timeliness of a selling appeal plays an important part in the consumption of the sales. What is more opportune than to set forth the cooling influences of a portable electric fan to a perspiring person on a hot muggy day in August? If August is the psychological time, surely the telephone provides a way for bringing fans to the attention of the greatest number of people in the shortest possible time.

One alert contractor conceived the idea that while many people were away from home during the summer months it would be an ideal time to install service or to overhaul any electrical appliances in need of repair. He turned to his telephone and canvassed his prospects and customers with the result that he found many glad to avail themselves of the opportunity of having the work done in their absence, thus relieving them of annoyance and inconvenience.

Planning for the Fall

As timeliness in suggestion very often leads to sales, what at this period of the year would be more appropriate than spending some time and thought in planning a telephone sales campaign for the early Fall? Most housewives are now looking forward with more or less dread to their Fall cleaning. This then would seem to be the proper time to suggest the use of vacuum cleaners. It may be possible to sell the cleaners outright or failing in this, to rent them by the day or week. In many cases renting the cleaners has proven so satisfactory that they have been purchased outright, the amount of the rental charge being credited against the purchase price. In this connection it should be possible by working in close co-operation with some cleaning companies or reliable employment agencies to secure men to operate the vacuum cleaners wherever this additional service is desired by customers. If the coming Autumn is anything like the autumns of the past and it is expected that it will be, there are going to be many cool days and cooler evenings before the winter heating systems are put in operation. A portable electric heater is just the thing to take the anticipated chill out of the air and a suggestion to this effect over the telephone should result in effecting many sales and securing considerable "cold cash."

Reviving Inactive Accounts

There is another phase of telephone selling which should not be overlooked. Every business house, including those dispensing electrical appliances, has its inactive accounts. Two months, six months or a yearf or more ago John Jones was an active customer but lately for some unknown reason nothing has been heard from him. Mr. Jones' account was of considerable size and he always paid his bills promptly. In short he was the type of person we are all constantly on the alert for. Something must have happened for he hasn't bought anything in a long time. It would seem like good business to find out the cause for this. A satisfied customer is worth innumerable prospects and the reliable business house owes it to John Jones and to itself to make things right if they are wrong.

Here is where the telephone steps to the front again. A friendly chat by telephone with Mr. Jones will determine the reason for the continued absence of his name on the journal, and a way will be opened to satisfy him and bring him once more within the fold. It is practically impossible to outline a talk of this kind that would apply to every case but it should be breezy and free from formality. Mr. Jones might be appoached along the following lines:—

"Do you know, Mr. Jones, you have caused us no little concern recently for we have been wondering why we have not received an order from you. Our records show during 1915 you did over $5,000 worth of business with us. Our last shipment to you was fifty electric washers. I remember that order particularly because I inspected it myself before it went out. There was nothing wrong with it, was there?

Soldiers and Sailors Monument, Indianapolis, Ind.

No matter how hard we try to prevent them, little irregularities will creep in now and then. I am glad to hear everything was all right. You know we cannot afford to let our customers slip away from us without knowing the reason why. By the way, Mr. Jones, on July 1st we received a large consignment of Good-light reading lamps. You formerly bought these regularly, etc., etc."

One concern using a telephone talk of this kind revived more than 25 per cent. of its inactive accounts.

Speeding Up Collections

Even in collection work the telephone can be used to advantage. When good judgment indicates that an overdue bill should be brought to the attention of the customer in some way more forcibly than by a statement of the account, a tactful and courteous telephone reminder is quite sure to be found more effective than any number of written requests for payment.

Telephone Courtesy

The counterpart of selling by telephone is buying by telephone. There are just as many people doing the buying as the selling, and it behooves merchants to give their in-coming telephone business, whether it be inquiries or sales, the same attention they would if the coustomers were "on the ground." The reputation of the dealer is weighed in the balance far more in telephone sales than to face to face transactions. In view of this, care should be exercised by the merchant to the end that prompt, courteous and intelligent treatment is accorded every person calling his store. The value a concern places on new business is reflected in the way it handles its in-coming telephone calls.

The selection of the salesmen to handle by telephone work should be made with the greatest of care. It should be remembered that one is entirely dependent on his voice to impress his personality upon the prospective buyer and some salesmen are more adapted to this work than others. There is need for quick perception on the salesman's part, for he has none of the usual signs to tell him that the cake is burning in the (non-electric) oven or that there is "company" down-stairs. The habits of each community will suggest what are the opportune times for telephone calls.

The possibilities of the telephone in the field of selling seem unending. One idea suggests another. Whether it be the securing and developing of prospects, the consummation of sales, the executing of follow-ups, the satisfying of customers, the promotion of educational work, the fostering of good will, the reviving of inactive accounts or the collection of ovedue bills, the telephone has its part and every day develops a new use for it in the electical appliance world.

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Flood-Lighting at Indianapolis

A recent notable flood-lighting installation is that for the Soldiers' and Sailors' Monument at Indianapolis. Four batteries of 25 each of "X-Ray" projectors were placed on the roofs of buildings facing the monument and 230 feet away. Each projector contains a 250-watt "Mazda" gas-filled flood lamp and projects a beam of light 110,000 C. P. The intensity of illumination is 4-5 foot candles, uniformly distributed over the entire surface of the monument. There are also installed eight additional projectors which have red and blue lenses inserted for illuminating the cascade fountain on two sides of the monument.

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Aids Contractors to Develope Good Will

Time was when the electrical contractor carried his office and kit with him from place to place. Now there are contractors in each locality doing business on a reasonable basis and at prices based on known costs of construction These men carry stocks of goods, know the requirements of various jobs, do their work carefully, according to specification and the requirements of the insurance companies. Their prices are based on known conditions and the figures named permit of a reasonable profit that will permit carrying on business and development on a sound basis.

To convince the public of this is the purpose of a series

of twenty newspaper advertisements. These have been prepared and mailed to jobber and contractor members of the Society for Electrical Development for use in their local newspapers in assisting them in building good will by pointing out the benefits of dealing with recognized contractors. The advertisements, have complete directions for the printer so that the members will not be troubled with the detail of writing and laying out copy. Each advertisement emphasizes the fact that price alone should not govern the letting of contracts for electrical work.

The society has prepared also as a help to these contractors, a slip to be attached to bids or tentative specifications, telling why the lowest bidder may not be the best one to have the contract. Both of these sales helps should be found of material assistance to the sound, reliable contractor.

This work on the part of an association opens a field untouched so far. Instead of recommending that this kind of advertising be done, the advertisements are actually prepared and placed in the hands of the men to be benefitted. The advertisements were arranged by an expert and will prove of material assistance to contractors using them. Contractors are constantly using newspaper space, but the advantage of using space for building good will is an opportunity that this series of overlooked. It is to meet this opportunity that this series of advertisements was prepared.

Houses of the 17th Century Wired

Houses are never too old to wire. Throughout New England a number of very old houses have been wired for electric service.

The Copper-Austin house, Cambridge, built in 1657, and the oldest residence now standing in the city, has been wired. The installation includes twenty-two 15-watt and six 25-watt Mazda lamps, with eight receptacles The service is from overhead lines, through the usual pipe conduit, enabling the leads to be carried into the house with minimum disturbance of its appearance. A Colonial porch lantern equipped with a 25-watt lamps is another appropriate feature. This house remained in one family for a period of 250 years.

The oldest house in Plymouth, built in 1666 by William Narlow, has been wired with nine 25-watt lamps all told, including the front hall, dining room and front room. In both the above houses the chimneys have withstood the ravages of time with the need of little or no alterations.

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In lighting the chancel of St. Patrick's Cathedral in Norwich, Conn., six projector units are used, three on either side of the chancel arch, at a distance of 35 feet from the altar, lighting a space of 65 x 40 feet and bringing out the altar in beautiful relief. The result is most satisfactory.

Our Monthly Window Display

The general layout of the window depends on local conditions, so that the window illustrated will serve only as a guide. The four pedestals may be made up in any convenient manner, so that they are near the right height.

Get eight old sad irons, the older they are the better, you can borrow them easily, an old-fashioned candlestick and candle, and one of the more modern sad irons with a detachable handle. In the center of your window, place the cutout. Put a piece of cloth before it, as indicated, and affix the electric iron to the hand Attach cord and plug to a prominent receptable in your window. In placing this central cutout, try to have the figure's eyes on a level with the average height of the eye of the passerby. The more level the figure's eyes, as indicated, the oftener will the passerby be compelled to stop and look into your window. Try it out for yourself. In arranging the irons on the right fixture under the "Evolution of the Iron," get a flat, white rock for the first stage, as shown.

On the left pedestal in the rear, place the candlestick and a small silk shade portable. Burn the candle for a few minutes in the candlestik and let the tallow run down the side. Then extinguish the flame so that th wick rmains charred. Attach the plug of your silk shade portable to a live socket so that it may be illuminated at night. Put irons, as indicated, on the right rear pedestal and on and under the small fixture on the left. After you have placed your cards, your window in finished. These cards, and the figure cutout, can be secured from the nearest branch of the Western Electric Company.

Industrial Leadership

(*Continued from Page 32*)

clear that, in future, the man who *owns things* will not be as important a factor in the world as the man *who can do things.*

The articles which we read from time to time telling us what will happen when the war is over are all very interesting, but inasmuch as the conditions which will obtain after the war, are dependent, to a large extent, upon what happens during the war, and the length of time the war may last, all of these ideas are mere speculations. The one thing, however, which is sure, is that, the ability to do things will be of more importance to the welfare of individuals and of nations than simply the ability to own things. Plans to secure our share of the markets of the world may bring wealth, but wealth is not as great a national asset as the power to create wealth. No better illustration of this fact can be found than that Germany, a nation poor in natural resources, but in educated and trained men, and organizations capable of directing their efforts harmoniously, is able to hold off the combined efforts of a large part of the civilized world.

One of the most significant things which has happened during this war is the action of Great Britain in taking the industries needed for munitions out of the hands of their owners and putting them under the absolute control of the one man whom it was thought best able to operate them. By this action Great Britain did away with the theory so strongly cherished by Anglo Saxons that a man should have absolute control over his own property As soon as it became clear that the efficient use of that property was necessary for the life of the nation that theory was disregarded. A careful consideration of this subject indicates that this is a theory suited only to times of peace and prosperity, and not suited to times of war, or even to strenuous industrial competition. For instance: The control of weapons is always put into the hands of those who can utilize them best; and in nations or tribes whose existence depends, more or less, upon war, the Chief is the greatest warrior. It would seem, therefore, that in nations which depend upon industry for their livelihood the chief should be he who was most capable of directing industry. Suppose a party was travelling in a desert country where food was scarce, and they were on the point of starvation when a deer was spied in the distance; suppose further, that there was only one rifle in the party and that owned by a man who was known to be a very poor shot, and that Mr. Roosevelt was in the party but that he had no rifle. It would probably be suggested by some that Mr. Roosevelt be given the opportunity to shoot the deer, but it is also quite likely that if the owner had been brought up with our traditions, he might insist upon the right to use his own gun and thereby lose to his party the chance of procuring food; it is safe to say that, if on the following day, a second deer should be spied, the question as to who should shoot it would not be argued very long.

If we are willing to generalize from this incident, we should see that when *conditions are sufficiently critical the community will insist that the implements needed for their welfare must be controlled by the people who can use them efficiently, whether such persons are the owners or not.*

It is agreed on all sides that after this war is over we are bound to have strenuous competition; hence, it behooves those who control the tools of industry to learn how to use them efficiently, and to do it quickly; for if democracy is to compete with autocracy in the long run, it must develop organizers and executives who are at least equal to those which Germany has shown it possible to develop under autocratic methods.

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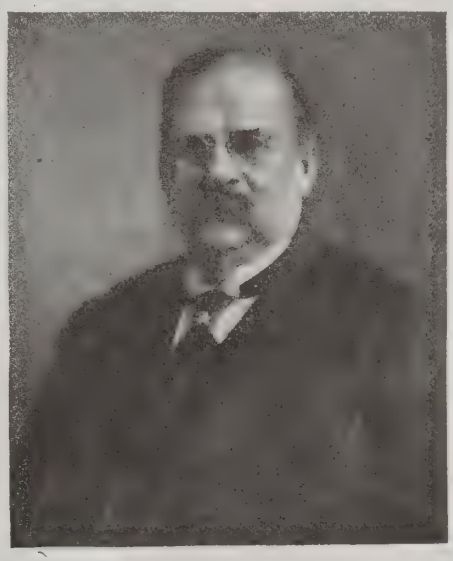
Mr. George E. Emmons, for twenty-one years manager of the Schenectady Works of the General Electric Company has been elected vice-president of the Company. Starting with the Thomson-Houston Company thirty years ago. Mr Emmons' career has been one of steady and well-earned progress.

Obituary

Mr. James Frank Morrison, first President of the National Electric Light Association, died at his home in Baltimore on July 3. His business career began at the age of fifteen, in Boston. Going to Baltimore in 1862 he became a telegraph operator for the B. & O. and later for the Western Union. In 1870 and the years following, as Superintendent of the fire-alarm department, he completely reconstructed the Baltimore fire and police signal systems. The first long-distance telephone line in the world, extending 210 miles from Georgetow , D. C., to Cumberland, Md., was constructed by him for Chesapeake & Ohio Canal Company.

Mr. Morrison's services to the electric lighting industry began in 1880 when he was prominent in the construction of Baltimore's first plant, supplying power for arc lighting by the Brush System. As the electric service developed, Mr. Morrison's energy and aggressiveness were of great value in the pioneering work of the several plants which have since been consolidated into the United Electric Light & Power Company of Baltimore. In 1885 he was one of the founders of the National Electric Lamp Association, and for the first three years its President. Mr. Morrison, with the late William Baxter, Jr., did much to develop the early electric motor. As only series service was available, their machine was of that type, and with the change of systems it has become obsolete. The work of its progenitors, however, helped to create the first demand for electric motor drive, now of fundamental importance to the industry.



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W. R. Patterson, of the firm of Patterson & Davis, engineers, Chicago, died on July 19. He was one of the pioneers in telephone manufacturing, having been connected with the Western Electric Company since 1877. Much of the early work on telephone cables was done by Mr. Patterson; the lead-sheathed cable was known for years by his name. Later he had charge of the design of buildings for the Western Electric Company at Hawthorne and at many other points in Europe and Asia.

Mr. Patterson was born at Effingham, N. H., in 1854 and graduated from Dartmouth in 1876. He is survived by his widow, two daughters and a son.

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Edward A. McCoy, head of the firm of J. B. McCoy & Son, manufacturers of electric fixtures, of New York City, died on June 24. He was President of the Lighting and Fixture Association of New York City. A widow and two children survive him.

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Mr. H. S. Wilson has resigned from the managership of the power department of the New England Engineering Co., to undertake other work.

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Automobile Lighting Switches are described in a new edition of a booklet published by the Cutler-Hammer Mfg. Co., of Milwaukee. Part of the booklet is devoted to useful diagrams which show the method of wiring for single lamps and various combinations.

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"Arrow E" Wiring Specialties are listed in a pocket-size booklet sent out to the trade by the Arrow Electric Company of Hartford, Conn. Switches, sockets, bases, wall-plates and cut-outs with the customary size and price data are shown. The catalogue is known as Number 17, and it is also issued in 8½ by 10 inch size, both loose-leaf and bound.

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Push-Button Press Control is the title of a new four-page newspaper size broadside just issued by The Cutler-Hammer Mfg. Co., of Milwaukee. It describes the Kohler System of Push-Button Press Control which, the folder states, is now in use in 80 per cent. of the printing establishments of this country. The folder is of newspaper page size and is built up in columns very similarly to the newspapers.

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"The Economy Produced by Using Reversing Planer Motors on Machines Having Reciprocating Motion" is the title of descriptive leaflet (No. 3554-A) just issued by the Westinghouse Electric & Mfg. Company, in which this subject is thoroughly discussed, illustrations and a summary of machine tool operating expense given.

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Electrically Heated Candy Manufacturing Appliances are described in an eight-page booklet just issued by the Cutler-Hammer Mfg. Co., of Milwaukee. It includes descriptions of electrically heated chocolate warmers of the rectangular and round types, electrically heated side pans for use with the chocolate warmers, and electric batch warmers for providing radiant heat in the manufacture of hard candies where pulling or stretching is necessary.

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"Something In It For You" is the striking title of a very attractive booklet just issued by the Westinghouse Electric & Mfg. Company in order to assist its agents and dealers in marketing the Westinghouse Electric Range. This booklet describes in a brief concise manner the advantages of this type of range together with a number of illustrations, and in addition outlines several methods of selling them and gives some suggestions covering newspaper advertising, window trims, demonstration, etc. The booklet is being distributed to central stations and dealers.

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"Typical I-T-E Circuit-Breaker Installations" is a book of 350 pages which shows excellent illustrations of this class of work. Every type of circuit breaker is shown "on the job" protecting circuits under every condition. As a record of what has been done, the book will be of great value to the contractor and designer who are certain to find in its pages one or more installations which have been the solution of problems similar to their own. Engineering data for many of the plants add to the interest and value of the book. The publishers, the Cutter Electric & Mfg. Co., of Philadelphia, are to be congratulated on the excellence of the whole work.

A Bibliography of Public Utility Valuation has been prepared by the library staff of the American Society of Civil Engineers. It comprises seventy-two pages. Copies may be had from American Electric Railway Association, 8 West Fortieth St., New York City.

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"Engineering in Foreign Fields," tells through the medium of many excellent illustrations the diversity of work undertaken by the J. G. White Companies, of New York and London. The scene changes from place to place throughout North and South America and our insular possessions. Construction of the most diverse character is shown.

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"An Epoch in Railway Electricification" is a new publication of the General Electric Company, telling of the electrification of the mountain divisions of the Chicago, Milwaukee & St. Paul Railway. Many interesting photographs, diagrams and curves make the thirty-page booklet one well worth preserving.

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"The New Anaconda" is the title of a 32-page booklet prepared and distributed by Eugene Meyer Jr. & Co., 14 Wall St., New York City. It contains a popular description of what electrification and new metallurgical processes have made of those famous mining properties in Colorado. All is reduced to terms of "earnings per share," for the benefit of those interested in the financial side.

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X-Ray Floodlighting is the title of a 12-page booklet showing numerous examples of the fine effect produced by this form of illumination. Data for engineers is also given and suggestion for typical layouts. This publication, as well as its catalog No. 19, has just been issued by the National X-Ray Reflector Co., of Chicago. The latter book lists their entire line of reflectors for direct, store-window, show case and flood lighting.

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Transmission-Line Insulation is the subject of a carefully prepared book of 180 pages issued by The Locke Insulator Mfg. Co., of Victor, N. Y. It is really more a resume of the best modern practice in line-construction, containing as it does information on mechanical features, outlines of specification for structures, poles, cross-arms, and wire tables of wire and cable properties, and notes on electrical design. A number of lines on which "Victor" products were used are illustrated, and the company's line of insulators for high and low tension is shown and dimensioned in a manner both complete and attractive. The book should be n every transmission-engineer's library.

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Books Received

ALTERNATING-CURRENT ELECTRICITY, by W. H. Timbie and H. H. Higbie. 729 pages. New York: John Wiley & Sons: $1.50.

PRINCIPLES OF ELECTRICAL DESIGN, by Alfred Still. 365 pages. New York: McGraw-Hill Book Co.: $3.00.

ELECTRIC WIRING DIAGRAMS AND SWITCHBOARDS, by Newton Harrison, E. E. Second edition 303 pages. New York: The Norman W. Henley Publishing Co.: $1.50.

OZONE: ITS MANUFACTURE, PROPERTIES AND USES, by A. Vosmaer, Ph. D. 197 pages. New York: D. Van Nostrand Company: $2.50.

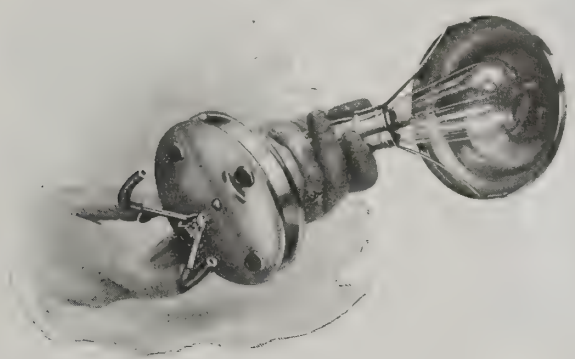
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Appearing in This Section Will Be Gladly Supplied on Request

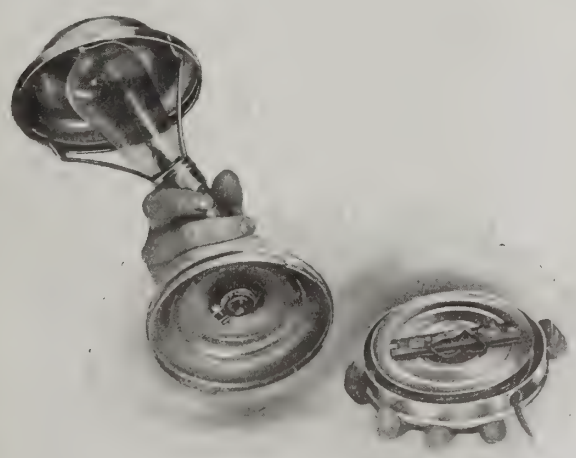
A Cord-Retrieving Portable Lamp

Constant need for a portable electric lamp which can be attached to walls or furniture has led to the introduction of quite a number of these handy devices. One of the best is that recently put on the market by Rubes Electric Devices, Inc., of 255 Classon Ave., Brooklyn. One of the specially desirable features of this lamp is the positive clamping device shown in Fig. 1. The two L-shaped hooks will go over the top or side of a bed, dresser,



or chair, and will hold the lamp rigidly. Once the lamp is placed there is no danger of it slipping off, as there is with spring-wire devices. All points of contact are protected by rubber, so that thehe is no danger of scratching. When the hooks are not in use they lie flat against the base of the lamp, below the rubber feet.

The cord of the average "portable" after a few weeks' use, is a fearful tangle of knots and kinks. A number of devices have been proposed to wind the superfluous wire on a reel in the base of the lamp. The "Rubes" lamp has avoided their defects by



using phosphor-bronze spring contacts between reel and lamp; a flat spiral spring for winding, and a positive catch which is not released by accidental jerks on the cord. By a twist of the base, it, with the reel, can be removed, to inspect the reel mechanism.

Eight feet of silk-covered cord and a separable plug are supplied with the lamp, and the whole, less the bulb, is packed in an attractive leatherette-covered box. The retail price is $3.50.

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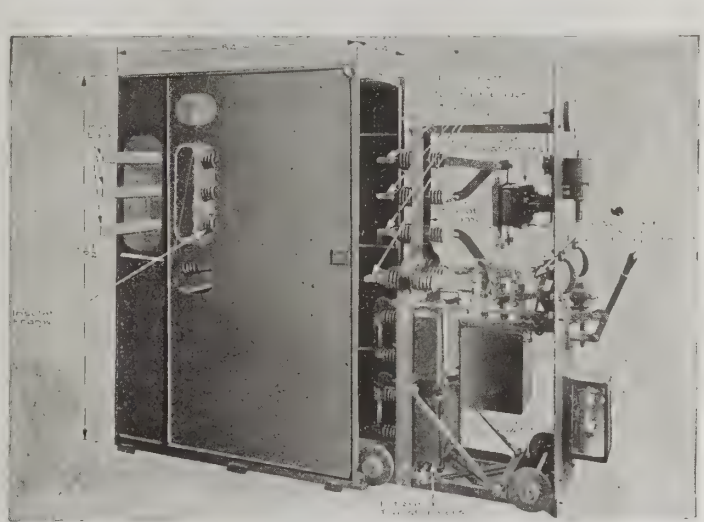
Truck Type Switchboards

In every switchboard installation, protection against accidents should receive careful consideration. This applies particularly to the industrial plant, and doubly so if the panels are mounted in such location that access to them can be had by employees comparatively unfamiliar with electrical devices. In the latter case the safety first truck type switchboard units here shown are eminently fitted.

All live parts are enclosed, and danger of coming in contact with live circuits is practically eliminated. Oil switches, busses and other live parts are in compartments. This tends to reduce fire hazards and to limit disturbances to a single point. Extensions can be readily made or the units moved to other locations if desired.

Another marked advantage of this type of construction is the ease of inspection or replacement. The switchboard panel is



mounted on a carriage which can be readily removed from and replaced in a stationary structure, but only when the oil switch is open. With the oil switch closed it is impossible to remove or insert the truck because of an interlock between the operating toggle of the oil switch and the stationary unit. In plants where feeeders are standarized, spare panel trucks will permit systematic inspection of equipment with the least possible interruption of service.

The stationary member of the switchboard carries current and potential busses and disconnecting switch studs Barriers between the current bus studs prevent accidental contact by any one who enter the compartment. The rear ends of the current disconnecting switch studs run to busses and incoming or outgoing leads; the potential bus wires to small contact studs near the top of the compartment. The side walls have hand holes, so that the

bus bars and bus wires can be continued from unit to unit. Access to the rear of a compartment can be had by means of a two-section sheet steel door.

The removable truck is mounted on wheels, and when withdrawn, the equipment is dead and accessible from all sides. The fore part of the truck carries a sheet panel on which is mounted the instruments, meters, oil switches and other appliances as shown. The current transformers are mounted on steel brackets on the back of the instrument panel. The rear of the truck carries the movable parts of the disconnecting switches, the potential transformers and small wire accessories. To center the truck and to assist in placing it in or removing it from a compartment, rails are provided for the wheels to run on.

The field of application of standard size units is limited to 7500 volts and 2000 amperes at 60 cycles, and 3000 amperes at 25 cycles, on the main bus. Special units can be obtained for use up to 15,000 volts and 300 amperes. The current capacity of the removable element is limited to 500 amperes at 2300 volts and above, and 800 amperes up to 600 volts. The units illustrated are 76 inches high, 24 inches wide and 52 inches deep. The General Electric Company is the manufacturer.

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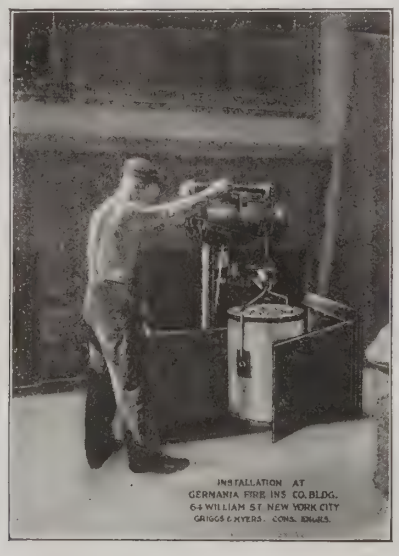
Electric Ash Hoist

Of interest to the building contractor as well as to the operating man is the telescopic ash hoist manufactured by a New York City firm. The removal of ashes from a city basement involves a lift of from ten to thirty-five feet and where there is not enough "traffic" to justify an elevator, the hoisting of heavy cans is a serious job. As everywhere else, electricity lightens labor, and by the installation of motor-operated hoist one man can handle the work readily.



In operation the cans are placed at the foot of the shaft; by the turning of a crank the operating head is pushed up into position, raising the doors as it goes; and the operator then climbs to the sidewalk. By means of a specially designed hook he catches the bail handle of one can, and raises it by the motor to the sidewalk level. The illustration shows how he turns the hoisting head to swing the can through the safety-door onto the sidewalk. When all cans have been raised, the device is lowered into the shaft and the gates are closed.

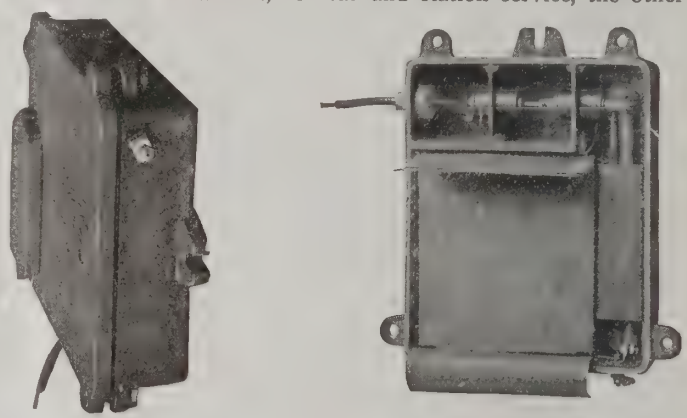
The electrical equipment of the hoist consists of a 1 h.p. enclosed motor, series-wound for direct current; squirrel-cage for alternating current; single-speed controller with brake and automatic upper-limit stop. The gears run in oil, and the bearings are fed by the splash system. The maximum capacity is 500 lbs. at 30 ft. per minute. For the hoist alone the price is $275.00 f. o. b. New York City; complete with doors as shown, the price is $385.00.

Condenser Type, Direct Current Lightning Arrester

The arresters illustrated, designated as type K-3 and recently placed on the market by the Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa, are for use on voltages from 100 to 1,500, direct current. They are especially adaptable for the protection of direct current railway and power motors, direct current generators, and rotary converters. When properly connected they are also of value in preventing flashovers on the commutators of rotary converters. They are furnished for car, pole, or wall mounting.

These arresters are the result of several years' experience with a condenser arrester known as the type K, which has proven eminently successful in the protection of apparatus under the most excessive static conditions prevailing in any part of the country. The K-3 however, due to later developments in the method of building condensers, is smaller in size, of less weight, and of greater electrostatic capacity than the type K.

Type K-3 arresters are made in two forms, one consisting of a condenser with a spark gap in series with it and a high resistance in shunt with it, for car and station service, the other



consisting of the condenser alone, without series gap or shunt resistance, for line mounting. The condenser is of the flat plate form, of high electrostatic capacity and amply tested for breakdown voltage. For car mounting, the condenser is of 1 microfarad capacity, equivalent to the capacity of 100 miles of average line. For line mounting the capacity is .3 microfarad, equivalent to the capacity of 30 miles of average line. In the line mounting form, without gap or resistance, the condenser is connected direct to the line and ground terminals. In the forms that include gap and resistance, the line terminal is connected through an adjustable spark gap in a separate chamber. This gap is in series with the condenser, the ground lead being connected to the case, and a resistance is connected in shunt across the condenser serving to keep it discharged to zero value This resistance is so high that even with the spark gap closed only a negligible amount of direct current can flow. The spark gap provides a means of noting the discharge of the arrester by placing a test paper in the gap. It can be easily adjusted and set so close as to just prevent line voltage from bridging it.

Both forms of these condensers are mounted in a rectangular cast box with waterproof cover. The spark gap chamber is accessible by removing a small separate cover. They are easily mounted underneath or on roof of car, and in any position on car, pole, or wall.

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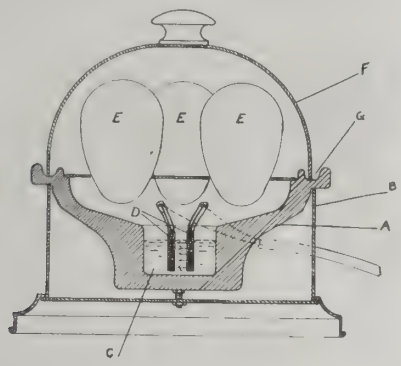
Electrolytic Egg Cooker

A new electrical cooking device has recently appeared which does not make use of heat developed in resistance wires but instead forms steam by the passage of current directly thru a small quantity of water in sufficient quantity to cause the water to boil. This device is used principally for cooking eggs and in this connection the use of a graduated quantity of water will al-

low of regulation of the degree to which the eggs are cooked without any further watching; the circuit breaking automatically when the water has been boiled away. The cooker is so arranged that it will cook the eggs to the same extent whether there is one egg or more and whether the eggs are large or small.

Referring to the figure a porcelain dish A is held in a nickel plated base B by means of a special bolt. The porcelain dish A has a small well C located in its center and in which the two carbon electrodes D are placed. The cover F sits in the groove G of the dish A. This groove is of sufficient capacity to hold as much water as the well C will hold.



The operation is as follows: A measured quantity of water is placed in the well from a measure. This measure is filled up to the desired point by covering one or more of the holes with the fingers thus determining the degree to which the eggs will be cooked, whether soft, medium, or hard. The eggs E are placed in a perforated metal holder H. When the current is turned on a sufficient quantity flows thru the water between the carbon electrodes to cause the water to boil almost immediately. The resistance of the water is materially reduced by the carbons which contain sufficient salts to insure satisfactory operation at all times. Salt must never be added to the water in the bowl as it is impossible to add a sufficiently small quantity.

For the uniform cooking of different size or different numbers of eggs it will be apparent first of all that the amount of steam condensed on the surface of the egg will be approximately proportional to the amount of heat absorbed by the egg. Thus when steam first begins to form the eggs are cold and will absorb a great deal of heat and the condensation on their surface will be great. It is obvious that a large egg with greater surface will condense more steam than a smaller egg. Now, as the eggs are placed directly over the sloping sides of the bowl all this condensed steam will run into the well and will be evaporated by the heating action of the electric current. On the other hand the steam which is condensed on the inside of the cover will run down into the groove G and remain there. Therefore when the eggs have become heated to the point where condensation no longer takes place on their surface the water in the well will boil out and be condensed on the cover meantime cooking the eggs to the desired point. Finally the water will all be boiled out of the well thus automatically turning off the current just when the eggs have reached the desired turn to fit the individual taste for which the water measure was set.

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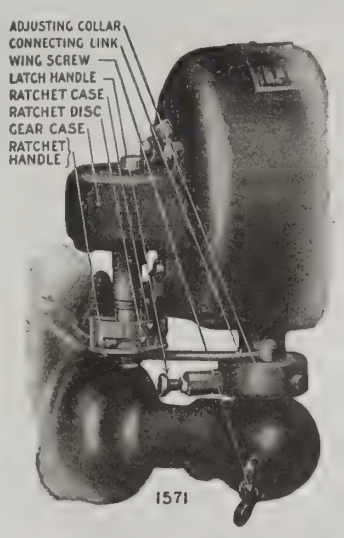
Fan Oscillator

Of interest not only for its results but for its excellent mechanical design is the oscillating mechanism used on the fans of a western manufacturer. As shown in the illustration, the oscillator operates on the wheel-and-worm principle, which gives positive oscillation. At the bottom of the vertical shaft is a ratchet adjustment by means of which the range of the fan's swing may be varied. Thus an arc of from 15 to 90 degrees may be secured by simply releasing the lever and moving it to indicate the desired magnitude of swing. Independent of this is the adjustment of the position of the fan about the centre of the motor-support. The entire motor including the oscillator may be turned to cover another part of the room by pulling out on a pin which then alllows the mechanism to turn. Such an arrangement is especially desirable for wall-mounted fans. There is no danger of injury while making adjustments with the fan running. The mechanism is enclosed in a dust-proof case which can be very easily removed with a screw-driver.



There is a safety clutch in the ratchetcase which automatically reduces the arc of oscillation if the fan guard or the motor body strike an obstacle. Another safety device is the provision against the motor's falling forward if the wing-screw should work loose. On account of the greater diffusion of the breeze, a more powerful motor is supplied than with a stationary fan. The extra power goes into driving more air; the oscillator consumes a neglighble amount of power.

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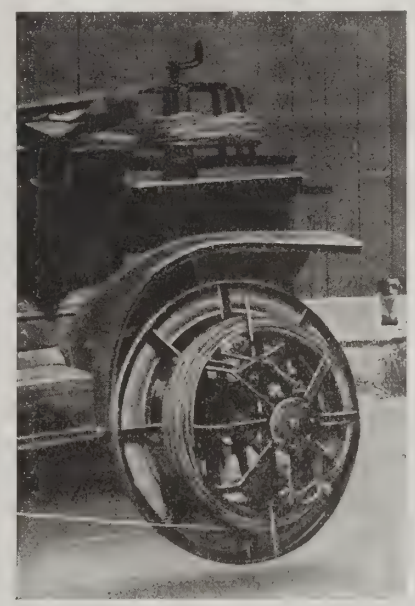
Auto Take-Up Reel

The growing popularity of light automobiles for "trouble-shooting" and light construction work has led to the development of the wire-reel illustrated. To put it into service, one rear wheel of the car is jacked up, and the reel clamped to it by two bolts. As will be seen, the frame of the reel is large enough to rest against the side of the tire, so that there is no danger of the paint being scratched, and for the same reason the bolts have wooden blocks which bear against the spokes. A guide for the wire is



attached to the running-board of the car, and the wire is passed through this and attached to the reel. While winding, the car's gears should be kept in first or second speed, and the driver, by means of the guide, distributes the wire uniformly. Over a half-mile of wire can be wound in ten minutes into a smooth, solid coil, which can be removed from the reel by withdrawing a single rod.

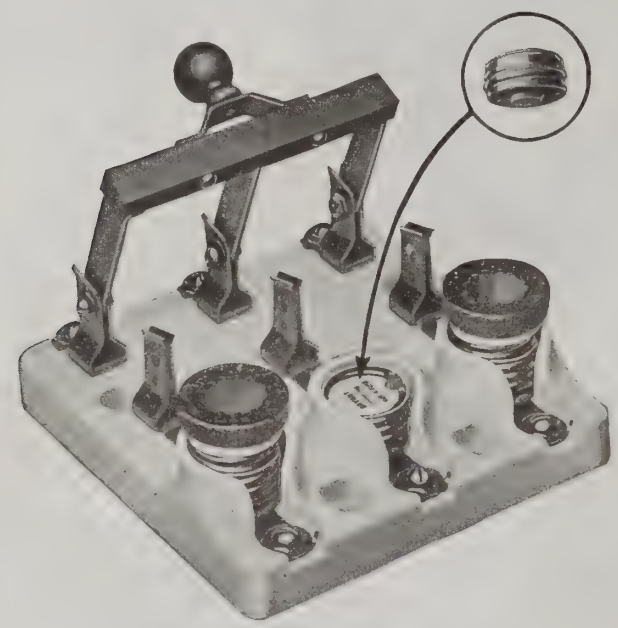
A light iron frame on which the reel can be mounted converts it into a pay-out or hand take-up reel. In this form it has the advantage of being light, and of the proper size to fit small open wagon-bodies. The price complete is $16.50.

A Novel Short Circuiting Plug

Rule 23-B of the 1915 National Electric Code specifies:

"That automatic cutouts (fuses) must not be placed in any permanently grounded wiring, except at the last cutout preceding the socket or other means of leading the current to its load."

This means that a fuse cannot be used in the grounded wire in the entrance cutout, or in any of the intermediate cutouts. To provide ready means for complying with this specification, the



makers of a line of switches have brought out their No. 599 Short Circuiting Plug, which has been approved for use under this rule when the plug is soldered to the screw shell so that the plug cannot be removed. This plug is made of a porcelain body with a copper shell threaded to fit the screw shell of the cutout. A slot in the top of the plug permits of the use of screw driver for turning the plug firmly into the screw shell. A projection on the base of the plug—similar to the contact projection on the fuse base—insures positive contact at this point. As will be noted in the illustration, a depression is provided in the procelain and an adjacent hole is provided through the side of the screw shell of the plug for conviently soldering the plug to the screw shell. These plugs can therefore be used with almost the same convenience as the ordinary fuse plug. The list price of the device is only 5 cents.

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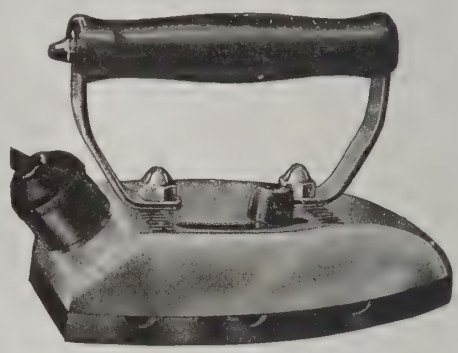
An Electric Regulator Iron

The "Regulator Iron," illustrated, is said to be the only electric flat-iron made in which the heat can be accurately controlled while in use, and maintained at any required degree of temperature. Four different heats (five in the larger irons) are controlled by the finger tips of the operator by the simple movement of the regulator lever on the iron, generating a heat from that suitable to the daintiest fabrics up to the high heat necessary for the heaviest damp material. The heat can be lowered or increased at will, by a simple movement of the finger tip. The ability to regulate the current to produce just the heat desired obviates the danger of scorching, and permits of continuous work at the proper heat for any material. A saving of 40 per cent. in consumption of current is effected to the construction of the element which concentrates the entire heat at the base of the iron, and only uses sufficient current to generate the degree of heat required at the moment. There is also a 25 per cent. saving in time as against the single heat iron, due to the greater efficiency of the worker with regulated heat.

The heating element is practically indestructible, thereby almost entirely eliminating the necessity for repairs. An element under current for 3,600 hours, after measurement in the Electrical Testing Laboratories in New York, was found to have suffered no appreciable deterioration after this severe test. There is no quick-break mechanism with its attendant weakness. The method of control being by the regulator



lever on the iron itself, with a sliding contact, the lever engaging the contact for the next heat before leaving the one in use, consequently there is no arcing or resultant deterioration.

Installations have been made in over five hundred of the garment factories in New York where the type of work and the necessary speed of the operators necessitate a flat-iron that will stand up under the roughest and hardest use. Under these conditions this iron is now used exclusively in every one of the above factories, and some of the irons have now been in constant daily use for over five years. It has demonstrated beyond question its greater serviseability in lower consumption of current (in many cases the purchasers having made the most thorough tests to satisfy themselves on this point before installation) increased output by the operatives, its ability to take care of all classes of work, and its complete freedom from mechanical defects.

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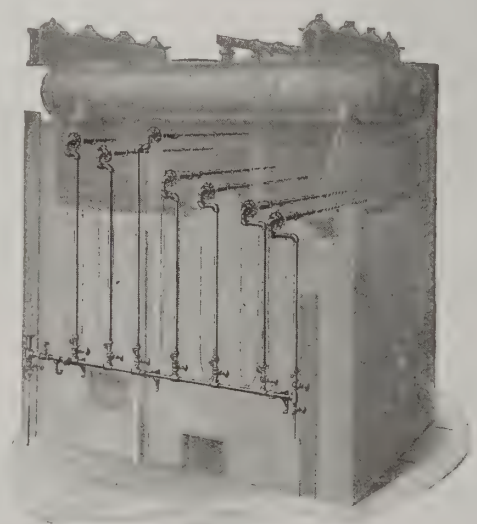
A Permanent Soot Blower

The necessity for working steam boilers up to their maximum capacity during peak-load hours of the day requires that every obstacle shall be removed from the rapid transfer of energy from the fire-bed to the steam-space. With high rates of combustion and high velocity of flue gases, the surfaces of the tubes must be kept clean outside and in. Removal of the deposit of fine ash,



soot, and clinker particles is one of the most important things to be looked after in the maintenance of a boiler.

The old practice of doing this was by means of a hand-operated steam lance, which inserted through hand-holes in the boiler setting. This was a hot, dirty, disagreeable job, and usually in-

effective, as it was impossible to reach the farthermost tubes, and the farce of the jet was much interfered with by the rows of tubes. A Western Pennsylvania manufacturer of soot cleaners has developed, as a substitute for the old method, a device which is permanently installed in the furnace and operated from the floor by cocks and controlling chains. As shown in the illustration, pipes carrying steam-nozzles project into the tube-space, and the jets of steam impinge on the sufaces at such an angle that the steam can readily scour deposit from the tubes. Operation should be about every six to eight hours.

The first cost of this equipment, installed, is from 5 to 10 per cent. of the cost of the boiler, but its regular use will increase the efficiency of the boiler so much that its capacity will be increased 50 to 100 per cent. On one particular installation, with approximately equal furnace temperatures, the flue gas decreased from 640 degrees to 476 degrees due to the greater absorption when the soot-cleaner was used.

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The "Motrola"

The Motrola is a small, compact, neat, electrical device which, attached in place of the usual crank keeps any talking-machine always wound. The principal part is a motor for either a-c. or d-c., and obtainable for any commercial voltage. On the axle of this motor is a worm gear that operates a wheel. This wheel, in turn, is fastened to the winding-rod.

Connected with the electric current, the Motrola winds up the talking-machine to about ¾ of its capacity. The resistance of the spring then becomes large enough to automatically shut off

the electrical current. When the talking-machine runs down to about ½ of its capacity, this spring resistance is lost and the current automatically turned on again.

Thus the Motrola keeps the spring of the talking machine constantly wound up between ½ and ¾ of its full strength—which is the strength required to give even time and true tones.

If the electric current fails, the Motrola can be removed and the winding-crank re-attached. This operation takes but a moment's time and requires no knowledge of mechanics.

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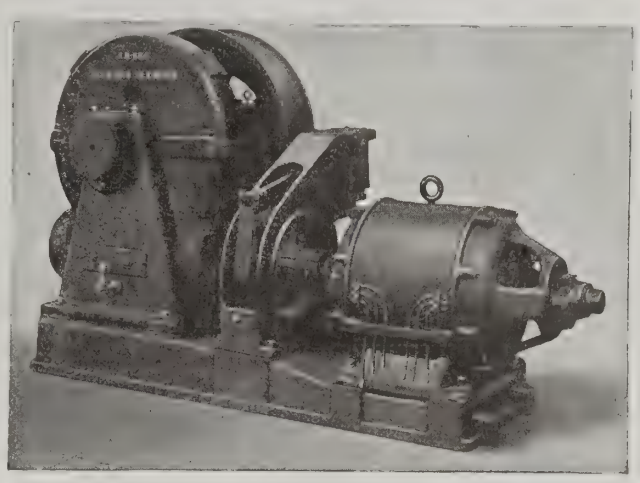
Two Speed Alternating Current Elevator Motor

The two speed-alternating current elevator motor ilustrated, is designed for operating high speed elevators. Until recently, the speed of the car for an alternating current elevator equipment was limited to 200 to 250 feet a minute owing to the necessity of using a single-speed motor. This limitation of speed was due to the fact that in slowing down for a stop, an alternating current equipment with a single-speed motor had to be stopped by mechanical brake. On a direct current outfit with field control, slow down and dynamic braking are employed. By the use of the two-speed alternating current motor a car speed of 400 feet a minute is now possible, and starting and stopping is accomplished as smoothly as with an equipment driven by a direct current motor.

The unique feature of this two-speed alternating current motor, which is made by the Westinghouse Electric & Mfg. Company, is the use of two separate windings in both stator and rotor. Mechanically, the construction of this type of motor is the same as that of the standard single-speed C1 elevator motors made by the same company. Special attention has been paid



to securing the quiet operating essential for apartment house, hotel, and office building service. The motor develops a high torque at low speed with a starting current only 50 per cent. above the current at full speed with full load.

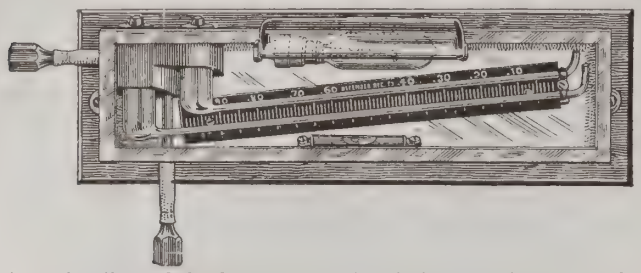
For starting, a 24-pole connection is used, giving a motor speed of 250 r. p. m. When the motor attains sufficient speed the connections are changed to give eight poles, and the motor then comes up to a speed of about 850 r. p. m. In slowing down, the 24-pole connection is again employed. At the instant this is done, the motor is running at a higher speed than the synchronous speed for this connection. As an induction motor driven above synchronism acts as a generator, this produces an electrical braking action that quickly brings the motor speed down to synchronism. Then by disconnecting the motor from the line and applying an electrically operated mechanical brake, the car is easily brought to rest. Both rotor windings are connected to the same slip rings so that only three collector rings are necessary. In operation, the 8-pole rotor windings responds only when the 8-pole stator connection is made and the 24-pole winding is only active when the stator is connected for twenty-four poles.

This line of two-speed alternating current elevator motors permits the use of alternating current for high-speed elevator service, and eliminates the loss in transformation, heretofore necessary, where direct current is not furnished by the central station. 25, 30, 35, and 40 horsepower are the standard sizes of these motors.

The controller employed consists of a number of magnetically operated switches and relays mounted on a slate panel and operated by a car switch located in the elevator car. When the car switch is thrown to either the full up or down position the controller connects the low-speed winding to the line resistance in the rotor circuit. As the motor accelerates, this resistance is automatically cut out by magnet switches, whose rate of operation is controlled by series current limit relays, bringing the motor up to the full speed of the low speed windings. A change-over switch then closes, opening the low speed winding and impressing voltage on the high speed winding with resistance in the rotor circuit. This transition is made so smoothly that it cannot be sensed in the elevator car. The resistance is then cut out automatically as above, bringing the motor and car to full speed

Illuminated Draft Gauges

The necessity for keeping a close watch on the steam gauge and water column in the boiler-room has made the use of some form of electric illumination invariable. Only too often, however, the draft gauge is installed in some position where the general illumination is not sufficient to allow it to be read with ease. A busy fireman has enough on his mind to make him willing to take special pains to read the draft guage when necessary for him to come up close and light a match or bring up a portable lamp. A manufacturer of gauges has recently equipped



his entire line of draft gauges with tubular-type lamps as shown in the cut, and reports that the popularity of the innovation shows that it meets a real need. The draft gauge may be located in the place most convenient for the necessary piping, and at any time the fire-room chief can tell just what conditions are. The model illustrated has two tubes one of which should be piped up to the space over the fire and the other to the last pass, if a water-tube boiler is used, or to the base of the stack if a return tubular type. Any loss of draft due to soot accumulations can then be readily detected.

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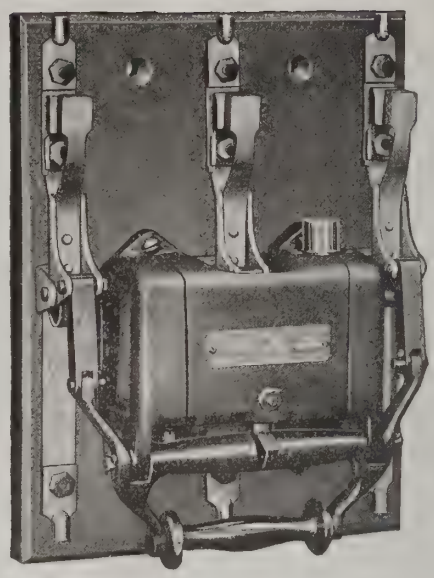
New Electrically Operated Remote Control Switch

The Type R, Form C, Electrically Operated Remote Control Switch is the latest development of the General Electric Company, in central control of lighting circuits, motors not subject to heavy overloads and other electrical apparatus located at a distance from the controlling button or buttons.

Control may be centered in one special push-button switch or in different locations by the use of a number of these push-buttons, wired in multiple. This special control button operates at finger-pressure and sends current through the two solenoid coils on the switch only at the moment of opening or closing. It is a single-pole, double-throw specially designed push-button and is normally in the open position. It remains closed only when held by the operator. One such switch with escutcheon plate ready for the wall mounting is furnished as part of full equipment and must be used as the solenoid coils are not intended to carry current continuously. Little current is used for operation. One coil opens the switch and the other closes it. This approximates on direct current 1.6 amperes at 110 volts and 0.81 amperes at 220 volts and on alternating current of 60 cycles, 10 amperes, at 110 volts and 6 amperes at 220 volts. The device is made specially for use on currents of the above voltages. There is also an insulated handle on the switch for manuel operation.



The switch itself is a self contained unit with two sets of contacts. The main set has the special G-E laminated brushes that make an "end on" contact with the switch blade with no tendency to force the laminations apart. The cross section, of the brushes, is correct for the current it is designed to carry and its arrangement permits a firm, strong, closing contact. The contact surfaces are kept bright and a good contact is assured by the wiping effect given the contacts every time the switch is closed. The secondary set of contacts take the arc on breaking the current. They are of blocks of selected carbon fastened without screws or bolts to flat phosphor bronze strips, shaped into holders at their upper ends.

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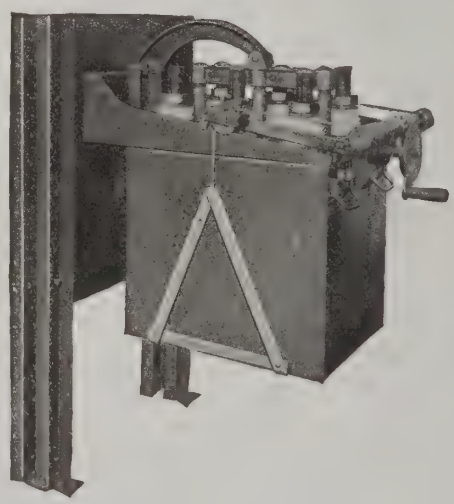
A Tank-Lifter for Oil Switches

Any power-plant or substation man who has helped to remove the oil-filled tank from a switch or circuit-breaker will welcome the extension of the General Electric Company's line of tank-lifters to include switches up to 1500 amperes. As shown in the illustration, the operation is very simple. The lifter is placed on the frame and fastened by two wing nuts; the operating handle is turned by a worm gear until the two triangular supports



are brought snugly against the bottom of the tank; the catches which hold the tank to the frame are unfastened and the tank is then lowered to the floor.

For use on varying sizes of the form of switch shown, the lifter is adjusted by moving the pulleys forward or back in order that the cords may be directly over the center of gravity of the tank.

termined. The maximum potential drop permitted here was 4 per cent. from the service to the farthrest lamp, with all lights burning. For the long feeders the allowable "drop" was divided unequally, allowing approximately 2½ per cent. in the feeder and 1½ per cent in the circuits. In the shorter feeders the drop was divided equally, i.e., 2 per cent. in the feeders and 2 per cent. in the circuits. This scheme made the arrangement of sizes about the best that could be determined. Each and every individual feeder and circuit was figured carefully, and its circular millage fixed. It was found advisable for many of the long and the heavily-loaded circuits to make them 3-wire from the panel out, connecting alternate outlets on alternate sides. This limited practically all the circuit wires to the range of sizes that may be solid conductor, viz: No. 14, No. 12 and No. 10. There were a few No. 8 circuits where the runs were exceptionally long. The 1,000 watt outlet circuits which carry a load averaging about 11,000 watts were all made 3-wire, the outlets being alternately connected one on each side of the 3-wire circuit, which was easily accomplished by the use of the three to two wire cutouts described above.

The total lighting load is approximately 160 k.w. The total quantity of wire used is over 102,000 feet, single conductor, or almost 20 miles.

The structure was designed by J. G. Bassenger, of New York, and the electrical installation was planned and carried out by L. K. Comstock & Company, of New York, Chicago and Montreal.

Coming Conventions

International Association of Municipal Electricians. Annual convention, Baltimore, Md., August 22-25. Secretary, C. R. George, Houston, Tex.

Association of Edison Illuminating Companies. Annual convention, Hot Springs, Va., September 4-7. Secretary George C. Holberton, San Francisco, Cal.

Pennsylvania Electric Association. Annual convention, Eagles Mere, Pa., September 5-8. Secretary, H. N. Muller, Duquesne Light Company, Pittsburgh, Pa.

American Institute of Electrical Engineers. Pacific Coast convention, Seattle, Wash., September 5-8. Secretary, F. L. Hutchinson, 29 West Thirty-ninth Street, New York City.

Illuminating Engineering Society. Annual convention, Philadelphia, Pa., September 18-21. Assistant secretary, C. D. Fawcett, 29 West Thirty-ninth St., New York City.

Association of Iron and Steel Electrical Enginers. Annual convention, Chicago, Ill., September 18-22. Secretary, W. O. Oschmann, Oliver Steel & Foundry Company, Pittsburgh, Pa.

American Electrochemical Society. Semi-annual meeting, New York City, September 28-30. Scretary, J. W. Richards, South Bethlehem, Pa.

New England Section, N. E. L. A. Annual convention, Pittsfield, Mass., October 17-20. Secretary, O. A. Bursiel, 149 Tremont Street, Boston, Mass.

Telephone Pioneers of America. Annual meeting, Atlanta, Ga., October 19-20. Secretary, R. H. Starrett, 15 Dey Street, New York City.

Mr. Arthur Stanley has been elected second vice-president of Stanley & Patterson, 23 Murray Street, New York City, jobbers of electrical supplies, and will devote his time to the firm's sales work.

Mr. L. H. Mesher has been appointed sales manager of the Kearney & Trecker Company of Milwaukee, Wisconsin.

Memorial Planned for Westinghouse

A memorial to the late George Westinghouse, Jr., in the form of a park and statue at his former home, "Solitude," Homewood, is said to be under way.

Business associates of the famous inventor propose to purchase the estate at Homewood and convert it into a public park, it is said, turning it over to the city at no cost whatever save that of maintaining the grounds. It is understood that several hundred thousand dollars have already been raised for the project.

A few of the nearly 800 designs submitted in the competition for posters for "America's Electrical Week", held by the Society for Electrical Development.

New York Metal Prices

July 31, 1916

Copper, prime Lake*	25.25@25.75
Electrolytic*	26.26@26.75
Casting*	24.25@24.50
Wire, base*	31.50
London std. spot	111—0/0
Lead	6.50
Nickel	45.00@50.00
Zinc, sheet, f. o. b. smelter*	15.00
Tin, straits	38.50
Aluminum, No. 1 Virgin, 98@99%	59.00@61.00
Spelter	9.55@ 9.80

Old Metals

Copper, heavy*	20.50@21.00
Brass, heavy*	12.00@12.50
Brass, light*	9.00@ 9.50
Lead, heavy*	5.00@ 5.25
Zinc, new scrap*	9.00@ 9.50

*Nominal.

ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

Vol. 49 **SEPTEMBER, 1916** **No. 3**

Lighting a Moving Picture Studio

By Benjamin Gross

A very up-to-date film manufacturing plant has recently been erected by the Universal Film Manufacturing Company, at Leonia Heights, N. J. It is composed of three buildings, known as the Laboratory Building, Studio, and Administration Building. They are generally of steel and reinforced concrete construction. The Studio Building is partitioned off on the lower floor, almost entirely into dressing rooms; whereas the upper floor is enclosed on three sides and top by ground glass, held in place between structural iron. The roof is shaped in the form of a large inverted V, being supported by twelve trusses. This is one of the largest and finest-equipped moving-picture studios in the East, so far as facilities for taking pictures inside, during the day as well as by artificial lighting at night, are concerned. The night lighting equipment is fully described hereafter.

The main service to the building is alternating current, 2300 volts, 2 phase, 60 cycle and is transformed to 110-220 volts, single phase, 3-wire for general lighting and small motors; 220 volts, 2 phase, 3-wire for larger motors; and to 125-250 volts, 3-wire direct current through motor generator sets, for stage lighting.

The service is brought in underground to a transformer vault in the administration building, by the local lighting company. There transformers are installed for the general lighting of two buildings, and the high tension line continued to transformers in the laboratory building for light and power in the latter. The laboratory building has a local switchboard for the control of all light and power therein. The transformers in the administration building provide general light and power for that and the studio building. The lighting throughout is provided in the usual manner, through distributing feeders, panelboards, local push button switches, etc.

Fig. 1. Interior of the Universal Studio

As direct current has been found far more advantageous for studio lighting than alternating current, a converting plant was installed in the administration building, that consists of a 200 k.w. and a 100 k.w. motor generator set, with space and provision for a future 200 k.w. outfit. Each of these sets was built by the Burke Electric Company, and consists of a 2,300 volt, 2-phase squirrel-cage alternating current motor, and a 125-250 volt, 3-wire direct current compound-wound generator. The motors are each provided with auto-starting compensators, equipped with no-voltage and overload relays. The two generators are paralleled by the aid of a differential voltmeter, which reads "O" when the voltage of the two machines is equal. It has two coils, acting in opposition, one being connected to each machine.

The larger outfit operates at a speed of 690 r.p.m. and the smaller 860 r.p.m. Each motor starter is connected to the high tension line through an oil switch, the operating handle of which is on the main switchboard, and the tanks in the transformer vault behind the switchboard.

There is quite a saving to the owners by their purchasing power from the lighting company directly from the high tension line rather than through transformers and low voltage motors, as is usually done. The efficiency is also naturally higher, as the losses of transformers are eliminated. The load for the studio is quite large and occasional, and this consequently means some appreciable saving, as rates are much lower for high tension supply than for low tension.

These sets are installed for supplying direct current to the Cooper-Hewitt and arc lamps used in the studio, which is divided by overhead trusses into six stages, each approximately eighty feet long by twenty-five feet wide. Each stage is compos-

ed of the space included within three trusses, the area between any two consecutive trusses being known as a "bay." Hence one stage equals two bays. Each truss is provided with a pair of tracks running parallel to the length of each bay, as can be clearly distinguished in the illustrations. A lamp carrier, the length of which is about equal to the width of a bay, is arranged with a set of wheels at each end. These wheels are run into the tracks at the sides of any bay in question. The carrier may thus be drawn from one end of the bay to the other by a rope pulled from the floor. At one end of the studio is a gallery and a

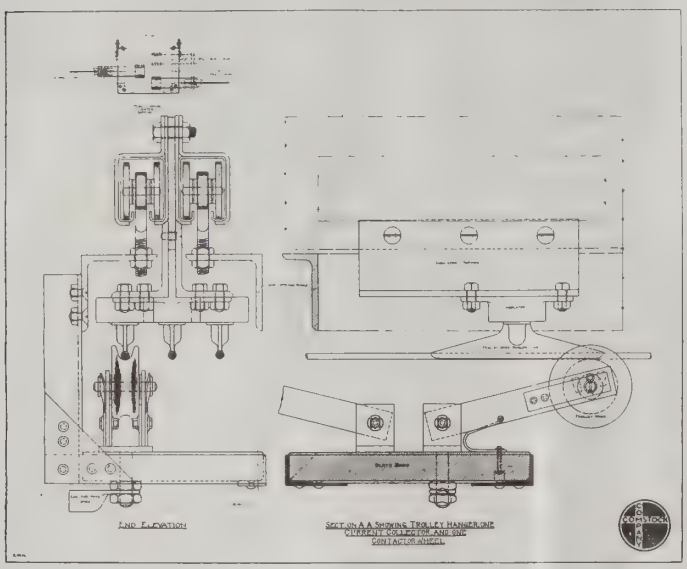


Fig. 2. Assembly of Trolley Hanger and Current Collector

traverser track, on which is mounted a truck arranged to receive a lamp carrier. By running a carrier onto this truck, it can be shifted from one bay to another.

Heretofore, and in even in plants under construction at the time this was completed, a system of flexible cords was hung from above and extended over pulleys, through separable plugs, to the overhead lamps. This meant cables always hanging about, too long or too short, continuously drawn over pulleys, caught under wheels and roughly handled, thereby soon becoming worn and torn and eventually a dangerous fire hazard among such highly inflammable material as films and stage scenery. From the standpoint of appearance alone, such an equipment could not begin to compare with the trolley system that was installed in this studio.

A set of three bare solid copper trolley wires, No. 0 B. & S. Gauge, are suspended by special insulated hangers from the truss work, immediately beneath the centre line of each pair of tracks. These trolley wires and their supports are clearly in view in both photos. The trolleys are held in place by strain insulators at one end and insulated turnbuckles at the other end. The hangers are of the "clinch type," being tightly hammered around the wires to form a flush edge, so that the trolley wheels can readily slide over them. A set of three wires is provided for each bay. Each bay is fed by an independent sub-feeder from the stage switchboard, described below. Connection is made to each trolley wire at one end by means of a rigid copper bar, thoroughly insulated, with varnished cambric tape, which is passed down through a slot cut in the vertical bar on which a pair of tracks is supported, as can be seen in the detail sketch. The trolley ear near this point is provided with a lug, into which a piece of solid round copper wire is secured, this wire being soldered into the above-mentioned rigid copper bar. By this means any possible interference between the moving carriages and the supply feeder is avoided.

A specially-designed current collector is installed on each carrier, by means of which contact is made to the trolley line. The main contact is made by copper trolley wheels, which are held tight against the bare wire by heavy rolled springs. Figure 1 shows one of these contactors very clearly. The lamps on each carrier are connected alternately on both sides of the 3-wire system, thus balancing each carrier within itself. This is required to avoid any unbalance on the generators. At times, one and a half stages may be used for one setting; that is, three bays; under which conditions, if but one bay were on a 2-wire system, and balanced against the adjacent bay, then with three bays in use, with equal loads in each bay, there would be an unbalance of 50 per cent. There are also times when several carriers are operated on one trolley, consequently if one-half of the stage had more carriers on it than the next, there would again be an unbalance on the 3-wire system. It can easily be seen that with each trolley being a 3-wire system and each carrier balanced within itself, an unbalance is impossible. The capacity of each trolley is 30 k.w.—that is, 60 k.w. per stage or a total of 360 k.w. for overflow lighting on the entire floor of six stages.

Fig. 1 shows the lamp "tanks" attached immediately to the carrier, and the luminous tubes hung therefrom by cables; there being one pair for each outfit. These cables are wound on drums by means of a shaft operated through a worm gear by a long pole. There are absolutely no cables hanging below the lamps proper, only the cords for the adjusting of the position of the tubes. The entire design and full working details of all the electrical work were completely drawn up, and all special parts such as insulating hangers, current collectors, etc., manufactured and installed by L. K. Comstock & Company.

This system is highly recommended for moving picture studios, as it has passed the close scrutiny of the Fire-rating experts, and its use results in an appreciable reduction of the insurance rates for the owner. As a matter of fact, the first year's fire insurance saving almost pays for this stage equipment.

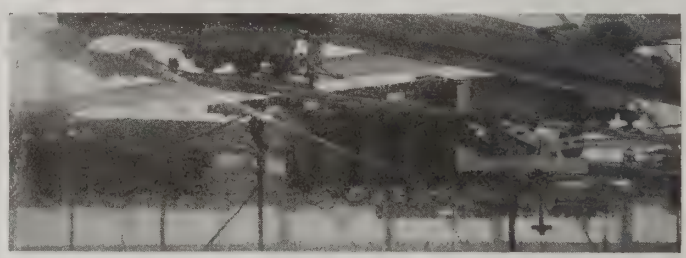


Fig. 3. Close-up View of Trolley System

In addition to the overhead lighting, stage-plug pockets are provided, set flush with the floor, for portable lighting standards. Figure 1 shows a few Cooper-Hewitt and also some arc lamp types. There is a capacity of 40 k.w. for portable lighting of each stage, or a total of 240 k.w. for the entire floor. The stage switchboards are of front-connected type, mounted in steel cabinets. There is a 3-pole fused switch for each trolley and another for each floor pocket. One cabinet is provided for each pair of stages, the control switches for both being on one board. All in all, the stage

Continued on page 50

Fundamental Aspects of Illumination Design

By C. E. Clewell

Assistant Professor of Electrical Engineering, University of Pennsylvania

The planning of industrial lighting systems may be carried out according to a method of comparison, that is to say, by comparing the given location to be lighted, with other similar location, which is equipped with lamps and by test has demonstrated its success for the class of work and the surroundings involved, and making the new system conform to the old. In the hands of one who has the data of the old system in hand, and who knows the conditions surrounding it in detail, a scheme of this kind may be used with a fair degree of success. If, however, the designer of a new lighting system merely has data of an older system in hand without a fairly accurate knowledge of the surrounding conditions, such as ceiling and wall colors, details of work performed, and similar items, there are a number of ways in which errors of judgment may be made. It is principally for such cases, as well as for the ability it may give even to the experienced designer in checking given plans, that it is well to have a working knowledge of the general principles of illumination design in hand when plans are to be made.

Legislation

Another reason of growing importance is the fact that legislation is beginning to be enacted here and there for the purpose of enforcing definite lighting standards. In the commonwealth of Pennsylvania, for example, a code of lighting for factories, mills and other places, was put into effect so as to be operative on and after June 1st. of the present year. One of the principal sections of this code is a tabulated statement of the illumination intensities which shall be maintained in that state. According to this table, fine manufacturing operations must have a minimum intensity of 3.50 foot-candles, and other classes of work have similar intensity. Factory lighting must now be planned, at least in this particular state, not in the haphazard manner which has characterized so much lighting in the past, but rather in such a way that the factory owner and manager may be assured in advance of the installation, that it will conform to the legal requirements for the class of work involved. It means likewise, that in older shops, the lighting must be tested to determine whether or not it conforms to the code, and if not, intelligent steps must be taken to rearrange the layout of the lamps and wiring so as to make the results accord with the regulations of the code.

Factors Involved in an Unsatisfactory System

An interesting and profitable way in which to summarize the factors which constitute the successful industrial lighting system, is to consider it first from the negative point of view, that is to say, to view the elements of the system from the standpoint of ascertaining what the things which cause a lighting system to be *unsatisfactory*. On a basis of this classification, it is then readily possible to set forth positively or constructively the requirements which should be met in the successful system.

Prominent causes of unsatisfactory factory illumination may be listed as follows:[1]

1. *Insufficient* illumination. The number of lamps or their size may be too small, or they may be arranged in such an irregular manner as to result in dark spaces where certain workmen are located.

2. *Glare.* The lamps may be used without reflectors or globes so that the intense filament or arc produces a temporarily blinding effect of more less extent, on those whose line of vision intercepts a lamp or lamps now and then. This may also be caused even when glass reflectors are employed, but where the units are mounted so low that they are almost continuously in the line of vision.

3. *Unsteadiness and unreliability.* These difficulties are sometimes caused by poor voltage regulation due possibly to excessive loads on inadequate supply circuits. Many electric lamps are very sensitive even to slight voltage changes, so that fluctuations in the supply voltage are likely to cause very objectionable changes in the illumination intensity. Similarly, if the operation of the power house, connected with a factory, is unreliable, so that the lighting system fails now and then at a time when most needed, for example, on dark winter afternoons, or during night shift, the demoralizing effect will likely be such as to produce wage losses considerably in excess of the actual time of failure of the service.

4. *Antiquated methods of lighting.* As a rule the method of lighting adopted (such as flame arcs, inverted incandescent and high pressure gas, and metal filament electric lamps), are modern and efficient, but instances are to be found of the use of antiquated systems which can be justified only in special circumstances. In some engineering processes, for instance the work on boring machines and power hammers, gas jets are still commonly employed on account of the rough usage to which the local light sources are necessarily subject, but apart from these special instances they are objectionable in many ways. (From British Report.)

5. *Neglect of upkeep.* Considerable loss of light may result from the accumulation of dirt on the surface of reflectors, globes and lamps, and particularly so if these accumulations are allowed to gather from month to month without systematic attention to the details of the maintenance of the system. Again where the lighting system consists of a number of small or medium sized lamps, one and another of these small units may gradually become dim with age or even burned out completely, and yet remain unnoticed unless regular care is given to inspection and renewals by the proper department in the factory.

6. *Inside obstruction.* The British Report calls attention also to inside obstructions as being less noticeable, perhaps, in artificial lighting than in natural lighting, since in the former there is wider choice in the placing of the lamps as light sources. It may occur, however, in factories, where large and complicated machines (such as Jacquard looms) are used, or where the sources are situated over a traveling crane or other obstruction, as in some foundries. Some cranes, in fact, have lamps mounted on their surface, which travel with the crane, and when overhead lamps are blocked out during a loading operation by the interference of the crane itself these under lamps serve to illuminate the space immediately below the crane.

7. *Shadows.* Objectionable shadows and sharp contrasts sometimes result from interference due to the machinery or belting or both, which intercepts the light in certain directions from overhead lamps, and thus casts a deep shadow at the position of a workman here and there. (Pennsylvania Code of Factory Lighting.)

Characteristics of a Successful System

Constructively, every successful factory lighting system should possess the following characteristics:

1. *Adequacy.* The ilumination should, in general, be sufficient to meet the needs of each workman irrespective of his exact location on the floor space.[2]

[1] Several of these causes have been suggested by and adapted from the First Reportof the Department Committee on Lighting in Factories and Workshops in Great Britain, page xi.

[2] Several of these items of classification have been suggested by and adapted from the Code of Lighting for Factories, Mills and Other Work Places, issued by the Illuminating Engineering Society in 1915 at 29 West 39th. St., New York, N. Y.

2. *Avoidance of eye strain.* Glare should be minimized by the proper use of reflectors or globes, and the selection and installation of the lamps should be such as to avoid eye strain, that is to say, the size of the lamps should be adapted to the ceiling height and they should be installed high enough, whenever possible, to be above the ordinary line of vision.

3. *Circuit capacity.* To reduce unsteadiness in the illumination, lighting circuits should be run independently of power circuits, a course which will tend to prevent the severe voltage fluctuations which are so common due to heavy motor loads which are supplied from lighting circuits. Furthermore, the lamps should be operated from circuits which, in themselves, are sufficient in capacity to assure reasonable constancy in supply voltage with changes in the number of lamps turned on. It is obvious, that the ordinary precautionary measures should be provided in the factory power house to increase the possibilities of reliable and continuous lighting service.

4. *The type of lamp* should be selected with due care as to its efficiency and adaptability to the conditions which constitute the location to be lighted.

5. *Systematic maintenance,* as a part of the routine of the shop electrical department, should be conducted with regularity so as to prevent undue accumulations of dirt and dust on lamps, reflectors and similar auxiliaries. Large losses of light result from such accumulations. Care should also be excerised to renew burned out lamps promptly and to attend to all the items which tend to reduce the illuminating efficiency of the system.

6. *Distribution.* The system should be so designed that it may be satisfactory in regard to distribution, that is, sharp contrasts and shadows should be avoided in as far as possible.

7. *Lamps mounted overhead.* As a general policy, it has been found satisfactory to mount the lamps overhead and to depend on these overhead units for the entire illumination in a given factory section, without the ordinary hand lamps close to the work, except in special cases which make such an addition desirable.

8. *Shade holders.* There are numerous types of shade holders on the market, but it is most important that the shade holder selected for use in a given lighting installation, be such that the reflector with which it is used shall be supported in a way to assure that the filament of the lamp (or other source) be housed in the reflector so as to prevent glare and to secure the most effective distribution of light that is possible with said reflector.

9. *Side components of the illumination.* In addition to the illumination which reaches the work in a downward direction, it is often important to consider also the proper illumination of the sides of machine tools and work, which will sometimes call for a fair intensity of side components in addition to an adequate measurable vertically downward component.

10. *Control by switches.* It is a good plan to arrange the wiring so that a few lamps may be controlled in a group from a single switch. This makes it possible, conveniently, to turn on only such lamps as may be required at any one time.

11. *Light surroundings.* It is an economy to keep the ceilings and at least the upper portions of side walls, light in color, for the purpose of increasing the efficiency of the illumination system and to assure better diffusion of the light than could otherwise be the case. The lower portions of side walls may be a darker tone as they are thus more restful to the eyes, and for this purpose a medium or darker tint may be used.

Checking up the Design

It is important for the designer to realize that calculation does not tell the whole story. A useful guide in all cases is knowledge of the effects secured in similar installations, and this knowledge may be obtained without special effort by observing the details of the design in well lighted rooms into which one comes every day. It is also wise where circumstances permit to install a few fixtures as a trial, especially where the situation is new to the designer. After the system has been installed, observations of the foot-candle intensity on the working area should be secured by means of a portable photometer or illuminometer, at a sufficient number of representative points to make it possible to secure an average or mean value of the illumination. There is practically no other way for gaining the assurance that the design has been handled correctly and the surroundings correctly sized up, and that the system fulfills the conditions which formed the basis of the calculations. If possible, too, the lighting effects should be observed by the designer during one of the periods of service and the employees questioned regarding its degree of success or satisfaction from their own individual standpoint. All data resulting from such tests and inquiries, besides serving to check up previous calculations, help a great deal in new plans under similar or even different conditions, and in case of errors in previous instances, they tend to an avoidance of like occurrances in subsequent experiences.

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Pennsylvania's New Illumination Code

The Industrial Board of the Department of Labor and Industry, Pennsylvania, has adopted a comprehensive and valuable code for proer artificial lighting in factories, mills and other manufacturing establishments in the state. This code covers every essential feature of general industrial operations with concise and effective data, and indicates an important move in the right direction for the consistent regulation of lighting arrangements for workmen's benefit.

By the inauguration of this measure, Pennsylvania becomes one of the few states to institute adequate standards of artificial illumination for its various industries. It sets an interesting and notable example for other states to follow, offering exceptional possibilities for the general welfare of industrial employes in the adoption of suitable laws for this important phase of working conditions in plants and factories.

The provisions of the Pennsylvania lighting code, summarized in six rules, are as follows:

Rule I—General Requirements

Working or traversed spaces in buildings or grounds shall be supplied during the time of use with artificial light in accordance with the following rules whenever natural light falls below the intensities specified in Rule II.

Rule II—Intensity Required:

The desirable illumination intensity to be provided and the minimum intensity which shall be maintained are indicated in the accompanying table.

This rule is intended to provide adequate illumination at the work. For purposes of measurement a horizontal reference plane 30 inches above the floor is to be taken, and a properly standardized portable photometer or illuminometer used.

For purposes of very rough estimate, it may be stated that with a good overhead system of lighting one candlepower (spherical) per square foot of floor area should produce an illumination intensity of about three foot candles.

	Minimum Ft. Candles.	At the Work. Ordinary Acceptable Practice—Ft. Candles.
1. Roadways and yard thoroughfares	.05	.05-0.25
2. Stairways, passageways, aisles and storage spaces	0.25	0.25-0.5
3. Rough manufacturing operations, such as foundry work, rough machining, rough assembling, rough bench work	1.25	1.25-2.5
4. Fine manufacturing operations, such as fine lathe work, pattern and tool making, light colored textiles, tobacco manufacture	3.50	3.50-6.0
5. Special cases of fine work, such as watch making, engraving, drafting, dark colored textiles	5.0	10.00-15.00

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The Calculation of Illumination

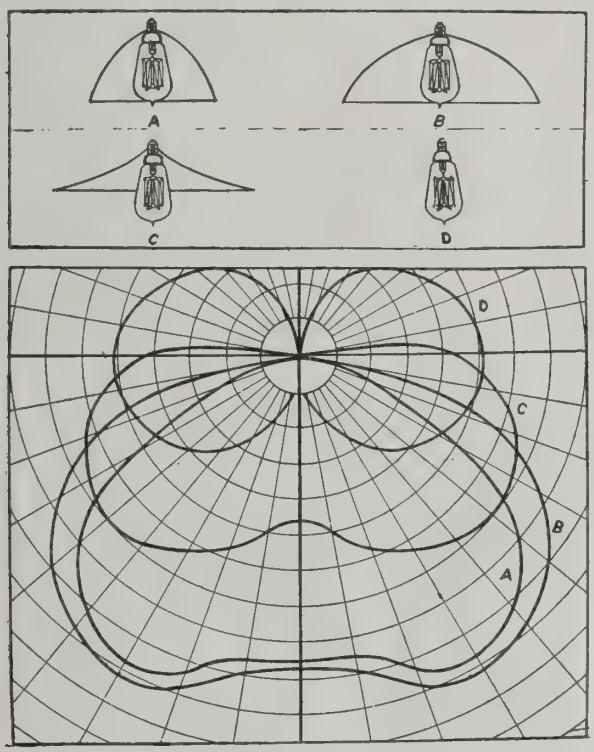
By R. Thistlewhite

Instructor, New York Electrical School

A perfect understanding of the methods of calculating the number and size of lamps required to illuminate an area can only be obtained by first geting a working knowledge of the measurement by means of which these calculations are made.

LET us consider first the luminous intensity; this could be likened to the pressure at which the light rays are concentrated about the luminous portion of the light source. The unit is generally known as candle-power, although to be correct this should be called simply "candle" as it does not represent any power in the sense usually used. It has, however, been called candle power so long that we shall use this term. At one time spermaceti wax candles were used as a standard of light by which all other illuminants were measured, their values being stated in terms of "candles."

The luminous intensity is measured in this way. The lamp is set up on a measurement bar or photometer so that the tip points up. The rays are directed along a horizontal plane which passes through the luminous center of the lamp, and



Percentage Light Flux				
Unit	A	B	C	D
Total light from lamp	100.0	100.0	100.0	100.0
Light absorbed by reflector	37.0	18.6	14.8	0.0
Light in upper hemisphere	0.0	0.0	6.4	48.6
Light in lower hemisphere	63.0	81.4	78.8	51.4
Light in 60° zone	53.4	59.2	41.3	20.5

Fig. 1

in order to get a mean value of the intensity—all around the lamp, it is kept revolving while the measurement is being made. This is the value referred to when the rating of the lamp is given, namely, the mean horizontal candle power.

If the lamp is turned so that its axis makes varying angles with the horizontal, and candle-power is measured for each of these angles, we may then plot the values obtained on a polar coordinate paper, obtaining the familiar diagrams, Fig. 1. From this it is possible to calculate the total light given off; this is called the luminous flux and is measured in lumens. If we have a point source of intensity I = 1 candle-power, then the total flux is 4πI. Hence if we know the total flux F we can readily calculate the average intensity, for it is F ÷ 4π.

Power Requirements

This will probably raise the question as to how many watts are required to produce one candle, and how many to produce one lumen. These values depend upon the type of lamp used and are given in the table below:

Illuminant	Watts per Candle	Lumens per Watt
Tungsten vacuum type	1 to 1.35	12.5 to 9.3
Tungsten gas type	0.8 to 0.55	15.6 to 24.0
Mercury Vapor	0.43	29.2
Mercury Vapor Quartz	0.43	29.2

By means of this table, the quantity of light can be obtained from any of the lamps mentioned, provided the wattage is known thus: What quantity of light will be delivered from a bare tungsten lamp, vacuum type if the label on the lamp bulb reads 100 watts, 115 volts.

A 100 watt lamp has an efficiency of about 1.02 watts per candle; then I = 100 ÷ 1.02 = 98.1; F = 98.1 × 4π = 1232.

The foregoing calculations deal with what the lamp is capable of doing, but the calculations must also be made for

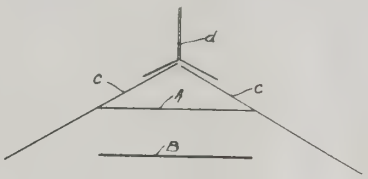


Fig. 2

this light after it has been received. If a person goes into a perfectly dark room, no impression of any object in that room can be registered on the brain through the eye but let a ray of light be allowed to penetrate and the object which it strikes is instantly seen and that object is said to be illuminated. If the light source is large enough, the whole of the room can be illuminated and everything registered perfectly on the brain. The illumination striking these objects depends upon the distance they are from the light source as will be seen by Fig. 2. Suppose the two radial lines CC represent the boundary lines of the light rays given out by the illuminant D, there will be a certain amount of light embraced between these lines, all of which will strike the line drawn at A, which is touching the lines CC; now lower this line, keeping it the same length, to position B and it will be readily seen that some of the rays escape without striking it. Therefore the illumination is less in the second position or where the distance from the light sources is increased—in fact, the amount will vary inversely as the square of the distance from the lamp.

The unit of illumination is experessed by the symbol B and is called the foot-candle. Any area is said to be illuminated to a value of one foot candle it is receiving a quantity of light equal to one lumen per square foot. Roughly speaking one candle power per square foot of illuminated area with lighting units hung from 12 to 16 feet from the floor will produce about 2.75 to 3 foot candles.

Example: A certain area of 1200 sq. feet is illuminated by 10-100 watt lamps of the tungsten gas-filled type. What is the value of the illumination assuming that all the light given out by the lamps is received upon the area to be lighted and none is lost?

Efficiency of gas filled lamp about 0.8 watts per candle $100 \div 0.8 = 125$ C.P. $125 \times 4\pi = 1570$ lumens.

for ten lamps $1570 \times 10 = 15700$ lumens.

foot candles or lumens per sq. ft., $15700 \div 1200 = 13.2$

In practice there is a great deal of the light lost during its journey from the lamp to the plane to be illuminated, and this example must be used only to illustrate the procedure. Considering the loss of light brings in the question of efficiency and great care must be exercised in not confusing them with one another. The "watts per candle" efficiency has already been spoken of, and it is known that the value will vary with the type of lamp used. It would be far more desirable to have an efficiency which would be the same for all illuminants. This can be obtained by getting the ratio of the total light given by a lamp and the total light received upon the plane of illumination, which is called the efficiency of utilization and is equal to:

Efficiency = effective lumens, ÷ total lumens.

The effective lumens are the amount of light received on the plane of illumination.

Utilization Constants[1]

Tungsten Lamps 25 Watt to 1000 Watt Sizes

Per Cent. Lumens Effective

Reflector	Ceiling Walls	light	light medium	light dark	medium light	medium medium	medium dark	dark medium	dark dark
Prismatic Clear		0.64	0.56	0.51	0.55	0.51	0.48	0.44	0.42
Prismatic Satin Finish		0.54	0.50	0.45	0.50	0.45	0.43	0.39	0.38
Bowl Steel		0.51	0.49	0.47	0.50	0.48	0.47	0.47	0.47
Dense Opal		0.58	0.55	0.51	0.54	0.51	0.49	0.49	0.49
Medium Density Opal		0.54	0.49	0.45	0.48	0.45	0.41	0.39	0.38
Light Density Opal		0.49	0.45	0.41	0.44	0.41	0.37	0.36	0.35
Dome Steel, etc.		0.56	0.54	0.51	0.55	0.52	0.51	0.51	0.51
Bare Lamp		0.43	0.37	0.31	0.37	0.31	0.26	0.25	0.23

Fig. 3—Foot-candle Intensities for Various Interiors

Armory	2.0	Office	3.5
Art Gallery Walls	5.0	Operating Table	10.0
Auditorium	2.0	Pattern Shop	3.0
Auto Show Room	5.0	Power House	2.5
Billiards:		Press Room	4.0
Room	1.0	Residence:	
Tables	4.0	Pantry and Kitchen	2.0
Bowling Alley		Laundry	1.5
Pins	4.0	Furnace Room	0.6
Car Barns	1.5	Restaurant	3.0
Carpenter Shop	2.5	Rug Rack	15.0
Church	2.5	Sewing Room:	
Dance Hall	2.0	Light Goods	4.0
Drafting Room	3.0	Dark Goods	8.0
Tables	8.0	Skating Rink	2.0
Engraving	10.0	Spinning	3.5
Factory:		Stable	1.0
General (with local)	1.5	Stock Room	1.0
General (no local)	4.0	Stores	3.0—5.0
Local (bench work)	4.0	Store Room	0.6
Foundry	3.0	Swimming Pool	2.5
Freight House	1.5	Telephone Exchange	3.0
Garage	2.0	Train Shed	1.0
Gymnasium	2.5	Type Setting	8.0
Laundry	2.0	Warehouse	1.5
Laboratory	3.5	Weaving	5.0

[1]From "A Handbook of Incandescent Lamp Illumination"—Edison Lamp Works.

This conception of efficiency is valuable as a means of estimating the quantity of light required for a given area but it is not the true efficiency, nor is it possible to calculate the true efficiency. It might be called the operating efficiency or service efficiency, in that it has to do with the length of time the lighting can be worked under without eye-fatigue. The longer a person can use this equipment without bad effect, the higher will be the service efficiency, which would depend upon the positions, mounting heights, correct shading, and spacing of the lighting units, together with the correct amount and quality of light. No matter how much light is used or how much current is supplied, whether too much, too little or exactly the right amount, if the lamps are not arranged so as to eliminate all possible glare, deep shadows and contrasts, eye-fatigue will result and consequently decrease the efficiency of the system.

It has been known for a long time by manufacturers who have collected statistics along these lines, that the majority of accidents and mistakes occur in the later hours of a day's work when the eyes are getting tired, thus causing a decrease in the efficiency of the worker. This has been corrected to such an extent that the output of the factories has been materially increased by altering the existing lighting, and paying more attention to the decorations of the walls and ceilings. It has been a common failing in the past to pay more attention to the amount of current consumption than to the quantity of light required, and in consequence a great many establishments cannot get the best results even with a correctly designed lighting unit properly spaced.

Calculations for a Typical Installation

To illustrate how the problem of designing a lighting scheme should be attacked we will give an example and show the procedure for both direct and indirect lighting.

It is required to illuminate a floor, used as a grocery store, 150 ft x 80 ft. having 14 ft. ceilings. The decorations are light ceilings and medium dark walls. The ceiling is to be wired in conduit having the control switches in panel boxes which are supplied by three-wire feeders 110-120 volts.

Direct Method of Lighting

Referring to Fig. 3, it will be seen that a grocery store requires from 3.0 to 5.0 foot-candles or what is the same thing 3.0 to 5.0 lumens per square foot. This amount must be placed on the working plane which will be in some parts of the store on the counters and in other parts upon the floor. In order to give a comparison figure, it requires 2.5 foot-candles to read fine print, so unless the store wishes to have a large quantity of light for advertising purposes, 3 foot-candles should be ample, however, allowing a little for advertising purposes, we might use a value of 4 foot candles for the area under consideration.

The area of the floor is 150 by 80 ft. = 12000 sq. ft., so that $12000 \times 4 = 48000$ lumens of light required for the whole area.

Of course much of the light produced will fail to reach the working plane, the fraction depending on the color of the walls and ceiling. Average values are given in the accompanying table. Let us assume that in this case we will have to produce $48000 \div 0.60 = 80{,}000$ foot-candles.

It would not be possible to place this quantity of light in one fixture in the room on account of the dense shadows that would be produced, so it must be distributed over the entire area so as to give as even an illumination curve as possible. A maximum variation from the average foot-candles of about 30 per cent. is for all practical purposes uniform. In stores, churches, factories, etc., a maximum of 50 per cent. might easily be allowed, that is to say, the average illumination in a room being say 4 foot-candles a maximum of 6 and a minimum of 2 foot-candles.

Continued on page 49

Lighting of an Amateur Theatrical Performance

By Glenn Marston

In the early part of August an amateur theatrical performance for the benefit of a charitable organization was given on the estate of Mr. James L. Breese at Southampton, Long Island. The production was a "girls-and-music" affair such as "gets over" anywhere from Maine to California, and is frequently staged by local organizations. While in the setting of this play no expense was spared, many elements were common to less pretentious productions.

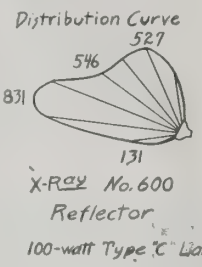
THE entertainment was given in a large tent, in which a dancing floor was built, with an elevated stage at one end. In order to avoid "tent-show" atmosphere the stage was banked solidly with trees and shrubbery at the sides, but the back was left open, giving a view of two apple trees several hundred feet away. Behind these trees was a hedge, and just a glimpse could be seen of the white corner and big red chimney of a neighboring cottage. This constituted the "back-drop."

The Back-drop of this Stage was 200 ft. Away

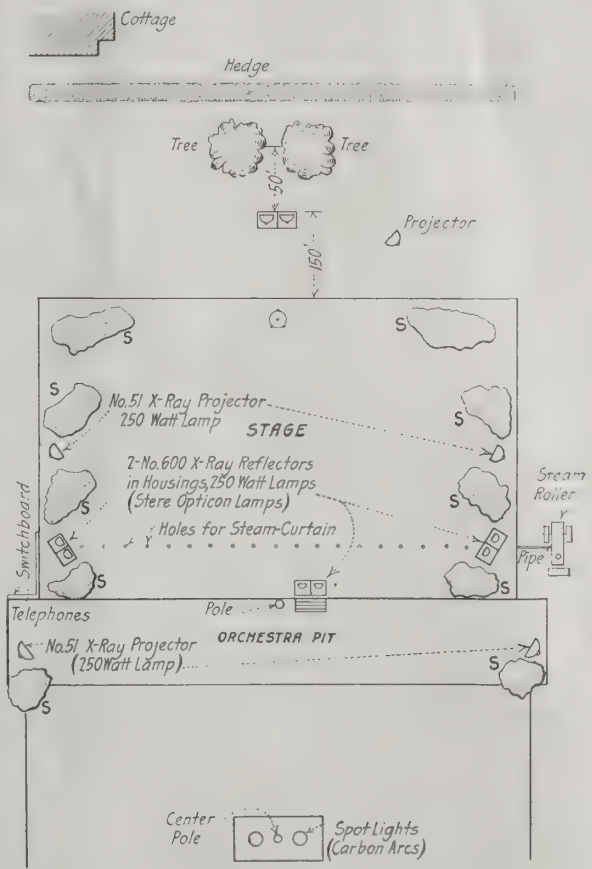
It was impossible to hang a curtain without erecting a framework which would have detracted much from the beauty of the stage setting, yet some sort of screen between the stage and the audience was essential to the action. The village road roller was run up beside the stage, connected to a pipe under the stage, and holes were bored in the floor to correspond with small holes in the pipe. When steam was turned on, a striking curtain effect was produced, by colored lights from projectors playing on it.

For illumination of the tent there were rings of lights around the poles, but when the steam came on, these lights went out, and when the steam disappeared, there was the stage in nearly total darkness. Then the front of the stage became luminous from some indistinguishable source of light, but all the rest was still dark. The light crept further and further back, changing color as it went, until all the "nations" of the grand opening tableau were alight, save one. Just as the general lighting of the stage, all in subdued colors, came to its height, a spot-light, hung from a platform high up in the centre of the tent, focused its rays on the central figure, "America," and gradually brightened until she stood dominating the entire scene, bathed in a radiance of pure white light. The spectators were very much impressed with the beauty of the scene, as their applause showed. Throughout the performance the amateur actors had their audience "right with them," and while this was due largely to their skill, yet the scenery and lighting played a large part. A description of these will be of interest to any who have to arrange lighting effects for an amateur show either indoors or out.

The stage setting was unexpectedly beautiful, simple though it was. There were a few marble statutes, and a wonderful bronze tripod from some ancient Roman ruin, but the really important part of the setting could be approximated by going forth into the fields and cutting suitable boughs and branches. The stage was made to seem illimfitable by not following the usual practice which hedges in three sides and leaves open only the fourth. We left the back open and let nature help us with the setting. A complete light-plot was prepared in advance for the entire show by conference with the stage director. From this a light-plot for each lamp was made out, and explained to the man who was to operate that particular lamp. All operators were inexperienced, save the two spot-light men, and the smoothness of thier team-work was remarkable. Quite a help was an impromptu telephone system which was rigged up by robbing a couple of automobiles of their loud-speaking instruments. These were attached to three dry cells, and connected the main switchboard telephone with the opposite side of the stage and with the spotlight operators in the top of the tent.



The lighting equipment was designed with the understanding that it was to be useful for other purposes than the particular performance under discussion. In order to keep it as simple as possible, so that it could be handled by amateurs on occasion, the light-sources were confined to a few units. The entire equipment consists of only nine easily portable pieces, in addition to



General Arrangement of the Stage

the spotlights. There were five "X-Ray" flood-lighting projectors mounted to bring them about 6 ft. from the floor. For floor lighting metal boxes were made up just large enough to accommodate two No. 600 "X-Ray" containing 250-watt lamp units side by side. These were turned so that the light was thrown horizontally and upward. From the light-distribution diagram shown in the figure, it will be seen that most of the light goes out at an angle slightly above the horizontal and that enough goes vertically upward to illuminate a player's face when he comes quite close to the lamp. Each of the two sockets was wired in cable to the switchboard, so that different colors could be controlled separately.

By the zone system each lamp lights a certain area of the stage, and is confined by reflectors to that area only. In the central part of the stage, of course, all the zones overlap, and give a mixture of all the colors used on the individual lamps.

The Extemporized Switchboard: Simple but Sufficient

In outdoor lighting one cannot depend on diffused light reflected from the surroundings. There is a little reflected light, but the quantity is so small as to be useless, and what there is is bad because it is green. Therefore all shadows from one side must be cut by direct illumination from some other direction. In this performance we concealed in one floor-box as described above, two 250-watt lamps behind the piano, the filaments of the lamps being even with the stage-level. These were dimmed or cleared as occasion demanded for the cutting of shadows which would have otherwise been unpleasant. No color screens were used on these lamps at any time, their intensity being always only enough to eliminate shadows, but not enough to give the impression that there was direct illumination from the front of the stage.

The location of the various lamps is shown in the accompanying diagram. Four projector units were used, mounted on extension stands. Two were on the stage, giving light from about six feet above the stage floor. Two were on the ground before the stage, giving light about three feet above the stage floor. In addition to the clear footlights mentioned above there were two floor boxes, one at either front corner of the stage. The diagram shows roughly the areas covered by each zone of light and indicates how the concentration of all lamps on the centre of the stage gives good illumination at that point, though in the central area it is not possible to mix colors and have any single one stand out clearly. In one of the dances one side was all pink, and the other side all pale green, the lights of one side brightening up the shadows of the other. There was, of course, a definite "shadow line," which prevented the faces from appearing flat, but strictly speaking the shadow did not exist; there was merely a difference in color.

In the Quaker dance all operators were instructed to use pale green, pink, and purple colors "hit-and-miss," which means that they were not to be governed by one another, but to make the changes at will, the effect being a gradual melting of one color into another on the very pale grey of the costumes, and imparting warmth and variety to the number.

In the surf-bathing dance the participants wore purple bathing suits with cerise colored cloaks. The action assumed that the girls were in the water when they came to the front of the stage. The two projectors on the ground were colored green for this number, and when the green color fell on the purple of the costumes the result was a surprising degree of "wetness" on the costumes. A little study in the properties of color will frequently make possible unexpected effects. Costumes can be completely changed in color, brilliant ones darkened, and dark ones brightened, by the proper color screens.

Color effects are secured by sheets of gelatine placed in frames of the size to fit the opening before the light source. Grooves are placed on each piece of apparatus into which the color frames slide as their use is demanded, so that frames can be used for all equipment. I have found the most advantageous size to be 12 x 12 or 13 x 13. The gelatines and frames can be obtained from any stage-lighting firm.

The chief advantage of this lighting equipment is its great flexibility. Any organization giving a performance involving a hundred performers or so will find this equipment sufficient to meet ordinary needs. It is easily movable, and the dimmers are interconnected so that one or all can be operated at a time. The next advantage is that the cost is within reach. The essentials of this equipment can be purchased for something like $300, excepting the spotlights, which can be hired for a reasonable sum. It is not advisable to purchase spot lights for pageants or amateur performances because they require expert operation, and generally the light and the operator can be hired together for a figure little more than the cost of either separately.

Lighting Plot for Left Foreground Projector

Make sure you have the following screens: Red, green, light green, amber, magneta, pink.

After Overture.

STEAM CURTAIN—Hit and miss *red, green, amber.*

1. Tableau. About 10 min.
   Light green, until characters start down stairs, then clear and spot them to exit.

STEAM CURTAIN—*red, amber.*

2. School days, 6 min. Buster Brown costumes.
   Pink throughout.

3. Dance of seasons. 10 min. Four girls at a time, in long ruffled shirts.
   Spring. First 4 girls. 1¼ min.
   Open *blue.* On signal change to *magenta* for five second, then five seconds of *pink,* then *amber* to the end of dance.
   Summer. Four more girls. 1¼ min.
   Amber throughout.
   Autumn. Four more girls, with canes. 1¼ min.
   Open *amber* for 45 seconds, then *magenta* to finish.
   Song and ensemble. Clear.

4. Tarantella. 10 min. white shirtwaist, red, and green costumes with sashes.
   Open *red* until solo, then *amber,* after solo, clear to exit.

5. Surf-bathing Rag. 4 min. Girls, cerise cloaks over bathing suits.
   Green throughout.

6. Quaker dance. 8 min. Grey costumes, men with big hats.
   Hit and miss, *pink, purple, green,* use green very little.

Intermission 2 minutes.

The balance of the program was covered in a similar manner.

Patents and Inventions

By Bayard H. Christy

This is the first of a series of articles by Mr. Christy on the general subject of Patents, The author's long experience as a patent attorney qualifies him to tell our readers the important points to be observed in the securing and marketing of patents...Fundamental definitions are dealt with in this issue.

The natural order in which these questions should stand is, What is Invention? What is a Patent? For invention comes first: the invention must be made before a patent for it can be granted. But the inverted order is better. People know in a general way what an invention is, and their first concern is to find out more exactly what a patent is.

Let us begin then with an invention already made, and let us be specific. Let us take the case of Mr. Marconi, for example, and his invention of apparatus for wireless telegraphy. If there were no patent law his invention would be of little value to him, for he could not use it without letting other people understand it, and other people seeing and understanding could duplicate the apparatus and use it, and Mr. Marconi would be powerless to prevent.

But Government intervenes: it says to Mr. Marconi (and to every inventor), in effect, this: "Prepare and submit to Government an accurate and intelligible description of your invention—a description which others may understand and follow. Government will thereupon issue letters patent in your favor. The letters patent (which are open to the public) will have attached to them your description of your invention. Under those letters patent no one but you and those authorized by you may, during seventeen years, enjoy the invention. When seventeen years have passed the invention will become public property: any one who wishes may then enjoy it."

A Patent Confers no Right to Enjoy

It is to be very carefully noted at the outset (for there is a common misunderstanding here, which leads to a great deal of difficulty) that a patent does *not* confer upon the patentee the right to enjoy his invention. The right to enjoy an invention before there was any patent law. All that the patent law does is to impose limitations upon that right to enjoy. The voice of the law is not directed to the patentee, saying, "You may enjoy this invention," but it is directed to the rest of the public, saying, "You may not enjoy this invention." The patent law confers upon the patentee only the right to prevent others from enjoying the invention. In other words, the mere fact that a man has a patent is no assurance that he has the right to use the thing patented.

This is a hard saying; and, to understand it, one must consider the case, not of one inventor alone, but of two successive inventors. The first inventor—Mr. Marconi, let us say—invents apparatus for a system of wireless telegraphy and patents it. Subsequently, the second inventor invents, let us say, a new and better sort of detector for the Marconi system; and he gets a patent for it. Now, manifestly, the fact that the second man has patented a detector is no reason why he should be permitted to use Mr. Marconi's patented system of wireless telegraphy. This is true, even though his patented detector has no practical value, except as a part of the Marconi system. On the other hand, Mr. Marconi may not in his system use the second inventor's patented detector. Of course, Mr. Marconi might license the second man, and authorize him to use the patented system; or the second man might license Mr. Marconi, and authorize him to use the patented detector. And, in addition to that, since Mr. Marconi's patent is the earlier, it will expire first, and after it has expired, the second inventor may use the system freely, and may then freely enjoy his patent for the remainder of its term. But neither may, without authority, use the invention of the other. This illustration will suffice to show that the Government, in granting a patent, does not grant a right to use it: it grants only the right to prevent others from using it. Whether he may use it depends on other circumstances.

No Obligation to Secure a Patent

An inventor, *then,* is not *obliged* to get a patent. He may, if he wishes, and if the invention is of such a kind as to make it possible, keep his invention a secret. But if he does not get a patent, and if his secret should happen to be discovered, he could not prevent a stranger from enjoying the invention.

A patent is a grant by Government, and it confers upon the patentee for a term of seventeen years the right to exclude others from making, using, or selling the thing invented. It is this *exclusive* right which is the essential feature of the patent. If there were no patent law, any one who had knowledge of the invention might enjoy it; but, under the patent law, a patented invention may during the life of the patent be enjoyed by no one, except the patentee and those authorized by him. If the others infringe, the courts are open to the owner of the patent: he may stop infringement by injunction and he may have redress for damage done him.

Invention is Discovery

We come now to the second question, What is Invention? What is it that may be a patented? The Constitution provides that "The Congress shall have power . . . to promote the progress of science and useful arts by securing for limited terms to authors and inventors the exclusive right to their respective writings and discoveries." Patentable invention then, in the contemplation of the Constitution, is discovery related to "the progress of science and useful arts."

Congress, exercising the power conferred in the language just quoted, has enacted that "Any person who has invented or discovered any new and useful art, machine, manufacture, or composition of matter, or any new and useful improvements thereof . . . may . . . obtain a patent therefor." There are four categories then, four classes of subjects, in any of which, according to law, patentable invention may lie. (1) art, (2) machine, (3) manufacture, and (4) composition of matter.

The Four Categories

An *Art,* in the meaning of the patent law is commonly spoken of as a *method* or *process.* Novelty here lies neither in material under treatment nor tools employed but in the way in which material is treated, the method employed, the operation to which material is subjected. A good illustration of a patentable art is Goodyear's invention of mixing sulphur with India rubber and subjecting the mixture to heat. Therein was a new process —a new *art*—the art of vulcanizing India rubber.

A *Machine,* in the meaning of the patent law is nothing else than a machine in common understanding: it is the inanimate physical means for accomplishing an end, doing work, producing an article for use or sale. Its value may lie in its operation, as is the case with an air-brake apparatus or a telephone; or its value may lie in the tangible, physical thing which it produces, as is the case with a glass-bottle machine or knitting machines. A patentable machine may be simple as a can-opener or a corkscrew, or intricate as a cash register or a player piano; if it be *new* it is patentable.

A *composition of matter* is exemplified in the article of commerce, carborundum, chemical union of carbon and silicon, discovered not many years ago. But it is not chemical combinations alone which are patentable as compositions of matter. Physical combinations too are patentable, as for example, a metallic alloy of new composition and new commercial value, or a mixture of unctuous substances having peculiar value as a lubricant.

The remaining one of the four categories named in the statute (the third in order) is *Manufacture*. And when we come to this we have to realize that the enumeration which the statute affords, though exhaustive and all-inclusive, is nevertheless not logically exact; for a machine is a manufacture, and so is a composition of matter. Strictly speaking, there are three categories, and only three, in which inventions may be grouped: an invention may concern a method of working, that is an *art;* it may concern the mechanical means of working, that is a *machine;* or it may concern the result of working, that is a *manufacture.* And that is all. The phrasing "machine, manufacture, and composition of matter," though redundant, is inclusive. And in the term *manufacture,* as commonly used in patent law, are included those products of invention which are not (in common readers' ranking, at least) machines, on the one hand, nor yet compositions of matter, on the other. In this category are ordinarily included such matters of invention as games, toys.

The statute says that patentable invention may lie in any one of these four categories, or in an *improvement* upon that which lies in any one of these categories. The distinction between a patent for what is altogether new and one for an improvement upon what is old is theoretical rather than actual, and may be dismissed with very brief notice. It is very rarely that invention is made of something altogether new: Goodyear's invention of vulcanizing rubber is an outstanding instance, and Acheson's of carborundum is another. Ordinarily invention is by way of improvement, and there have been improvements made and patented in both of these particular fields, as well as in every field of industrial work.

One thing more needs to be said before turning from the subject-matter of invention. A single invention may lie in more than one of these classes or categories. Take Goodyear's invention, for instance, he invented, in a single inventive act a *process* that is the art of vulcanizing rubber and also a *product,* a manufacture (a composition of matter, if you will), vulcanized rubber. Acheson invented at one and the same time a method of treating sand and coke (an art) and also the product, carborundum (a composition of matter, or manufacture). So a man may, in a single invention, invent a method and a machine by which the method is performed. In all such cases the invention is one single act, though in the adaptation of human law to a natural condition there is a seeming duplication.

What is Invention

One essential question remains, What is Invention? We have considered the subject-matter of invention: that which, under the law, may be patened. But it is true that any change in industrial method, any alteration in machine structure, any variation in proportion of the ingredients in a mixture may be patented? Surely not.

Take the case of a workman who has learned a trade or an engineer who has studied his profession. Each is possessed of peculiar expert knowledge, and it is his business to apply that knowledge, to work intelligently. Each of these men in the course of his work has presented to him constantly new problems: he is required daily to apply his peculiar knowledge and skill to ever changing circumstances. In doing this he is not ordinarily making invention. The skilled workman will modify his methods and adapt them to variations in material; the engineer, when called upon to build a machine, will go ahead and build it; though the method in one case may be in some respects unique, and the machine in the other case may be in some respects unlike any other machine, still there may be no patentable invention involved. So long as the workman uses the common knowledge of his trade, and nothing more; so long as the engineer merely does what any other trained engineer would do under the same circumstances, there is no invention.

Invention is Creation

Invention is a creative act—a creative act of the mind. It involves in the very essence of its meaning the doing of something not obvious; taking a short-cut, where common experience would go round; leaping to a conclusion which otherwise is laboriously attained; seeing in the dark, and proceeding to previously undiscovered places.

The line which divides the realm of invention (the realm of the creative faculty of mind) from the realm of mechanical skill is not easy to trace. Many a case rises of which it is doubtful, whether there be invention or no. All that can be done is to indicate the principles involved. Every case must be resolved in and of itself, and herein even the ablest and most intelligent inventors need and seek the asistance of patent lawyers. And indeed it is a large part of the function of the courts sitting in patent cases to resolve this question, Is the thing patented a matter of invention, as distinguished from mere mechanical skill?

Novelty and Usefulness Essential

Finally, an invention to be patentable must be *new* and it must be *useful.* A man to-day, having no knowledge of what Goodyear did sixty years ago, might, conceivably, do precisely the same thing which Goodyear did. So far as he is concerned, he would then be just as truly the inventor of the process of vulcanizing India rubber as Goodyear; he would, as an able and intelligent person, be entitled to just the same praise and high esteem as ever Goodyear was. But he could not have a patent. He would be an inventor but not the *first* inventor. His invention would not be *new,* and it is only a *new* invention which, under the law, may be patented.

And the patentable invention must be useful. Sometimes and under particular cirumstances, novelty of invention is tested by the result—whether the end attained is a better end, a more useful end (if you will) then had previously been attained. But, ordinarily, to be patentable an invention need not be useful beyond what has gone before. It must be practicable, serviceable, leading to a certain and desireable end. But, beyond that, the patent law makes no requirement.

We shall, in subsequent articles consider The Way to Obtain a Patent, and The Enjoyment of Patent Rights.

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Municipal Ownership a Bugaboo

Recently a movement was started in Independence, Kan., for a municipal electric plant. The campaign to date is having an early death, and the Independence *Daily Reporter* in an editorial has this to say of Municipal ownership:

"Independence has just about as much need of a city owned electric light plant as it has of another city hall and a second set of city officers. There isn't a man, woman or child on the town site who can justly complain of the service given the city and its citizens by the electric light company now operating under a franchishe granted it by the city. The plant is one of the finest anywhere in the middle West and not even the loudest advocate of municipal ownership has ever said otherwise.

"There is no sense whatever in plunging this city farther into debt when the thing desired—lower electric light rates—can be secured by a simple and inexpensive appeal to a state board created to hear exactly such cases and to render decisions that are fair, just and impartial.

"Taxes and rents in Independence are high enough now. A city-owned light plant would simply mean a tax increase on every foot of property, on every dollar of merchandise, within the corporate limits—taxing a man's property whether he used electricity or whether he didn't use it. It woud mean higher rents for every non-home-owner and these people are having hard enough times to make ends meet now. The only beneficiaries would be a few of the local industrial plants—owned by the richest men in the community—who might profit in the competition for power business that would probably ensue between city-owned and private-owned electric plants. And herein, incidentally, is one of the numerous bugs under the chip in the agitation for city-owned electric light plant. Others can be driven out and shown up if necessary."

EDITORIAL

Selling Illumination

In accordance with custom, this issue is our Fall Lighting Number. The return of cooler weather and the lengthening evenings draw our attention to lighting needs, and the time is auspicious to begin to push sales.

Elsewhere in this issue we publish a number of articles on various phases of illumination, treating the subject from both theoretical and practical standpoints. All of them are written by men who have a first-hand knowledge of their subject, and treat it in a clear and concise manner. Professor Clewell gives the general considerations to be observed in designing an installation; Mr. Thistlewhite explains the underlying theory; Mr. Gross and Mr. Marston describe actual installations; Mr. Duncan tell about portable lamps and how to sell them. We feel that each of these articles comes up to Electrical Age's standard: to help its readers to solve problems in their own daily work.

So much for the articles; they must speak for themselves. If they are to serve their purpose, our readers must make the practical application themselves. It is an apt paraphrase which says: "You can lead a boy to college, but you can't make him think." The only way to get any good out of a technical paper is to read it over slowly and carefully, check the author's computations, and try out his formulas on a familiar case or installation. If an obstacle is encountered which will not yield to conscientious study, write to our Question and Answer Department about it; we are always glad to help you out.

But beyond the calculation of physical values is another form of mental exercise—the use of the imagination. It is that which makes some men and some organizations go ahead faster than others. The dealer who learns that certain shades will be in style six months hence for decorations can proceed to order his lamp-shades accordingly; the astute Mr. Coffy, of Everett, Washington, uses his imagination to tell him that charitable organizations would be glad to hold their sales in his central-station show-room. Countless opportunities lie at the hand of every business-getter to put two and two together and find that they make five; the extra unit being a sale.

Anyone who talks with the smaller dealers about the opportunities which lie beyond their door-sills will hear the iterated answer, "Yes, but I don't have time to get away." In some cases that is true, but in many more what ties a man to his desk or his counter in sheer inertia. The routine work is there to be done and it envolves no mental strain. Pushing sales, however, requires effort from start to finish. If one could put an oscillograph on the mental voltage of one of those fellows, the record would show a bad "dip" when any aggressive sales work might be suggested.

These points apply particularly to illumination. With a little effort it should be possible to place a portable lamp or two in every home, and to suggest the purchase of better lighting fixtures where they are needed. Illumination has much of the aesthetic in its appeal, and the exercise of imagination in planning for the customer will yield a handsome return.

* * *

Department Stores and Appliance Repairs

The practice of department stores in conducting cut-price sales of electrical appliances, such as irons, percolators, toasters, etc., is often embarrassing to the appliance department of a central station. As a result of such a sale, the appliance store is liable to be harrassed by housewives who bring in their appliances for repairs or renewal of parts. Usually the department store has no repair man, and so the central station is looked upon as the logical place of resort.

This situation is hardly fair to the central station. The latter has not enjoyed the benefits of profit derived from the sale of the appliance, and it is clear, should not be expected to keep the appliance in repair, though it is to its advantage that the apparatus should be kept in working condition and connected to its lines.

Some central stations are in the habit of sending the purchaser back to the department store, which in turn is likely to take the appliance and return it to the manufacturer for what is usually a trivial repair, or the replacement of a part which would cost less for renewing at the store than the postage or expense would amount to, if sent back to the factory.

A cure for the evil is in the provision, by the department store, which goes into the electrical appliance business, of a competent repair man who will give the appliances the care and renewal which they require. This employe need not be on extra man; often an electrician who is employed about the store in the care of the lights can be trained in the construction and upkeep of household electrical devices. Having such a man in readiness to serve will relieve the central station and the manufacturer alike of needless bother and expense.

* * *

Political Power Vs. Arbitration

The passing of the crisis in the dispute between the railroads and their trainmen has left us easier in mind

as to the regular receipt of freight shipments and the possibility of meeting delivery promises. The action of the President and Congress has brought to an end an industrial dispute as unjustified in its cause and discreditable in its settling as any in our history.

So extensive have been the newspaper accounts of the proposals made by both sides that the reading public are quite familiar with the claims of both employers and employees. We shall refer only briefly to the facts which lie at the root of the controversy, while pointing out the conclusions which flow from them.

The interest of every person in the United States is best served when each receives a wage which fairly represents his contribution to the common good. When wages are so adjusted, each worker does his best, for he knows that excellence will be rewarded as promptly as inefficiency will be punished. If, however, one man or one class of men are paid more highly than they deserve, a much larger group must be penalized to make up the excess. What this means in the case in hand is apparent from the following figures:

During the year ending June 30, 1914, the railroads paid to men of the classes represented by the four trainmens' brotherhoods $387,587,000 in wages. If ten hours' pay should be given for eight hours work, there will be a 20 per cent. increase, which on the basis of 1913-14 would be $77,400,000 a year for the same number of man-hours. Should time-and-a-half be paid for overtime, the increase will be considerably more than that sum. Now during the year referred to, there were 309,174 men of this class employed, so that their average annual wage was about $1,253. In order to increase this sum by 20 per cent. to $1,510, every man, woman and child in the country is to be asked to contribute seventy-five cents a year to the prosperity of 309,000 men whose power is great enough to extort it.

It has been said that the primary contention of the Brotherhoods is for the eight-hour day. Many of our readers have first-hand knowledge of railroading, and know that the hours of a man's service depend on the nature of his run, and that in a great number of cases while he may earn a day's pay in four or five hours he may be kept away from headquarters for ten hours or more through circumstances over which no one has control. We are in favor of a day of eight hours where the workers can speed up their production to accomplish a day's work in that time, but we doubt whether that is possible in railroading.

Just where savings have been made in railway operation in the past and who has benefitted from them, is interesting in view of certain claims made by Brotherhood leaders. Figures from a responsible source show that during the eight years from 1906 to 1914 the following percentage increases were made:

	Passenger miles	Freight ton-miles	Wages
Conductors	29	23	42
Engine Men	37	30	42
Firemen	37	30	47
Other Trainmen	23	17	49

Obviously the trainmen have been well compensated for their extra productivity, yet any one familiar with the engineering side of railroad operation will realize that the increases in units handled have been due to the longer trains handled, which in turn have been permitted by heavier permanent way and larger locomotives. We grant that firing a heavy freight locomotive is an arduous task, but we cannot see that the conductor or other trainmen who take out a long freight-train have much more to do than on a short one.

Concerning the attitude of the Brotherhood chiefs toward arbitration, we are compelled to say that it is contrary to the spirit of our democratic institutions. Long ago it was found that the only way men could live together was by their agreeing to be bound by the decisions of tribunals when they could not settle their differences by other means. If in any particular instance an individual resorts to force, the community through its officers quickly steps in and compels submission. The only reason that this method has not been applied to industrial disputes is because both courts and common-sense agree that a man cannot be compelled to work for another against his will. Hence statutes for compulsory arbitration will always be one-sided in that they cannot be enforced against the employee. If, then, **voluntary** arbitration is the only alternative to costly strikes, every individual or organization which refuses to arbitrate is doing his share toward discrediting and destroying an institution which will become more and more necessary in our future industrial life. This distinct disservice to the community is one which we call to the earnest consideration of every one of our readers.

There is another aspect of this refusal to arbitrate which is most significant. The contestant with a poor case dreads the courts, and will settle outside whenever he can. If the trainmen were conscious of the justice of their demands, and the practicability of the granting of them, they should have enough of patience and confidence in the justice of public opinion to go before any of the available tribunals with their case.

Electrical Age does not side with any political party, and avoids questions of party politics. But the actions of the President and Congress have been such that we cannot pass them by without comment. Having taken upon himself to settle this controversy, Mr. Wilson immediately announced that the Brotherhoods' claim for the eight-hour day was just. Without hearing a particle of evidence, he came out for a twenty per cent. wage-increase to one of the best-paid classes of labor in America. Throughout the conferences he has been the champion of their cause and a special pleader in their interest. The Congress, with cowardice unparalleled, made concessions such as no special class has ever before obtained. The disgusting spectacle of our representatives abandoning without a struggle such a contest is one which fills us with gravest concern for the future of democracy.

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Seasonal Rating of High Voltage Underground Cables

LOADS that may be carried by a underground cable with safety in the winter time or possibly during months of normal weather conditions may result in excessive heating and eventual if not rapid failure if resorted to during excessively hot and dry weather. The recent hot spell, when the heat has been excessive and rain absent for more prolonged periods than is usually the case has resulted in an increase in the number of cable failures. These failures did not occur immediately with the commencement of the really hot dry spell but increased and continued to increase at the later stages, due no doubt to the time lag between atmospheric and subterreanean temperatures.

The large number of cable breakdowns have revived, and rather acutely, the question of varying the rating of cables at different times of the year. Such a practice is not a new one, for it has, indeed, been in force for several years by some companies and with very satisfactory results. While the basis upon which the reduction has been made has in the most part been empirical—one company reduces its loading fifty per cent. during the summer—in all cases the aim is to reduce the number of burn-outs by "playing safe."

Causes of Heating

The heat generated in a high voltage underground cable is due the I^2R losses in the conductor and the losses in the insulation. Up to a certain loading, and for a definite voltage—the point where dielectric losses require careful consideration seems to be at voltages above about 9,000 volts—the I^2R losses in the conductor are the predominating cause of heating. This heating is more or less uniformly distributed throughout the conductor's length and varies with the loading and temperature of the conductor. The heating dut to dielectric loss is not necessarily a uniform loss, as for example where insulation is defective, joints poorly made, air pockets, ionization, sharp curves, etc., and at such places hot spots will exist. The resistance of a dielectric decreases as the temperature increases, and thus as the temperature rises due to the load carried by the cable dielectric losses start to increase. Since these dielectric losses increase with heating hot spots cause a further increase in the losses—it is a cumulative effect—and the cable becomes self-destructive. Extreme cases of heating due to dielectric loss have occurred where a cable has been kept alive but with no load on it, and yet the low dielectric resistance was such that the dielectric losses causes breakdown.

During extreme hot weather the top and sub-soils become heated which causes a decreased current-capacity of a cable for a definite temperature. In the absence of rain and with an extended period of heat the soil dries out the moisture and as its heat resistivity rises the soil becomes less of a conductor and more of a heat insulator. A cable is thus very liable to become overheated throughout, and the likelihood of hot spots occurring in enhanced. Still another possibility tending to increase the internal and external temperatures of a cable during such time is that the drying up of the soil tends to affect the resistances of ground plates, etc., and in this way the relative resistance of various grounds existing in the city change, shunting foreign current to the cable sheath. This feature may be present far more often than supposed, and while not being a predominating cause of hot spots may easily contribute toward them.

A Complex Problem

While the effects of high voltage upon rating and dielectric loss, and the influence of extreme prolonged summer weather must, from the nature of the problem, be rather indefinite and difficult to determine, the advantages of doing so are very great. The problem is necessarily one that is complex because of the exceptionally large number of variables and unknowns entering. Of these the more obvious and the number and type of ducts installed; number of cables installed and in use and the load and load factor of each; the nature of the surrounding soil and subsoil, its relative heat conductivity, etc.; the cable itself, its voltage, the insulation its specific heat, and whether varnished cambric, paper, rubber or graded. Knowing all these factors it is not commercially possible to determine with any degree of accuracy the internal or sheath temperatures of a large number of cables, because of the inability of determining them for all conditions that may arise and to know when they have arisen.

Cables Which Gave Trouble

It would appear, prima facie, that the cables operating at the higher voltage would be the ones requiring the greater reduction in rating during the summer months. This is borne out by experience this summer, and cables operating at 12,000 and 20,000 volts have given more trouble from breakdown than have those operating at 9,000 volts. In one notable instance in one large underground network the cables of higher voltage have given more than unusual trouble, and also have the lower voltage cables, namely 4,000 volt, whilst the 9,000 volt cables seem to have been affected only in the ordinary way. At first this might suggest that the theory of dielectric loss was not the real and predominating cause of cable breakdowns during hot weather, yet on looking into the matter a little more closely another factor arises that offers a reasonable explanation. The 4,000 volt underground cables in question supply an extensive overhead network of 4,000/2300 volt conductors. These overhead conductors have been subjected to atmospheric conditions during thunder storms in the immediate proximity as well as over distant territory. Some of these circuits opened during the storms others did not. In this case, while dielectric losses and heating therefore occur, of course, to some extent,

the probable explanation of their increased failure is that the insulation was somewhat damaged and weakened by the surges, induced charges, etc., of the lightning storms, transmitted to them over the aerial conductors. The heating of the conductors due to I^2R loss and dielectric losses also contributed, no doubt, to their failure.

The hot spell has brought to light still another annoying and expensive occurrence, namely that since, and during the hot spell failures of the same cable in quick succession have occurred. Often the failure has been found to be at the joint last repaired. This is also due to the hot weather, although only indirectly so. Frequent failures keep men of the underground departments busy, resulting in longer hours with accompanying fatigue. At the best of times manholes are unpleasant places, but during torrid weather they become almost unbearable—the temperature is high and the atmosphere noxious. Working under these conditions does not tend to the best of workmanship, with the result that splices fail when subjected to high potential test or after only short time in service.

Man and beast requires more careful and judicious handling in the hot weather than in cold, otherwise they may become hors de combat through prostration brought on from internal or external causes. Underground high voltage cables, likewise, are prone to failure if worked as hard in summer as in winter, from internal heating whether due solely from internal causes or assisted by external conditions. Seasonal ratings will effect fewer shut downs with their accompanying expense to the central station company and the customer. Data are too vague, are in fact lacking, upon which to base summer ratings. They must be such that the temperature of the hottest spot will be below that at which the dielectric resistance begins to become self-destructive, and serious dielectric losses occur. That each company interesting itself in this matter has formed a different opinion is emphasized by the fact that the safe sheath temperatures are stated to be from 90 to 125 degrees fahr. It is probable that in the absence of a means upon which to base the change of rating due to the inability to determine at all times the transitory condition of the medium surrounding the cable that each company will continue to adopt a rating based upon empirical factors of safety or operating data, this latter being after all the criterion of safe ratings.

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Spring Lake Drainage and Levee District

The Spring Lake Drainage and Levee District is located in Tazewell County, Illinois, along the Illinois river, and extends from a point about five miles below Pekin to a point about three miles below the Copperas Creek locks. This district has an area of about 12,500 acres and is 18 miles long, the width varying from ½ to 3 miles depending upon the distance from the river to the bluffs. Before the levee was constructed and the drainage system put into operation this land was considerably below the level of the river for the greater part of the year. Now, the levee with its ditches, canals, and pumping plant, makes it possible to remove the water to a level that permits the land to be farmed.

The pumping plant is at the extreme lower end of the district along the river, and is about fifteen miles from Canton. Power is furnished by the Canton Gas and Electric Company, over a three-phase, 60-cycle, 13,000 volt transmission line, extending from a substation in Canton to Bell's Landing, about three miles above Copperas Locks on the opposite side of the river from the pumping plant. From Bell's Landing the wires are carried across the river on four steel towers of the four post type set on concrete foundations and piers, the base of the tower being three feet above high water mark. The total distance spanned in crossing the river is approximately 2,000 feet. From the river crossing the line then extends for about six miles along the levee district to the pumping station. A substation is maintained at the pumping plant. It consists of four 25 foot poles, one on each corner of a concrete foundation 5 ft. wide and 15 ft. long. On these poles are mounted lightning arresters, disconnecting switches, choke coils, and fuses. The transformers, each of 200 kva., 13,000 to 460 volts, are mounted on the concrete base.

Outdoor Installation of the Pumping Plant

The orginal equipment of the pumping plant in 1909 consisted of two 48 inch R. D. Wood and Co. pumps driven by two cross compound Russell engines direct connected, and operating at speeds of from 170 to 215 r. p. m., and one 24 inch Worthington pump direct connected to single cylinder Russell engine driven at 250 r. p. m. The pumps were primes by means of steam ejectors, and the lighting of the plant was furnished by a small vertical engine directly connected to a direct current generator. The boiler equipment consisted of two 300 horse-power water tube boilers with hand fired grates, the necessary draft being obtained from a steam driven induced draft outfit.

Due to the difficulty of obtaining coal, in obtaining and holding good engineers and operators, and to the further difficulty of obtaining repairs in case of emergency, the commissioners of the district decided to change the plant over from steam to electricity. In 1914 they advertised for electric motors with controllers and sprocket drive for operating the pumps.

The preliminary work leading up to the electrification of this pumping plant was done by Hoppin and Rich, engineers and constructors of Peoria, Ill., who made a thorough investigation of the proposed change and the method of making the same, for the Canton Gas and Electric Co., who are now furnishing the power. At the time of the proposed electrification the Canton Gas and Electric Company had no schedule of rates which could be applied to this class of service. The schedule of rates now in effect in Canton and vicinity applying to drainage and pumping was devised by Hoppin and Rich after a study of existing rates and the cost of power at the company's switchboard. The power is sold at a certain rate per kilowatt hour per acre per month, the rate depending on the amount of land served and the amount of power used.

Pumping Equipment of the Spring Lake Plant

The pumping plant as now operated consists of the following equipment: Two, 300 horsepower and one, 100 horsepower, 440 volt, Westinghouse induction motors with controlling equipment consisting of auto transformers operating three switchboard type oil circuit breakers. The larger motors are connected to the 48 inch pumps by two 25 inch silent chain belts. The 24 inch pump is driven by a 10 inch chain belt. Sprockets are placed on the pump shafts in the position orginally occupied by the flywheel and eccentrics when the plant was steam driven. A 16 by 8 inch Ingersoll-Rand compressor used as a vacuum pump replaces the steam jets which were used for priming the pumps when operated by steam engine.

The specifications required that the pumps should be operated at two speeds, as the maximum efficiency of the pumps and the motors is obtained with different speeds. By selecting two separate motor sprockets to be fitted to the shaft as the head changes against which the pump must work it is possible to operate the pumps at two different speeds. The lower speed is used when the pump is operating against low heads, and the higher one when the lift is near maximum.

The plant does not operate continuously at its full capacity nor does it operate every day. The pumping depends largely on the season of the year and the amount of rainfall. Heavy pumping is required for only about three months of the year, 65 to 75 per cent. of the total yearly work being done from March 15 to June 15. The remaining work is distributed about evenly throughout the other nine months. The usual load on the plant is 250 kw., and during a part of the year this load is on the lines about ten or twelve hours per day. During the heavy pumping season the motors are sometimes operated from 18 to 20 hours a day. In extremely wet periods all the pumps, taking practically 600 kw. have been operated a few hours at a time.

The cost of operation has compared favorably with steam operation and the certainty and freedom from interruption have made the service very satisfactory to the commissioners.

Three Wire Generators

By R. H. Willard

On account of a considerable saving in copper the three wire system is often used for direct current distribution, the common voltage being 110 volts from either line to neutral and 220 volts between lines. There are several arrangements for getting three wire power. One scheme which would give the desired result would be two 110 volt generators in series with the neutral wire brought from their common connection. This scheme has been largely superseded in practical installations by the three wire generator. This is a standard d. c. generator wound for the voltage between outside wires with the addition of a pair of slip rings which are tapped into the winding 180 electrical degrees apart. Connected to these slip rings is a "balance" coil which is a reactance coil with a tap at the center making it in effect a 2 to 1 ratio auto-transformer. Fig. 1 shows the connections. Coil A is always connected to end A^1 of the balance coil through the slip ring; similarly, B is connected to B^1. As the armature revolves coil A passes first under a North pole then under a South while B is passing under a S and a N so that the voltage impressed on the balance coil is alternating. When A and B are under the brushes full machine voltage is across the balance coil; when they are half way between, the voltage is zero. At any other position the voltage across the balance coil is equal to that generated in the part BA^{11} of the winding since the potential generated from A^{11} to D is cancelled by the potential from D to A. Since the balance coil tap is in the middle its potential will be half way between the potentials of coils A and B at all times because of its action as an auto-transformer. On account of the rings being tapped into the winding the equivalent of one pole pitch apart, the part of the winding between A and the + brush is equal to the part of the winding between B and the — brush. The middle of the balance coil is not only half way between the potentials of A and B but also half way between the potentials of the + and — brushes, so that it is a true neutral to the line wires in all positions of the armature and the voltage from it to either line wire is half the machine voltage. With no direct current load, then, the balance coil carries a small alternating exciting current like any auto-transformer.

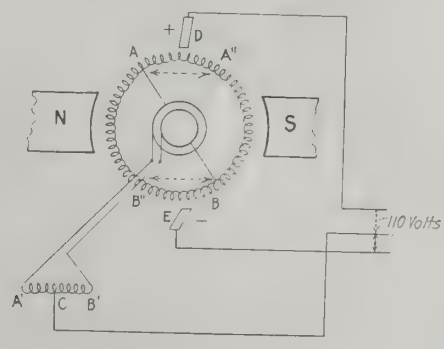


Fig. 1

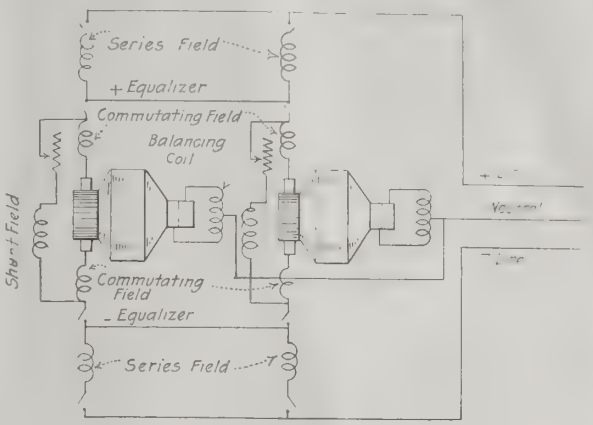


Fig. 2

Suppose a load be put on between the outside wires. This will not affect the current in the balance coil or the voltage of its middle point.

Now suppose a load connected from the + line to neutral. The current comes from the + brush, through the load, back through the neutral wire to C. From here it has four paths in parallel to complete its circuit to the + brush:

(1) $CB^1BA^{11}D$
(2) CA^1AD
(3) CB^1BEAD
(4) CA^1AEBD

The voltages of all the paths are equal since the center C of the balance coil is kept at all times at neutral—i. e. at a fixed potential to D. Since the voltages of these parallel paths are equal the current will divide according to their resistances which change constantly as the armature revolves. The resistance is a minimum when A and B are under the brushes. This would tend to cause the current to flow mostly first through one end of the balance coil then through the other. Due to the inductance of the balance coil when the current from C to B^1 starts to increase a voltage is induced acting from B^1 towards C which opposes this increase (Lenz's Law). Sinces A^1C is wound on the same core as CB^1 this counter e.m.f. shows up also in A^1C as a voltage acting from C toward A^1. Consequently there is a voltage induced in CB^1 tending to limit the increase in current and also a voltage in A^1C tending to increase the current through it. Both these tendencies are toward maintaining equal currents in the halves of the balance coil. The induced voltage depends on the inductance and the rate of change of current so with a given coil if the alternations are very slow, the curren is each half of the balance coil will pulsate more than when they are fast as in a turbine driven set. Hence, to obtain the same de-

gree of even distribution more inductance is required for slow speed, low frequency machines which means a bigger balance coil. The current in the balance coil on unbalanced d.c. load is seen to be an alternating exciting current combined with a more or less steady direct current. The current in the neutral wire is a pure direct current.

Although the balance coil does not distribute the unbalanced current absolutely uniformly in the armature conductors the extra heating is so small that it is not found necessary to reduce the rating for three wire operation on unbalanced loads up to 10 per cent. which is as high as commercial systems usually run.

In operating three wire machines in parallel it is found necessary to split the series and commutating fields putting all the N poles on the + side and all the S poles on the — side or vice versa. The reason for this is that if the unbalanced load were drawn from + to neutral with the series and commutating fields on the — side there would be no current through these fields and consequently no compounding or proper commutating field. This necessitates two equalizers. In applying circuit breakers it is necessary to use four pole breakers breaking +, — and both equalizer connections for if the equalizer connections were not broken the machine would be driven from the bus as a shunt motor.

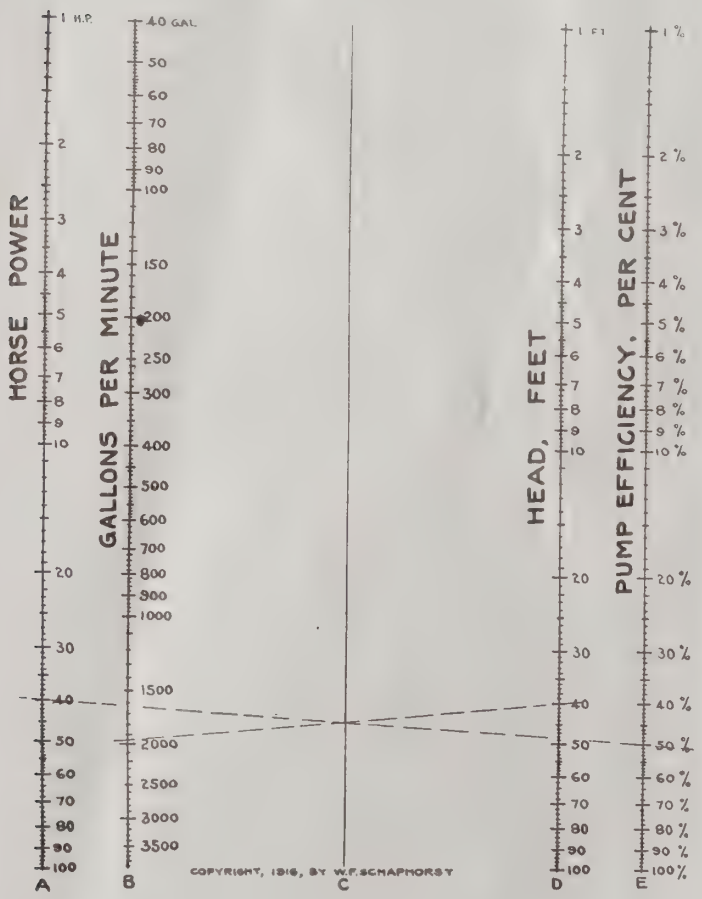
* * *

A Handy Chart for Figuring Pumping Capacity

By W. F. Schaphorst

This chart will be found useful for finding the horse power necessary to do almost any pumping job up to 100 h. p.; for finding the gallons of water a given pump will lift per minute; for finding the head; or for finding the efficiency of a given installation.

For example, how many gallons per minute will be pumped by a 40 h. p. motor through a 40 ft. head, the efficiency of the pump being 50 per cent.? Join the 40 (column A) with the 50 per cent. (column E) and locate the intersection with column C. Then run a straight line through that intersection (column C) and the 40 (column D) and the answer (1950 gallons per minute) is found in column B.



The principal point to remember is—always connect A and E; B and D. The two outside columns must be used together, and B and D must be used together.

It is plain, now, that knowing three of the values in A, B, D or E, the fourth one is easily and quickly found without any computing.

Whether the motive power is electric, steam, gas, or water, makes no difference. And it doesn't matter about the pump either—whether duplex, triplex, reciprocating steam, centrifugal or air lift.

When figuring efficiencies I usually allow about 80 per cent. for duplex, triplex, and reciprocating pumps in general; a good modern centrifugal pump, about 60 per cent.; and for air lift pumps 40 per cent. is considered pretty good. Higher efficiencies than these have been obtained with all of the above pumps, to be sure. It you know the exact efficiency of your pump or the pump you have in mind, that is the efficiency to use in the chart, of course.

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New York Metal Prices

Aug. 31, 1916

Copper, prime Lake*	27.00@27.50
Electrolytic*	25.75@28.00
Casting*	25.00@25.25
Wire, base*	33.00
London std. spot	109—0/0
Lead	6.50
Nickel	45.00@50.00
Zinc, sheet, f. o. b. smelter*	15.00
Tin, straits	38.875
Aluminum, No. 1 Virgin, 98@99%	60.00@62.00
Spelter	8.80

Old Metals

Copper, heavy*	22.00@23.00
Brass, heavy*	13.00@13.25
Brass, light*	9.75@10.25
Lead, heavy*	5.50@5.625
Zinc, new scrap*	7.75@ 8.00

*Nominal.

Coming Conventions

Indiana Electric Light Association. Annual Convention, Anthony Hotel, Fort Wayne, Ind., September 12-14. Secretary, Thomas Donohue, Lafayette, Ind.

Illuminating Engineering Society. Annual Convention, Bellevue-Stratford Hotel, Philadelphia, September 18-20. Asst. Secretary, G. B. Fawcett, 29 W. 39th St., New York City.

Association of Iron & Steel Electrical Engineers. Annual Convention, Chicago, September 18-22. Secretary, W. O. Oschmann, Oliver Steel & Foundry Co., Pittsburgh, Pa.

American Electrochemical Society. Semi-Annual Meeting, New York City, September 28-30. Secretary, J. W. Richards, South Bethlehem, Pa.

Electrical Supply Jobbers Association. Quarterly Meeting, Hotel Statler, Cleveland, Ohio, October 10-12. Secretary, Franklin Overbaugh, 411 South Clinton St., Chicago.

New England Section, N E. L. A. Annual Convention, Pittsfield, Mass., October 17-20. Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston.

Jovian Order. Annual Convention, Indianapolis, October 18-20. Secretary, Ell C. Bennett, Syndicate Trust Building, St. Louis.

Telephone Pioneers of America. Annual Meeting, Atlanta, Georgia, Oct. 19-20. Secretary, R. H. Starrett, 195 Broadway, New York City.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Digging Pole Holes With Dynamite

By Thomas M. Knight

A most efficient method of digging pole holes is by the use of dynamite. Dynamite has been used very successfully for years in digging small post holes and in loosening up the ground to be dug. This process, all are well acquainted with, but the digging of deep pole holes with explosives is probably a new proposition to many.

This new method has been found to be so successful that it is fast supplanting the old and expensive hand work, and in these days of labor scarcity the employment of any agent that will lessen the number of laborers required is of great value. An advantage not to be lost sight of is that the force of the explosive tends to pack the dirt solidly around the sides of the hole, making a much firmer hole than is possible to make by hand. Then again, in putting down hand holes in hard soils the tendency is to make them shallow, and this danger is completely eliminated by using explosives.

The Hole should be Started with a Shovel

To determine the best and most economical methods of doing this work many experiments were carried on carefully in various classes and conditions of soils. From these the following method has been determined:

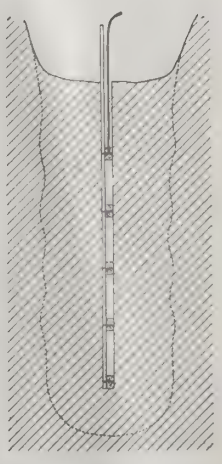
In order to relieve the pressure on the soil that is to be excavated and to prevent the excessive shattering of the sides, a hole from six to ten inches dep is put down to the full diameter of hole required. The sides of this shallow hole should be trimmed straight and clean. The next step is to put down a small bore or loading hole in the center of this shallow hole to the depth of the hole desired. This work is done by drills, bars or augers, depending on the nature of the ground and the particular preference of the operator. The ordinary punch bar, however, will not work well in deep holes.

The dynamite must be placed at intervals in these bore or loading holes and the best method of spacing the explosives is with the aid of a lath or some other small piece of wood. The charge intended for the bottom one is tied on the end of the lath and the other charges, consisting of a piece of a cartridge up to a whole cartridge, are tied to the lath at intervals varying from six to twenty-four inches. The space between the charges is determined by the hardness of the soil and the required diameter of the desired hole.

The top cartridge or piece of cartridge is primed with a No. 6 blasting cap and fuse or with an electric blasting cap. This primer is tied on the lath so when it is placed in the bore or loading hole it will be from twenty inches to two feet below the surface.

The dynamite thus tied to the lath is lowered into the hole, the primed cartridge, of course, being placed up. In placing these charges in the hole, it should be seen that no loose dirt,

An Auger is Then Used



How the Dynamite is Placed

clots of sod, loose stones or any other similar matter fall in, as these would interfere with the proper loading and firing. It generally adds to the result of the explosion if there are a few inches of tamping in the top of the hole. Here, again, care should be taken to see that no dirt or other tamping material falls below the priming charge. If the hole is filled with water no tamping is necessary. The primer is then fired and the balance of the charges are exploded by the concussion of the priming charge.

Following the methods of loading and firing as described above, many test shots were made in soils that varied from hard dry clay to those of wet clay with more or less shale. The bore holes were put down to a depth of four and one-half feet with a hand chisel. Some of the results are as follows:

In one hole one-half cartridge of Low Freezing Extra 40% dynamite was used, untamped, in the bottom of the hole. A large cavity was blown in the bottom of the hole and the dirt for two and one-half feet was thoroughly disturbed. Results poor.

In the bottom of another hole was placed one-third of a

The Charge Ready to be Placed

cartridge of 60% dynamite, another charge of same size eight inches from the bottom, and one-half cartridge of 40% Low Freezing Extra twenty inches below the top. Cap placed on top charge and no tamping. A good, clean, straight, open hole was blown. Results very satisfactory.

Another clean and open hole was dug by placing a whole cartridge of 60% Straight dynamite at the bottom of the bore hole, another cartridge of the same kind twelve inches up, and twelve inches from that still another cartridge of the same kind. The results secured were excellent and more dirt was thrown out than in the hole mentioned just before this.

It will be interesting to note that in one, a wet blue clay soil, a bore hole was put down to a depth of six feet. Seven charges were placed six inches apart, beginning at the bottom. Each charge contained one-third of a cartridge of 50% Straight dynamite. This blew a clean-cut uniform hole seventy-eight inches deep, which required but little hand work to clean out. The earth was well compacted back into the walls of the hole. The results were as good as any we could desire.

Other tests were made with practically the same results as have been described. It will be noted from these various experiments that it is a good practice to make trial or test shots to see what charges and spacings will work best in the soil to be dug.

Sometimes a plug or bridge of earth is left over a well blown hole. This can readily be shoveled out in a very short time. Generally speaking, from two to six minutes of hand work is all that is required on the blasted holes.

Straight dynamites probably give better results in warm weather, while the Extra and Low Freezing grades will be found satisfactory in both cold and warm weather.

Practical Design and Construction of Direct Current Electromagnets

By Norman G. Meade

There is probably no one piece of electrical apparatus that is used to a greater extent or has a wider application than the electromagnet. It is the purpose of this article to give details of the design and construction of direct-current electromagnets of various types, for different kinds of work.

Direct-current tractive magnets are designed to exert a certain pull and may be divided into short-range and long-range types. The conventional type of short-range magnet, commonly called "horseshoe" type is shown in Fig. 1. Such a pair of magnets consists essentially of round wrought-iron cores, wrought-iron yoke and armature, fiber heads on the cores, insulation and the winding. The plunger type of magnet shown in Fig. 2 is best suited to long-range work. The illustration shows a pair of magnets forming a closed magnetic circuit the same as the short-range magnets shown in Fig. 1. The coils are wound on brass or bronze spools, insulated with mica or fiber. The yoke is provided with two stops of the same material as the yoke itself, generally wrought iron, which project a short distance into the magnet core. This form of construction has a wide range of applications among which may be mentioned the operation of brakes on electric traveling cranes.

The iron-clad magnet shown in Fig. 3 is the most efficient type for a single-plunger magnet and is mechanically the best protected from injury. The frame of the magnet is generally an iron forging or steel casting with a spool or bobbin on which the wire is wound, made of brass or some other nonmagnetic material so that the core will not stick to the frame. The core is usually constructed of soft iron. A highly effi-

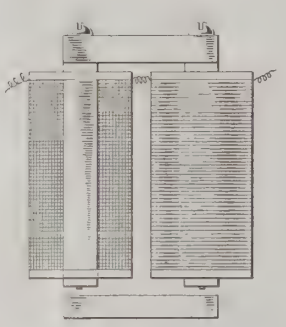


FIG. 1.

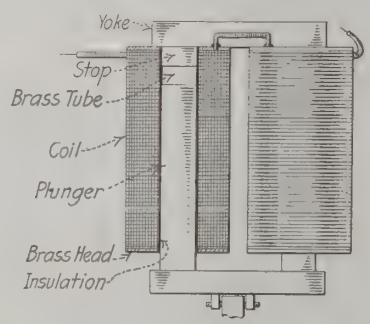


FIG. 2.

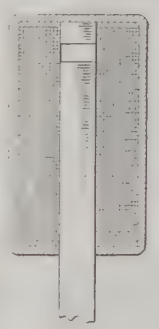


FIG. 3.

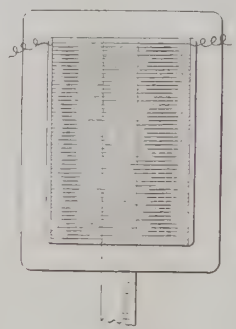


FIG. 4.

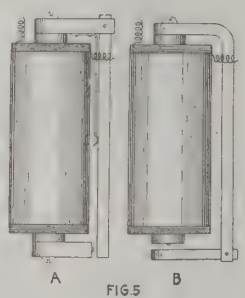


FIG. 5

cient modification of the iron-clad magnet is shown in Fig. 4. The winding is partially surrounded by a rectangular forging or casting with a area which is equivalent to that of the core. As with the iron-clad magnet, the spool or bobbin should be constructed of nonmagnetic material. Where space will not permit or the design of the apparatus is such that it is desirable to use a single short-range magnet, the designs shown at A and B in Fig. 5 are applicable.

Proportions of a magnet depend upon the purpose for which it is designed, but as a general rule the length of plunger magnets are determined by the range of action and the area of the

core by the pull desired. The diameter of the coil should be about three times that of the plunger, or the core, and the length of the coil two or three times its diameter. In open circuit plunger magnets the pull is exerted between the windings and the core since the flux density is greater at the center of the core.

Definitions and Formulas

For those readers who are not familiar with the design of magnetic circuits, a few definitions and formulas will be given as an aid to the design of magnets which will be taken up later. The relation between the magnetizing force and the actual amount of magnetism produced in the core of an electromagnet should be throughly understood before beginning the design. The magnetic density in air depends entirely upon the intensity of the magnetomotive force. The magnetic density, however, which is produced in a magnetic substance such as iron when placed in a field of magnetic force depends also on another quantity, the magnetic permeability of the substance. The most convenient way to consider the relation between flux density and magnetizing force is as follows:

Let B = magnetic density in lines per square inch.

H = magnetizing force in ampere-turns per inch of magnetic path.

Then B = 3.192 H in air, where the permeability is constant for all values of flux density. The permeability of iron and its alloys decreases with increasing flux density, so that the relation between B and H is generally expressed by curves, Fig. 6. The tendency of the substance to become less permeable is

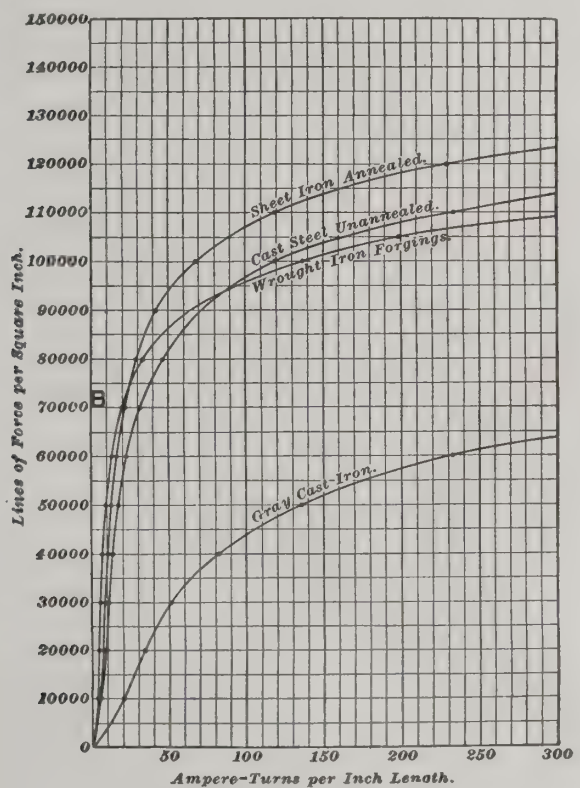


Fig. 6. Magnelization Curves

called magnetic saturation and is well illustrated by the curves in 6. A limit is never reached where actual saturation takes place, but there is a limit beyond which it becomes impractable to magnetize the substance. The practical saturation point in wrought iron, soft annealed sheet iron, and cast steel is when the density is between 120,000 and 130,000 lines of force per square inch. Hence in these metals, B may have any value from 0 to 130,000. In gray cast iron the practical saturation limit is from 60,000 to 70,000 lines of force per square inch. The intensity of the magnetomotive force is very seldom carried beyond 15,000.

The pull of a short range electromagnet is determined by the formula

$$P = \frac{B^2A}{72{,}134{,}000} \text{ in pounds, in which}$$

P = pull in pounds,

B = magnetic density in lines per square inch,

A = area of the core in square inches.

For an electromagnet the capacity is limited by the amount of heat which it can dissipate without exceeding a given temperature rise. The general equation for the final temperature rise in a given coil is

$$T = k \frac{P}{A} \text{ in degrees C,}$$

In which P = power in watts dissipated in the coil; A = outside cylindrical surface of the coil; k = the temperature rise in centigrade degrees per watt per square inch of outside cylindrical surface. For electromagnets open, k =95; for electromagnets iron-clad, k = 130.

For determining the area of the wire for a given electromagnet the following formula is used,

$$A = \frac{12\ l\ H}{E}$$

where A = equals sectional area of conductor in circular mill, H = ampere turns, and l= mean length of one turn in feet.

Mechanical Considerations

Where a great number of magnets are to be wound, special machines have been developed to do the work rapidly and allow of quickly placing and removing the cores or forms. For only a few pieces, a lathe is generally used. It should be run at slow speed until the operator becomes proficient at guiding the wire into place on the coil. Where fine wire is used, it must generally be laid by hand, but coarse wire can be guided by a rest held in the tool-post, which is moved by the screw-cutting motion. Wire reels usually have grooves in the edge of each head, in which a cord held by a weight to provide some tension on the wire. Where a treadle control of the lathe can be devised, its use will effect a great saving of time and patience. The best form is that in which pressure of the foot removes a brake and applies the power. This device allows of a quick stop being made if the turns become crossed.

(To be Continued)

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Questions and Answers

Why the Circuit-Breaker Blew

Q. In the testing department of a manufacturing company the order was given to shut down quickly a motor-generator set while it was driving a number of direct-current machines on test. The man in charge pulled the generator field switch as it was nearer his hand than the circuit-breaker trip. Immediately the circuit-breaker opened, the flash showing that a considerable current had been broken. Why did this happen?

A. Under normal running conditions the counter—e. m. f. of the motors is almost as great as the line voltage. As soon as the generator-field is de-energized, its generated voltage drops, but the motors continue to run by their momentum, becoming self-exciting shunt generators, and holding the line voltage at nearly its former value. The armature of the former generator being still connected to the line, offered a path of low resistance, through which a very large current immediately flowed, and which at once operated the circuit breaker.

Belt Slips on Gasoline Generating Set

Q. (1) What is the proper distance a belt driven generator and engine should be placed apart, from center to center of pulleys?

(2) What is the usual belt slip of small dynamos .3 k.w. to 1.5 k.w. running at 1700 to 2800 r.p.m. using iron pulleys 1.5 in. to 2.5 in. face, 1.5 in. to 2.5 in. dia., in per cent of dynamo speed?

The above has arisen out of an experiment of a 1½ h.p. gasoline engine, speed 450 r.p.m. pulley 10 in., and a shunt wound generator size .3 k. w. speed 2800 r.p.m. pulley 1.5 in. face, 1.5 in. dia. The generator is designed to deliver 7.5 amperes at 40 volts, but will only deliver 6.5 amperes at about 37 volts, when full load is thrown on, using a lamp load, the more of a load there is put on after this point is reached, the more the voltage drops then. No load voltage is 54 volts. A 12 ft. belt, 1.5 in. wide is used. The above trouble, not being able to obtain 7.5 amperes at 40 volts I believe is due to excessive belt slip. Should a larger engine pulley or a smaller dynamo pulley be attached to overcome this trouble?

A. (1) The distance center to center between pulleys is given in the American Handbook for Electrical Engineers as follows:

Ratio of Pulley Diameters	Minimum Distance Between Centers (in feet)
2:1	8
3:1	10
4:1	12
5:1	15
6:1	20

A ratio of six to one should not be exceeded. In your case the ratio is 10:1.5 or 6.67:1 which may be made to give satisfactory results.

(2) The usual belt slip is between 2 per cent. and 4 per cent. divided between the two pulleys. This means a 2 per cent. to 4 per cent. loss in speed from no-load to full load, and hence a drop in voltage.

Your difficulty is undoubtedly due to belt slip, which is excessive at the generator pulley. The best remedy is to install an idler pulley, arranging that the belt on one side of the generator pulley shall be parallel to the belt on the other side. Liberal applications of belt-dressing and adhesive compound should be made. If an idler is used, it will not be necessary to have the machines any farther apart.

Induction Motor Starting Characteristics

Q. (1) Why does a squirrel-cage motor give such a small torque at starting although it is taking several times full load current?

(2) How or why does the insertion of resistance in a wound rotor circuit improve the starting torque? V. F. M.

A. (1) In order that the torque of an induction motor should be a maximum, the current in the rotor should lag 90 deg. behind the flux set up by the stator. The rotor current is produced by an e.m.f. in its windings which always lags behind the stator flux by 90 deg. Therefore the rotor current will lag behind the position of maximum torque by an angle which depends on the power factor of the rotor circuit. Now power factor is

$$\text{P. F.} = \frac{R}{\sqrt{(2\pi\ F\ L)^2 + R^2}} \quad \text{where}$$

R = rotor resistance.
F = frequency of fluxcutting rotor conductors.
L = self-induction of rotor.
R = resistance of rotor.

For any induction motor L is always large, and for a squirrel-cage rotor R is small. The frequency f is proportional to the slip, so that at starting it is about 10 times what it is at running. Hence the denominator of the above fraction is very much larger than the numerator and so the power-factor is small. That means that the rotor currents lag far behind the position which would give them maximum torque.

At the instant of starting, the low-resistance squirrel-cage acts just like a short-circuited-transformer secondary—i. e.—the current flowing in it tends to demagnetize the primary and thus allow a larger primary current to flow. As the speed picks up, *f* decreases, and the angle of lag of the rotor, current decreases, thus reducing the demagnetizing effect. Hence the current in the stator rapidly decreases with increasing speed.

(2) Referring to the equation, we can increase the power-factor *P.F* by increasing *R*, that is, by winding the rotor with wire and cutting in a series resistance. This will increase the torque and cut down the primary current; in fact *R* may be so selected as to make these practically the same at starting as at full-load running speed.

Steam Turbine Design

Q. (1) Where can I get formulas to find the dimensions of a steam turbine for a given brake horsepower, including the number of blades in both stator and rotor, and the size of the turbine complete for about 90 or 100 brake horsepower.

(2) What would be the steam consumption?

(3) How high would the pressure go when a charge of explosive gas is exploded in a closed container if pressure before explosion was atmospheric?

A. (1) The formulas require too much explanation to give here, but may be found in "Steam Turbines," by J. W. Roe. 143 pages, $2.00 or "Steam Turbines," by L. G. French, 418 pages, $3.00. We can send either book on ten day's examination, on receipt of the price named.

(2) For a 100 b.h.p. turbine at full load the steam consumption will be about 43 lb. per hour, operating non-condensing.

(3) The final pressure varies enormously with the kind of gas, and the material of the container. If you will give us this information, we can get the answer.

Separate or Common Ground Wires

Q. Can I ground primary and secondary arresters on the same ground wire when arresters are on the same pole?

A. There is nothing in the National Electric Code nor the handbooks to prohibit the use of a common ground wire. However, if by any chance the circuit to ground should be opened below the common connection, a lightning surge from either line would be discharged into the other. The result of this might be disastrous if the high voltage surge reached circuits which enter buildings. A safer method would be to run separate wires down opposite sides of the pole to separate ground-cones.

It is not usual to provide secondary arresters on local distribution systems, as primary arresters give sufficient protection. In the rare cases where lines of considerable length—say a half-mile are connected by transformers, the extra expense of two ground wires is easily justified by safety considerations.

Commutator does not Share Load

Q. An electroplating generator has an output of 2000 amperes at 6 volts, there being two commutators on one armature. From the brushes of like sign leads are brought to terminal blocks from which cables run to the switchboards. The leads from one commutator run very hot while the others run cool. Could you explain the trouble and how to overcome it? J. R.

A. The trouble is due to more load being carried by one end of the commutator than by the other. This is due to the voltage across one pair of brushes being higher than that across the other. The remedy is to shift one set until its voltage is that of the other. To do this, disconnect one set of brushes, and with a load of 1000 amperes on the others, place them at the position of best commutation. Measure the voltage across brushes carefully, then lift this pair and re-connect the other pair. Shift these until, with 1000 amperes flowing, the voltage across them is exactly equal to that measured across the first pair. The two sides of the machine will then operate in parallel satisfactorily. Should it be necessary to move both sets of brushes for better commutation, each should be moved exactly the same distance as measured on the commutators.

Questions to be Answered

Q. Will you or some of the readers of the Age give me the directions and kind of material for making an electric air heater large enough to warm or keep a room say 10 or 12 ft. square from freezing. The heater is to be used on 120 volts 60 cycles alternating current. F. M. G.

Q. What will cause copper to lose its conductivity? In a plant where I am located we had a pair of 800 amp. S. P. switches, and one pole about two years ago began to heat with about 600 amps. flowing and it was at first though that the contacts were not good. We removed the switch from the board, cleaned thoroughly all contact surfaces, but on putting it back into service the heating gradually became worse. We removed and cleaned and tightened three times, but it finally got so we could not carry more than 200 to 300 amps. without abnormal heating, and we had to replace the blade with a new one when the trouble ended.

A notable feature of this was the change in color of the copper. From the time the switch began to heat, it began to change in color to a yellowish-green.

I would like to have some one explain the cause for this heating. The system was 125 V. D. C. F. C. D.

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Trial Installation of Concentric Wiring at Chicago

For the purpose of ascertaining comparative costs of concentric and standard types of wiring the Commonwealth Edison Co., of Chicago, has installed the General Electric Company's concentric wire and fittings in a small frame 2-flat building. The wiring was for a total of 20 lighting outlets and 2 wall switch outlets. Two circuits for each flat being installed. A total of 24 lamps connected. Each flat was wired for one wall switch, one base board outlet, one wall outlet and seven ceiling outlets. The total cost of the material including service wires, was $38.90; and 33 hours of wiremen's time and 50½ hours of helper's time was used. The cost of the fixtures was $39.86. Figured on the basis of flexible metallic conduit and armored cable, this job would have required $24.73 worth of material, 33 hours of wiremen's time and 33 hours of helper's time. While it is expected that reductions in cost of material will be made by the ordering in quantity which is bound to follow an increase in use, yet it is not expected that this reduction will amount to more than 25 per cent. The largest saving is expected to come in the labor cost which it is hoped can be reduced to amount to about one-third of the present figure when the workmen become accustomed to handling this sort of work.

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Boston Traction Employees Get First-Aid Kits

Each of the 9,000 employees of the Boston Elevated Railway Co. has received a first aid kit consisting of a small rolled bandage, a tube of healing ointment, a bottle of alcohol-iodine solution and instructions for use. The outfit is contained in a box suitable for carrying in the pocket, and provided with a hanger by which it may be hung upon a wall by men who are always at the same post. The idea is that if small wounds are treated promptly they will heal much more readily than if neglected until after infection has taken place. In a letter accompanying the kits, the company's officials take this view of employees' responsibilities.

"We have not only ourselves to look after, but millions of people who are passengers on our cars, pedestrians, people riding or driving, and our fellow employees. Others are apt to be more careless than we; at least, all do not have the advantages of safety committees and safety instruction, so we are often called upon to do more than our share."

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The South Carolina Light, Power & Railways Company, Spartenburg, S. C., has awarded to The J. G. White Engineering Corporation, 43 Exchange Place, New York, a contract for the consulting engineering in connection with the design and erection of a concrete dam 600 feet long and 45 feet high, on the Broad River, near Gaston Shoals, approximately thirty miles from Spartanburg. This dam will be in connection with the company's hydro-electric development at Gaston Shoals.

America's Electrical Week

Outlining the plans for America's Electrical Week, the Society for Electrical Development is sending out a booklet outlining what can be done by central stations, manufactures, jobbers, contractors and dealers. All are advised to keep in touch with their local committees, and to let the society know what items of publicity material can be used. These include 8-sheet posters, window lithographs, car cards, window cards, poster stamps, folders, lantern slides, newspaper electros, muslin signs, and pennants. Suggestions for specializing on certain lines are also given.

As the result of careful consideration of nearly 800 designs the judges of the Society of Electrical Developments poster competition have awarded prizes as follows:

First prize of $1000—Harold von Schmidt, San Francisco, Cal.

Second prize of $500—John A. Bazant, Bronx, N. Y.

Art Students prize of $200—Edward Staloff, Jersey City, N. J.

First school prize of $100—Harold H. Kolb, Sommerville, Mass.

Second school prize of $50—Wm. E. McKee, Jr., Hollywood, Cal.

Third school prize of $25—Armand Moreda, Brooklyn, N. Y.

Fourth school prize of $15—Ruth M. Jameson, Buffalo, N. Y.

Fifth school prize of $10—Edna E. Crowley, Chicago, Ill.

"The Modern Aladdin"

The Public Choice prize of $300 was awarded to poster No. 41, the work of Vincent Aderente, of New York City. This was determined by the highest total of votes registered by the public attending the exhibition of posters at New York, Philadelphia, Atlantic City, Chicago and Milwaukee.

The society will issue, about August 22, an attractive booklet showing in colors the best posters submitted. The booklet will be sent free to 25,000 men of the industry.

With the idea that electricity is the present day "Slave of the Lamp" to do our bidding at command, the society has given the prize-winning design the caption, "The Modern Aladdin." As far as possible, this caption will appear on all the 200,000,000 reprints of the design which the society plans to send out in its "America's Electrical Week Campaign."

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Cooking by wire is becoming popular among the birds of Southern California. On two occasions snakes were done "to a turn" by being dropped across the wires of transmission lines.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Pointers on "Portables"

By John F. Duncan

THE first nip of Fall is in the air these cold evenings, and after the early twilight is over, indoors seems like a mighty good place. Mrs. Housewife begins to look about her furnishings and decorations, and wonders what changes and improvements she can make to brighten up the house and make the rooms attractive for the Fall and Winter. New furniture, wall-paper, hangings, are the obvious—and expensive-solution; it is only the exceptional person who realizes what a difference can be made by a change in lighting methods—and at how little cost. There lies the electrical salesman's opportunity and a good one it is to secure orders profitable not only in themselves, but as the entering wedge for further sales.

Lighting furnishes an interesting field for any one who is willing to give the time necessary to become thoroughly acquainted with it. The purchase of a fixture involves a considerable outlay, especially if really artistic results are to be secured, and the man who wants to build up a trade in fixtures of the best class must know much about architecture and interior decoration. Fixtures, too, are bought but once in a long time, and the better the customer is satisfied the less chance for "repeat" orders. Portable lamps, on the other hand, are within the reach of anybody's purse. The more substantial types are long-lived, but since they can be removed so easily they are shifted around to make room for newer ones. It is a curious fact that once a home-dweller buys a portable lamp, she (or he) catches the fever, and one after another new style is added to the collection. So useful and so decorative are well-chosen lamps that all remain in service, to form an ever-increasing central-station load.

What the Salesman Should Know

To be able to suggest the right sort of portable, the salesman should know something about the various styles of interior decoration, in order that he may be able to form a picture in his mind of the furniture which the customer calls Adam, Sheraton, or Chippendale. Such knowledge can readily be picked up from books. In addition there are certain principles of taste which are here briefly outlined.

In general, the base of a portable should harmonize with the furniture of the room, and the shade with the decorations. Thus oak or bronze will go with "mission" furniture, mahogany with any red finish, white laquer with the popular French Gray of bedroom suites, old gold with the gilded-brass-and-onyx stands still remaining as a relic of the nineties. As for the shades, pale gray and white, or black and white harmonize with the wall-paper of gray or white tone usually seen in bedrooms; brown in one or two shades with natural leather upholstery, while green and gold would be most suitable for the principal light in a room where the curtains in those tones dominate the wall-space. So great is the variety in shade materials that practically any color effect can be secured.

While the light from fixtures is for but one purpose—to give illumination, that from portable lamps may be for either of three uses. It may be designed to throw most of the light up, as does the lamp in Fig. 1. It may throw the light downward onto a table, or the book of one who sits nearby, as is the case with most of the lamps shown. Or it may be for frankly decorative purposes, being used to bring a spot of color into an otherwise dusky corner When a lamp is used in this last way, it should not be too bright, and its color may contrast with the scheme of the decorations.

Lighting a Living Room

It is becoming "the style" nowadays to light a living-room under normal conditions by portables exclusively, with rather a low intensity, having a few side-lights for higher-intensity general illumination when entertaining. Such treatment makes the room much more "homey," and this effect is an excellent talking-point for the salesman. There should be one lamp of good size to light the central part of the floor and table area to fair brilliance. Lamps of this type are those in the back row of Fig. 2, some of those in Fig. 4, and the lamp in the initial at the beginning of the article. Such a lamp should have a wide enough circle of illumination to allow a book to be read by any one sitting beside the table when the lamp stands in the center. The shade

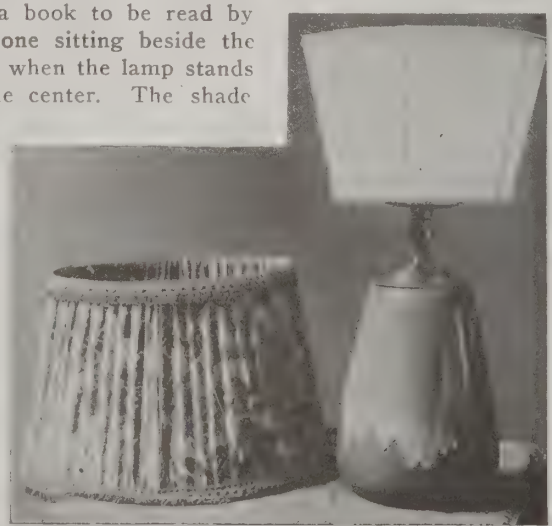

Fig. 1. This lamp, shown with outer shade removed, directs most of its light onto the ceiling

should come down far enough to prevent direct light from the filaments reaching the eyes of anyone in the room. To secure high efficiency of reflection, the lining of the shade should be white—either paper, silk, or opal glass, according to the material of the shade.

Often a portable lamp can be used to advantage as the permanent light in a reception hall or other room which is merely traversed by members of the family. A very low intensity is sufficient to distinguish objects in the room, especially by one who is thoroughly familiar with its contents. Here one of the pot-

Fig. 2. An Attractive Display in a Central Station Show-Room

tery lamps on the front of the table in Fig. 3 can be used, as very little light is given out. In other words, here practically all the illumination can be sacrificed to decorative effect. Where a high intensity is demanded, a small ground glass enclosed design may be used, set high up, as on a mantel or newel-post. If the globe is of clear glass, the bulbs should invariably be frosted.

The most effective illumination of a dinner-table is by portable lamps, since they give a high intensity on the table, the center of interest, and leave the rest of the room in obscurity. This effect may of course be secured by a dome, but an interior looks better if the ceiling is clear, and the low-hanging fixture is in the way if the room is to be cleared for dancing. Whether "candles" or a single large lamp are used, especial care should be taken to screen the light-sources, as it is impossible to keep them out of the line of sight. The stem of the single lamp should be slender, and the shade high enough not to obscure the view of those at the table.

Shades of Many Materials

Passing now to the mechanical features of lamps, the materials for shades first claim our attention. Silk is very popular just now, and no wonder, for it makes an attractive shade at a moderate price, it is light enough in weight to be used with a light wooden base, it has a wide range of colors, and is easily replaced. Its disadvantages are that it is a dust-catcher, fades readily in the cheaper grades, and soon dries out and goes to pieces. Paper is cheap, and lends it self to hand decoration. Parchment is sometimes used, but it becomes brittle with age and is then easily damaged.

None of these materials should be placed directly above a lamp unless protected by a mica shield, as the ascending current of hot air chars them, and may even singe them brown. Glass either solid or leaded is too common to call for comment. Pottery is opaque, and is now so high in price as to be almost out of the question.

The purpose of the base of a portable lamp is to hold the shade and bulbs at the right height and nothing more. Yet how many stands are so slender compared with the size of the shades that they look, at least, as if they would topple over! When a salesman recommends a portable he must remember that the accidental blast of air, or careless touch, is someday going to come along, and then if the lamp is top-heavy, over it goes. Even if the base passes muster on that score, its outlines should not be so conspicuous as to attract attention. A metal base should never have "ornaments" soldered to it, nor should it be a piece of statuary or serve half-a-dozen other purposes. An exception may of course be made in the case of a desk-lamp which begins life as a pin-tray, becomes next an ink-well and finally a pen-rack before achieving its end. In its surroundings, utility is paramount, and it is well-designed when it gracefully falls in with the fashion.

Wicker and Rare Porcelain

There are two special types of lamp which deserve special mention. One is the wicker-frame portable such as stands at the left of the second row in Fig. 2. This is especially suited for porch use, as it is not affected by dampness, and harmonizes well with wicker furniture. The salesman who keeps his eyes open may see quite a few porches being enclosed for the winter, and such a lamp can readily be placed on each of them—unless someone else has "beaten him to it."

The second type is the porcelain vase made into a portable lamp. It is an easy matter to do this by fitting about the top a metal cap, which carries the lamps and shade. Wires are led in through the cap or, better, through a hole drilled in the vase near the bottom. Many people have a favorite vase in some rare design which they would be willing to have converted were they sure the work would be done neatly. It is not difficult to drill porcelain, and the top can be attached by any wireman. Two beautiful examples of this treatment are shown in the initial letter and in Fig. 3.

Openings for Lamp Sales

The salesman's most perplexing problem is often that of securing "leads." One of the times at which people are most favorably inclined to buy a portable lamp is when re-decorating an interior. Cordial relations with dealers in wall-paper and an occasional call on each one of them will turn up a goodly number of really "live" prospects. If the central station makes a periodical inspection of customer's apparatus the access to homes will afford an opportunity of seeing where a portable lamp could be used to advantage. Monthly bills may carry folders illustrating various types of lamps. When talking with a prospective customer who has come into the show-room, it will be found that he or she has a pretty well-defined idea of an upper limit in price. The salesman should avoid this subject as long as possible, dwelling on the improvement in the appearance of the interior which will result from the purchase of a suitable lamp. A little conversation will bring out the general arrangement and size of the room, and will lead up to the very important point that a central table-lamp which leaves the corners of the room in darkness will make the room seem more spacious. As most entertaining is done in the evenings, and among people of moderate circumstances will include only a few guests, a modest interior may be greatly enhanced by the use of an artistis lamp. As it will be the most conspicuous object in the room it is good policy to spend enough money to get a thoroughly desirable article.

Fig. 3. A Graceful Design in Black-and-White

The average purchaser looking over an assemblage of lamps will, nine times out of ten, be attracted by the ones which are most conspicuous. A wise salesman will remember, however, that the same qualities which make the lamp "stand out" in the

shop will make it conspicuous at home, and that if it is out of harmony with its new setting the customer will not be satisfied. To be sure, he may not know what is the matter, but he knows he doesn't like the effect. He has to live with the lamp, and its unfavorable impresion will perhaps prevent his buying others. To avoid this, particular inquiry should be made about the present decoration when any decided pattern, such as Fig. 3, seems to be favored.

With the holiday season approaching, desirability of portable lamps for gifts should be emphasized. A home can always find place for another attractive lamp; endless variety of style makes duplication unlikely; and such a gift remains in use as a constant reminder of the giver. The silk-shade types are especially suitable, for without the shade they are comparatively inexpensive. If a dealer arranges to supply these lamps, including base, etc., and the wire frame, any deft-fingered woman can cover the latter with whatever material her taste and purse suggest. Oddly enough, this field has never been really cultivated; while the department stores in some cities realize their opportunity and have put in stocks of bases, frames, etc., and give instructions without charge, the wire frames are almost impossible to get in the smaller towns. A central station which has a large salesroom might profitably have classes in shade-making, selling its own materials and arranging with a dry-goods store to furnish the services of a clerk to handle a well-selected stock of fabrics, bindings, and thread. Arrangements can be made with a competent instructor through a domestic-arts school to be on hand one afternoon a week for four weeks before Christmas to give instructions in shade-making to all who apply. This scheme has the further advantage of getting people into the company's showroom where they are exposed to the contagion of "doing it electrically."

Fig. 4. Portable Lamps made by Jefferson Glass Co.

Mention has been made of the paper-shade portable. While this shade is not durable, it is cheap, and easily decorated by even an amateur artist. A "hand-painted" object has a value in peoples' minds far above its merits, and especially when it has been presented by the one whose labor it embodies. By a little missionary work among art-schools and art departments of other schools, the pupils may be interested in making such gifts for Christmas.

The central-station manager can get a picked audience by presenting a lecture on interior lighting given by a specialist of known ability before local organizations of women. Their members are always glad to schedule a lecture which has "art" as its keynote. Such oportunity for arousing women's interest in lamps and for creating friendly sentiment toward the company, should not be overlooked.

Portable lamps are particularly attractive as window displays, and every dealer should "go strong" on that form of publicity during the next few weeks. A window containing a well arranged assortment of lamps works day and night, and with a few attractively lettered cards will arouse interest which will later develop into sales. It must be remembered, however, that the article is to be sold on the basis of quality, rather than price, so that this element should be inconspicuous or absent.

Finally, the profits from portable lamp sales depend on many transactions at moderate expense. It would not pay to send a man out indiscriminately to talk lamps, unless his visit were of advantage from a "policy" standpoint. But if the salesman and his "boss" use their customary energy, enthusiasm, and imagination to distribute artistic and useful lamps among their patrons, they will reap a bountiful harvest in good will as well as in money.

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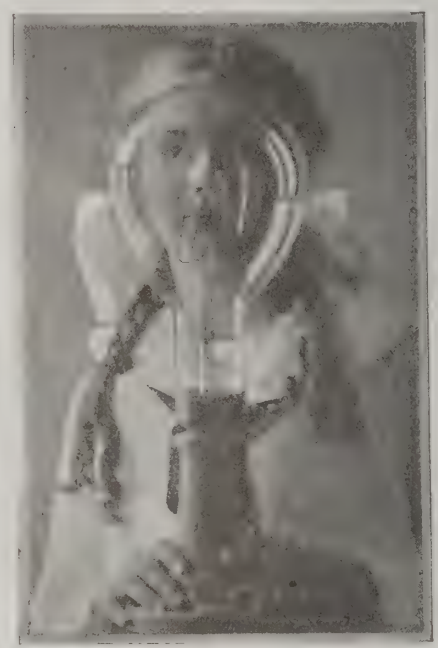
"Little Miss Mazda"



Miss Genevieve Brand, whose picture we are pleased to show, holding an Edison Mazda C lamp, is thirteen years old, yet is already in the Oakland High School. She has always stood very high in her classes and has the reputation of being a wonderful scholar.

Her interest in Edison Mazda lamps started last Fall, when she enlisted as a "salesman" for the Kimball Electric Company of Oakland, California, during the Edison Day Contest. At that time she was a prize winner against a field of over thirty children. The next highest contestant sold but about one-half as many lamps as Miss Brand. She also made over $40.00 in commissions. Her success was not in securing many large orders, but rather in the great number of small orders she brought in.

After the contest was over, Mr. H. W. Kimball offered her a steady position during her spare time after school and Saturdays. He says, "Her scholarship has shown in her sales work, for, regardless of the great many small orders which she takes, they are always very accurate as to quantity, price, name, initials, address, proper voltage, etc.

She has her own business card, which she designed herself. Beneath her name are the words "Little Miss Mazda" and "Agent for Edison Mazda Lamps, More Light for Less Money."

Edison Sales Builder.

Calculation of Illumination

Continued from page 30

Table 4 will serve as a good guide to find the correct spacing or distance apart of the lighting units. The values may have to be altered to suit architectural conditions such as pillars, galleries, etc. The spacing limits are here shown for a 14 ft. ceiling as from 10 to 16 feet. This means that the large area of 150 x 80 ft. must be divided into small areas as nearly square as possible. Assuming that there are no pillars or other architectural conditions to be taken into consideration, make a selection of any value, as a trial say 10 feet—this is a value which is not only between the spacing limits but also divisible into the dimensions of the large area. There will then be 8 ten-foot squares along the short dimension and 15 along the long dimension giving a total of 8 x 15 = 120 small areas, in the center of each will be an outlet for some quantity of light. Lumens per outlet equal 80,000 ÷ 120= 666 or say 700.

Fig. 4—Spacing Distances For Direct Lighting

Room	Ceiling Height in Feet	Spacing Limits in Feet
Armories	12—16	12—16
Auditoriums	12—16	12—16
Rinks	Over 16	15—26
Stores	Over 15	14—22
Stores	8—11	8—11
Stores	11—15	10—16
Offices (with indiv. desk lts.)	10—20	12—18
Offices (without " " ")	9—12	7—11
Offices (without " " ")	12—16	9—14
Offices (without " " ")	Ovr 16	11—18
Public Halls	Over 16	15—16

If tungsten lamps of an efficiency of 1.1 watts per candle be used, these outlets will have to have to be supplied for

$$\frac{\text{lumens} \times \text{watts per candle}}{4^{\pi}} = \frac{700 \times 1.1}{12.7} = 60 \text{ watts each.}$$

Before going any further with this value for spacing the outlets, it would be well to see how the arrangement will answer the purpose. First the maintenance would be high. It would cost about 1¾ cents per unit to clean which should be done about once every three weeks in order to keep the lamps up to their full efficiency, making a cost of about $3.00 per month. The lights could not be wired up to the best advantage, as it is not good policy to place more than five outlets at the very most on one circuit. This would mean that at least 24 circuits of about 300 watts each would be needed, or only one-half the amount allowed. The distribution of light would be very good, and using so small a lamp the glare would be reduced to a minimum, but the decorative

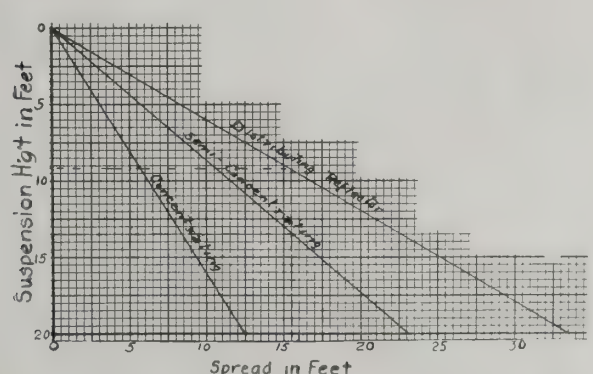


Fig. 5. Illumination Cones for Direct Lighting

effect of so large a number of single pendents hanging from the ceiling would not be at all good. Therefore, it would be better to space the outlets a greater distance apart and use larger lamps.

For the second attempt, try 15 feet as a spacing, this will give 5 rows 16 feet apart by 10 deep 15 feet apart a total of 50 outlets. Here the small area is not a square as the 15 foot spacing will not divide evenly into 80 feet, or 80÷ 15 = 5 1-3 or 6 and a choice of either 5 or 6 outlets may be used on this selection can be made by making the ratio of the two dimensions of the room equal to the ratio of the number of rows of outlets to the number of outlets per row: 150:80 = 1.875:1; 10:5 = 2:1. These two results are closer to equality than if 6 rows were allowed so this is the value chosen.

With 50 outlets, the lumens per outlet will be 80,000 ÷ 50 = 1600, and the watts required for each outlet will be

$$\frac{1600 \times 1.1}{4^{\pi}} = 140, \text{ or say } 150 \text{ watts.}$$

Fig. 6—Reflection Constants for Indirect Lighting

Minimum Dimension of Room Divided by Ceiling Height	Efficiency of Utilization Medium Walls	Light Walls
1.0	0.20	0.24
1.5	0.22	0.26
2.0	0.24	0.28
2.5	0.28	0.30
3.0	0.30	0.32
3.5 and over	0.32	0.34

Four outlets each supplying a 150 watt lamp could be placed on one circuit, and would not exceed the good practice rule of 4 outlets and 600 watts per circuit. There would be a total of 13 circuits, 12 serving 4 outlets and one serving two outlets.

These two outlets can be placed in a location where it is probable that more light would be required as at the center of the store or close to the show windows, as these two outlets will only be working on half load.

The calculations completed for the distance between outlets, the distance above the floor must now be considered, shows the mounting heights for various spacing, the spread

Spacings for Indirect Lighting

For such areas as banks, court rooms, hotels and clubs, barber shops, billiard rooms, card rooms, restaurants, writing rooms, offices, schools, assembly rooms, class rooms, laboratories, reading rooms, stores and sales rooms:

For ceiling heights up to 12 feet maximum spacing should not exceed 1.5 times the ceiling heights.

12 to 17 ft., 1.75 times ceiling height.

Above 17 ft. twice the ceiling height.

For such areas as drafting rooms, operating rooms, sewing machine rooms.

For Ceiling heights up to 12 ft. maximum spacing should not exceed 0.75 times ceiling height and above 12 ft. should not exceed the ceiling height.

For such areas as armories, are galleries, churches, gymnasiums, ball rooms, corridors, dining rooms, lodge rooms, residences, station waiting rooms, studios and the like the effect should be as even a ceiling illumination as possible, but the fixtures should not be so close to the walls that an undue amount of light will strike them.

of the light being the same as the distance between outlets, this value for the case in hand is an average of 15.5 feet, following the line dotted in this curve up to the semi-concentrating curve, and then at right angles until the line repre-

senting the suspension is reached, the value here being 13.5 feet above the working plane. This value could not be used as the working plane for a grocery store will be about 2.5 feet to 3 feet above the floor and the ceiling would not be high enough to allow for this. Commencing once more at the spacing distance and running up to the distributing reflector-curve, the suspension height is given as about 10 feet.

To sum up, there will be required 50-150 watt pendant fixtures each with a distributing reflector suspended 5 feet from the ceiling. The reflector and lamp must be arranged so that a line drawn from the bottom of the filament and touching the edge of the reflector will produce a 60 to 70 degree angle with a line drawn vertically through the lamp filament, the eye will be protected from any glare under most conditions, as the design of the lighting units would have to be left to the customer as it is a matter of price as to how elaborate they are.

Fig. 7—Lamp Data

Tungsten Vacuum Type—Straight Sides

Tungsten Gas filled type

100—130 Volts		200—260 Volts		105—125 Volts	
Watts	Lumens	Watts	Lumens	Watts	Lumens
10	75.5				
15	117.7				
20	167.5			100	1257
25	215.0	25	186	200	2680
40	256.5	40	310.2	300	4310
60	550.0	60	484.5	400	5745
100	962.0	100	864.5	500	7180
150	1634.0	150	1330.0	750	11600
250	2723.0	250	2258.0	1000	16760

Lighting by Indirect Fixtures

The indirect method of distributing is one in which the rays are first directed up to the ceiling, which acts as a secondary radiator, redirecting the rays back onto the floor. The complete limination of glare, and, with rough plaster ceilings a most perfect diffusion of light, makes this method much more desirable than the direct lighting. Further, the fixtures can be spaced a greater distance apart and much larger lamps can be used, thus cutting down the first cost of installation and although the cost of operation is slightly increased, this disadvantage is more than ofset by the increased service efficiency.

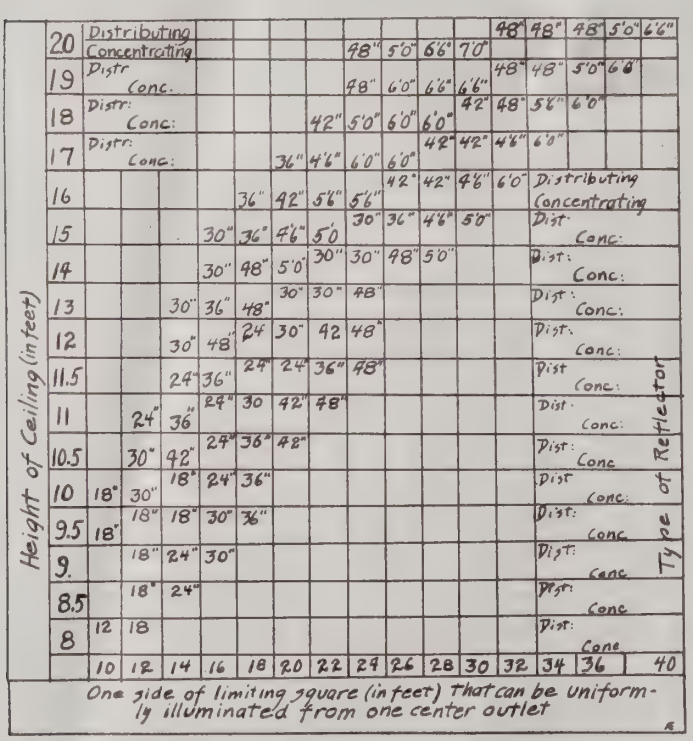


Fig. 8. Data for Indirect Lighting. (Courtesy National X-Ray Reflector Co.)

The calculations arevery much the same as before, (and using the same value for the intensity, the quality of light required will be the same as before or 48,000 lumes. The efficiency of percentage of light lost will be a little greater as the rays have all to be reflected once before they arrive at the working plane. This efficiency will be found in Fig. 6 which as will be seen varies with the ceiling height and the width of the room, in the present case being equal to 80÷ 14 = 5.7 giving an efficiency of 0.32. The total lumens to be supplied by lamps will then equal 48,000 ÷ 0.32 = 150,000 lumens.

The spacing as given in the table for indirect lighting should be between 19 to 26 feet. Assume for the work in hand a value which is divisible into the short dimension of the room say 20 ft. This would give a layout of 4 rows of outlets 7 deep or a small area of 20 by 21.5 ft. the lumens per outlet will equal 150000 ÷ 28 = 5400 (approximately) and by referring to table 7, using gas-filled tungsten lamps, one 400 watt lamp per outlet would be all that would be required, or using ordinary tungsten lamps two 250 watt or four 150 watt could be used. In any case the outlets would have to be wired one per circuit giving a total of 28 circuits. It must be remembered that if 400 watt gas-filled lamps used a mogul socket would have to be used instead of a medium base socket.

The mounting height will be found on Fig. 8 as follows: Find the average spacing distance—in this instance (20 + 21.5) ÷ 2 = 20.5 ft. Locate this value at the bottom of the table, and run up to the ceiling height 14 ft. reading 5 ft. for a concentrating reflector or 30 in. for a distributing reflector. This is the distance down from the ceiling to the top of the reflector; it may be used as a guide, while raising or lowering the fixture to suit the preference of the customer or the decorative effect desired. The best results will be obtained when the fixture is hung as near to this distance as possible.

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Lighting a Moving Picture Studio

(*Continued from page 26*)

lighting capacity is 600 k.w. For the present, of course, the entire capacity is not utilized, the 300 k.w. plant being large enough for the business now being handled, but provision is made for an additional unit of 200 k.w.

The laboratory building has many special dark rooms for developing, fixing, printing, perforating, etc., of the films. As a great quantity of films is handled in these dark rooms, and since unfixed films must not be exposed to any light other than a deep ruby light, it was necessary to devise a special means of controlling the lighting in these dark rooms, so that only responsible people can operate the switches; also, at the same time, to avoid the possibility of white lights being thrown on accidentally by anyone while undeveloped and unfixed films are exposed. There are often thousands of dollars' worth of films exposed in these dark rooms, in the process of development. The least carelessness on the part of anyone controlling the lighting in these rooms would result in the ruining of such films, and consequently a system had to be devised for controlling the lighting which would be as nearly "fool-proof" as possible. Each dark room is provided with a few semi-indirect fixtures, giving red light, and a few white light fixtures to provide illumination required when repairing apparatus, mixing and preparing solution, cleaning out rooms, etc.

The scheme devised is such that the white lights cannot be thrown on while red lights are burning. When red lights are on, it generally means that films are exposed and being handled. The red and white lights in any room in question, are controlled from a separate special lock type switch in the private corridor among these rooms. The red-light switches have red tops, and the white, white tops. Each switch is also equipped with a red or white pilot lamp, as the case may be, these lamps being lit when their respective switch is on and the lights burning. The red-light switches are of double pole type, but specially constructed so that when one pole is closed the other is open. The white light switch, however, is of a standard type. One leg of a white circuit is connected to the pole of the red light switch that is open when the

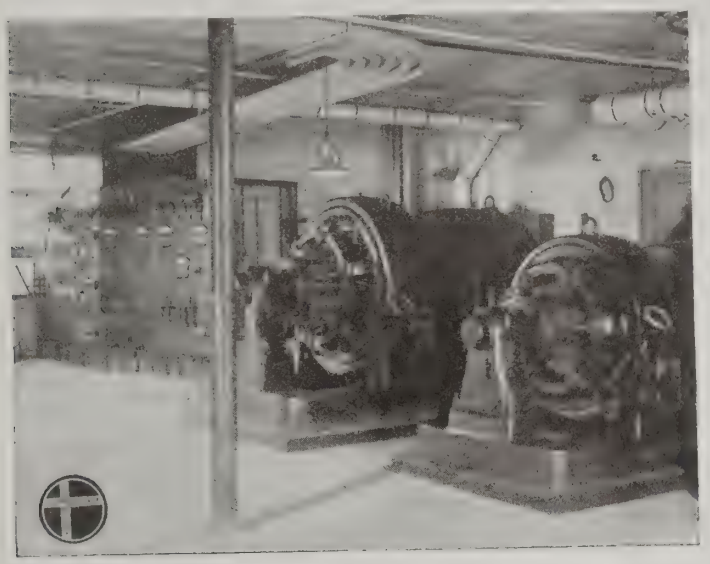

Fig. 4. Switchboards and Motor-Generator Sets

red lights are on. Consequently, when the red light switch is on and the red pilot is lit, any manipulation of the white light switch cannot throw on the white lights. For further precaution, different keys are used for the white light switches than for the red, only a few highly responsible persons carrying the white light switch keys. These keys can also operate the red lights, as red thrown on at any time cannot cause damage. The red light switch keys, however, cannot control the white lights. Where more than one switch for red lights in any room is required, due to excess capacity for one circuit, one wire of the white light circuit in that room is connected through the open poles on the two red light switches in series, so that if but one red light switch is on, the white lights are off and cannot be thrown on, by any manipulation of the white light switches. This was a very important system, and was given considerable thought in its design.

To transfer films from one dark room to another, or from a dark room to the adjoining wash room, a round sectional barrel type conveyor is used, similar to a revolving entrance door. Films are laid on the floor of one section, and the barrel revolves so that that section faces the adjacent room. Since the partitions between the sections are made light-tight, there is no possibility of any light travelling from one room to the next.

The buildings are also equipped with fire alarm signal systems and public telephone equipment, and are in every respect—structurally, mechanically, electrically and otherwise—as complete as experienced and up-to-date engineers can design and erect for the manufacture of the chief necessity for the greatest industry of this country and decade.

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Doherty May Ascend Olympus

Mr. Henry L. Doherty of Henry L. Doherty & Company, New York City, has announced his candidacy for the office of the next, Fifteenth, Jupiter of the Jovian Order. Mr. Doherty makes this announcement in final response to the urgent requests of hundreds of prominent men in the electrical industry and the Jovian Order who have been pressing him to agree to accept the office.

From the days when he sold newspapers on the streets of Cleveland, Mr. Doherty has shown a genius for building business. "Service" was his slogan, then as now, when he is at the head of one of the largest public utility organizations of the country. His ready affability and keen, though kindly, sense of humor, have made him welcome among magnates or laborers.

The Jovian Order now numbers approximately twenty thousand members, with seventy-five Local Leagues, and both the membership and number of Leagues are increasing rapidly. Given the advantage of the splendid leadership of Mr. Doherty, together with the added prestige that his name will lend it, the Order will be able during the next administration to accomplish even more than it has done in the past as an instrument for the constructive development of the electrical industry.

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Colonel Robley S. Stearnes, the new President of the N. E. C. A., is a Southerner of the finest type. He was born in Virginia and educated in his native State, subsequently entering the employ of the General Electrical Company. His residence in the South began with his engagement by the Southern Electric Company as manager. He organized a number of lighting and railway properties, one of which the Algiers Railway & Lighting Co., he man-

aged for some time. Mr. Stearnes is now president of the Standard Electric Construction Company of New Orleans, which does one of the largest businesses in the South. He has always been active as a Jovian, and has been an Apollo of that Order.

In addition to bearing his part as a citizen of New Orleans, Mr. Stearnes has been active in the affairs of the state, one of his offices having been that of Colonel and Aide-de-camp on the Governor's staff in 1914. He is an Elk, and belongs to the New Orleans Country Club, and other social organizations.

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Arthur H. Halloran (Vice-President and Managing Editor, Journal of Electricity, Power and Gas) the well-known electrical man, has been appointed Pacific Coast representative of The Society for Electrical Development. Mr. Halloran's headquarters will be in the Crossley Building, San Francisco, Cal. He will represent the society in the states of California, Arizona, Nevada, Utah, Idaho, Oregon and Washington.

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Harold Lomas, for over thirteen years a member of the Sales Department of the Crooker-Wheeler Company was killed on July 1, in the British Drive, Friecourt, France. Mr. Lomas served the Crooker-Wheeler Company as manager of its Denver office and also as manager of its Baltimore office. He later held the position of Acting Secretary of this Company. At the time of his death he was holding the rank of First Lieutenant in the 20th Manchester Regiment.

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Two Interesting Exhibitions

The keynote of the New York Electrical Exposition of 1916, which will be held in Grand Central Palace, New York City, October 11th to October 21st, will be the improvement of working conditions in factories and shops. Exhibits of electric drive for all sorts of machinery will be shown. There will be model installations in full operation of a bakery, a dairy, a photographic studio, a silk plant complete, from cocoon to fabric, an electric welding outfit, a laundry, and a dentist's office. In addition there will be a large display of domestic appliances. A number of electric automobiles will be shown; the United States Government will make exhibits of aircraft, battleship fire-control, and field radis and telephone apparatus. Students of New York vocational schools will carry on their practical work in a large working exhibit.

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At the Grand Central Palace in New York the week of September 25th, there will be conventions of the American Electrochemical Society, American Chemical Society, Mining Engineers, Technical Association of the Paper and Pulp Industry and the Society of Chemical Industry. The Second National Exposition of Chemical Industries will be held at the same time, and there will be lectures and conferences daily for the discussion of current problems.

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Pennsylvania's New Lighting Code

(*Continued from page 28*)

Uncertain cases and intermediate requirements are to be left to the judgment of the State Industrial Board.

RULE III—SHADING OF LAMPS:

Glare either from the lamps or unduly bright surfaces produces eye-strain and increases accident hazard.

Exposed bare lamps shall not be used except when they are out of the ordinary line of vision; lamps should be suitably fitted to minimize glare.

RULE IV—DISTRIBUTION OF LIGHT ON THE WORK:

Lamps shall be so arranged as to secure a good distribution of light on the work, avoiding objectionable shadows and sharp contrasts of intensity.

RULE V—EMERGENCY LIGHTING:

Emergency lighting shall be provided in all work space, aisles, stairways, passageways, and exits; such lights shall be so arranged as to insure their reliable operation when through accident or other cause the regular lighting is extinguished.

RULE VI—SWITCHING AND CONTROLLING APPARATUS:

Switching and controlling apparatus shall be so placed that at least pilot or night lights may be turned on at the main point of entrance.

A penalty has been adopted for the violation of any of these provisions, making it a misdemeanor, and punishable by a fine of not more than one hundred dollars.

Our Monthly Window Display

This attractive display of lamps and lighting glassware was arranged by the Window Display Service of the Society for Electrical Development

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Electrical and Ignition Supplies sold by Stanley & Patterson, New York City, are listed in that firm's catalog No. 18. A very complete line of wiring devices, fans, portable lamps, batteries, and automobile accessories is shown.

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Vaughan Flow Meters, made by the Spray Engineering Company, Boston, Mass., operate on the ingenious principle of the gradual increase of an orifice as the rate of flow increases. They are illustrated in a booklet recently issued by the manufacturers.

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"Spraco" Cooling System is described in a 16-page booklet issued by the Spray Engineering Company, of Boston. Where cooling or condensing water is scarce, the method of spraying it into the air reduces its temperature with a very small loss. Much space is also saved as compared with the use of cooling towers.

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Posters for America's Electrical Week are pictured in a booklet just issued by The Society for Electrical Development, New York City. An account of the competition is given, and 52 of the best designs are reproduced in black-and-white. On the last page is a colored insert of the prize-winner, "The Modern Aladdin."

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"Reliable Wiring Devices" is the title of an attractively-bound pocket catalogue of the General Electric Company's wiring specialties. Sockets, receptacles switches and cutouts in great variety are illustrated and briefly described in the book's 200 pages. An index and several pages of general information add to its usefulness. The size, 3¼ by 4⅝ in. makes it easy to carry in the vest pocket.

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Public utility properties in which Standard Gas and Electric Company is interested are described in a profusely-illustrated book just issued by H. M. Byllesby & Company, Engineers and Managers. The company's investments extend over sixteen states, and comprise a controlling interest in thirteen operating companies and a large interest in two more. Sixty-nine per cent. of these companies' gross revenues are from the sale of electricity. While the book is written principally for the stockholder and investor, yet the excellent ideas it gives of the state of development of many Western communities will be of value to those interested in them.

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In a laboratory in which a large number and variety of electrical instruments are tested, it is important that means be provided for the rapid and accurate control of the electric generators which provide the current for testing. In Scientific Paper No. 291 by P. G. Agnew, W. H. Stannard, and J. L. Fearing, published by the Bureau of Standards, an elaborate system of this kind which is in use at the Bureau, is described. The control rheostats are not handled by the observers directly, but are operated by small motors which are controlled from any one of several laboratory rooms by means of small, multiple lever switches.

Copies of this report will be ready for distribution in a few days and may be obtained without charge upon application to the Bureau of Standards, Washington, D. C.

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New Even-Lite Bowls and Lighting for Homes are described in two folders sent out by The Jefferson Glass Company, Follansbee, W. Va.

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Mechanical Counters for application to printing presses, punches, pumps, and other machines are described in a booklet issued by the C. J. Root Company, Bristol, Conn. Revised price-list are included.

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"The Telegraph in Selling" is a collection of actual experiences which many houses have had in the use of Western Union lines in pushing sales campaign. The company claims for telegraph messages the fact that they always get a hearing, and that the psychological effect favors immediate and favorable decision.

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"Bates Steel Pole Treatise" gives very complete dates of the manufacture and use of expanded steel poles. Details of the fittings for attaching cross-arms, brackets, strain insulators, etc., are also shown. Useful tables of the mechanical properties of various conductors, definitions, and several ingenious graphic methods for shortening pole-line calculations make the booklet one of value to transmission line foremen and engineers. It is prepared by the Bates Expanded Steel Truss Co., of 208 South La Salle Street, Chicago.

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"Better Electric Motors" through the use of SKF Ball Bearings is the subject of an attractive 64-page book issued by SKF Ball Bearing Company, Hartford, Conn. Examples of the large maintenance economies which have been effected by the use of ball bearings are given, and also a table showing the possible reduction in overall length, a matter of importance in cramped quarters. The illustrations, which are taken from photographs of actual installations, are splendidly reproduced and of much interest to motor and industrial experts.

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Book Reviews

ALTERNATING CURRENT ELECTRICITY AND ITS APPLICATIONS TO INDUSTRY, by W. H. Timbie and H. H. Higbie. 729 pages. New York: John Wiley & Sons: $1.50.

As the second volume of a two-volume series on this subject, the authors have treated generators, transformers, transmission lines, motors, and converters. The avowed purpose of the book is "for the man who is responsible for the maintenance of good service in the electric plant or system, and for the man who pays the bills and seeks the profit, rather than for the designer." This purpose is admirably carried out by clear explanations from the physical standpoint of what actually happens, step by step, in the operation of various pieces of apparatus. Equations are confined to those of trigonometry, and a knowledge of that much of mathematics, while not essential, is desirable. Few proofs or detailed theoretical discussions are given.

For the technical graduate of some year's standing, the book will be valuable to "brush up" on many items of knowledge which disuse has nearly allowed to be forgotten. Especially will the practical data from both be interesting and useful, and the use of actual test figures in problems will make the latter much more vivid. The student who works out these problems should have a very fair idea of the relative magnitudes to be met in practice. At the end of every chapter is a summary

which should be useful as a guide to information contained in the text proper.

The authors are to be congratulated on the numerous and well-designed vector diagrams, and it is to be hoped that anyone reading the book will make himself master of this method of dealing with alternaing-current phenomena.

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OZONE: ITS MANUFACTURE, PROPERTIES AND USES, by T. Vosmaer, Ph.D. 197 pages. New York: D. Van Norstrand Company: $2.50.

The present interest in the many uses of ozone where oxidation without heat is desirable will make this volume timely. The author has had many year's experience with ozone, and is well acquainted with the rather scattered sources of information concerning it. Starting with a general and historical account of ozone and various methods of manufacture, he comes to the methods which involve electrical discharges, which he describes in detail. A chapter on the uses of ozone for the purification of drinking-water and air, and in therapy, is of decided interest.

The style of the book is rather more personal than is usual in technical works; the author is not afraid to stand sponsor for his own views, nor to differ from others when the circumstances seem to justify it. In a field where there is so much speculation, this attitude is unquestionably the best one to take, no author has a right to lay down as established, a principle which is still only tentatively proposed.

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ELECTRIC WIRING DIAGRAMS AND SWITCHBOARDS, by Newton Harrison, E. E., with additions by Thomas Poppe. 303 pages. New York: The Norman W. Henley Pub. Co.: $1.50.

This is a second edition of a book published in 1906. It describes the methods of calculating the proper size of wires for a given service, the lay-out of a wiring system, various fittings, and a number of the more usual circuit diagrams. It is to be regretted that the arragement of subjects treated is not more systematic, and that obsolete methods, such as the use of brass armored conduit and paper tubing, were not omitted. No mention is made of "concentric" wiring, nor is data given concerning the tungsten vacuum and gas-filled lamps, nor concerning motor-sizes for various machines. These defects are unfortunate as they decrease the usefulness of a book evidently designed for busy practical men.

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HOMANS' AUTOMOBILE HANDBOOK, by J. E. Homans. 248 pages. New York: Sully & Kleinteich: $1.00.

The name of Homans has for many years been associated with books on automobile construction and operation. This volume maintains the reputation of the author for conciseness and clearness of statement, and completeness of treatment of its subject, the gasoline car. Starting with a description of the general construction of the chassis, the book takes up various types of drive, giving some attention to the magnetic transmission. The engine and its adjustment comes next, then the carbureter and ignition devices. Operation of ignition systems is well covered, but electrical readers will regret the lack of descriptions of the various electric starting and lighting systems. For the man who wants enough information to care for his own car, the book is well suited, as it gives the general considerations common to all makes, and is a valuable introduction to the handbooks furnished by automobile manufacturers.

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PRINCIPLES OF ELECTRICAL DESIGN, by Alfred Still. 364 pages. New York: McGraw-Hill Book Company: $3.00.

This book is a distinctly valuable addition to the already long list of works on design of direct and alternating-current machines, not so much for any novel methods introduced, but for an admirable clearness of statement which means much to the beginner. From his experience with his classes at Purdue University, Professor Still has realized the value of having a concrete mental conception of the internal workings of electrical machinery. An excellent example of this is the explanation of the theory of commutation, which follows the Lamme method, while omitting some of the refinements of that method which lead to undesirable complications. The author also emphasizes the limitations of the commercial designer to the use of standard frames and punchings and the resulting possibility of short-cuts in calculations.

As a text-book for a course in electrical design, the book is admirably adapted to the needs of technical students, and gives much information as to what may be expected in actual practice.

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EXAMPLES IN ALTERNATING CURRENTS (Second Edition), by F. E. Austin. 223 pages. Hanover, N. H.: Published by the author: $2.40.

The compact form of this book will make it especially useful to those who wish to refer quickly to some part of the great amount of data which it contains. There is a great deal more in the book than electrical problems; a brief outline of trigonometry and calculus is given in accessible form, and a number of useful tables give data not often found in reference-books. The author uses whatever mathematics are necessary for the readiest solution of each problem, giving a full explanation of the process in each case. By this means the student is accustomed to use the calculus without hesitation. As a source of problems for classroom work the book will apeal to all teachers, while those who must study alone will find the book one of the best of its kind.

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WATER POWERS OF CANADA: a compilation. 361 pages. Ottawa: Dominion Water Power Branch.

This is a reprint under one cover of five monographs treating of the water-power situation in Canada, originally prepared for distribution at the Panama Pacific Exposition and particularly for the members of the International Scientific Congress held at that time. The authors of the individual papers are men of high standing and authoritative knowledge of their respective fields. A detailed description and many illustrations of each important development is given, together with statistics on available and developed power, rainfall, etc. Regulations and terms under which power sites may be secured for development in each Province are given together with the names of officials to whom application should be made. The book is well worth a place in any hydro-electrical library.

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INDUSTRIAL LEADERSHIP, by H. L. Gantt. 128 pages. New Haven: Yale University Press: $1.00.

This volume is a collection of the Page lectures, delivered by Mr. Gantt in 1915 before the Senior Class of the Sheffield Scientific School. The title is drawn from the first lecture, which is very similar to the one printed in ELECTRICAL AGE in August under that title. In the other lectures the author outlines the principles of the task system of industrial management which he designed, and concludes with an interesting study of the economic relation between production and sales. The book of course does not pretend to do more than suggest, but it does that well. Being addressed to young engineers, the author makes very clear the important function of the engineer in spanning the gap between capital and labor, in harmonizing them and keeping them employed for their common good. Since even the sum of human wisdom can be expressed in a few sentences, all that any author can do is to put those facts which he treats into a form which will readily "tie in" to the reader's body of knowledge. This Mr. Gantt does, giving his conclusions tersely and in a way which will appeal to engineers as a whole.

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Books Received

ELECTRIC HEATING, by E. A. Wilcox, E. E. 286 pages. San Francisco: Technical Publishing Company: $2.50.

RETAIL SELLING, by James W. Fisk. 335 pages. New York: Harper Brothers: $1.00.

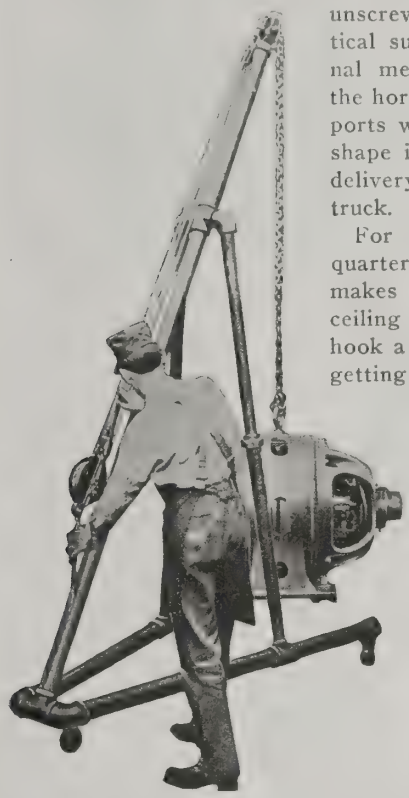
New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Appearing in This Section Will Be Gladly Supplied on Request

A Handy Portable Crane

Many a contractor who has had to install a motor high up near the ceiling has wished for a portable crane which he could load on his truck and set up on the job. Such a crane has recently been developed and placed on the market under the name of "Pull-u-Out." As will be seen from the cut, all that has to be done to knock it down for transportation is to unscrew two unions in the vertical supports, when the diagonal member will fold between the horizontal parts and the supports will be beside it. In this shape it will easily go into the delivery-body of a wagon or truck.



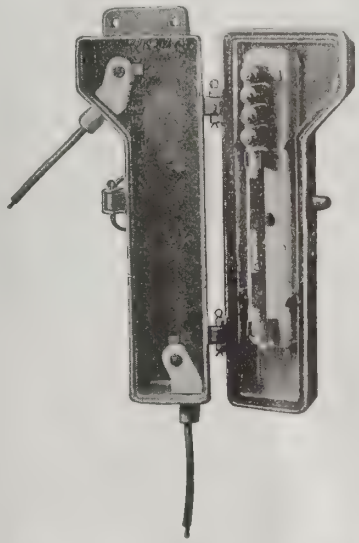
For hoisting into confined quarters the small head-gear makes the clearance between ceiling and highest position of hook a minimum, and allows of getting into places where a larger crane could not go. The lifting device consists of a ratchet-and-gear-operated drum which winds up a high-grade steel cable. This passes through blocks roped 4:1 to a chain which is attached to the load. The entire device can be removed from the crane and used to draw heavy motors on skids when loading or unloading, or for any of the hundred-and-one uses for heavy pulling power.

Complete, the Pull-u-Out Crane weighs but 250 lbs., has a capacity of one-ton, and a lift of 9 ft. 6 in. The price is $50.00, f. o. b. factory.

* * *

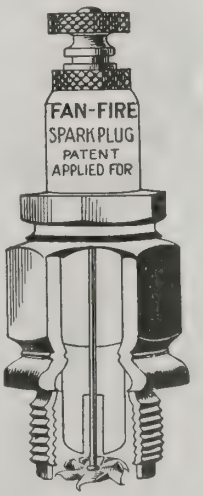
Single Pole Lightning Arrester for Distributing Transformer Protection

For use on alternating current circuits of any frequency, from 1000 to 2500 volts, and of unlimited capacity, the Westinghouse Electric & Mfg. Company, has recently placed on the market the type CR lightning arrester illustrated herewith. This type of arrester is for pole mounting and is similar in many respects to the type C arrester made by the same company, with the addition of series resistance. It consists of four knurled, non-arcing, metal cylinders mounted on a porcelain base, with a series resistor which is held by fuse clips, the whole being mounted in a cast iron box. The arrester unit is mounted on the inside front cover of the box so that it is automatically disconnected from the circuit when the box is opened. This safety first feature eliminates all danger of accidental shock to linemen when making inspections and repairs. This method of mounting the arrester unit is especially desirable in an arrester of this kind which will ordinarily be used in considerable numbers on a line and receive routine inspection. Like the type C, the type CR arrester is designed particularly for the protection of distributing transformers and is unlimited in application.



"Fan-Fire" Spark Plug

A spark plug that stays clean is the ideal of motorists, and many attempts have been made to produce a plug which will not become clogged with soot. A New York concern is placing on the market a plug which by its construction cleans itself automatically. By reference to the illustration it will be seen that at the end of the central rod is a small nickel-steel fan which projects beyond the casing. The currents of gas circulating in the cylinder keep this fan rotating at high speed, thereby throwing off any particles of carbon which may strike it, and constantly presenting new points of contact for the spark to strike. Accuracy in the fan is secured by stamping in a die, thus ensuring a constant air-gap between it and the iron casing.



Owners of Ford cars will be interested in the account of an installation of "Fan-Fire" plugs made on an old car of this make, equipped with a vibrator coil. The owner found that he could close the gasoline-admission to the carburettor by one-half turn of the screw, and also loosen the vibrator-tension. To use his own words, the motor ran much more "sweetly" after the new plugs were working.

A Branch-Off Fitting

In order to take off a branch from an existing conduit line fitted with "Pipe Taplets," the branch-off fittings shown make the job an easy one. Where the line is run on the surface, the fitting in Fig. 1 is used, and where the old line is concealed

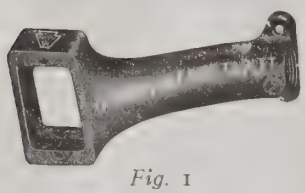


Fig. 1

Fig. 2

and the new line is to be exposed, Fig. 2 is employed. Any outlet which was connected to the former box is removed temporarily while the wires are being spliced, and is then replaced on top of the branch-off fitting. No cutting of pipe or distortion of the run is necessary.

Another interesting feature of this line is the switch holder (Fig. 3) used for fastening the stock snap switches, round base rosettes and receptacles, and other round devices to the standard forms of pipe-taplets. The rectangular side of the holder fits on the pipe-taplet, while the round base is

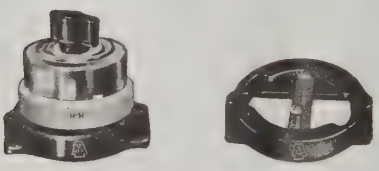


Fig. 3

Fig. 4

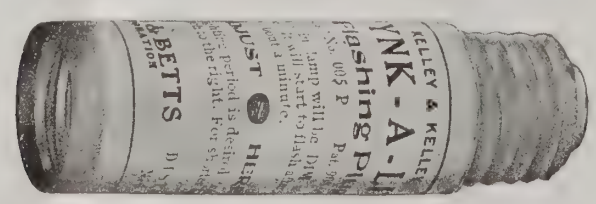
used for the fittings. A movable bar with screw holes spaced for different centers of holding screws, adapt the switch holder for use with many different sizes and makes of devices. The holders are made in three sizes, for the ordinary size 5 amp., 10 amp. and 20 amp. switches, and other devices with the same size of base. All of these sizes of holders fit on the ½ and ¾ inch sizes of pipe-taplets.

For the introduction of service wires, the service hood fitting (Fig. 4) is placed on a Type "A" pipe-taplet to make a complete service outlet hood. They can also be used as "Split B," or a pot head. This fitting solves the difficulty of pulling heavy wires around the curves of a "B," or an "F" outlet hood. The fitting is not put on the type "A" pipe-taplet until after the wires are pulled. The wires are threaded through the porcelain cover, which can then be placed on the service hood fitting either before or after the fitting is placed.

* * *

Flasher Plug

The necessity of adjusting flasher plugs to correspond with the temperature of the surrounding air no longer exists, according to the makers of the "Wynk-a-Lite." It may be immediately transferred from the hot sun to ten degrees below zero without its certainty of operation being affected. This is a particularly desirable feature for open-air use, where

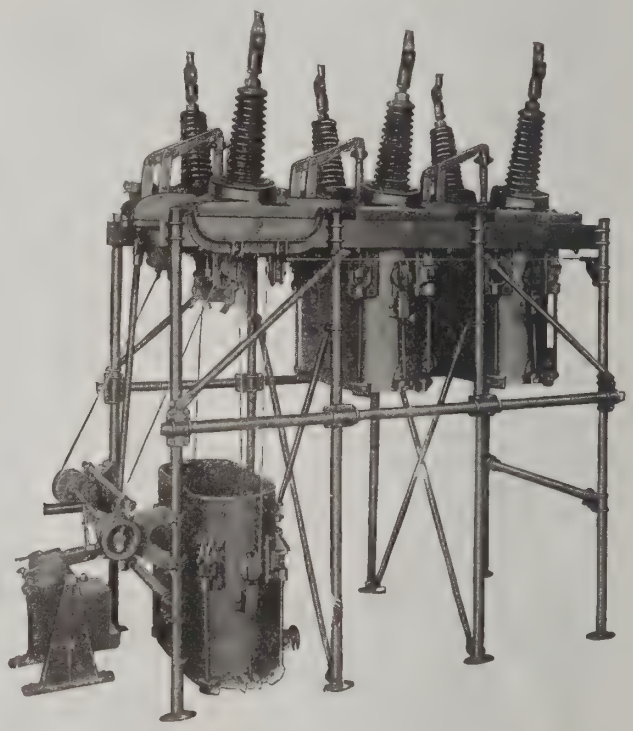


rapid changes are usual. Another good feature is that it will work on any voltage from 50 to 220, and will flash tungsten lamps from 20 to 60 watts. Adjustment of the period of flashing can be made by turning a screw in the side of the case, without removing the "Wynk-a-lite" from its socket.

Large Capacity Tank Type Circuit Breakers

The main changes that have been made recently in tank type G. E. oil circuit breakers have been introduced to make the breakers more accessible for inspection and repair. No radical departure in the design of the current carrying or operating parts has been necessary.

Types K-21 and K-26 oil circuit breakers are used indoors on voltages from 35,000 to 150,000, and the K-22 and KO-26 are used on outdoor work from 22,000 up to 150,000 volts. The K-22 is like the K-21, except that the K-22 has outdoor bushings and the mechanism is protected from the weather by an iron housing. The KO-26 is like K-26, except weatherproof covers and bushings are used for outdoor installations. The cut shows Type K-21, for 35,000 volts and 300 amp. per phase.



General Electric Type K-21 Circuit Breaker

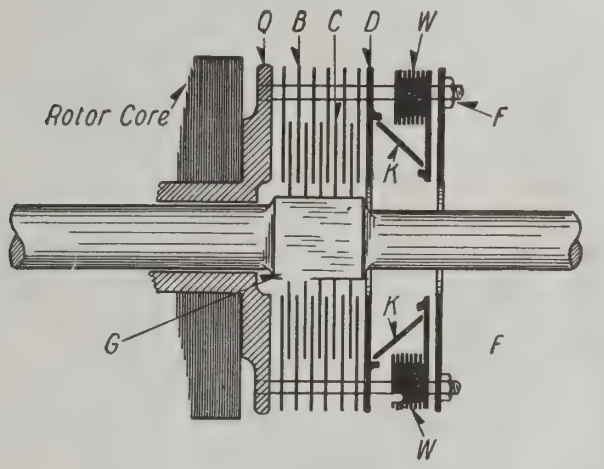
A noteworthy advance in the breakers consists of mounting them on framework and in the handling of the tanks by a tank-lifting device recently designed. The lifter consists of a detachable frame with shaft, handle, worm gear and winding and unwinding drums. The advantage of this equipment is that it allows a tank to be removed or placed in position without difficulty. The device is readily detached and can be moved by one man from one switch to another, thus making it a very simple operation to lower or raise an oil tank, and also making it easy to align, inspect contacts and oil, and replace contacts if necessary.

These top connected circuit breakers are self-contained for use on systems of potentials up to and including 200,000 volts. One tank with two breaks in series is used in each phase. The breakers are made for either automatic or non-automatic operation. The breakers are closed by hand, solenoid or air, and the automatic breakers are tripped under overload by series trip coils (mechanical trip indoor only) or current transformers. In using these circuit breakers for hand operation, they can be installed behind the switchboard panel with the operating handle in front and connected to the breakers by connection rods and bell cranks. All the breakers can be mounted on a framework except 110,000 volts and above. All the breakers can also be operated by a removable wooden lever connected directly to the mechanism.

Starting Devices for Single-Phase Motors

The single phase induction motor designed with a split phase winding for starting and not equipped with some other auxiliary device seldom develops more than full load torque at starting. For many applications, notably pumps, the split phase type of motor is desirable, but it must have a starting torque greater than full load. In order to accomplish this a clutch, similar to that used on an automobile is applied to the single phase motor. The function of the clutch is to allow the rotor of the motor to reach nearly full load speed before the shaft and its connected load are started. The two members of the clutch are then automatically engaged and the shaft exerts approximately two times full load torque upon the connected load. The early clutches were of the drum type in which weights were held close to the shaft by springs. When a certain speed was reached centrifugal force carried the weights out against the drum and the friction between them and the inner surface of the drum brought the shaft up to speed. In the latest design of motor the drum type of clutch has been abandoned for the multiple disc clutch. This is very similar to the type of clutch so successfully used upon all modern high grade automobiles.

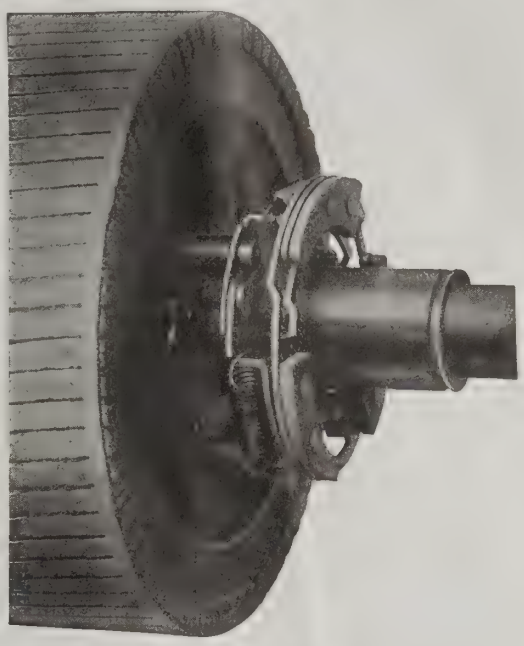
The multiple disc clutch has been developed by the Westinghouse Electric and Manufacturing Company for their split-phase induction motors, and has a number of advantages over the old type of clutch. A high starting torque is developed, the motor picks up to full speed under heavy and increasing loads, and a smooth acceleration of the driven machine is obtained, as well as overload protection for the starting winding. Centrifugal weights are used to operate the clutch as before, but instead of the weights themselves pressing against a drum, the friction between alternate plates of steel and phosphor bronze is used in locking the rotor to the shaft.



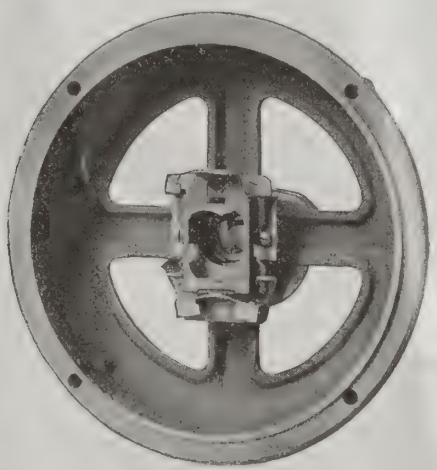
Multiple Disc Clutch

An idea of the method of operation can be obtained from reference to Fig. 1. The weights are shown at W and fly out when a predetermined speed is reached. This compresses the plates through the toggle links K, which force down the pressure disc D against the alternate disc shown at B and C. The weights are normally pulled toward the shaft by springs which are omitted in the figure to prevent complication of the drawing. The rotor spider Q carries the phosphor bronze plates upon the studs F, while the steel plates have square holes in the center which fit upon the square portion of the shaft shown at G. Thus one set of plates must turn with the rotor, while the other set must turn with the shaft. The weights and springs are so adjuster on both the clutch and the switch, used to open the starting winding, that when the motor is operating, the switch must open before the clutch starts the shaft. When the motor is retarded by an overload the clutch will slip before the starting winding circuit can be closed. This gives absolute protection against burnout to the starting winding.

Slots are cut in the plates to prevent warping when one portion becomes heated more than another, and they also assist in clearing the clutch of oil and dirt. The discs are arranged so that they can be easily replaced should they become scored or burned due to prolonged overload, but in no way can the operating mechanism be harmed. The split phase motor equipped with this clutch gives the highest starting torque that can be obtained from a split phase motor and it will bring up to speed any load it can start.



Single phase induction motors using the split phase method of starting require a switch to cut out the starting winding. This switch is always arranged to operate by centrifugal force just before the motor reaches full load speed. The old type of switch operated by the centrifugal force of the contact fingers, while reliable for light service, did not meet the increasing heavy demands put upon single-phase motors. The new switch developed by the Westinghouse Electric & Mfg. Company of East Pittsburgh, Pa., for use on its small single phase induction motors has been designed for great endurance and reliability combined with simplicity.



The switch consists of two parts, a stationary part mounted on the motor bracket, and a rotating part mounted on the shaft. The former consists primarily of one stationary and one movable punching each of which carries two heavy copper block contacts insulated from the punching, the contacts on the upper part being short circuited by a phosphor bronze spring. This part is free to move up and down, thus opening and closing the circuit with the two blocks on the stationary part. This movable part is held

in either of its extreme postions by means of two steel springs near the upper part of the switch which also give it a certain amount of over-travel so that when it is pushed in one direction through about half of its travel it will jump the remainder of the way.

The operating mechanism for the switch is mounted on the shaft and consists of three weights arranged in an approximate ring. These weights run between two lips on the sliding part of the switch. When the motor slows down the springs pull the weights together and they strike the lower lip, throwing the switch into the closed position. Owing to the over-travel of the switch the lips move out of contact with the ring in both the open and closed positions so that the only time the rotating part is touching the stationary part is at the moment of transition.

This switch makes a quick clean break, the contacts are large, permitting quick radiation of heat, and by thus keeping the contacts cool reduces arcing to a minimum. The contacts are designed to have a wiping action which keeps a clean contact surface. The mounting of the stationary element is metal, insuring correct alignment and spacing, while the only insulation used is the bakelite micarta used to separate the contacts from the punchings. One of these switches selected at random from stock was operated 1,000,000 times at more than full load current and at the end of the test was still in good operating condition.

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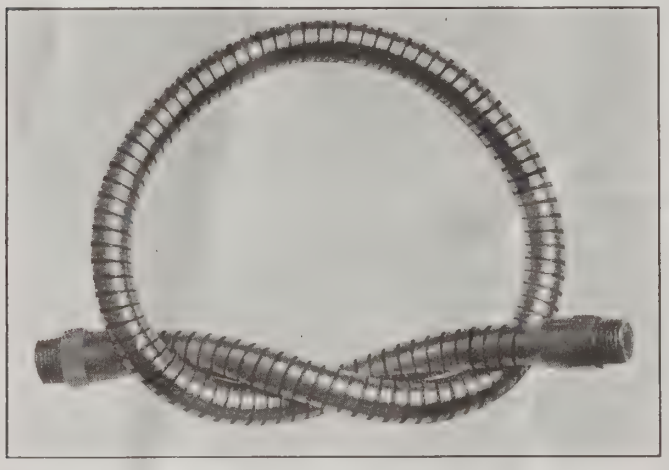
Flexible Metallic Tubing

Our readers who have to do with gasoline, oil, or steam frequently make use of hose for carrying these fluids. All of them have a destructive effect on rubber and rubberized fabrics, so that hoses of the usual type rapidly deteriorate. A further serious cause of depreciation is the wear incident to dragging hose on concrete floors. For these reasons the flexible metallic tubing illustrated is being more and more used under severe conditions. It is made of two spiral tapes which form a rolling joint, similar to a universal pipe joint.



"Power"

Hence no packing is needed, and there is no rubber or other organic material to decay.

For conveying liquids, the tubing is furnished with standard pipe fittings, while for electrical purposes it is shipped plain. For the latter use it is especially suitable around machine tools, for it is possible for oil to get to the rubber and braid insulation of steel-armored cables and ruin them. Where flexible tubing is used; it is impossible for oil to penetrate the outer covering.

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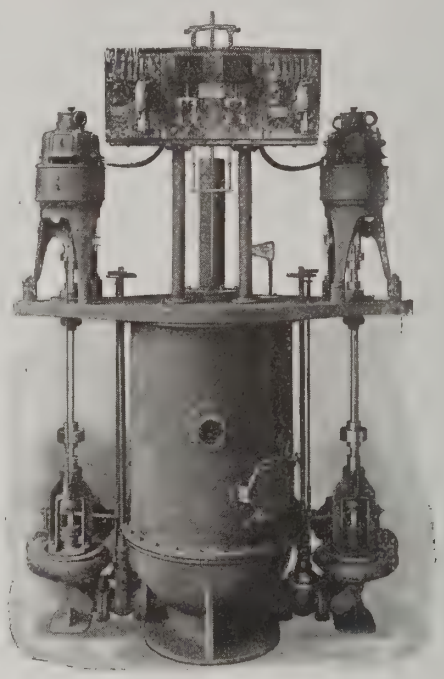
Duplex Sewage Pump

A manufacturer of pumping machinery has recently placed on the market a duplex sewage-pumping unit for use in buildings which go below sewer-level. The noteworthy feature of the equipment is the accessibility of all parts—a most important matter when repairs or cleaning is necessary.

The equipment consists of a cast-iron sewage receiver in the center of a dry pit, built of concrete, or of steel imbedded in concrete, into which are connected all low-level sewers which will not drain by gravity into the street sewer or other outlet. In the annular space between the receiver and the



ejector pit are two centrifugal pumps with suctions connected to the bottom of the receiver, and discharge connections brought together with long turn fittings and valves to a double-branch connection. The pumps are directly connected to vertical motors supported at the floor level by a heavy cast-iron plate which also forms the cover of the receiver. The motors are controlled by a float running in an 8-in. pipe casing inside the receiver, and operating automatic starters mounted on panels on top of the receiver, as shown in the illustration. The machine is being built in capacities ranging from 200 gal. to 1,000 gal. per minute from both units. The pumps are so arranged that the casings can be opened up for cleaning or inspection without disturbing the shafts or bearings, and clean-out and manhole openings are provided on the suction connections and sewage receiver. A cast-iron screen 3 ft. in diameter is provided on the inside of the receiver, and the design of the receiver is such, the manufacturer states, that there is no possibility of accumulation of solids, as in the case of submerged sump pumps.

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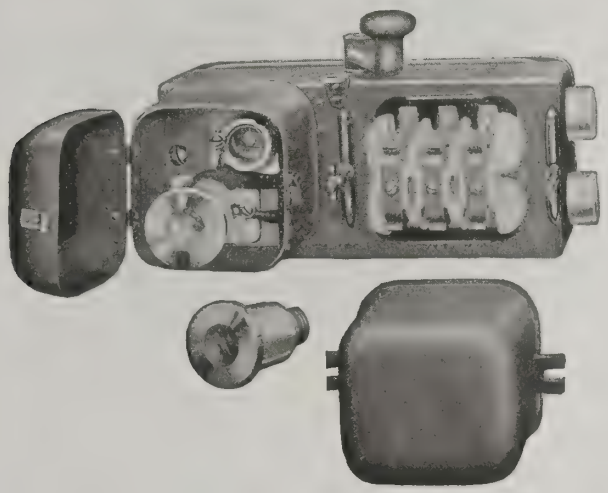
Small Industrial Oil Switch

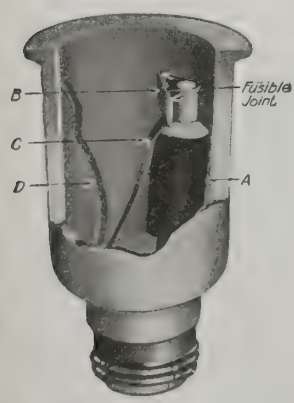
The switch here illustrated is used for starting and protecting three-phase induction motors up to 10 horsepower and 600 volts. It conforms strictly to safety first principles. There are but few operating parts. These are supported from the switch frame which can be mounted on any flat vertical surface, such as a wall or post, or by supports on the motor driven machines which the switches control. All operating or live parts, with the exception of the switch handle, are enclosed. The contacts are under oil and the terminals in the interior of the frame which is provided with a tight fitting sheet steel cover. The oil tank is pressed from a single piece of sheet steel. A line indicates the depth to which it should be filled with oil. The switch is built in the following styles: Non-automatic; with two-coil series overload time limit trip; with plain low voltage release; and with combined lower voltage and overload protective plugs. All switches are arranged for either open or conduit wiring.

The contacts open by gravity assisted by torsion springs, and

have a quick downward double break per phase. The mechanism is accurately constructed and parts are interchangeable. "On" and "off" on the frame indicate whether the switch is open or closed. The current carrying parts are liberally proportioned to secure low temperature rise and long life. The switch studs and moveable contacts are mounted in a porcelain block and separated by porcelain barriers. Contacts, terminals, etc., are securely held in place by lock washers, preventing loosening from vibration. Stationary contacts consist of drop forged fingers with flared ends. The moveable contacts are copper strips bent to the form illustrated. This construction insures good contact under strong pressure when the switch is closed. The non-automatic switch is held closed by a latch. In opening, the handle is moved some distance before the latch releases, after which the contacts are rapidly snapped open. The automatic



switch with two-coil series overload time limit trip is opened automatically on overload by a trip coil plunger. The switch cannot be held closed on overload or short circuit. Overload trip setting can be varied between the normal current rating of the trip coil and twice normal by a calibrating device in the tube surrounding the lower portion of each trip coil plunger. After a current setting is made, the device is locked in position by a set screw. Each trip is individually calibrated and the tube is then marked in legible white numerals on the black background of the tube. For time delay in automatically opening the circuit, each overload trip coil is equipped with an inverse time limit attachment consisting of an oil dash pot connected to the tripping plunger. The time setting is accomplished without removing the dash pot from the calibrating tube. At proper setting, protection is afforded to the motor against overload and against running single-phase, but at the same time prevents the switch from opening while the motor is starting. The switch with low voltage release is tipped out instantly if the line voltage falls to approximately 50 per cent. of normal. To reduce the watt loss of the low voltage trip to a minimum, a small auto-transformer is used in conjunction with the low voltage release coil except at 110 volts 60 and 40 cycles, where the transformer is not necessary. The switch with overload protective plugs and low voltage trip is similar to switch just described, but equipped also with time limit overload protective plugs connected in series with the switch leads.



In this case overload protection is obtained by two-time-limit, protective plugs as shown in Fig. 2. These protective plugs contain a stationary contact post with heating coil "A," and a fusible link "B," which binds a spring contact arm "C," to the stationary post. The heating coil is in the motor circuit which also passes through the post, link and spring contact arm. When the post is heated to a temperature that will melt the low-fusing alloy that holds the link together, the spring contact arm is released and takes the position as shown by the dotted line "D," thereby opening the circuit between the arm and the post. After the circuit has been opened by the protective plug a new link should be installed.

By reason of the time lag in the heating coil, the momentary inrush of starting current will not cause the plug to open the circuit. The plugs guard the motor against any conditions of overload that if maintained for a sufficiently long period would overheat the motor. Under the conditions that exist when multiphase motors are running single-phase, or when an attempt is made to start stalled motors, or when a motor is called upon to drive too heavy a load, the plugs will open the circuit.

These oil switches are known as type F, Form P-10. They are manufactured by the General Electric Company.

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Metal Conduit for Surface Wiring

For surface wiring a new type of metal molding has recently been introduced under the name of "Wiremold." While it is made up of two pieces—base and capping—these are permanently assembled at the factory and the wiring must

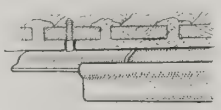


Fig. 2

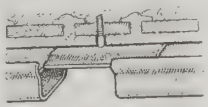


Fig. 3

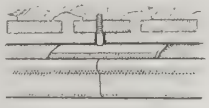


Fig. 4

Fig. 1

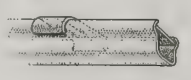


Fig. 5

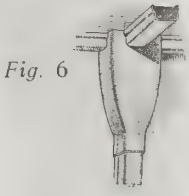


Fig. 6

be finished as into conduit. The makers claim for it the advantage of extreme simplicity. No special tools being required for its installation. Each length is furnished with a couplings shown in Fig. 1. To install, the coupling is pushed forward and a No. 8 flat-head wood screw is put through the hole as shown in Fig. 2. The next length is then placed over the coupling and shoved up to make a butt joint with its neighbor. Where support between the ends is required, a clamp (Fig. 5) is screwed to the wall and the molding snapped into it.

An extensive line of fittings has been prepared for use with the conduit, one of the more interesting being shown in Fig. 6. This corner box provides in a single fitting for most of the combinations required. Knockouts allow of any of three sides or all being entered by diverging conduit lines.

The conduit is supplied in two-wire size and 10 ft. lengths only. Accessories are packed in units of five in most cases—making it unnecessary to carry a stock much larger than the work in hand requires.

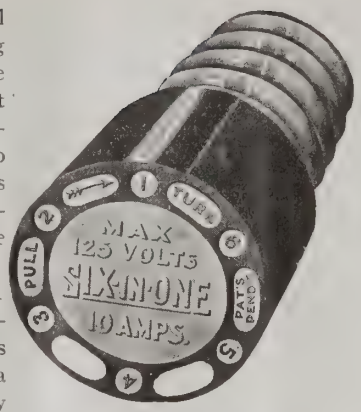
❖ ❖ ❖

Six Fuses in one Plug

It is a well-known fact that fuses always "blow" just when there's most need of service, and no good fuses to replace them. The necessity for the use of hairpins, nails, or bits of copper wire to "get the juice on again" has been removed by the introduction of a fuse-plug which contains six fuses, each of which may be used in succession.

As the illustration shows this plug screws into any Edison

base cut-out. Inside the shell are six holes, each containing a fusible wire. When any one of these burns out, the next may be put in service by pulling out the cap and turning to the right. A new fuse comes into circuit and service is restored. Not only is this done almost instantaneously, bu there is the certainty that the new fuse is the proper capacity for the circuit — thus avoiding any chance for a fuse of much higher capacity being substituted by mistake.

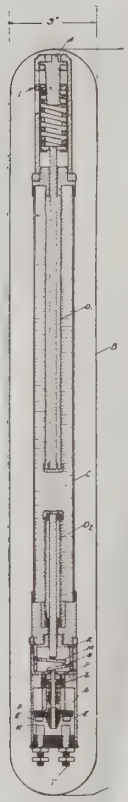


* * *

Thermo Switch

The manufacturers of a line of temperature-controlled values have added a switch which is closed by fall of temperature. The numerous applications for this device in the field of electrical heating make its operating features of special interest.

The operating mechanism employs a brass tube filled with a heavy hydro-carbon oil, which on expansion compresses a spiral tube inserted in the oil. This spiral tube is capable of withstanding pressures up to 2,000 lbs., but a special safety device is furnished in the form of a heavy steel spring in the regulating head. The following is a description of the electrical switch:



The expansion element pushes a rod out of the end of a tube by the expansion of a liquid, derived from increase in temperature. The movement is multiplied by levers. A motion is obtained sufficient to operate the snap switch even with very slight changes in temperature?

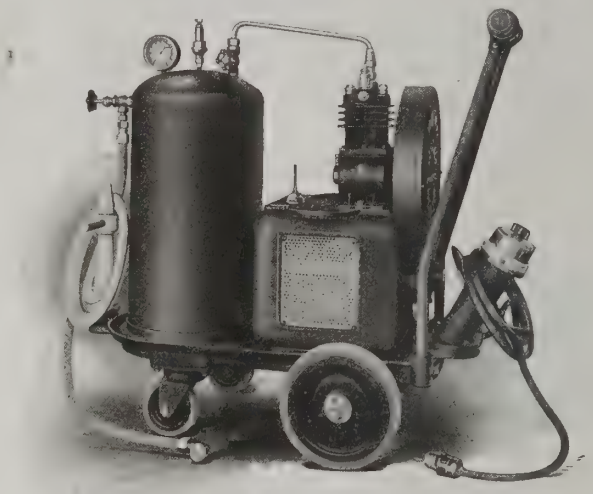
The cut shows the instrument in the "hot" position with the plunger extended. As the instrument changes to "cold" position, the rod "R" is slowly withdrawn into the tube followed up by the plunger "P," which operation is based upon the action of the spring "X." The insulating member carrying the switch blade "F" is held in its illustrated position by the brass seat against which it rests, therefore, the plunger head "H" is withdrawn slowly through this insulating member expanding the spring "S," which is an endless coil spring free to roll from one end to the other of the plunger head, carrying with it the insulating member which carries the switch contacts. As the plunger draws through this switch member, the spring "S" expands and as the point of greatest diameter of the plunger head passes through the centre of the spring "S," the compression of the spring "S" causes it to travel down the plunger head, carrying with it the insulating member carrying the switch arms, which then hop over and locate themselves on the terminal posts "T," thus closing the circuit. This condition then obtains until the process reverses itself by application of a warmer temperature.

This switch is perfectly safe to operate on a 220 volt circuit and it will carry 5 amperes. Its action is very quick and positive. The device will work with lamps in series without causing a flicker. The instrument shown has a calibrated scale from 58 to 78 deg. F. and is intended to operate the switch with a change of approximately 2 deg. in temperature. It can be constructed for any temperature up to 325 deg. F.

Portable Tire Pump

The garage outfit here shown is a complete electric pumping plant, mounted on wheels, ready to be rolled wherever air is needed, and may be connected to any convenient electric outlet. It is complete with motor, pump, seamless drawn steel tank of 7 gallons capacity, manometer, safety valve, electric connecting cord and steel covered air hose.

This plant is supplied with either two or four cylinder air pumps geared to motors of 1-6, ¼ or ½ hp., for alternating or direct currents. The motors are enclosed in a cast hous-



ing with ventilating openings; all wiring is protected from damage. The tank is tested up to 250 lbs. and the safety valve may be set as desired up to that point.

The truck is mounted on quiet-running wheels, the two front wheels being set in ball-bearing swivel mountings.

If no electricity is available at the point where air is needed, the tank may be filled to a pressure of 200 lbs. in five to eleven minutes and wheeled to the desired position.

The two-cylinder outfit weighs 260 lbs. crated for shipment, and the four-cylinder pumping plant 275 lbs. Both sizes of pumps, it is stated, have piston rings, without leather packings, which are likely to leak.

* * *

Steel-Clad Heating Units

A step toward the universal application of electric heating in industrial processes has been made by the introduction of a rugged, compact, indestructible heater by the Westinghouse Electric & Mfg. Co., East Pittsburg, Pa., that is suited to a wide variety of industrial uses, among which are: the heating of ovens and drying rooms, air heating, and the heating of press heads and hot plates. This type of heater, known as "Steel-clad," is made in two widths and in various lengths to secure the proper amount of resistance, the selection of the right size being governed by the aplication. Three degrees of heat are obtain-

able with the wider of the two: the narrower one is for one heat only. Where two single-heat heaters or multiples of two are used however, three heats may be obtained by interconnection of the heaters, using a three-heat Westinghouse snap switch for control.

The "Steelclad" heater consists of a flat ribbon resistor assembled in a mica sheath, and encased under pressure in a heavy steel casing. Suitable terminals and terminal covers are provided. This construction reduces to a minimum the possibility of injury and also provides rapid transfer of heat from the resistance element, thus insuring long life under severe conditions of service.

ELECTRICAL AGE

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Bending and Installation of Conduits

By Benjamin Gross

This article describes and illustrates, various methods of conduit installation utilized in some particular cases, as well as the general means employed in the handling of electric pipe at different points in the system. This includes the schemes for setting conduits in concrete foundations to definite dimensions in small isolated plants, the installation of heavy feeder conduits systems, the arrangement of pipes at panel boxes in shafts and in walls, the placing of conduits in telephone terminal rooms to location templates supported from the floor and from the ceiling, the setting of pipes on forms to be cast integrally in the concrete floor arches, the installation of conduits in the floor arches to be covered in the floor fill and finished floor, the erecting of conduit exposed on ceilings, as well as the actual methods of bending and setting conduit.

Appropriate and economical installation of electric conduits is a problem that must be solved for each individual case. It is necessary to take into account the construction of the entire building, the purpose for which the building in question may be used, whether large changes may be later required by local tenant needs, whether additional capacity for future or increased in load in advisable, etc. A conduit system can be likened to the building itself and the wiring in it to the equipment to be installed therein. As a matter of fact the writer is familiar with a case where a large industrial plant was being erected by two parties, one paying the cost of the building and the second supplying and placing the equipment, in which the electrical contractors were required to divide the cost of the installation so that the former would pay for the conduit system and the latter for the wiring, panel boards, fixtures, etc.

Viewing the installation of the conduit system from the economical standpoint, it is essential to the owner to see that it be so placed that changes or additions, if necessary, can be made with a minimum of building construction work. In the case of commercial buildings, for instance, office buildings, tenants occupying more space than that set aside for a small office, invariably have definite ideas as to the arrangement desired for their various rooms. This at once means change in lighting. There are several methods by which the conduits or wire rollways can be installed to minimize the necessary building changes coincident with a layout of lighting different than that already in. These will be described below. For industrial and factory buildings, increase, expansion and extension of the system must be looked into, at the same time mak-

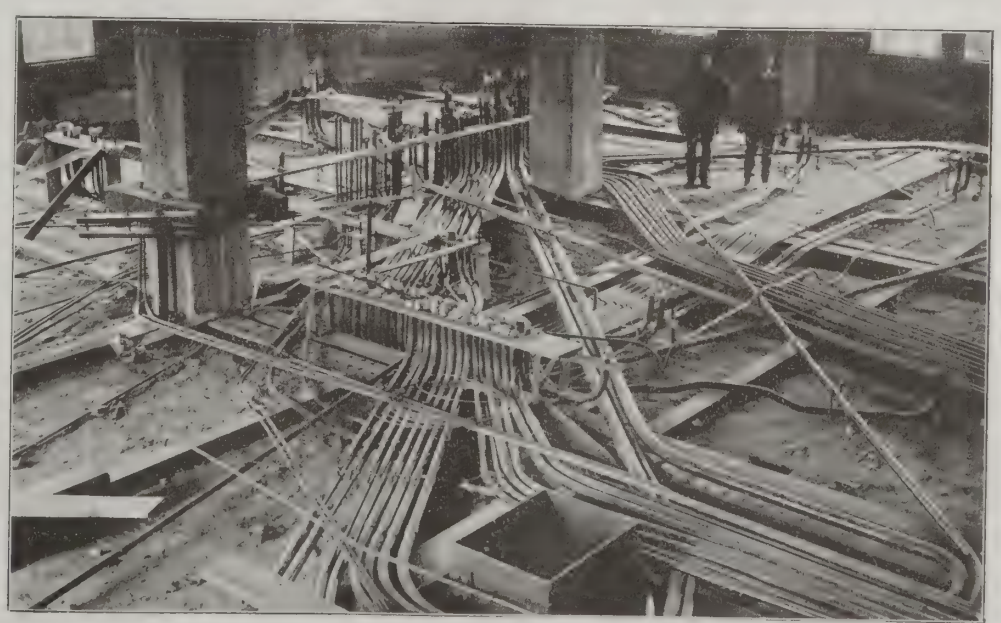

Fig. 1. Conduits in Parkway Building of Bell Telephone Company, Philadelphia. Templates were supported from the floor and from beams.. Note the pipe-bending machine fastened to column at left of picture.

ing the first installation little more than actually required but creating the possibility of extending and increasing the same with a minimum of change to the distribution system and a minimum of interruption to production which is sorely needed when increased business requires larger electrical facilities. As regards the contractor it is sometimes expressed that the profits of a contract can be entirely lost or made in the "roughing in" as the installation of the conduit system is known in the trade. A contractor must make a

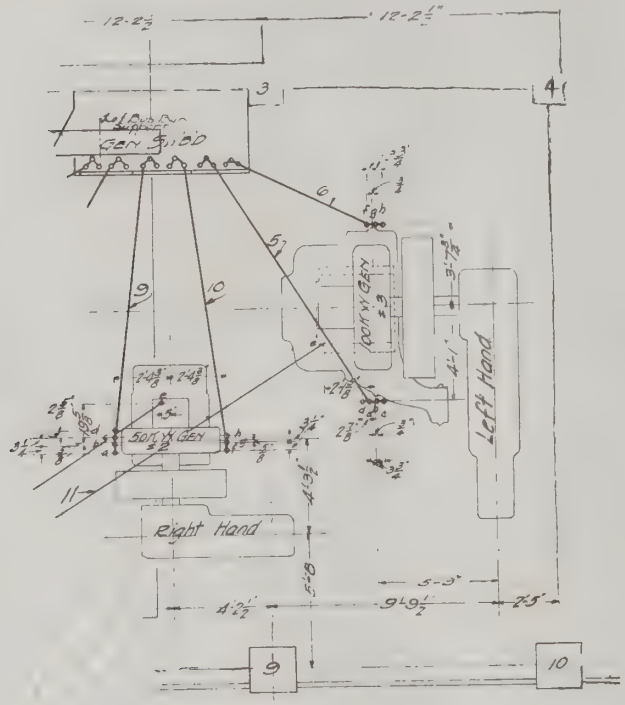

Fig. 2. Conduit Layout for Power Plant

thorough survey of the distribution system in order to economically install his piping. We can thus see that the provisions made for the wiring of any building is a distinct problem in each case and deserves some study. This paper gives several cases and methods used by contractors of wide experience in both small and large work.

Laying Out Conduits for Power Plant

Nowadays, many of our commercial and industrial structures are provided with privately operated generating plants. In such a case order and simplified operation is a very essential requirement for continuity of service. If continuity is not assured all advantage in having one's own plant rather than purchasing power from public service corporations, is lost. A little study of the entire situation in advance will go a great distance in creating such order and simple operation.

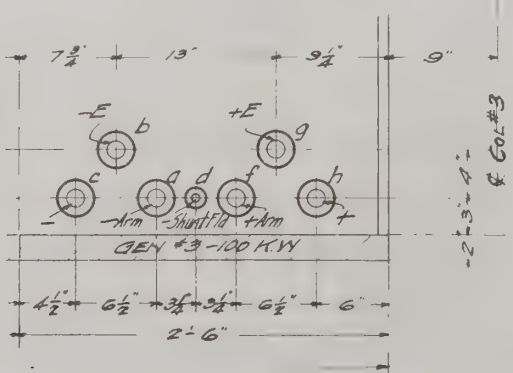

Fig. 3. Detail of Switchboard in Fig. 2.

First, the general arrangement of the generator and switchboard must be such as to present an orderly and systematic appearance. —Fig. ?? shows a method of laying out the conduiting for an average sized isolated plant. Drawings are obtained from the generator and engine manufacturers, showing the dimensioned location of all terminal lugs on the generator giving their horizontal position both ways from the center-line of the generator and the height of the lug above the generator base. With the aid of the foundation plans, each foundation always being located dimensionally from steel centers, and the combined engine and generator drawings, the vertical and horizon-

Top of Conduit

GEN.	LINE ME	COND MARK	POLARITY	CABLE	CONDUIT SIZE	CONDUIT VERTICAL DIST. TO C.L.	CONDUIT HORIZONTAL DIST. TO C.L.	FITTING AT GEN	FITTING OTHER END	LUG ABOVE FLOOR AT GEN	LUG ABOVE FLOOR OTHER END
#3 100 K.W.	5	a	-Armature	1-350,000 CM. L.C.	2"	6"	4"	V.V.-96	V.V.-96	22 3/4"	18"
		b	-Equalizer	"	2"	6"	4"	"	"	2'-4 3/4"	3'-6"
		c	-Series field	"	2"	6"	4"	"	"	22 3/4"	18"
		d	-Shuntfield	1-8 L.C.	3/4"	6"	10"	"	"	2'-4"	
	7	e	Compensator	1-2 L.C.	1-2"	3/4"		V.V.-91	V.V.91	2'-1"	
	6	f	+Armature	1-350,000 CM. L.C.	2"	6"	4"	V.V.96	V.V.96	22 3/4"	18"
		g	+Equalizer	"	2"	6"	4"	"	"	2'-3 3/4"	3'-6"
		h	+Series field	"	2"	6"	4"	"	"	22 3/4"	18"
	8		Neutral	1-0 B/S	1"			V.V.91	"		

Fig. 4. Part of Cable Schedule for Fig. 2

tal centerlines of each generator and the height of the lugs above the floor can be determined. Similarly, from dimensioned drawings of the switchboard the exact location of each lug can be fixed as well as its height above the floor. Now we have definitely located by dimensions from steel centers, the terminating points of all pipes, and by allowing sufficiently slack between the end of pipes and the respective lugs we can fix the height above the floor at which all pipes should terminate. Incidently it might be mentioned that the polarity of each terminal lug on the generator is indicated on the above mentioned generator drawing, which means we can now lay out clearly each pipe line on a scale drawing in such a manner that each cable will pass directly into its lug without any cross-

Fig. 5. Panel Box. Note Offsets at Top and Bottom.

sings. Thus the connections at both generator and switchboard ends are simplified to the limit. The same can be done in the operation of the switchboard and the wiring thereof.

The riser conduit system is next in line in importance. These contain the backbone of the distribution system, as it were. The routes of these from the switchboard are usually more or less determined by the plumbing and heating pipes and the ventilating ducts

in the spaces over which the feeders run. Often these conduits are installed in the fill of the floor over that on which the switchboard is located. Most often, however, they are installed on racks hung through the floor above or from the steel framing overhead; and thus run exposed on the ceiling of the switchboard level. This is perfectly the means of installation, since such pipes are usually large, sometimes containing heavy feeders that heat quite a little, and would therefore need plenty of ventilation, and above all, the backbone of the system is readily accessible in the event of any trouble. The pulling of the cables in these pipes is also quite an important matter. Pull boxes can be very easily installed and are accessible in exposed work but hardly so in work set under a floor. These pull boxes can be arranged with little or no extra cost to take additional conduits laid upon the pipe supports already in place. This is done by making the racks slightly heavier than actually required for the present and having the boxes arranged with spare knockouts to take such additional conduits. These share knockouts can be had with absolutely no extra cost from manufacturers of boxes with average equipped shops.

Supporting Vertical Runs

In the installation of conduits vertically, each should be properly supported and preferably from the steel floor framing. This can be done in various ways, by the use of a pair of proper size band-irons bent about the pipe and bolted together near both ends of the bands. One end is allowed to rest on a piece of the floor steel, or if the pipe is between two pieces of framing each end of the straps can rest on the steel. Another means, when all the conduits are of the same size is to place a channel or angle on each side of such pipes, bolt the angles or channels firmly together and support such braces on or from the floor steel. Still another method to be used where conduits are not the same size is to set them flush on one side, place a channel or angle iron across that fact and bolt each pipe to same with U-bolts; or in groups of the same size, by pieces of flat iron parallel to the channel or angle, securing such flat iron by bolts passing between the pipes to the main support which is similarly held to the floor steel. Standard 3 or 4 in. channel or 2 to 2½ in. by ¼ in angle iron with ⅜ in bolts will be found large enough for practically all cases, except of course very heavy ones. The angle or channel supports should be fastened in position to prevent sliding laterally. In such cases where cable supporting is necessary quite considerable economy can be effected by building cable support boxes of such height as to eliminate cutting and threading of nipples. Such boxes can be made to such height that full lengths of pipes can be used almost throughout the run. Slight variations could be made up with couplings and chase nipples at boxes. Fig. 5 shows a case where the panel box was used as a cable support box and a jog built in the back, not quite the height of the box proper so as to avoid the necessity of cutting or nippling the feeder conduits.

Branch Circuit Work

Fig. 5 shows a panel box installed in the electric shop of a large department store. All branch conduits were 1 in. and there were a great number of them which meant quite a cost for bending up those that came to the panel from within the floor and down those from the floor or ceiling above, if the box had not been set as shown, i. e., with its bottom below the floor level. There are objections to this method as far as

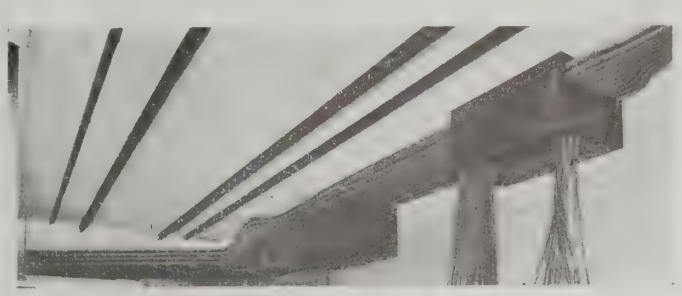

Fig. 6. Neatness of Special Bends

pulling wire is concerned, as they are pulled against oneself. However if the boxes are made deep enough this objection is not serious, and the gain of the method overshadows the disadvantages.

In concealed work, in reinforced concrete buildings, where the conduits and outlet boxes are set on the forms and cast into the concrete it is essential to white or red lead each coupling joint, thus making them as water tight as possible. The writer has seen cases where an entire building had to be rewired due to the careless omission of this item. Within one year of the original installation circuit after circuit was burning out, water and acids finding their way into the pipes at joints and rotting the insulation until it broke down. The same case is met with conduits set on the arch within floor fill which is always wet when poured. Care should be taken that the substance thus used is a perfect conductor, or almost so, in order not to break the electrical circuit of the conduit system. Another thing to be avoided is the use of running threads, where building conditions are such that straight lengths of conduit cannot be installed except by running them together at the coupling. Unions similar to the Erickson, or right and left couplings, should be used, as there is considerable danger of joints not being properly made up at running threads.

It is frequent that a man must leave his work unfinished for various reasons and plug up with wood plugs the ends of pipe runs left uncompleted. He re-

(*Continued on page 50*)

Fig.7. Conduits bent and fitted ready to be put in place.

Frequently, the design of the building is such that a marquise extending over the sidewalk or a cornice at one of the lower floors furnish ideal locations for projectors. The light is thrown upward along the surface of the building as indicated in Fig. 3 which shows a building illuminated from a morquise. The projectors are installed behind the line of sight from the street level, as indicated, and their axes inclined towards the face of the building. The amount of this inclination of course depends on the height of the building. In order that the illumination may not be "streaked," the projectors must be carefully adjusted. In order to eliminate the shadow which the projecting window ledge would cast on the face of the building above the seventh floor, four additional units are installed at this elevation. They point directly upward intensifying the illumination on the top-most cornice.

Sign Lighting

Many a sign works only during the day. The owner appreciates that this sign would be a still better business producer if it were illuminated at night. Not only would the working hours be increased from 50 to 100 per cent., but the sign itself would attract greater attention. The reason the sign is not lighted is because it is hard to reach. The maintenance of lighting equipment for illuminating it is difficult and expensive. By means of projectors, a sign may be lighted from a distance. The projectors may be located at a convenient point, and a strong beam of light directed to the sign.

A chimmey sign may be illuminated by means of projectors located on the roof of the adjoining power house. These signs are invaluable, when illuminated, because they loom up against the dark sky background, and are visible for long distances. The projector provides the only economical and convenient means of securing the desired results. At the great distances usually intervening, it is impossible to confine all the light from the projector to the sign, but despite some loss, the results secured are highly satisfactory.

Sign lighting by means of projectors has a number of advantages over the old style local lighting now in common usage:

(1) Signs have a better day appearance, since no reflectors, arms, conduit and wiring extend out in front of the board.

(2) The lighting is uniform, eliminating the spotted and glaring effect noticeable with local lighting.

(3) The equipment is less expensive to purchase and install.

(4) Cost of electrical energy is lower, since a few large lamps may be used, and a board illuminated with a lower total power consumption.

(5) Cost of maintenance and lamp renewals is lower. Since the reflectors and lamps are enclosed in a weatherproof housing, cleaning is not necessary except about one in 1,000 hours when the lamps are renewed.

(6) The projectors may very easily be dismounted and moved to another location. This is important to the man in the sign advertising business, since he must sometimes lease a location to his customer unlighted, which already may have a complete lighting equipment installed, which means he will have an investment lying idle for the term of the lease.

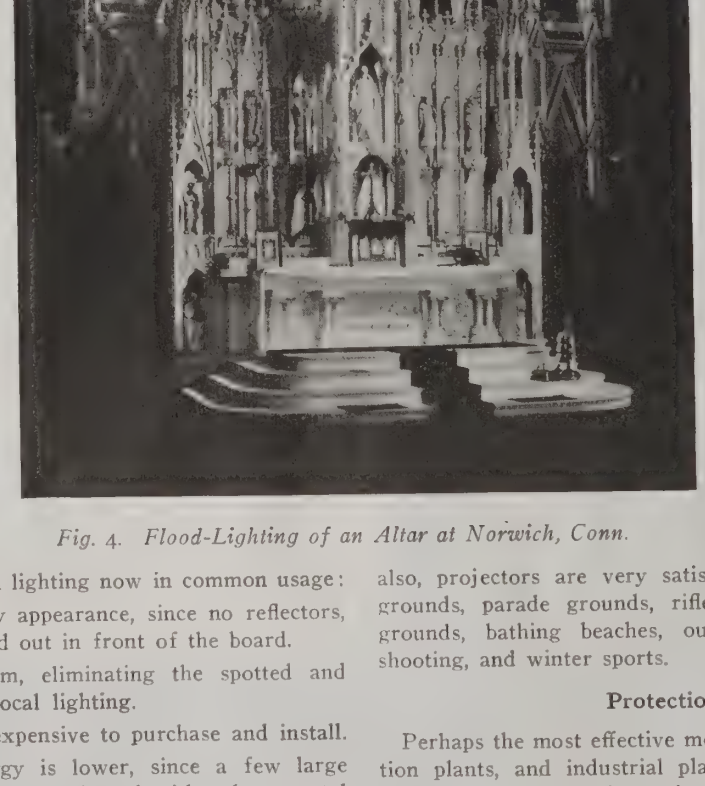

Fig. 4. Flood-Lighting of an Altar at Norwich, Conn.

Campaign Banners

All of the foregoing reasons for flood-lighting of signs apply equally to the lighting of campaign banners. It is especially desirable to keep this form of publicity working by night as well as by day, for its season is limited to a few weeks just before election-time. A banner swung across a street lends itself particularly well to flood-lighting because it has the black sky for a background, it can be seen from a great distance if well lighted, and it is usually easy to mount projectors. The best way is to place one projector at each side of the street for each side of the banner, or four in all, using window ledges, roof cornices or pole tops. In every case the unit should throw the light upward so as to avoid glare in the eyes of people in the street. The projector is of course the only practicable means of banner-lighting as the proper suspensino of lights opposite the banner is an extremely difficult undertaking.

Night Work

Project units, because of the facility with which they may be transported from place to place and quickly installed, are being used in night construction work. This enables contractors to work in two and sometimes three shifts. In many sections of the country where the natural ice harvest is an uncertain quantity, it is essential that the ice be cut quickly when the time is opportune. Efficient lighting for night harvesting is solved by the use of projectors, which may be set at a few convenirent points, dispensing with the need of the old overhead method, with its poles to be set, wires to string and globes and sockets to attach. Other uses that suggest themselves are for the assembly of large machinery, freight unloading, the lighting of coal piles, grain elevators, quarries, mines and oil wells.

Outdoor Sports and Festivities

For the foregoing reasons also, projectors are very satisfactory for illuminating athletic grounds, parade grounds, rifle ranges, toboggan slides, playgrounds, bathing beaches, outdoor-theatricals, pageants, trap shooting, and winter sports.

Protection Lighting

Perhaps the most effective means of protecting arsenals, munition plants, and industrial plants from malicious intruders at night, is to virtually fence them in with a "wall of light." For this purpose projectors are particularly valuable, since they may be located where they cannot very easily be put out of commission by the persons bent on mischief. Similarly prison walls may be illuminated. Lighting of this character makes the watch more effective, and even permits a reduction of the number of watchmen required to patrol the works.

Recently projectors have been applied to the illumination of

Flood-Lighting

By John A. Hoeveler

Assistant Chief Engineer National X-Ray Reflector Company.

Flood-lighting which sprang into sudden prominence about a year ago, because of its application on a large scale at the Panama-Pacific Exposition, and on the world's greatest skyscraper, the Woolworth building, New York, is such a great departure from, and wonderful improvement over, former methods of lighting building exteriors, that at first thought one is inclined to wonder why it was not used before. The reason is that we really did not have convenient means. Incandescent lamps were unsuitable, not only because of their low light giving capacity, but chiefly because their luminous element deviated so greatly from the point source so essential for projection purposes. Arc lamps required expensive reflecting accessories, and

Fig. 1. Flood-Lighting Projector as Designed for the Woolworth Building.

expensive maintenance. This combination of reasons perhaps accounts for the persistence with which we have stuck to outline lighting with incandescent lamps.

While incandescent lamps may be used with good effect in outlining a building structure, they do not illuminate the building. In fact they very effectively obscure the finer architectural detail. Hence this system, although used for advertising purposes, in illuminating theatre fronts, amusement parks, dance halls, and in some cases mercantile establishments, has not been very extensively applied for lighting public buildings, churches and monuments. With flood-lighting, on the other hand, a building may be illuminated in a manner which closely simulates daylight, under which the architect judges the design. Thus a historical or architectural gem may be revealed to the public gaze at night, without loss of dignity.

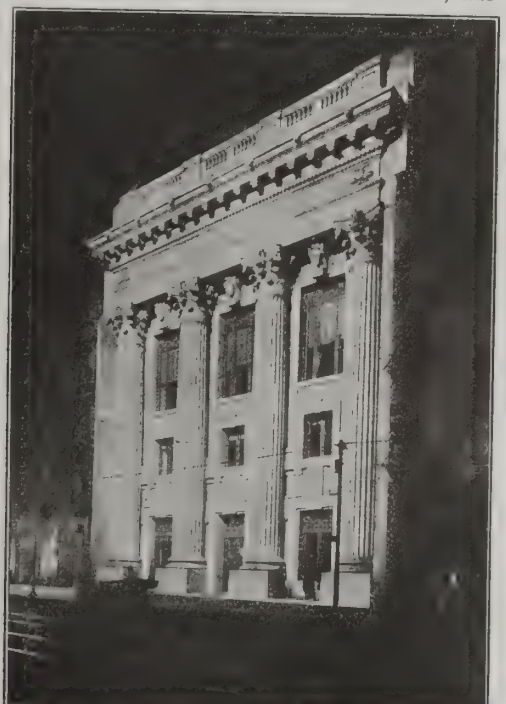

Fig. 2 First National Bank, Cleveland, Ohio.

To flood the entire surface of a building so that it is illuminated, and the means of lighting is not made evident, the lighting usually must be done from a distance. This requires the use of a projector, employing a mirror reflector of the parabolic type or a lense projector. With either of these types of projectors an approximate point source of illumination is needed. The recently perfected concentrated filament gas-filled tungsten lamp places at our disposal such a light source, and one of great light giving capacity. The second requirement is a suitable projector reflector enclosed in a ventilated and weatherproof housing, since these units are for exterior use where they are subject to rain, sleet, and snow. A commercial projector unit is shown in Fig. 1. It consists of an enameled metal housing, containing a silver mirror projection reflector, weatherproof socket, and a device for focusing the lamp. It is thoroughly ventilated in a manner which will prevent the entrance of moisture to the lamp or reflector. The glass cover is made of heat resisting glass which withstands extreme and sudden temperature changes, as would occur were the lamp lighted with a coating of snow on the glass.

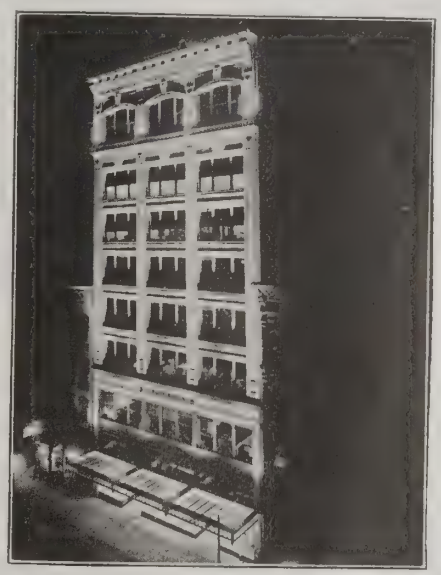

Fig. 3. Z. L. White & Co. Store, Columbus, Ohio.

Flood-Lighting Buildings

The flood-lighting of a building requires careful planning by the man on the job, who will be called upon to decide how many projectors will be needed, whether to locate them at a distance or on the building itself, and at what angles the beams from the various projectors must be directed.

Take a building like the bank illustrated in Fig. 2. The design of this building front, which is 80 ft. high by 70 ft. wide, makes necessary installing the required twenty-four projectors on the roof of the building across the street. In order that the lighting would be uniform like daylight, it was necessary to space the projectors uniformly. Furthermore, the beam of light from each projector was carefully adjusted to get the ideal results indicated by the picture, and so that pedestrians on the street would receive no glare in the eyes.

church interiors. Fig. 8 shows how an altar can be made to stand out by using four 250-watt projectors located behind the last pillars on either side of the chancel, which is about 100 ft. high and 45 ft. wide. The lamps are about 50 ft. from the floor and are turned so as to illuminate the side of the altar farthest from them in order to get better "modelling" of the intricate carvings on the altar. As the "throw" is only 30 ft. this method allows each lamp to cover a somewhat wider surface. The adtar looks as thaugh it were bathed in bright sunshine, and against the obscurity of the remainder of the church it presents a wonderfully beautiful appearance.

An installation lately made by Mr. Glenn Marston on a large estate on Long Island, shows how well projectors are adapted to the night illumination of gardens. At one end of each pergola a 250-watt projector was installed about 1 ft. below the top lattice. These were screened in pale-blue. The central part of the garden was lighted from the roof of the house. Lamps playing on

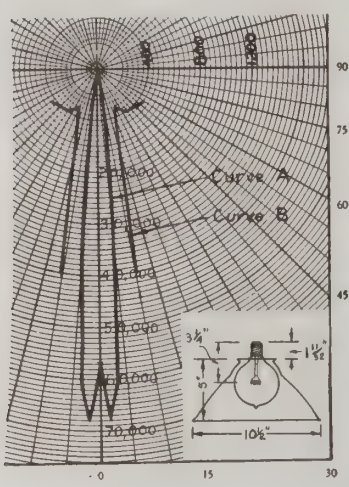

Fig. 5

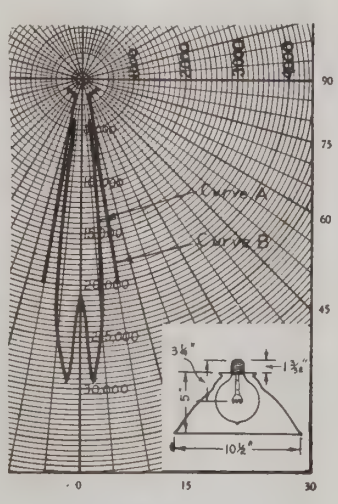

Fig. 6

statuary were colored amber, pink, blue or purple, and special projectors were provided as needed.

Illumination Data

In order that the illuminating engineer may be in a position to solve his flood-lighting problems and forcast accurately the results he will secure, he requires specific photometric data on the lamps and reflectors offered him for this purpose by the manufacturer.

Figure 5 gives the light distribution of the projector of Fig. 1 with the 250 watt lamp at the focus, and shows the greater concentration of light obtainable with this reflector. Table I gives the data from which this curve is plotted. The small diagram of the reflector in the lower right hand corner shows the lamp position. Curve "A" is for the zone 0°-10°, and the vertical scale gives the candle-power values, whereas curve B is for the zone 10°-60°, and the horizontal scale gives the candle power values.

Figure 5 gives the light distribution of the projector of Fig. inch in front of the focus, and shows the greatest spread of light obtainable with this reflector. Table II gives the data from which this curve is plotted.

The beam of light from a projector is conical, and hence when it strikes a surface perpendicularly it illuminates a circular area. On the other hand, if the beam is directed to the surface at an angle, it illuminates an area which is elliptical in shape. The greater the angle at which the beam strikes, the larger the area of the ellipse lighted and as a consequence the lower the intensity of illumination. When the beam is perpendicularly directed to the surface to be lighted, the field is illuminated with practical ly uniform intensity, but when the beam strikes the surface at an angle, the portions of the field nearest the projector are brightest, and the remote portions less bright. The greater the angle of projection, the greater this difference.

Table III gives the length and width of area illuminated, and the average foot-candles intensity of illumination, for various angles of projection, at various perpendicular distances from the surface, when the angle of divergence of the beam is 12°, as for the condition of Fig. 7 and Table I. The square feet area of the illuminated field may be obtained from the formula, area .7854 L. W.

Table IV gives the same data for an angle of divergence ot 20° as represented by the conditions of Fig. 6 and Table II.

The value of illumination intensity represents the average over the entire field, and of course is a lower quantity than the intensity at the center or nearer portions of the illuminated field.

All data above is for the lamp and reflector only, and does not take into account the absorption of light in the glass cover of the housing. The clear glass cover of the projector absorbs about 15 per cent. of the light flux, allowance for which must be made in making calculations. When color screens are used over the projector, account must be taken of the absorption of these screens, when calculating the resulting intensity.

Table I

Lamp—250-watt; concentrated filament; gas-filled tungsten; voltage 115; lumens, clear-lamp 3510; w. p. c. (hor.) 0.80; reduction factor 0.896; bulb—G30 clear.

Angle	Candle Power	Angle	Candle Power
0	56750	8	3630
1	63100	9	2060
2	67750	10	1300
3	61200	15	523
4	43750	25	363
5	26800	35	399
6	17200	45	403
7	7190	55	423

Table II

Lamp—250-watt; concentrated filament; gas-filled tungsten; voltage 115; lumens, clear-lamp; w. p. c. (hor.) 0.80; reduction factor 0.896; Bulb—G30 clear.

Angle	Candle Power	Angle	Candle Power
0	20800	8	12980
1	22250	9	7860
2	27130	10	4070
3	28400	15	675
4	27000	25	347
5	24700	35	363
6	22500	45	388
7	17850	55	391

TABLE III — Length and Width of Area Illuminated, and Average Intensity for 12° Angle of Divergence

Angle of Projection	Dist. 25 ft.			Dist. 50 ft.			Dist. 75 ft.			Dist. 100 ft.			Dist. 200 ft.			Dist. 300 ft.		
	L.	W.	F.C.	L.	W.	F.C.	L.	W.	F.C.	L.	W.	F.C.	L.	W.	F.C.	L.	W.	F.C.
0°	5.3	5.3	70.2	10.5	10.5	17.6	15.8	15.8	7.8	21.0	21.0	4.4	42.0	42.0	1.1	63.1	63.1	.49
15°	5.6	5.4	63.3	11.3	10.9	15.8	16.9	16.3	7.0	22.5	21.7	.39	45.2	43.6	.98	67.7	65.3	.44
30°	7.0	6.1	45.6	14.1	12.1	11.4	21.1	18.2	5.1	28.1	24.3	.29	56.3	48.5	.71	84.4	72.8	.32
45°	10.6	7.4	24.5	21.3	14.9	6.1	31.9	22.3	2.7	42.5	29.7	1.5	85.0	59.5	.38	128.0	89.3	.17
60°	21.7	10.5	10.3	43.5	21.0	2.6	65.2	31.5	1.1	87.0	42.0	.65	174.0	84.1	.16			
75°	92.8	20.3	1.0	185.0	40.6	.3												

TABLE IV — Length and Width of Area Illuminated, and Average Intensity for 20° Angle of Divergence

0°	8.8	8.8	24.5	17.6	17.6	6.2	26.4	26.4	2.8	35.3	35.3	1.56	70.5	70.5	.39	106.	106.	.17
15°	9.5	9.1	22.5	18.9	18.2	5.6	28.5	27.3	2.5	37.9	36.5	1.40	75.8	73.0	.35	114.	110.	.16
30°	11.9	10.1	12.6	23.7	20.3	3.2	35.7	30.3	1.4	47.5	40.7	.79	95.0	81.3	.20			
45°	17.5	12.4	8.9	35.1	24.9	2.2	52.5	37.2	.99	70.2	49.9	.56						
60°	38.9	17.7	2.8	77.8	35.3	.71	117.0	53.1	.31	156.0	70.5	.18						
75°	230.	34.0	.25															

Glass cover of housing absorbs approximately 15%

Telephone Subway Reconstruction in New York City

By Clifford M. Hartley

*Assistant Engineer Empire City Subway Company**

Construction of the new rapid-transit subways in New York City has made necessary wholesale rearrangements in the electrical conduit lines.. The solution of the difficult problems of relocation will interest underground construction men, who often have such work to do, though fortunately on a less extensive scale.. This article is an abstract of three papers appearing in "The Telephone Review" of May, August and September.

The rapid transit subway lines, both old and new, follow, in the main, the principal north and south thoroughfares. Further, they are built so close to the surface as to practically divide the city into a number of longitudinal zones. It is but natural, owing to the topography of the island of Manhattan, that the trunk lines of the public utilities companies should also follow much the same routes. There are, at the same time, trunks running east and west, which but further complicate the situation, as they must cross the rapid transit subway structure at certain points, and these crossings involve exceedingly difficult construction features. They are so difficult, in fact, that subsequent connections between these zones will be impossible. An indication of the great magnitude of the rapid transit work may be had from the fact that the total cost of the subway lines, old and new, will be approximately $366,000,000.

Profiting by the lessons learned and the experience gained in the building of the existing subway lines, a Bureau of Subsurface Structures was formed at the commencement of the present work to carry on the planning and execution of the work of restoration of subsurface structures. This Bureau, consisting of some seventy men, is a part of the Engineering Department of the Public Service Commission. Its function is primarily that of recording the existing subsurface conditions when the streets are opened, preparing the necessary plans for the restoration of the structures disturbed, and supervising such resoration.

S. E. Corner Broadway and Pearl Streets, Empire City Pipe Ducts on Top.

The Plan of Attack

The preparation of these plans may be likened to the merry game of chess. Before us, as on a board, we have a certain section of street, filled with the various pipes, conduits, etc., of the public service companies. Each structure has its own moves. One may be moved in a certain direction, when it is found to be blocked by another. This one is then moved, and in turn may block, or may be blocked, by a third. And so on. Be it said to their credit, however, that the engineers on this work have never yet been checkmated.

Let us follow out the mode of procedure in a typical case. A section of street is opened. As soon as practicable, the field engineers of the Public Service Commission locate all the subsurface structures in the cut, and these locations are then platted up, and from the plan thus made is prepared a restoration drawing. Advance prints of this drawing are sent to the interested companies for their suggestion and criticism. They are given ten days in which to submit any changes they may wish made. If none are suggested, approved prints are issued, and the work proceeds. If changes are desired, within the legal responsibility of the Commission, the advanced prints are altered to conform to these changes, and approved prints are issued, as before. In the restoration of all structures distributed by the rapid transit operations, the law requires that the same service be provided for as originally existed. Then, too, the contract drawn by the Public Service Commission provides that the owners of the utilities may take advantage of the opportunities offered, to prepare for future needs by making enlargements of, and additions to, their present plant.

S. E. Corner Broadway and Houston Streets. Telephone Cables Exposed During Reconstruction of Manhole.

Protecting Exposed Cables

One of the most important phases of this work is the maintenance and protection of the exposed cables. When a street is being excavated, the car tracks, decking, and subsurface structures are all carried by timbering erected on the sides and bottom of the cut. This timbering is built to a prearranged plan, and this plan must be adhered to, in order to bring about the correct spacing in regard to the steelwork erected later. Consequently, the fact that in many instances a timber or bent will come right in the center of a manhole offers no alternative but that the manhole shall suffer. The ducts are generally protected by a wooden covering,

*The Empire City Subway Company constructs and maintains in the streets of Manhattan and the Bronx boroughs of New York City, subways and conduits for the reception of low-tension conductors of the New York Telephone Company and other companies having legal authority to operate their wires in the streets.

where possible. The design of the tunnel, and the elevation of the tunnel roof, are such that generally the greatest mass of timbering comes right among the cables, making the task of maintenance a very difficult one.

The Extent of the Work

During the construction of the old rapid transit system there were 7.8 miles of subway and 53.7 miles of cable exposed; and on the present work, to date there have been 20 miles of subway and approximately 205 miles of cable exposed and under inspection. One mile of this construction had been closed in prior to 1915, but during this entire year there were 21 miles of subway and approximately 196 miles of cable exposed, and consequently, under inspection, as well as 313 manholes. These figures are large, and bring before us most graphically the extent of this work. In the course of the year there were reported 1,229 cable damages on rapid transit, classified as follows: 777 in manholes, 16 at building entrances, 360 in boxed-in section, or where supported along the line of the work, and 76 in wrought iron pipe. Comparatively few of these damages were what might be called serious. There were during the year, three disasters along the line of rapid transit construction; namely, the fire at Seventh avenue and 43d street, and the cave-ins at Seventh avenue and 24th street, and Broadway and 38th street. The first was the most disastrous from the point of view of the telephone interests involved. At the same time, these accidents, while occuring on rapid transit work, and causing cable damages, should be differentiated from those arising directly from the subway construction operations, such as the puncturing of a wrought iron pipe and the inclosed cable, and minor damages to cables exposed in manholes and along the line of subway work.

The performance of this work of maintenance and restoration is in the hands of the rapid transit contractor. It is a part of his contract to take care of the existing structures in the street, and to restore them, upon the completion of the tunnel, to a condition which will permit of their giving the same service as originally. On the whole, there is a pretty thorough appreciation of the necessity of carefully guarding these interests, and a disposition on the part of the contractors to co-operate with us in maintaining service.

Co-operation with Other Companies

It being a part of the rapid transit contracts to make restoration of sub-surface structures, this is, of course, done at the expense of the contractor—provided, however, that the restoration is to include no additions to the existing plant. When it is deemed expedient to make such additions, to provide for future expansion, it must be at the owner's expense. It is frequently desired, for instance, to enlarge a manhole. This usually involves the relocation of one or more contiguous subsurface structures. At the same time, it might happen that the owners of these structures also wished to make a change at this particular location, in which event the situation would tend to become extremely involved, to say the least.

As mentioned before, the rapid transit routes are all along trunk lines of subways. The existing lines are heavy, and in planning for enlargements, the electrical companies generally provide, as far as possible, for their future needs. This is not only a far-sighted policy, but, under the circumstances, an absolute necessity. It is even difficult to get in, in many cases, while the rapid transit work in going on; but it would be practically impossible to come back later and try to enlarge some of the lines. Certain locations where this is manifest even to the layman will be described later on.

If the original layout of the subsurface structures had possessed any semblance of order, the problems presented now would not be so complicated. However, in common with those of other American cities, the streets of New York are filled with pipes laid in a most haphazard manner, and any scheme for restoration involves also the necessity of trying to bring order out of chaos.

Construction Materials

As in standard electrical subway construction, most of this work is built with vitrified clay conduit. However, a large amount of wrought iron pipe is also employed, its use being made necessary by reason of the following: In many instances the roof of the rapid transit tunnel is but five feet, or less, below the surface of the street. This forces the subway close to the surface, which location necessitates the use of iron pipe. Then again, the many tight situations encountered often cause the line to become a series of complicated bends, which cannot be made with clay conduit.

Time was when all bending of wrought iron pipe was performed by hand. Even before the advent of rapid transit work it was, of course, occasionally necessary to install iron pipe in curves, which were laboriously made by manual labor, a very lengthy and expensive process. For the last three years, however, the majority of pipe-bending jobs have been performed with the aid of a hydraulic pipe-bending machine. With this machine it has been possible to make some complicated bends. For instance, there are examples of both a horizontal and a vertical bend in one twelve-foot length of pipe, and a reverse curve is not at all uncommon.

(*To be continued in November*)

S. E. Corner Broadway and Canal Streets. 24-duct subway above; 16-duct below.

S. W. Corner Lexington Avenue and 76th Street. Showing a Bend in a 36-duct run.

Obtaining a Patent

By Bayard H. Christy

In the second article of his series on Patents, Mr. Chrisy tells who may apply for a patent, the relation of the patentee with his attorney, and the cost of obtaining a patent.

Under the law, the inventor, and the inventor only, may obtain a patent.

The invention may be the product of two minds working together; that is to say, a joint invention. It does not follow, however, that, because two or more men work together in development of a machine or process in which invention resides, they are joint inventors: joint workmen are not necessarily joint inventors. One man may make an invention and may employ another to take his idea and put it in physical form, and if the man employed merely follows instructions and uses the common knowledge of the particular industry, he is not a joint inventor. Two men may work together on a machine and, while both lend their hands, one only may lend his brains in a creative way, and in that case one is the sole inventor.

Doubtless many patents are wrongly applied for; it not infrequently happens that, through ignorance or carelessness, one man applies for a patent on an invention really made by another; one applicant seeks the invention really made by two; or two seek a patent for the invention of one. This happens, and in some cases the mistake is never recognized, and never becomes a matter of practical consequence. But, on the other hand, patents are often defeated because sought for and obtained by others, not the real inventors. If one man alone is inventor, and a patent is granted on a joint application made by him and another, the patent is liable to defeat. There is need then for care at the very outset: the inventor, and the inventor only, should apply. And, in case of doubt and uncertainty regarding inventorship, an attorney should be consulted.

What the Law Provides

The law provides that, "Before an inventor or discoverer shall receive a patent for his invention or discovery, he shall make application therefor, in writing, to the Commissioner of Patents, and shall file in the Patent Office a written description of the same, and of the manner and process of making, constructing, compounding, and using it, in such full, clear, concise, and exact terms as to enable any person skilled in the art or science to which it appertains, or with which it is most nearly connected, to make, construct, compound, and use the same; and in case of a machine, he shall explain the principle thereof, and the best mode in which he has contemplated applying that principle, so as to distinguish it from other inventions; and he shall particularly point out and distinctly claim the part, improvement, or combination which he claims as his invention or discovery. The specification and claims shall be signed by the inventor and attested by two witnesses."

The Patent Office publishes and furnishes Rules of Practice, governing the preparing, filing, and prosecuting applications for patents.

There is nothing in the law to forbid one who wishes to do so to prepare, file, and prosecute his own application. But, unless the inventor has given study to patent law and understands both its principles and the modes of procedure, he will do well to put his invention in the hands of a patent attorney on whom he can rely, and leave it to the attorney (whose business it is), under proper advice and with full discussion and explanation, to prepare and prosecute his application for him.

The essential thing is that he give his attorney full information. The attorney should understand the invention in every detail. This understanding may be given in personal interview; it may be given by having the attorney go to the mill or shop where the invention is being practiced and seeing it operate; information may be given by drawing, by model, by showing the thing itself. But, however accomplished, this explanation to the attorney must be full and exact. Nothing may be held back, nothing left unexplained.

Choosing an Attorney

And here a word may be said about attorneys. Everyone knows that there are in all the professions sharp practitioners, persons whose first aim is not to do a good piece of work but to get money for poor work, and in every relation of professional confidence there is opportunity for the crafty or dishonest man to take advantage. Generally speaking, attorneys who resort to tricks of advertising are to be shunned —the "no patent no pay" men, those who advertise lists of desirable subjects for invention, and such like. And generally speaking, those who lay stress on the fact that they "do it cheap" are to be avoided. Another point: It is well to avoid the attorney who requires his client to sign a contract with him in advance. If a man doesn't already know an attorney in whom he can place confidence, he will do well to go to some man in whom he has confidence and who is acquainted in such matters and ask him where to go.

When the attorney has been selected and the invention has been explained, the attorney has several questions to consider. The first is, whether the supposed invention is in its nature a patentable invention. In an earlier paper it was explained that not every invention is patentable. Newton discovered the laws of gravitation, but he could not get a patent for them; Hertz discovered those electrical phenomena which bear his name, but they were not patentable to him. He could only patent the means by which, the method in which, he made them available in "the useful arts." So the patent lawyer's first question, when a supposed invention is laid before him, is, Is it in its nature patentable?

Is the Invention New?

The second question is, Is it new? Attorneys of experience gain a great deal of knowledge of particular lines of industry, and it not infrequently happens that on being consulted an attorney is able to speak out of his own knowledge and experience, and say that the thing explained to him is not new.

Again, it is not infrequently the case that a man who is following inquiry in a particular field of the useful arts desires to know what others have done in the same field. He may then go to his attorney, tell him what he is at work on and say that he wishes advice as to what others have done in the same field.

In the United States Patent Office all the patents which have been granted—more than a million of them—are classified according to subject-matter, and arranged where they are available for examination and study. These are United States patents, only. There are, besides, in the Patent Office, ways available for investigating in particular cases foreign patents and technical liturature on the subject in hand. A man then may instruct his attorney to search for him and select and submit to him copies of such patents previously granted to others as may bear most closely on his work. He may desire these for a two-fold reason: to test the novelty of his own ideas, and also (with the assistance of his attorney) to learn whether he in following his contemplated course will be infringing existing patents already granted to others.

(*Continued on page 51*)

America's Electrical Week

Mr. Gerard Swope

There is not an electrical man in the country who does not know something of the aims of "America's Electrical Week." In all the cities there are local committees who are hard at work on plans to make the week even more successful than was its predecessor. The smaller places, too, have their share in the bigger business which publicity will bring, provided the local men do their part in bringing home to their fellow-townsmen the advantages of electricity. A special message to contractors and dealers outside the large centers has been sent by Mr. Gerard Swope, Vice-President of the Western Electric Company and Chairman of the America's Electrical Week Executive Committee. To an "Electrical Age" representative Mr. Swope said:

"'America's Electrical Week' is a period when all the agencies furthering the use of electrical devices unite together to show to the public what has been accomplished and what convenient devices can be operated by electricity, with which many people are not yet acquainted.

"The manufacturers who make the apparatus, the jobbers and distributors who sell the apparatus, the contractors who install the apparatus, and the central stations who furnish the current operate the apparatus are all united in this effort. All of them, whether large or small, have an interest in the success of this work.

"New electrical devices are being brought out every day, and it is difficult, except through such a co-operative movement, to keep the public adequately informed. The dealers and contractors in the smaller cities, as well as the central station, and as well also as the dealers, contractors and central stations in the larger cities, will feel the stimulating effect.

"The society for uniting the efforts of these four agencies referred to above is the Society for Electrical Development, which conducted a similar week last year, and which will conduct again during the week of December 2nd to 9th, 'America's Electrical Week."

"The broad publicity campaign will reach the remotest village; newspapers will have special articles; Collier's, Scientific American, Scribner's and Leslie's Weekly will issue special numbers. All these will start people thinking and talking about the part that electricity is playing in everyday life and may be made to play in theirs. This is going to be of real service to the dealer and contractor who makes himself part of this movement, contributes his thought and his effort to it, and then gets some of the resulting advantages which are bound to accrue.

"The Society for Electrical Development has prepared quite an elaborate series of helps, much of which is free to non-members as well as members. These give plans which have been tested and found to be good and which will work, provided there is someone back of them to make them go.

"In a time like this when everyone is busy, especially the contractors in small places, it is difficult sometimes for them to see why they should make an effort to stimulate the further use of electrical devices when they have all they can do to-day, but in a business such as this, one cannot be satisfied only with the efforts of to-day, but must build for the future. This is a broader view, too, which has done a great deal for central stations, and which will do as much for the contractors, and that is, service to the community; and there can be no truer service than to make the members of the community aware of the benefits that electrical devices can play in their lives, in making their work less arduous, more convenient and more efficient; and it must follow that the community will reward those who serve it."

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The keynote of the campaign is best set out in a booklet just issued by the Society of Electrical Development, entitled, "How to Plan your Work and then Work Your Plan." The booklet says:

Broadly speaking it is your duty as a committeeman to provide ways and means for demonstrating in your community:

—that electricity, the all-pervading force of the universe, is the greatest, most willing and most reliable servant in the world.

—that through electricity, homes where drudgery now exists may be made cleaner, brighter, healthier.

—that electricity is a necessity, not a luxury; is economical, not expensive; is simple not complex; is safe, not dangerous; and is useful every day in the year.

—whatever electricity does, it does safely, silently, cleanly, speedily, thoroughly.

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Some of the America's Electrical Week activities reported to The Society for Electrical Development for the current week follow:

Lexington, Ky.

The Electric Transmission Company of Virginia co-operating with the local committee plans to flood light all public buildings in Lexington, to provide illustrated lectures to the school children, fix discounts on housewiring done during the week, and upon appliances bought during the week, to conduct electrical pages and to arrange a city wide celebration in co-operation with the Commercial Club.

Syracuse, N. Y.

The feature of the America's Electrical Week celebration this year will be an illuminated parade of electric pleasure and business vehicles including several new tractors used in rural communities about the city. It is probable that last year's electrical show will be repeated with electric devices used on the farm as a feature.

M. O. Dell Plain announces that the civic organizations which promoted the Noc-No-Mor and Sac-Bust'r celebrations will co-operate with the local committee in special street illuminations and decorations of Syracuse's new lighted shopping center.

Louisville, Ky.

Electric exposition in the armory, which is the second largest in the United States. Appropriation of $2,000 for high-class entertainment during the week's show. Show managers plan to run feature days and feature nights, thus bringing into the celebration all of Louisville's mercantile and industrial interests.

The Federal Sign Co. and the Thomas Cusack Co. with ten of the livest electrical dealers and contractors of Louisville have undertaken a campaign to induce Louisville merchants to use decorative lighting, the idea being to make these displays prominent. Contests and campaigns are designed to stimulate a house-wiring campaign which has been in progress more than two years.

(*Continued on page 52*)

EDITORIAL

America's Electrical Week

Elsewhere in this issue we publish brief news items from committees in charge of local celebrations of America's Electrical Week. So thoroughly are the leaders of the industry convinced of the benefits they will reap from this widespread publicity that they are now hard at work on the preliminaries which will make the week's events run off smoothly. But these committees are in the larger communities; what of the smaller towns up to, say, 10,000 population?

As Mr. Swope points out, the campaign in the national publications will reach people outside the cities as well as in. But useful as national advertising is, it lacks the vividness of an appeal made by someone whom one knows, whose store one passes every day. It impresses the reader with the national scope of the A. E. W. movement, but that impression, not backed up by local publicity, is likely to convey also the idea that the electrical way may be less suited for the small townsman than for his city brother. It is strictly up to the home contractor and dealer to show their customers how electricity will help in the daily home tasks.

There is no class of electrical men who do less general sales promotion work than the two we have mentioned. The reasons for this are two—lack of imagination, and lack of time. Practical men are accustomed to handling practical problems of which the elements are physical quantities, or the articles themselves. When it comes to planning a demonstration which will appeal to the public, those in charge must know how to attract and hold interest, how to "get their message across"—feats at which even the cleverest men sometimes fail. Yet the problem of reaching the people of a small town is by no means difficult of solution. As there are few distractions, an audience is not difficult to get, especially if the sponsorship of some well-known church or charitable organizations backs up an electrical show given for its benefit. One of the publications of the Society for Electrical Development instances a show given in an empty store-room at a cash outlay of $50 which resulted in more than $300 worth of sales. Careful study of this and other booklets which will be furnished free on application will supply ideas which can be elaborated in conference with newspaper men, leading merchants, and central-station representatives. The idea to keep in the foreground is that all is being done to help the community by means of improved (electrical) methods; then the project has a dignity above that of a mere sales campaign for electrical goods.

Lack of time on the part of electrical men is a handicap which must be overcome also. Sometimes this is a mere excuse, but too often it is quite real, and is a symptom of one of the most common ills of the trade. Nine times out of ten when an electrical man pleads "too busy" it means that he is rushed to death doing actual wiring and installation. We need not dwell on the evil of this situation, in which the head of a business is occupying himself so much with purely mechanical labor that he has no opportunity to plan ahead. In the case of America's Electrical Week we strongly urge all such men to delegate as much responsibility as possible to their men and let go everything possible in order to contribute somewhat of their time and energy to the campaign. As Mr. Swope points out, this will lay up a store of good will and prestige which will be valuable for all time.

* * *

Training for Leadership

It is one of the curious anomalies of industrial life that as soon as a man enters an organization his formal training for advancement ceases. Every worker has had the advantage of school training in some degree, but whether this has ended at the age of sixteen or of twenty-six, he is usually done with instruction when the school doors close behind him. There are, to be sure, night and continuation schools in some cases run by the employer. All of these, however, teach men that formal book-knowledge which though desirable is far from sufficient. It is in the broader field of human relationships that success is won or lost.

"The proper study of mankind is Man," and nowhere is this more true than in modern industry, where the interrelations between man and man are intricate. The necessity for co-operation has developed a human machine more delicate and complex than any product of the inventor's brain. Even a small organization will require much tact, judgment, and firmness to keep things moving smoothly. Yet only in rare cases is formal training given to its members in the methods of management. It is left to each employee to pick up as best he can the rules of the game and show in his daily work the ability to handle larger units.

The evils of this most unsystematic "system" are often evident. While men of exceptional ability come to the front, the powers of less capable men, being undiscovered, remain undeveloped and unused. For every $10,000 man, there are a score of others who with proper training could fill ably those jobs a little above the rank and file which are the constant worry of the executive. To be sure he can get someone to sit at the desk and draw the salary, but he never knows when

some bit of "big-head" insolence, some "morning after" grouch may set the whole section on edge. Nervous, harassed employees are capable of any mistake whose consequences may be most serious.

A second bad but to be expected result hampers the growth of the organization. Vacancies occur continually and often unexpectedly. If no one has been trained in readiness, the position must be filled by an untried man under just the circumstances of unfamiliarity, half-suspicion by subordinates and, more than likely, a heavy overload, which would try a seasoned veteran to the breaking-point. The man higher up has before him the alternative of taking this risk or adding the responsibility to his own burden. Hence opportunities for excursions into new business fields, of accepting chance-brought contracts, of enlarging facilities at an opportune moment, are passed by because there is no one available with knowledge of the organization and its methods to take the responsibility of seeing the project through.

As far as the organization is concerned, failure to train for leadership is one of the most serious but least suspected causes of the present industrial unrest. A generation ago, men were willing to endure hardships, to work at monotonous tasks, for the hope of independence ahead. Nowadays workers realizing that they must remain employees all their lives, are determined to make their lot as happy as possible by wresting every concession from their employers. With their underlying sentiments we are in hearty accord. Employers must realize that modern industrial methods have deprived workers of much of the individuality which is so precious to all mankind. As compensation the industry should (as its increased efficiency can well afford), pay the employees enough and give them hours short enough to allow them to live their real lives outside the factory walls.

But higher pay and shorter hours are not all. Which of us can forget the thrill with which we issued our first order to our first "gang?" or that more sober joy with which we watched the wheels of our little organization turning smoothly? There is a pleasure and a satisfaction in leadership which is the greatest reward to the true leader, and to which few fail to respond. Napoleon explained the prowess of his army by saying that each man carried in his knapsack a marshal's baton. Of course they knew that most of them could never reach that eminence, but they also knew that each man could certainly reach whatever post he was fitted for and that his superiors were always "trying him out" for advancement. In the same way the executive who realizes this fundamental of human nature will make it clear to even the humblest workman that the road to promotion is always open, that certain personal and intellectual qualities are necessary, and that it is well to be prepared for the try-out in a higher position which will surely come.

As to the actual machinery which applies such a scheme, we cannot go into detail here. By one system each man considers himself to act in three capacities: To fill his own job, to train the man below to fill it; and to learn the duties of the man above. By another, men are shifted into other jobs temporarily during vacation- or sickness-leave of the regular incumbent. We hope to present some information in a future issue on this subject, which will give details of some actual plans. It has been well said that the executive must be first of all, a teacher of men. He must teach them to do their own work better, to do new kinds of work, to fulfil the duties of a more advanced position. Breadth of vision, cool judgment, leisure to think and plan are essential. No less desirable are these qualities to his subordinate, who must train the man under them. The wise executive will develop the first, train the second, and plan for the third, nor will he allow mistaken consideration for the self-conceit of an associate to check the tactful words of personal counsel which often may prevent serious error.

On Page 45 of this issue is a new section, "Short Cuts and Minor Methods," which is intended as a bulletin of ways our readers have found for solving construction problems. We hope that anyone who has hit upon a method which has saved him time or made him money will share it with his fellow readers. There is money in a new idea; read the first contributions over and see what you can tell "the boys" in November.

The Trouble Man

Where danger lurks on the high flung wire
Man's harried care to bilk.
Where the copper spills its spiteful fire
With a sound like tearing silk,
When night is wild with its whipping rain
And loud with thunder roll,
While his weight bears down on his spur points slim
A-top the trembling pole.

Since man asks light with his bed and board
And twists a key thereat,
Since power must answer its constant lord
At the arm of a rheostat,
On a motor-cycle across each night,
Spring soft or winter keen,
By the still ranked windows that careless sleep
He must ride the press of his need to keep
His lines and record clean.

He serves as the blithe old knights and true
Served boldly in their pride;
When the call comes in for hands to do
It is his to mount and ride;
It is his to mount to the cross-arms high
Through moonlight pale, or murk;
And he does not boast that his task comes first
But he flaunts in the ruck of best and worst
The gage of Daily Work!

—*Charles Campbell Jones.*

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Automobile Lamps and Lighting

By A. R. Dennington

THE electrically equipped automobile has come to be the regular product and it is only the exceptional machine that does not have auxiliary devices for starting, lighting and charging the battery, which is the heart of all systems. Though the use of electric lighting is practically universal, it is not unusual to find that the lamps are being wrongly used or that they are not giving as good effects as might be attained by devoting a small amount of attention to adjusting them correctly.

Lamps for Electrically-Propelled Vehicles

Automobile lamps are made for four distinct battery systems. One of these systems is included in general by the electrically propelled vehicles and is entirely apart from the other three, which are used on cars driven by internal combustion motors. Lamps for use on electric automobiles range from about 25 to 90 volts and have the general construction which characterizes large lamps for multiple circuits. The length of filament is great, hence it is coiled and mounted in a series of loops placed as closely together as practicable. Lamps of the type mentioned can be used in parabolic reflections with very good results, but the area of the light source is larger than in lamps of lower voltage, thus causing the beam of light to spread more than is desirable. If the beam from a parabolic reflector spreads so that the rays reach the eyes of those in front of the machine, it produces the effect known as glare and does not meet the requirements of the anti-glare laws which have been passed in many States. The redeeming features of the situation are that these electric vehicle lamps cannot be made at the high intrinsic brilliancies which characterize the low volt head lamps and that electric vehicles ordinarly use decorative lanterns in place of parabolic reflectors when being operated in congested districts.

Lighting Conditions of Gasoline Cars

Automobiles driven by internal combustion engines and using a battery to supply electrical energy only for starting, lighting and perhaps ignition, require lamps rated at six to eight volts, 12 to 16 volts, or 18 to 24 volts. The lamps which are made for the six to eight volt group are more rugged than the others and have the filament more closely concentrated. The greater number of starting and lighting systems use either a three-cell battery or a six-cell battery. In both cases the battery floats on the line and is charged by a dynamo while the car is running. The six-cell system in general has the battery divided into two groups of three cells, each group connected in parallel to the lighting circuit and charging dynamo. The cells are connected in series only when operating the starting motor and hence the lamps and lighting are the same as for a three-cell system.

Some starting systems require nine or twelve storage cells for their operation. The twelve-cell systems are connected so that the lighting circuit is supplied from the two halves of the battery in parallel, thus calling for lamps rated at 12 to 16 volts, while the nine-cell system requires lamps designed for 18 to 24 volts. Lamps for use on a circuit supplied from six storage cells in series may be made up without a supporting anchor for the filament. Longer filaments must be mounted with one or more anchors. These higher voltage lamps cannot be focused as accurately as those of the six to eight volt group, because of the greater length of the coil. The filaments which give the best results in a parabolic reflector are arranged in a narrow V or, for lamps of less than six volts, in a short spiral along the axis of the lamp. By keeping the filament within a space of one-eighth inch each way a strong well defined beam of light can be produced. With a light source of comparatively large area the beam spreads because only one point of the source it at the focal point of the parabolic. All elements of the filament not at the focal point cause either converging or diverging rays from the reflector. The converging rays cross a short distance in front of the headlight and then become divergent. In both cases, therefore, the area of the light source determines the spread of the beam of a carefully focused lamp. If ordinary care is not used in focusing it is possible to get better results with a lamp having a large space occupied by filament, as some point of the source will then probably come at the focal point.

Good Driving Light Without Glare

Much has been said during the past year about the danger and annoyance caused by glaring headlights on automobiles. Laws have been enacter in a number of States covering this subject, much to the mystification both of police and car owners. To add to the confusion the market has been flooded with various devices, each guaranteed to give perfect driving light and eliminate the glare. The agitation seems to have reached everybody concerned except the majority of automobile manufacturers, who apparently feel that the problem does not in any way belong to them.

The essential conditions for obtaining a good driving light and reducing to a minimum the glare which blinds the other fellow are as follows. (a) Tilt the headlights slightly downward so that when the car is standing on the level the center of the beam strikes the roadway 75 to 100 feet ahead. Car manufactures can be of great help in the campaign for reducing glare by making this adjustment when the car is being assembled. (b) Frost or lacquer the lamp bulbs from the tip back to within about 5/8 inch of the base. (c) Carefully adjust the lamp to make the beam of light as narrow as possible. If these conditions are complied with, the result will be a strong beam of high intensity directed onto the roadway at the point where the driver needs most light. As the beam is directed slightly downward the intense rays will be below the eye level of pedestrians and drivers of approaching cars who will not be annoyed or blinded. Since the front part of the lamp bulb is frosted or coated the direct rays of light from the filament cannot reach the eyes of those ahead of the car and, in addition, a well diffus-

ed light near the front of the car is obtained, which illuminates the sides and the roadway, so that objects once discerned by the aid of the powerful beam are not lost sight of as the car approaches. It must be kept in mind, however, that the correct focusing of the lamp is an essential element in getting good results.

Devices for Preventing Glare

Some devices for eliminating glare either diffuse or entirely cut off the light from one-half of the parabolic reflector. Usually a metal clip or a specially frosted bulb is used to keep the direct rays from the filament away from the lower part of the reflector. In this case only the upper half of the reflector produces the driving beam and this may or may not cause glare, depending upon how the lamp is focused. If the filament is placed slightly ahead of the focal point the rays reflected from the upper part of the parabola will be directed downward and the beam will strike the ground at some distance ahead of the car. However, if the filament is placed slightly back of the focal point the beam reflected from the upper part of the parabola will be directed upward and the result is as bad, or worse, than if no attempt had been made to reduce the glare. If the filament is behind the focal point then the lower half of the reflector must be used to direct the beam downward.

Prismatic glasses are used to reduce the glare and they are fairly effective. The principal defect seems to be too great a reduction in the intensity of the beam. No device which has yet been developed can prevent the beam of light rising into the air when the car is just coming over the brow of a hill. Also, in turning corners the beam sweeps around, giving light on the surrounding scenery instead of ahead of the wheels, where it is needed. Each driver should realize that under some conditions of roadway and traffic the intense light from his headlamps may annoy and disconcert another driver or a pedestrian and hence he should be as glad to offer as to receive the courtesy of dimmed lights.

Manhole Covers for Power Houses

By M. M. Samuels

It is often necessary to install manholes in conduit runs of power house, either to facilitate pulling or to allow for splicing or interchanging of cables. These manholes are altogether different in their character from street manholes and it will hardly be possible to use a standard street manhole cover or frame. A power house manhole will as a rule not be very deep, especially in hydroelectric stations where it is necessary to reduce the depth of conduit below the floor as much as possible, since every inch of depth taken up by conduits will cause the lowering of hydraulic apparatus and an added amount of expensive concrete construction.

The type of manhole cover generally used in recent years is shown in Fig. 4. An angle frame is set in the concrete and held

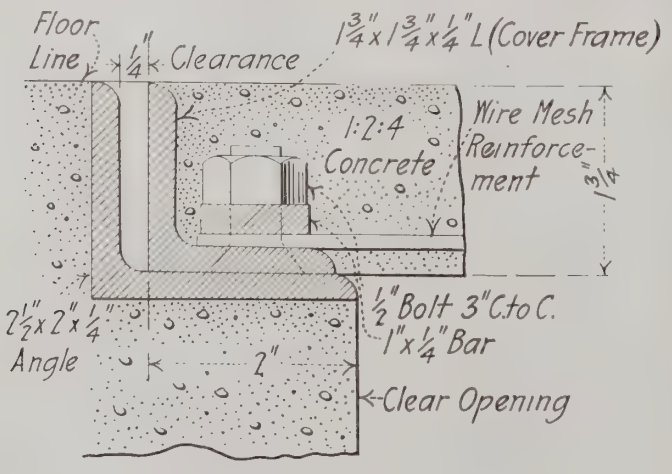


Fig. 1.- Detail of Cover and Curb Angle

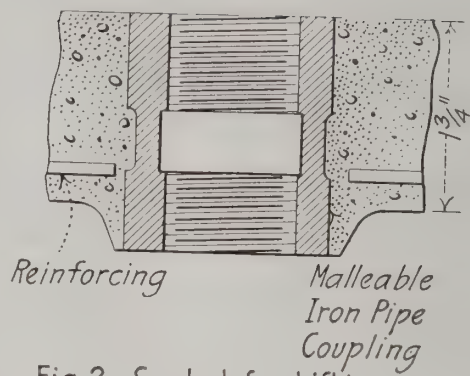


Fig. 2.- Socket for Lifting Cover

by means of a chor bolts. A strap-iron having the same thickness as the cover plate is rivetted to the curb angle to prevent chipping out the concrete edges when placing or removing the cover which generally consists of a 3/8 inch or 1/2 inch standard checkered steel plate.

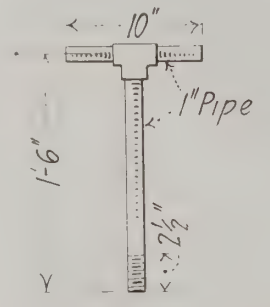


Fig. 3.- Handle for Lifting Cover

This construction is satisfactory when there are only one or two manholes in the floor, or when the covers are not exposed to view. However, when it becomes necessary to install a great number of manholes, steel covers will give the whole power house a very bad appearance, and in recent years engineers are devoting more and more attention to appearance in power house construction. In such cases concrete manhole covers will be used, such as shown in Fig. 1. A curb angle is set in the concrete with the opening facing upwards, and no anchor bolts are needed. The depth required by this angle is not more and in most cases will be less than the depth required by the curb angle for a steel cover. The cover itself is made up of a square angle iron frame which can be rivetted together in the shop and shipped completed. A sheet of wire mesh reinforcing is bolted or rivetted to the angle by means of a strap-iron, and a suitable mixture of concrete is then poured into the frame and finished according to requirements of the floor finish. Two pipe couplings are inserted in the cover as shown in Fig. 2 by means of

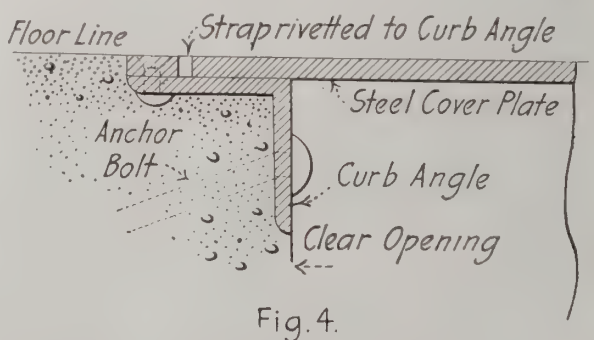


Fig. 4.

which the cover can be lifted with handles made up of standard pipe, such as shown in Fig. 3

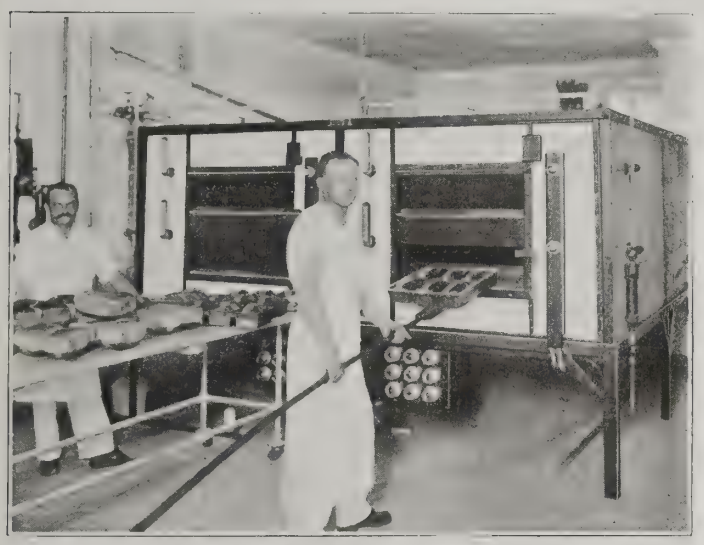
For large areas the cover should be made in sections, the limiting features being the weight. No cover should weigh more than 150-200 lbs.

Covers such as shown here were used by the J. G. White Engineering Corporation in the Ocoee Power House described in the August issue of this magazine.

World's Largest Electric Bake Oven

So far as is known, the first brand of bread to be put on the market which will be extensively advertised as being baked electrically, has made its appearance in Salt Lake City. The New Vienna Baking Company of that city announced this new product during the recent convention of the National Association of Master Bakers in session in the Utah city. The company does an exclusive wholesale business, its entire product being sold through retail dealers.

Full-page advertisements in the Salt Lake City papers, while the baker's convention was in session attracted much attention, and practically every baker in attendance at one time or another, visited this new installation. The owners have a thoroughly modern bakery throughout, including individually motor driven mixers, dividers, rounders and electrically heated wrapping and sealing machines. When the new "Butter-Krust" bread was announced during convention week, it sprang into instant popularity. The day following the publication of a full page advertisement which appeared in the Salt Lake papers, the demand for Butter-Krust bread increased from 10,000 to 18,000 loaves in one day.



The Oven in Action.

Dimensions of the Oven

The electric oven used is one of the largest ever installed, and is the Hughes standard type No. 415. The main body of the oven measures 4 ft. high, 10 ft. wide and 12 ft. deep It rests on an angle-iron frame 27 in. high. It is divided into four chambers each 56 in. by 34 in., by 16 in. high, which provides a baking surface of 208 sq. ft. The oven has a capacity of 836 12-oz. loaves or 456 25-oz. loaves of bread. The oven is divided in the center by a partition with two baking compartments on each side, one above the other. All compartments have 1¾-in. tile floors. The customary steam connection is provided for each. Each half of the oven has three heating units: One in the top of the upper compartment, one in the top of the lower compartment, and one directly under the floor of the bottom compartment. With this arrangement, heat is provided for the top and bottom of each baking chamber. Each compartment has a mercury thermometer and inside lights.

Electrical Characteristics

The heating units are made up of resistance wire wound on insulated rods. These rods are mounted in an angle-iron frame, which may be slipped in and out of the oven for inspection and repairs. Each unit is divided into three sections, and each section has three heats controlled by "three-heat" switches which are located near the center of the oven in front and within easy reach of the operator.

The oven is wired for 220-volt, two-phase, service. It takes a maximum of 75 k.w., and averages 48 per cent. of this demand baking sixteen hours per day and 55 per cent. on eight hours' baking per day. When making ¾-lb. loaves, it requires forty-five minutes to load the oven, bake the bread and take out the finished product. On this schedule 25,000 ¾-lb. loaves could be baked in twenty-four hours' continuous baking.

Advantages of Electrical Heat

A talk with the manager and with the head baker brought out the fact that both are very enthusiastic over electric baking. While they state that the bare cost for electricity is some higher than the cost of coal, they point out that when one considers the many advantages of the electric oven, not the least of which is the entire absence of the dirt, dust and smoke which inevitably go with the old brick oven, and the saving in space, the higher cost for fuel is much more than offset.

Some of the following points in favor of electric baking are familiar to electrical-cooking "fans," but they are none the less worth emphasizing:

Simplicity of operation: By turning the switch the desired heat is quickly obtained. No fuel to buy, store nor bother with. No ashes to be continually taken out. No keeping the fire "going" all night for early morning baking.

Ease of control: The entire oven is under absolute control at all times through the medium of its three-heat switches. A baking temperature is reached within a very short time. Any desired temperature is quickly obtained by the proper operation of the switch. This feature helps greatly in securing satisfactory results.

Perfect heat distribution: The heat comes from coils of resistance wire wound on asbestos tubes which are mounted between the decks. The front part of the oven is just a little hotter than the back part, to allow for loss of heat when doors are opened. Also, the elements are graduated as to heat production, the lower element being the hottest. This allows for the gradual rise of heat to the top of the oven. Thus the distribution is virtually perfect.

Better results in baking: Because electric heat is always constant and uniform and its application in the electric oven is just where it is needed, more healthful and more evenly browned bread, cakes and pastries, etc., are invariably the result. Moreover, the food is not contaminated by the dirt and poisonous fumes, and bread especially, retains more moisture than when baked in a brick oven—therefore keeping its freshness longer.

Utilization of all heat generated: The electricity never need be on—and burning up money—except when the oven is being used. Very little heat escapes from an electric oven because the walls are heavily insulated. Virtually every unit of heat generated and paid for is used.

Cleanliness and sanitation: Electric heat gives off no poisonous gases to contaminate the food. There is no dust and dirt which is always found in brick ovens. There are no coal nor coke boxes near; no fires to attend—all of which makes for the most sanitary conditions.

Great saving in floor space; and new building costs: The electric oven occupies approximately one-fourth to one-half as much space as the ordinary brick ovens. Furthermore, no large space in front of the oven is necessary for the manipulation of the peel. The floor space of coal and coke storage bins is also eliminated. Owing to the light weight of the electric oven, no special construction is necessary when building a new bakery.

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For the purpose of enlarging the municipal plant at Cleveland, Ohio, to furnish power to the Cleveland Railway Company, a bond issue of $1,750,000 will be submitted to the voters at the Fall elections.

Delivery of Shop Mail by Electric Trucks

Throughout the East Pittsburgh Works of the Westinghouse Electric & Mfg. Co., interdepartment mail is now delivered and collected by means of electric trucks. As will be seen from the illustration, the superstructure of the truck is divided into pockets similar to those used on railway postal cars, the chassis being of a standard type. While much of the mail was handled by pneumatic tubes, the more bulky pieces were carried by messengers to a central point from whense they were distributed. By means of these trucks it is possible to deliver much of the mail picked up without carrying it to the mail room, making a

Rear View of Truck

saving in time of 50 per cent. The arrangement of the works is particularly adapted to this service, as there are in general but two levels and practically the whole area is under one roof.

At the present time the mail trucks are averaging six trips per day and the time for covering each route varies from 60 to 95 minutes, depending upon the condition of the aisles and the amount of mail handled.

Each truck carries a total of 80 compartments the size of which are 3½ inches wide, 10 inches high and 12 inches deep, and also a shelf on the front about 18 inches deep and 24 inches wide which is used as a sorting table. Mail is sorted while in transit and delivered direct to each department instead of returning to one central sorting point as heretofore.

Adjustable wooden labels are added to the compartments which are alphabetically arranged and changes in the same may easily be made. Compartments are open at both ends and a screen door having large wire mesh and spring hinges is attached to the outside of the compartment to prevent mail from being lost.

Each truck has a driver and clerk both of whom assist in the handling of mail so as to reduce the time for covering the route to a minimum.

Locomotives for Hoosac Tunnel

The Hoosac tunnel of the Boston & Maine Railroad is the largest electrified tunnel in America. The work of digging the tunnel was started in 1851 and completed in time for the first steam train to pass through on February 9, 1875. It is 25,081 feet long and is double tracked throughout. Until its electrification in 1911 it was always an obstructing feature to the traffic of this railroad. Under steam operation the entire tunnel was a block, only one train at a time being allowed to pass through. Under electric operation several trains are permitted in the tunnel.. The electrification, which is of the Westinghouse single phase system, has been entirely successful in operation, proven by the ease with which the heavy freight traffic of the road has been handled. Freight trains are no longer packed three or four deep at each portal waiting for a chance to get through.

The Tunnel Portal

As many as 77 trains a day pass through the tunnel and regularly 71 trains pass through every 24 hours. Of these about 17 are passenger trains, the remainder freight. Up to the present time the entire traffic through this tunnel has been handled by five Baldwin-Westinghouse, 130-ton, 11,000 volts, single phase electric locomotives. Traffic, however, has been increased to such an extent that it has become necessary to supplement the present equipment. Due to the great success achieved by the electric locomotives already in service the Boston & Maine have placed an order with the Westinghouse Electric & Mfg. Company of East Pittsburg, Pa., for two additional 130-ton Baldwin-Westinghouse electric locomotives similar to the five now operating, of which the one illustrated is typical.

The locomotives have but one cab, with two articulated trucks, each truck consisting of two pairs of 63-inch drivers and a pair of pony wheels 442 inches in diameter. Each locomotive has four, 375 horsepower, Westinghouse, single phase motors of the series commutating type, with short circuiting auxiliary field windings. The gears on the locomotives are of the flexible type, which minimize vibration and prevent any strains or shocks on the teeth of the gears, also aiding the motors to start under very heavy loads.

In electrifying this system the crossing of the 600-volt lines of the city railway by the 11,000-volt single catenary construction of the Boston & Maine was accomplished. This was one of the many interesting engineering features encountered in the installation of the overhead construction, all of which was furnished by the Westinghouse Company.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

The Testing of Switchboard Ammeters

By H. A. Cozzens, Jr.

When an individual generating station was operated as a single unit, the switchboard operator knew approximately the load carried on each feeder. Where this condition prevailed, the ammeters served the purpose of but indicating the presence of the load on the circuit. Little or no attention was paid to the magnitude of the deflection and as a consequence not much attention was paid to maintaining accuracy.

With the advent of the load dispatching system in connection with the parallel operation of generating stations, the need of accurate ammeters with which to determine load conditions is readily apparent. This condition has brought about the periodic testing of ammeters and in large companies much stress is laid on the importance of this class of work.

The accuracy which can be expected of the indicating instrument is not as great as that which is demanded of an integrating meter. Experience has revealed that the average operator rarely reads between the scale divisions particularly on the feeder ammeters. On the other hand the ammeters located on the important transmission lines and on the generators should receive some attention and should possess a high commercial accuracy.

DATE:
STATION
ALTERNATING CURRENT AMMETER

Serial No. Type. Form.
Manufacturer Scale Range
Current Transformer Ratio Panel No.
ON CIRCUIT:

Standard As Read	Standard Corrected	True Amps.	Switchboard Meter Reading	Error	% Accuracy.

Cover Removed.
Meter Cleaned.
Meter Adjusted.
Remarks as to Condition.

Fig. 1. Form of Test Sheet.

In the large operating companies, the work of maintaining the accuracy of indicating instruments on the switchboards is usually placed in the hands of a testing department supported by the company. The work naturally falls into two classes, periodic or routine inspection of the instruments and special work done when complaints are received that the instrument is out of order.

The first class or routine work is done by two men who are travelling from station to station. This work must of necessity be done quite rapidly so that the work has been highly systematized and is done at a low cost per instrument. The men are equipped with tools adapted for instrument repairs and carry spare parts for all types of instruments. These supplies together with the standard instruments against which the switchboard instruments are calibrated, are packed in special felt lined trunks so as to be easily transported by express or automobile. In case an instrument is in need of extensive repairs, the routine testers merely replace it with another from stock and the defective instrument is returned to the shop for repairs.

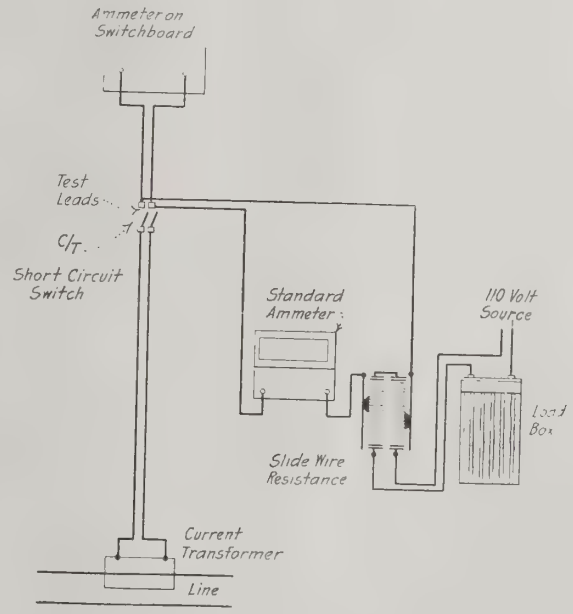

Fig. 2. Test Connections for a. c. Instruments

The men who answer the complaint calls can, usually by means of office records, determine the type of instrument and need only carry such tools as will be necessary for repairs to such types. This greatly reduces the amount of equipment to be carried.

The question often arises as to the feasibility of permitting station electricians and operators to do the testing and repairing of instruments. The advantages of such practice are that the

work would be promptly attended to and at a low cost since there would be no transportation charges. On the other hand the work when done by a laboratory or testing department is done by trained specialists who are men who have served in instrment factories. It is an advantage to have the standard instruments located in one department where they may be frequently checked. The facility for ordering and keeping spare parts in stock is another advantage gained by the establishment of a central testing bureau.

The work if undertaken by the station operators will never result in the assurance that it will be done correctly as is shown by the following illustration.

Cases frequently arise in which a rotary flashes over or a surge occurs on the feeder causing the ammeter pointer to jump over the stop at the end of the scale. When the operator notices this he often removes the instrument cover and pushes the pointer back to zero mark. As the instrument is of more or less delicate nature, this operator may have changed the balance of the instrument by roughly handling the pointer. Often through fear of breaking the pointer the operator fails to straighten it thereby affecting the accuracy of the meter.

Where astatic-type ammeters are used on direct current circuits the pointers are placed on zero when no load is on the circuit and when the magnet in the ammeter is energized by the load the pointer advances in error resulting in a wrong indication. The "fixing" of instruments by those unaccustomed to this work will often introduce friction into the instrument and result in mechanical and electrical troubles.

While numerous schemes are in use for making tests on ammeters the following are quoted as being representative. Where the ammeter is to be checked at a few points on the scale a routine test the following method may be used.

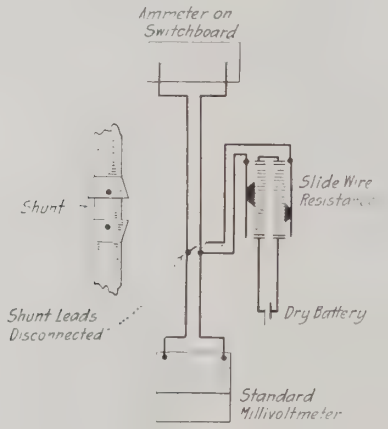

Fig. 3. Test Connections for d. c. Instruments.

The current transformer is first short-circuited either by the use of test clips or by ammeter short circuiting switches now usually placed in the ammeter circuit. These switches greatly facilitate the work of testing instruments since the switch automatically short-circuits the series transformer and removes the ammeter from the circuit. Without these switches it is necessary to trace all the wiring and short-circuit the transformer at the terminal block. The wires then had to be removed from the instrument terminals to permit the test clips to be attached.

It is often difficult to remove the wires from over the terminal lugs since switchboard wiring is strung quite tightly. Often the wiring becomes disarranged and the general neat appearance of the rear of the board is destroyed. With the special switch, the test leads may be attached directly to the upper jaws eliminating the disadvantage mentioned above.

The instrument on the switchboard is then placed in series with a cluster of lamps and a standard ammeter. If the ammeter is not reading at zero the pointer should be adjusted. One lamp at a time is placed in the circuit and the reading on each instrument is noted. These readinggs should be corrected for the standard and then multiplied by the current transformer ratio to get the amperes, when the percenage of accuracy is found by dividing the reading on the switchboard ammeter by the equivalent reading given by the standard. By this method it is possible to connect a whole string of ammeters in series and give them a rough check very rapidly. The presence of friction in any one instrument will be revealed by removing each lamp from the circuit in order and noting if any discrepancy appears in the results; the same readings should be obtained when going both up the scale and then back to zero.

The method of recording the results in conjunction with testing ammeters in strings has much to do with the rapidity with which the testing may be accomplished. Sheets printed up as shown in Fig. 1 are filed in a book. One tester reads off the data as required for the top of the sheet. As each lamp is thrown in, the other tester takes the book and sets down the readings as called out by the man reading the ammeters. The accuracies are computed and instruments which need adjustment are marked and retested after such adjustments are made. The scheme results in few errors and possesses ease and rapidity of recording the result and gives an individual sheet for each instrument which may be filed for future reference.

When a more accurate calibration is required, a meter testing load box and slide wire resistance may be used to advantage. The wiring scheme for this test is shown in Figgure 2. The slide wire resistance may be used for both the A. C. and D. C. ammeter tests. There are certain classes of feeders which have ammeters which require a calibration around some particular operating point as for instance street lighting or "tub" transformer stations. This test is of value for such conditions.

On the direct current circuits the ammeters are millivoltmeters connected to shunts. The method of testing is somewhat similar to the A. C. ammeters. The leads are first removed from the shunt and the current is supplied by a dry battery short circuited across the slide wire resistance as shown in Figure 3.

It is necessary to equip the testers with cards giving the drop across the shunt in millivolts when the old type shunts are encountered. With the later types the drop is standardized so that it may be readily computed by glancing at the ammeter scale.

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Proper Fitting of Carbon Brushes

By H. H. Wikle

Everyone acquainted with the operation and maintenance of direct current machinery is also aquainted with carbon brush trouble. At the beginning of the electrical industry very little thought was given the carbon brush; everything that would carry the current from the dynamo to the outside circuit was deemed good enough. As the demand for high efficiency electrical machinery increased, more and more attention was given the carbon brush, until to-day the simple carbon block which looks so unromantic to the layman, represents the products of the minds of the best engineers of the country. Regardless of the amount of research and engineering intelligence used in producing this highly efficient carbon brush, it is of no avail unless a reasonable amount of intelligence is used in its proper operation.

From time to time various articles have appeared in the technical papers emphasizing the importance of a good contact between the commutator and brush. Since there is nothing to be said to the contrary, it remains to find out the best means of getting this good contact, if after all, it is of the first importance.

It seems to be the universal practice among operators, when fitting brushes to a commutator, to slide a piece of sandpaper between the brush and commutator in the direction of rotation. Fig. 1 is the somewhate exaggerated sketch of a radial brush that has received this treatment. It is touching the commutator at all points and fulfills all requirements of good surface contact. But let us take a look at the position of the brush in the holder; it is touching only at the points *a* and *b*. Any upward thrust caused by an eccentric commutator would be opposed by the portion *b, c, d,* of the brush, and when the brush wears away

—as brushes will—it cannot move freely in the holder because of the portion *a, e, f*. Consequently, a poor contact is made between the brush and commutator with its resultant sparking. This binding in the holder at first thought may not seem serious, but take an actual case. Suppose the brush holder to be 2 in. high and the brush extending 0.5 in. above the holder and 0.125

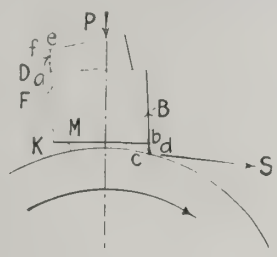

Fig. 1.

in. below. As a rule the brush is made about 0.005 in. smaller than the holder to allow a sliding fit. The distance $KM = 0.005$ in., $Ka = 2.0$ in. and $KM/Ka = 0.0025$. But the angles *KaM, fae, cbd* are equal, therefore $ef/ea = 0.0025$, or $ef = 0.0025\ ea$ or, substituting for *ea*, $ef = 0.0025 \times 0.5 = 0.00125$ in. Similarly $cd = 0.125 \times 0.0025 = 0.0003125$. That is to say, if a slight irregularity on the commutator should force the brush up, instead of its sliding smoothly in the holder there would be a tendency for the edge *b* of the holder to dig into the brush, forming a ledge as much as 0.3 mils deep, and similarly when a depression allowed to spring to force the brush down, the edge *a* would dig in, forming a ledge which might grow to be 1.25 mils deep. It is no wonder that brushes frequently stick in their holders, under the rapid blows given by commutator irregularities, even tho they may feel free enough when moved by hand.

Now let us look at a brush under which the sandpaper has been pulled against rotation, Fig. 2. We have exactly the same condition as in Fig. 1, but when the machine is rotated the brush will pull away from the holder at the point *a*, and as it wears

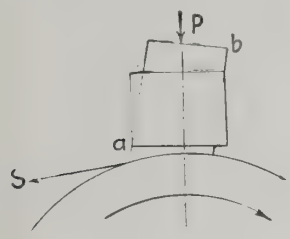

Fig. 2.

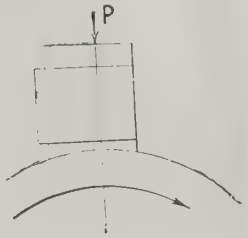

Fig. 3.

away it will assume the position shown in Fig. 3. This is the position that saves wear and tear on the commutator and the religion of the operator.

Now take the case of the "trailing" brush holder, nine operators out of ten will say, and they will speak from experience, that the brush will tip up and bear only on a point at the heel of the brush when the commutator is rotated. This is true if only rough sandpaper is used, but if fine sandpaper is used and the brush face carefully wiped off to remove all grains of sand, this difficulty will be reduced to a minimum. In order to tip up, the brush friction must overcome the spring pressure, a theoretical impossibility, but a practical fact to a slight extent even with the best care in fitting. However, no one has been able to so fit a brush that it will start wearing over the entire face at once. The "facing" brush holder is easy; pull the sandpaper in the easiest possible direction, namely, the direction of bevel. With careful sanding it will soon assume a position resting against one side or other of the holder, depending upon which is larger, the coefficient of friction of the brush of the cosine of the angle. The ideal condition would be when the two are equal, a practical impossibility because of the variation of the friction with temperature, speed, pressure, humidity, current density, and many other factors.

A great deal could be said regarding the effect of spring pressure, current density, commutation and lubricants, upon the successful operation of carbon brushes but such is not within the scope of this article. Suffice to say, too much care cannot be given to the brushes, for a direct current machine is no stronger than its commutating device.

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Practical Design and Construction of Direct Current Electromagnets

By Norman G. Meade

(Continued from September)

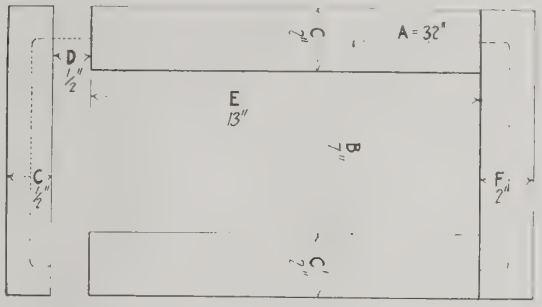
In Part 1 the general details of magnet design and construction were discussed and in this article the actual calculations for specific problems are taken up.

Problem 1.

Design a short range electromagnet of the type shown in Fig. 1, Part 1, which will lift a weight of 100 pounds through a distance of one-half inch. This will require a lift of 50 pounds for each magnet of the pair. The magnet is to be operated from a 110-volt circuit.

Solution

Let the cores, yoke and the armature be made of wrought iron and the density of the magnetic circuit be 40,000 lines of



force a square inch. As shown in Part 1 the area of the core must be

$$A = \frac{72{,}134{,}000\ P}{B^2}$$

Then $A = \dfrac{72{,}134{,}000 \times 50}{40{,}000^2} = 2.2$ sq. in. approximately,

which corresponds to a diameter of about 1.5 inches. In order to allow for magnetic leakage and to be able to use standard stock, the diameter of the cores will be made 2 inches. As a preliminary calculation the coils will be made three times the diameter of the core or 6 inches, and the length of the coil twice that of the diameter of the coil. The yoke and the armature will be made two inches square. The dimensions of the various members of the magnetic circuit are given in Fig. 1. If the armature is drawn up against the poles, the average length of the magnetic circuit will be 2 $(12+1+1+13) = 56$ inches.

From Fig. 7 it will be found that for wrought iron with a density of 40,000 lines of force per square inch, 10 ampere turns per inch of magnetic circuit will be required. Then the total number of ampere-turns for the iron will be $56 \times 10 = 560$. The total length of the air gap is $2 \times 0.5 = 1$ inch. Then for the air gaps the ampere turns required will be

$$H = \frac{B\,l}{3.192} = \frac{40{,}000 \times 1}{3.192} = 12{,}500 \text{ approximately.}$$

The total number of ampere-turns required will be 12,500 + 560 = 13060. For each magnet the ampere-turns will therefore be $13060 \div 2 = 6530$. The required size of wire in circular mils will be

$$A = \frac{12\ L\ H}{E}$$

Mean length of one turn in feet is found as follows: Circumference of core 6.28 inches. Circumference of coil 19.24 inches. Then the mean length of one turn will be $(19.24 - 6.28) \div 2 = 12.76$ inches or approximately one foot.

$$\text{Then } A = \frac{12 \times 1 \times 6530}{110} = 712 \text{ circular mils.}$$

Referring to a copper wire table it will be found that 712 circular mils corresponds nearest to a No. 21 B. & S. gage wire, but as the two magnets are connected in series the resistance must be halved which will require a No. 18 wire. There are 12 inches between magnet heads and by Fig. 4 it will be seen that there are 19.5 turns to the inch for single cotton-covered wire. Then $12 \times 19.5 = 234$ turns for the length of the magnet. The number of layers required will be $6530/234 = 28$ nearly. From the same table it is found that there is allowed 23 layers to the inch. In practice it is rarely possible to wind the wire sufficiently perfectly to conform to the mathematical allowance of wire spaces so that the preliminary estimate of 6 inches in diameter for the coils will not be far from correct.

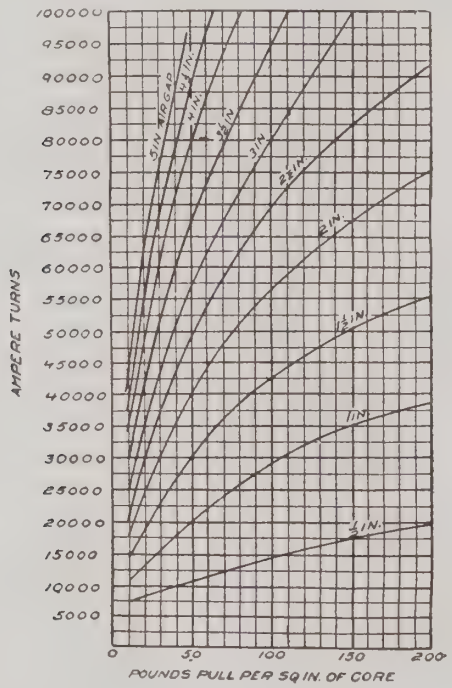


Fig. 5.

There are a total of 13,060 turns connected in series on the two magnets. The average length per turn is one foot. There will be required a total length of 13,060 feet of wire. From the wire table it is found that the resistance of No. 18 copper wire at 50 deg. C is approximately 8 ohms per thousand feet. Then the total resistance will be $13.060 \times 8 = 104.48$ ohms which will be made 105 to avoid fractions.

$$\text{From Ohm's law } I = \frac{E}{R} = \frac{110}{105} = 1 \text{ ohm approximately.}$$

The loss in watts in the coils will be $I^2 R = 1^2 \times 105 = 105$. The cylindrical area of the coils is determined as follows: Outside circumference = 19.24 inches, length 12 inches. Then $19.25 \times 12 \times 2 = 461.76$ = cylindricalmarea of coils.

Temperature rise = $k P \div A$. For open magnets $k = 95$, therefore $T = 95 \times 105 \div 461 = 21$ degrees approximately which is well within the safe limits.

Problem 2

Design a single open circuit plunger magnet that will lift a weight of 50 pounds through a distance of 3 inches.

Solution

Figure 5 shows the relation between pounds pull, ampere-turns, and air gap, or the maximum distance of the pull. For a magnet of the capacity given it will be found from the table that 57,500 ampere-turns will be required. The remaining calculations are performed in the same manner as for short range magnets.

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An Effective Mine Signal System

The A. Hanna Coal Company, operating mines in Northern Michigan, has equipped its shafts with a signaling system as effective as it is novel.

Confronted with a signaling problem in connection with their cage operations the mine officials co-operated with the Western Electric Company in the design of a special system which operates essentially as follows: At each of the various mine levels loud ringing extension bells are installed in pairs, each pair consisting of one six inch and one eight inch weatherproof type loud ringing gong. In connection with these bells, special switches are installed at each level. They consist of a telephone switch hook housed in a weatherproof cast iron casing. Attached to the switch hook and hanging from the casing is a long leather strap similar to the well known street car strap. Pulling this strap makes contact and rings the six inch bells on every level and one in the engineer's room. When a man has loaded a car and wants it hoisted he pulls the leather strap a number of times—the number corresponding to a prearranged signal that corresponds to the operation desired. The bells ringing on each level in connection with the engineer's bell serves as a warning to the men on the various levels. The six inch bells are on one circuit and the eight inch bells on another—the latter being rung by the engineer when he is ready to hoist, or as a summons.

The wires of the signaling circuit are used for a telephone system with a telephone set in the engineer's cabin and a set on every level. The system is simply a magneto party line circuit and is used as a means of communication in connection with the signaling system, between the various levels and the levels and the engineer.

The company has placed great reliance in its new signal system and has taken great precaution to keep it in operation. A supplementary circuit has been wired so that if the ringing current in connection with the system should fail warning bells will ring, summoning a repair man. The Hanna Coal Company is at a loss to understand how they ever got along without the signal system that permits of better and quicker work with less hazards.

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Generator Would Not Pick Up

By F. C. Parham

Some operators may recall instances where the old two pole generators on which copper brushes were used, would be unable to "pick up" their fields: this was partly due to the oxidation of the brush surfaces; partly due to the highly glazed condition of the commutator; and, no doubt, in isolated cases, to a combination of these conditions coupled with the practice of starting the engine with the line switch closed. Even under otherwise normal conditions a shunt wound generator will build its field magnetism much more promptly when the line switch is open, because when it is closed, the external circuit, to a certain degree, short-circuits the field. On the more modern corbon brush machines the difficulty sometimes occurs, but it is not so likely to obtain because there are many more brushholders and the chances of all of the brushes simultaneously making poor contact, are more remote. That such a condition is possible on a modern 8-pole generator, is illustrated by the following:

An operator complained that a generator that he had been running for years, but which had been equipped with a new commutator within the last year, was developing a tendency to give trouble in "picking up" its field even with no load in the ex-

ternal circuit. He stated also that if the commutator were well sandpapered, the difficulty would disappear but would reappear in about a week. Furthermore, he had discovered accidently that the machine could be made to "pick up" as promptly as it originally had, by sticking a pinchbar into the center of the pulley end of the armature shaft and shoving the armature over as far as it would go.

The trouble proved to be due to slightly high mica, which held the brushes off the commutator when the armature was in motion. The sandpapering of the commutator would lower the surface of the mica sufficiently to give a few days of relief and shoving the armature over to one side, would bring the brushes onto an unwiped zone of the commutator, where the mica was not high. With a straight edge as a guide and with a piece of hacksaw blade as a cutting tool, the mica was undercut and all trouble thereby eliminated. It might be of interest to note that in the case of similar trouble with a motor, the poor contacts due to the high mica, would so affect the voltage applied to the armature as to materially decrease the armature speed.

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Short Cuts and Minor Methods

Perhaps you've worked out a new way of doing this or that, which saves time, money or temper. Don't be selfish with it; give the rest of "the boys" a chance to profit by your ingenuity. We will pay for all contributions accepted for "Short Cuts," and you will have the satisfaction of having done somebody a good turn. Rough sketches should accompany the items when necessary.

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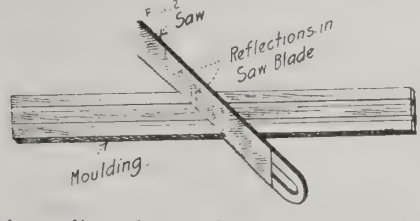
Reflection as a Guide in Metering

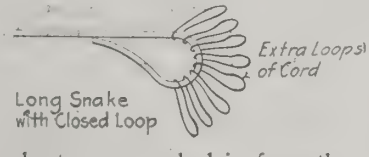
Cutting mitres in wooden moulding can easily be done without the aid of a mitre square or a mitre box if the saw blade is kept bright. Place the saw across the moulding at approximately



45 degrees, then adjust, by moving the saw blade either to the right or left until the reflection of the moulding in the saw blade is at right angles to the moulding itself. The saw blade must be held vertical.

Fishing With Two Snakes

Conduits are sometimes so long that it is almost impossible to fish them with one snake, and a long snake has to be pushed in as far as possible having a closed loop at its end, which is



then met by a shorter one pushed in from the other end of the pipe having an open loop. The two snakes are then pushed in and out until such times as they hook together, when the shorter snake is kept tight taking up all the slack as the longer one is pushed all the way through.

If the loop on the end of the long snake is wound with strong thin cord so as to form a great many closed loops the chances of catching the two snakes together is greatly increased.

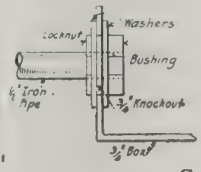
Contract Drop at Switch Blades

It quite often occurs that large knife switches will get hot at the contacts or hinges due to the blades not making proper contact over their entire surface. It is difficult to know when they are making good contact by inspection, but if the switch is closed and a volt meter connected across the contacts or hinges the reading of the meter will very readily tell when the conditions are correct. This reading should read as low as possible, say about 1-2 volt at the most and if this is not the case a little powdered emery and oil applied on the blades and the switch opened and closed about a dozen times or so will soon bed the two together.

K. R. O.

Conduit Box Bushings

Often times it is necessary to run a 3-4 inch box in an installation into which 1-2 and 3-4 inch pipes have to be fastened. The 1-2 inch pipe can be made perfectly secure if two large washers are used, one on each side of the box, then use the regular locknut and bushing to fasten.



R. T.

Ground on Two-Wire Branch

When a ground comes on the "high side" of a branch tapped from a three-wire Edison system, it makes a short-circuit due to the current flowing from the outer wire through the fault to ground, and back into the grounded neutral. I have often cleared such troubles temporarily by interchanging the branch wires at the connection block so that the grounded wire is connected to the neutral. The fault can then be repaired at any convenient time.

W. J. E.

Replacing Top of Floor Pocket

When cutting boards for a floor pocket I cut through on an angle making the lower side of the piece shorter than the upper. Then when this piece is put back it will rest firmly without bracing the floor. Before replacing the piece, however, nail a thin piece of wood or cardboad over the cut to make up for the thickness of the wood destroyed by the saw-blade in cutting out. The board can now be replaced and will lay flush with the other part of the floor.

R. T.

Fishing Above Furred Ceiling

Fishing around corners in finished house work many times saves a great deal of labor and material. Fig 1 shows the floor plan of the second story of a residence recently wired by me where I used this method. The building was brick, lath and

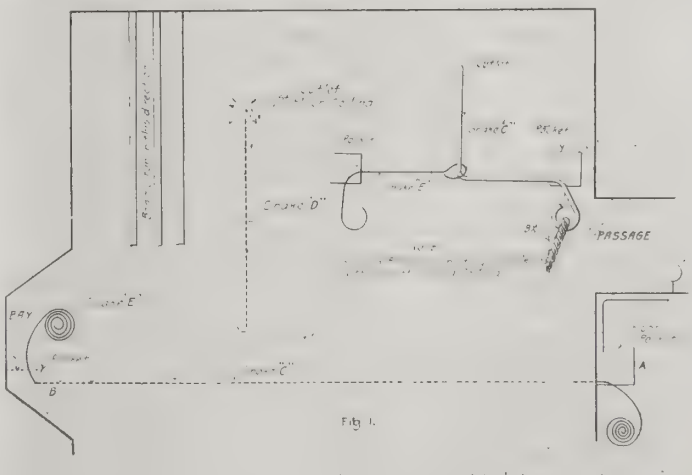
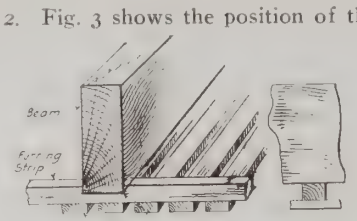


Fig 1.

plaster partitions, ceilings furred, (Fig. 2) floor completely covered with carpet which I was not allowed to take up.

A pocket was cut at A and B and a snake from one to the other, the outlet to be wired was the hall light on the first floor, no pocket was taken up here on account of the carpet so the fishing was done from the ceiling of the first floor. A snake was passed this point with an open hook to catch the one fished from A to B. When snake D caught snake C it was pulled toward the outlet, the end B of snake C after a third snake E attached to it was let loose and eventually reached the outlet. A fairly large loop was now placed on the end of snake E through which snake C was passed when the ends of snake C were held and snake E pulled back as far as it would come. The BX was now attached to end A of snake C and pulled toward BX from being

caught in the corner of the beam and the furring strip opposite the outlet, Fig. 2. Fig. 3 shows the position of the snakes when



all is ready for pulling the BX through. The outlet was fed from the hall bracket on the second floor. F. J. C.

Questions and Answers

We invite our readers to send us questions on technical or commercial problems which have arisen in actual practice. All will receive replies, either by letter or through the "Questions and Answers" Column.

Replies to questions asked are particularly desired from our readers. For all replies printed we will extend the contributor's subscription for one year, or send the paper to any address he may designate. Where the circumstances justify it, we will pay for answers at regular space rates.

A Trolley Line Network

Q. A 9-mile trolley line with generator station at one end has two feeders. One of No. 0000 soft copper wire extends from generator 6 miles along trolley and is tied to trolley every 2 miles. The other of hard drawn copper, 8×10^6 C. M. in cross section extends from generator along the trolley for 3 miles and is tied to trolley at the end only. There are 3 cars on line, distributed as follows. car I, 3 miles from generator station, takes 100 amps., car II, 5 miles from station, takes 50 amps., car III, 7 miles from station, takes 40 amps. Trolley wire is No. 0 hard drawn copper. Track resistance is .03 ohm per mile, generator voltage is 580 volts. (a) What is voltage across each car. (b) What is efficiency of transmission. (c) If trolley wire breaks between generator and place where No. 0000 feeder is tied to it, what would be the voltage across each car.

Assume resistances per mil-ft. to be hard drawn copper, 10.65 ohms; soft copper 10.4 ohms. F. W.

A. This is a complex network problem which requires no particular ingenuity but a considerable amount of work to solve. The only laws involved are Ohm's law, and Kirchhoff's two laws of networks, viz.:

1. Around any "mesh" in a network through which a steady current is flowing, the sum of the resistance drops taken in order is equal to the sum of the generated voltages, due regard being paid to algebraic signs.

2. The sum of the currents entering a junction-point is equal to the sum of the currents leaving it.

By computing the resistance of each piece of the network, and putting E, E_2, E_3 for the counter-e.m.fs. of the motors we could set up a series of equations, one for every mesh and one for every junction-point. If enough data has been given, we should have at least as many equations as there are unknown quantities, and they could be solved in the usual way. If any of our readers care to undertake this, we shall be glad to publish the result.

Reactive Voltage of Comutation

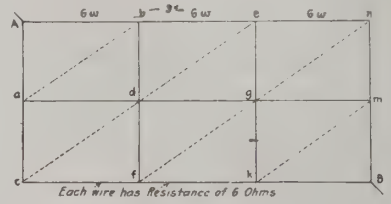
Q. The armature of a 10 kw 100 volt bipolar d. c. generator rotates at 1200 r. p. m. The commutator contains 50 segments and the inductance of a coil connected across adjacent segments is .00003 henry, assumed constant. What is the rotational e.m.f. that must be induced in the coil to reverse the current in this coil at a uniform rate during the commutation period, (a) at full load, (b) at half load.

A. Our correspondent has not given the number of bars spanned by one brush, but we will assume that the number is 1.5. The lenggth of time during which the current is to be reversed is that during which the coil is short-circuited by the brush, which is the time during which the brush spans the insulation between adjacent bars. This time will be $1.5 \div 50 = .03$ of the time of one revolution, or $.03 \times .05 = .0015$ sec. During this time the current will change from + 100 amp. to — 100 amp., or 200 amp. or at the rate of $200 \div .0015 = 133{,}000$ amp. per sec. This will generate an e.m.f. in the coil of $.00003 \times 133{,}000 = 4$ volts, hence the voltage impressed on the coil will have to be 4 volts in the direction opposed to the original direction of the current. (A current varying at the rate or 1 amp. per sec. through an inductance of 1 henry will set up an e.m.f. of 1 volt in a direction which will oppose the change.

"Window-Light" Problem

Q. Will you please print a solution of the "window-light problem," as shown in the accompanying sketch? F. W.

A. The "window-light problem" is to find the resistance from A to B, diagonally opposite corners of a rectangular net-



work of equal resistances. Consider a current entering at A. It will divide into two paths of equal resistance, hence the two currents and potential will be equal, and therefore *a* and *b* will be at the same potential. At each of these points the current will divide again, flowing in equal amounts over equal resistances to *c*, *d*, and *e*, hence these points will be at the same potential. Starting now at B and working backward, by the same reasoning we find that *k* and *m* are at the same potential, and so are *f*, *g*, and *h*. Between the dotted lines *cde* and *fgh* we have 5 paths in parallel, each of 6 ohms, hence the resistance of this section is $6 \div 5 = 1.2$ ohm. Between *ab* and *cde*, and between *km* and *fgh* there are 4 paths in parallel, hence the resistance is $6 \div 4 = 1.5$ ohm each and from A to *ab* and from B to *km* the resistance is 3 ohms each. Hence the total resistance from A to B is $3 + 1.5 + 1.2 + 1.5 + 3 = 10.2$ ohm.

Inquiry for Goods Out of Stock

Q. When anybody come into my store and asks for something we do not have in stock what should I do—tell them we are out of it and let them go to one of my competitors?

A. No, you should always endeavor to make the sale yourself. If the article is carried by a competitor, send out for it while the patron waits; or promise to deliver it later in the day. When it is something you have on order, or can get in a day or two from your jobber, a little tactful questioning will often show that delivery a few days later will serve the customer practically as well. Above all, show him that you want to make the sale; indifference is so usual that the reverse will make a good impression.

Q. What do you think of printing a dealer's name on his wrapping paper? W. F. J.—Washington, D. C.

A. When the package is wrapped with the dealer's name outside, we feel that it is an unwarranted effort at advertising at the expense of the consumer. If however a few lines about the care of electric apparatus are printed over the dealer's name on the inside of the wrapper, they are sure to be read. Here would be a good place for emphasizing the dealer's interest in the performance of every piece of apparatus he sells.

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During a recent convention in Baltimore, the Consolidated Gas, Electric Light & Power Company illuminated the Washington monument. Now the company offers to continue the illumination free of charge for one year.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

The Monthly Bill as a Sight Draft

By G. D. Crain

One of the specially interesting features of the collections system which is use by the Louisville, Ky., Gas & Electric Company, is the manner in which increasing numbers of the monthly bills of the company are treated as sight drafts on the customers' banks would be. The plan, in Louisville, is not a new one by any means, since it was in use fifteen years ago by the old Louisville Lighting Company, although it was not until recently that the company resulting from the merger began to suggest to its customers that they adopt it. It is steadily increasing in popularity and an interesting sidelight on its practicability is that the Louisville Water Company and the Louisville Home Telephone Company have put a similar plan in effect. Another company that has adopted it in Louisville is the Federal Sign System (electric).

Until recently the method of handling such collections was offered principally as a convenience to customers and the positive step was taken by the customers who found it more convenient to meet their bills in that manner. It does not appeal especially to the depositor who is customarily drawn right up to his balance and who frequently finds himself compelled to hustle to the bank with a deposit to cover oustanding checks. But to the man or the customer who always has a safe balance against the dimensions of the "gas company's" bill it represents a real convenience. Large corporations which use quantities of current or gas, which want the charge on their books as of the date the bill was paid and to which the full discount period means actual money are not prospects for the system. But there is a large class of customers which, as the town is circularized, is coming into the plan with approval. The end of June saw nearly 1,000 of the company's customers paying bills which they did not see until they received their cancelled checks from their banks.

Form of Application

The manner in which the plan works is extremely simple. Only one form is used and that is the form which the customer fills in when he determines to adopt the plan of cancelling the bills issued against him by the company. This is addressed to the customer's bank and is a request which reads as follows:

Gentlemen:

Please pay to the Louisville Gas & Electric Company the net amount of their bills for gas and electric service rendered to me at (house number and street) upon their presentation, and return the receipted portion of the bill to me with the paid checks drawn on my account.

Yours very truly,

These requests of the customers, usually delivered to the gas and electric company's offices, although sometimes sent directly to the banks, which, however, immediately deliver them to the company for checking up, are compared with the records of the company. This is to make sure that the customer's only account with the company is covered by the one house number and street, and to enable the cashier's office to record the name of the customer's bank in his files. A card index of these "sight draft" customers is maintained in the cashier's office, containing name of bank and data on the accounts if there is more than one. Delivered to the several banks, the orders on them to pay the bills on presentation are filed for reference, sometimes with the signature cards, sometimes in files by themselves.

Notation on Ledgers

The ledger in the bill room of the gas and electric company shows which bills are to be paid by the banks by the notation "Pay Through Clearing," written beside the account of the customer. The notation is written out in full, instead of being indicated by initials, so as to make sure that it will not be overlooked. In time, when a larger proportion of the customers pay through their banks it is likely that some more simple distinctive means will be developed to indicate these accounts, but for the present the note quoted suffices admirably.

In the regular course of making out the bills, the blank forms are put through an addressing machine which stamps the customer's name on each, the bills then going to the bill room to be made out. As the accountant, in filling in the charges, comes to the account of a customer marked "Pay Through Clearing," he rejects the customary blue form, reaches for the same kind of a form printed on red paper, on which he writes the name of the customer, destroying the unused blue form. As the number of "sight draft" customers increases this destruction of the blue forms would become a good sized waste, but ths can be obviated by rearrangement of the names on the addressing machine and stamping the "sight draft" customers on a sheet by themselves, or on some forms of addressing machines the selection processes can be made to single out the special class so as to obviate waste of the printed bill forms.

Transacting With the Banks

As the bill making progresses the several red-body bills are laid in piles by themselves and each day—the Louisville company bills one group of its customers every working day in the year—the red bills go to the cashier's office, where a clerk writes conspicuously in each bill head the name of the customer's particular bank. They can be safely marked "paid" on the books, for it is indeed rare that any of these bills come back marked "no funds." When they do they are carried along for a few until the bank does pay them. The whole batch of red bills goes over to the bank of the gas and electric company along with the other deposit, the bills addressed to the particular bank sorted from the lot, and the rest delivered to the clearing house where they are cleared exactly in the manner of checks. Each bank then handles the bill as it would a check or draft and the customer receives it with his paid checks at the end of the month, at which time he may consult it and check it against other months if he desires.

Advantages of the Plan

"This company has followed this plan since its organization, nearly three years ago," said Donald McDonald, vice-president and general manager of the company in a letter to the Electrical Age, "and one of its constituent companies followed it more than fifteen years ago. Of course the plan is available only to those people who have bank accounts, and a great many of these avail themselves of it. I have never heard of a single case of dissatisfaction on account of the plan, or any customer countermanding the order to his bank and returning to the old system. Of course it does not improve collections. The sort of people who give such orders would pay their bills anyhow; but it does insure that the customer never misses his discount, and in this way obviates the occasional dissatisfaction which the customer feels when he forgets to pay his bill during discount days."

There are several advantages from the viewpoint of the gas and electric company which are well worth considering. In the first place it insures the company having the use of the money involved on the first day the bill is payable, instead of on later days up to the end of the discount period. This is seldom a consideration of importance to the individual customer, although in the aggregate it is an advantage to the company. The value to the customer of the "use of the money" for a week can be offset for a series of years by one failure to take advantage of the discount period and loe his 10 per cent. of the gross amount of the bill.

Satisfaction to Customers

This system obviates any necessity of having to send a collector for those who forget to mail their checks within the discount period. This is both an annoyance to the customer who is "good pay" and an expense to the company. The plan does away with the cost of the stamp where the statements are mailed out, an item of importance. It saves cost of collections in the outlying suburbs which are served by the company, and cost of collections from residents of the surrounding country, and residents of such places are showing particular interest in the plan. Another good thing is that it tends to keep the customer complacent about the service. A bill that is a month old and apparently excessive will not ordinarily cause the effect that a fresh bill of the kind does. As a matter of fact the customer is losing no chance to correct a charge. He is given as careful and as courteous attention on a complaint of this nature as he gets under any other circumstances.

As is true with every company a considerable proportion of the Louisville company's customers are given to frequent comings and goings. Their homes or their offices are likely to be occupied only at certain times in the average months, or servants maintain the houses and continue using the dual service of the company. The method of paying the monthly bills through the banks appeals particularly to this class, since their balances are uniformly sufficient to take care of any possible demand from this source, and they are thus insured of their 10 per cent. discount no matter where they may be sojourning. Until the last few months there has been only a limited effort on the part of the company to list its bank-depositor customers in this class. Now, the mutual advantages having been thoroughly appreciated all of the customers are being solicited by circular.

Method of Increasing Use

The appeal is put on the basis of insuring the customer of obtaining his discount. The customer is addressed on a dodger, on the reverse side of which is the blank form on which the customer may write the order on his bank. It is a printed statement of the plan pointing out the advantages of the system, and is delivered to the customers along with the bills they receive. This statement of the proposition reads as follows:

You Can Always Get Your Discount and Save Yourself Trouble by Paying Your Bills Through Your Bank

Many hundreds of the customers of this company never see their bills for gas and electricity until their bank returns them along with their checks at the end of each month. Customers who do this always get their discount, and are saved the trouble of remembering to pay their bills. They do not lose any of their right to have a bill corrected.

If you desire to avail yourself of this convenience, fill out and sign the form printed on the back of this slip, and this company will make arrangements with your bank, and will in future present the bills to the bank, and you will receive the receipted bill along with your checks.

How the Banks Regard the Plan

And there has never been the slightest information from any of the sixteen banks in the city, or from the outlying banks, that the system is objectionable to them. In fact the appear to welcome it, since they can legitimately point to additional service they are giving their depositors. Louisville banks are accustomed to the red bills and they go through with no more comment than any other order to pay. There are sixteen banks in Louisville with an average of 3,000 depositors each, while the gas and electric company is maintaining 75,000 meters. This is merely to indicate the possibilities in the case.

As it is, one-third of all the bills of the company are paid by checks mailed into the office, Another third is collected through pay stations of which there are now 106 in all parts of the city and more likely to be established. The remainder of the bills are paid by means of the "sight-draft" system or over the counter in currency or by check.

Collections Through Pay-Stations

There is a point of interest in the collection system of the Louisville company in connection with the pay-station plan, which costs the company nothing to maintain and which, at the same time is of much service to the customers. Leon S. Mayer, auditor of the company, has found, he said, that neighborhood drug stores are more desirable than other such depots, for the reason that they ordinarily remain open until 10 o'clock each night. However there are some banks on the list, some grocery stores, some bakery shops, some shops where other commodities are handled. For the reason that this system brings many people into their stores or other places of business these representatives of the company are keen to represent it, and all of them cheerfully give bond to insure the company at against losses.

They collect in each bill two cents over and above the net amount, the cost of a postage stamp if a check were to be mailed in, and no customer has ever been heard to complain of this charge. Collections in each case run only during the discount period, payment after that time being made direct to the office of the company. An assistant cashier of the company makes the rounds of the pay stations in his automobile, carrying with him an adding machine which he uses to run up the totals of the bills collected by the pay station keepers. He often returns from such rounds with sums between $5,000 and $10,000.

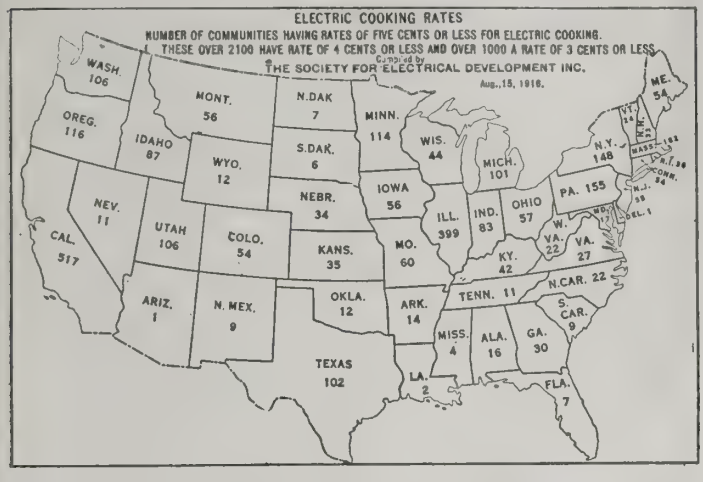
New Market in St. Thomas, W. I.

The recent completion of the work of installing an electric-lighting system in St. Thomas appears to have opened up a new market for American electrical supplies. There should be an especially attractive field here for good but moderately-priced electric fans, which are almost unknown on the island.

St. Thomas lies in the Tropics, and because of this location of its principal town (Charlotte Amalie) on the southern slope of a high ridge of mountains, where refreshing breezes are lacking most of the time, the employment of electric fans would be appreciated everywhere for all the year round. At the cinema shows, which are given two or three times each week, a number of large hand-made fans are suspended from the ceiling and are operated by cords pulled back and forth by small boys stationed back of the screens. In the hotels, business offices, and private houses, though, there are no such appliances, and it is believed that immediately after the first electric fan has been introduced it will become generally popular.

Heating Rates

The rapidly increasing demand for electric ranges with their convenience, relibility and cleanliness has led to an investigation of rates for electric current by The Society for Electrical Development. This load for central stations is extremely desirable because the bulk of it comes on the off-peak and thus assists in straightening the load curve. The accompanying map shows the number of communities having special cooking rates and the location of these communities by states.



In analyzing the compilation of rates for electric cooking in the United States the interesting fact develops that of some 3,000 communities listed where rates are 5c or lower, 1,884 are located in the Eastern half of the country, and 1,250 in the Western half, or, taking the Mississippi as the dividing line, 1,638 are East of the Mississippi as against 1,506 West of the Mississippi River.

Contrary to the general impression that low rate for cooking are largely confined to the western states, it will be seen that central stations in the east have realized the advantages of this load and are offering special rates as an aid in building it.

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Our Monthly Window Display

Radiators from the most timely domestic electric articles to advertise during the cool days of fall before the real cold weather arrives. The accompanying illustration shows an excellent window display for pushing these radiators because it brings out one of their most important uses; namely, in the nursery.

Simple as this display is, it has, nevertheless, been carefully planned. It will attract attention and make an especial appeal to mothers. Nothing is called for in it that any other central station or dealer cannot obtain without trouble. The screen forms a background that is particularly desirable in case the rear of the window is open. The frieze at the top of the screen is a piece of wall paper border for children's rooms and similar designs can be obtained from any wall paper store. The radiator in front of the baby and the two at the extreme ends should be lighted. Toys of any kind can be used, but they must be scattered about in confusion in order to be true to life.

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News of the Associations

Seattle Conventions

At Seattle, Washington, the annual Pacific Coast Convention of the A. I. E. E. and the annual convention of the Northwest Electric Light and Power Association were held jointly from September 5 to 9. About 225 delegates and guests were present. Officers of the Northwest Association for the following year are: President, M. C. Osborn, Washington Water Power Company, J. D. Thornton, Willapa Harbor Light & Power Company; for Oregon, C. J. Edwards, Coast Power Company, Tillamook; for Idaho, H. B. Waters, Idaho Power Company; for Montana, J. F. Roche, Montana Power Company, Billings. New members of the executive committee are O. B. Coldwell, Portland Railway Light & Power Company, and Norwood Brockett, Puget Sound Traction Light & Power Company.

Edison Convention

The thirty-seventh annual convention of the Association of Edison Illuminating Companies was held at Hot Springs, Va., on September 5 to 7. Reports were received from committees and there were a number of addresses. The officers for next year will be Peter Junkersfeld, Commonwealth Edison Company, Chicago, President; L. L. Elden, Edison Electric Illuminating Company, Boston, Vice-President; George Holberton, Pacific Gas & Electric Company, San Francisco, Secretary; W. W. Freeman, Union Gas & Electric Company, Cincinnati, Treasurer.

Pennsylvania Electric Association

September 5 to 8 were the dates of the annual convention of the Pennsylvania Electric Association at Eagles Mere, Pa. It was shown that the membership of the Association now serves 95 per cent. of the total population now reached by electric lines The subjects di cussed were operating problems, including the testing of instrument transformers, the operation of boilers, and methods for building up the personnel of an organization. Officers for next year are: President, George B. Tripp, Harrisburg Light & Power Company; first vice-president, Ernest H. Davis, Lycoming Edison Company, Williamsport; treasurer, W. R. Kenney, West Penn Electric Company, Connelsville; the permanent secretary is H. M. Stine, whose office is at Harrisburg.

New England Electrical Contractors

The annual convention was held at Hartford, Conn., on September 26, 27 and 28, with L. L. Gaillard of Waterbury in the chair. Papers of general interest were presented and an exhibition of electrical appliances and fittings was held with more than 500 manufacturers participating.

Indiana Electric Light Association

At the convention of the Indiana Electric Light Association the principal papers were on the commercial aspects, including rural loads, range sales methods of financing, power surveys, and the effect of the National Electric Safety Code. Officers for the new year will be: President, Sam. W. Greenland, Fort Wayne; Vice-President, J. P. Ohmer, Elkhart; Secretary-Treasurer, Thomas Donohue, La Fayette.

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14th Annual Jovian Convention

The fourteenth annual convention of the Jovian Order will be held at Indianapolis, October 18-20. Registration will begin at the Hotel Sherman on October 17. Sessions of the convention will be held in the ball-room of the Hotel Severin. The program is as follows:

Tuesday, Oct. 17

Afternoon—Registration of Indianapolis Jovians.

Evening—Registration, Reception and Dance, Buffet Supper.

Wednesday, Oct. 18

Morning—Registration, Formal Opening, Business Session,

Afternoon—Business Session,
Evening—Concert, Photo-Play Parties.

Thursday, Oct. 19

Morning—Business Session.
Afternoon—Auto Race at Speedway, followed by an Hour or two at the Indianapolis Athletic and Canoe Club.
Evening—Annual Rejuvenation.

Friday, Oct. 20

Morning—Business Session, Election of Fifteenth Administration Officers.
Noon—Luncheon Tendered by the Indianapolis Chamber of Commerce.
Afternoon—Degree Team Competition.
Evening—Installation of Fifteenth Administration Officers, Auto Drawing, Closing Entertainment—"A Night in Bohemia," Buffet Supper.

With the withdrawal of all other candidates for the office of Jupitor, the election of Henry L. Doherty to that post is assured. Constitutional changes to advance the interests of local leagues will be brought up. In addition to the routine reports to be presented, there will be addresses as follows:

Mr. D. C. Cooper, Engineering Dept., National Lamp Works, "Voltage Standardization;" Hon. Henry Lane Wilson, formerly Ambassador to Mexico, "Trade Relations with Mexico and Central America;" Mr. W. A. Layman, President, Wagner Electric Mfg. Co., "Building A Career;" Mr. Robley S. Stearnes, President, N. E. C. A., "Jovianism from the Contractor's View-point;" Mr. J. M. Wakeman, General Manager, Society for Electrical Development, "Co-operation with the S. E. D.;" Mr. H. W. Alexander, Director of Publicity, Society for Electrical Development, "America's Electrical Week;" Dr. Katherine M. H. Blackford, "Character Analysis by the Observation Method."

At the degree-team competition on Friday afternoon the ownership of the loving-cup may be settled. It is to go to the team winning it for three consecutive years, and the St. Louis team now has two legs on it. A prize of $250 cash goes to the team which wins, and also a jewel worth $100 to the individual who best protrays his role. An elaborate program of entertainment has been arranged, and special efforts are planned to occupy the time of the ladies while their escorts are in attendance at the business sessions.

"Mercury" Ell C. Bennett, Syndicate Trust Building, St. Louis, has charge of the general arrangements.

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Coming Conventions

American Electric Railway Association. Annual convention, Atlantic City, N. J., October 9-13. Secretary, E. B. Burritt, 8 West Fortieth Street, New York City.

Electrical Supply Jobbers' Association. Quarterly meeting, Hotel Statler, Cleveland, O., October 10-12. Secretary Franklin Overbaugh, 411 South Clinton Street, Chicago, Ill.

New Mexico Electrical Association. Executive meeting, El Pas del Norte Hotel, El Paso, Tex., October 15-17. Secretary pro tem, E. A. Thiele, 112 West Third Street, Roswell, N. M.

New England Section, N. E. L. A. Annual convention, Pittsfield, Mass., October 17-20. Secretary, O. A. Bursiel, 149 Trenton Street, Boston, Mass.

Jovian Order. Annual convention, Indianapolis, Ind., October 18-20. Secretary, Ell C. Bennett, Syndicate Trust Building, St. Louis, Mo.

Telephone Pioneers of America. Annual meeting, Atlanta, Ga., October 27-28. Secretary, R. H. Starrett, 195 Broadway, New York City.

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"How to sell an idea," a booklet issued by the Society for Electrical Development for electric range salesmen, makes the significant point plain that while "It's almost impossible to sell an electric sove, it's easy to sell the *idea* of electric cooking." In its 32 pages (4 x 7) it gives many points of value in selling, and in putting on electric campaigns.

Bending and Installation of Conduits

(*Continued from page 27*)

turns some time after and continues, coupling up the next length and carelessly forgets to remove the plug, forcing it into the pipe at the coupling. This is not discovered until the pipe is snaked for wire pulling which is always after the finished floor is laid. Sometimes they can be removed by blowing out with high air pressure, but many times the floor must be taken up or the pipe abandoned. We have removed many such plugs by discharging a revolver into the pipe, the force of the bullet carrying the plug with it to the other end.

A good method of installing circuit work where there are false or furred-down ceilings is to run the circuit from the panel in rigid conduit to a junction box in each bay, in the floor above. From this junction box flexible conduit is run to the local switches and the ceiling fixture outlets in the hung ceiling leaving a little slack in the flexible conduit. Then in the event of a change being desired, the ceiling is punctured at the new point, the old outlet fished for and drawn over to its new location, and the original opening is plastered up.

Exposed Work

Exposed work throughout is now coming into use for industrial buildings to a far greater extent than ever before. It is easily installed and readily leads itself to change and extension. There are few modern

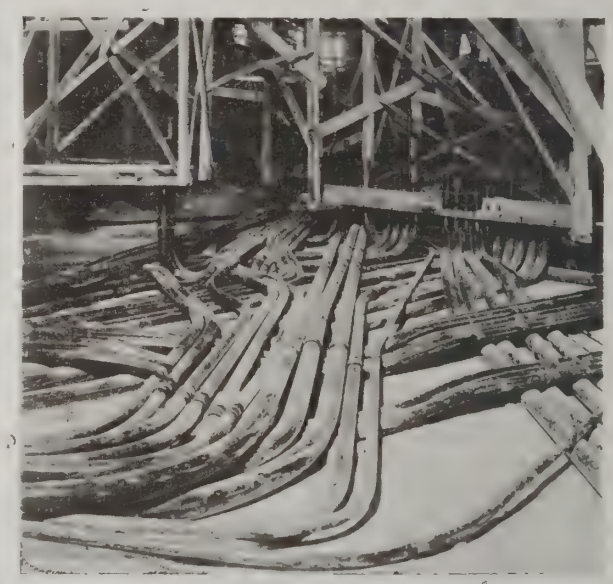

Fig. 8. Templets Suspended from Ceiling.

factory plants, that are progressing, that do not require greater and greater electrical capacity each year as their production increases. For this purpose alone the exposed system has every advantage over the concealed, and then again the electrical contractor has very little to do on the job until the building or a good part thereof is completed. With practically no exception, such buildings are of reinforced concrete (where not of wood construction). Inserts are put on the rough wood from which the stringers, shafting and machinery are hung. By installing a few more at locations where the lighting outlets and motor connections occur, and in the route of the pipe work, the electrical conduit system can be supported therefrom and installed very economically without the necessity of drilling for expansion bolts. There are many good

devices on the market that can be used for inserts. A most interesting case of exposed circuit work is illustrated in Fig. 7 and described below. For grounding it is recommended that the conduit system be bonded to the sprinkler piping at various points; this in no way harms the latter.

Special Construction

A very interesting conduit problem is the work in telephone terminal rooms. A tremendous quantity of pipe is laid in floors of such rooms as can be readily seen from Figs. 1 and 8.

The accuracy with which this work must be installed is what makes it quite difficult, as each conduit terminal must exactly fit the finished furniture and operating desks when set. The pipes are all set in the floor and later covered over with the fill, and cement or wood flooring, whichever is used. A very important requirements is to get these conduits in a minimum of depth so as not to cast down the head room any more than absolutely necessary. Careful bending of the pipe is the essential item. The use of standard elbows is almost completely abandoned, the pipes being bent up as desired. A form of bender we use is shown mounted on a column in Fig. 1. It consists of a malleable iron wheel mounted rigidly, and a second wheel between a pair of heavy flat straps. These wheels are both grooved on the circumference, so as to take a pipe between them. By inserting the conduit, and pulling the level around with the aid of a pole or piece of 2 in. rigid pipe, the conduit is easily bent. A little practice and common sense quickly enables the men to do very accurate and good work with this bender. It can be used for pipes 1 in. to 2½ in. Hickeys are of course used for ½ in. and ¾ in sizes. In Fig. 1 the wood templates bared for each pipe are supported on iron braces from the floor beams. After the floor is partly in and set over the pipes, these braces are cut off close to the top of the rough floor, the templates removed and the finished floor laid, covering up the exposed ends of the braces. In Fig. 8 the templates had to be braced from above, as the quantity of pipes in a given space was quite large and grouped very closely, so that some chance would have been taken in, laying the rough and finished floors with braces up from the beams, as in the other case.

Another type of bender we used recently had wheels of similar type to that on the above mentioned bender but both were laid flat on the floor, one supported on the long side of a timber laid in one direction and the other on the end of a second timber laid at right angles to the first so as to have the two wheels face one another. Both timbers were arranged to be rapidly fastened down. The pipe, 2½ in., 3 in. or 3½ in. were slipped in between the wheels, one end held rigid and the other pulled around with a chain block, fastened to the opposite wall and lying on the floor. We bent 3 in. and 3½ in. conduits to 90 degrees. in little more time than it takes the average wireman to properly bend a ¾ in. pipe a similar amount with a hickey. These benders are comparatively inexpensive and easy to handle, as they can be shipped in parts, timbers being picked up locally. Both benders described can also be very readily used for making offsets of any angle.

Fig. 7 shows an ingenious arrangement for the installation of typical exposed circuit work. All parts were made up at a bench, the outlets fastened on, and all made ready to hoist to the ceiling and put in place. A truck was made upon wheels, a team of men on the truck and a gang distributed each branch to their proper positions. As the truck came along, each branch was pushed up to its location with the aid of long sticks and the team fastened the branch in place. It is very apparent how economical and with what speed such an installation can be made.

In laying out a conduit system it is important to have in mind the pulling in of wire and cable throughout. The quality of this branch of the equipment often determines the quality of the entire distribution, and a poorly laid out and installed conduit system means deficient and expensive operation and maintenance even in a greater degree than a poorly constructed building. With the well developed methods of to-day there is no excuse for a defective conduit installation.

Obtaining A Patent

(*Continued from page 33*)

What has just been said concerns inventors who are working in the front ranks of their particular industries. In these matters they require the careful work of skilled lawyers, and the sufficient advice to them is to consult with their lawyers.

The Casual Invention

Otherwise, and in the case of the casual invention, the inventor, when putting his invention in his attorney's hands, may raise with him the question of a preliminary examination. The attorney will in many cases advise such an examination. He may have in his employ young fellows who do this work; if he has not, he knows how to avail himself of the services of those who do. Preliminary examination is a running through of United States patents in the class to which the invention in hand belongs, with a view to determining whether it is anticipated in any patent already granted —for the law is that a man may have a patent for an invention which is "not known or used by others in this country, before his invention or discovery thereof, and not patented or described in any printed publication in this or any foreign country, before his invention or discovery thereof, or more than two years prior to his application.") Such a search, to be exhaustive and sure, would be more costly than to file an application (in which case the Patent Office examiner makes search), and in the common run of cases so great an expense is not desired. The preliminary examination costs only a few dollars, and, though its results are not sure, still in the majority of cases they are correct; and because the examination is inexpensive, it is in many cases to be recommended as "insurance," for if the invention be anticipated (that is, found not to be new) the inventor is saved the much greater cost of an application.

So much for novelty, in preliminaries. Utility is a matter within the peculiar knowledge of the inventor. He knows best the practicability of his invention. And, unless the contrary is obvious, the Patent Office will accept the applicant's oath that his invention is useful. That is to say, the Patent Office, having found the invention new, or, rather, having failed to find it old, will allow the application, and the Commissioner will grant the patent, on the strength of the applicant's oath that the invention is "new and useful." As has been said before, utility, under the law, is not utility to a greater degree than anything that has gone before; utility here means practicability. The powers of the Patent Office are exhausted, and further question as to patentability lie with the courts. They can declare, on proper evidence, that the invention for which a patent has been granted is not new or not useful, and that the patent is void. Such action by court is familiar to everyone.

What a Patent Costs

A patent, when granted, has cost the inventor approximately a hundred dollars—in exceptional cases the cost may be much greater. The Patent Office fees are these: on the filing of the application, $15; on allowance and before the

issue of the patent, $20. Fees, then, amount to $35, of which $20, is not payable until the case is allowed. Most applications require drawings; and these ordinarily cost $5 a sheet. Then there is the attorney's fees for prosecuting an application. This varies, necessarily. Some unscrupulous attorneys, unable to command higher fees, use their lower fees as an advertising asset. The attorney's fee ordinarily will approximate $50. Some attorneys have a fixed charge for heavy and light cases alike; some have no fixed charge, but fix their fees in each case individually, according to time spent upon it. There are almost always incidental expenses, such as express, telegraph, railroad fare. Ordinarily, then, a patent costs the inventor from $85 to $100.

But it not infrequently happens that an application fails to go smoothly through the Office. A difference of opinion may arise; the examiner may hold the applicant's claims to be unpatentable, though the applicant and his attorney may have good reason to entertain the contrary. Appeal then becomes advisable. Again, an application may be involved in interference with another application of another inventor in which the same invention is claimed. In such like cases the inventor has need of the advice of his attorney, and herein further appears the importance of having a trustworthy man. Of course, in such case additional expense is involved.

It is often the case that the inventor is in the employ of some manufacturing concern, and that the invention has to do with the employer's business. Under such circumstances it is usually the desire of both parties that the employer pay for the patent and in return acquire the patent or rights under it. This brings us to the question of the Enjoyment of Patent Rights, which will be the subject of the next paper.

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America's Electrical Week

(*Continued from page* 34)

Cleveland, Ohio.

The Chairman, G. E. Miller, has appointed three sub-committees to lay out a city wide celebration. The first includes men interested in lighting, the second, those interested in heating devices and the third, those interested in power devices.

This committee will report at the general meeting of the Cleveland America's Electrical Week committee next week. Plans were discussed for a dinner to all clerks in all the Cleveland stores which participate in America's Electrical Week.

The lighting sub-committee is convassing all Cleveland merchants in an endeavor to tie up all window displays not only with the general advertising of the week but by means of some unique lighting feature. An essay contest similar to the one which was so successful last year will be undertaken again.

Pennants furnished by the Society will be placed by the local automobile club upon all cars owned by the city and by those driven by members of the club.

The entire America's Electrical Week committee has arranged to meet regularly with the advertising managers of all Cleveland mercantile and industrial interests, the aim being to link up Cleveland's activities as a unit.

Cincinnati, Ohio.

The Ohio Valley Electrical Exposition, the outgrowth of last year's highly successful Cincinnati Electrical Show, will be held at Music Hall, Cincinnati, November 18th to 25th, inclusive. It is held under the auspices of the Cincinnati Electrical Company, of which W. W. Freeman is President. Charles M. Crofoot of the Crouse Hinds Company is Chairman of the committee in actual charge of the exposition.

From the viewpoint of the visitor this show will greatly excell the show of 1915. There will be a greater variety of attractions, more demonstrations and a greater variety of them. Applications for space in the exposition include both manufacturers and retailers. Cincinnati's retailers are exhibiting an extraordinary interest and almost all of them will be represented. More out of town manufacturers are interested than last year and this will increase the show's popularity. It is notable that the Cincinnati Electrical Show was unable to accomodate the attendance. On many occasions it was necessary to close the doors, although the exhibition was given in a hall having a floor space of 25,000 square feet, with an auditorium adjoining, seating 4,000 persons. The Cincinnati Electrical Show Company, anticipating a much larger number of exhibitors and at least as large a throng of vis tors as last year, has taken under option the third hall of Music Hall, with 27,000 square feet of floor space. The management believes it will be able to fill the entire space with attractive axhibits.

The Ohio Valley Electrical Exposition will have a great drawing card in the introduction to Cincinnati of professional ice skaters. The stage of Music Hall, measuring 70 by 112 feet, will be covered with fresh ice daily frozen and controlled by electrical machinery. The ice will be illuminated and a corps of American and foreign skaters will entertain visitors to the Exposition afternoon and evening. The usual use of bill boards and poster advertising will be supplemented by a great electrical illumination on Fountain Square in the heart of Cincinnati's downtown district. Illumination in front of Music Hall and on it's interior will be the most modern obtainable and will consume a great deal of current. Popular enthusiasm will be further stirred by the special prizes offered by the company for building, store and window electrical displays. These prizes will be made sufficiently attractive to draw a large general display.

Denver, Colo.

The Denver America's Electrical Week committee, which this year controls the activities of the entire State of Colorado, has appointed sub-committees in every leading town and city in the State. These are to report at a general meeting of the Denver committee within a few days.

Birmingham, Atlanta and Charlotte.

George W. Hill, traveling representative of the Society in a report to J. M. Wakeman, General Manager, announces that Birmingham, Atlanta, Charlotte, Nashville and Memphis committees have held meetings, appointed sub-committees to cover official city participation in America's Electrical Week. In each of these cities the general scheme of participation by Chambers of Commerce and by non-electrical merchants has been adopted. To this program will be added, according to the plans discussed at the preliminary meetings, electric vehicle parades and in the case of Birmingham and Charlotte an electrical pageant.

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Business Notes

Mr. A. B. Megraw has assumed charge of the Philadelphia office of The Jefferson Glass Company of Follansbee, West Virginia. The new office is located at No. 704 Perry Bldg., 16th and Chestnut Streets.

The Edison Storage Battery Supply Company announces the opening of its Los Angeles office on the fourth floor of the San Fernando Building, corner Fourth and Main Sts.

Mr. James F. Rogan, who has been acting as local distributor of Edison Storage Batteries in Los Angeles will become resident manager.

The Edison Storage Battery Supply Company also maintains two other officers on the Pacific Coast, one at 206 First Street, San Francisco, in charge of District Manager, Mr. E. M. Cutting, and another at 65 Columbia Street, Seattle, under Mr. F. C. Gibson as resident manager.

The Pyrolectric Instrument Company has been incorporated under the laws of New Jersey with E. F. Northrup, President; Dudley Willcox, Treasurer; H. F. Porter, Secretary. Offices will be at 148 East State Street, Trenton, N. J.

The purpose of the company is to manufacture and sell high-grade electrical temperature-measuring apparatus, and a limited line of electrical measuring instruments; chiefly such as are used in connection with measurements made in the laboratory with alternating currents. Special instruments will also be designed and built to order.

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Flexible Shaft for many purposes, together with its accessories, such as drills, screw-drivers, grinders and truck-mounted motors, is shown in Bulletin No. 102, of the Stow Manufacturing Co. of Binghamton, N. Y.

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Effects of vibration in structures, the preliminary report of an investigation being made by the Aberthaw Construction Company of Boston, gives some interesting experiences of the effects of vibration on workers and machinery.

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Printing and Binding Machinery driven by direct-current motors are described in Bulletin 48707 just issued by Sprague Electric Works of the General Electric Co. Various forms of manual, remote and automatic controllers are shown installed for typical machines.

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Industrial heating appliances as manufactured by the Westinghouse Electric & Mfg. Company are described and illustrated in leaflet No. 3918 just issued by this company. A brief description and some of the uses are given of each of these different devices.

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Portable Electric Tools made by the Stow Manufacturing Co. of Binghamton, N. Y., include drills of many sizes, buffers, grinders, screw-drivers, tool-post, bench and floor grinders and sensitive drills. Bulletin No. 101 describes and illustrates the line.

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Northrup Pyrovolter is the title of a pamphlet describing a new voltmeter for use with thermo-couples, which, it is claimed, unites the sensibility of the ploentiometer method with the easy-reading features of the deflection instruments. The apparatus is put out by the Pyrolectric Instrument Co., Trenton, N. J.

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"Clarage" Multiblade Fans, on the cylindrical principle, mounted as blowers for many purposes, together with such accessories as pipe coil heaters, are shown in Catalog No. 5 of the Clarage Fan Company. An "appreciation" of the fan's home town—Kalamazoo—by George Fitch, gives a touch of humor which is not out of place in a catalog of air-moving devices.

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"Railway Line Material for Direct Suspension." (Bulletin 44004A) gives illustrations and demensions of the General Electric Company's products. The 92 pages contain, in addition to the apparatus, a list of material for one mile of cross-span and bracket constructions, and some interesting data under "Construction Notes."

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Adjustable-Speed Motors on the well-known "Stow" principle are described in Bulletin No. 100, recently issued by the Stow Manufacturing Co., Binghamton, N. Y. Exactness of adjustment to any speed within the wide range of the motor is had by turning a hand-wheel which inserts or withdraws a plunger inside pole cores. Up to 3 h.p. a bi-polar design is used and up to 20 h.p. four-pole form. The company's shunt wound constant speed and induction motors are also described.

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Toronto Hydro-electric System's Fifth Annual Report (1915) contains a general description of the distribution system which purchases electricity from Ontario Hydro-Electric Power Commission for retailing to the city of Toronto. The rates charged bring an average return, in cents per kw.-hr. as follows: Residence lighting, 2.86; commercial lighting, 2.26; commercial power, 0.97. A total of over 109.5 million kw.-hr. were sold. The peak load was 29,975 kw. giving a load factor of .4417. An interesting feature is the honor-roll of employees now serving with the colors.

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Book Reviews

RETAIL SELLING: A Guide to the Best Modern Practice, by James W. Fisk. 335 pages. New York: Harper & Brothers: $1.50.

The author has made good use of his experience in selling and his knowledge of teaching to prepare a book which goes most systematically into modern merchandising. Many dealers have awakened to a consciousness that study of their market and proper adaptation of their stock and methods means often the change from failure to success. It is often impracticable for them to adopt the methods of others without making changes to fit their conditions, and the necessary changes are difficult to determine without a knowledge of the general scheme of merchandizing. Here this book will fill a real need, for it discusses in a practical way the problems to be solved in the analyses of the selling field and the competition in it; the determination of sales policies, organizing and instructing the selling force, arranging the stock, and getting people into the store. Many illustrations from actual happenings sustain the human interest from start to finish. The "atmosphere" of the book is that of the department store, but electrical dealers will find many hints of value for their work.

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ELECTRIC HEATING, by E. A. Wilcox, E. E. 285 pages. San Francisco: Technical Publishing Company: $2.50.

This book fills a gap in the literature of electrical practice of which we have just become conscious. On the theoretical side there is little to be said concerning electric heating, but in its practical application there is perhaps no other use of electricity which requires such a multiplicity of devices. A 500 watt motor will drive any machine requiring not more than that amount of power, provided the speeds are properly chosen, but a 500 watt heater takes on a different form for each substance it may be wanted to heat. From the author's experience as electric heating specialist for the Great Western Power Company, he has written a book which will meet the needs of the great body of men who are interested in "load building" and in electric heating in general. The book covers the fundamental theory, then passes to applications in lamp-socket devices, electric cooking, heating of water and air, furnaces and ovens, welding, steam production, miscellaneous forms. A brief discussion of rates for heating service is also given. As the book went to press in July, it is closely up to date, and the illustrations are of the latest devices in each line.

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PRINCIPLES OF ALTERNATING CURRENT MACHINERY, by Ralph R. Lawrence. 614 pages. New York: McGraw-Hill Book Co.: $4.50.

This is a text-book prepared primarily for use in the author's classes at the Massachusetts Institute of Technology, but equally suited to the needs of senior classes who have had Calculus. The

usual ground is covered in an admirably clear manner, and while the author has not hesitated to use mathematical reasoning, including complex quantities in practically every case. Illustrations are from pen-and-ink drawings which are very well done.

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Books Received

APPLIED ELECTRICITY FOR PRACTICAL MEN, by A. J. Rowland, New York: McGraw-Hill Book Co. $2.00.

HANDBOOK OF MACHINE SHOP ELECTRICITY, by C. E. Clewell. New York: McGraw-Hill Book Co. $3.00.

MECHANICAL ENGINEERS' HANDBOOK, L. S. Marks, Editor-in-Chief. 1840 pages. New York: McGraw-Hill Book Co. $5.00.

RADIODYNAMICS, by B. F. Miessner. 206 pages. New York: D. Van Nostrand Co. $2.00.

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News Items

Kenney Vacuum Cleaner Patent Sustained

In the District Court of the United States a permanent injunction has been issued against the Innovation Electric Co., Inc., enjoining this company from making or selling vacuum cleaners, it being held that the manufacturers were infringing on a patent granted to David T. Kenney on March 19, 1907 and at present held by the Vacuum Cleaner Co., The injunction is temporarily suspended pending appeal. This is the basic vacuum cleaner patent and the court points out that the "fundamentally important proposition was the vacuum idea as contrasted with the air-current theory." The claim which was infringed was for "a cleaner comprising a suction chamber provided with a narrow inlet slot,—the slot being bounded and defined by lips which lie in the contact surface of the cleaner." The court held that it makes no difference whether this slot is wide or narrow so long as the dirt was removed by air being drawn through the fabric into the suction chamber of the cleaner.

New Plant in Service

The addition to the factory of The Robbins & Myers Co., at Springfield, Ohio, which was started early in 1916, was completed September 1st. The equipment is now being installed and a part of it is in operation. The new building is of the same construction as the older buildings, concrete with steel window sashes and wood floors. It is 62 feet in width, 436 feet in length and has five floors, showing a total of about 135,000 square feet. With the completion of this building ground has been broken for another building which will be erected immediately adjoining the building just completed.

Substitutes for Copper

for the substitution of iron, aluminum and zinc for copper in electrical machinery. In general the trend is to prohibit the use of copper in hazardous locations, such as in chemical or explosives factories. Copper is allowed where compactness or light weight is essential, as in very small machines, or where losses would be excessive as in very large machines.

Thus for direct current machines up to 2 kw. all windings may be of copper, from 2 to 10 kw. the field coils must be of aluminum, from 35 to 175 kw., zinc field coils and aluminum auxiliary pole and armature windings; above 175 kw. aluminum main and auxiliary field windings and copper armatures. Commutators to be of iron from 2 to 175 kw., otherwise of copper. On all machines 10 deg. C. Additional temperature rise is allowed during the war.—*Electrical Engineering,* (London) August 17.

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In order to encourage the use of larger lamps the department of Light of Kansas City, Kansas, will sell all lamps up to and including 100 watts at the price of 19 cents. The loss on lamps sold below cost is expected to be recovered through increased sales of current.

Personals

E. R. Kelsey, advertising manager of the Toledo Railways & Light Company, operated by Henry L. Doherty & Company, who has just recovered from a three months illness, is looking for the man who sent him a box of cigars on the day of the appendicitis operation. A card that accompanied the cigars read—"You will enjoy these cigars as I understand you are going to smoke soon."

Mr. Ray Palmer, formerly Commissioner of Gas and Electricity for the City of Chicago, has recently been made President and General Manager of the New York and Queens Electric Light and Power Company, Long Island City, N. Y. He is a graduate of the University of Wisconsin and has had many years' experience in traction and consulting work.

Dr. P. G. Nutting has been made director of the Research Laboratory of the Westinghouse Electric & Manufacturing Company at East Pittsburgh. Dr. Nutting is noted for his contributions to the science and art of illumination, and has been with the Eastman Kodak Company for the last three years.

W. F. Raber, vice-president and general manager of the Arkansas Valley Railway and Power Company, Pueblo, Colo., was elected a member of the Executive Committee of the Colorado Electric Light, Power and Railway Association in annual convention at Glenwood Springs, September 22-23.

Robert Montgomery, manager Commercial Department of the Louisville Gas & Electric Company, Louisville, Ky., has been appointed chairman of the Louisville Advertisers Club committee having in chage arrangements for Advertisers' Week, October 2-6.

September 15 was the twenty-fifth anniversary of the entrance into the electrical and utility field of Frank W. Frueauff, of Henry L. Doherty & Company and vice-president of the Cities Service Company. In consequence Mr. Frueauff was the recipient of many congratulatory messages and also "American Beauties" from the members of the Doherty Organization in New York and Denver.

In June, 1891, Mr. Frueauff graduated from the East Denver High shool and the next day, laying aside the ribboned diploma, he put in an application with the old Denver Electric Company. As the doors of this concern were not opened to him he occupied the summer by working elsewhere. On September 15 he began his career as public utility operator, although at the time the position was termed lamp boy. The Denver Electric Company was later merged with the Denver Gas Company, which in turn became the present corporation—the Denver Gas & Electric Light Company.

D. C. Green, formerly connected with the organization of H. M. Byllesby & Company as local manager at two Oregon and Washington properties, has been ppointed general manager of the Fort Smith Light & Traction Company, Fort Smith, Arkansas, succeeding H. C. Hoagland who has been managing that property in connection with his work as manager of the Muskogee Gas & Electric Company for some time past. Hr. Hoagland will continue as manager of the Muskogee Gas & Electric Company. The change will take effect September 26.

Donald McDonald, manager of the Louisville Gas & Electric Company has been elected a director of the Louisville Industrial Foundation, and has been appointed vice-president by the board.

Obituary

Mathias Pfatischer, inventor of electrical devices pertaining to navigation, died at Roselle, N. J., on September 10. He helped to develope the single phase a. c. motor, and received the John Scott medal of the Franklin Institute in 1908 for the invention of the auxiliary-pole variable-speed d. c. motor. He was a member of the A. I. E. E., and a number of other technical societies here and in Germany.

New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

Th: Names of Manufacturers Not Appearing in This Section Will Be Gladly Supplied on Request

A Sewing Machine Motor

When a motor is to be attached to a domestic appliance already in service, simplicity is one of the most important points of design. When the method of attachment can be such that the purchaser can put the motor in place without the services of a mechanic, the sale is more easily made for the initial cost is lower and the motor will be installed and working during the first flush of enthusiasm which accompanies its purchase. One of the best features of the sewing-machine motor just put on the market by the Shelton Electric Company of New York City is that it can be connected to 90 per cent. of all machines by simply putting it in place on the table with its friction pulley in contact with the hand wheel.

As will be seen from the illustration, the motor is hinged to a supporting stand in such a manner that its weight holds the pinion and the wheel firmly in contact. Cork is used for the pinion, so that there is no slip at ordinary loads. However, should anything go wrong, slip would occure, thus protecting the mechanism. The motor is of the universal type, wound for either 110 or 220 volts, and consumes about 33 watts. Control is secured in a positive manner by a small rheostat moved by pressure of the operator's foot. Normally it holds the circuit open, and as pressure is increased the motor speed is raised in six steps, at any one of which it may be operated indefinitely. As an illustration of the power available it was found impossible to hold the needle-bar of a sewing-machine when its controller was set to the third speed.

It is a fact that the average woman cannot tell offhand the direction in which the hand wheel of her sewing-machine motor turns. With some motors it may be necessary to change the connection to correct the direction of rotation—a job which few purchasers care to try. Reversal of the Shelton motor is secured by the simple expedient of turning it end for end on its stand, withdrawing the pinion from the hollow shaft, and placing it at the other end. A buffer or an emery wheel may be substituted for the driving pinion in the same manner. Both of these are furnished with the motor. The finish throughout is nickel, and the outfit, including eight feet of cord from the foot-switch to the attachment plug, retails at $13.00.

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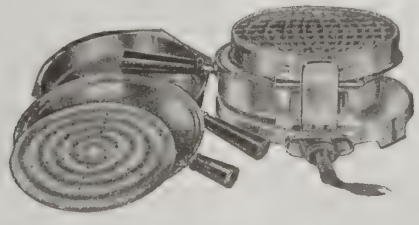
New Radiant Grill

The manufacturer of a line of electrical cooking appliances has placed on the market a three-heat "Radiant Grill." This grill operates from any lamp-socket, and cooking can be done both above and below the glowing coils. It is equipped with three heats in such a way that it is a very simple matter to adjust the heat to the user's needs. The composition switch-plug is simply inserted at the different points in the plug receptacle marked "High", "Medium" and "Low," using 600, 300 and 150 watts respectively. By a unique arrangement the switch-plug is attached at the base of the appliance, the receptacle being nearly concealed. It is claimed cool contact is absolutely assured by having the receptacle thus removed from nearness to the coils

The burner is supplied with a heating element of very rugged design, of the open-coil-reflector type. It is made of exceptionally heavy gauge resistance wire and supported by high-grade mica insulated cross-bars. These bars are reinforced and protected by metal cross rods which form a very strong grating for the cooking surface. The frame is made of heavy pressed steel, and every part is finished in highly polished nickel. The grill has four wide, fibre tipped feet which provide a very firm base, and prevent any mar or injury to the very highest polished surfaces. It is furnished with two dishes, deep stew-pan with broiling grid, and shallow dish. There is also reflector (to concentrate heat on one operation) which may be used as a cover, and for a cake griddle. Each dish is equipped with black, always-cool, ebonized wood handles, which assure comfort and convenience in handling. These dishes may be used either above or below the coils. Ordinary cooking utensils may also be used on this grill.



The complete outfit is priced at $6.00.

20,000 Ampere Circuit-Breaker

The 20,000 ampere d. c. circuit breaker, pictured on this page is the most recent solenoid operated type of circuit breaker developed by the General Electric Company for controlling direct current circuits of unusually high capacity. The normal continuous rating is 20,000 amperes. This circuit breaker is one of four of the same capacity built for the Aluminum Company of America for installation at Massena, N. Y. The closing and opening movements under normal conditions are controlled by a single-pole double-throw control switch mounted remote from the breaker on the switchboard or in any other convenient location. On overload or short circuit the breaker opens automatically by means of a direct-acting trip. The breaker is mounted on a 2½ inch slate panel, and the solenoid mechanism is supported by a steel base.

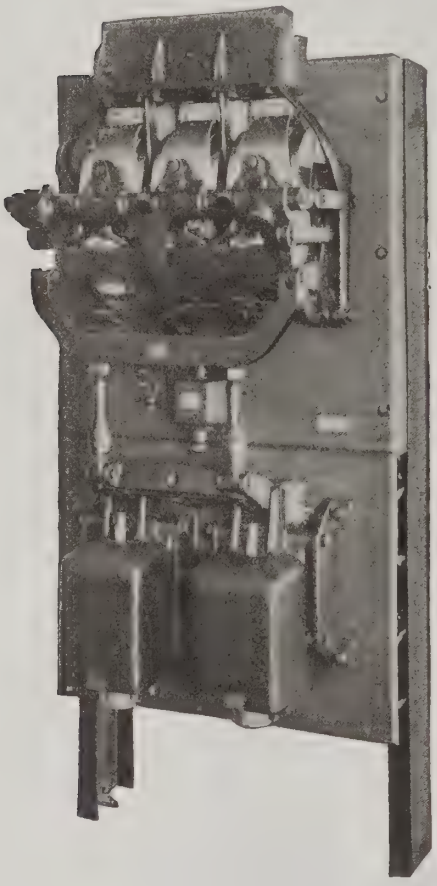


Fig. 1.

Fig. 2.

The use of solenoid-operated and other types of distantly-controlled circuit breakers simplifies station wiring, reduces length of main cables, and economizes space at the point from which operations are controlled.

Solenoids which operate this and other large carbon or oil breakers require much larger curents for their operation than can be interrupted by control switches without ruinous arcing. In such cases a relay, such as the one illustrated is used between the control switch and the solenoid. The rugged construction of these relays is evident from Fig. 2. No detailed description is necessary, but it is worth while pointing out that the moving arm turns upon a pivot which carries no current, as it is strapped by a flexible copper cable. Due to the spring support of the movable contact, it "wipes" the fixed contact in closing. For hand operation of the relay, its plunger can be raised by lifting on the ensulating button at the bottom.

Portable Electric Tools

In all cases the prime advantage of the portable electric drill lies in "carrying the tool to the work." This advantage is augmented by speed with which the work can be done and the fact that the tool frequently is utilized for work which formerly required special machinery.

The efficiency of a portable electric drill when substituting for expensive machinery is demonstrated in the plant of the Sterling Engine Company of Buffalo, New York. Here a portable electric drill is used to drill 0.25 inch oil holes in dropforged crank shafts and the holes drilled through the shaft at an angle of 29 deg. The drill is attached to an inexpensive frame made in the Sterling Works. Provision is made for moving the drill vertically and horizontally and also for swinging the drill either right or left to an angle of 29 deg.

The two operations of drilling and reaming "in place" are used to a considerable extent in automobile assembly work and, with the exception of holes involving micrometer limits, the portable electric drill is used altogether for these operations; also where a true hole is required free from chatter, such as bed plate bolts for marine engines, or column bolts which have to be reamed in place to secure a perfect fitting bolt an operation that cannot be done with a reciprocating type portable tool or by hand. The electric drill and reamer can better perform this operation owing to its smooth transmission of power.

In timber rafting the construction of a crib requires 0.875 in. holes drilled at 3 ft. spacing through two or three 10 in. or 12 in. timbers. This drilling was formerly done by an auger driven by belting on a three-sectio flexible boom, somewhat like three-sections of a folding foot rule, with the pulleys at the ends of joints. This permitted the auger to be moved quickly from end to end of the timber. This required a boiler, an engine, a man to run them and the man at the auger. The portable electric drill abolished the whole outfit, one man now doing a former days work in an hour.

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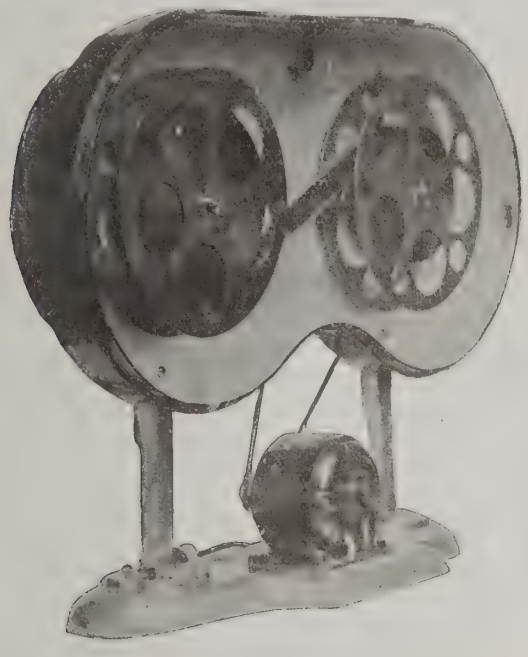
Motor Driven Film Rewinder

The rewinder illustrated, was devised to assure absolute safety in the winding and rewinding of moving picture films, and is the only machine approved by the National Board of Fire Underwriters that entirely encloses the film when rewinding. This machine is driven by an enclosed Westinghouse motor, selected as best adapted for the work both from principle of operation and construction. The cost of operation is said to be less than 5 cents a day based on a 12 hour performance.

As shown by the illustration this rewinder is very simple. It is supported by two uprights which in turn rest upon an iron base, giving proper rigidity without undue weight. There are two magazines, one larger than the other. Each is a separate enclosed compartment, with a cast aluminum cover or protector designed to conform to the shape of the reels. The larger magazine is used for the reels during rewinding; the smaller one contains the operating mechanism.

The machine will take reels of 2,500 feet or less of any make, and will operate only when the magazine covers are closed, unless set for examination or inspection of the film. This feature makes it fool-proof, checking the possible explosion of ex-



posed films due to carelessness. The attention of the operator is not required at the end of a film as the machine will automatically stop when the film has been completely rewound. Should the film break while the machine is in operation the rewinder will automatically stop at the point where torn and allow splicing of the film, after which it will proceed to rewind the balance of film on reel.

Operators and owners are often give a great deal of annoyance by the presence of "rain" on the screen. This is caused by dust and particles of dirt which collect on the face of a film during rewinding, when such rewinding is done in the ordinary way. As the Horting rewinder winds the films under cover perfect pictures are assured as no dust can get on the film. It has an additional advantage, in that it protects films from mutilation and does away with unnecessary cutting of film, as the perfect rythm of rewinding prevents tears and breaks during projection.

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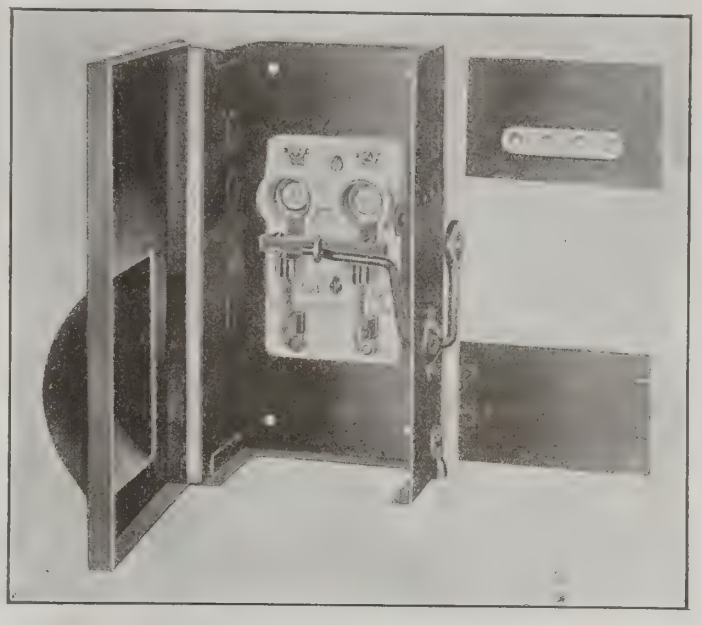
Safety Switch

The effect of "Safety-First" agitation has been shown recently in the development of a number of safety switches, of which one of the most interesting is here shown. This type, known as the "Square D" has the switch and cut-out unit completely enclosed in a metal box provided with a hinge cover which is held closed with a simple spring catch. The switch is operated by a crank handle located outside the box. The switch may also be locked in the "off" position to prevent accident when repairs are in progress. Means are also provided to lock or seal the cover shut to prevent unauthorized persons overfusing the switch or tampering with live connections.

The "Square D" enclosed switch is also recommended for the use of central stations as entrance service equipment where metered service is given. It effectually prevents the theft of current which is generally accomplished by wiring around the meter. The switch terminal and fuse are under lock and key, and while the electric current user can turn the current on or off at will by means of the handle outside the box, the current carrying parts and wiring remain inaccessible. Meter trims for joining the switch box and meter are available for any type of current meter.



The type of switch illustrated has a pressed-steel case, and is intended for voltages from 125 to 600, and for currents up to 300 amperes. A cast-iron type is also made which is operated by pushing or pulling a knob. The box cannot be opened unless the switch is in the "off" position. Around the edge of the removable front plate is a rubber gasket to make the box fire, water, and fumed proof, thus enabling the use of the box in damp or hazardous localities.

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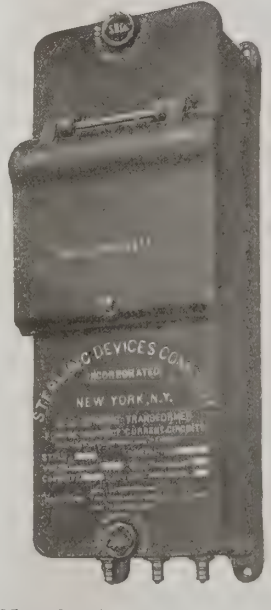
Pole-Changer for Bell Ringing



The supplying of a low voltage current for the operation of bells, annunciators, electro-magnetic trips, etc., is frequently attended with considerable annoyance, as well as expense, especially where primary batteries are depended upon. Where alternating current is available the installation of one of the many excellent bell ringing transformers now on the market has solved this problem in a most satisfactory and economical manner, but where direct current only may be had, the engineer who would tap the power mains to secure a dependable low voltage for his bells, etc., has been obliged to install either a motor generator or some form of potentiometer. To meet the demand for a dependable means for supplying low voltage power a New York concern has brought out a new type of transformer in which a small current taken from the 110 volt D. C. lighting circuit is caused, by means of a vibrating mechanism, to traverse, alternately, and in reversed direction, two primary coils of a static transformer. There may then be taken from the secondary winding an alternating current of low frequency and any de-

sired voltage which is peculiarly well adapted to operate bells, annunciators and kindred devices.

The breaking contacts in the bells, which are a frequent source of trouble, may be entirely eliminated where this transformer is used, as the frequency of the current alternations will produce the proper vibrating effect desired; yet, on account of the low frequency of the secondary current, the ordinary vibrating bells and buzzers, with breaking contacts, will operate perfectly with this curent.

These transformers have been in use for more than a year but the manufacturers have withheld them from the market until assured that they could be absolutely depended upon. Careful micrometer measurements of the contacts after long service indicate a contact life of five years and then it will be necessary to renew contacts only. This transformer has been tested and approved by Underwriters' Laboratories. The conduit for the primary wires may be brought direct to the case, knockouts being provided on both sides. The dimensions are: height, 18 in.; depth, 6 in.; width, 7 in.; weight, 55 lbs.

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Induction Regulator of Improved Design

After a considerable amount of engineering and experimental work with a view to improving the electrical performance and mechanical details, the Westinghouse Electric & Mfg. Company has placed on the market the improved design feeder voltage regulator illustrated. This is a single phase induction regulator, known as the type C, for 2300 volts, 60 cycles, 10 per cent, regulation, and it is standardized in all ratings from 5¾ kva. to 69 kva. The refinements secured in this new design have increased the reliability of the regulator in service and have simplified and decreased the expense of the wiring necessary for installing accessories for automatic operation, in addition to improving the electrical efficiency. Figure 1 shows the regulator removed from tank.

The rotor is wound with form-wound coils, as shown by Figure 2, and constitutes the primary element. The short circuiting coils in the rotor are formed from a large number of turns of

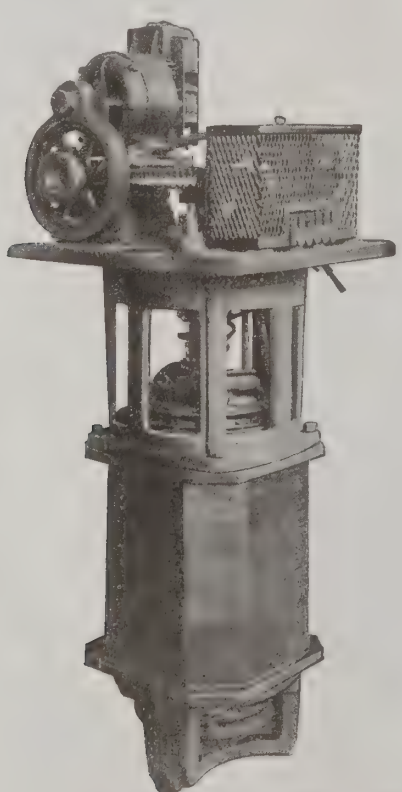

Fig. 1. Regulator Removed from Tank

relatively small size enamelled copper wire, thus reducing the watts loss in these windings without decreasing the neutralizing effects for which they are provided. The core is of the frameless construction so largely used for induction motors. Thus the cross section of the stator core is increased without a corresponding increase in size of other parts and of floor space, resulting in a decrease of iron loss and exciting current. Further, the insulating oil in which the regulator is immersed in the tank comes in direct contact with all surfaces of the stator core with more efficient cooling effect.

In a regulator, the insulation of windings is of vital importance because of the severe conditions of operation. The coils for both primary and secondary are therefore carefully insulated and impregnated, and are assembled in open slots, where they are held by fibre wedges driven in small grooves at the top edges of the slots. Heavily insulated steel bracing rings are assembled around the exposed ends of the stator coils at both ends of the

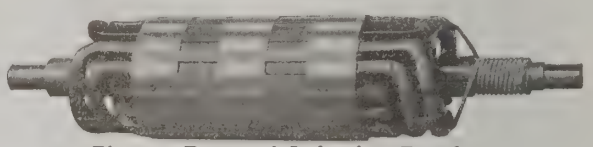

Fig. 2. Rotor of Induction Regulator

core. These rings are bound to the coils with cord, and greatly stiffen the coils against distortion from mechanical shock caused by current surges in the feeder during periods of line disturbance or short circuit. This feature is an important one, increasing the protection to the coil insulation and the factor of safety of the regulator in service.

An electrically controlled switch or auxiliary relay for the operating motor, formerly mounted separately from the regulator, is now mounted directly on the regulator top cover and includes the limit switch. This arrangement cuts down the number of wires required in the control circuit for automatic operations, and simplifies and lessens the expense of installation. The chance of failure in the control circuit is correspondingly lessened as well, and inspection of the wiring is made easy.

The operating motor is provided with a quick acting magnetic brake as heretofore, but the operating mechanism has been changed, so that the regulator now requires only 10 seconds for the complete range of travel from maximum buck to maximum boost, 20 per cent. regulation.

The regulator is made as a unit and may be quickly removed from the tank by simply unbolting the top cover, thus making inspection and repairs comparatively simple. The tank is formed from sheet steel walls with oxy-acetylene welded seams and with top and bottom flanges cast on to the walls. This type of tank is the same as that used with Westinghouse oil insulated self cooled transformers. It is strong with undue weight, and free from oil leakage. Due to the large surface exposed, the radiation quality is necessarily very high.

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Faucet-Type Water Heater

Experience has shown that the greatest source of expense in heating water electrically is the supplying of heat which is radiated from the storage boiler and the piping system. Unless the pipes are carefully lagged—a condition difficult and expensive to secure—fully as much heat will be wasted as is delivered in the water flowing from the faucet. On this account a heater located at the point of utilization will promote the economy which is so desirable in all electrical heating.

An ingenious device for this purpose has been placed on the market by a New England manufacturer. His heater, which is illustrated, contains a cylindrical porcelain body perforated to allow the water to flow through it freely. In the same passages are coils of resistance wire. There is a switch which is controlled by turning the handle which turns on the water. When this handle is in the neutral position both water and current are cut off; when thrown to the right, both are turned on, and the temperature of the water is regulated by the amount which

passes through the heater. With the handle to the left, however, the current is not turned on, and thus cold water can be drawn from the same faucet. For installation in a new house, this appliance will save the cost of the present system of pipes for hot water. It has the further merit of supplying water at any temperature desired, up to the boiling point, at a turn of the handle

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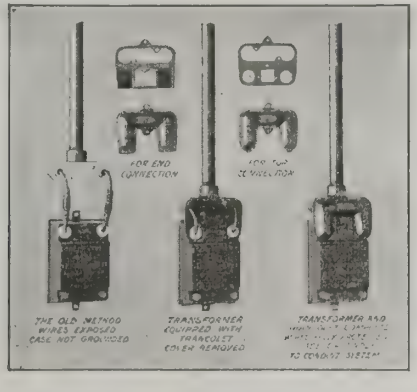
Fitting for Bell-Ringing Transformers

A wiring device called "The Trancolet" is expected by the makers to fill the long-felt want for a fitting to bridge the gap between conduit and the high-tension terminals of a bell-ringing transformer. Heretofore it has been necessary to leave the leads exposed in this space, making a needlessly conspicuous exhibition of wire-splices.

The Trancolet consists of two parts; the base which is designed to screw on the transformer and the outlet fitting; to-



gether with the cap to cover same. The base is apertured to correspond with the opening of standard outlet fittings, and to receive the primary bushings of the transformer. When installed the base is first placed on the transformer and fitting, the joint is then made with the service, after which the cap is screwed in place.

Besides insuring absolute protection to the wiring the Trancolet permanently grounds the transformer case to the conduit system.

"Geyser" Family Washer

Under the name of The Geyser, the Capital Electric Company, of Chicago, is marketing a cylinder type of washer with an all-metal tank and frame, electrically welded. The cylinder, which is removable, is of triple plated metal, and is easy to keep clean and sanitary. Due to the absence of chains, belts, and gears, this cylinder is easily removable thus making it possible to keep washer tank clean without great effort. The wringer is reversible, has safety release, and can be used at the same time as the washer, or independently. A ¼ horsepower Westinghouse motor operates both washer and wringer. Levers on the top edge of the washer control both, and a snap switch is provided for turning on current.

By the method employed in the Geyser, the clothes are always completely under water in a cylinder free to revolve, and a powerful circulation of hot suds is forced through them. Thus, as the clothes are not stirred around and lifted out of the water they do not become matted together, and are not strained or torn by rubbing or plunging. The washer is small but roomy.

The one illustrated, known as the family size, has a capacity of 6 sheets. A home laundry size is made, having a capacity of 9 sheets, and a smaller one for light washing, called the Baby Geyser, which is only 14 inches wide but has a capacity of 3 sheets. It is admirable suited for use in bathroom or kitchen.

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Candle Lamp for Soldering

The time-honored means for soldering wire-joints involves the use of a candle, although other forms of heat-production, such as the gasoline and alcohol torch or the hot soldering-iron, have been used, each has so great disadvantages that linemen and installers prefer the old-fashioned candle. Its heat is just great enough to allow of easy soldering, while

it is not powerful enough to anneal or crystallize the wires. Numerous wire-breaks on aerial lines can be traced to these causes.

A Pacific Coast inventor has just put on the market an improved form of holder which protects the flame from draughts, and yet allows it to be brought close up to

the wire which is to be heated. In use, the device is placed on the wires by raising the cap 16 a sufficient distance to uncover the slot 20 as shown in Fig. 3 and 4, sliding it on the wire the cap is then let drop so that its slots 21 seats over the projecting wire, thus all draft is excluded at this point and the device is held suspended and the hands of the operator left free for the soldering operation. Tubular solder may then be inserted through the hole in the top and rubbed against the wire. The candle may be lighted in strong winds since it is so well protected by the housing. A substantial economy in candles is effected, since all the melted tallow is saved and there is no loss by abrasion when the outfit is thrown into a tool-bag.

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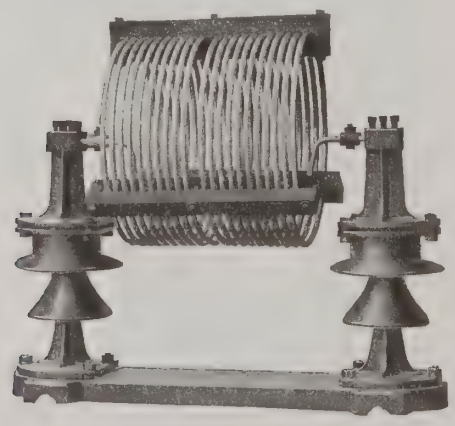
Nine and Fifteen-Inch Choke Coils

In the protection of electrical apparatus against lightning a good coke coil is almost as important as a good arrester. The high frequency or steep wave front of lightning and other surges builds up an excessive voltage between the ends turns of electrical apparatus connected to the line as well as a high voltage to ground. A choke coil connected ahead of the apparatus will take the place of these end turns and the strains will thus occur across turns whose insulation is especially designed to stand it. Even if the insulation of some of these turns does break down no harm will result, as in the case of a transformer, as the air insulator is self-healing and the coils have no short circuit energy to maintain an arc between turns.

A good choke coil must have sufficient inductance to choke back the greater part of each high voltage surge, and high insulation to ground. It must also have high mechanical strength



so that it can support its own weight without sagging and can resist the stresses due to line short circuits when they occur.

The Westinghouse Electric & Mfg. Company has recently added to its line of 15-inch choke coils a new line of smaller coils 9-inches in diameter. Both sizes are listed for outdoor or indoor mounting up to 130,000 volts, with a separate line of 9-inch coils for indoor mounting up to 49,000 volts. These coils are of the typical Westinghouse construction and are made up of a helix of aluminum rod in the 200 and 400 ampere capacities and of copper in capacities of 600 amperes and above.

A typical feature of their design is the thorough bracing of each turn of the coils, which gives them all the rigidity necessary to withstand the stresses due to line short circuits. The bracing of the turns makes it unnecessary to reduce the diameter of the center of the coil and thus sacrifice much of the inductance in order to prevent sagging. Another notable feature is the construction of the insulator supports which (except in the case of the 9-inch outdoor coils below 49,000 volts) permits inverting the insulators so that the coils can be mounted either upright or suspended from the ceiling.

In the case of the very high voltage coils where built up insulator columns are used, the porcelain units are bolted together and it is therefore easy to replace broken porcelains or add more units when desired.

The 9-inch coils, now offered for the first time, have as much inductance as is ordinarily used, and can be applied in a great many installations where lightning conditions are not abnormally severe and where the apparatus to be protected has good modern insulation. The 15-inch coils have about 5 to 7 times the inductance of the 9-inch coils and afford correspondingly greater protection. They are the largest helical coils now on the market for lightning protection and should be used wherever lightning conditions are very severe or where apparatus is not new and rugged. For the protection of high-voltage motors and generators connected directly to transmission lines even larger choke coils are vitally necessary.

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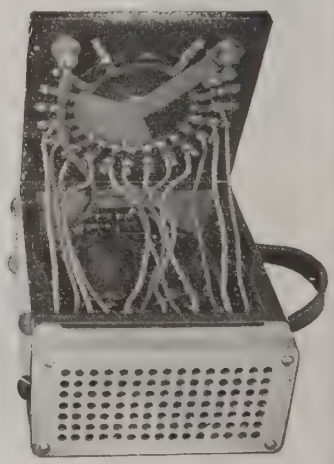
Phamton Load Box

A new phantom loading box, known as their type F, has been designed by a company which has had many years' experience in this work. As will be seen in Fig. 1, the instrument is of attractive appearance, having bakelite moulded top and operating handle. The secondary current in amperes is marked on the stationary outer circle, and an arrow on the moving part indicates the value set for. Reference to Fig. 2 shows, in the bottom of the box, the small transformer which reduces line voltage to 5 volts for currents above 5 amp., and to 10 volts on the lower part of the scale. This is done to offset the greater drop through the current coil of a small meter.



The instrument is calibrated with a definite pair of low-tension leads, which should not be altered. Current steps are 0.1, 0.2, 0.5, 1, 2, 5, 7.5, 10, 15, 20, 25, 35, 50, 75. A power-factor of nearly unity at all loads is secured. The Type F meter is particularly suitable for use with a rotating standard test meter.

In use, the potential of the line is connected to the circuit through a cord and special plug put in the holes marked "110" or "220" (See Fig. 1) according to the voltage. The wires are also connected to the potential coil of the standard watthour

meter. Connection is made from the heavy secondary binding-posts to the current coils of both meter in series. The desired load is then indicated by short-circuiting various resistances, located in the metal cage, by means of the sector and hand-wheel and readings are taken in the usual manner.

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New Electric Washer

A Western Manufacturer has recently placed a new washer on the market, known as the "Wonder," which is sold with a five-year guarantee. The tub is made of heavy cold rolled polished copper, tinned on the inside. The legs are of steel tubing with steel braces. They are copper plated and polished to match the finish of the tub. A stand is made for the tub which folds back out of the way when not in use. The wringer is reversable and is provided with ball bearings. The gears are fully enclosed. The operating mechanism of the washer is provided

with ball bearings and is so constructed that the gear is automatically disconnected when the cover of the tub is raised. The water capacity of the washer is 17 gallons, and it weighs 115 pounds. It is belt driven by a ⅛ horse-power motor, manufactured by The Robbins & Myers Company, Springfield, Ohio. The motor is a splash-proof design which is made especially for washing machine service.

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Electrolytic Lightning Arresters

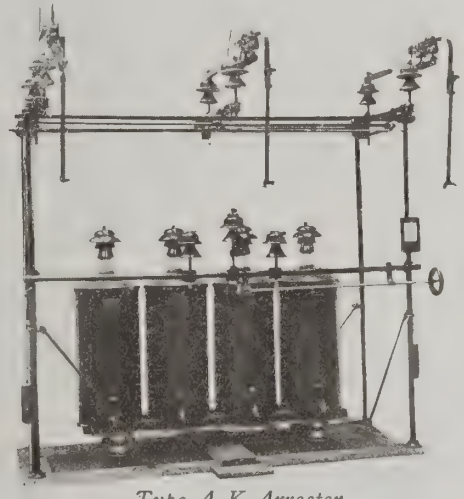
The Westinghouse Electric & Manufacturing Co., as a result of research work, which is carried on continuously for the purpose of increasing the efficiency of electrolytic lightning arresters, has made several improvements in its line of such apparatus and now offers the two forms illustrated, designated as types A and AK. The type A arrester is designed for voltage up to 2,450 and is furnished for indoor mounting only; the type AK is for operation on alternating current at 2,000 volts and above, particularly where generators are to be protected.

Type A Arrester

The electrolytic lightning arrester offers a very high resistance to the flow of current at normal voltages and very low resistance to current at abnormal voltages, the change in resistance being instantaneous with the charge in voltage. It also acts as a condenser, so that its effective resistance to current at low or normal frequencies is great, but to currents at high or abnormal frequencies such as the frequencies of static disturbances, it is small. These two properties are due to films electrochemically deposited on aluminum trays in the arrester.

While designed for direct current service in railway or lighting power houses and substations, the present form of type A arrester with spark gap may be used for low-voltage alternating current installations. It is similar in construction to the type AK except that no charging resistance is required. The same aluminum trays are used, and these are mounted in an iron tank of ample strength, and of such size as to provide sufficient oil for cooling purposes under all possible operating conditions. As the size of aluminum plate exposed to the electrolyte is twice that of any other alternating current aluminum arrester, this arrester exceeds in discharge capacity any other arrester for similar sevice. It is not limited to any particular kilowatt capacity of circuit. It is furnished with a fuse mounted on top of the tank with a gap for insulating the arrester from the line. This gap can be easily short circuited for charging purposes, which operation should be performed once a day. The arrester can be operated on direct current with the gap closed, but in this case the leakage current disintegrates with the aluminum trays and the electrolyte, giving them a much shorter life than when a gap is used.

The type AK arrester consists of a system of nested, aluminum, double cone or cup-shaped trays, supported on porcelain and secured in frames of treated wood, arranged in a steel tank. The system of trays is electrically connected between line and ground and between line and line. These



Type A K Arrester

trays contain a liquid electrolyte which forms a film on their surfaces. This film prevents flow of current at normal voltages but forms a free path for abnormal voltages or static discharges. The distinctive features about this arrester are: A new inorganic electrolyte that is more stable chemically, less affected by heat, and which causes less dissolution of the film between charging periods than any electrolyte previously on the market; double cone shaped aluminum trays, the area exposed to electrolyte being double that of any other arrester; trays spaced by porcelain pieces and not touching wood; ventilating duct in center of tray stack for additional circulation of oil; tank linings of bakelite micarta, impervious to moisture; charge and discharge resistance on all arresters, and fuses included.

Type AK arresters for outdoor service are the same as the indoor arresters except that the outdoor arresters are provided on terminals. The outdoor arresters are not furnished for voltages of less than 10,000, as for voltages below this the horn gaps cannot, with safety, be set close enough together out of doors to take advantage of the freedom of discharge of the electrolytic element. If the horn gaps are set too close they are short circuited by rain.

Horn gaps are furnished on all type AK arresters, they are readily adjustable for any line voltage and so arranged that the bridging necessary for charging is easily accomplished.

On indoor arresters, for voltages below 9,900 volts, bridging is accomplished by tilting one horn of each pair until a phosphor bronze strip attached to each movable horn comes in contact with the corresponding horn and short circuits the gap. A spring insures the return of the movable horns to their normal position after charging. For charging arresters on circuits of 10,000 volts and higher the proper adjustment of the gap is obtained by setting a stop on the horizontal bar that turns one of each pair of horns about on its own axis. When properly adjusted for operation the horns are slightly offset. When the arresters are to be charged the horns are swung back until they are in the same plane. The horns, when opened to their widest extent, serve as a disconnecting switch and insure safety to those working about the arrester.

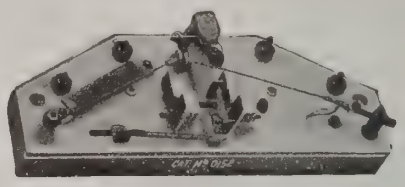
Charge and discharge resistance connected between the main horn gap and the arrester proper is furnished with all type AK arresters. These resistance units consist of rod resistors in shunt with small spark gaps. The resistor is of a composition known as "Koppat," the resistance possessing the quality of remaining practically uniform under all conditions of service. The shunt gaps are between small horns. In the low voltage arresters one resistance rod and one shunt gap are used. In the higher voltage arresters, two of each are used in series.

Condenser arresters have been in use for over three years on direct current lines of voltages up to 5,000 with almost perfect success, so they can no longer be considered an experimental proposition. These arresters can also be used on low voltage alternating current circuits, but they are not yet available for 2200 volts alternating current or higher. A condenser arrester has the same protective effectiveness on alternating current as on direct current circuits, and its development for alternating current service is dependent simply on commercial conditions.

Tu-Way Flasher

Makers of display devices will be much interested in a new flasher called the "Tu-Way." This is designed to energize two circuits alternately by moving a central contact between two points. Heretofore it has been impracticable to operate such a device thermally, and motor-operated flashers have been too expensive for the multitude of displays which need current alternately in two circuits.

The principal which makes positive contact on either side is most ingenious. By reference to the illustration, the long V-shaped wire is heated by passage of current through the spiral which surrounds it. As it expands it allows the coiled spring to draw the bar to the left. At the end of this bar will be seen a U-shaped piece which carries a strip of sheet steel. This strip is held bowed out toward the contact-point which it touches. As



the pressure against this point becomes heavier, the steel suddenly snaps over and bows out in the other direction. The movement of its center is enough to bring it into contact with the other point, and current now flows through the other circuit. The heating coil is then out of circuit and the wire cools, contracts, and draws the contact bar up against the contact tighter and tighter until it snaps over to the other contact.

All contacts are of platinum-iridiurm, ensuring long life; a condenser is also connected across the contacts. These have a capacity of 1.50 amperes. The retail price of the device is $10.00 to the public.

There is no danger of the spring losing its elasticity, as the current density is very small, due to its liberal design.

ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

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Between Company and Consumer

By John F. Duncan

The New York Edison Company maintains a Bureau of Home Economics to care for the point of contact between the company and the home-maker, and as an intermediary between manufacturers and the public. The Bureau reaches housekeepers with purely educational material, given out in the form of articles for womens' magazines, lectures and demonstrations before clubs, a cooking-school held in the Bureau's demonstration room, and letters to selected lists of patrons. It tests new appliances under actual working conditions, advising the manufacturer of the results, and suggesting possible improvements. A great number of devices are on display, and the Bureau maintains a completely equipped electrical kitchen. At the annual Electrical Show the Bureau has a large exhibit.

PERHAPS the most characteristic feature of central-station commercial work is the amount of time and money spent on purely educational publicity. Especially is this true in the domestic applications of electricity. There is no more conservative institution than the family kitchen, and the housewife lags behind everybody else in doing things electrically. Hence it is necessary to use every means to reach her with the message that the electrical way is the best way of performing most of her household tasks. The channels through which information is conveyed vary widely, depending on the community and the amount of money available for the work. One of the most interesting recent developments has been the testing department for domestic appliances of which the Bureau of Home Economics of the New York Edison Company is perhaps the best example. While the cost of the Bureau as a whole is beyond the means of all but a few companies, yet there are many single activities which fit so nearly the needs of individual communities that the necessary expense can well be justified.

According to Miss Anne Broome, Manager of the Bureau, her organization performs two distinct functions. First, it furnishes a point of personal contact with the Company's domestic patrons, and second, it acts as an intermediary between the public and the manufacturers of electrical goods. Its quarters occupy an entire floor of the Company's building on Forty-second Street, in the heart of the shopping and theatre district. The staff includes the manager, who reports to the Commercial Manager, an Assistant Manager, a special cooking instructor, seven demonstrators, and a maid.

Toward the public, the Bureau takes the attitude that its mission is purely educational. It tries, first of all, to teach the best modern ways of doing things in the home. Of course, the methods used are all electrical, but no special effort is made to push electrical devices, nor does the Bureau make any direct sales. Every piece of apparatus bears a tag, giving the maker's name and address, and the selling price. It is suggested to an inquiring patron that she communicate with her nearest dealer. When so requested, the Bureau will give an order to ship the goods C. O. D. It is felt that the knowledge that the Bureau has nothing to sell makes the public feel freer to come for information before determining to purchase, and it allows the demonstrators to recommend the most suitable apparatus without regard to make.

Furniture Does Much to Create a Favorable Impression

During the winter of 1915-16 the Bureau held a series of seven lecture-demonstrations on cooking, which were arranged in an ingenious way. The suggestion was made to a prominent New York club-woman that she organize a "Home Economics Division" of the Federated Women's Clubs. This she was glad to undertake, and by appearing personally before the local organizations she interested about two hundred women of the progressive sort who, once converted, make most useful friends for electricity in the home. The new Division met seven times, at monthly intervals in the Bureau's demonstration room, listening first to a talk on some phase of home management by a speaker

Visitors May See it "Done Electrically"

which they secured. Then one of the Bureau's representatives spoke on electrical methods in the home, including the preparation of many appetizing dishes. Afterward, the audience had opportunity to examine the wide variety of appliances on display, the corps of demonstrators being on hand to answer their questions.

For the coming season the Bureau's activities will be widened by the introduction of two new plans. A regular cooking school will be held in the company's building, free of charge to all. This will be in charge of a special cooking instructor, who will give six lectures on particular classes of foods and their preparation, and four on the preparation and service of complete meals. For this purpose tables carrying individual equipment of the usual school type will be installed, and for larger work the regular kitchen will be available.

The equipment of this kitchen is intended to be a model for a family of six to eight people. It occupies a space of 13 ft. by 8 ft. at one end of the demonstration room, yet has working space large enough for three people to prepare a meal without confusion. The apparatus installed is as follows:

Apparatus	Size	Cost
Westerburg & Williams refrigerating system	¼ h. p.	$350.00
Western Electric two-disc range with movable oven	2,000 watts	35.00
Buzzini Warming Table (also used as kitchen table)	805 watts	125.00
Westinghouse Automatic Range with oven, broiler and three outside discs	6,850 watts	105.00
Rapid Dishwasher (can also be used as kitchen table)		29.85
Reynolds Power Unit (for turning all kitchen utensils which are usually turned by hand)	¼ h. p.	35.00
Hamilton-Beach Drink Mixer for beating eggs, making mayonnaise, etc.	50 watts	12.50
Sprague Electric Works Ozonator for counteracting odors	75 watts	75.00

In order to carry information to a larger circle, the Bureau is preparing to give lectures before womens' clubs throughout its territory. As in its other work, the aim will be to teach the preparation of certain dishes and the performance of certain tasks, the desirability of electricity being suggested only by inference. These lectures will include foods prepared with lamp-socket devices, such as chafing-dishes, two-plate kitchenette ranges, percolators, etc. There is a great field for this in New York on account of the large number of people who have no regular kitchen facilities, and who now depend on restaurants for their meals. It is felt that many of these people can be induced to prepare at least the lighter meals themselvs, if they can be shown how little trouble it is to "do it electrically." There will be other lectures on kitchen arrangement, laundry and cleaning and domestic refrigeration.

With the assistance of the Company's "Follow-up Bureau" sales-promotion letters are sent out to selected lists of customers. One of the most successful appeals was that of a letter announcing that Santa Claus had left some of his wares on display before he put them in his pack, and that if kiddies and grown-ups too would come they might tell him what they'd like to have left in their stocking. Over twelve per cent. of those written to responded, and their elders played with the electric trains and motors as eagerly as did the children.

A much wider form of publicity is the furnishing of suggestions or entire articles for women's magazines. The Bureau feels that the time and effort is well spent

Youngster and Oldsters Were Delighted

for the national magazines reach many of their own patrons, and it is glad to make this contribution to the good of the industry.

The service of the Bureau to manufacturers is rendered by making, free of charge, tests on new apparatus under actual service conditions. When a new type

(*Continued on page* 55)

Decorative Lighting for the Home

By C. E. Clewell, Assistant Professor of Electrical Engineering, University of Pennsylvania

IT IS hardly necessary to use the word decorative in the above title in connection with home lighting, since the lighting effects in the home should practically always be decorative, and the plans and methods followed should be looked upon as constituting an art and should receive careful study just as the plans for the physical interiors of rooms and halls in the well designed home are made the object of careful study from the artistic point of view by the successful architect.

One of the greatest criticisms which can be made of most of the older home lighting, and unfortunately of many modern cases as well, is the excessive attention which has been directed towards decorative fixtures and the fact that too little thought has been given to the way and means for obtaining decorative lighting. Examples of this are to be found on every hand and one of the principal objects of this article is to set forth some of the steps which have been taken to improve these conditions.

Fig. 1 *Fig. 2*

It should not be inferred from the foregoing paragraphs that utility is to be entirely neglected and over-ruled by considerations of appearance in the average conditions of home lighting. The illumination of each particular room has its peculiar requirements and these should be carefully studied and provided for when selecting the lighting equipment.. At the same time appearance need not be sacrificed because, in the main, by judicious planning, average home lighting conditions can be made highly efficient and effective and also pleasing from the decorative standpoint.

Difficult to Set Standards

One of the peculiar features of home lighting is the fact that each individual property owner or house holder, in general, considers himself his own best illuminating engineer. The architect or the builder installs the kind of fixtures in the various rooms which happens to appeal to his own individual taste or possibly more to his financial limitations, and then the tenant of the house feels free to modify the size of lamps in given fixtures to suit his own fancy.

This state of affairs has quite naturally led to a widely diver gent set of conditions in home lighting and also to wide-spread abuse of the most simple and obvious principles of good illumination. Again, the numerous types of residence structures make it almost, if not entirely impossible to standardize the lighting of given rooms in residence lighting work. About all that can be done is to suggest ways and means which have been found useful in obtaining good lighting effects in such typical cases as the living room, and the like, in the hope that such suggestive information may assist those who have similar problems to solve, in obtaining equally successful results.

It should be apparent that the exceedingly diverse nature of the homes in a community, their many and varied arrangements of rooms and the various shapes and sizes of given rooms in a certain class, are all conditions which probably make home lighting one of the most important branches in the entire lighting field, and one in which there is a unique demand for originality and for the exercise of judgment on the part of the designer.

It is unfortunate that so often the choice of lighting fixtures and the system of illumination for a new home lies in the hands of one but little acquainted with the elements to be sought if good illumination is to be secured. Upon such, the responsibility of future improvements in this field largely rests. At the same time the tenant often desires to purchase a new fixture or to modify existing fixtures for producing new results. From this standpoint, his own eduation up to the possibilities in the situation become an important and prominent factor.

While rules covering general cases are rather difficult to make, there are several features which have been the object of considerable study with materially improved results. One of these is concerned with recent developments in

Table and Stand Lamps

The older types of table and stand lamps have been, in many cases, characteristically and fundamentally bad. Composed of an upright stand, as is so often the case, with an art glass shade resting on some form of support at the top of this stand, the bare lamps distributed beneath the shade, not only result in a poor distribution of light under the lamps, but are often mounted at such unfortunate distances below the shade, as to make the filaments themselves visible to occupants in various parts of the room. Older table lamps have therefore usually possessed poor light distribution characteristics and have produced glare, thus failing to meet two of the most important conditions required in good lighting.

Figs. 1 and 2 are shown as examples of marked improvements found in the better table lamps now available. The finished table lamp in Fig. 2 has an artistic semi-transparent shade mounted over the unit composed of the lamp and its glass reflectors. The art shade (not shown) conceals the parts of the lighting units shown in the illustrations and gives the lamp as a whole a finished and pleasing appearance.

In Fig. 2 either the ordinary Mazda or a gas filled lamp is placed in a vertical position at the top of the stem. This lamp is mounted in a glass reflector which sends part of the light directly to the ceiling of the room through an opening in the outer art shade, and by direct transmission through the glass reflector, the art shade is illuminated. Moreover, a useful but diffused part of the light is transmitted downwards at oblique angles so that a considerable portion of the total light is thus transmitted to the table surface and to adjoining part of the room. Any given point in the room is thus, in general, illuminated partly by light transmitted directly through the glass reflector and

partly by light reflected by the ceiling due to that part which is sent upward by the reflector immediately surrounding the lamp.*

The light may be furnished altogether by the lower cluster of lamps (upper unit turned off), in which case practically all the light on the table surface is directly transmitted through the lower bowl. Again, the upper unit may be used alone, thus sending a large proportion of the light to the ceiling and thence to the table surface; or both may be used together, thus giving a combination effect. This scheme removes, or at least greatly reduces the difficulties found in the older and inferior table lamps, and it produces an illumination which is soft and free from glare and at the same time so distributes it that the result is more efficient as well as more pleasing. In the unit shown in Fig. 2 a rheostat is made a part of the lamp so that the light may be reduced at will.

Use of Opaque Reflector

Fig.. 2 shows a somewhat different arrangement Here an opaque shade (interior of mirrored glass) surrounds the principal lamp, sending its light to the ceiling and producing in the room an effect practically identical with that of the total indirect system. Small lamps mounted below this opaque shade, but which are inside of the silk outer shade, give an artistic setting to the unit as a whole by illuminating the outer silk shade. Fig. 3 furnishes an excellent idea of a living room equipped with a table lamp of the kind shown in Fig. 2. Note particularly in Fig. 3 that most of the illumination results from ceiling reflection, and yet the small lamps under the silk outer shade furnishes enough direct light to give a sense of warmth and cheerfulness to the interior.

One of the most common mistakes made in earlier residence lighting was the adaptation of the older gas fixtures to electric lamps by merely mounting an electric lamp at the end of each of the arms of the gas fixture. This natural, although bad practice of continuing the design of electrical fixtures along the old lines which had been developed for gas lighting, led to many examples of the worst possible home lighting. It is not uncommon, even now, to find many fixtures with badly exposed Mazda B or even Mazda C lamps at the ends of fixture arms, at or near the centre of the room, the lamps being so low as barely to clear the heads of those who may stand immediately below the fixture.

The gradual adoption of the numerous examples of semi-indirect fixtures has been a most welcome change. Fig. 4 is selected merely as one of many cases which might be shown, where a semi-indirect fixture, in this case usng an Alba bowl, is mounted near the ceiling in a living room. This is an excellent illustration of semi-indirect home lighting and in this case it should be noted that a considerable portion of the illumination is due to ceiling reflection, but at the same time, there is a direct transmission of light through the bowl, thus giving possibly more warmth to the fixture than could otherwise be realized.

The foregoing examples are merely suggestive. Many others of equal interest might be discussed with profit, and in using these special cases outlined, it has been the object to describe briefly the main features and to point out some of the most important points which should be secured. Where the comfort and convenience of such a vast number of people are involved throughout the homes of the country, it follows that all efforts made by central station solicitors and by others to improve the conditions of the illumination in such places, should go just so far towards the betterment of the ideas of those who use the light, concerning the nature of the items which can be used today in the production of good illumination results.

*Fig. 1 refers to products of the Geo. C. Lynch Co., N. Y., and Fig. 2 refers to a table lamp of the National X-Ray Reflector Co., Chicago.

* * *

New York Rate Case

In connection with the reopened rate case of the New York Edison Company before the Public Service Commission, Mr. John W. Lieb, vice-president and general manager, has made an interesting statement of his company's position. Under the rate schedule which went into effect May 1, 1915, presumably for three years, there was a net saving to consumers of about $2,100,000 per year. This is a revenue loss to the company which, had it not been for a tremendous increase in sales, would have meant a net revenue loss on the year's growth. This increase is too ephemeral to give it any standing in the case.

Of the class whose bills average less then $2.00 per month, there are 45,000 on the lines. If a rate less than the present 8c were to go into use it would be necessary to have a minimum bill, which would "shake out all the little fellows"—resulting probably in a net revenue loss.

In order to show a profit in the face of rising prices, it has been necessary to practise rigid economies, even to the curtailing of salary advances. Earnings for the year ending May 31 last show an excess of but $1,885,000 over interest and dividends, which is only 3 per cent. on more than $60,000,000 which the company claims as the excess of assets over funded debt and capital stock. If it be granted that this excess of value be entitled to interest at 8 per cent. the shortage in the last year is $3,000,000. Since 1900 the annual dividend has been less than 4 per cent.

Indirect Lighting from the Lamp of Fig. 1

Semi-Indirect Lighting

Telephone Subway Reconstruction in New York City

By Clifford M Hartley

Assistant Engineer Empire City Subway Company

This article is continued from the October issue in which Mr. Hartley covered the general aspects of the work.

Having covered, in a general way, the precautions necessary to prevent service interruptions on cables exposed to the rather rough mercees of subway contractors, and the nature of the difficulties encountered in locating duct-runs in cramped quarters, it may be of interest to tell of some places where reconstruction was particularly difficult. One of the most unusual jobs was the crossing at Church and Cortlandt Streets, so we will take that up first.

Broadway and 27th Street. Iron-Pipe Telephone Ducts Below Other Pipes

The Cortlandt Street System

This crossing, which is almost in a class by itself, in that it possesses certain features of design not found in any other subway, is known as the Cortlandt street syphon, and is so called on account of its resemblance to what is termed, in sewerage practice, an inverted syphon. The subway, consisting of 127 ducts, extends from a manhole on the east side of Church street, under the structure of the rapid transit subway to a manhole on the west side of Church street, and its construction in this form was made necessary by reason of the following:

Before the rapid transit line on Church street was built there was a subway of 100 ducts running west on Cortlandt street from the Central office, and carrying, among others, the main trunk cables to New Jersey and points beyond. On the west side of Church street, between Dey and Cortlandt streets, there was a line consisting of 27 ducts. Upon planning for restoration at this inter section, it was discovered that owing to the underground station of the Hudson & Manhattan R. R. Co. and the new subway line, it would be impossible to replace these ducts in their original location, or in the street. They were therefore relocated in the only remaining space, namely, under the sidewalk on the east side of Church street, and close to the building line. This made it necessary to add 27 ducts to the original 100 crossing Church street, or a total of 127 ducts to be carried across a narrow intersection containing, besides the usual water, gas, and steam mains, and elevated railway, a street-car line, the rapid transit tunnel, and part of the Cortlandt street station. There is a clearance of less than five feet between the top of the subway roof and the street surface, and it was obviously impossible to bring across this shallow, congested section a subway of such size. There was but one way out, and it was a case of "get out and get under." The principal features of the design of this work are as follows:

On either side of Church street, just outside the walls of the rapid transit tunnel, a special manhole was built. These manholes are 18 feet and 2 inches long by 8 feet wide, with a clear headroom of 16 feet and 6 inches. They are of heavily reinforced concrete, and are each provided with four castings, to permit of access to all of the compartments into which the hole will be divided by the racking and stowing of the complete cable plant. The duct-bank, consisting of 127 3½ inch wrought iron pipes incased in concrete, is solid throughout the greater part of its length, but before entering the manholes it is split in two parts (6 wide and 10 deep) and each of these is in turn halved, so that the ducts enter the manholes, from the bottom, in four separate clusters. The problem of racking the cables from this entering direction was solved by carrying the ducts up in a pyramidal form, so that they are stepped up from the outside toward the center, the lowest ones being 18 inches above the floor, which places the open ends above the elevation of mean high water. These openings are further protected by hoods fitting around the cables and over the pipes. Special center racks and methods of racking are employed, as the cables are brought up vertically, and then bent over into a horizontal position. In place under the subgrade of the rapid transit tunnel, the top of the subway is 25 feet below the surface of the street.

The wrought iron pipes which form this subway, issuing from the bottoms of the manholes in a vertical position, are bent to a very short radius in order to bring them to the

N. W. Corner Broadway and Broome Streets. Manhole Under Construction.

horizontal. It is the customary practice, as noted before, to make such bends in wrought iron pipe with the bending machine. On this particular job, however, they were hot-bent, each to its predetermined radius, as shown on a drawing prepared by the Public Service Commission. This was made necessary by reason of the great number required (254 bends) and the short radii used, some being only 3½ feet.

Reconstruction at Broadway and 42d Street

One of the most important points, and one of the most difficult, from the constructional viewpoint of the rapid transit contractor, along the routes of the new dual system, is at

Broadway and Forty-second street. Here—for example—the existing rapid transit subway runs, in part, under the Times Building, and the new Broadway and Seventh avenue lines form a connection with the old system, also crossing underneath it to continue up Seventh avenue.

This intersection of Broadway and 42d street is the governing point in the studies for restoration and new subways along the Broadway line. It was necessary to determine accurately just what could be accomplished there, and for this reason a two-block-long subway was built (from 41st to 43d streets) in advance of rapid transit construction. This subway is unique principally in its location, which is between the car tracks, preliminary studies having indicated that to be the only possible space in which to build a subway of the number of ducts desired, namely, fifty-two.

The formation of the ducts leaving the manhole at 41st

Southeast Corner, Broadway and Pearl Streets. Empire City Ducts on Top

street and running north on Broadway is six wide by nine high, which, with 3½ inch wrought iron pipe, requires a space 34 by 48 inches. At 42d street, where the line crosses over the present rapid transit subway structure, it was necessary to change this formation to 13 wide by 4 high, and even when thus flattened the top of the conduit is only 17 inches below the street surface. On the north side of 42d street, two gas mains—a 20 inch and a 12 inch—were relocated, and a specially designed sleeve was placed on a 12 inch water main, in order to permit of the passage of our structure; and further on, between 42d and 43d streets, it became necessary again to change the duct formation, and to split the subway in two parts to enable it to pass a 20 inch water main.

Added to these difficulties, there was the fact that this work must be performed entirely at night, or between the hours of 10.30 P. M. and 7 A. M. The volume of traffic at this intersection is enormous, and, as a matter of fact, it was not possible to accomplish much, on the surface, until after midnight, owing to the after-theatre traffic. Every morning, upon finishing work, the excavation was planked over, and reopened the next night.

There is a certain phase of this subject of electrical subway construction in its relation to rapid transit work which is worthy of consideration. It is the peculiar nature of the engineering work involved in the solving of the problems presented in this restoration of subsurface structures. Many engineering works of seeming difficulty, possessing spectacular features calculated to arouse and claim the interest not only of the general public, but of the technical world as well, are, in reality, comparatively simple in their design and construction. Ofttimes the magnitude of the undertaking carries an appeal which overshadows lesser works involving, more than likely, engineering problems of greater difficulty. Most engineering structures may be designed, and built as designed, without let or hindrance. But he who enters here leaves design behind. It may be said without fear of contradiction that in all this rapid transit work, involving as it does the expenditure of hundreds of millions of dollars, and the construction of mile after mile of tunnel, the most baffling and puzzling features are to be found in the subsurface restoration situations. Many an engineer, expert and capable in designing a bridge, for instance, would be at a loss when confronted with an intersection which is an apparently hopeless tangle, offering not a loophole of escape. Yet there are many such intersections, and they present real engineering difficulties which arise most unexpectedly, and in the twinkling of an eye. Their solution, as we say, requires a highly specialized form of engineering experience. To successfully handle this work, the engineer must have a knowledge of the practical application of engineering as applied to sewer and waterworks construction, gas and steam-main installation, and, of course, the construction of electrical conduits. Much of this must be obtained by experience on this particular work, the exact duplicate of which is nowhere else to be found.

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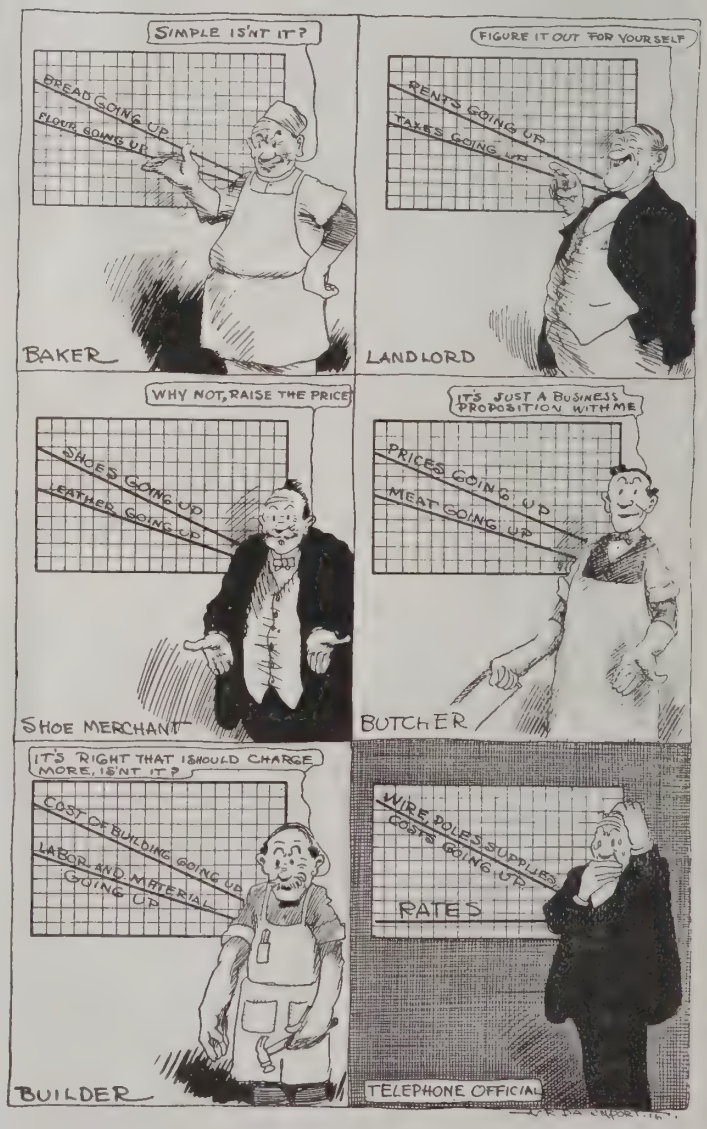
—and Central Station Rates, Down!



Bell Telephone News

The Enjoyment of a Patented Invention

By Bayard H. Christy

This is the third and last of a series of articles by Mr. Christy on the general subject of Patents.

HE who owns a patent may, unless by word or deed he has obliged himself to do otherwise, freely sell it or any fracpart of it, or he may grant license under it to whomever and to as many as and on such terms as he pleases.

One who is with others a joint owner of a patent cannot sell it *all*. He cannot restrain his co-owners and those authorized by them from enjoyment of the invention; but, in other respects, his rights are full and complete. And, whether his share be a half, a tenth, or a hundredth, he may (subject, as already explained, to possible restraint under prior dominant patents) make and use and sell the thing patented; he may assign his share in the patent to others; he may grant licenses under it. Of course, in respect to any and all these things, the owner of part of a patent may have bound himself by contract with his co-owner: for example, he may have received his share on condition not to sell it without the consent of his co-owners; or he may have agreed to share with them his profits. Such contracts are good and enforceable. But, with recognition of this, the fact remains that, unless specifically prevented by such a contract, the owner of a fractional part of a patent may deal freely with his portion of the title and with the invention.

The transfer of a patent, of the legal title; or the transfer of any fractional part of the legal title; or the transfer of the exclusive right to make, use, and sell within a certain specified territory—any such transfer is an assignment, and must, if it is to be effective, be made in writing and the writing must be recorded.

Making an Assignment

Assignment may be made while application for a patent is pending, and in anticipation of the grant, or it may be made after the patent has been granted.

There are no particular words in which assignment must be made; the essential thing is that the words used shall express the clear intention to assign. The pamphlet published by the Patent Office, containing the Rules of Pratice, contains also forms of assignment which may safely be followed. It is quite common that assignment is made on conditions or under circumstances which rended the published from insufficient; and in such case a man desiring to make assignment should consult his lawyer.

The written assignment must be recorded in the Patent Office, and must be recorded within three months of its date; otherwise, it is of no effect against a subsequent purchaser for value without notice. That is to say, if A sells his patent to B, and the assignment is not recorded, and then more than three months later A sells the same patent to C, and C pays money for it, and C has no knowledge of the earlier transaction with B, then C gets the patent.

Of course, in the case just mentioned, A could never challenge B's right; it is only the *bona fide* purchaser, a stranger to the first imperfect assignment, who can act in disregard of it. And so, if A should undertake to sell his patent to B by word of mouth only, B, no doubt, would acquire a right as against A—A could never challenge B's right to use the invention. But B would not acquire legal title. B could never sue some one else for infringement.

Granting a License

But, while transfer of the title or of a fractional part of the title to a patent must be in writing, the mere grant of a right to use the invention—that is to say, a license—need not be (though ordinarily it is) in writing, nor need it be recorded.

The grant of any right under a patent, less than the whole monopoly or than a fractional part of the whole monopoly is a license. To illustrate: The conveyance of the exclusive right for the State of New York to make and use and sell the invention is an assignment; for the thing conveyed is, within the territory defined, the monopoly. But the conveyance of exclusive right for the State of New York to make and use, without the right to sell; or of exclusive right to sell, without the right to make, is a conveyance of something less than the *whole* monopoly; and, so, of course, the conveyance of a right, not exclusive, to make and use and sell, is conveyance of something less than the whole monopoly, and is not assignment. It is a license, and nothing more.

A license may be granted in writing, as has been said, but it need not be. Like other contracts, it may be proved independently of any writing. Indeed, it is not necessary that it be granted in so many deliberate words. It may come into being by implication, and in consequence of the acts of the parties concerned, as will presently appear.

Some notes and comments on this general subject are pertinent:

When an Employee Signs a Contract

A man enters the employ of a manufacturing company, and when he does so he makes a contract—signs a contract in writing—in which he agrees that, in case he makes an invention, it shall belong to the company; the company will pay the cost of the patent, and the inventor will assign the patent to the company. The employment begins, the employee makes an invention, makes application for a patent, and a patent is granted. The patent belongs to the employee; he is the owner, the legal title is his. But there are rights under the contract which the employee will not advisedly disregard. The company, though it has not yet the title, has *the right to obtain the title*; it is the *equitable* owner; it may, if the employee is recalcitrant, go into court, and on proper showing the court will require the employee to transfer his patent to the company.

Note, the employee was not required to sign the contract at the start, but he signed it; he wanted the job badly enough to enter the contract. Having made it, he must abide by the consequences. If, violating his contract, he assigns the patent to someone else, he will be answerable for breach of his contract; and, unless the purchaser has acted in good faith and has paid a valuable consideration, the company may follow the patent and get it back again.

Right to Invention Without Contract

Such a situation is common. But there is a commoner one. The employee enters his employment with no agreement respecting future inventions. He is a trained and intelligent man. He becomes acquainted with the employer's methods and operations, and he makes an invention pertaining to the business. He builds a machine for the practice of the invention; in doing this he spends the employer's time and the employer's money. The machine operates, and its product goes to the company's wareroom and is sold in regular course. The employee obtains a patent. Can he then restrain his employer from using the invention? No, not on the facts stated. He has by his very acts put his employer in the position of a licensee; he has by his acts created an implied license in favor of his employer, and that license he has no power to revoke.

This subject of implied license incident to employment is not simple; every case must be determined on its peculiar facts and circumstances. The general principle is that in this matter the employee is bound by his own acts, and if he has so acted as to confirm a license in his employer, he cannot take away by direct act what he has conferred by implication. But the right so created will not be any greater or more extended than the

facts justify. And it it is a matter of a single machine, in a shop where many such are used, the employer's right will be limited to a single machine, unless there lies in the circumstances an implication that the employer may use more So, again, if the employer operates a number of plants geographically separated, there must be peculiar and positive basis for an implied license extending to all the plants.

Here again the advice of a lawyer will in particular cases be required.

License by Implication

License by implication is very common in patent law, and under various circumstances. Here is another instance: A man gets a patent for a cork-screw. Under the patent he has exclusive right to make such a cork-screw, to use such a cork-screw, and to sell such a cork-screw. He may see fit to hold his patent and make none. If someone else makes one, if another sells it, if still another use it, the patentee has a distinct and separate cause of action against each of the three; each has infringed the patent. But if the patentee himself makes one of the cork-screws (or causes it to be made for him) and sells it without restriction, then it may be used and resold without limit, and neither the man who sells nor the man who uses it infringes the patent. Why? Because the original sale carries with it by implication a right in the purchaser to use and resell, without limit. But there is no implication about making more of them. The purchaser, though he may use and sell what he has bought, may not lawfully make another. To do that would be to infringe the patent.

Transferability of License

If I give another the right to use my patented process, if I sell to another my patented machine and license him to use it, my license in either case may enjoy the invention and sell the product. But, unless I expressly say so, he may not convey to a third person the right which I have conveyed to him; if he should die, the right would die with him. No heir could inherit it. That is to say, a license is not transferrable, unless by the express authority of the licensor.

On the other hand, if I sell in open market, to whomever chooses to buy, my patented article, the implied license to use goes with the article into whose hands soever it may come. The first purchaser may sell, and sale after sale may follow, and always and everywhere the right to sell and the right to use will attend the article—because this was implied in the original public sale.

The Work of an Inventor

It is common thought (and the thinking is loose) that inventors generally fail of their reward; that the invention is gobbled up by some rich and conscienceless "corporation" which throws the inventor a penny and then proceeds to fill its coffers with rich rewards. Doubtless iniquities of that sort have been committed, but they are of rarer occurance by far than people think. Very often an invention though made and patented is still far from the status of commercial utility and success. Often experimentation remains to be done—with large expenditures of time and money—often the building of machinery and equipment is required, the establishing of commercial conditions; engineering problems have to be worked through, new and ancillary inventions made; often the final test of meeting and satisfying and continuing to satisfy public demands has to be endured. All these, and such like, matters need to be taken into account before it can be said how much a patent is worth.

Ordinarily, in the eye of the inventor, his invention is of transcendent importance; it looms larger to him than anything else in the world. "There are millions in it" he thinks and says. May be there are—and, may be, there is just nothing in it at all. If the inventor then is determined to sell his patent outright, let him realize that he is not justified in asking millions for it; he must set his price at some compromise figure, between the millions he believes to be in it and the nothing at all which (after all) may be the outcome.

In many, indeed in most, cases the fair way is to dispose of a patent on a royalty basis—so much for every article sold, or such a percentage of net profits. Such an arrangement makes the money return contingent on and proportionate to commercial success. A certain amount of money paid down when the patent is transferred, with a royalty besides, may be best of all.

A Suggestion to Inventors

But it often happens that the inventor has no money, or cannot afford to put money into a possibly profitless patent. A patent lawyer is often asked to give advice in such a case. He will ordinarily advise the inventor to put his invention in black and white, draw and describe it on paper, show the description to others, have them date and witness the papers. Then, having done this by way of precaution, the inventor may take his invention to some one who deals in such matters and ask him whether he cares to interest himself—whether he cares to consider the purchase of a patent thereon. The truth is, one is never protected against a thief, but we all of us every day run the risk of being robbed. And in this matter of invention (which, after all, is only property of a certain sort) one must, as in other matters of property, act reasonably.

It is a remark which every lawyer hears—referring to some article in commercial use—"I invented that twenty years ago." The remark is made with a certain mental attitude on the speaker's part of irritation, and a clearly indicated feeling of the injustice of fate. But again, the feeling is often too hastily entertained. It does not follow that because a thing is commercially used it is a commercial success. A great deal of money has been dug of the mountains of Colorado, but, someone suggests, how much money has been put into the mountains of Colorado? People are apt to forget that very large sums of money have been put into patents (It has cost $35,000,000 and more to pay merely the government fees on patents thus far obtained), and to think only of the money (and it is great) that has been got out of patents.

When all is said and done, the whole patent system is intended "to promote science and useful arts." Patents are intended to aid industry. In point of fact many (probably most) of the patents granted are of no importance whatever. But in making this observation, we must not lose sight of the fact that the important and valuable patents are, on the whole, very valuable; that the patent system does indeed accomplish its intended purpose; that, so far as men can see, the patent system has had a large part in making American industry secure, and in bringing America into the front rank of the nations in science and the useful arts.

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How Britain Fills the Gap

Labor Dilution as practised in the new industrial organization of England is a form of scientific management. Early in the war many skilled men enlisted from iron and steel plants and shipbuilding yards. "Dilution" was invented to meet the situation.

The idea is that all available skill should be completely utilized. In each plant that the government found necessary to control for military purposes the task of each employee seems to have been studied. Wherever a man was engaged upon any operation beneath his best skill, he was given a task which utilized his entire ability and a less skilled man who was really adapted was given his old job. Men were also shifted from one establishment to another. Finally, women were placed in the plants for operation for which they were sufficiently skilled, or which required no special training. In 150 to 300 establishments controlled by the government on the Clyde fourteen thousand women were introduced. *The Nation's Business.*

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At a special election the establishment of a municipal light and water plant at Coeur d'Alene, Idaho, was blocked by the voters' refusal to authorize a bond issue of $280,000.

Adventures of a Sales Manager

By H. A. Lemmon

An electric-sign campaign and how the manufacturer's representative didn't sell them—and then did. This is the first of a series of articles by Mr. Lemmon, who is sales manager of the Reno Power, Light & Water Co.

The new sales manager wished to put on a sign campaign. It might as well be admitted right here that the sales manager was in fact "new." While he had been in the employ of the company some years it had been in an entirely different capacity.

His company had just decided to handle appliances and to organize a new-business department of three, including the sales manager. Only he was called commercial agent. "Sales manager" is a title he assumed because a short experience proved that it made a much better impression upon that portion of the public with whom he came in contact. "Agent"is synonymous with "peddler" in many minds, and to these people, at least, a letter signed "sales manager" carried with it a complimentary degree of authority.

His qualifications were merely an assumed knowledge of advertising methods, (because he had been a newspaper man previous to his reformation), a somewhat varied experience in public policy matters, and the completion of two correspondence courses in salesmanship—but no experience. His two assistants were equally new in the work, one having been in the accounting department and the other in the purchasing end. The department was obviously created to give these three old employees something to do during a slump in general conditions. The manager's instructions were brief:

"Go to it. Get the business. Don't bother me with any of your troubles—I don't want to hear them. Get your estimate of the year's expenses in by Saturday."

Dignifying the Doorstep Work

The two newly-made salesmen didn't take kindly to a house-to-house canvas. The sales manager didn't know how to handle the situation; but he believed that a little diplomatic delay would straighten out this stumbling block. In the meantime he parroted a lot of words regarding the dignity of salesmanship, the real service the house-to-house man was giving the lady upon whom he called; told the boys that Washington and Napoleon peddled books from door to door, (only he always avoided the word "peddled"), and otherwise wasted oratorical talent. Strange to say neither of his hearers seemed fired with ambition to emulate either the Father Of His Country or the First Consul. Also underneath it all the two assistants ill concealed their opinions of the manager's wisdom in elevating their fellow employee to a position in which he presumably had some authority over them—an authority not earned by either superior knowledge or ability.

How the Campaign Started

Because the sales manager wasn't really capable he temporized and stalled, and planned some other method of selling. Hence the sign campaign. His town of twelve thousand people supported ten electric signs, four of which were illuminated only on bonfire occasions, such as the annual state fair and when Bryan came to town. Also he had a friend who was western representative of a large sign manufacturer. It was obvious that neither the sales manager nor his force knew anything about selling signs so the Western representative was called on to furnish a man who did.

"I am sending our Mr. Kingsley to you—one of the best salesmen in the country," wrote the sign man, "and he can sell signs around anybody you ever saw. Considering the population of your city you should sell twenty-five new signs at an everage price of $250."

Twenty-five new signs! The joke was too good for the sales manager to keep to himself.

"I'll bet you a box of cigars your paragon doesn't actually sell over five signs in our city," he wrote to the sign man.

"You're on, and another that he sells over twenty," was the telegraphic reply. This challenge was accepted with the mental reservation that the extreme penalty would not be exacted. "I may be green at selling signs, but I do know the business men of my home town," he chuckled.

Enter Mr. Kingsley

One morning the sign salesman arrived and presented his card. He was attired in the latest. He wore more dollars worth of quiet clothes that the sales manager ever hoped to possess, and so neat that he was almost a walking affront. He said "good morning," and that was about all he did say. He was as quiet as in a sick room after the visitors have departed. Even when told of the absurd wager his manager had made on him he didn't seem to appreciate the joke and only ventured a courtesy smile.

The first day out he sold a sign to a moving picture house for fifteen hundred dollars. This appeared to be a fair day's business but then the picture house had long wanted a sign and had been held in line for just this occasion. A week went by and no more sign sales. Then another signless week passed. One or the other of the local salesmen went with him every day to pick up points as they could. Those boys reported that Kingsley didn't seem to be much of a salesman after all. They said he couldn't even talk. In fact, if anyone wanted a sign he would have to sell it to himself.

The sales manager wrote the western sign representative designating his favorite brand. The western representative came back with an offer of an additional wager based on twenty-five sales.

The Sales Manager Takes a Hand

The sales manager concluded to introduce the sign salesman for a day and guided him to the hardest proposition he could think of—a druggist who employed spiders and flies only, to do his show window decorating, because they worked without pay.

"Why haven't you a big, fine electric sign in front of your place" was Kingsley's approach. "You don't want to buy a gas stove to-day do you?" filled the sales manager's mind as the warning conveyed by lesson number one on what not to say. It seemed to him that Kingsley hadn't improved it much—(That was because he was new—he knows better now.) When his mind reverted to the conversation again the druggist was vigorously enumerating a varied and extensive stock of reasons why he didn't want an electric sign. The initial cost was too much, the operation and maintenance were too high, the benefits were nothing, and besides everybody in the city knew where he had been for over thirty years. "There is no use saying anything about it. I am busy to-day. Good-bye. I don't want———."

Almost, But Not Quite

"Excuse me just a moment," said Kingsley. At this point a scarf pin in the salesman's cravat had worked out to the point where it was about to fall on the floor. The druggist and the sales manager noticed it at the same time, but the druggist was first to speak—

"Pardon me, but you are about to lose your scarf pin," and he stepped up close and readjusted it. Kingsley was profuse in his thanks, relating many tender associations connected with the pin to emphasize the value he placed upon it.

The druggist did not seem so busy. Kingsley asked his advice regarding a cold remedy, purchased a bottle, chatted a bit

about the affect of the war on chemical prices and started for the door.

"You see I have been here so long that I don't need a sign. Everybody knows me and my place."

"Probably everybody knows of Heinz' 57 varieties. Heinz spends hundreds of thousands of dollars refreshing their memory. Heinz is a successful firm. It doesn't waste money."

The druggist abandoned this position and took up another. He said he couldn't afford to pay $400 or $500 for a sign and neither could he afford to pay $15 or $20 a month for its operation. The sales manager exercised considerable self-restraint and said nothing, but he inwardly fretted that Kingsley did not correct these over-estimates. The druggist, sure of his ground in the absence of denial, used his arguments over and over again, with increasing vehemance, Kingsley apparently on the defensive without any defence at hand. In fact it appeared that Kingsley was rather unfortunate in the few words he did venture for they seemed to encourage the druggist to even more extravagent figures. Finally in the midst of another tirade about an investment of $500 the sign salesman interrupted with—

"A sign will cost $225 installed."

The druggist paused a bit, somewhat confused, and then burst out—

"No business like this can stand $20 a month for an electric sign. No sir."

"To operate that sign five hours a night, including new lamps, as the old one burn out, will cost you $5.25 per month. How much newspaper space can you purchase for $5.25? How many people will see your sign every day and night?" And only then did he disclose that the sign would be paid for on installments covering three years. The sales manager wondered how many salesmen would reserve this seemingly introductory point for the last.

The conversation went on. Kingsley baiting his man into extravagent objections; gently dispelling them at the proper time with facts, and finally the dotted line bore the signature.

How He Did It

He anticipated no possible objection—contrary to the advice of the correspondence courses—but encourated his victim to make all he could think of, and then skillfully led him into a position he could not maintain in support of them. In other words he made a selling argument out of every objection offered. He probably used less than five hundred words, while the druggist used several thousand.

His trick with the stick pin was a stock one. He purchased these pins by the dozen at the ten-cent store and had learned to work them out with his coat. It is human nature that having performed a service for a stranger we feel kindly toward him.

Had the druggist not given him an opening when he started to walk out he would have departed, but the next day would have called and purchased something else. Sooner or later the subject of signs would be brought up by the druggist. He did in fact sell the sign to himself, and so did the others. Kingsley made no arguments; he merely corrected the misapprehensions existing in the mind of his victim.

It was a new one to the sales manager. It wasn't according to the book, but it worked. It seemed to him that it might be a very dangerous method in the hands of a less skilled salesman; but later he found it extremely effective. It requires primarily a knowledge of all the facts relating to the goods, and a tremendous amount of self restraint to direct the conversation to the inevitable end. "I can't lose a sale by talking too little" said the sign salesman, "for I always go back. I can easily lose one by talking too much."

Never Let Him Say "No"

One of his rules seemed regular. "Don't let the customer say 'no'. Let him think it as much as he pleases, but never allow him to strengthen his resistence with the spoken word. Leave him before this happens and he is yours later."

When the number of signs sold had reached thirty-seven the sales manager wrote the western representative of the sign company to select his cigars and have the bill sent in. The reply was by wire:

"I never smoke. Admit that Kingsley can sell signs and the debt is paid."

* * *

The New York Electrical Show

A description of an electrical show boils down to two things: a list of the exhibitors and their displays, and an appreciation of the decorative and lighting effects. Neither of these have much real significance for the man who does things. We have therefore asked Mr. George B. Parker, General Manager of the Electrical Exposition Company, to tell or readers something of what lies behind the scenes—what makes the show successful.

A Glimpse of the New York Show

"The first show was held in Madison Sqare Garden, ten years ago. We had about six months to prepare plans, line up exhibitors and get the necessary publicity. So successful was the first show that we formed a permanent organization and immediately began to plan for the next year. Now we have most of the exhibit space contracted for before the preceding show is over. We gave five exhibitions in the Garden, and this is our fifth in Grand Central Palace.

"Back of the Electrical Exposition Company are the central station interests of the city. Support of this sort is both proper and essential, for the central station should assume the burden of education which will continue to sell current to the user of electric devices, while the manufacturers' and dealers' opportunity ceases with the sale. The New York central stations, however, do not make a charity proposition out of it; their contribution is limited to buying exhibit space at regular rates and also tickets at a special price. Two tickets go to every patron on the lines and a great number are distributed in other ways. These consumers' tickets are good only on a definite day, to ensure a distribution of the crowd over the slack days of the week. Each permits the holder to buy an indefinite number at one half the usual price. In spite of this gratis distribution, there is quite a large percentage of admissions at the full price of fifty cents.

"As to the spirit of the show, that is intended to be educational from start to finish. Exhibits of the Government and the State, such as models of battleships, wireless and signalling sets, rapid-fire guns, census tabulating machines, and canal models, attract great crowds. This year we had a complete set of silk mill machinery; a printing plant; an electrically oper-

(*Continued on page* 49)

EDITORIAL

A New Rate-Scheme

A most interesting experiment in rate-making is about to be undertaken by the Peoples Gas Light & Coke Company, of Chicago. Providing the necessary legal approval be secured "the company proposes that after deducting all normal operating expense as heretofore from gross income; and after deducting bond interest and 6 per cent. on any future securities issued under authorization of the State Public Utilities Commission in exchange for new capital—the remaining earnings shall be divided between the company and the consumers in the following manner: 85 per cent. to the company and 15 per cent. to the consumers."

There is in this proposal a recognition of the best present-day public opinion—that a utility is the trustee of the public's investment in plant and organization for public service. Under this conception it is evident that the public as well as the investors have an interest in the prosperity of the enterprise. A utility can serve its patrons best when it is prosperous, although there are many who seem to wish that the company be kept the verge of bankruptcy. When consumers have a stake in the net earnings, there will be a large body of people who will oppose in private conversation any sentiment of opposition to the utility. A body of support of this nature is particularly desirable in the present case, when under already adverse public opinion, it is necessary for the company to change the quality of gas from one exceedingly expensive to manufacture to another one lower in cost but also lower in illuminating quality when used in open-flame burners.

As far as the company is concerned, the scheme is an excellent one. If concessions must be made they should not be such as will kill initiative. To formulate and put through schemes of business-getting and cost saving means hard thought, exhausting effort and great responsibility. If each economy is to be followed by a reduction in price, the busy manager may well ask himself if the game is worth the candle. The public has no inherent right to share in any savings; it contributes nothing but its patronage, and even that is had only at a cost of an energetic Sales Department. If utilities had contented themselves with things as they were ten years ago it is not improbable that the stockholders would have been just as well off to-day, but the public would be paying a much higher price for inferior service.

From the only figures at present available it is not clear how the security holders will come out of the deal. Bondholders will of course be unaffected, but from figures in the company's 1915 report it would seem that the dividend rate must be reduced from eight to perhaps six per cent. for the present net revenue will not stand the cut. If approval is given to change from water-gas to coal-gas, sufficient savings may be effected to make up for the loss in revenue. It is interesting to note that subsequent issues of stocks will receive six per cent. dividends before any payments are made to present stockholders or the consumers. This is a wise provision for future financing, since any new stock will be practically preferred as to dividends over the present issue.

What the paying public will think of the scheme only time will tell. On the basis of 1915 business, the refund would amount to but 2.82 per cent. on consumers' bills, a small sum to the residence consumer, whose "weight of numbers" is most important in the formation of public opinion. For the sake of public utilities as a whole, we hope that this experiment may prove an acceptable solution of the problem. Continued agitation for public ownership, fostered mostly by persons unfamiliar with public service problems, needs to be offset by every available means. The present scheme, that of voluntary partnership between owners of capital and patrons served, is much more likely of success than a forced co-operation of the entire body of taxpayers to provide, through municipal ownership, service for only a part of the community. Its success will be the more significant as showing that the best rates are not the lowest nor the highest, but lie at a point beween where there is the greatest return to the owners in dividends, as to the patrons in continued high-standard service.

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Some Forms of Educational Publicity

There are two reasons why we work. The first one —because we need the money—calls for no comment. As old as labor itself are appeals to men to do more and better work for the sake of a bigger pay-envelope; when there is a close relation between the two, as in the newer bonus and piece-rate systems, satisfactory results are secured readily enough. But when the boss tries to get us to do better work for "the pleasure that is in it," he has a pretty hard task.

Now we will have to admit that with lots of enthusiasm or when a crowd is watching, it is a good deal easier to do great deeds. Unfortunately, we get tired, and we have to work along where nobody will ever know how well or how poorly the job was done. That is the time to remember the story of the wire-layer "somewhere in France" who had come back alive, as by a miracle, from a particularly dangerous job of

repair work between the lines where a false move meant discovery and death. Though he often had to lie motionless while a star-shell lighted the field, he kept on until he found the break, repaired it and crept back to the lines. Some curious correspondent questioned him as to "how he did it"—to which he replied: "I said to myself, 'Jimmy, my boy, that girl at home has her eye on you, and you're doin' this for her!' and every time I said that I crawled a bit farther."

It is a far cry from Jimmy and his girl "back home" to the corporation employee and his "company paper" but the cases are after all the same. Approval of fellow men, spoken or silent, when a man's name appears in a house-organ with praise for good work, is something which everyone values. The success of these often most unpretentious sheets and the interest with which they are read is the best of justification for their existence. Their effect cannot, of course, be measured directly for it is seldom that anyone will think that he did this or that because he hoped he might be praised publicly. On the other hand, the conviction that the right thing is the only thing that a decent man could do, is the most powerful force in our daily lives, and when a man is shown that his "crowd" think certain things are right, he is very likely to do them, even against inclination. Just this is what the house-organ does, for it puts the stamp of public approval on men who have done what was right.

"Company spirit" is no less desirable for the small concern than the large, but many managers feel that the expense of a house-organ would be more than they could afford. Fortunately, the smallness of such an organization makes it possible to use a simple and inexpensive publication — a mimeographed leaflet or even a typewritten notice on bulletin-boards. A good example in another field is the military "Orders of the Day" read to each command every morning; mention in one of these for gallantry is a most coveted honor. The important thing is not how the news is published, but what is published.

One of the essentials of such a publication is that it shall deal with facts, adding only a few terse comments. The story of how Bill Smith used his "First-Aid" training to patch up a party of injured automobilists is more likely to bring the rest of the force to "First-Aid" classes than editorial exhortations. It is well to talk about economy, but what "gets under the skin" is how a certain district keeps its unoccupied time down by having inside jobs ready for the line crews on rainy days.

Another point to which more attention might be given is the interest of employees in the success of the operations of certain departments or the company as a whole. In one power-station a bulletin with changeable figures gives the kilowatt-hours generated during the last month and the unit cost. To the lowering of this figure every station employee can contribute and the change of a unit in the last decimal place can be made of as much significance as a home run in the ninth inning when the score is tied. Other matters of interest, such as the securing of a larger order by a manufacturing company, should be given the shop force by bulletins at least simultaneously with its release to the press. When the management tells its employees as soon as it tells anybody else it makes them feel that they are not less important to it than the general public.

So much for some of the things publicity will do among employees. It must not be forgotten that it is never a substitute for genuine good will as shown by the provision of proper facilities, reasonable hours and good pay. Just as in advertising, if the advertiser does not "deliver the goods," his printers' ink is spread in vain. No intelligent man can be deceived by fine words, and a figurative slap on the back is no substitute for a merited increase of pay. But let other conditions be right, and publicity among his fellows for good work will set any man "on his toes" to do it again.

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Central Station vs Dealer

Two contributors to this issue, Mr. Parker and Mr. Bullen, touch upon that sore spot in the electrical merchandising field—competition between central station and dealers in the sale of appliances. Mr. Bullen shows the undesirability of competition to the general good of the industry, while Mr. Parker says that in the particular case of the electrical show with central station backing, the good will of the dealers is essential to success.

Previously we have had occasion to point out that the interest of the consumer is service—that what he buys is so many units of light, heat or power. Kilowatt hours mean nothing to him apart from his monthly bill—what concerns him is the ability to do something at the turn of a switch. There is no logical reason why the central station's responsibility should cease at the meter, rather than at the appliance, save that fairly satisfactory results have been secured so far by allowing the consumer to buy appliances of whatever sort seemed most desirable at the time of purchase. During the last few years the public has been educated to demand more and more service for its money—free delivery by merchants is a case in point. It is safe to say that it is only a matter of time to be educated in electrical methods until the householder will insist on having the same unfailing readiness-for-service from her electrical appliances as from the gas or coal stove or the broom and dish-pan. That means maintenance expense and the central station is the logical agency to give it. Central stations might properly insist in some say as to the quality and reliability of the apparatus they have to repair, and use this as an argument for selling or renting it. If the dealers are to combat this, they must sell only the very best, assume some responsibility for its performance, and show readiness to co-operate in every way with their local central station in placing and keeping equipment on its lines.

Installation, Operation
Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

Electrical Equipment for Automobiles

By Frank Conrad

On account of the wide variation in engine speed, special devices are used to secure either constant voltage or constant current. Merits and defects of the various systems are shown. Mr. Conrad, who is an electrical engineer of the Westinghouse Electric & Manufacturing Company, presented this paper before the Detroit-Ann Arbor Section of the A. I. E. E.

The electrical equipment of the present day automobile covers practically the whole range of electrical development, comprising, as it does, primary and secondary generating apparatus, with distributing and control for the devices which perform the various functions required. The applications to which electrical apparatus has been particularly suited comprise ignition of the explosive mixture in the engine cylinder, lighting, motor drive for engine starting and signalling devices. The special nature of the duties required of each particular device has resulted in the development of designs particularly suited to these conditions, and these special designs presented the greatest problem in the application of electrical devices to the automobile.

The primary source of electrical energy consists of a generator driven by the gasoline engine. As this engine has an operating speed range which may extend from 1 to 25, and in some cases even more, it requires a generator with some method of output control which shall permit of operation over this wide range of speed. The control schemes in use may be divided into two classes:—current and voltage control. In the current control type, the regulation may be obtained by: compound field winding, the series coil being connected for a drooping characteristic; by exciting the shunt field winding through an auxiliary brush, displaced from the normal commutating position; and by the use of an auxiliary regulating device which controls the generator field current.

Current Control By Series Winding

Of the above, the compound wound, or bucking series type as it is sometimes called, is the simplest, and probably the most reliable, but it is at a disadvantage in regard to weight, as compared to the auxiliary brush type, on account of the extra room required for the series field winding. It gives a characteristic curve in which the current rises rapidly at first, approaching the normal value at a certain speed which is determined as corresponding to the average car operating speed. Above this speed, the rise is very gradual, giving approximately constant current. By connecting the lamp load inside of the series field, the output can be increased while the lamps are being operated, thereby compensating to a certain extent for the increased requirements of night over day operation.

Regulation by Field Distortion

The auxiliary or third brush type operates through the effect of field distortion on the voltage between one of the main brushes and the auxiliary brush. This system has the advantages that the generator can be designed on the line of a simple, shunt wound generator. It, therefore, gives a minimum of weight and cost. The exact position of the auxiliary brush is important, and the voltage impressed on the field circuit is such that the contact drop of the brush is a large percentage of the same. This type of machine is, therefore, rather sensitive to the condition of the brushes, and is not quite as stable in performance as the reverse series type. It gives a characteristic curve which, at the lower speed, is similiar to that of the reverse series type. At speeds above the normal operating point, however, the current can be made to fall off rather than increase. This, in a measure, has a certain advantage in that the maximum output can be obtained at speeds corresponding to the every day operation of the car, while if the car is operated at continuous higher speeds, as in extended touring, the output will be lowered, and thereby prevent excessive over-charging of the battery. These two systems of control require that a battery shall be at all times connected to the generator circuit, as they are essentially constant current systems, and in addition, their stability of operation depends on being connected to a circuit in which the current will vary widely with a slight variation of voltage. This is particularly true in regard to the third brush type. In the case of the reverse series type, it would be possible to operate the generator without a battery, provided a lamp or equivalent load consuming the normal output which the generator is designed to give, is used. In the case of the third brush type, however, the instability is such that it would not operate at any given output unless connected to a load having the characteristics of a storage battery. This, however, is no real objection, as the necessity of continuous current supply, independent of the operation of the engine, requires in all cases the use of a storage battery.

Auxiliary Regulator Controlling Shunt Field

In the auxiliary regulator type, a mechanical device is used which varies the resistance of the shunt field circuit. The operation of the regulator is usually controlled by variation of the generator current, it increasing the field resistance on an increase of generator current, and decreasing the field resistance with a decrease of generator current, although in one type the change of field resistance is made proportionately to

the speed, the regulator being centrifugally-operated. The design as a whole is so proportioned that when the generator is connected to a battery, the regulator will give the field values necessary to enable the generator to deliver the normal current to the battery circuit. Of course, with this arrangement, the regulator will go through its cycle of operations whether current actually flows in the circuit or not, so that it does not actually determine the generator output, unless all the conditions are normal. In the case of the regulator with current control, any change of conditions which would result in a higher or lower current will give a corresponding change in field strength to bring about a proper adjustment of generator current. This arrangement can be made to give a constant current at all speeds above a certain minimum, and has the apparent advantage that the operation can be perfectly stable on any type of load. As the regulator, of course, entails an additional mechanical device, it may be a question as to whether it has any advantages as compared to the inherently regulating types previously mentioned, as the final generator performance is practically the same in each case.

Regulation for Constant Voltage

In the constant voltage system it has, in all cases, been necessary to employ a separate regulating device. This regulator functions similar to the usual type of voltage regulators supplied with the ordinary power generator. In order to permit of operation in connection with a storage battery, it is necessary that the regulator give a characteristic to the generator in which the voltage droops slightly with increase of current. Should the regulator maintain constant potential at the generator terminals, it would entail an abnormally large current delivery to a discharged battery, thereby loading the generator to a dangerous limit. This type of machine, while possessing the disadvantage of implying an additional mechanical part has a compensating advantage in that it gives an ideal performance to the generator equipment.

Comparative Advantages of the Two Systems

In the constant current system it is necessary that the output be adjusted to a value which is estimated as the maximum average output required under the various conditions for which the car is intended to operate. The fact that the constant current system has given satisfaction has been mainly due to the characteristic of the storage battery, of being able to absorb an amount of energy considerably in excess of that which may be returned to the system. It is, of course, necessary that the energy delivered to the battery be equal to that which the battery re-delivers to the system plus the incidental losses. It is possible, however, to greatly increase the input of the battery without doing any great harm, other than decomposition of the battery solution. There is, of course, a limit to the extent in which this condition can exist, and the constant potential system, therefore, can be expected to give wider range of application and more generally satisfactory service. With a proper adjustment of the characteristic curve given by the regulator and generator as a unit, the battery will be charged at the highest possible rate, as determined by the generator capacity, when it is in a discharged condition, and this rate will be automatically lowered as the battery reaches a charged condition. It is also possible to operate without the battery and without any particular regard to the nature of the load, although this, of course, may be considered as an emergency feature. It ensures a long life to the storage battery and more constant voltage at the lamp terminals. The system, of course, has, as mentioned above, the disadvantage of requiring more apparatus which is subject to disarrangement and the accompanying higher cost of equipment.

A Special Type of Storage Battery

The next step in the generating system is the storage battery. As in the case of the generator, it has been necessary to design a particular type of battery to give satisfactory performance under the abnormal load factor to which the generating system is subjected, the conditions on the automobile being such that the generator in the case of the constant current system is designed to give an output corresponding to the average load which is expected to be on the system. The current demand, however, will vary from that required by ignition, and by the lamps, which is of the order of the generator output, and which may be stated as being in the neighborhood of 60 watts, to that required by the starting motor in starting the engine, which may be as high as 3,000 watts. In order that a battery in which the ampere hour capacity corresponding to that required by the current demands when the engine is not operating should be able to give the excessive output required for starting the engine, it has been necessary to design a battery having extremely low internal resistance. This implies the use of a large number of very thin plates, and the elimination of separators which offer any appreciable resistance, such as the rubber separators used on the electric vehicle types of batteries.

Lighting

The lighting problem has been solved by the low voltage tungsten lamp,* and in fact, it is doubtful if electric lighting on the automobile would be practical with the ordinary carbon filament lamps. As it is, the lamp is practically standard, and but little change may be expected in the near future. The use of gas filled lamps in place of vacuum lamps for headlights is coming in, although they have but little real advantage, other than the permitting of the use of high candle power lamps with the generating and battery equipment now supplied. The use of this high candle power lamp, however, is questionable, owing to the effect of the intrinsic brilliancy of the filament and intensive illumination on other users of the road.

Ignition by Magneto

Of all the the translating devices, ignition is probably the most important, as upon its uninterrupted operation depends the performance of the car. On the earlier types of automobiles, the electrical equipment was exclusively devoted to the function of ignition, which resulted in the development of the present day magneto as a complete unit, this device combining in itself the function of a generator with timing and high tension transforming apparatus. In its latest form, it consists of a generator of the permanent magnet type having an armature which constitutes an induction coil. The circuit through the primary winding is controlled by an interrupter, which serves to interrupt this circuit at predetermined times, thereby setting up high voltage impulses in the secondary winding, which, by means of a distributor, are distributed to the various cylinders in the proper order. The magneto has reached its highest development in Europe, and although

*See an article "Automobile Lamps and Lighting," by A. R. Dennington, in the September issue of Electrical Age.

there are large numbers of them now manufactured in this country, it can hardly be said that they are the equal of the European types, especially those of German manufacture.

Storage Battery Ignition

Extension of the electrical equipment to other uses has brought out ignition systems in which the main generator and battery is employed as a source of electrical energy, the ignition unit itself consisting of the timing and high tension transforming device, the timing device being an interrupter and distributor operating synchronously with the engine, the interrupter serving to interrupt the primary circuit of an induction coil, and the distributor distributing the high tension impulses from the secondary of this induction coil to the various cylinders in the proper order. So far as actual performance is concerned, either type can be made to give the same results; the self-contained magneto having the advantage that it is an independent unit, and, therefore, not influenced by any conditions existing in the balance of the electrical equipment. It has the disadvantage of requiring to be operated at a given minimum speed before it will deliver sufficient energy to ignite the charge, and, therefore, does not give good starting conditions of the automobile engine. The auxiliary unit, which is operated from the main generator and battery, is able to deliver the igniting spark at very low speeds, as it obtains its energy from the battery. It has the disadvantage, however, that it is more difficult to deliver as much energy to the spark plug as the magneto type, and still give good performance over a wide speed range; this being due to the fact that in the magneto, the voltage applied to the induction coil increases with speed, thereby compensating to an extent for the shorter time allowable in which to charge this coil. In the case of the auxiliary or battery system, the voltage applied is, of course, constant at all speeds; thereby giving a sparking energy which falls off with increase of speed to a greater extent than in the case of the magneto. This condition, however, can to a large extent be compensated for in the design of the unit by some means such as the use of a resistance in series with the primary circuit, which has the property of increasing in value considerably with an increase of current, thereby preventing an excessive rise of current at the lower speeds. It is also, in some cases, performed mechanically by a centrifugal device which varies the resistance in the primary circuit, with variation of speed.

Electric Starting Schemes

The installation of electric starting of the gasoline engine is probably one of the factors which has most to do with the popularization of the automobile. It has introduced problems in motor design which are quite different from those encountered in the usual electric motor. The motor which is used for engine starting must have an exceedingly high output for a very short time, and its proportions be such that it will give a comparatively high stalling torque. As developed, it is of the ordinary series type, and owing to the low voltage employed, it is possible to use strap windings, so that a very high space factor is obtained in the windings. The output of the average starting motor ranges from one-fourth to one horse power, and it is probably able to deliver this output for a period of possibly one-half hour. As the generator is inoperative during the period over which the starting motor is required to operate, it is possible to combine the functions of generator and starting motor in one piece of apparatus. This has been carried out in several ways, the two principal systems being:—

1st:—One in which the generator and motor windings are both placed in the same structure, the armature having two windings, each with its own commutator, the design being such that the operation as a generator is at much lower speed than as a motor, a corresponding change of gear ratio being made when operating as a generator or motor.

2nd:—In this arrangement, the machine operates as a generator or motor, depending on whether its speed is above or below the value required to generate the battery voltage, the gear ratio at times remaining constant. With the engine standing still, on closing the circuit, the machine will act as a motor, starting up the gasoline engine. When the engine operates under its own power, driving the generator above the critical speed, the operation will be reversed and the power delivered to the battery. This scheme, of course, implies a larger torque at the motor shaft than in the previous system, owing to the limitations of gear ratio, to permit of the engine being operated at the higher speeds.

Selection of Voltage

As to the details of the installation, there are several factors which have been the subject of considerable development and which have been worked out along different lines. One of these is the question of the voltage to be employed. This voltage has ranged from 6 to possibly as high as 40 volts.

The choice of voltage is determined by the kinds of lamps, size of battery, and design of generator and motor. The higher voltages permit of more convenient proportions of generator and motor, especially in those systems in which a single unit performs the functions of both generator and motor. With the separate units, the development has been towards the lower voltage, namely:—6 volts. This has been made possible by the use of single turn strap windings for the motor and by the use of low resistance brushes now available, which do not entail an appreciably larger loss than in the case of brushes used with the higher voltages. As regards the lamps and battery, the advantage is distinctly with the lower voltage; the low voltage lamp with its corresponding shorter and thicker filament being better able to stand the vibration of the car. The efficiency of these lamps can also be made higher, and lower candle power lamps, such as required for dash and tail lights, are more readily manufactured. With the battery, a lower voltage entails a less number of cells with the corresponding advantages of lower total weight and less connections and jars, with corresponding reduction of possibilities of trouble. It may be said, therefore, that the use of a low voltage is, taking all things into consideration, the best solution and the 6 volt system is rapidly becoming the standard.

Car Wiring

The distributing scheme on the car has been carried out along two main lines, one in which all apparatus was insulated from the car frame, the two sides of the circuit being carried to each device. In the other, the apparatus was arranged to have one connection made to the car frame, one wire being carried to each device, the car frame being used as a common return or ground. Owing to the low voltage employed, the insulation is merely a matter of mechanical separation. It is, therefore, usually more convenient to insulate a single conductor from the grounded circuit than the two conductors from each other, and in addition, on ac-

count of this low voltage, the question of wiring drop becomes an important item. This renders advisable the employment of the comparatively large amount of metal in the car frame as one conductor. There is also an advantage in the use of the grounded system from the reduction of conductors to practically one-half and the resulting simplification of the car wiring.

At the present time, the general trend of development in the line of new systems or schemes of operathe reduction of weight and cost, rather than development in the ine of new systems or schemes of operation. The mechanical problem of properly connecting the generator and starting motor to engine has been the subject of considerable development. The use of 6 volts is becoming practically standard, as is the grounded system of wiring. Future improvements may be looked for in the line of standardization of various component parts, and improving the reliability of operation, thereby assisting in the rapid extension of the field of usefulness of the automobile.

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Central Station Service for Refrigerating Plant

By H. N. Sessions

An interesting installation of electrically driven refrigerating machinery in a restaurant is that of the B. & M. Cafeteria at Los Angeles. The building has a seating capacity of 812, and the daily average number of meals served is 4950. One hundred and sixty persons are employed. Cabinets and storage boxes to the number of 18 are distributed through the working spaces and there is a three-room cold storage apartment in the basement as well as a 40-can ice cream storage tank and a 500 gal. water cooler.

The outfit consists of a seven and one-half horse-power Type K.T., G. E. motor belted to an Automatic Refrigeration Co.'s compressor of 9,000 pounds daily refrigeration capacity. No brine circulation is employed, the system being handled by the direct expansion of liquid ammonia through refrigerating lines always partially flooded with the refrigerant under a low pressure and temperature. The work of refrigeration is nearly equally divided between the low pressure distributing lines, on which lines the chambers being cooled are connected in series with each other. Each chamber or box refrigerated is cut into the low pressure line by a by-pass valve, and by the adjustment of the by-pass valve the temperature of each cabinet or chamber is set and maintained constantly at any desired degree. The two low pressure lines or circuits are about 1,500 feet each in length and of pipe ranging from ¾ in. to 1¼ in., the exposed portions of the line being carefully insulated with specially thick cork covering. These circuits operate at approximately thirty-five pounds pressure, which pressure is maintained by automatic expansion valves from a ½ in. high pressure liquid supply line from the ammonia receiver; the pressure of the condenser is also maintained automatically at about 175 pounds. The two pressure circuits diverging from the ammonia receiver, in shunt with each other, converge into a common suction return at the compressor intake. As all the refrigerated boxes are in series and cooled by direct expansion, all stations are sympathetic to a rise in temperature at any one station on the line; hence a fixed ratio of temperatures always exists between the stations. A sensitive thermostat located in one of the cabinets near the suction end of the line acts as a master temperature control for the whole system, actuating, through a relay switch, the motor control, stopping and starting the plant on a fall or rise in the temperature of a few degrees, maintaining practically a uniform temperature in each refrigerated chamber.

The whole performance of the plant and system is completely automatic, needing no manual attention except occasional inspection, oiling and wiping. No switches or valves are required to be opened or closed by hand; the plant starts to work and stops automatically, operating not a moment unnecessarily; its behavior is perfect on duty or in face of an interruption of electric power or water supply; the master thermostat automatically controls its hours of operation; an automatic pressure regulator gives an exact expansion to the refrigerant; the flow of the condensing water is controlled by an automatic water regulator which shuts off the water when the condensing pressure reaches a predetermined point shortly after the plant stops and turns on the water again when the pressure rises; in case of failure of the water supply to the condenser and consequent rise in pressure at ammonia condenser, an automatic high pressure safety regulator actuates an electrical cut-off shutting down the motor and when the water supply is renewed and ammonia pressure of condenser reduced to normal, this safety regulator cuts in and starts the motor.

The motor is a General Electric Company's standard squirrel cage type, three phase, 220 volts, 1200 V. P. M. with friction clutch, pulley belted to the compressor through a counter shaft. The average consumption of the plant is 5.25 kilowatts per hour and the average time of operation, being the total of several operations daily, is 15.2 hours per day or 80 KWH per day. At least two and one-half tons of ice daily would be needed to furnish the equivalent refrigeration of this plant at present, and with ice at $3.00 per ton the cost would be $225.00 per month.

An offer was made by a local ice and refrigeration company, having an ammonia refrigeration system of distribution by pipes in the street, to supply the cafeteria with its service for a flat price of $150.00 per month. The monthly cost to operate this plant by electricity, however, is about $45.00 for current from the Southern California Edison Co. The other additional slight expenses when added would still keep the monthly operating cost below $50.00. The further saving of electrical refrigeration as demonstrated by this plant, in time, labor, etc., more than offsets the fixed costs such as interest, depreciation, etc., on its investment. City water is used for condensing purposes, but as this is reused in the kitchen and boiler room, its first use for the cooling of the condenser, therefore costs nothing; in fact, the heat imparted to this water is a distinct advantage and a saving rather than an expense.

Ten other motors for various power purposes are in use in this cafeteria, making a total monthly consumption of about 4800 KWH, which acording to the Los Angeles schedule of power rates earns an average rate of about 1.9c per kilowatt hour.

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Two New Street-Lighting Systems

"White Way" lighting systems have been inaugurated recently in both Salt Lake City and San Francisco. That in Salt Lake City was put in service on the night of Sept. 29 with impressive ceremonies. Each standard of which there are three to the block, carries three inverted luminous arc lamps, of 6.6 amperes. The standard fits over and conceals the trolley poles. Each lamp is rated at 1500 cp., the diffusing glassware absorbing 30 per cent. of the light. Installation was principally at the cost of property owners; being $25,535 or $4.12 per foot. The cost of operation will be about $10.30 per ft. per year, plus about $4,000 contributed by the city. Current is furnished by the Utah Power & Lighting Company.

A similar system was put in service in San Francisco on the night of Oct. 4, extending along Market Street from the ferry house. A two-day fete celebrated the inauguration of the system, which included spectacular lighting of prominent buildings, an illuminated parade, and a ball at the municipal auditorium.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Windings for Alternating Current Machines

By T. Schutter

The armature of an alternator or a synchronous motor and the stator of an induction motor are all wound in the same way, and follow somewhat the same principles as direct current windings, as far as the spacing of the coils, and the placing into the armature core or stator is concerned.

The winding is divided into two classes: Half-coiled and whole-coiled windings as shown in Fig. 1 and Fig. 2. Both of these figures have four poles, in Fig. 1 there are two coils on the armature or ½ coil per pole, and in Fig. 2 there are four

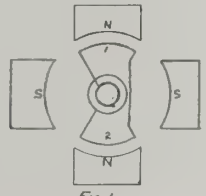

Fig 1.

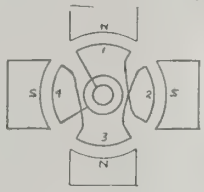

Fig 2

coils or one coil per pole. The rules for the above are as follows:

Rules for Winding

Rule 1. In a half-coiled winding there are as many coils or groups of coils per phase as there are pairs of poles.

Rule 2. In a whole-coiled winding there are as many coils or groups of coils per phase as there are poles.

All coils must be spread so that one side will be under the influence of a North pole, and the other side under the influence of a South pole: this spread is found by the following formula

$$\frac{\text{Number of winding elements}}{\text{Number of poles}}$$

If the result of this formula is an even number, it must be made an odd number by adding or subtracting 1. A winding element is one side of a coil, and may consist of one or any number of conductors: to find the number of winding elements multiply the number of coils by two.

As explained in the rules for half and whole coil winding each phase consists of a number of groups of coils which may consist of one or a number of coils per group. All coils forming a group as well as the groups forming a phase are connected in series: the following are the rules for making the connections.

Rule 3. In a half coil winding the coils forming a group are connected the end of one coil to the beginning of the next, and the groups forming a phase are also connected the end of one group to the beginning of the next.

Rule 4. In a whole coil winding the coils forming a group are connected in the same manner as in half coil winding but when interconnecting the groups forming a phase connect as follows: the end of the first group to the end of the second, and the beginning of the second to the beginning of the third, etc. These methods of connection are necessary so as to have the induced electro-motive-forces to flow in the same direction, as will be shown in the following diagrams.

Single Phase Machines

Single phase motors are not self starting unless specially designed to include a starting winding, or a specially built commutator. Fig. 3 is that of a single phase whole coil induction motor stator winding, consisting of 16 coils, 4 of which are the starting coils. These coils will only be in the circuit while the motor is starting, and when it is up to speed they will be cut out of the circuit automatically by a centrifugal switch; the size of the wire in the starting winding will be much smaller than the running winding.

The spread of the coils is found by the formula given above. $\frac{\text{Number of winding elements}}{\text{Number of poles}}$. In 16 coils there will be 16 times 2 or 32 winding elements, then 32 ÷ 4 equals 8, this being an even number it must be made odd as previously explained: then 8 plus or minus 1 equal 7 or 9. In this winding there will be two winding elements per slot, and 16 slots in the stator: then by using 9 for the spread, the first coil will be composed of winding elements No. 1 and No. 10, these will be located in slots

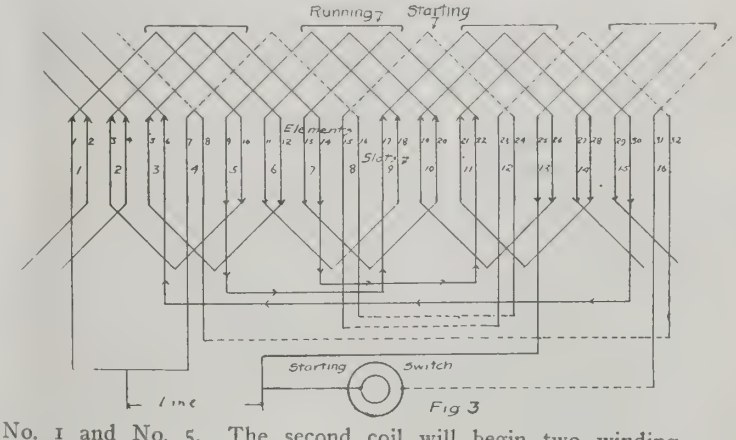

Fig 3

No. 1 and No. 5. The second coil will begin two winding elements from the first either to the right or left: then by beginning the scond coil at winding element No. 3 it will spread from No. 3 to No. 12. The following is the table for placing the coils, odd-numbered elements lying in the bottom of the slots.

No. 1 running coil from winding element No. 1 to No. 10
No. 2 running coil from winding element No. 3 to No. 12
No. 3 running coil from winding element No. 5 to No. 14
No. 4 starting coil from winding element No. 7 to No. 16
No. 5 running coil from winding element No. 9 to No. 18
No. 6 running coil from winding element No. 11 to No. 20
No. 7 running coil from winding element No. 13 to No. 22
No. 8 starting coil from winding element No. 15 to No. 24
No. 9 running coil from winding element No. 17 to No. 26
No. 10 running coil from winding element No. 19 to No. 28

No. 11 running coil from winding element No. 21 to No. 30
No. 12 starting coil from winding element No. 23 to No. 32
No. 13 running coil from winding element No. 25 to No. 2
No. 14 running coil from winding element No. 27 to No. 4
No. 15 running coil from winding element No. 29 to No. 6
No. 16 starting coil from winding element No. 31 to No. 8

The starting winding must be evenly distributed among the running winding, this is done by placing three running coils and then one starting coil. When the coils have all been placed the winding is then divided into groups: the number of coils per group are determinded by the following formula:

Number of winding elements / Number of poles × number of phases × 2, then $\frac{32}{4 \times 1 \times 2}$ = 4 coils in series per group. By following Rule 4 the connections will be made as follows:

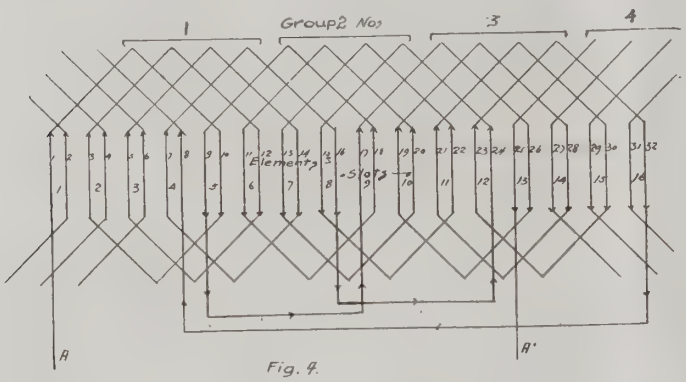

Fig. 4.

The first group of running coils:
The end of coil No. 1 to the beginning of coil No. 2;
The end of coil No. 2 to the beginning of coil No. 3.
The second group of running coils:
The end of coil No. 5 to the beginning of coil No. 6;
The end of coil No. 6 to the beginning of coil No. 7.
The third group of running coils:
The end of coil No. 9 to the beginning of coil No. 10;
The end of coil No. 10 to the beginning of coil No. 11.
The fourth group of running coils:
The end of coil No. 13 to the beginning of coil No. 14;
The end of coil No. 14 to the beginning of coil No. 15.

The starting winding consists of coils No. 4, 8, 12, 16. These are shown in dotted lines in figure No. 3.

The connection between the groups are made as follows:
The end of group No. 1 (coil No. 3) to the end of group No. 2 (coil No. 7).
The beginning of group No. 2 (coil No. 5) to the beginning of group No. 3 (coil No. 9).
The end of group No. 3 (coil No. 11) to the end of group No. 4 (coil No. 15).

The terminals connected to the line are the beginning of group No. 1 (coil No.1) and the beginning of group No. 4 (coil No. 13).

The starting coils are connected as follows:
The end of coil No. 4 to the end of No. 8,
The beginning of coil No. 8 to the beginning of No. 12,
The end of coil No. 12 to the end of No. 16.

The beginning of coil No. 4 and the beginning of No. 16 are the terminals of the starting winding. Both windings are connected across the line but the centrifugal switch is connected in series with the starting winding, which will open and cut this winding out of circuit when the motor is up to speed.

The winding for the armature for a single phase alternator which follows the same principle as Fig. 3 is shown in Fig. 4.

Polyphase Machines

Considering polyphase machines, since no starting winding is required for motors, the method of connecting both generators and motors is identical.

In a two phase machine when the winding has been divided into groups, the groups which are 90 electrical degrees apart will be connected together. This will form two distinct windings which will be 90 degrees apart. A simple method to connect a two phase winding is to connect groups Nos. 1. 3, 5, 7, etc., as one phase and groups Nos. 2, 4, 6, 8, etc., as the second phase. When a two phase winding is spaced into groups the groups will always be 90 electrical degrees apart.

Fig. 5 shows a two phase winding of the half coiled type and has four poles and 16 coils on the entire winding: that is, 8 coils per phase.

The coil spread in a two phase winding is found by the same formula: $\frac{\text{Number of winding elements}}{\text{Number of poles}} = \frac{32}{4} = 8$. In a half coil winding the spread of the coil can result in any whole number odd or even. There will be one winding element per slot; the layout will be as follows:

Coil 1	from winding element	1 to 9	in slots 1 and 9
Coil 2	from winding element	2 to 10	in slots 2 and 10
Coil 3	from winding element	3 to 11	in slots 3 and 11
Coil 4	from winding element	4 to 12	in slots 4 and 12
Coil 5	from winding element	5 to 13	in slots 5 and 13
Coil 6	from winding element	6 to 14	in slots 6 and 14
Coil 7	from winding element	7 to 15	in slots 7 and 15
Coil 8	from winding element	8 to 16	in slots 8 and 16
Coil 9	from winding element	17 to 25	in slots 17 and 25
Coil 10	from winding element	18 to 26	in slots 18 to 26
Coil 11	from winding element	19 to 27	in slots 19 and 27
Coil 12	from winding element	20 to 28	in slots 20 and 28
Coil 13	from winding element	21 to 29	in slots 21 and 29
Coil 14	from winding element	22 to 30	in slots 22 and 30
Coil 15	from winding element	23 to 31	in slots 23 and 31
Coil 16	from winding element	24 to 32	in slots 24 and 32

When the coils have been placed they are then divided into groups by this formula: $\frac{\text{Number of winding elements}}{\text{Number of poles} \times \text{number of phases}}$, then $\frac{32}{4 \times 2}$ = 4 coils in series per group. From the general appearence of Fig. 5 it is divided into two groups of eight coils each. Each of these two groups will be divided into two groups

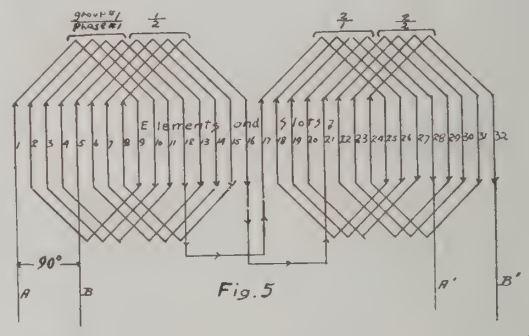

Fig. 5

of 4 coils: these four coils will be connected in series by connecting the end of one coil to the beginning of the next in each group separately, as explained in Rule 3.

To find the number of winding elements which equal 90 electrical degrees use this formula: $\frac{\text{Number of winding elements}}{2 \times \text{number of poles}}$, or $\frac{32}{2 \times 4} = 4$.

The winding is now divided into four groups of four coils each, and it will be seen that the beginning of coil No. 1 and tne beginning of coil No. 4 are four winding elements or 90 electrical degrees apart. This will make groups Nos. 1 and 3, Phase 1 and groups 2 and 4, Phase 2. The interconnections between groups of the same phase are also made as in Rule 3, the end of the first group to the beginning of the second.

The term Electrical Degrees may not be easily understood but in Fig. 6 position 1, 2, 3, 4, 5, shown in the four pole frame are 90 electrical degrees apart. If a conductor has passed from position 1 to position 5 it has passed through a complete electrical cycle which is taken equal to 360 deg. To find the

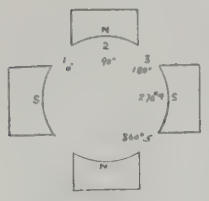

Fig. 6

electrical degrees between any two positions, multiply the mechanical degrees by the number of pairs of poles.

Fig. 7 shows the winding of a four pole two phase winding of the whole coiled type, it has 16 coils total or 8 coils per phase. The first step is to find the spread of a coil and this is found by the formula:

$$\frac{\text{Number of winding elements}}{\text{Number of poles}} = \frac{32}{4}$$

, then = 8 as previously explained this result must be made an odd number by adding or subtracting 1, then the result will be 7 or 9. By using the spread of 9, we get the following winding table:

Coil	1	from winding elements	1	to 10	in slots 1 and 5
Coil	2	from winding elements	3	to 12	in slots 2 and 6
Coil	3	from winding elements	5	to 14	in slots 3 and 7
Coil	4	from winding elements	7	to 16	in slots 4 and 8
Coil	5	from winding elements	9	to 18	in slots 5 and 9
Coil	6	from winding elements	11	to 20	in slots 6 and 10
Coil	7	from winding elements	13	to 22	in slots 7 and 11
Coil	8	from winding elements	15	to 24	in slots 8 and 12
Coil	9	from winding elements	17	to 26	in slots 9 and 13
Coil	10	from winding elements	19	to 28	in slots 10 to 14
Coil	11	from winding elements	21	to 30	in slots 11 to 15
Coil	12	from winding elements	23	to 32	in slots 12 to 16
Coil	13	from winding elements	25	to 2	in slots 13 to 1
Coil	14	from winding elements	27	to 4	in slots 14 to 2
Coil	15	from winding elements	29	to 6	in slots 15 to 3
Coil	16	from winding elements	31	to 8	in slots 16 to 4

When all the coils have been placed it is then divided into groups: the number of coils per group are found by the formula:

$$\frac{\text{Number of winding elements}}{\text{Number of phases} \times \text{number of poles} \times 2} = \frac{32}{2 \times 4 \times 2}$$

, then = 2 coils per group. This will divide the winding into eight groups of two coils each, and as previously explained that alternate

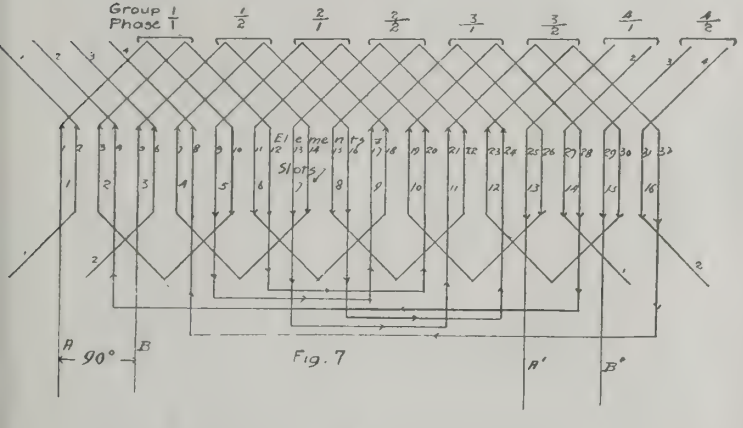

Fig. 7

groups will belong to the same phase, and by following the method of connection as in Rule 4, first connect the two coils in each group in series and then connect groups 1, 3, 5, and 7 in series for the first phase and groups No. 2, 4, 6, and 8 in series for the second phase. The beginnings of the first and seventh group are the terminals of Phase 1 and the beginnings of the second and eighth group are the terminals of Phase 2. For a three-wire two phase connection join the end of the first phase to the beginning of the second phase, and this will be the center wire of the three.

Three-Phase Windings

In a three phase the winding is divided into three parts each being 120 electrical degrees apart: to find 120 electrical degrees use this formula:

$$\frac{\text{Number of winding elements}}{\text{Number of Pairs of poles} \times 3} = \text{Number}$$

of winding elements which will equal 120 electrical degrees.

Fig. 8 represents a half coil 3-phase 4-pole winding, having 24 coils. The placing of the coils in a 3-phase half coil winding is a little different than in single or two phase; the coils will be placed in groups and each group will be 120 degrees from the others.

To find the spread of a coil in a half coil winding: Number of winding elements $\frac{48}{\text{Number of poles}} = \frac{48}{4}$, or = 12; and to find the number of coils in series per group:

$$\frac{\text{Number of winding elements}}{\text{Number of poles} \times \text{number of phases}} = \frac{48}{4 \times 3}$$

, or = 4 coils in series per group.

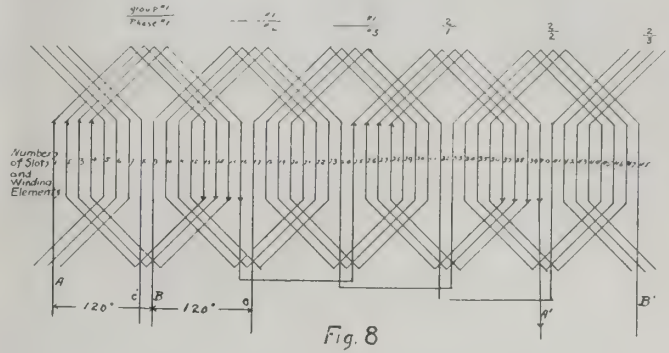

Fig. 8

The winding table is then as follows, there being one element per slot:

First group	Coil No.	1,	from winding elements No.	1	to 13
	Coil No.	2,	from winding elements No.	2	to 14
	Coil No.	3,	from winding elements No.	3	to 15
	Coil No.	4,	from winding elements No.	4	to 16

After the 4th coil has been placed it will be necessary to advance 120 degrees to begin coil 5 which is the first coil of the second group. 120 deg. $= \frac{\text{Number of winding elements}}{\text{Number of poles} \times 3}$,

or $\frac{48}{2 \times 3} = 8$.

Sec. group.	Coil No.	5,	from winding elements No.	9	to 21
	Coil No.	6,	from winding elements No.	10	to 22
	Coil No.	7,	from winding elements No.	11	to 23
	Coil No.	8,	from winding elements No.	12	to 24
Third group.	Coil No.	9,	from winding elements No.	17	to 29
	Coil No.	10	from winding elements No.	18	to 30
	Coil No.	11,	from winding elements No.	19	to 31
	Coil No.	12,	from winding elements No.	20	to 32
Fourth group.	Coil No.	13,	from winding elements No.	25	to 37
	Coil No.	14,	from winding elements No.	26	to 38
	Coil No.	15,	from winding elements No.	27	to 39
	Coil No.	16,	from winding elements No.	28	to 40
Fifth group.	Coil No.	17,	from winding elements No.	33	to 45
	Coil No.	18,	from winding elements No.	34	to 46
	Coil No.	19,	from winding elements No.	35	to 47
	Coil No.	20,	from winding elements No.	36	to 48
Sixth group.	Coil No.	21,	from winding elements No.	41	to 5
	Coil No.	22,	from winding elements No.	42	to 6
	Coil No.	23,	from winding elements No.	43	to 7
	Coil No.	44,	from winding elements No.	44	to 8

The coils forming the same group will be connected as in Rule 3; the groups which form one phase are also connected as in Rule 3.

The beginning of group 1 is the beginning of phase 1 and the beginning of group 4 is the end of the same; advancing 120 deg. or 8 winding elements, the beginning of group 3 is the beginning of phase 2 and the beginning of group 6 is the end of same; advancing again 120 deg. or 8 winding elements to the beginning of group 5 we have the beginning of phase 3 and the beginning of group 2 will be the end of same.

Figure 9 shows a whole coil 4 pole 3 phase winding having 24 coils.

The spread of a coil will be found by the usual formula:

Number of winding elements 48
———————————, or — = 12. As previously explained this result must be an odd number then 12 + 1 = 13. The coils will be placed according to the following table:
Number of poles 4

Coil 1 from winding elements 1-14 in slots 1- 7
Coil 2 from winding elements 3-16 in slots 2- 8
Coil 3 from winding elements 5-18 in slots 3- 9
Coil 4 from winding elements 7-20 in slots 4-10
Coil 5 from winding elements 9-22 in slots 5-11
Coil 6 from winding elements 11-24 in slots 6-12
Coil 7 from winding elements 13-26 in slots 7-13
Coil 8 from winding elements 15-28 in slots 8-14
Coil 9 from winding elements 17-30 in slots 9-15
Coil 10 from winding elements 19-32 in slots 10-16
Coil 11 from winding elements 21-34 in slots 11-17
Coil 12 from winding elements 23-36 in slots 12-18
Coil 13 from winding elements 25-38 in slots 13-19
Coil 14 form winding elements 27-40 in slots 14-20
Coil 15 from winding elements 29-42 in slots 15-21

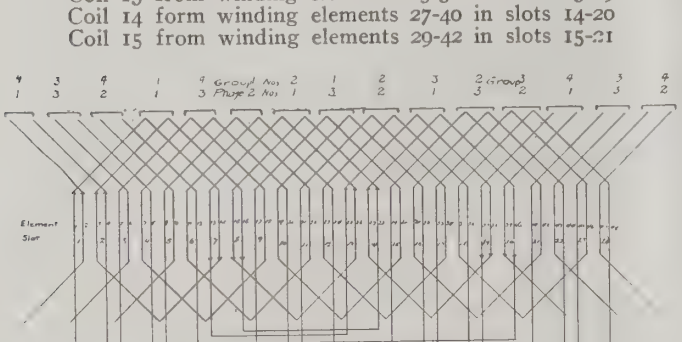

Fig. 9

Coil 16 from winding elements 31-44 in slots 16-22
Coil 17 from winding elements 33-46 in slots 17-23
Coil 18 from winding elements 35-48 in slots 18-24
Coil 19 form winding elements 37- 2 in slots 19- 1
Coil 20 from winding elements 39- 4 in slots 20- 2
Coil 21 from winding elements 41- 6 in slots 21- 3
Coil 22 from winding elements 43- 8 in slots 22- 4
Coil 23 from winding elements 45-10 in slots 23- 5
Coil 24 from winding elements 47-12 in slots 24- 6

When all the coils have been placed they are then divided into groups and connected as in Rule 4.

Number of winding elements 48
——————————————— = ———————
Number of poles × umber of phases × 2 4 × 3 × 2

2 coils in series per group. Remembering that in a 3-phase winding the phases are 120 degrees apart, this will make groups 1-4-7 and 10, Phase 1; groups 3-6-9 and 12 Phase 2; groups 5-8-11 and 2 Phase 3. The complete connections are shown in Fig. 9.

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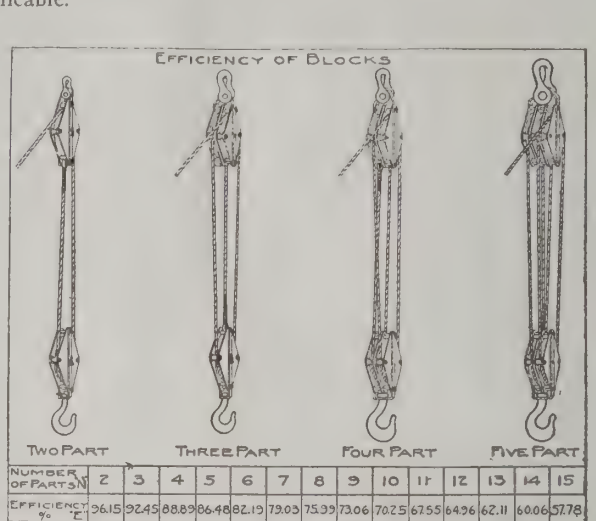
Wire Rope Tackle

In the field of construction and engineering, tackle using wire rope has largely supplanted that using manilla rope. Such tackle ropes as used on derricks, hoists, etc., a e reeved with a number of parts using single or multiple sheave blocks.

The number of parts supporting the load is determined by counting the ropes leading to and from the moving block. To arrive at the stress on the lead line, common practice is to divide the weight of the load by the number of parts of rope supporting same; this, however, is not correct as it does not take into account the friction of the blocks nor the rigidity and internal friction of the rope.

The maximum stress, when hoisting, occurs in the lead line, since this part besides taking the proportion of load on a single part, also takes the accumulated friction of blocks and rope in all the other parts of the tackle.

The ropes usually used in construction work are 6 x 19 construction and "Blue Center" steel quality, though plow steel can be used if the stress is within the limits of this quality. The ropes range from ½ inch to ⅞ inch diameter inclusive. With the ropes included in the above requirements and with the *tread diameters* of the sheaves in the blocks not less than twenty times the rope diameter, the values of efficiency and lead line pull factors are given in the plate "Efficiency of Blocks" are applicable.



To show the error arising in assuming all parts of rope in a tackle equal proportions of the load, we give an example of a seven part hoist raising a load of 35,000 lbs. Usual practice for stress in lead line is 35,000 ÷ 7 = 5,000 lbs., and assuming all parts pulling equally. This stress occurs, however, only in the becket line. The correct method for maximum stress is 35,000 × .1807 = 6,325 lbs. where .1807 is the lead line pull factor for a 7 part tackle. This stress of 6,325 lbs. occurs in the lead line only and is 27.5 per cent. greater than the value found by the first, incorrect method.

If a rope were to have been chosen on the basis of the 5,000 lbs. stress with a factor of safety of 6, this factor of safety would in reality have been only 4¾ with the resulting stress of 6,325 lbs. In many cases contractors do not use such a large factor as 6 to start with, and hence the actual factor is reduced in proportion and short rope life results frequently causing dangerous and costly accidents.

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Standard Wiring Diagrams

On the opposite page appear the first four of a series of diagrams which will appear in successive issues of Electrical Age. There is at present no collection of diagrams used in special light circuit work and it is necessary when something of this sort is wanted to design the circuits. This series will appeal to the wireman as a ready reference manual; for this reason we have arranged the material so that the page can be cut into leaves for pocket notebooks. Succeeding issues will take up multiple control of lights, burglar protection lighting, and motor wiring.

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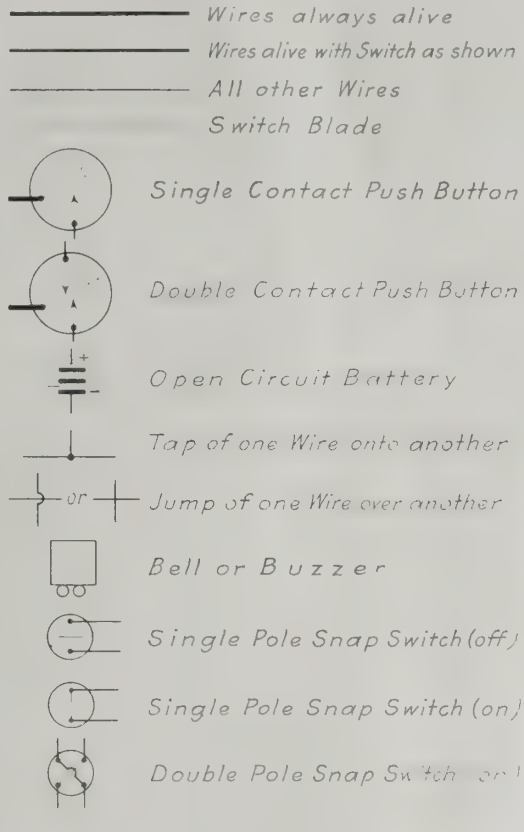
A souvenir gold dollar, specially minted by the U. S. Treasury department in connection with the new McKinley Birthplace Memorial now in course of erection at Niles, O., where the martyred president was born, is now ready for distribution. The new dollar has on one side a likeness of McKinley and on the other a bas relief of the magnificant memorial building. These coins, of which no more will be minted, are certain to be highly prized by collectors. They will be sold at $3 each, and may be obtained from the leading banks in the principal cities, or from the McKinley Birthplace Memorial Association, Youngstown,

—CONVENTIONS—



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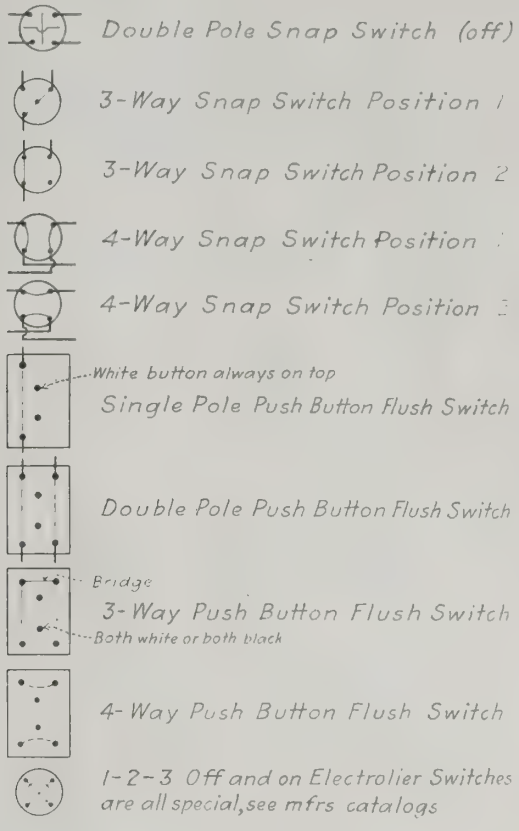
—CONVENTIONS—



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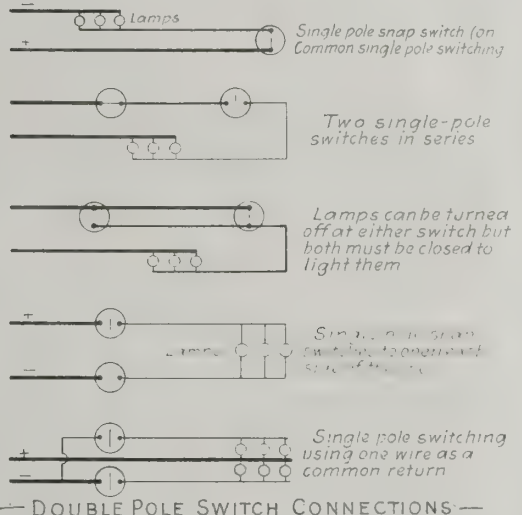
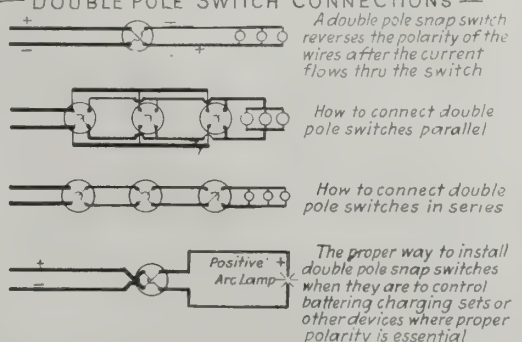
—SINGLE POLE SWITCH CONNECTIONS—



—DOUBLE POLE SWITCH CONNECTIONS—



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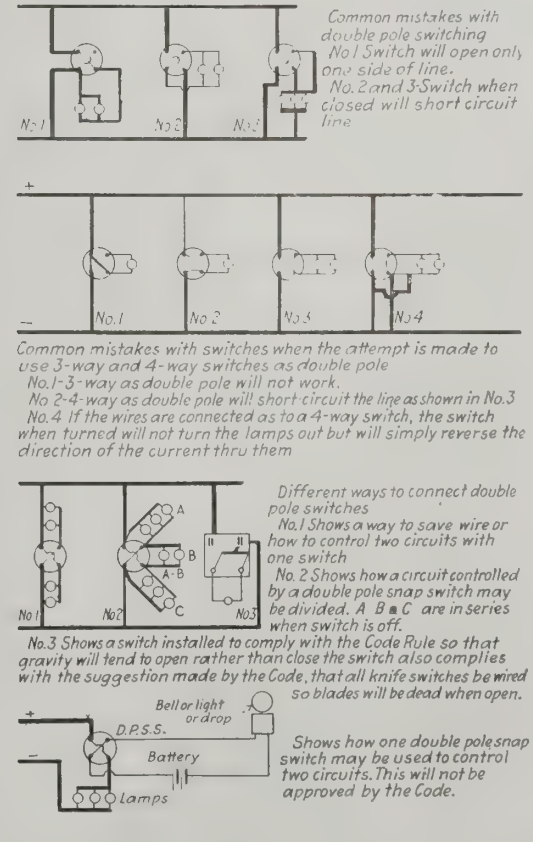
—DOUBLE POLE SWITCH CONNECTONS—
(CONTINUED)



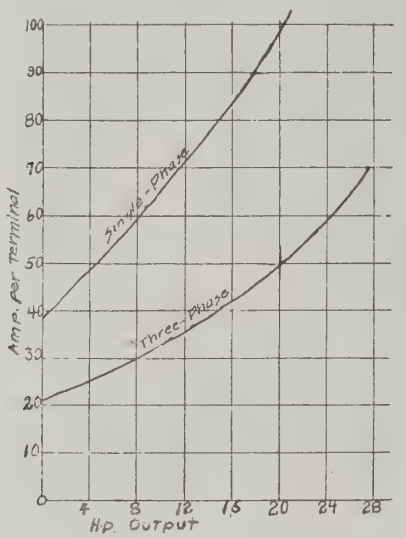
4

Questions and Answers

Q. Will you please publish a curve showing the amperes-per-terminal input to a 3-phase 220 volt 20 h-p. squirrel-cage induction motor for normal and for single-phase running?

W. H. J.

A. In the accompanying curve you will note that the motor running light takes about 70 per cent. more current per line single-phase than three-phase. At ½ load the current is nearly double, and at full load practically double. This represents



about an average motor. By special design other characteristics may be obtained. This shows, however, the general relation between a given motor running three-phase and single-phase.

A. E. AVERRETT,
Induction Motor Department, General Electric Co.

* * *

Short Cuts and Minor Methods

That "the boys" are interested in our new department is evident from the response to its first appearance. What do you know that's new? Send it along; there's money in it!

Replacing a Broken Wire

It often occurs that a wire will break off close to the coil or almost inside the coil so short that it is impossible to splice another piece on by means of a regular twisted splice. If the end is formed into an eye as shown in the sketch and completely covered with solder it will complete a splice which will hold even better than a twisted splice. Of course this kind of connection can only be made in the small wires—larger wires take up too much space.

I have made splices of this kind when a bottom lead has broken from an armature coil and being so short that it has been necessary to make the loop on the broken end by means of a pair of tweezers and required a small 10c soldering iron to get between the coils to solder it.

R. F. Jones, Hoboken, N. J.

Occasionally Also Used on Face and Hands

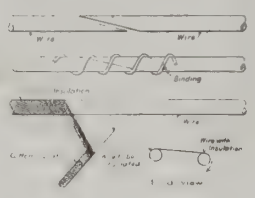
If a piece of soap in kept in the tool bag it will often be found useful to lubricate the threads of a wood screw before screwing it into the wood. It is suprising the difference it makes. Soap is also useful for holding back the frayed insulation on bared telephone and bell wires making a much neater looking job.

There is no better lubricant than soap for lubricating the rubbing surfaces of two pieces of wood.

C. D. Schermerhorn, Cedar Rapids, Iowa.

Splicing in Close Quarters

Splicing armature wires which have broken inside the slot can readily be made by making a splice as shown. Lay the two scarfed ends together and bind roughlyl with binding wire. Completely cover with hard (50/50) solder and then remove the binding wire and by means of a fine file take off all the solder right down to the copper. Take another short piece of copper wire which has an insulation of cotton and unwrap this but at the same time wrap on the splice. Then a little shellac varnish to hold this in place will complete a splice which is no larger than the wire.



The weakness lays in the solder which should be very hard otherwise if the coil gets hot through overload the splice is liable to break.

R. Thistlewhite, Morris Plains, N. J.

Tests for Polarity

A piece of ordinary blue print paper if moistened will turn white at the negative wire when testing for polarity.

When testing polarity of fields a small pieces of iron long enough to reach from one pole to the rets will be attracted if the fields are connected to produce north and south polarity. If they are connected to produce two norths or two souths no attraction will result, and one of them must be reversed.

The piece of iron must be laid accross the poles faces of two poles if only placed on one pole attraction will result in all cases.

J. E. Williams, Rocky Hill, N. Y.

Cutting Out a Coil

A ready method of jumping out a coil in lap wound amatures when no means of soldering are at hand is to burr the commutator bar so that it connects with the bar next to it. This would have to be done at a point where it would be clear of the brushes. If the commutator is undercut drive a thin copper wire between the two bars which are to be shorted. If this jumper is to clear an open this is all that is required, but if it is to clear a shorted coil the coil will have to be cut from the commutator and also one or two turns cut on the end winding.

C. Eastburn, Atlanta, Ga.

Counting the Turns

There are times when coils have to be wound and the turns counted. If no counter is available fasten a piece of thin stick or strip of metal to the head-stock of the winding lathe in such a manner that it will engage with some part of the stationary part of the lathe and make a click.

It will be supprising how this assists one in counting.

E. Fisher, High Point, N. J.

For Splicing Drills

Where a hole has to be bored that requires a drill eight or ten times as long as the ordinary drill, but where the drill hole itself does not have to be of excessive depth. Take a piece of wrought iron or soft steel rod about double the diameter of the drill. Drill a hole in its end (with the drill that is to be spliced to it) absolutely parallel with the axis of the rod, and to a depth of about four times the drill diameter. Heat the drilled end of the rod, and cool the drill shank, insert the drill, and you will have a shrink fit that will hold the drill, but which can be made to let go when the job is finished by again heating the rod.

R. L. Bourke, New York City.

To Make an Emory-Wheel

In most cases it is very difficult to make emery stick to a wooden wheel, but instead of trying to make the emery stick to the wood, first glue on a felt or heavy woolen cloth and then smear it with hot glue, and roll it in emery that has been heated quite hot. Three coats of emery should be applied.

C. E. Finch, Chapel Hill, N. C.

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Selling More than Sockets and Wire

By William Dales

Mr. Average Electrical Contractors, why are you in business?

The answer is obvious—to make money so that you can enjoy the good things of life and provide increasing comforts and advantages for those depending upon you.

What are you giving the community in return for the money it pays to you?

Remember that you generally get out just about as much as you put in.

True, there are some lucky dogs who seem to get money for nothing, but they are the exception and not the rule. Ordinarily, you must produce to get the big return.

Are you content just to sell wiring devices and material? There are thousands of contractors who seemingly are. They are engaged in fierce competition—always sharpening their pencils, cutting the price in order to beat out the other fellow. When the job is awarded, they are obliged to scratch further in order to get out with a whole skin.

What is the result?

The contractor does not make money, and the customer does not get the best—either in workmanship or service from the installation. What is equally important, the progress of the whole electrical industry is retarded. There is an old saying that "A man is no better than his generation."

What are you doing to help the electrical business in your town?

Why is it that the great majority of the houses, office buildings and factories in your town have little or nothing more than a bare elemental electrical installation and are thus prevented from realizing the fullest comfort and utility from that most willing and able of all workers—Electricity?

It is because you and your fellow contractors spend your time and energy in trying to under-quote each other and are content with an income just a little better—perhaps not quite as good—as when you were a wireman. If you are now a real contractor and desire to make an income greater than you did in the plier and blow-torch days and want to see the electrical art in your town advance, you must learn how to sell more than just sockets and wire.

Here's the big idea!

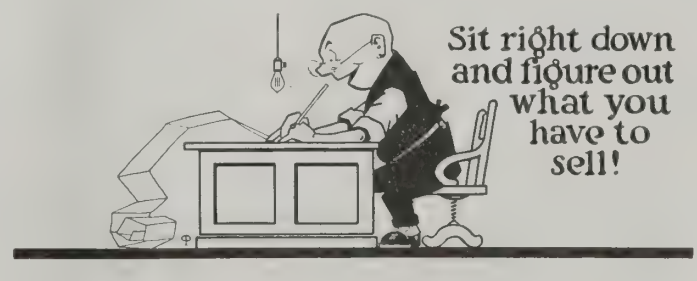
Consider the lawyers in your town. Some are poor, both in purse and in clients; others are busy and have an increasing bank balance. They all know the mechanics of their trade; They all know the fundamentals; such as, affidavits, subpoenas, writs, appeals and reversals, but the fellow who knows more than these elements and gives his clients other legal service is the chap who owns a car and lives in that comfortable home on that attractive street.

You, Mr. Contractor, must make up your mind to sell more than the mere elementals of your business. Sit down right now and figure out what you have to sell. The manufacturers and jobbers have placed at your disposal the appliances and the material. You have no corner on this market. Your fellow contractors have the same sources of supply for sockets, wire, etc., and if you are trying to sell just these things, you will always have competition. It is time you were getting out of this nerve-racking, profit-killing rut of competition. Note the successful lawyer. He can select the profitable business and pass up the work which has little or no money in it, but the "shyster" is obliged to take everything that comes his way—for he and his must live.

It is time that you, Mr. Average Electrical Contractor, began to sell your services.

Right now, make a big mental note that the next time you bid upon a house-wiring job, you will go to the owner and, if necessary, to the architect and talk service. Explain that there are different grades of material and fittings as well as different kinds of workmanship. Undoubtedly, they all look alike to your prospective customer—so do automobiles to the wild men of Borneo. The prospective purchaser must be educated. Explain the differences—show that the initial cost alone should not be considered, but that the cost divided by the years of service that high grade apparatus properly installed will give is the correct and sane way to consider the investment. Explain to the builder of a proposed residence or the owner of an old home which he is thinking of having wired that he ought to have conduit and box work—explain its advantages over the knot and tube work—tell him that it costs more, but in the name of "Jove" don't forget to tell him WHY he should make the additional investment. Urge that he provide sufficient baseboard outlets and that he put a floor pocket in his dining room; also that he wire his dining room table, put in a heater control combination in his kitchen, additional outlets in his laundry and automatic switches on his closet doors.

You will not do all of this for his convenience alone. It will prove to be to your advantage as well, as it will pave the way for the sale of floor portables, vacuum cleaners, toasters, per-



colators, irons and washing machines, and don't forget to recommend the installation of a master control switch to be located in the bed room, which gives the owner independent control over the whole lighting of the house. Explain how he from his bedside can light up his whole house any hour of the night. He will recognize that a brilliantly lighted house, porch and grounds is worth two or three policemen.

Show how these little additional touches increase the value of the property, either from a renting or a selling point of view. It is just these little extra things that ofttimes are vital factors in closing the deal.

When next you figure on a factory job, tell your prospective customer about the advantages of the new safety enclosed switches. Explain to him how their installation would prevent accidents and suits for damages. Talk over the desirability and economy of motor drive—show how efficient lighting increases the output. Do all of these things—**TALK AND SELL YOUR SERVICES,** and you will find yourself in a class by yourself. Competition will be one of the bygones of the days when you sold nothing but sockets and wire.

January first is the time to take an inventory of the stock of your material, but there is no better time than now to list what you have to offer in the way of services. Get out your back copies of the trade papers—look over the catalogs and be prepared to try out the "big idea" on your next prospect.

If you are progressive in the least degree, you must read your trade papers. Then you are abreast of the times. You know about the latest devices that have been designed and placed on the market.

It will not be easy—nothing that is really worth while ever comes that way. Perhaps the first—yes, maybe the second—time you will fail to get it over, but keep at it and you will succeed, and it will pay you well.

Keep in mind that if you don't sell more than sockets and wire, you are not measuring up to the fullness of your opportunity, and the progress of the electrical industry in your town is being retarded.

Use your head as well as a sharp pencil when next you estimate.

Editor's Note: In the November 30 issue of *Leslie's Weekly* will appear an article by Mr. Dales addressed to the buyers of electrical construction, urging them to consider qualtiy of materials and workmanship rather that price and to patronize contractors who have an established reputation for first-class work.

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Electric Cooking Appliances and the Dealers

By J. E. Bullard

With more than 3,300 communities already supplied with current at a rate that makes electric cooking practical there is good reason to believe that the manufacture of electric cooking appliances will soon become a very important part of the electric industry. The greatest danger lying in the path of the most rapid growth is the possibility that central stations will follow in the path of gas companies in the marketing of these appliances rather than hew out new and better paths of their own.

The growth of the electric i dustry during the past thirty years is the best proof that electric men can discover extremely good ways of doing things. Central stations have already built up large power loads and have made very satisfactory progress in the lighting business. All that remains to be done is to develope the electric heating field.

The wonderful growth that the industry has experienced in the past has been due, to a very great degree, to the close co-operation that has existed between the central stations, the dealers, the contractors, the jobbers and the manufacturers. Everybody has been working together and th's combined effort has made it possible to overcome the greatest obstacles.

With the advent of electric heating, however, there is a danger of disrupting this ideal condition. Already there is more or less being said in favor of central stations selling cooking appliances at prices so low that the dealer will not be able to sell them at a profit. The manufacturers have suggested that the dealers be given a bigger discount than the central station but there appears to be serious objections to this procedure.

The one solution to the problem that has not yet been given sufficient serious attention is that of applying better salesmanship to the sale of domestic appliances. It certainly should not be necessary to antagonize the dealers in the effort to increase the cooking load of central stations any more than it has been necessary to antagonize them in the development of the power load.

The retail dealer is a very important factor in the sale of any commodity. He shoul always be protected; not penalized. No concern or industry that has ignored him has been able to make the success those that have worked with him and have protected him have made.

At the present time those dealers who handle cooking appliances are confining themselves for the most part to coal and oil appliances. The policy of selling gas appliances for less than cost which has been pretty universally adopted by gas companies has very effectively barred them from doing much business with gas ranges. These dealers are ready and willing to become the allies of the electric industry provided they are guaranteed protection. All they ask is a reasonable profit on the sale of appliances. It rests with the electrical industry whether or not they are given this guarantee and are won over to the electric cooking idea.

In the electric industry there has always been co-operation. To-day this co-operation is stronger and more workable than every before. In the gas business there has never been co-operation to any marked degree. Gas companies have usually adopted the policy of attempting to do everything by themselves. The effect of these respective policies is reflected in the comparative growth of the two industries. The value of co-operation, therefore, is clearly shown if we compare the present size and age of these two utilities. This comparison works out as follows.

The central station business is only 34 years old but already has an invested capital of over two billion dollars divided among more than five thousand companies. The gas business is one hundred years old but has only about one billion one hundred million dollars of invested capital which is divided among approximately eleven hundred companies. The electric companies serve over 3,300 communities with current at a rate that makes electric cooking practical. Gas companies serve only 2,500 communities with artificial gas.

A study of these two industries indicates that the greatest difference that existed between them has been the difference in the degree of co-operation that has existed between the individual companies, the dealers and all others interested. If the electric industry had not been an industry in which co-operation is a prominent characteristic, while the gas industry has been one in which this characteristic has been conspicuous by its absence, it is certain that the percentages in favor of electricity would not be so great as they are to-day. We, for instance, would not find as we do that the central station industry has 80 per cent. more invested capital than the gas industry, 80 per cent. more companies, and 32 per cent. communities served with current at rates so low as to premit of electric cooking and heating, than the total number served by artificial gas companies.

Possibly there is no better way to illustrate what the ulimate effect will be when service companies ignore the rights of the dealer than to quote from the abstract of a paper to be presented by Geo. S. Barrows and C. C. Winterstein at the next convention of the American Gas Institute. The following is quoted from the September issue of the *American Gas Institute News.*

"Current periodicals and literature on the subject of house heating indicate but little careful study of the use of manufactured gas for house heating and it appears as if it is categorically assumed that it is out of the question. For this trend of opinion we may be to blame for insufficient publicity as is indicated by a recent edition of a handbook on "Heating and Ventilation," published by a well-known engineer, in which the author has found it pertinent to add a short chapter on electrical heating and has made therein an approximate computation of the relative costs of electrical and coal heating. No similar comment, however, is to be found regarding the relative costs of gas and coal heating and the thought naturally arises, therefore, as to what the motive could have been which impelled this authority to span the breach between these two widely different methods of house heating while entirely ignoring the fuel "Gas." It would seem that the electrical industry, despite obvious obstacles, has been able to demand a hearing in consideration of this topic while the more logical fuel "gas," and we refer here to manufactured gas in particular, has failed to make a very deep impression.

Here is a case where we find electricity already being given serious consideration as a house heating agent in spite of the fact that gas is not even mentioned. It will be noted that the excuse given in the abstract for this states of affairs is "insufficient publicity." The real cause for this insufficiency of publicity, however, is not mentioned. This cause can be found in the lack of the co-operation which must always exist before any co-operative publicity work can be made successful. This lack of co-operation is directly traceable to the attitude taken by the gas companies towards the dealers, which in its turn is the result of the policy adopted by gas companies of selling appliances at less than cost and thus monopolizing the sale of all gas consuming devices.

One can hardly expect a dealer to spent time and money in experimental and research work if he has every reason to believe that he will be robbed of his reward. Very few dealers are in a position or a frame of mind to do philanthropic work for public utility companies. Just so long as it is profitable to do so dealers will co-operate with these companies. When the profit disappears they will leave anything pertaining to a public utility company severely alone.

This being the case it is very essential that any policy finally adopted by electric light companies for the sale of electric cooking appliances give careful consideration to the dealers. It will never prove profitable for central stations to attempt to monopolize the appliance business by selling appliances for less than a living profit. Should they try to do so it will prove detrimental not only to the dealers and the contractors but also to the central stations themselves.

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New York Electrical Show

(*Continued from page* 34)

ated dairy in which cows were milked by machines; a working bakery, and an exceptionally complete showing of the vocational school pupils at work. Our public knows that it is going to be entertained and instructed, and so it comes back year after year.

"If our success is due to one thing more than another, that element is the constant effort we make to serve our exhibitors. We have their booths ready for them on time, and a force of men to help get the materials into place. We suggest the product we believe they can display to the best advantage, and we deliver a crowd which as potential customers are practically hand-picked. For instance, New York is the greatest center in the United States for exporting firms; we send invitations and tickets to every one of them, and to exporters in nearby cities. The central stations do not compete with local retailers in appliance sales, and hence we are able to get all the important electric shops to exhibit at our show.

"Education is vitally important for users of electricity, and the opportunity to come into actual touch with apparatus in perfectly informal way makes people feel much freer to ask and investigate when they are not sure of their own minds. While exhibitors are perfectly free to solicit orders, they all consider their opportunity to be one of ground-breaking for a harvest to be reaped later."

Distinguished Guests at the Show: Standing: Alexander Maxwell, W. Greeley Hoyt, W. J. Clark, W. S. Gifford, Walter Neumuller, E. F. Tweedy, George F. Parker. Sitting: Arthur Williams, Maj.-Gen. Leonard Wood, George B. Cortelyou.

Asked for suggestions to promotors of shows in smaller communities, Mr. Parker said:

"First of all, they should get a competent manager to assume the responsibilty, and keep him season after season. Of course they need only employ him for a few months in the year, but he should be given a chance to get acquainted with the exhibitors and learn their needs—which means that the more shows he puts on, the better exhibits he can get. In my own case, I have a very wide acquaintance in the business, which helps a great deal. Then the men in charge shouldn't attempt to do too much the first year. It took a lot of patience and painstaking attention to "service" details to gain the confidence of Government officials so as to get the excellent displays we have now. All the machinery of the show runs more smoothly as the seasons pass. Then again a small show, well lighted and decorated, with good music, and an admission fee will pull a better crowd for your exhibitors than a "public market" affair where little money is spent by either exhibitor or visitor. In brief, I would say, remember that your exhibitor is the man who must be benefitted, and that your central station should back the show, and with a good manager and loyal support, you can "put it across."

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Plans are already under way for the first National Complete Building Show to be held in the Grand Central Palace, New York City, March 5-11, 1917. A similar show held in Cleveland last February showed that the educational effect on the man-about-to-build well repaid manufacturers and dealers who exhibited. The New York exposition, while giving quite as much attention to the home building interest, will be broader, more diversified and comprehensive in its scope. It will deal in a large way as well with the problem of the public and commercial building, demonstrating the most up-to-date methods, ideas and skill, both in construction and furnishment. Guided by their experience in the Cleveland show, for some of the men active in that event are interested in the promotion of this, the management will make it a complete show in the fullest sense of the word.

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The men who make money are the men who make a town. No town prospers where it is a sin to make more than two dollars a day—E. W. Howe.

America's Electrical Week

Current notes from the field concerning plans for the celebration of America's Electrical Week indicate that the men in charge in various cities are lining up their forces and preparing to make this the greatest new-business event ever pulled off. A few more suggestive reports follow:

Louisville Electrical Exposition

The Louisville Jovian League will hold its second annual electrical exposition at the Louisville armory, December 4-9 inclusive, tying in with the national event "America's Electrical Week." The exposition last year was one of the largest and most profitable affairs of the kind ever held in this country, the attendance for five days being in excess of 50,000 people. This year preparations are being made to exceed last year's exposition in every department and the admittance charge will be 25c instead of 10c. Practically every exhibitor at last year's show will be represented this year although the rate for exhibit space has been advanced 100 per cent. As an example of how the exhibitors profited last year it is cited that an electric automobile company sold three electric cars during the show and three more a short time later as a result of inquiries received at the exhibit. The Louisville armory which is one of the largest in the United States will have an exhibit space entirely around the outside of the room, leaving the center portion open with the exception of a large oval platform stage. The increased revenues from exhibit space and admittance charges will be expended in securing high class vaudeville acts which will be staged every afternoon and evening. Although the show will be essentially an electric one it will be broadened as much as possible with other features. One night, for instance, will be known as fashion night and every department store in the city will have fashion night and every department store in the city will have fashion reviews with live models. Electrical dealers and contractors will hold contests of various kinds to secure prospects for housewiring and household appliances, etc., etc. An effort is being made by one of the dealers to festoon about forty business blocks with special lighting to remain throughout the month of December.

San Francisco, California

Six electrical demonstration shows in various sections of the city will be the center of the AEW activities. The largest will be in the nave of the Ferry Building and will display the uses of electricity upon the farm and in the home. The California Development Board will co-operate in this exhibit. Another will be installed in the Board Room of the Chamber of Commerce in the Merchant's Exchange Building; another in a vacant store on Market Street. A building close to Fillmore and Sutter Streets will cover the Western addition, while the Richmond District will be covered by a store at 6th and Clement Streets and the Mission district by a store at 22nd and Mission Streets. These stores will be rented by the AEW committee for two weeks. Each will contain complete working exhibits of electrical appliances. Salaried attendants will demonstrate each device which will be furnished by various local concerns. Each store will have electrical signs. No devices will be sold.

Superior, Wisconsin

Mr. W. H. Winslow of the Superior Water, Light & Power Co., announces a local poster competition. One prize of $10 and five prizes of $2 will be given for the best posters designed by High School or Normal School students of Superior. One prize of $5 and five prizes of $1 each will be given to the best poster designed by children in the grades attending any school in Superior. The posters must be in by November 4th. Each young artist must use a non-deplume. Each poster must have the words "America's Electrical Week, December 2 to 9, 1916, Superior, Wisconsin, Do It Electrically." The posters may be done in three or four colors. In this novel way Mr. Winslow expects to awaken the widest interest among the younger people of Superior in the meaning and objects of the week.

Atlanta, Georgia

Mr. Rawson Collier reports that the Atlanta Committee will center its activities about a Georgia State Electrical Show. Offsprings of the show activities will include a Parade Committee, Decoration Committee and an Entertainment Committee. Practically every business interest in Atlanta, including the telephone and telegraph companies, and all the concerns which have transferred over to the electric drive, will participate in the show activities. Special illumination of the business center with the prospect of flood lighting the cty's principle buildings, and one of two pieces of statuary, are included in the program to date.

The Society for Electrical Development

The society has issued several booklets during the past month. The first, "More Customers, More Sales, More Profits," is full of sales ideas, telling particularly what can be done by all branches of the industry to make the week successful for themselves. "How to put on an Electric Show" and "How to put on a Parade for America's Electrical Week" are two very practical booklets which go into all sorts of details concerning these affairs. Any energetic Chairman reading them is sure to be inspired to "go straightway and do likewise," so interesting and profitable does the work seem. In each case an actual affair is recounted in detail.

Our Monthly Window Display

This trim links the "Shop Early" idea with America's Electrical Week. The radiators and cooking utensils are especially timely. Flashlights too are useful now that night falls early.

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Leaflet 3922 covering **Equalizer Pedestals** issued by the Westinghouse Electric & Mfg. Company describes this piece of apparatus in some detail.

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Railway Motor Gears and Pinions are listed and discssed in Bulletin 44419 of the General Electric Company. Important points for the user to note in the placing, use and removal of gears are noted.

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"Hughes" Electric Bake Ovens are shown in a 12-page catalogue issued by the Hughes Electric Heating Company of Chicago. Of especial interest is a phantom view showing the arrangement of the heating elements in an oven.

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Polyphase Induction Feeder-Voltage Regulators for medium and large capacities are described in leaflet 3919, recently issued by the Westinghouse Electric & Mfg. Company. The purpose of the feeder regulator, its construction and operation are thoroughly described in this leaflet.

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"Cashing in on A. E. W.," an eight-page folder, has been mailed by the Westeern Electric Company to dealers, telling of the sales helps, such as printed matter and electros available in connection with a special drive on the company's products during America's Electrical Week.

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Switchboard, Portable and Precision Instruments made by the Westinghouse Electric and Manufacturing Company are described in the 118-page catalogue 3-B. Ammeter shunts, instrument transformers and relays are included, and the description of the various instruments is excellent.

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A Manual of its System of Water Purification has been issued by the American Steel & Wire Company, of Chicago. The use of sulphate of iron as a coagulant for bacteria before filtering is described. Numerous tables and practical points make the book of value to those interested in water purification.

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Ammonia Valves and Fittings made by the York Manufacturing Company, York, Pennsylvania are shown in the fourth edition of the company's catalog. In addition there are many accessories shown and numerous tables of piping and refrigerating data should give the book a place in every refrigerating library.

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"How Sixty Window Experts Display National Mazdas" is the very descriptive title of a booklet recently issued by the National Lamp Works, Nela Park, Cleveland. It is being sent to every entrant in the company's window-trimming contest, and contains pictures of sixty of the best "trims" produced in the contest of last year, with reading matter emphasizing the features that lend selling value to each display.

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The Silver Voltameter is the standard instrument by which the International Ampere (the unit of electric current) is determined. The National Laboratories of England, France, and Germany, as well as the Bureau of Standards in this country, have conducted investigations of the voltameter with a view to improving its accuracy and also to provide specifications for its use, but as yet no international agreement has been reached for the specifications. The investigations at the Bureau of Standards have extended from 1908 to 1916, during which time the results have been published in a series of eight papers. The present paper contains a summary of these eight papers and carefully drawn specifications, which are the practical results of the Bureau's work. The Bureau issues these specifications as its proposal for international adoption. A biblography of papers dealing with voltameter problems is given in an appendix. This paper is now ready for distribution and those interested in the subject may obtain a copy free by addressing a request to this Bureau.

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"The Farmer's Electrical Handbook" is a 160 page volume just issued by the Western Electric Company as the principal item in a campaign of education in the uses of electricity on the farm. The book gives in a popular way the many advantages of electricity, tells how a small plant may be installed, what supplies to order, the approximate costs of installation, etc. A section is devoted to the telephone, and includes advice on line construction and the formation of rural telephone companies. Each left-hand page shows electrical apparatus of various sorts, with the retail prices.

This book is now being offered free of charge in advertisements in farm papers, and the names of applicants are sent to Western Electric distributors for the territory concerned, in line with the company's policy of selling only through recognized retail dealers.

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"How to Succeed as a Mazda Lamp Merchant," is the title of a 165-page book compiled by the National Lamp Works of the General Electric Company. Starting with the business relations of the manufacturer and jobber to the dealer, the book takes up the facts about Mazda lamps, giving many illustrations showing the manufacture and particularly the uses of high-efficiency lamps. Helps in selling and advertising, building of prestige; the importance of the "turn-over," store arrangement, and the merchandising of miniature lamps make up a book of great suggestive value to the lamp seller.

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Book Reviews

How to Build Up Furnace Efficiency, by Joseph W. Hayes. 154 pages. Chicago: Published by the Author. $1.00.

This book takes up, in non-technical language, the source of fuel waste and the way to locate them; how to stop the leaks and how to keep them stopped. Leaky furnace-settings, lazy firemen, improper grates, and unsuitable coal come in for their due share of knocks from the author's cudgel, which he swings in the true Donnybrook style. Mr. Hays makes the important point at the outset that preventable waste is due first of all to the indifference of the plant manager, who will not inform himself of what becomes of the B.t.u. for

which he pays his money, and refuses to provide the appliances necessary to find out just what service each unit is giving. The book is full of "horse-sense" and should be read by every man from coal-heaver up, who has to do with the production of steam.

ELECTRICAL TABLES AND ENGINEERING DATA, by H. C. Horstmann and V. H. Tousley. 330 Pages. Chicago: Frederick J. Drake & Co.: $1.00.

This book is a most useful compilation of all sorts of practical electrical data, giving in concise form just the information that will be wanted by the busy contractor or salesman. The subject matter is arranged alphabetically. Some of the less common tables give bus-bar data; dimensions of insulated magnet wire, elevator motor requirements; dimensions of screws. The usual tables of wire sizes and current-capacities are given in great number. Much attention is given to illumination data.

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ELECTRIC MOTORS, DIRECT AND ALTERATING, by D. P. Moreton. 241 pages. Chicago; Frederick J. Drake & Co.: $1.00.

On the title page of this handy volume it claims to be "A Practical Book for the Practical Man," and the contents well justify the claim. Starting with fundamental principles of electric and magnetic circuits, the author next takes up the common methods of measuring resistance, voltage, current and power. Two chapters are given to a treatment of armature windings for direct and alternating current motors, three to the construction, operating characteristics and control of d. c. motors and three to a similar consideration of a. c. motors. Throughout the book a number of examples are worked out in illustration of the theory.

This is a book which we can unhesitatingly recommend to our readers who wish for a concise practical text and reference book on electric motors.

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HOW TO MAKE LOW PRESSURE TRANSFORMERS, by Prof. F. E. Austin. Third Edition, revised. Hanover, N. H.: Published by the author: 40 cents.

An extremely practical book on the construction of small transformers, it is intended for amateurs of limited resources who wish to make a transformer to step down the house voltage to voltages suitable for operation of bells and toys. Detailed diagrams and directions are given. Cores of the ring type made from electrical punchings, or wound from a strip of stovepipe iron; and rectangular cores made from strips either of transformer steel or from the sheets recovered from old tin cans by heating in an open fire, are the types recommended.

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RADIODYNAMICS, by B. F. Miessner. 206 pages. New York: D. Van Nostrand Company: $2.00.

This is the first systematic survey of the field of radio control of mechanisms, such as torpedoes. A chapter is devoted to histo· after which the general subject of wireless telegraphy is covered from the viewpoint of its use for the control of various devices. The present systems of control are each taken up and described as fully as the secrecy surrounding them allows. From the illustrations and diagrams it is evident that the author is giving out as much information concerning this subject as could possibly be secured for publication, and from his close connection with the art and the style in which the book is written there is every reason to believe that his statements are accurate.

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REASONABLENESS OF THE "MINIMUM CHARGE," by Samuel S. Wyer. New York: American Gas Institute: $1.00 (500 copies or more, 40 cents each).

This make a most readable booklet of some eighty pages, 6 x 9 inches, and contains two alphabetical tables, showing the adjudicated and non-adjudicated monetary allowances for minimum charges in existing rate schedules.

The necessity of the "minimum charge" to prevent discrimination and compel each class of consumer to pay for the service they are receiving, is demonstrated, as well as the fact that there are ample precedents for making the "minimum charge" proportional to the size of the consumer's demand for service. The various decisions underlying these principles are also quoted.

The subject of rates and the establisment of schedules that will prove absolutely fair to *all* consumers, and give a proper return on the investment of the company is one of the most important questions before the industry to-day.

Every public utility is vitally interested in the facts contained in Mr. Wyer's paper and should be familiar with the arguments set forth therein. The public they serve should know them as well, that the many erroneous impressions existing to-day with regard to minimum charges may be corrected.

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American Advertising in the Russian Press

The American-Russian Chamber of Commerce, 60 Broadway, New York, has organized an extensive advertising campaign for American products and American firms to be carried on through the use of the advertising pages of the leading newspapers in Russia, in the belief that, unless active and aggressive steps are taken at once to introduce American firms and their products in the Russian market, the opportunities which the Russian field offers will not be realized to their fullest extent.

Present conditions make it extremely difficult to complete and carry out ordinary commercial business with Russia, and it is extremely important that before the termination of the war American firms should have made direct connections with reliable Russian business houses, if they are to have a permanent share in the Russian trade. To assist American firms in securing and establishing such connections, the American-Russian Chamber of Commerce is therefore creating in the leading Russian newspapers—not only the metropolitan, but also in the large provincial papers covering important commercial and industrial districts in Russia—special pages of American advertising, to appear in the Sunday editions of these papers. Through the use of these special pages of advertising American firms can in a most effective way attract the interest and attention of reliable Russian distributors, and these papers will reach a circulation of nearly 2,000,000. By the creation of such special pages of advertising and because of an arrangement with the exclusive advertising agent for some of the important Russian newspapers, the Chamber is in a position to furnish its members with very liberal discounts in their advertising rates, amounting approximately to 55 per cent.

The Russian market requires every kind of merchandise at the present time. Russian firms are extremely anxious to open up direct connections with American houses. Hitherto they have not been furnished with many opportunities for creating such connections, except through their representatives in this country. This advertising offer furnishes, therefore, an opportunity for American firms to introduce their names and their products effectively in the Russian market at a relatively low cost, and it is believed that this active advertising campaign will arouse a real interest among Russian business houses and will furnish a medium for the creation of those direct connections which alone will give the United States a large and permanent share in the Russian market.

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Patrons of municipal water or power plants have a right to the kind of service that could be obtained from a private plant, and if this is not forthcoming, it seems entirely proper that the city should be ordered to improve its service.

News of the Associations

At Hartford, Connecticut, New England electrical contractors held a two-day convention on September 27-8. Col. Robley S. Stearnes, President of the National Association, W. K. Tuohey, a past-President and A. J. Hixon, President of the Massachusetts Association addressed the gathering. Papers were presented as follows: "Electricians' Licensing Law in Massachusetts," J. E. Wilson, Boston; "Unifom Inspection Rules," Ralph Sweet land, Boston; "The Work of the Suburban Fire Insurance Exchange," G. E. Bruen; "America's Electrical Week," E. E. Whitehorne. There was vigorous discussion of the relations between contractors and jobbers, led by Mr. Tuohey, and Geo. J. Murphy of the Pettingell-Andrews Company, Boston.

Colorado Electric Light and Railway Association

The annual convention was held at Glenwood Springs, Sept. 21-23. "Utility Investments," by W. C. Sterne, of Denver; "Sensible Rates," by L. P. Hammond, of Denver; "The Electric Range Game," by H. L. Titus; "Service Rules," by F. J. Rankin, engineer of the Colorado Commission; "Customer Ownership," by William H. Hodge of the H. M. Byllesby & Co.; "Utility Regulation," by M. H. Aylesworth, Chairman of the Colorado Commission; "Getting More Lamps into Use," by S. E. Doane of the National Lamp Works; "Protection of Transformers," by C. B. J. Wheatlake of the General Electric Company; "Depreciation Accounts," by F. W. Herbert, statistician of the Commisson; "Tell the Public What You're Doing," by S. J. Ballinger of Trinidad; "Maximum Demand Meters," by S. G. Hibben, of the Westinghouse Electric & Manufacturing Company, were the papers presented.

Electrical Supply Jobbers' Association

The fall meeting was held at the Hotel Statler, Cleveland, on October 10 to 12. A proposition to reorganize the association into eight geographical sections which would hold frequent section meetings, with but two national meetings a year, was laid on the table after considerable discussion. It was urged that manufacturers adopt some simple, easily remembered system of numerals for designating outlet boxes by means of which the dimensions and types might be readily identified. The use of net quotations was also favored. The association is compiling a net-price book to contain 600,000 price figures, which will be sold at $10.00 per copy.

The next meeting will be held in May, 1917, at a Southern resort to be determined later.

New England Section, N. E. L. A.

The annual convention was held at Pittsfield, Mass., on Oct. 17-18. The usual reports were presented, that of the Secretary showing a gain of 21.9 per cent. in membership during the past year. Municipal competition was considered not to present any serious features; it was recommended that such enterprises be under control of the commissions. W. H. Blood, of Stone & Webster, told how his company had reduced their average fire insurance rate from 1.50 to $0.35 per $100 by taking note of construction details which will secure lower rates. M. R. Griffiths told how accident prevention work in the Schenectady Works has reduced fatal accidents from five in 1910 to one in 1915; fractures, from 86 to 50; excisions from 36 to 16, in spite of an increase of employees from 8,000 to 19,000. Other papers on liability insurance and extension of service to rural consumers were also presented.

The officers for next year are: President, Robert W. Rollins, president and general manager, Worcester (Mass.) Electric Light Company; vice-president, A. B. Lisle, of Providence, R. I.; treasurer, Bowen Tufts, of Boston; Secretary, Miss O. A. Bursiel, 149 Tremont St., Boston. Executive committee: Maine, A. H. Ford; New Hampshire, R. D. Smith; Vermont, E. E. Larrabee; Massachusetts, Clifton R. Hayes; Rhode Island, S. B. Tuell; Connecticut, G. B. Leland.

Jovian Order

At Indianapolis on October 18-20 the fourteenth convention was held with more than 900 members and guests. The purpose of the Order is to bring together men in the electrical field, and the spirit of hospitality and good fellowship thrown around the gathering by the hosts, the Indianapolis League, helped mightily toward that end. The principal business of the convention was the adoption of the new constitution as outlined in our last issue, the increase of annual dues from $2.00 to $4.00, and the election of officers. The choice of Henry L. Doherty as Jupiter, and Ell C. Bennett as Mercury was unanimous.

Committees of N. E. C. A.

The Executive Committee and Publication Committee of the National Electrical Contractors' Association met at Cleveland, October 4th and 5th, to continue the study of problems confronting the members of the association. Col. Robley S. Stearnes, of New Orleans, the newly elected N. E. C. A.. President, emphasized his absolute belief in a price preferential for N. E. C. A. members in buying goods on the grounds that the N. E. C. A. members are entitled to this better price because they are a part of a great buying power and are responsible and reliable. He believes that the Association should have a trade mark or emblem for the use of members. Col. Stearnes has offered a handsome loving cup to the member who secure the largest number of new members this year.

The Executive Committee and Publication Committee of the N. E. C. A., guests of the National Lamp Works of the General Electric Co., at Nela Park, Cleveland.
Top row—Harry C. Brown (Assistant Secretary), Utica; S. E. Doan (Chief Engineer, National Lamp Works, of General Electric Co.), Nela Park; W. C. Harrington, Cleveland.
Second row—Jos. A. Fowler, Memphis; Geo. H. Duffield (Secretary), Utica, N. Y.; Geo. E. Shepherd (Chairman Publication Committee), Wilkes-Barre; Harry C. Turnock, Cleveland.
Lower row (left to right)—Paul H. Jaehnig, Newark, N. J.; W. C. Peet, New York City; G. M. Sanborn, Indianapolis; J. T. Marron, Rock Island; Col. Robley S. Stearnes (President), New Orleans; M. G. Buchan, Cleveland; Jas. S. Hilton (Treasurer), Syracuse.

Mr. Fowler, Chairman of the N. E. C. A. Labor Committee, has pointed out to the Association that labor on any contract, large or small, is a gamble and he feels the N. E. C. A. should give to its members accurate information on this subject.

Members of the Association have suggested subjects for consideration by the Executive Committee and these were reported at the last meeting as follows:

J. T. Marron, of Rock Island, Ill., Executive Committeeman, feels that electrical contractors should be paid for bidding on contracts. He feels that if an electrical contractor spends his time and money to prepare an estimate, he should be paid for it even if he is not successful in getting the job.

M. G. Buchan, of Cleveland, Executive Committeeman, feels that electrical jobbers are getting into the field of the electrical contractor by closing contracts direct. Mr. Buchan suggests National consideration of this subject.

Paul H. Jaehnig, Newark, N. J., Executive Committeeman, Chairman of the N. E. C. A. Legislation Committee, is collecting laws and ordinances from over the United States and furnishing this information free to members who desire to work for better electric ordinances in their cities. Mr. Jaehnig believes the N. E. C. A. should take active steps with a view of trying to bring about guaranteed wiring by the N. E. C. A. for its members.

W. C. Peet, New York City, Executive Committeeman, feels electrical contractors should be protected in making estimates and bids so that a general contractor or house owner could not use one contractor's price to lower the price of another bidder.

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American Association of Engineers

Quite a number of people were turned away from the second annual booster dinner of the American Association of Engineers at the City Club, Chicago. The speaker of the evening was Prof. C. F. Harding, of Purdue, on "Marketing Engineering Ability." The membership is now above 1,200.

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Coming Conventions

American Mining Congress. Hotel La Salle, Chicago, Ill., November 13-18. Secretary, J. F. Callbreath, Denver, Colo.

Electric Power Club. Hot Springs, Va., November 15-18. Secretary, C. H. Roth, 1410 West Adams Street, Chicago, Ill.

Ohio Society of Mechanical, Electrical and Steam Engineers. Annual meeting, Columbus, O., November 16. Secretary, F. E. Sanborn, Ohio State University, Columbus, O.

Association of Railway Electrical Engineers. Annual convention, Hotel La Salle, Chicago, Ill., October 31 to November 3. Secretary, A. J. Andreucetti, Chicago & Northwestern Railway Company, Chicago, Ill.

Kansas Public Service Association. Annual meeting, Topeka, Kans., December 7-8. Secretary, E. A. Wright, Manhattan, Kans.

American Institute of Chemical Engineers. Annual convention, New York City, January 10-13, 1917. Secretary, J. C. Olson, Cooper Union, New York, N. Y.

American Association for the Advancement of Science. Annual meeting, New York City, December 26-30. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

Southeastern Section N. E. L. A. to Meet

The convention of the Southeastern Section of the National Electric Light Association will be held in Tampa, Florida, on November 15th, 16th and 17th. A list of papers and their authors follow:

"The Maintenance of Central Station Electrical Instruments," by F. M. Farmer, Chief Engineer of the Electrical Testing Laboratories, New York. "Advertising Electricity—Its Service and Applications," by J. C. McQuiston, Advertising Manager, Westinghouse Electric & Mfg. Company. "Accounting, as Essential of Management," by F. G. Whitney, auditor of the Southern Utilities Company, Jacksonville. "General Store and Window Lighting," by F. E. Lauderbach and Norman B. Hickox, of the National X-Ray Reflector Company. "The Conservation and Direction of Human Energy," by J. H. Finney, General Manager of the Aluminum Company of America. "The Heating Device Load," by Mr. Frank Hammond, Birmingham Light & Power Company. "Up-to-date Developments in Steam Turbine Designs," by M. B. Carroll, General Electric Company. "Everyday Problems of Municipal Ownership," by Arthur Williams, Commercial Manager of the New York Edison Company. "Notes on Grounding of Secondaries and Lightning Arresters," by Mr. E. P. Peck, Superintendent of Tests and Repairs, Georgia Railway and Power Company. "The Future Street Lamp," by Mr. W. P. Hurley, Westinghouse Electric & Manufacturing Company. Mr. T. C. Martin, General Secretary of the National Electric Light Association, will also speak. An interesting program of entertainment has been arranged and all delegates are requested to bring their wives.

Revision of National Electrical Code

The biennial meeting of the Electrical Committee of the National Fire Protection Association will be held in March, 1917, in New York City, the day and place of the meeting to be announced later. As usual, the provisions of the National Electric Code as they now exist will be considered, together with reports of all sub-committees.

Suggestions for amendments to the Code, in order to be included in the Bulletin, must be specific and where a change is desired in a rule or section of a rule definite wording for such cange must be given together with the reasons why the change is recommended and these suggestions, together with all committee reports must be in the hand of the secretary, Mr. Ralph Sweetland, 141 Milk Street, Boston, not later than January 15th, 1917.

As heretofore, the meeting will be open to all interested and such persons will not only be welcome but are urged to be present and give the committee the advantage of their experience and advice.

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Of Personal Interest

W. R. McGovern has been appointed chief engineer of the Central Group of Bell Telephone companies, succeeding James G. Wray, who resigned and will hereafter be associated with the engineering firm of Hagenah and Erickson.

Mr. McGovern, who was formerly state engineer for the Chicago Telephone Company, is succeeded in that position by J. S. Ford, formerly building engineer in the state engineering department.

Mr. McGovern is an associate member of the American Institute of Electrical Engineers, a member of the Chicago Association of Commerce, the Traffic Club and the Electric Club.

Mr. Edward F. Kelly, formerly chief clerk to the general manager of the Buffalo, Lockport & Rochester Railway Co. has been appointed purchasing agent, with headquarters at Rochester, N. Y.

Mr. W. L. Waster, chief clerk, Payroll & Distribution Department, Chicago Surface Lines, has been appointed superintendent of materials and supplies of that company, vise Mr. J. F. Henning who as become assistant general manager of the Vesta Accumulator Company, of Chicago.

Mr. B. J. Fallon, formerly engineer, M. of W. Department, Chicago Elevated Railways, has been appointed chief engineer of the Chicago, North Shore & Milwaukee Railway Company. He retains jurisdiction over his former department.

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A New "Get Rich Quick" Stunt

A good way to get a man's money is shown by the way A. K. Young, new business manager of the Toledo Railways & Light Company, gets his'n. Mr. Young attended the Jovian convention at Indianapolis as a Tribune from Toledo, and the "Little Red Devil" the convention paper, is responsible for the following article exposing Mr. Young's financial scheme:—

"Of all the hard-luck tribunals, A. K. has the dogondest time. About eight months ago, in Toledo, they put ont R. B. Woolley, erstwhile sales manager of the Standard Electric Stove Company, through the wicket. Woolley insists that check was duly forked over. And for some seven months he tried to get his pin and official notification. As a potential—he was not. So he borrowed a pin nevertheless—bold as life—and came right up

to the convention. Of course, they refused to give him a badge or anything else. No notice of the passing of R. B. W. was ever handed into the main office. Result: Woolley hunts up A. K. Y. and makes him come up to the desk and explain. Lo and behold, A. K. remembers that there are eight other new Toledo neophytes that have never had any recognition of passing the Sacred Portal. Heltopay. It cost A. K. just $50 to square himself with Woolley. If you don't believe it, ask him

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Obituary

Mr. Harry H. Gribben, superintendent of the Oakland factory of the Standard Underground Cable Co., died suddenly September 25th at his home in Oakland, California, aged 56 years. Mr. Gribben was a native of Pittsburgh, Pa., and lived there until 1899 when he moved to California to take charge of the factory which the Standard Company had then just completed. Previous to this he was general foreman in the company's Pittsburgh factory. He had been in the employ of the Standard Co. for over 30 years and was one of its most faithful, loyal and competent superintendents, and a man who by his personal qualities endeared himself not only to his business associates but to every one with whom he came in contact. At a recent meeting of the board of directors suitable resolutions were passed expressing the Standard Company's sense of loss in the passing away of one of its oldest employees in point of service. Mr. Gribben was a member of the First Presbyterian Church of Berkeley, Cal.; a trustee of the Oakland Y. M. C. A.; director of the Mount Hermon Association and San Francisco Bible College; a member of Duquesne Lodge No. 546 F. & A. M. Pittsburgh, Pa.; Sierra Council No. 1642, Royal Arcanum, and Forest Camp No. 102 W. O. W. He is survived by his wife, Mrs. Carrie Thompson Gribben. Interment took place in Mountain View Cemetery, Oakland, Cal.

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Between Company and Consumer

(*Continued from page 26*)

of washing-machine is ready for the merchant, one is sent to the Bureau where it is put to work on various kinds of goods. Woolen blankets, table linen, fine shirt-waists, are washed, and the time and power required, the thoroughness of the work, and the effect on the goods are noted. From their long experience, the demonstrators can suggest points for improvement, both as to performance and convenience of operation. The attention of the Electrical Age representative was called to the fact that many of the larger machines, especially dishwashers, are so arranged that much stooping is necessary in their operation. Apparently manufacturers have not remembered that the strength of the housewife, often not great, can be much conserved by machines designed to avoid bending over when using them. Points of this sort the Bureau sees, for its attitude is that of the user, and it gives constructive criticism wherever necessary.

Another service of equal importance is the discovery of additional uses for various devices. Thus it has been found that the rotary drink-mixer so frequently seen at soda-fountains is an excellent egg-beater and cream whipper for kitchen use; it will mix mayonnaise dressing without the need of special chilling of the ingredients, and the oil may be added much more rapidly; and it will save the tiresome hand beating of thin batters.

The public is encouraged to make the fullest possible use of the Bureau to solve domestic science problems. As has been said, the fact that nothing is offered for sale makes people feel free to come for information as to how to do particular things by power instead of by hand. In this way the Bureau keeps closely in touch with public needs and can offer valuable suggestions to manufacturers as to now or modified products. Purchasers are also instructed in the use of new devices—a service of particular importance to domestic users. Architects and owners who are about to build or remodel are advised on points of kitchen arrangement so as to take full advantage of the space-savings possible with electrical cooking. Pains are taken to have plenty of baseboard and floor outlets provided during construction, in order to care for the inevitable demand for lamps and appliances later.

At the 1916 Electrical Show the Bureau had a frontage of about 65 feet, of which part furnished as a living-room was taken charge of by the Womens' Suffrage Party. Many lamp-socket devices were shown and used in the serving of afternoon tea each day. Another section was used by the Tribune Institute to show how it tests domestic appliances, and in the third part was an exhibition of modern home canning methods from the U. S. Department of Agriculture. The purpose of the entire exhibit was to show the use of electricity without bringing the Bureau itself into the foreground.

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Business Notes

The Nordberg Manufacturing Co., of Milwaukee, Wis., announces the appointment of Mr. H. W. Dow as sales manager. Mr. Dow has been associated with this company in the engineering and sales departments for 12 years. The Nordberg Mfg. Co. build steam and electrical hoists, Corliss engines, popet valve engines, uniflow engines, air compressors, oil engines and Nordberg-Corliss Diesel engines.

The Western Electric Company has moved its offices and show rooms in Buffalo from 98 Terrace to 709-711 Main Street. The new location with two large show windows fronting on as many streets affords spendid display facilities. A full line of Western Electric products will be carried. J. W. Tabb is the manager.

The New York office of the Adams-Bagnall Electric Company is now located in the Engineering Building, No. 114 Liberty Street, New York City, under the management of Mr. F. C. Perkins, Eastern representative.

Mr. William Miller Tompkins has been made the Philadelphia representative of the Ward Leonard Electric Company of Mount Vernon, N. Y. Mr. Tompkins' broad experience in the electrical field, his particular knowledge of motor and dynamo controlling devices puts the trade in a good position to receive expert, prompt information on these subjects. His address is 4813 Haverford Avenue, Philadelphia, Pa.

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New York Metal Prices

October 30, 1916

Copper, prime Lake*	28.25 @28.50
Electrolytic*	28.50 @28.75
Casting*	27.125@27.375
Wire, base*	33.00
London std. spot	125-0/0
Lead	7.00
Nickel	45.00
Zinc, sheet, f. o. b. smelter*	16.00
Tin, straits	42.00
Aluminum, No. 1 Virgin, 98@99%*	64.00 @65.00
Spelter*	10.30 @10.55

Old Metals

Copper, strictly crucible*	24.00 @24.50
Brass, heavy*	13.50 14.00
Brass, light*	10.25 @10.50
Lead, heavy*	5.875@ 6.00
Zinc, new scrap*	8.00 @8.25

*Nominal.

New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers Not Appearing in This Section Will Be Gladly Supplied on Request

Deep-Bowl Reflector

For the economical lighting of large interiors a manufacturer of lighting devices has recently placed upon the market a new reflector of the deep bowl type. It is intended for use with 300, 400, and 500 watt sizes of Mazda C lamps, and is provided with an adjustable holder which will fit any Mogul socket or any type of suspension. The reflector is intended to be hung near the ceiling, eliminating the use of long drop cords. As will be seen from the flux diagram, the light is well distributed over the most useful part of the lower hemisphere, comparatively little leaving at an angle which would interfere with comfortable vision. The dimensions of the reflector are: Height, 9⅜ in.; diameter, 11⅞ in.; weight, 4½ lbs.

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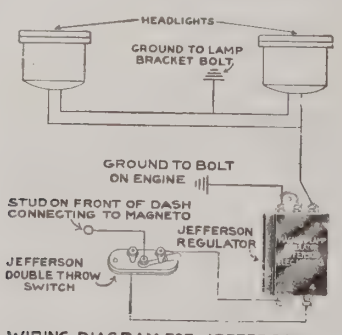
Magneto Lamp Regulator

In the operation of low-priced automobiles where the current for headlights is taken from the magneto trouble is experienced from the wide variation of voltage with the speed of the engine. When this is low, the lamps burn too dimly to be of use, and when it is high, as for instance when the engine "races," lamps are frequently burned out. The headlights are connected in series, so that if one gives out, the other is out of service also. All of these troubles are avoided by the use of a small "Regulator" as installed shown in the accompanying cut.



WIRING DIAGRAM FOR JEFFERSON 6-VOLT MAGNETO REGULATOR

As indicated, the regulator is connected through a double-throw switch to the terminal of the magneto. The regulator is itself a transformer, from the secondary of which one wire runs to ground on the engine frame, and the other goes to one side of the lamps. These are connected in parallel, one side being grounded. Six-volt lamps are used.

The makers claim for this device that it allows a 6-volt battery to be used interchangably with the magneto system. The high efficiency of the regulator prevents its interfering with the ignition system. Six volt lamps can be obtained more readily than the present standard 9-volt lamps, and renewals are much less frequent. This item alone will soon save the first cost of a regulator, which sells at $2.50 retail. Its weight is 2.5 lb.

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Speed-Reducing Gear

The advantages of high-speed electric motors are so conspicuous that they will more than make up for the losses and inconveniences of speed-reducing devices such as belts and gears. However, these draw-backs represent the waste of real money, and any new way to gain greater efficiency will be most welcome. Recently an internal gear of the herringbone type has been placed on the market which, it is claimed, has an efficiency

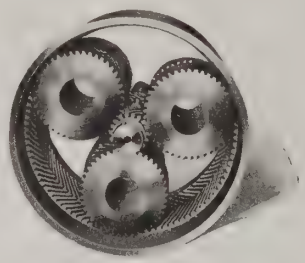

Fig. 1

of 98.5 per cent. The high-speed member, as will be seen from Fig. 1, is in the center and drives, through three floating intermediate gears, the slow-speed outside member. The general appearance and size of the gear can be seen in Fig. 2, where it reduces the speed of an 1800 r.p.m. induction motor in the ratio 13:1 for driving an ammonia compressor. As compared to the old method of belt transmission, the "Turbo-gear" saves materially in floor space and maintenance charges, and gives a much neater installation.

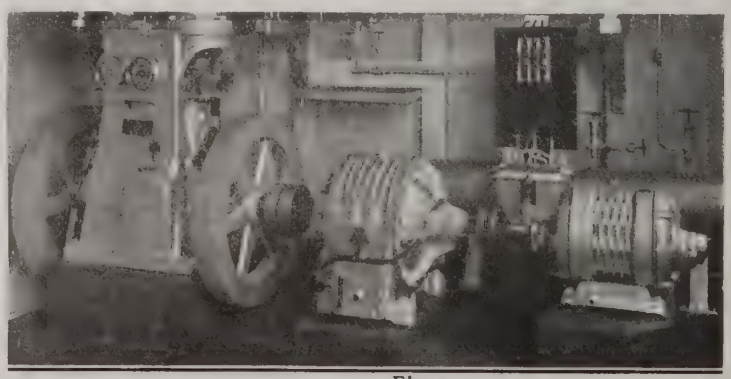

Fig. 2

At present the Turbo-Gear is made up with gear ratios from 3.4:1 to 19:1, and for the transmission of 8 to 400 h.p. Oil is sprayed on the wearing surfaces through holes in the inmost pinion, and eventually drains back into the circulating system. The high-speed bearings beside having forced feed lubrication, have oil rings and reservior for emergencies. The superfluous oil forced into the high-speed bearings is collected by a centrifugal oil ring and forced through the hollow shafts carrying the intermediate bearings. The gears do not run in oil as this would cause a considerable back-pressure with corresponding loss of efficiency.

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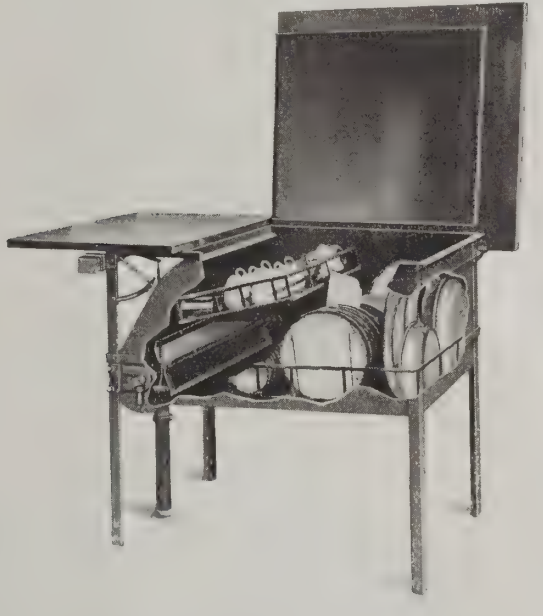
"Rapid" Dishwasher

One of the best ways in which electricity can help in the household is in dishwashing. That the old hand method is generally detested is well known and the number of dishwashing machines on the market is further evidence. A new machine called "The Rapid" has recently been introduced which it is claimed, is more easily kept clean and does its work with less bother to the housewife than any previous design.

As shown in the illustration, this machine consists of a tinned copper tank into which metal baskets containing the dishes are set. A tea-kettle full of boiling water and a quantity of washing soda are put in, the cover closed and the motor started. The paddles shown on the left throw the soapy water over the top of the dishes, whence it flows down through them, dissolving or washing away the food particles adhering to them. After a few minutes the motor is stopped, the water is drained off into



a pail or the sewer, and another kettle-full of clean water is put in to rinse the dishes, which are then removed and dried by the heat stored in them, if boiling rinse-water has been used.

Practically no extra floor-space is occupied by this machine as it takes the place of a kitchen table. Its top is aluminum—an excellent surface for culinary operations. For an average family the dishes are placed in the machine after each meal and a day's accumulation is washed at one time. The close-fitting cover prevents any odors escaping. Sewer connection is desirable but not essential. A universal motor is used, The retail price is $40.00.

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Fireproof Film Rewinder

Publication of a description of a new motor-driven motion picture film rewinder in these columns last month brings to light the fact that this is not the only rewinder on the market which is thoroughly fireproof. As shown in the illustration, the "Fulco" rewinder consists of a fireproof box large enough to take 15-inch reels. An interlocking device prevents the film being wound unless the door is closed. For inspection purposes, however, two fire trap valves are fitted to the top of the box

through which the film can be passed. In case of fire, no flame can penetrate them. This machine has been approved by the Inspection Department of the city of Chicago.

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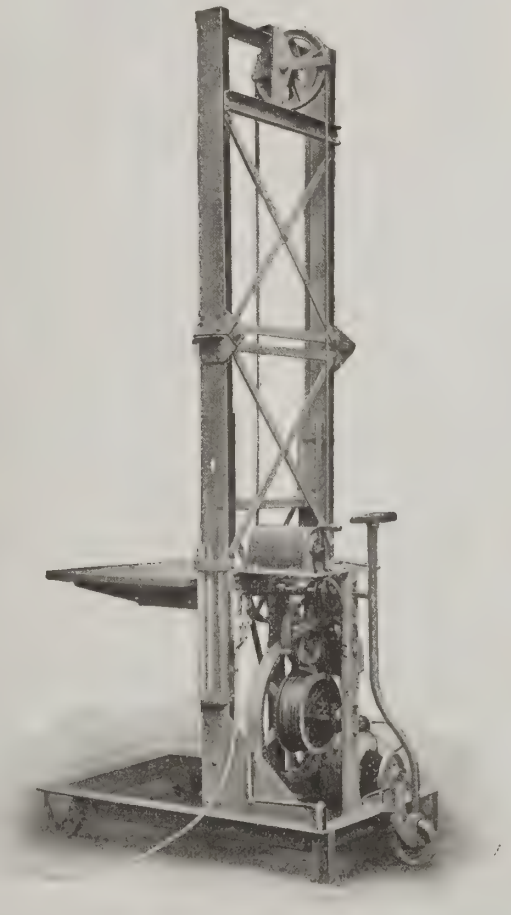
"Economy" Tiering Machine

Of interest to all warehousemen is a portable steel tiering machine driven by an electric motor. This machine can be wheeled to the place where it is to work and by the insertion of a plug into some nearby outlet loads of 1,000 lbs. and upward can readily be raised. The speed of the lifting platform is from 30 to 50 ft. per minute and limit switches are furnished



at both ends of the travel. An automatic safety stop can be added. Where floor space is at a premium the savings possible from higher piling of goods will more than make up its cost in a few months. Here again electricity has the advantage over muscle in the amount of backbreaking drudgery that it saves; the makers estimate 50c per day for power.

"Golden Glow" Projectors

For the many and varied uses of flood-lighting, the manufacturers of "Golden Glow" headlights have developed a portable projector involving the same principle as their earlier product. This centers on the effect of various light rays on the human eye. If the spectrum be analyzed, it will be found that the violet, ultra violet and other high frequency rays form the blinding, dazzling, brilliant portion of the light from the ordinary incandescent or arc lamp. Illumination by such light has so long been common practice that one naturally judges a source of light by its intrinsic brilliancy rather than by its effect on the human eye.

The reflector is moulded from a greenish-yellow glass, ground to a true parabola by special machinery and polished and silvered as would be the finest French plate glass mirrors. The violet ultra violet and other high frequency rays are absorbed by the glass reflector thus projecting a powerful beam of golden-yellow light which is non-blinding and wonderfully adapted to penetration of fog, dust or moisture. These non-blinding and penetrating features make the "Golden Glow" particularly well adapted to flood-lighting where the effect of the light on the workmen's eyes is to be considered, and for illuminating piers where fog and moisture in abundance must be penetrated.

These "Golden Glow" Projectors are manufactured in two sizes, the smaller size being equipped with a 9 inch diameter reflector while the larger size employs a 12 inch reflector. Concentrated filament lamps of any wattage up to 150 in G-25 bulbs having a light center distance of 2¼ inchs may be used with the 9 inch reflector, while the 12 inch reflector takes concentrated filament lamps up to 250 watts in G-30 bulbs, having a light center distance of 2¾ inches. They are equipped with a focusing device accessible from the outside of the shell so that the beam of light, by this simple adjustment of the focal center may be concentrated in a straight beam or dispersed to cover a large area. The projector proper is mounted on a pipe standard which is adjustable in height and anchored in a large circular base of light but durable construction. "Golden Glow" Projectors are readily portable on account of their light weight and well balanced due to their large bases.

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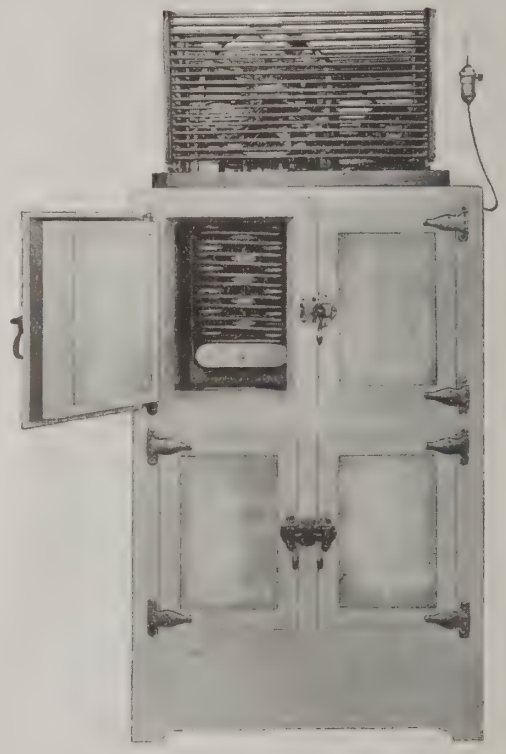
A Domestic Refrigerating Machine

Ease of installation and simplicity of operation are two important features of the domestic refrigerating machine made by a Detroit manufacturer. As will be seen from the illustration, the apparatus is mounted on an ordinary refrigerator, the only work required being the cutting of a hole 13 in. square in the top of the ice compartment. Since it comes crated as a unit, no assembling is necessary, the apparatus being merely set in place and connection made to the nearest lamp-socket.

As in all compression-type outfits the medium, sulphur dioxide gas, is compressed in a rotary compressor, passed through the cooling coil shown surrounding the moving parts, and released as a liquid through an expansion valve into the refrigerating coil. This valve is set so as to maintain atmospheric pressure in the coil, under which condition sulphur dioxide liquid boils into a gas at 14.4 deg. F. A thermostat in the refrigerating compartment operates a circuit-breaker which starts or stops the motor on a variation of one or two degrees above or below the normal. This is a distinct improvement over the performance of melting ice, where there may be a variation of 30 deg. F. The thermostat has a positive, "vibration-proof" action, so that there is no chattering of the circuit-breaker or false starting of the pump.

At the bottom of the expansion-coil there is an ice-making chamber in which small cubes may be frozen for table use.

Moisture abstracted from the refrigerator is deposited on the coil, and freezes, because the coil is at 14 degrees F. The machine operates intermittently, so that this frost does not accumulate. On the standstill period the frost will melt and run off through the drain pipe of the refrigerator. The quantity of the drain is minute as compared with the melting of ice and creates no slime because there is no vegetable matter in this frost as there is in all ice.



Two sizes are manufactured—the smaller, for a 200 lb. box is operated by a 1-4 h.p. motor, costs $275.00 and weighs 230 lbs.; the larger, for a 400 lb. box, has a 1-2 h.p. motor, costs $425.00 and weighs 350 lbs. In localities where the rates for current and for ice are average, the machine will do the work for one-half the cost of purchasing ice.

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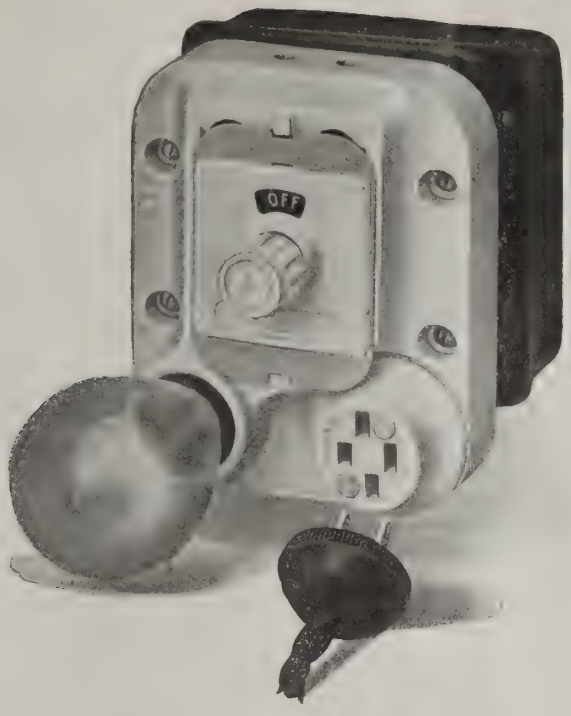
An Improved Surface Heater Switch

There has recently been put on the market an improved design of Surface Heater Control Switch particularly useful for installation in kitchens, pantries, laundries, etc., of the private residence or apartment. Combining, as it does, a 10 ampere, 250 volt indicating switch, a concealed receptacle and in parallel with it, an Edison receptacle for a pilot lamp, this is the lowest priced substantial heater control on the market. By means of a standard cap which fits into the receptacle, current can be supplied for the electric iron, washing machine, and other current consuming devices. The standard caps for use with this outfit have two parallel blades for making connection with phosphor bronze spring contacts located in the slots well below the surface of the receptacle. Where polarized connection is desired the unique construction of the blades insures insertion of the cap in only the correct manner.

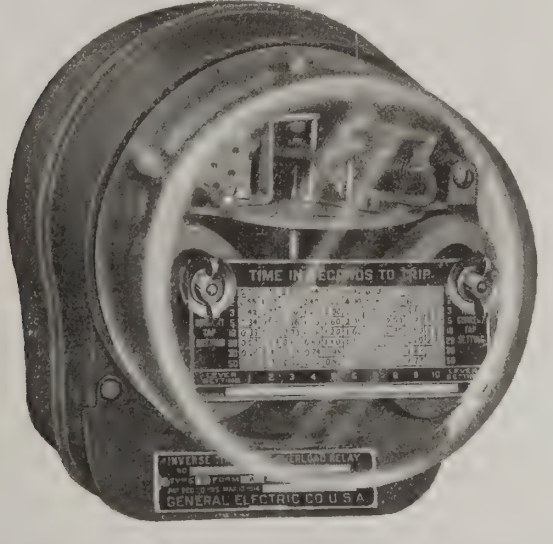


While the switch itself is of the indicating type, unmistakable visual evidence of the use of current is provided by the pilot lamp. The No. 466 is approved for use on concealed, cleat, or moulding work. When used for concealed work, it can be attached by means of four screws furnished, to any standard two-gang box as shown in the illustration. For cleat or molding work the wires are led into base through the two holes provided in the end thereof. The cover is reversible so that in cleat and molding work the feed may come from either the ceiling or the floor.

* * *

Induction Relay for Selective Overload Protection

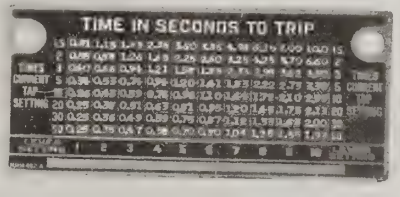
The General Electric Company has recently placed in production an induction type, time limit, overload relay which is particularly applicable to those systems where extreme accuracy in timing is required for tripping two or more air or oil circuit breakers selectively.



The operating or characteristic curves for the various time-current settings are entirely separate and distinct at even the heaviest overloads and never become instantaneous. This is because of the inherent characteristics of the relay which produce a curve consisting of an inverse time portion up to approximately 2,000 per cent. of minimum contact closing current, blended into a definite time portion with a slight downward slope. Consequently, the relay will do the work ordinarily required of both inverse and definite time limit relays. The heaviest overloads do not disturb the form of the curve, nor cause vibration or chattering of the moving parts.

The relay is made in single pole elements, is circuit closing, and operates with a time delay which is inverse for the lower current values and which approaches a definite minimum for the higher current values. It is designed for use in the secondary of current transformers, the normal load rating being five amperes. However, by means of the current tap plate, the relay may be set for 4, 5, 6, 8 and 10 amperes, positive operation being obtained throughout this range.

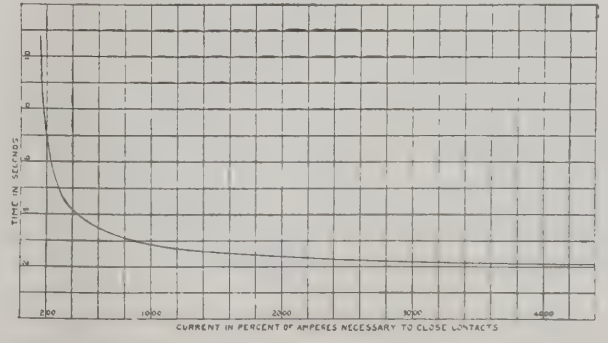
The contacts are closed on overload by the rotation of a disk actuated by a "U"-shaped driving magnet with shading coils on the pole pieces. No tripping current is carried through the revolving parts. When the contacts have been closed they are firmly held in that position until tripping occurs, by the armature of a holding coil connected in series



with the contacts, the trip coil of the air or oil break circuit breaker and an auxiliary switch which opens when the breaker is tripped. This insures current on the trip coil continuously until the circuit breaker opens, and prevents flashing at the relay contacts.

The values given in vertical columns 1 to 10 on the index plate, are the time delays which will be obtained at the different degrees of overload represented in the "Times Current Tap Setting" columns at the extreme right and left sides of the index plate. The factors appearing in the "Times Current Tap Setting" columns, when multiplied by the current tap setting, represent actual secondary current values.

To obtain a given current setting, it is only necessary to insert a tap plug in the current tap plate at the desired current marking. Time settings are obtained by moving a small lever in the front and near the top of the relay, to the column in which the desired time appears. For example: using current tap 6, it is desired that the relay be set to operate in 1.20 seconds with 120 amperes in the current



transformer secondary. 120 amperes is 20 times "Current Tap Setting" 6. Referring to figure (photo A), in the horizontal row of the time values opposite factor 20, we find 1.20 seconds, the time desired, in vertical column 7. Therefore, in setting the time lever, the index point will be placed exactly over graduation mark 7 on the lever scale.

If the nature of the work is such as to require time sett-

ings intermediate to those given on the index plate, the proper time lever setting may be closely estimated or, if necessary, may be calculated by interpolation. For a given time lever setting, the characteristic curves for all current tap settings are practically identical. Curves for consecutive time lever settings less time maximum, fall below the maximum curve shown herewith in the same order as the settings.

The contacts are designed for use on direct current. They are made of a special metal which is non-corrosive and which has high heat resistance. They will carry 18 amperes momentarily without damage to the contact surfaces. The current closing capacity is therefore ample to trip even the largest of the General Electric Company's circuit breakers. A thermostatic device within the relay compensates for any variations in room temperature. Following wattmeter construction, the movable element is supported by a jewel bearing, thus minimizing friction and eliminating vibration. A dust proof glass cover protects the operating parts of the relay and facilitates the reading of the index plate.

The relay is being furnished in two styles, one for 25 and one for 60 cycle circuits. Although the principle of operation and the inherent characteristics are the same in both relays, the relays themselves differ only in slight details of construction.

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Electric Engine Warmer

With the rapidly increasing use of the gasoline automobile during the winter months, chilled engines and frozen radiators are the most serious problems of the private garage owner. To adequately heat the entire garage all winter is quite expensive and moreover unnecessary—as the vitals of the car under the hood are the only parts which need to be protected from te extreme cold. To drain the raditor every time the car is brought in means its refilling with warm water in the morning—all of which is very inconvenient to say nothing about the engine which is usually so cold that it requires considerable work and priming to start it.

The problem has been solved by an electric engine and radiator warmer which is simply screwed into any lamp socket in the

garage and placed in the hood of the car between the engine and the radiator. The body of the heater contains a rugged heating element which consumes one-tenth of a kilowatt—and gives off just enough heat to keep the radiator from freezing and the engine from causing starting trouble. The hood of the car, however, should be blanketed in severe weather to hold in the heat. This heating element is enclosed in a black enameled metal shell-shaped like and about the size of an ordinary dry cell—which is perforated to allow for circulation of the heated air from within. The entire outfit is well insulated, fireproof and safe in every respect, weighs less than a pound and comes equipped with ten feet of cord.

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Overhead Relay for High Voltage Circuits

For high-voltage stations requiring overload protection where the extra cost of current transformers prohibits the use of extremely accurate relays, the one illustrated, recently placed on the market by the Westinghouse Electric & Mfg. Company, is an economical substitute, affording ample overload protection and a fairly accurate time element. It is designed for indoor use and is suitable for operation on high voltage alternating current circuits of any frequency.

This relay, known as the type HB, consists of a strongly built solenoid mechanism which operates a timing and circuit closing element through a micarta chain of such length as to provide ample insulation for the voltage in use. There is no lost motion in the chain as it is constantly in tension, the action of the solenoid raising a weight on the contact mechanism. For voltages up to 44,000 the chain consists of 12 links. Twenty links are provided for voltages up to 66,000, and 30 links for up to 110,000 volts. The links may be removed to shorten the chain, down to a minimum of one link for each 6,600 volts.

The relay coil is inserted directly in the high voltage lines, but the contacts and timing parts are thoroughly insulated and can be handled, adjusted, or tested without disconnecting the feeder. The coil can be mounted on a disconnecting switch or choke coil and the use of separate insulators avoided, while the contact mechanism can be mounted in the position most convenient.

The relay is furnished in two forms—one having an inverse time element, the other a definite time element. The inverse time element relay can be set for practically instantaneous action. In this form of relay the solenoid and chain are opposed in their motion by a bellows with an adjustable valve. The valve has a small numbered dial which permits of any setting between a maximum time element of about 20 seconds at 25 per cent. overload and a minimum of about one second at the same overload. With greater overload the relay acts in a shorter time.

In the definite time element relay the same kind of bellows and value are used as for the inverse time limit, but the solenoid chain does not act directly on it. The core and chain rise instantly when current reaches the tripping valve, and compress a spring. The spring in turn acts on the bellows. If the overload continue for the time for which the relay is set the tripping contacts close. The time required for the spring to close the contacts depends only on the setting of the valve, and is entirely

independent of the magnitude of the overload. The relay can be set for any time element between one and ten seconds.

The minimum current at which the relay will trip depends on the number of weights placed on the arm of the contact-making mechanism. This can be varied from 80 per cent. to 160 per cent. of the rated current of the relay.

As the type HB relays are controlled by bellows they are not as accurate as to time element as magnetically damped relays. Their time element will be found sufficietnly accurate to afford protection on the circuit to which applied, though selective protection with regard to other circuits in the system cannot always be satisfactorily obtained.

The type HB relay is intended for mounting on a disconnecting switch or other support on the high tension line, but insulating supports can be furnished where necessary. One relay is required to protect a single-phase circuit, two relays for a two-phase or three-phase ungrounded neutral circuit, and three relays for a three-phase grounded neutral circuit.

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Reflectors for Show Window Lighting

The manufacturer of lighting appliances has been kept busy developing accessories for use with the new type "C" lamps which are being brought out from time to time. A Chicago manufacturer, announces two new styles of show window lihting reflectors which are intended especially for the 75-watt type "C" lamp. These reflectors which are illustrated in Figures 1 and 2 are the "C Lamp Scoop" and "C Lamp Hood" to distinguish them from models similar in design which are now on the market and known as the "Scoop" and "Hood." It will be noted by the illustration that the new reflectors have a finer system of corrugations than was formerly employed in the Scoop and Hood. These fine corrugations are necessary to properly break up and distribute the light from the brilliant concentrated filament of the lamp.

C Lamp Scoop

C Lamp Hood

The "C Lamp Scoop" is intended for windows of average proportions where the trim is comparatively high on the background. The "C Lamp Hood" produces a higher concentration of light in the window and is therefore suitable for show windows which are shallow from glass to background, and of average height, about 9 ft.

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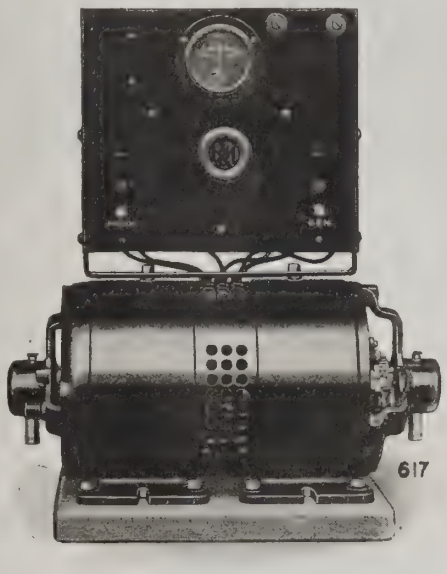
Battery-Charging Set

A new battery-charging outfit has been developed by The Robbins & Myers Company. The outfit is made especially for charging automobile and motor boat batteries and is supplied in three sizes, 80, 150 and 250 watts.

The 80-watt outfit will generate charging current in voltages up to 8 volts and the 150 and 250-watt sets are furnished to charge up to 15 or 30 volts as desired. The motors of these sets are furnished to operate from 115 and 230 volt direct current circuits or 110 and 220 volt alternating current of 25, 30, 40, 50, or 60 cycles.

The 80 and 150-watt sets are light in weight and suitable for portable service. They are provided with an oak sub-base so they can be placed on the running board of a car without injury to the finish. The 250-watt sets are not provided with the wood base as they are built for installation in a permanent position.

The sets are regularly furnished with a steel switchboard which is mounted on the frame at the top. This switchboard is provided with an ammeter in the generator circuit which shows the charging current, a rheostat in the generator field to regulate the rate of charge, a push button switch in both the motor and generator circuits, a fuse block with fuses in the motor line and terminals for connecting the motor to the line and the generator to the battery leads.



If desired the outfits can be furnished without the switchboard. When so furnished the 80-watt and 150-watt sets are provided with 10 feet of duplex cord with detachable plug on the motor side and with 10 feet of heavy duplex cable with universal lead covered test clips on the generator side for connection to the battery. These leads are brought out through heavy insulated bushings in the frame of the machine. The 250-watt sets without switchboard are fitted with leads which are fitted with brass connectors. The 150-watt and 250-watt sets are furnished with a rheostat in the generator field for adjusting the rate of charge but the 80-watt set without switchboard is not provided with a rheostat as it is so designed as to give a tepering charge to the battery and a rheostat is not absolutely essential.

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Electric Sewing Machine

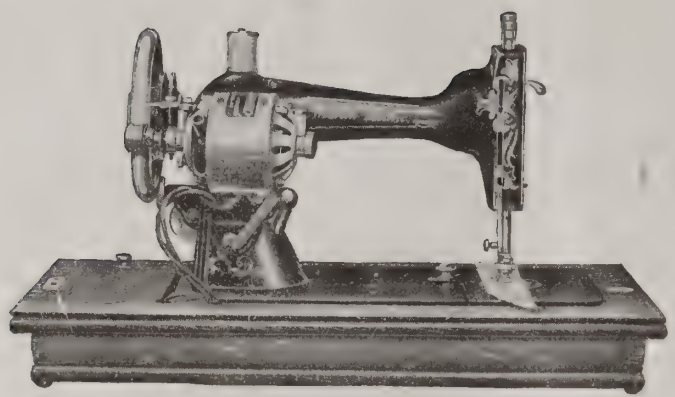
An ordinary sewing machine has two inherent disadvantages for the housewife. It is true that when Howe invented the sewing machine, it was quite a step forward in taking the drudgery out of sewing, but foot work necessary to operate the treadle and produce the necessary power, also back-ache and that draggy, tired feeling in the operator.

The second disadvantage was that a sewing machine, no matter how attractively designed and built, was in the way and it was quite a "moving" job to take it from room to room, and more of a job from floor to floor.

The first objection was overcome by the advent of the sewing machine motor. This did away with the laborious treadle work, and was a move in the right direction, but the second objection was still present, and prevented the housewife from realizing the utmost in convenience.

A portable, electric sewing machine, is being placed on the market this Fall, which fully overcomes the second and last objection. The entire equipment—the sewing machine head and motor—'s completely enclosed in a quarted sawed oak cover. When the machine is not in use, the rheostat and foot control are housed in this same cover.

The sewing machine proper is first-class in every particular, is of the rotary type, and posses all of the easy running and perfect stitching qualities typical of rotary machines. In addition, it has many desirable and exclusive features, including



tension that is self-regulating, automatically adapting itself to all classes of goods.

It portability is another feature which will appeal strongly to the modern housewife. Wherever there is an electric lamp socket, there the machine may be used. It is compact and simple and operates on either direct or alternating current. It may be used in any room, and in the summertime on a card or sewing table on the porch. The entire machine, cover and all, occupies only a small amount of space, and when not in use, may be placed out of the way in a closet or under a couch.

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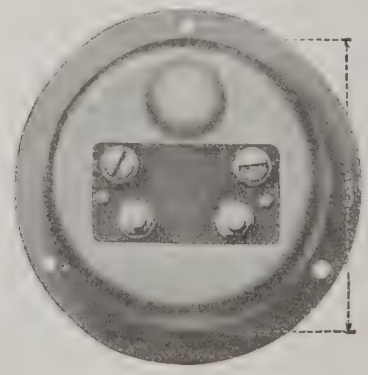
Direct Current Automobile Meters

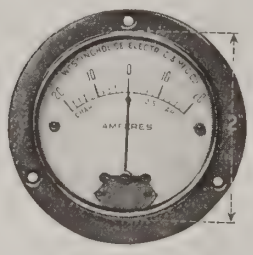
The two types of meters described have recently been placed on the market by the Westinghouse Electric & Mfg. Company. They are designed for use on automobile dash or cowl when electric generators, motors, and storage batteries, are used for starting, lighting and ignition. While especially developed for this service they also find similar application on motor boats, yachts, aerial craft, and the like. The meters possess a degree of accuracy entirely adequate for the service for which they are intended being greatest at the most important operating points on the scale. They are mounted in open faced circular pressed metal cases arranged with a flange for flush mounting and provided with terminal studs for rear connection. These meters are self contained, no external shunts or resistors being required. Two standard finishes are provided, full polished nickel and black rubberoid. The dials are of metal and are furnished in two finishes; white nickel with black figures and pointer, and black with white figures and pointer.



Rear View, Type EW Meter

The type EW meter is made as a voltmeter or an ammeter and is for use on large cars where a 3 inch dial is desired. The ammeter scale ranges from 15-0-15 to 30-0-30; the voltmeter scale from 3.5-8.5 to 7-17 volts. It operates on the D'Arsonval principle, involving a permanent magnet and a moving coil with spiral current carrying springs, mounted in pivot and jewel bearings, the movement being rendered dead-beat by winding the moving coil on an aluminum damping frame.

The type EI meter has a 2 inch dial and is made as an ammeter only, with scale ranging from 15-0-15 to 30-0-30. It is of the polarized vane type, in which a moving soft iron vane is polarized by a stationary permanent magnet and deflected over the entire scale by the action of a stationary current coil. No springs are used, thus resulting in great simplicity and ruggedness. The indications are made dead-beat by means of an air damper.



Type EI Meter

Depending upon the characteristics of the charging generator system, a voltmeter, an ammeter, or both are used. The voltmeter is usually connected across the storage battery, if a lead plate battery, to indicate its condition of charge. The ammeter is generally connected in series with the storage battery to indicate whether the battery is charging or discharging, and the amount of current flowing, thereby providing a check on the operating condition of the charging generator system.

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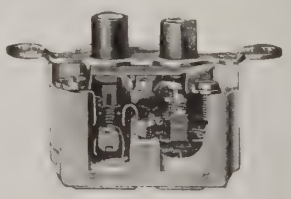
Electrolier Switch

Two-circuit and three-circuit electrolier switches are very desirable in most installations, whether in private houses or in public buildins. To control two or three circuits from a single switch is obviously both convenient and economical.

The main objection to such switches has been that they could only be procured in the surface snap or rotary flush type. For interior wiring the first was not practical and the second not standard with the push button switch which usually made up the balance of the installation.

Efforts have been put forth during the last few years to develop an electrolier type of switch with a standard push button movement and one or two such switches have been produced. The switch most nearly conforming, however, to the standard push switch is that just put on the market, and illustrated herewith.



This switch has the appearance and action of an ordinary single pole push button switch. Pushing the pearl button connects the circuits and pushing the black button disconnects the circuits. The black button, however, has an additional function. It can be rotated whether the circuits are closed or open to four different positions, giving four combinations of lights. This button is so shaped at one end that it offers a gripping surface and also indicates by sight or touch the circuit on which the switch is set.

It is not necessary to operate this switch, as in the old flush type or as in other electrolier push switches, through the various combinations to get to the "Off" position, or to make two or three useless turns or pushes to get the desired circuit. Neither is it necessary for the lights in the room to be turned off even momentarily to get another circuit, or a different combination of lights. The black button by its rotating movement can be set at whatever circuit is desired and then the switch operated as a single pole switch on that circuit.

In most electrolier combinations there is usually one circuit or set of lights, which is generally used. The other circuits, or lights, are only used occasionally. With this switch the black

button can be set on the circuit most generally used and the switch can then be operated as an ordinary push button switch on that circuit, entirely disregarding the other circuits. These, however, can be brought into service at any time desired by simply rotating the black button.

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Statement of the Ownership, Management, Circulation, Etc., Required by the Act of Congress of August 24, 1912,

Of ELECTRICAL AGE published monthly at New York, N. Y., for October 1, 1916.

State of New York } ss.:
County of New York }

Before me, a notary public in and for the State and county aforesaid, personally appeared Chas. B. Thompson, who, having been duly sworn according to law, deposes and says that he is the editor of the ELECTRICAL AGE and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, and business managers are:

Name of — Post Office Address

Publisher—Technical Journal Co., 233 Broadway, New York City.

Editor—Chas. B. Thompson, 233 Broadway, New York City.

Managing Editor—Paul B. Findley, 233 Broadway, New York City.

Business Manager—Wm. F. Eastman, 233 Broadway, New York City.

2. That the owners are: (Give names and addresses of individual owners, or, if a corporation, give its name and the names and addresses of stockholders owning or holding 1 per cent. or more of the total amount of stock.)

Technical Journal Co., 233 Broadway, New York City; Chas. B. Thompson, 233 Broadway, New York City; Wm. F. Eastman, 233 Broadway, New York City.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent. or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiants full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is. (This information is required from daily publications only.)

C. B. THOMPSON,
(Signature of Editor.

Sworn to and subscribed before me this 29th day of Sept., 1916.

(Seal) SIMON LEVINE,
(My commission expires March 30, 1918.)

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ELECTRICAL AGE

The Monthly Authority of the Trade

Technical Journal Company, Inc., New York

Vol. 49 **DECEMBER, 1916** **No. 6**

The Generators

Companion giants with compact turbines—the many-bladed for glut of power
Musicians massive and multipolar, herding the watts to the wire to send them
Down where the shuttling trolleys glide, where the tall, lit buildings crowd and tower;
They watch in their mountain meadows far, dwarfing the men who watch and tend them.

And I am just the little one, the spinning, singing little one,
A little high-speed engine driven at will of Tom or Bob;
And when the rheostat's just so I make my incandescents glow
To tell the folks in Littleville that I am on the job.

Direct-connected to compound engines; in enterprises the world embracing
Big-fellow partners, aloof, impassive; speeding men on who make and contrive them
Things that are marvels touched with skill—as a stamped watch-hand, or pieced pier-casing;
They sit in their high-roofed concert-rooms, hymning strange folk afar who buy them.

And I am lighting little stores, the smelly, tumbled little stores,
Where Jim will "mark it on the book" with figures two or three;
And homely rooms where men sit by and read with wonder-seeking eye
Inside the Chieftain—twice a week—of trading oversea.

Illuminating great halls that echo, and strong endeavor of quay or station,
Supplying carbons their arc of glory, marking a Way that is White and winning—
Out where the world's desire is big, for its wealth of pleasure a new sensation;
They chant by a globe-encircling march ending ever at its beginning.

And I am lighting little streets, the "Main and Maple" little streets,
With friendly lights on span-wires hung, and modest business signs;
And I am neither great nor strong, but I keep singing all night long
The light that shows the homeward road and from the window shines.

Handling Freight with Electric Stevedores

H. C. Yost

Power Bureau, The New York Edison Company

THE most efficient methods of handling all classes of freight at railroad and steamship terminals, are those which will relieve congestion, receive and deliver freight in the shortest time, pile it in the most compact and accessible manner, and reduce the amount of claims and the high cost of handling.

The machine has yet to be built, which in itself will accomplish all these things. However there are several machines, which, working together are going a long way toward solving the problem. Among these the most important are the electric industrial, or load carrying trucks, tractors and trailers, although movable cranes, conveying and piling machines, portable hoists and ramps really should work hand in hand to show a saving in operating cost and to give greater speed and capacity.

The problem of handling freight with modern machinery, has received a great share of attention. Railroad and steamship companies have held meetings to devise ways and means to relieve the congestion, reduce claims and to speed up the handling of all classes of material. Trucks of various types have been recommended and after consulting the manufacturing companies, one or more have finally been put on trial. At this point the interest of the purchasing company seems to have grown cold. Instead of having an efficiency engineer or a special representative keep actual record of the test, and make a complete report of the results, the question of the purchase of the truck is, in a number of cases, left to the report of the pier agent or superintendent.

Numerous successful trials and demonstrations have been condemned because the agent, accustomed to hand truck methods, practically had his mind made up before the machine arrived that it would not meet conditions. Obstacles are put in its way, necessary alterations to receiving sheds, piers, floors, runways, car floats, lighters and boats, to meet the new conditions, are not made. The machine is put to tasks it never was designed for, and unsatisfactory results follow. Selecting the right machine for each particular class of work is an important matter and should be considered from every angle. Piers that received 100 to 200 tons of freight, years ago, are now receiving from 500 to 800 tons a day. What provisions have been made to handle this increasing volume? The hand truck, with its human power is still in use, and no doubt will remain for a long time to come, unless definite steps are taken to install machinery to cope with this new condition.

Giving the Truck a Fair Chance

The industrial truck or tractor, designed for hard work, is like any other piece of machinery; it requires a little attention now and then. Instead of each operator being held responsible for the condition, running and minor adjustments of his truck, it is left to one man who is kept busy making repairs due to the operators' neglect or ignorance.

The carrying capacity of an industrial truck is sometimes forgotten when a quantity of material or heavy loads are to be moved. Two to four tons are often placed on the platform or on a trailer, and the truck is called upon to "get away with it." The result is a run down battery and a poor reputation given to the truck.

Load carrying trucks are used for the speedy handling of freight, baggage and mail where it is desired to have the trucks run into cars, boats and through narrow aisles. One disadvantage of industrial trucks is that they stand idle while being loaded and unloaded.

The cheapest and most rapid method of handling certain classes of freight, is the tractor and trailer arrangement. One man, one motor and one battery can keep over 400 square feet of loading space busy. Two or three tractors can keep up a continuous flow of freight; the object being to allow from nine to eighteen trailers to each tractor, depending on its capacity. While one third are being loaded, one third are in transit, and the other third are being unloaded. This keeps the tractor moving freight practically all the time.

Hauling 24 Bags of Seed with a Tractor

Where the efficiency of an industrial truck ends, and a tractor begins, depends on the class and quantity of freight, floor and storage conditions, piers and the speed at which material is to be moved.

Let us consider some of the operating costs of these electric stevedores, taken from actual figures.

Operating Costs

Interest, depreciation, repairs to the machine, battery and charging apparatus, and the electricity consumed in charging the storage battery, we find that 30 cents per hour per machine, is a good average, providing the truck is used for six hours a day. Considering a working day to consist of eight hours, at 30 cents per hour would amount to $2.40. Figuring the operator receives 40 cents an hour, for eight hours, would be $3.20, or $5.60 for all costs for the truck and operator.

To move 3,700 barrels of oil and rosin a distance of 2,000 feet by electric industrials, required 10 hours, and the services of 22 men:—12 loading, 6 operating the trucks and 4 unloading. The cost was .0775 cents per ton, as compared with .354 cents per ton to hand truck it, saving .276 cents per ton or 78 per cent. At noon, the batteries were charged for one hour. Each truck carried 616 barrels, a weight of 142 tons, a distance of 39 miles in 10 hours.

During a period of 30 days, the cost of carrying freight by electric trucks, including labor, interest, depreciation, maintenance, insurance, electricity for charging the batteries, etc., amounted to .1041 cents per ton, as against 25 cents per ton for hand trucking. The detailed costs were:

Labor	0.087
Interest, depreciation	0.0099
Maintenance	0.0033
Electricity for charging storage batteries	0.0039
Total	0.1041

Where electric trucks are employed for handling cotton, the following figures were collected:

The round trip from the loading point to the vessel, amounted to 2,500 feet. One industrial carried the equivalent load of 10 men with hand trucks, and made the trip in 9 minutes, while it took one man 24 minutes to cover the same distance. This shows the possibilities in saving time and cost, thereby increasing the efficiency and economy of such an installation.

Commodities in Bags

A few cases where the industrial was called upon to handle commodities in bags gave the following figures:

Material	Wt. of Bag	Total Wt.	Distance	Time	Cost per ton
Rice	185 lbs.	70 tons	190 ft.	1 hr.	4½ Cts.
Coffee	135 lbs.	270 tons	155 ft.	5 hrs.	4 Cts.
Sugar	320 lbs.	640 tons	200 ft.	15 hrs.	7 Cts.

In handling macaroni in boxes, six electrics did the work of 24 hand trucks; for grapes in barrels, two electrics did the work of 21 hand trucks. In the first case the saving in money amounted to $66.60, the entire cost of performing the work electrically being $21.00 and $87.60 to do it by hand. That hand trucking material is slow and inefficient is further shown by the following example:

To carry 82 tons of cement in 100 lb. bags, a distance of 135 feet by hand trucks, required two hours and cost 23 cents per ton.

The tractor and trailer efficiency is shown by the following: One tractor pulling three trailers carried 84 1,800 lb. casks of tobacco, a distance of 1,000 feet in four hours at a total cost of 7 cents per ton.

Comparative Costs

Some comparative costs of transportation will show the importance of efficient handling methods.

Teams hauling material on good roads
25 cents per ton mile
Steam railroads.....7.8 mills per ton mile
Canals.....2 to 3 mills per ton mile
Rivers and sounds.....1 mill per ton mile
Lakes and ocean.....½ mill per ton mile

Loading a Truck on "the Farm"

The cost of handling cargoes can easily vary from 45 cents per ton to 12 cents per ton according to the methods employed. This means that for loading and unloading ocean cargoes, the variation may be equal to 1,320 miles of haul at one half mill per ton mile. Under these circumstances, with 12 cent terminal facilities, goods can be shipped from Havana to Boston, as cheaply as from one dock to another in Boston harbor, if both docks have 45 cent methods.

A port having an advantage of 12 cent per ton loading and discharging rate, can attract traffic 500 miles from a rival port. To illustrate the high cost of handling a ton of freight as compared with railroad charges:—to carry freight from Philadelphia to New York, a distance of 90 miles:

Cost of "Hand-"ling

Labor cost of loading on wagon	25 cents
Unloading at freight station	50 cents
Cost to railroad in billing and other clerical work	40 cents
Actual operating expense of loading and switching freight car, etc	25 cents
	$1.40
Cost of handling in New York as follows:	
Terminal cost of New Jersey side of North River, average of all railroads	15 cents
Lighterage	80 cents
Terminal cost on waterfront of Manhattan Island	50 cents
Cartage expense in New York City	80 cents
	$2.25

The terminal charges at both ends equals a total of $3.65 on one ton of freight. It costs the railroad to haul freight, 3 mills per ton mile, or for 90 miles, between Philadelphia and New York, 27 cents per ton.

The cost of getting a ton of freight started on its journey at one end, and hauling it from Jersey City terminal to consignee's place at the other end, is nearly 14 times as much as it costs to haul the goods all the way from Philadelphia to New York.

How can the railroad and steamship companies co-operate with the installations of electrical trucks and tractors?

Good Trucking Conditions

The first requisite is a good floor surface. Concrete floors could be substituted for the present wood ones, making them more sanitary, more economical and more serviceable. It is well to keep as many wagons off the pier as possible. They take up space, block traffic, wear out the pier surface and are in general a nuisance. When a plank is to be replaced, a 2-inch or 3-inch board is put down where a 1½-inch plank would make the surface even. The edges are poorly beveled, which causes a hard jolt to passing electric trucks and is liable to shake off the freight or break the storage battery jars.

Pier entrances and the "farm," or space in front of the bulkhead shed, are in some cases paved with unevenly laid cobblestones. A thin mixture of concrete could be used to fill up the crevices, or at least a part could be laid out for trucking.

Bulkhead or receiving sheds at present are inadequate for handling the enormous quantity of freight that passes through each day. Teams stand for hours in line waiting an opportunity to discharge their burden. This condition does not advance the reputation of the railroad or steamship company which boasts of its prompt attention and efficient service.

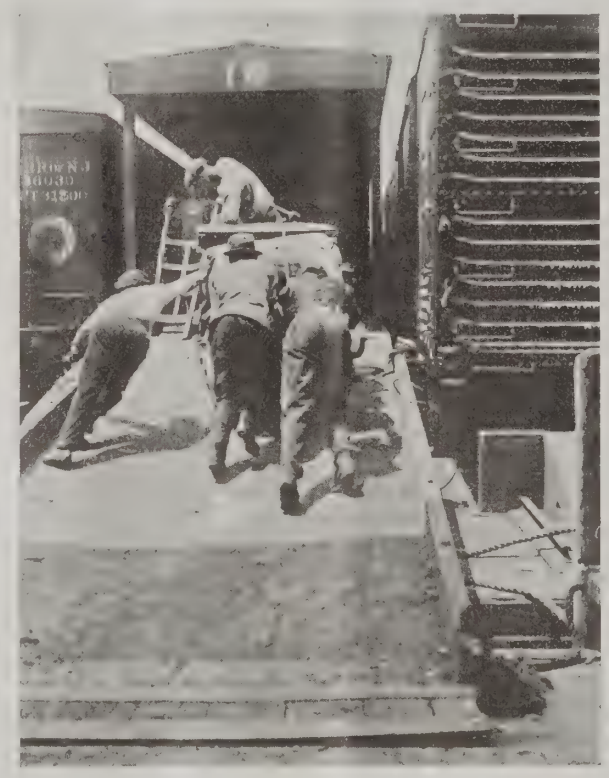
Additional temporary or permanent receiving platforms could be located on the farm for receiving freight in addition to the bulkhead sheds.

Gangplanks and Platforms

Gangplanks used for all classes of work are rather poorly constructed. They are too short, making a rather steep incline when used to connect with car floats or boats, and too narrow to allow hand trucks with large boxes, to pass one another. The ends of these planks could be tapered off more gradually, while thin iron plates securely fastened, would afford ample protection to the ends of the boards. Instances have been observed, where loaded industrial trucks approaching these planks, had to slow down, due to the uneven surface and the abrupt incline, for fear of breaking the steering apparatus or jarring off the freight.

The platforms on car floats should be widened and raised to a mean car floor level and the plates at the door openings should be enlarged and cut at either 30 or 45 degrees, so a truck could go in or out without the ever-present danger of running off the plate. The cars should be shifted on the floats so that the uprights, supporting the roof over the platforms, would not interfere with trucks going in or out of the car.

Where industrial trucks or tractors have been installed, the purchase of extra storage batteries saves the price of an additional truck, in many cases. When a truck is to be run more than eight or ten hours, the discharged battery can be removed from the truck and a fully charged battery put in its place, thus keeping the truck in operation. Otherwise the machine would have to stand idle while the storage battery was being charged, or an extra truck purchased.



Extra Labor Improperly Charged Against the Truck

Electrically—The Only Way

The ever increasing volume of freight that is being received by all the railroad and steamship companies, has to be met sooner or later by new and up-to-date machinery. Instead of making alterations and adding modern devices to the piers, they are satisfied to handle material in the same manner as they did ten, twenty and thirty years ago.

The hand truck, in almost every instance can be superseded by an electric stevedore, which will carry the load of from four to twelve men, more speedily, more economically and with less damage to freight.

Why are the companies, using the electric stevedores for handling their material, so well satisfied? Ask anyone of them whether they would care to go back to the old hand methods, after using the electric trucks.

New Construction for the Eastern Penna. Railways Company

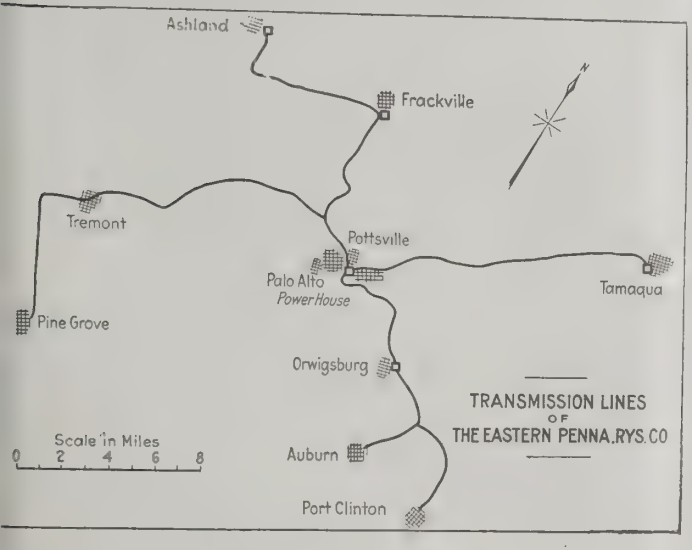
By M. M. Samuels

The Eastern Pennsylvania Railways Company, vith headquarters at Pottsville, Pa., is one of ie most progressive and best managed operat- ıg companies in the East. Through continu- us improvements in its equipment, service and ıanagement, it has grown from a very small be- inning to very large proportions and is still oing ahead. Of the new construction work one in 1915 and 1916 only the following parts vill be considered:

1. The reconstruction of the Palo Alto Power House.
2. The Transmission Lines.
3. The New Frackville Substation.
4. The Ashland Substation and various out- door substations.

1—Palo Alto Power House

The original installation consisted of several engines con- ected by means of rope drives to d.c. railway generators, hich were housed in the car barn basement in Section B, ig. 2, and fed from boiler room A. The switchboard was so located in the car barn basement. This original installa- on was a straight railway outfit. In 1907 the engine room arked Section "A" and Boiler room "B" were installed. his installation consisted of 2 1,000 K.w. Corliss engines,



iving 2300- volts, 3-phase generators, two banks of step-up ansformers, 2300-22,000 volt, two 22,000 volt outgoing lines d several 2,300 volt outgoing lines with necessary switch- ard, oil switch, and lightning arrester equipments. There re also installed one 400 kw. synchronous motor generator t, one 300 kw. induction motor-generator set for railway rposes and two exciters, one of which was steam driven d the other motor driven. There was further installed a ansmission line to the nearby town of Tamaqua, consisting two 22,000 volt, 3-phase circuits, and several substations r railway, power and lighting, the most prominent of which e at Tamaqua and Pottsville. Later one 1,000 kw. Allis- ıalmers turbo-generator was added.

However, the demand for power was so great that a com- ete reconstruction of the engine room became necessary,

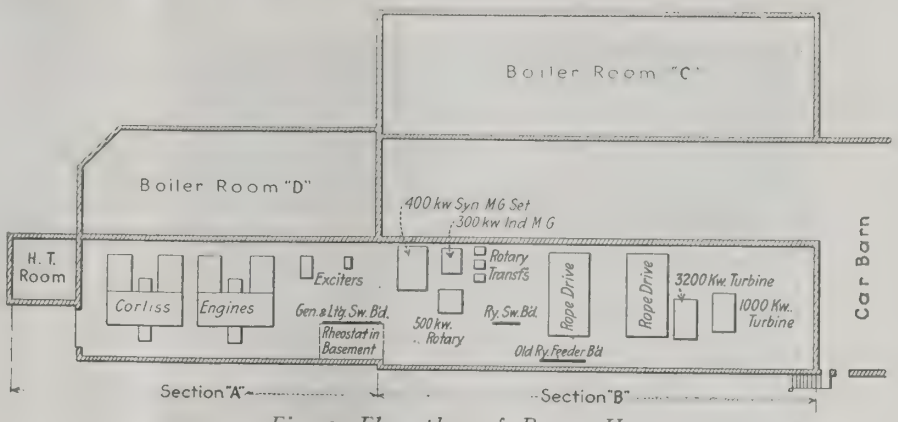


Fig. 2—Floor-plan of Power House

when it was decided to install a new 3,200 kw. Allis-Chalmers steam turbine. Fig. 2 shows the new arrangement of the engine room. The car barn floor of section A was removed and the old floor beams utilized for a new crane runway in Section B, so that the crane which was originally installed in Section A now runs the full length of the engine room. The floor level of Section A was the same as that of the old car barn basement, so that now the whole engine room has the same floor level. The removing of the car barn floor, which consisted of heavy brick arches between steel beams, had to be done with great care and skill in order not to disturb the operation of the old rope drive engines, the motor generator sets and the 1,000 kw. turbines. Fig. 3 shows old car barn floor removed with some of the steel work still in place, underneath which is seen the old rope drive.

The brick wall between Sections A and B also had to be removed to such a height as to permit the crane to pass from Section A to Section B. This wall being in close proximity to the switchboard and the 2300-volt switching apparatus had to be removed with very great care and required very skillful shoring.

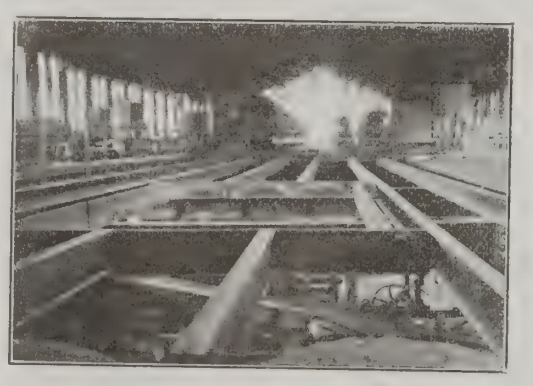


Fig. 3

In order to make room for the 3,200 kw. turbine, one of the rope drive engines was removed and replaced by a new 500 kw. Westinghouse rotary with the necessary transformers, switching apparatus and switchboards.

Switchboard Changes

The whole switchboard was re-arranged and separated into two parts, one comprising the generator and lighting feeder panels and the other a beginning for a new railway switchboard. The old d.c. board controlling the two rope driven

generators and the railway feeders was left in its old place for the present. Fig. 4 shows the new rotary converter and the two motor generator sets, which also had to undergo some re-arrangement. Fig. 5 shows the rotary transformers with their wiring and switching, and Fig. 6 shows the 3,200 kw. turbine in process of erection. A diagram of connections is given in Fig. 7.

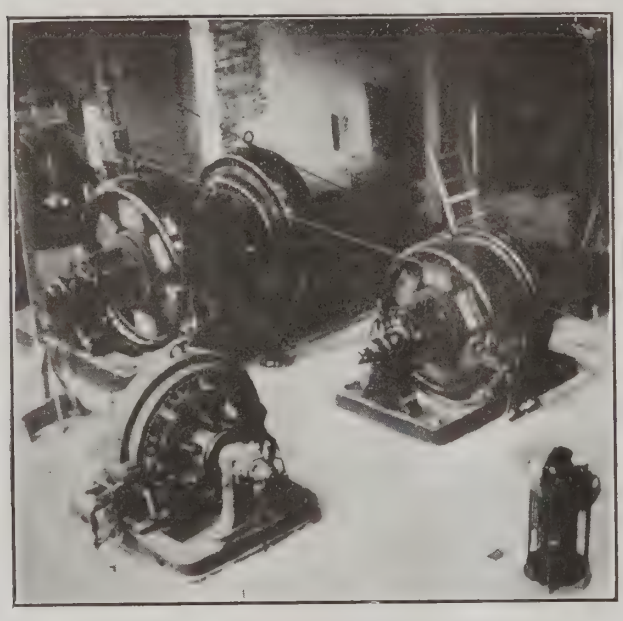


Fig. 4—Converter Equipment

The switchboard was completely remodeled and hardly any of the old 2,300 volt wiring was left in place, since a new bus arrangement was devised for the whole 2,300 volt system. All this rearranging of circuits and moving of switchboard panels had to be done while the busses and circuits were kept alive and in spite of this and other great difficulties which are encountered during the process of a construction of this

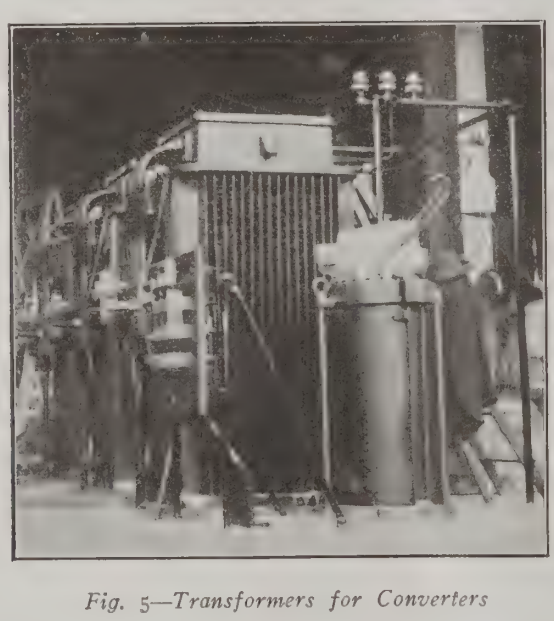


Fig. 5—Transformers for Converters

nature, the whole work was accomplished without any mishap to life or property, or any interruption of service.

Lighting

Of special interest is the new lighting which was installed in the reconstructed part B, since it may be called typical for up-to-date power house illumination. The room to be illuminated is about 136 feet x 44 ft. in floor space and approximately 36 feet in height from floor level to bottom of roof trusses. Most buildings of this size will generally have special fancy brackets on the crane columns, which are always being pulled down by the crane, or a great number of

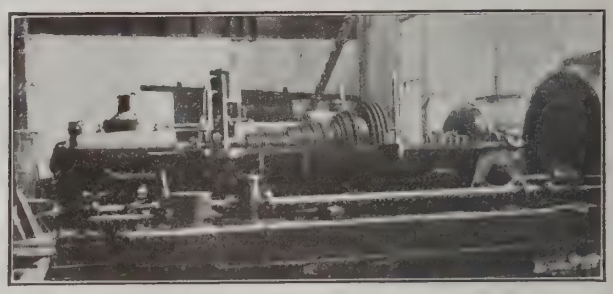


Fig. 6—Turbine During Erection

small lights all over the walls, and on all other available surfaces. None of these obsolete methods was used. The whole room was illuminated by 10 fixtures, each consisting of one "Benjamin" metal shade No. 6273 with one 500-watt Mazda C lamp. These fixtures were mounted overhead immediately under the roof trusses and spaced as uniformly as was practicable. The lamps can easily be handled from the crane and no climbing of extension ladders is required. This scheme gives a very good uniform distribution of light on the working planes around all machinery and also gives a perfectly satisfactory illumination of the switchboard.

High Tension Switching

The high tension apparatus is housed in a lean-to of section A as shown in Fig. 2, the transformers being located on the main floor and the high tension switches in a gallery above. The original switching installation consisted of two

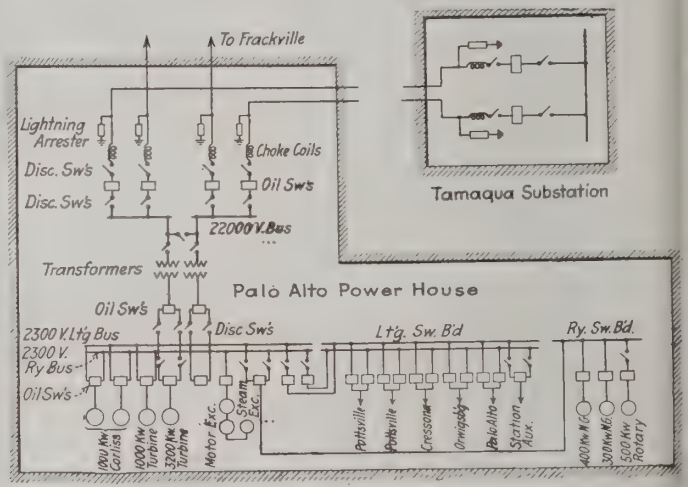


Fig. 7—Wiring Diagram

General Electric Company H-6 oil switches in brick cells together with the necessary current transformers and disconnecting switches. Two sets of multi-gap, three phase lighting arresters were arranged along the side walls. These two equipments controlled the double circuit 22,000 volt transmission line to Tamaqua. The space in the high tension room was then pretty well utilized, and a suggestion that it would be possible to install any more circuits without extending the buildings would have been laughed at. However, the great progress made within very recent years in the construction of oil switches and especially disconnecting switches made it possible to provide space for four additional complete line circuits in the same room by simply removing the multigap arresters and replacing them by electrolytic lightning arresters which are placed outdoors on a steel platform.

This shows clearly what wonderful progress has been made recently in the development of high tension apparatus. The new oil switches used are Westinghouse Electric & Mfg. Co.'s type G-1. The oil switch tanks are mounted on pipe frame work and require no foundation. In order to inspect or repair a switch it is only necessary to lower the oil vessel instead of moving the whole oil switch as was necessary with the older types. The disconnecting switches are double break pivot type and are arranged on each side of the oil switches, the middle insulators of all six switches being connected to one pipe mechanism, so that the six switches are operated simultaneously by one common lever. No switch hooks and therefore no wide operating aisles are required. The blades do not move at right angles to the plane of the three switches but within that plane, so that not much room is needed in front of the switches. Two such high tension circuits are now being installed, supplying a new 22,000 volt double circuit transmission line to Franckville and two others will be installed in the near future. While the old lines leave the building through the wall it was found to be more advantageous to bring the new lines out through the roof, thus again economizing in space. The lightning arresters for the new lines are also of the electrolytc type and are placed on a steel platform outdoors. The rearrangement of high tension apparatus and wiring is shown clearly in Figs. 8 and 9 and needs no further explanation.

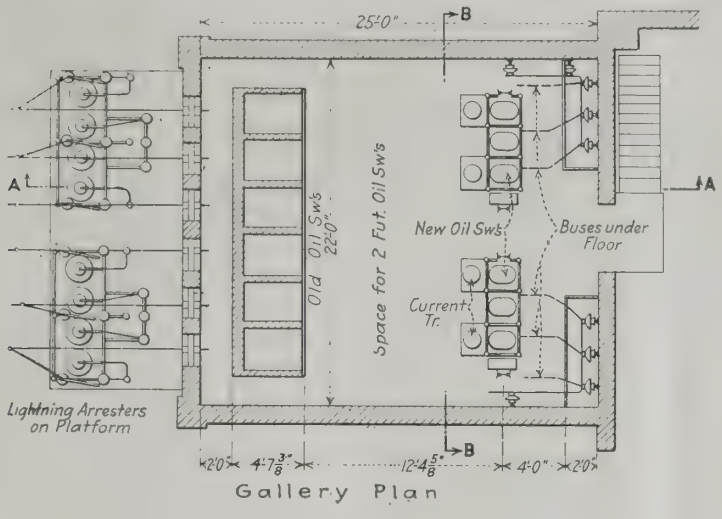


Fig. 8—Plan of H. T. Switch Room

The Transmission Line

The old transmission line consisted of a 22,000 volt double circuit line from the Palo Alto to Power house to Tamaqua.

The new double circuit 22,000 volt line runs from the Palo Alto Power House to Frackville and continues on through the new Frackville Substation to Ashland where a new substation is being installed in the old power house. At Wadesville which is located so that it forms a triangle with Pottsville and St. Clair the line branches out and runs through Minersville and Tremont to Pine Grove where outdoor substations are now in the progress of construction.

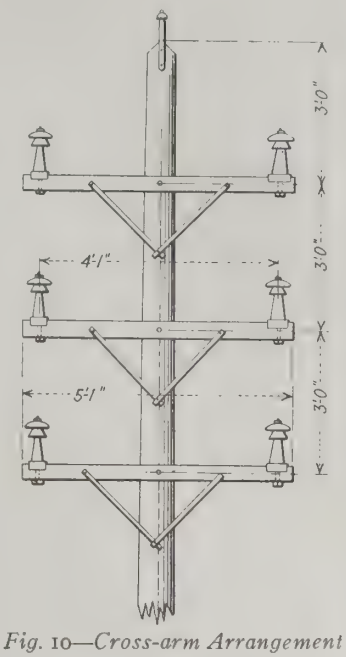


Fig. 10—Cross-arm Arrangement

A bank of 6,600 volt transformers were installed outdoors near the Palo Alto Power House and these feed a 6600 volt transmission line running through Orwigsburg to Auburn and Port Clinton at which points outdoor substations are being installed.

Fig. 1 is a rough map diagram of the transmission line and Fig. 10 shows a typical pole top construction for a 22,000 volt double circuit line.

The outdoor substations as well as the new Frackville substation and the reconstructed Ashland Substation will be fully described in a future issue.

The design and construction was done by The J. G. White Engineering Corporation of New York City.

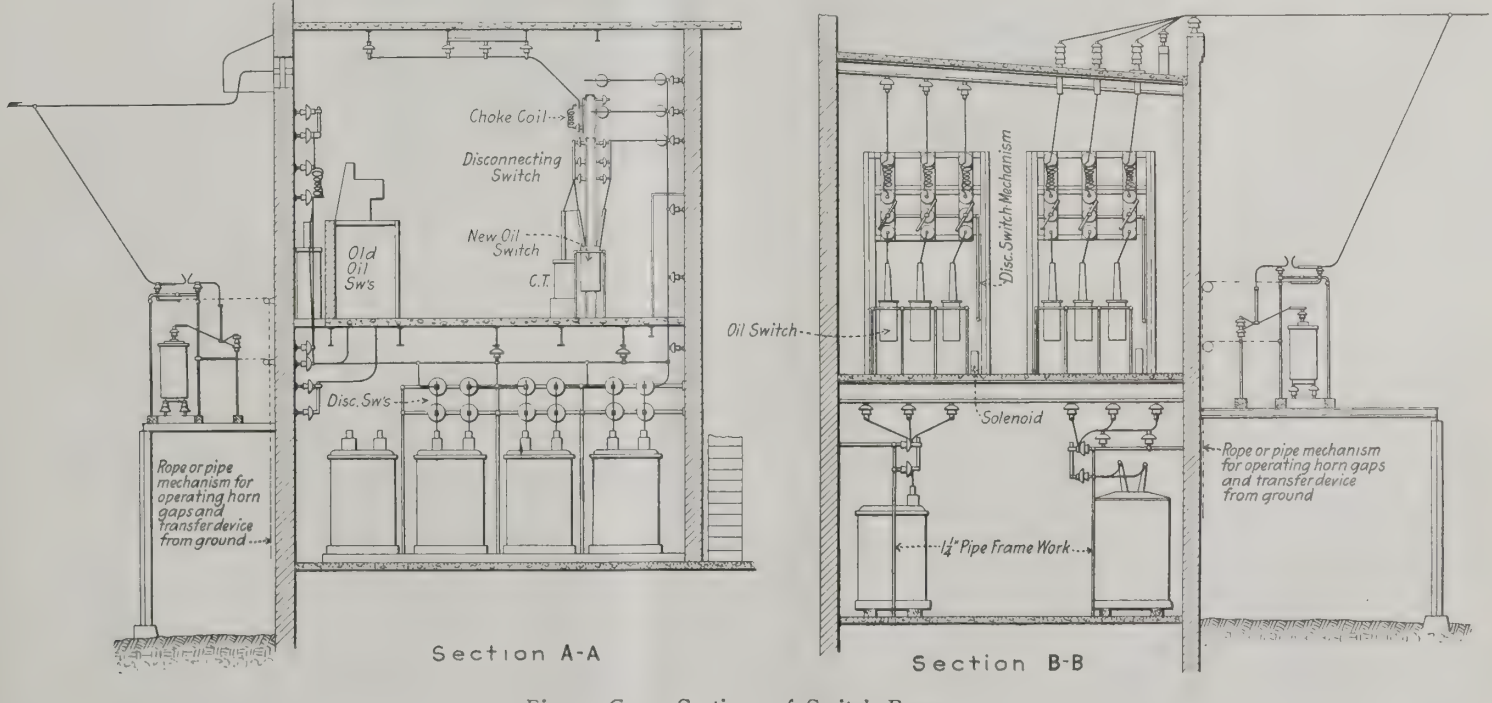


Fig. 9—Cross Sections of Switch Room

Liberty Illumination Opens A. E. W.

In the presence of the President of the United States, the Secretaries of War and the Navy, the Mayor of New York, and many notable men of the nation and the electrical industry, a radio flash from the Presidential yacht Mayflower set alight the Statue of Liberty in New York Harbor last Saturday night. The movement to which over 100,000 persons all over the country contributed, was brought to a fitting climax when in the illumination from 246 projectors, the Statue flashed out against the blackness of a December night. An added touch of romance was given by the circling flight of Miss Ruth Law in her aeroplane bearing the word 'Liberty" outlined in electric lamps and trailing a rain of fire from magnesium flares.

Following the illumination of the statute, the official party, including the committee of 200, which acted as hosts, came up in automobiles to the Waldorf-Astoria Hotel, where more than 1,200 persons sat down at a banquet. Downtown office buildings were brilliantly illuminated and amber lamps in the street-lighting fixtures made lower Fifth avenue a veritable path of gold. Speakers at the banquet were Mayor Mitchell, of New York, as toastmaster; Hon. Chauncey M. Depew, who delivered the principle oration at the formal presentation of the statute thirty years ago; M. Jules J. Jusserand, Ambassador of France; Mr. Henry L. Doherty, president of the Society for Electrical Development, which has done much to promote the movement, and Mr. Ralph Pulitzer, publisher of the New York *World,* which has been instrumental also in raising the fund for the illuminating equipment. Finally President Wilson spoke of the significance of the event, the meaning of liberty, and how it was given more and more to everyone in the world.

How the Statute is Illuminated

The sources of the flood lights are fifteen batteries of projectors. Eleven of these batteries are located upon the eleven salients of the old fort, known as Fort Wood, upon which the base of the statue was built. Three batteries are located upon the roofs of small buildings on the island. The other battery is upon the balconies of Liberty's arm, just below the torch.

The total number of projectors is 246, each being 250 watts. The lamps are thirty-five volt lamps, each of the 246 projectors having its individual compensator to step down the 220 volt current to the lamp voltage. The projectors and compensators are mounted on specially designed pipe framed circuits, individually designed for the different locations.

The Public Service Corporation of New Jersey supplies the 2,200 volt two phase current from its Marion Station through its Garfield Avenue sub-station. The current is carried by submarine cables under the channel between New Jersey and Bedloe's Island up to the old Government power house upon the Island.

In the power house this current is stepped down to 220 volts, and then carried through underground cables to the base of the statue and from there through suitable manholes and junction boxes is distributed by circuits to the various salients of the Fort and to the other fifteen projector batteries.

Within the torch itself is a fifth-order lighthouse lens made by the Macbeth-Evans Glass Company. The exterior of the torch consists of more than 600 plates of glass, held by metal grillage, and curved so as to follow the original design of a conventional flame as intended by the sculptor, Bartholdi.

To put "life" or a quiver into the simulated flame of the burning torch, about 15 500-watt gas-filled lamps were placed upon a series of flashers. The flasher is not set to certain revolutions, the experts preferring to allow it to carry out the unsteady but constant flicker and blaze of the flaming torch.

Thus a varible light like that of a flame and a steady light by means of the lens are obtained together. The two forms of light simulate exactly the flicker and the constant glow of the burning torch.

For the success of the flood-lighting of the statute, credit is due to Mr. H. H. Magdsick of the National Lamp Works, Cleveland, Ohio, and to Mr. R. F. Garbutt, of Henry L. Doherty & Co. Mr. Gutzon Borglum, a noted sculptor was responsible for the careful selection of the glass used in the torch, and its design.

* * *

Important Rate Case Pending

An offer of the local distributing systems of the city of Los Angeles has been made by the central-station companies. This is at a price of $12,561,500 on a partial payment plan extending over ten years, or $12,279,000 for cash, plus $1,412,000 as bond retirement expense. The companies are to continue to supply the street railways, and 50% of the power used by the city at 1.41 cents during 10 years, and after that time any additional power required above that generated by the city's hydro-electric plants.

On the other hand, the city is willing to pay $10,000,000 for the distributing system, including a generating station

(*Continued on page* 48)

EDITORIAL

Cutting the Cost of Handling

At the present time the daily papers are full of the agitation over high prices for foodstuffs. On the very day of its opening, Congress is flooded with bills containing every legislative nostrum, from investigation to government ownership. Officials and commissions have come, seen, and gone away, not conquering, but reporting. Each report places the blame on a different class—the retailer, the wholesaler, the railroad, the farmer, and even on the ultimate hen, cow, and potato. Through this fog of malediction, the public is coming to see that the real cause of high prices is the failure of our machinery of production and distribution to keep pace with the demands made upon it by a rapidly growing urban population. Every cog in the mechanism is ill-fitted to the duty which modern needs impose on, it from the one-man farm with its excessive amount of manual labor, through the railroads with their high terminal costs to the dealers with their antiquated merchandising and delivery methods. It is with particular satisfaction, therefore, that we publish in this issue an article which deals with that most accessible waste—the loss due to handling of goods between freight cars, steamers and wagons.

In this article the author, Mr. H. C. Yost, makes special reference to two points: First, the speed with which electric industrial trucks and tractors can move freight, as compared with hand trucking; and second, the necessity of close co-operation among all concerned in order to realize full efficiency from the equipment. As regards speed, it is evident that if a truck can do the work of ten stevedores, it will unload a car, perhaps in only one-third the time, but certainly so much faster as to reduce materially the time of holding the car at the platform or pier. An idle car is earning no money, and with the present acute shortage in rolling stock it would seem desirable to spend money freely for truck equipment which would release cars at the earliest moment after their arrival.

Mr. Yost draws attention to the usual, but no less inexcusable, lack of genuine endeavor or by pier and freight-house managers to provide every accessory for the easy and rapid operation of their motor vehicles. The very essence of electrical equipment is speed; if it is to show satisfactory cost records, it must be worked up to its safe limit all the time. Yet bridge-plates between cars and platforms are so narrow as to require "jockeying" to get the trucks over; ramps have gaps at the bottom which require slowing down and consequent loss of momentum; slopes are needlessly too steep for full loads to be taken up unassisted; and passings are so rough that speed is made at peril of broken knuckles or battery jars. It might be supposed that a truck expert's services were complete when he prescribed the type and number of machines, but it would seem that he must also overcome the management's inertia still further in order to have proper working conditions for his vehicles.

It must not be thought, from the fact that Mr. Yost describes specific conditions in large terminals, that electric trucks and tractors are of use only where there is a great volume of business. So great is the saving over hand methods that it is probable that a truck would "prove in" even if it stood idle a part of each day. The placing of a single truck, with its attendant charging equipment, is a piece of load-building well within the possibilities of many a small-town central station. We hope that this article may encourage a number of them to make a careful analysis of some local handling problem, then confer with truck manufacturers, and finally place before their prospect a proposition which will put money into both his pocket and theirs.

* * *

Partners in Business

It makes a great deal of difference to the man who has a particularly disagreeable task to perform, whether he merely wants to get through the day with the least inconvenience, or whether he has a real interest in the business. Set him to wading through water on a cold day with a pack on his back and he will grumble like the proverbial sailor, but let the load be the result of a day's gunning, and he only wishes it were heavier. The difference, of course, lies in the fact that the hunting trip was something of his own arranging and planning and for his obvious benefit, while the work done for his employer is nothing more than the carrying out of someone's else orders, with no particular visible result.

Several schemes have been tried to change this condition with fair success as long as they have not been expected to run themselves. The stock-purchase plan, by which employees may gradually buy stock at a reduced rate, paying from it by periodic deductions from their wages, is a good one as far as it goes. The trouble is that it does not make enough difference to the holders of a few shares how much he may save or waste. At the other extreme are the bonus and piece-rate plans whose effectiveness and limitations are well known.

There are other sentiments than the love of gain to which appeal can be made, and the chief of these is personal pride. Maintaining a perfectly kept station; helping to give uninterrupted service; keeping the cost per kw-hr. below that of any other station, are all sources of satisfaction to any red-blooded man, and the hotter the competition between neighboring units

the better he likes it. One of the secrets of the beautifully maintained roadbed of some of our Eastern railroads is the annual inspection and awarding of prizes to the best-kept section. Within walls the same thing may be done by pitting generating and substation against each other for neatness, and storekeepers for completeness of stock against its total amount.

When the battle cannot be joined along geographical lines, most of its results may be secured by putting one year against another. That means perhaps the establishment of a "bogey" from one year's results which is to be beaten the next. In an isolated plant, that might be pounds of coal per kilowatt-hour or per lb. of water evaporated "from and at." Such a comparison can readily be given out by posting on a bulletin board, preferably so located as to be in sight of the men at work.

It may be contended that men who know they are doing as well as last year will not exert themselves to break the record. If progressive improvement is to be expected, it is best to compute a new standard, taking into account a reasonable improvement. Care must be taken that this standard is not too hard to reach; men will quickly stop trying to attain the impossible, and the plan will defeat itself. Nor should there be any secrecy about the higher standard; if it is logical to look for better work each year, the men will recognize the fact and be willing to do their utmost to "make-good."

* * *

At Last—The Week

When this issue reaches our readers, America's Electrical Week of 1916 will be nearly, if not quite, ended. Nightly illuminations, crowded exhibitions, widespread publicity campaigns will have done their work, and the great American public will turn to other interests. Yet they will not forget the lessons they have learned, and when the need arises for the doing of some new thing, the electrical way will be first in mind.

We feel that the Society for Electrical Development has acted wisely in making education the dominant note of the week's activity. The public is so surfeited with selling devices, that it is a decided and refreshing novelty to attend shows where the intent is rather to demonstrate than to vend. Electric wares are so attractive to behold in their shining nickel and copper or glossy black, and attractive holiday packages make them so tempting to the buyer, that Santa's pack will bulge with toasters, percolators and flat-irons, to say nothing of the more bulky sweepers, washing machines and electric ranges which will fill the back of his sleigh. Gifts for the kiddies too—many of the really educational sort that encourage the youngsters to electrify railways, shops, and—occasionally—an unsuspecting parent.

This year the Community Christmas Tree celebrations so successful last year will be repeated and extended. There may be a few who scoff at them, and suggest more material charities on which the money of others might be better expended. It is noticeable that the objector is usually not a contributor to any other cause. We do not believe that any deserving ones go uncared for; in fact the spirit of Christmas festivity fostered by these celebrations undoubtedly loosen purse strings still further. We need community spirit, and the Public Tree is potent in its upbuilding.

It is well that the dates for the Week have been chosen to augment the "Shop Early" movement. A trip in time saves nine—if you want a particular gift for a particular person—and the nine trips may be necessary when the tripping is at its worst through crowded stores and congested streets. It seems almost a reflection on the foresight of our readers to urge—yet each year there is a "peak load" which spoils the spirit of Christmas for many an over-tired worker.

During the past year business conditions have brought more money than ever into the pockets of the American people—and almost as quickly snatched it out. A comfortable residue, however, is left, and with unemployment at a very low ebb, we have genuine cause for rejoicing. To all our readers we take this last opportunity to wish

A Merry Christmas and a Happy New Year

The "New Freedom"

We have heard a good deal about a "new freedom." I tell you that any new freedom that seeks to make conditions where inefficient managers of business can successfully compete with enterprising and capable managers of business is a dangerous sort of freedom. Any system which aims at hampering the enterprising and the capable, circumscribing men of vision and originality for the purpose of protecting and supporting other men who lack those qualities, is not only vicious in its morals, but is bound to be disastrous in its economic effects, in just the proportion that it is successful. Inefficient employers are not the ones who raise wages. They could not raise wages if they would. The important thing in our industrial life is not that any particular individual or concern shall be kept in business, but that business shall be so conducted that production goes on in the most economical manner. We frequently make the mistake of putting too much emphasis upon the division of present profits and too little emphasis upon the development of industry. Suppose a man of superior skill with the aid of large capital and the introduction of the most efficient methods does make a great fortune where none existed before, who really profits by it? The answer is that society will get all of it that he does not eat or wear out. His savings, just as much as the savings of his humblest employee, must find their way into reproductive employment. The industrial plant somewhere will be increased. Production will in turn be cheaper and society will be the gainer.

Installation, Operation Power Application

A Record of Successful Practice and Actual Experiences of Practical Men.

A Circuit Breaker Alarm

By A. L. Gear

It was noticed in the operation of the switchboard for a zinc smelting company, that the switchboard operator could not tell when the oil circuit-breakers opened, although he was standing fairly close to the switchboard. The steam engineer for the power plant being the operator he could not always be directly in front of his switchboard. This board is composed of eight ebony-asbestos panels 3 ft. by 4 ft. and one inch thick, making the switchboard 24 ft. long. Counting from the left-hand panel facing the switchboard, Panel 1 is supplied from the city at 2,200 volts, panel 2 supplied by

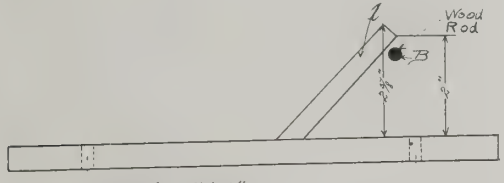


Fig. 1—Side View

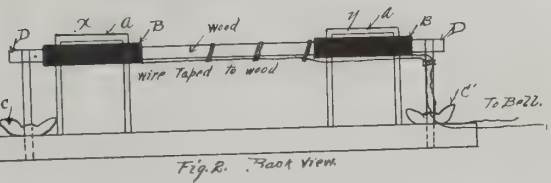


Fig. 2. Back View.

Generator No. 1, Panel 3 supplied by Generator No. 2, Panel 4 is an instrument panel including power-factor meter, city watt-hour meter, company's watt-hour meter and and Esterline graphic watt-hour meter. Panels 5-6-7 are the load panels, each having two circuits, with one ammeter to each circuit, and one Condit three-pole double-throw volt oil circuit-breaker for each three-phase circuit. The engineer complained to the electrician he could not tell when his circuit-breakers opened until some department operator came to the power house and complained he had no power at his motor. The electrician then wired up a signal bell which did not in any way mar the circuit-breakers or change in any way their construction, neither did it interfere with their operation.

Some of the circuit-breakers were "Condit" type LS; on thes the arrangement was as follows: One end of a No. 14 galvanized iron wire was formed into a hook or loop and fitted around the screw coming up through the slate base of the circuit-breaker, one wire for each of the two back screws, or screws furthest from the switchboard face. The other ends of each of these wires were also looped, forming eyes ¼ or ⅜ in. diameter. These loops were of such a height above the slate base that the metal operating mechanism f the circuit-breaker would strike a ¼ in. or ⅜ in. round wooden rod when passed through these loops as shown in Fig. 1. A is a metal portion of the operating mechanism, B the end of the round wooden rod. This rod is to be wrapped for a distance of from 1 in. to 1½ in. with bare copper wire and soldered forming a sleeve. This wrapped portion is directly behind the metal operating mechanism so that as the circuit-breaker opens, this metal operating mechanism drops back against the wire-wrapped portion of round wooden rod. Fig. 2. shows back view, showing both the wrapped portion of the rod and the operating mechanism, and both sides of circuit-breaker as it is a double throw breaker. Side X is open when side Y is closed, in fact the manufacturer has placed an automatic stop upon handle of circuit-breaker to prevent both sides being closed at the same time. To each portion of wrapped wooden rod is soldered one No. 18 annunciator wire later to be connected into the signal bell circuits.

On the "Condit" Type E circuit-breaker the arrangement of appartus is somewhat different. Here the contacts are carried on studs clamped to a bar which drops vertically to open the circuit. In order to preserve the same operating features, using wires making contact with wire wrapped rods, movable wires were clamped under the nuts of the outer contact studs. The wooden rod was held by clamps fastened to the framework of the circuit-breaker so that whenever a swith was open its wire made contact with the wrapping on the rod. The moveable wires of each double-throw switch were then connected by a flexible jumper.

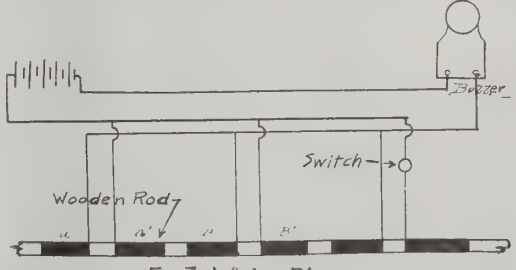


Fig. 3 - Wiring Diagram

The wiring of the bell circuit is as shown in Fig. 3, the wooden rod being so arranged that the portions A, A1; come opposite the projecting contact wires of one switch; B, B1 opposite another pair, and so on. Now one side of each switch is always open, and its wire in contact with the rod. If then the other side is tripped, the second wire will also make contact, and the alarm bell will ring.

To adapt this device to a single-throw switch, the contact-sections A, A1 would be placed close together, and a U-shaped wire would be fastened to the moving part of the

switch so that with the switch open the wire would bridge the contacts A, A1, and close the circuit.

If it is customary to leave some of the feeders open at times, a snap switch should be connected as shown in Fig. 3, to cut off the alarm. On other feeders, which are rarely left disconnected, the alarm can be cut off by inserting a piece of cardboard between the wires and the fixed contacts on the rod.

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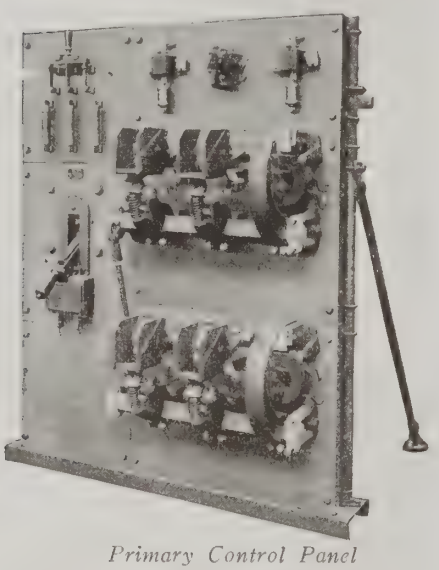
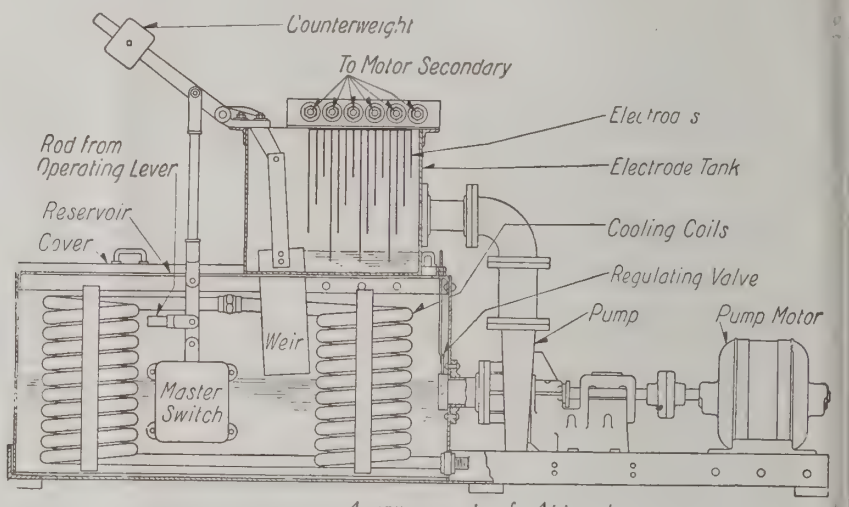
Liquid Rheostat Control for A. C. Motors

The extensive use of electric motor drive for mine haulages, hoists, dredges and similar applications, has brought to the fore the necessity for a controller for large wound-rotor induction motors which would give wide and accurate speed variation, positive time limit acceleration, and allow the motor to run at reduced speeds for long periods. To meet these conditions the Westinghouse Electric & Mfg. Company has designed the liquid type of control which is shown in the accompanying illustration. These controllers have been in successful operation in various applications for the last four years and have proven equal to the most severe requirements.



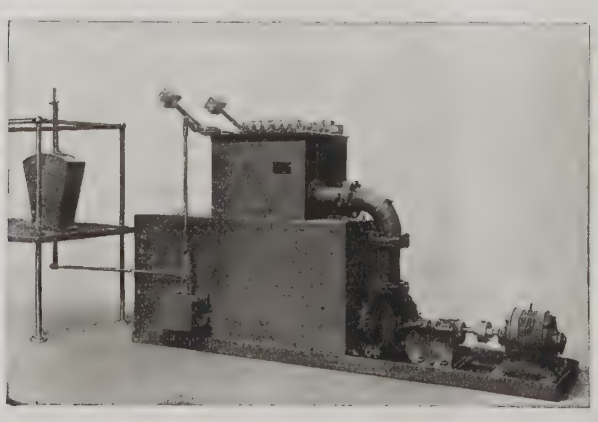
Primary Control Panel



Arrangement of Apparatus

A liquid controller consists essentially of a primary panel and a liquid rheostat. The primary panel is made up of mechanically interlocked magnetic contractors for starting, stopping and reversing the motor, oil circuit breakers which entirely disconnect the motor from the line in event of an overload, a fused knife switch for pump motor, and a low-voltage relay for the protection of operator and apparatus against voltage failure. The secondary control consists of a liquid rheostat complete with brass or wrought iron cooling coils for varying the resistance in the motor secondary, a pump and pump motor switch for the circulation of the electrolyte, and a master switch for the control of the equipment. For plugging service a single lever "H" slot device and two overload relays are used. These two relays are mounted on the primary panel and protect the motor from overloads when running, but are short-circuited when plugging the motor. When operating under these conditions the circuit breaker is set to protect the motor against exceptional overloads and short circuits on the motor, but too high to trip out in ordinary plugging service.

In the type of control shown the depth of the liquid, in which the electrodes are immersed, is varied. This principle insures smooth acceleration and close speed regulation of the motor as an infinite number of steps can be obtained by gradually varying the depth of the liquid. It eliminates objectionable jerks and sudden strains in both cable and equipment when starting loads of large inertia. The construction and operation of the control is so simple that even an inexperienced operator can obtain good results, and maintenance costs are low, since the electrodes are practically the only parts requiring renewal and these very infrequently. It is of especial value for heavy duty reversing service where starting is frequent and the motor is run at reduced speeds. It is furnished for any primary voltage and frequency and for either two or three phase.



Control Platform and Rheostat

As shown by the diagram, the three secondary phases of the motor are each connected to a set of electrodes suspended in the electrode tank. The operating lever is attached to an arm just above the master switch. When the lever is in the "off" position, the electrolyte, which is a solution of sodium carbonate (sal soda), is at its lowest level. When the operating lever is moved from the "off" position the contactors in the primary circuit are operated by the master switch and the weir raised. The electrolyte, which is circulated continuously by the pump, rises as the weir is raised. This immerses the electrodes more, decreases the resistance in the rotor circuit, and speeds up the motor. By adjusting the position of the weir the resistance in the rotor circuit is changed and the speed of the motor regulated.

A regulating valve in the pump discharge or intake pipe prevents the liquid from rising in the electrode tank at a rate greater than that for which the valve is adjusted. So the lever may be moved directly to the "full on" position while the liquid will raise at the rate determined by the valve setting. The weir, however, is of such a size and design that the electrolyte will flow through to the lower compartment speedily enough to take care of plugging when that is practiced.

For plugging service the single lever "H" slot device and the two overload relays afford a positive protection against the wrong operation of the lever. To prevent overtravel in hoist work either single or double pole hatchway limit switches can be furnished. When the hoists are used for lowering an overspeed device is desirable. Car limit switches form another means of protection, safeguarding against accidents due to carelessness on the part of the operator. These consist of a number of switches operated by means of cams mounted on a hexagonal shaft connected to the driving motor or the driven mechanism through a chain and sprocket, or through a worm gear.

✣ ✣ ✣

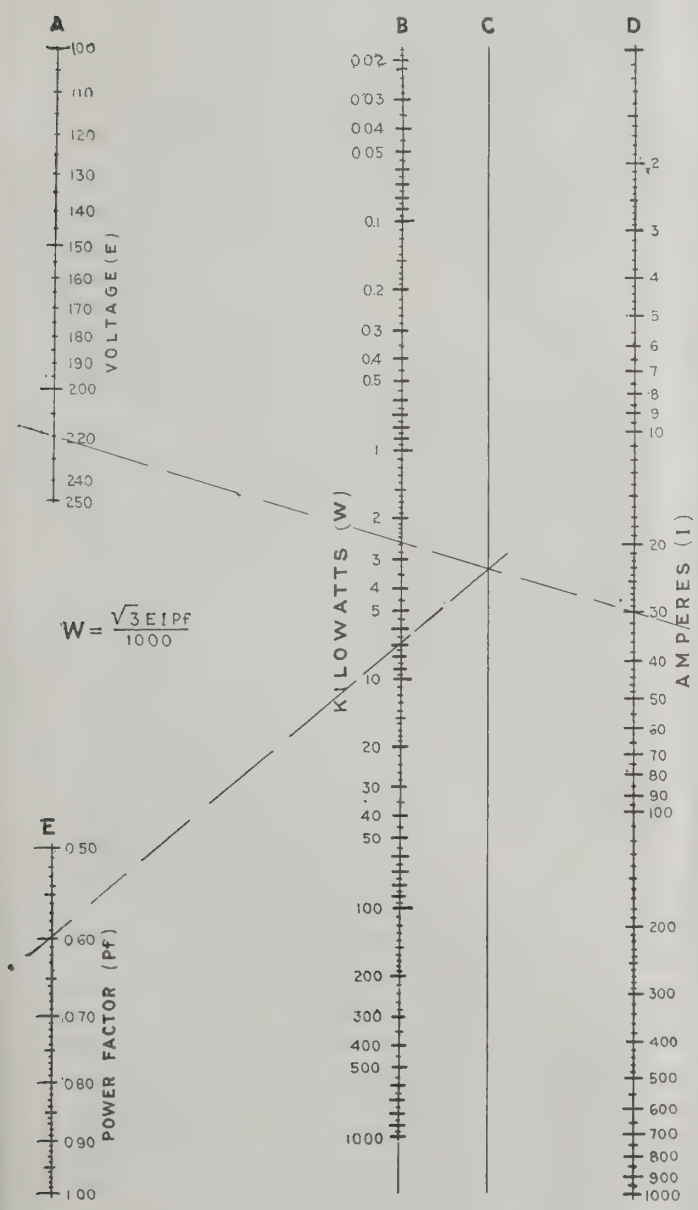
A Chart for Three-phase Power

One of the most frequently used formulas in electrical engineering is that for power in a three-phase circuit:

$$W = \frac{\sqrt{3}EIpf}{1000}$$

Where W = power in kilowatts
E = voltage between lines
I = current per phase
pf = power factor

The accompanying chart gives a ready means of finding any of the above quantities if the rest are known. Thus assume that we have 220 volts between lines; a current per line of 30 amp.; and power factor of 0.60. As shown on the chart draw a line from 220 on scale A to 30 on scale D; from the front where this line cuts line C draw a line to 0.60 scale E. At the intersection of the last line with Scale B, read 6.9 k.w. Actual calculation with a slide rules gives 6.86 which shows the accuracy which can be expected from this method.



It is often desirable to know roughly the current per conductor in a three-phase line carrying a given load. In this case draw a line from the power-factor scale through the proper point on the kilowatt scale to the C line; through this intersection and the proper point on the voltage scale draw a second line; where this cuts the ampere scale will be found the current flowing.

If the apparent power (kva) is wanted or given in place of the real power, that makes conditions the same as if the power-factor were unity. In the case the line from C to E intersects the E scale at 1.00.

When values of any of the quantities are too large for the scale, divide by some constant, and multiply the result by the same constant.

✣ ✣ ✣

Under Water 36 Hours

Three electric pumping motors supplying all the water used in the city of Rock Hill, S. C., were submerged during recent floods and remained under water for more than a day and a half. Yet when the water receded into the natural channel of the Catawba River the motors started up promptly when the current was applied and quickly dried themselves only a few hours after the flood had left their armatures. The use of a hose to wash the mud out of the motors and the removal of accumulations of sand and mud from the oiling system were the only precautions taken before starting up the motors. Deposits of mud completely stopped up the intake pipe of the pumps and it was necessary to lay a new pipe line to the river before the pumps were again started.

The Rock Hill pumping station is located five miles away from the city of Rock Hill. It is equipped with two G-E motor pumping outfits of 100 HP. each, and a third G-E motor outfit of 7½ HP. The motors are all controlled by the action of a self starter and two starting compensators. The pumps are operated without an engineer by simply closing an oil switch at the town end five miles away. The pumping station is inspected once a week. Power for the motors is supplied through a high tension line carrying current from the hydro-electric plant of the Southern Power Company at 11,000 volts. At the pumping station it is reduced to 550 volts, three-phase, and fed to the motors.

✣ ✣ ✣

Heating Molasses by Electricity

The Arkansas Valley Railway & Power Company, Pueblo, Colo., has called attention to a new use for electricity employed in the Arkansas Valley by farmers and stockmen. Manager Raber is quoted:

"A number of stockmen feeding mixed feed to stock have had trouble in winter with molasses freezing, and, after

thawing same out being unable to maintain one temperature so as to keep the molasses flowing.

"We overcame this through the use of 3600 watt, Immersion Heaters, installed in metal vats. Two vats were constructed; one 5 ft. x 5 ft. x 5 ft., another 4 ft. x 4 ft. x 5 ft., the smaller vat being placed in the larger vat. The smaller one contained the molasses and the larger one filled with water containing the heaters. To thaw the molasses out, all three heaters are put in use; to maintain one temperature one heater is used."

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A Portable Ice Plant

One of the most spectacular features of the New York Hippodrome is the ice-skating ballet. The freezing of this tank is a simple problem, as the pond remains frozen all the time, being covered by false flooring during the rest of the show. This year it was decided to put a second company on the road, and hence it was necessary to provide a portable refrigerating equipment which could be readily transported and set up where required.

As shown in the accompanying photograph the plant consists of a 10-ton York compressor driven by a 20-h.p. di-

rect-current motor. The two brine circulating pumps are driven by 3 h.p. motors. Where only alternating current is available, a motor-generator set is used for conversion. Direct-current as the final drive was selected on account of the desirability of varying the speed of the machinery and the fact that the total cost of electrical equipment was somewhat less by this arrangement. Westinghouse apparatus was used throughout.

Each unit is mounted on a skid, and the joints of the piping are such that they can be quickly broken and the whole outfit packed in a car for transportation. Two duplicate outfits are kept in service, and while one is with the show, the other is being shipped, erected, tested out and started at work freezing the pond. This is of canvas, 45 ft. long, 20 ft. wide, and 4 in. deep, and requires 24 hours to freeze.

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Flood Lighting Railroad Yards

The use of the flood light in railroad yards at night is a big stride, toward the goal of safe working conditions. The accompanying illustrations show the appearance of a terminal illuminated with Western Electric-Davis flood lamps and convey a good idea with which the track, frogs, switches, etc. are brought out.

It will be noted that the lamps do not throw out a defined and concentrated beam, but rather tend to spread the light uniformity over the section on which they are directed. The tall pole in the foreground is sixty feet in height, and the fact the the top is clearly visible illustrates the advantage of

the light bath with its soft, even illumination as opposed to the searchlight with its blinding effect.

When this system was demonstrated at the recent convention of the American Electric Railway Association at Atlantic City, the railroad men were enthusiastic in their praise of its virtues, and the feeling was prevalent that the flood lamp will be a necessary part of the equipment of the railroad of the future.

❖ ❖ ❖

Cost of Electric Cooking

A recent advertisement of the Minneapolis General Electric Company contains some statistics showing the actual cost of electricity in households of various sizes where cooking is done electrically. The figures are quoted:—

Number in Family	Average Monthly Bill
Family of three	$2.62
" " four	2.79
" " five	2.82
" " six	3.05
" " seven	4.46
" " eight	5.99

It will be remembered that the Minneapolis company in the spring of 1916 reduced its rates so that in the tertiary step all domestic customers secure electricity at a cost of 2½c (less 5% prompt payment discount) per kilowatt hour. As a result of this rate the amount of electric cooking business secured in Minneapolis during the Summer and Fall has been gratifying.

❖ ❖ ❖

Serving the Public

"The trouble with a great many of us in the business world is that we are thinking hardest of all about the dollars we want to make. Now that is the wrong idea right at the start.

"If people would go into business with the idea that they are going to serve the public and their employees as well as themselves, they would be assured of success from the very start. Everything with such a business enterprise would work toward its success and the money would come in without any worry on the part of anyone. The business man must make the public serve him in serving himself. By that I mean he must render the public a genuine service in selling it his products. The public is quick to get a sense of confidence but it is just as quick to lose it when there is cause. Just let a man take advantage of the public for his own selfish interest and see!"—Henry Ford in System.

Problems in Electric Practice

The how and why of generation, transmission, installation and construction.

Questions and Answers and Practical Discussions of Trade Affairs

Essentials of Direct Current Armature Winding

By T. Schutter

RMATURE winding is something that the average electrician has very little or no knowledge about, and almost every ctrician at some time or other is called upon to wind an ature.

There are a few simple rules and formulas which if followed ll make it possible for him to wind an armature and get the oper results.

There are two styles of direct current armature windings, mely, Lap or Parallel and Wave or Series windings.

Essential Data of an Armature

In stripping an armature the following data should be ken: number of coils on the armature, number of turns

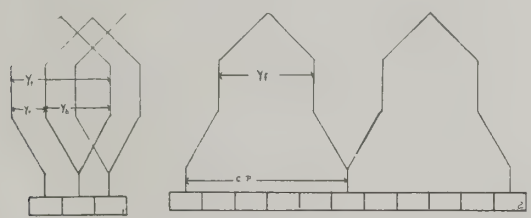


Fig. 1—Lap Winding *Fig. 2—Wave Winding*

r coil, size of wire, kind of insulation on the ire, the position of the leads from the coils the commutator bars, whether they connect straight out or ving to the right or to left and how many bars, and how many ots a coil spans. If the armature is lap wound the beginning id end of the same coil will be connected to adjacent commutator bars as shown in Fig. 1, and if the armature is wave ound the beginning and the end of the same coil will be a mber of commutator bars apart as shown in Fig. 2. To tell hether the winding is lap or wave, look at the armature from e side. If the leads from a group of conductors, bend toward ch other, as in Fig. 1, the armature is lap wound; if they nd away, as in Fig. 2, it is wave wound.

If an electrician or an armature winder were given an armare to wind with the following data, Coils 16, Poles 2, one coil r slot, he would proceed as follows: The first step is to find e pitch or spread of a coil by using this formula:

$$Y_f = \frac{2C \pm A}{P} \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

here Y_f is the forward pitch or spread, that is the distance in winding spaces from one side of the coil to the other;

C is the number of coils.

A is the number of armature circuits.

P is the number of poles.

The number of winding spaces per slot depends on the numer of slots in the armature and the number of coils to be laced. Coils times 2 = the number of winding spaces,

$$\frac{\text{winding spaces}}{\text{Number of slots}} = \text{number of windings per slot.}$$

To find the slots needed for a given number of coils with a given number of coils per slot,

$$\frac{\text{Coils} \times 2}{\text{Number of coils per slot}} = \text{number of slots necessary.}$$

When the first coil of a winding has been placed, to find the starting point of the second coil use this formula:

$$Y_b = Y_f - Y_r \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

where $Y_b = Y_f \pm Y_r$, Y_b is the backward pitch, Y_r the resultant pitch which is the distance between the beginning of any two adjacent coils and is always two winding spaces. In using the minus value of Y_r in the formula it is called a right hand winding, because the beginning of the second coil will be to the right of the beginning of the first coil; if the plus value of Y_r is used it will be called a left hand winding because the beginning of the second coil will be to the left of the beginning of the first coil as shown in Fig. 3.

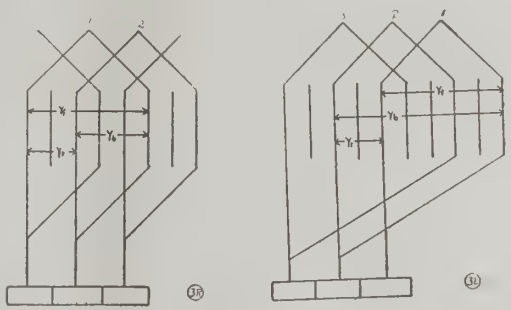


Fig. 3—Right Hand Winding. *Left Hand Winding*

In a lap wound armature there must always be as many brushes as there are poles, while in a wave wound armature there are only two brushes needed regardless of the number of poles. Wave wound armatures are seldom used in machines with more than 6 or 8 poles, and never with less than 4 poles. The reason for this will be explained later.

From the above it will be seen that in lap windings there are as many circuits through the winding as there are poles or brushes (two circuits for each pair of brushes). In wave windings there will be but two circuits since there are but two brushes used. By using the above rules and formulas the following winding will be worked out, using the above mentioned problem.

A Typical Case

The first step is to find the pitch or spread of a coil by formula (1), $Y_f = \frac{2C \pm A}{P}$. There are 16 coils to be placed; then $C = 16$.

There are to be two poles; then $P = 2$. In a lap winding there will be as many brushes as poles; then there will be two paths through the winding and $A = 2$. Applying these figures to the formula, $\frac{2 \times 16 \pm 2}{2} = \frac{34 \text{ or } 30}{2} = 17$ or 15 winding spaces will be the pitch or spread of the coil. By using Y_f as 17 or 15 the same results will be obtained. Take Y_f as 15 in this problem. Y_b is found by $Y_r \pm Y_r$ or $15 \pm 2 = 13$ or 17. As previously explained by using Y_b as 13 it will be a right hand winding and Y_b as 17 will make it a left hand winding.

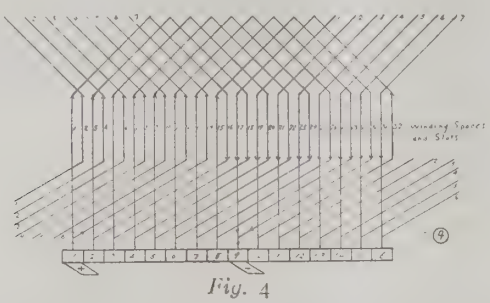


Fig. 4

In this winding there will be one coil per slot, so the number of slots required will be $\frac{\text{Coils} \times 2}{\text{Number of coil per slot}} = \frac{16 \times 2}{1} =$ 32 slots. By using the following values of $Y_f = 15$, $Y_b = 13$, the winding diagram in Fig. 4 was constructed.

Winding Table I will give the number of the winding space and the slot that each coil is wound into.

Winding Table No. 1

Coil	1,	wound	bet.	winding	spaces	1	and	16,	in slots 1 and 16
Coil	2,	wound	bet.	winding	spaces	3	and	18,	in slots 3 and 18
Coil	3,	wound	bet.	winding	spaces	5	and	20,	in slots 5 and 20
Coil	4,	wound	bet.	winding	spaces	7	and	22,	in slots 7 and 22
Coil	5,	wound	bet.	winding	spaces	9	and	24,	in slots 9 and 24
Coil	6,	wound	bet.	winding	spaces	11	and	26,	in slots 11 and 26
Coil	7,	wound	bet.	winding	spaces	13	and	28,	in slots 13 and 28
Coil	8,	wound	bet.	winding	spaces	15	and	30,	in slots 15 and 30
Coil	9,	wound	bet.	winding	spaces	17	and	32,	in slots 17 and 32
Coil	10,	wound	bet.	winding	spaces	19	and	2,	in slots 19 and 2
Coil	11,	wound	bet.	winding	spaces	21	and	4,	in slots 21 and 4
Coil	12,	wound	bet.	winding	spaces	23	and	6,	in slots 23 and 6
Coil	13,	wound	bet.	winding	spaces	25	and	8,	in slots 25 and 8
Coil	14,	wound	bet.	winding	spaces	27	and	10,	in slots 27 and 10
Coil	15,	wound	bet.	winding	spaces	29	and	12,	in slots 29 and 12
Coil	16,	wound	bet.	winding	spaces	31	and	14,	in slots 31 and 14

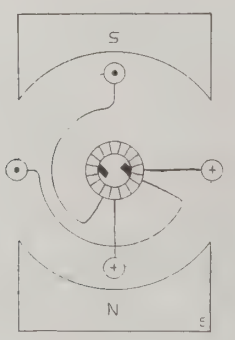


Fig. 5

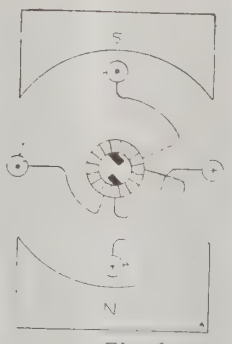


Fig. 6

Before a winder can connect the coils to the commutator bars (which will be the same in number as the number of coils to be connected) he must know how the brushes are set, that is centered between the pole tips or opposite the center of the pole piece; the reason for this is that the coils must be commutated, that is, short circuited while they are in a neutral position. The rule for this is that when the brushes are centered between pole tips the beginning lead of each coil must be connected to the bar opposite the slot in which the beginning of the coil is located. When the brushes are set opposite the center of the pole, the beginning lead of each coil is swung 90 electrical degrees to the right or left, this will cause the coils to be short circuited when they are in the neutral position, as shown in Figs. 5 and 6. The formula for finding the number of commutator bars which equal 90 electrical degrees is $\frac{\text{Number of commutator bars}}{\text{Number of poles} \times 2}$ should this result in a mixed number, increase it to the next higher number, for instance 6½ will be made 7, 8¼ will be made 9, etc.

The table for the connections is as follows when the brushes are set centered between pole tips.

Connecting Table No. 1

Coil	No.	1,	Beginning	to	Bar	No.	1,	End to Bar	No. 2
Coil	No.	2,	Beginning	to	Bar	No.	2,	End to Bar	No. 3
Coil	No.	3,	Beginning	to	Bar	No.	3,	End to Bar	No. 4
Coil	No.	4,	Beginning	to	Bar	No.	4,	End to Bar	No. 5
Coil	No.	5,	Beginning	to	Bar	No.	5,	End to Bar	No. 6
Coil	No.	6,	Beginning	to	Bar	No.	6,	End to Bar	No. 7
Coil	No.	7,	Beginning	to	Bar	No.	7,	End to Bar	No. 8
Coil	No.	8,	Beginning	to	Bar	No.	8,	End to Bar	No. 9
Coil	No.	9,	Beginning	to	Bar	No.	9,	End to Bar	No. 10
Coil	No.	10,	Beginning	to	Bar	No.	10,	End to Bar	No. 11
Coil	No.	11,	Beginning	to	Bar	No.	11,	End to Bar	No. 12
Coil	No.	12,	Beginning	to	Bar	No.	12,	End to Bar	No. 13
Coil	No.	13,	Beginning	to	Bar	No.	13,	End to Bar	No. 14
Coil	No.	14,	Beginning	to	Bar	No.	14,	End to Bar	No. 15
Coil	No.	15,	Beginning	to	Bar	No.	15,	End to Bar	No. 16
Coil	No.	16,	Beginning	to	Bar	No.	16,	End to Bar	No. 1

There will be two brushes and the spacing or the distance in commutator bars from the heel of one to the heel of the other is found by dividing the total number of bars by the number of poles. The first brush will be set on bar 1 and the other on bar 9, as found by the formula: $\frac{16}{2} = 8$.

Assuming that this is the armature of a motor, the current would enter the winding through the positive brush and leave through the negative. By following the arrows which indicate the flow of current, it will be seen that coils 1 to 8 are in series in one circuit and coils 16 and 9 are in series in the other

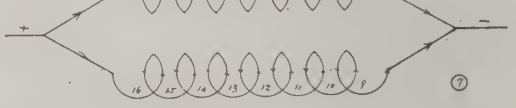


Fig. 7

circuit. Figure 7 is a graphical illustration of the two circuits through the winding. The winding just described is known as a one-layer simplex lap winding, because there is one coil per slot and one wire in hand while winding.

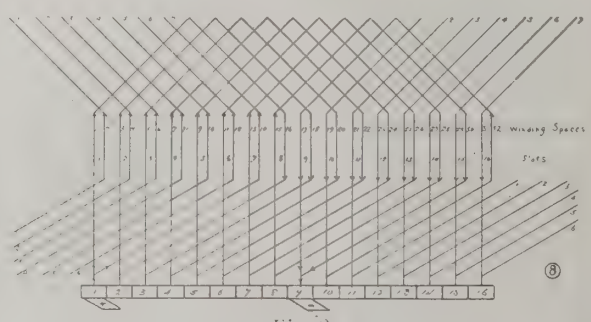


Fig. 8

Fig. 8 is the same winding shown as a two-layer or two coil per slot winding also of the simplex type. Y_f and Y_b will have the same value as in Fig. 4 that is 15 and 13 respectively. The number of the coils and the winding spaces and the number of the slot into which they are wound is shown in winding table No. 2.

Winding Table No. 2

Coil 1,	wound bet. winding spaces	1	and	16, in slots	1 and 8
Coil 2,	wound bet. winding spaces	3	and	18, in slots	2 and 9
Coil 3,	wound bet. winding spaces	5	and	20, in slots	3 and 10
Coil 4,	wound bet. winding spaces	7	and	22, in slots	4 and 11
Coil 5,	wound bet. winding spaces	9	and	24, in slots	5 and 12
Coil 6,	wound bet. winding spaces	11	and	26, in slots	6 and 13
Coil 7,	wound bet. winding spaces	13	and	28, in slots	7 and 14
Coil 8,	wound bet. winding spaces	15	and	30, in slots	8 and 15
Coil 9,	wound bet. winding spaces	17	and	32, in slots	9 and 16
Coil 10,	wound bet. winding spaces	19	and	2, in slots	10 and 1
Coil 11,	wound bet. winding spaces	21	and	4, in slots	11 and 2
Coil 12,	wound bet. winding spaces	23	and	6, in slots	12 and 3
Coil 13,	wound bet. winding spaces	25	and	8, in slots	13 and 4
Coil 14,	wound bet. winding spaces	27	and	10, in slots	14 and 5
Coil 15,	wound bet. winding spaces	29	and	12, in slots	15 and 6
Coil 16,	wound bet. winding spaces	31	and	14, in slots	16 and 7

The connecting table, spacing of brushes, the tracing of current and the graphical illustration will remain the same as for the first problem.

In figures No. 4 and 8 it will be seen that the pitch of the coils is approximately one-half of the circumference of the armature, these being two pole windings that will bring one side of a coil under a north and the other side of the coil under a south pole. In considering four pole windings the same thing must be kept in mind, about having one side of a coil under a north and the other side under a south pole. The application of the formula for finding Y_1 will always take care of that.

(To be continued)

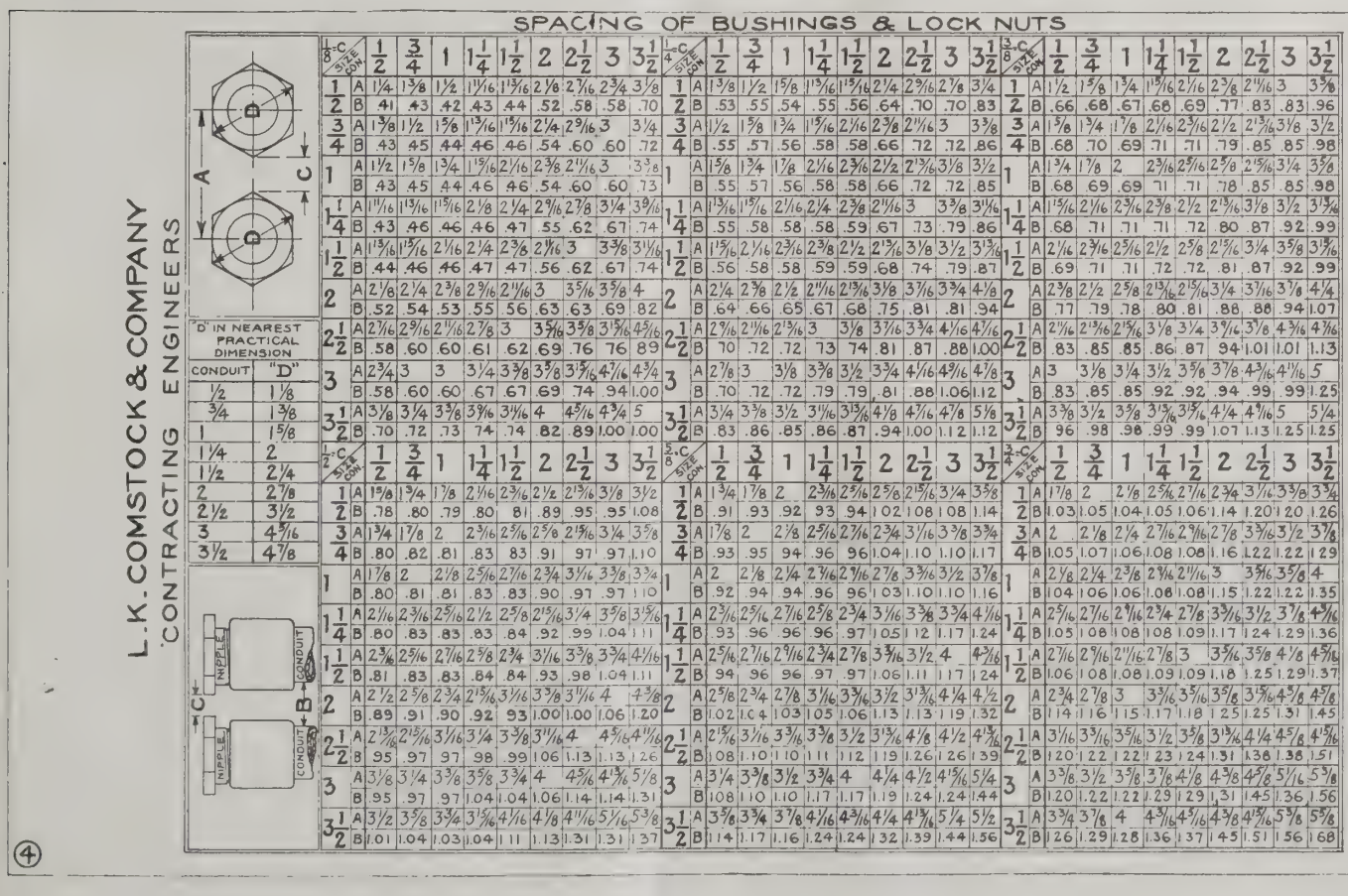
Conduit Spacing

By Benjamin Gross

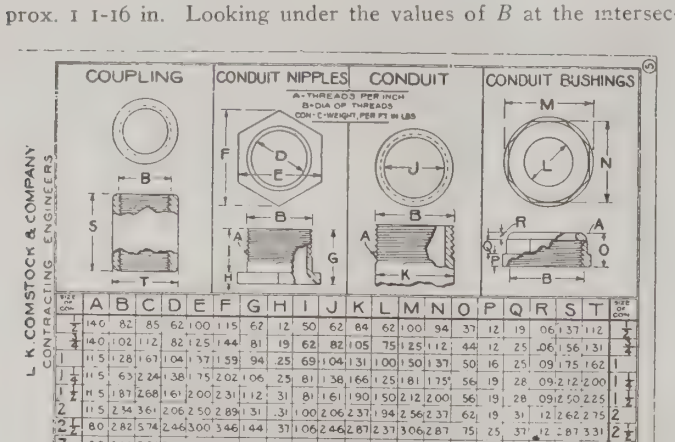
The neat arrangement of conduits at pull and junction boxes, cutout and panel boxes, switchboards, and in many other places where conduits are grouped depends upon the spacing allowed between the clearance holes in such boxes and the space allowed between pipes. Fig. 1 gives a series of tables from which the required center distance between holes can be easily and accurately determined, assuming only the space desired between adjacent conduits, the sizes of which are known. The small table at the left hand end gives the maximum outline of the locknuts, and Fig. 2 gives the dimensions of conduits, couplings, chase nipples and bushings, both inside and outside in each case, all being standard trade sizes.

Use of Tables

These tables are used as follows: The two details, above and below the small table at the left show the two conditions for which the tables supply data. The upper one, or plan view, gives the dimension *C* or the clearance between the maximum outline of the locknuts. The dimension *C* is taken at a minimum of ⅛ in. in these tables and is varied by eighths up to ¾ in., as can be seen in the triangular space at the upper left hand corner of each section. $C = ⅛$ in. is recommended as a minimum. Less than this is beyond proper working conditions. *A* in the plan view gives the distance between centers of pipes and appears in the upper row of each horizontal index of every conduit size and section. The lower, or elevation, also shows *C*, the clearance between locknuts, but in addition, the dimension *B* or the distance between the face of pipes for any value of *A* and *C*. This dimension *B* is found in the lower row of each horizontal index under every conduit size and section. Now let us assume it be desired to locate say eight ½ in. conduits in a minimum space on one line, terminating their in a box. Under the upper left hand section we find $C = ⅛$, and taking the figure one line *A* at the intersection of the vertical and horizontal ½ in. conduit size we get $A = 1.25$ in. For eight pipes in a row we have 7 spaces or 8.75 in. At the ends we should have as much space as between locknuts, hence by adding two more spaces or 0.25 in. we get 9.125 in. for the inside width of the box. The resulting space between pipes, $B = 0.41$ or approximately 13-32 in. Let us now assume that 1¼ conduits is to be placed on center with and adjacent to a 2 in. pipe, and further that we are not cramped for space, we would then allow say ⅜ in. between locknuts. Using the upper right hand table in which $C = ⅜$, we find on the intersection of the 2 in. and 1¼ in. columns taking either on the vertical that $A = 2$ 13-16 and that the resultant space between conduit surfaces is 0.80 in. or approximately 13-16 in.



Another case is of useful purpose. Say it be necessary to so install the 2 in. and 1.25 in. conduits to a box that a ¾ in. conduit pass between them at right angles somewhere near the box and the larger pipes may not be bent out of the way. Fig. 2 gives as the outside diameter of ¾ in. conduit $K = 1.05$ or approx. 1 1-16 in. Looking under the values of B at the intersec-



SIZE	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	SIZE OF CONDUIT
¼	1.40	.82	.85	.62	1.00	1.15	.62	.12	.50	.62	.84	.62	1.00	.94	.37	.12	.19	.06	1.37	1.12	¼
⅜	1.40	1.02	1.12	.82	1.25	1.44	.81	.19	.62	.82	1.05	.75	1.25	1.12	.44	.12	.25	.06	1.56	1.31	⅜
½	1.15	1.28	1.67	1.04	1.37	1.59	.94	.25	.69	1.04	1.31	1.00	1.50	1.37	.50	.16	.25	.09	1.75	1.62	½
¾	1.15	.63	2.24	1.38	1.75	2.02	1.06	.25	.81	1.38	1.66	1.25	1.81	1.75	.56	.19	.28	.09	2.12	2.00	¾
1	1.15	1.87	2.68	1.61	2.00	2.31	1.12	.31	.81	1.61	1.90	1.50	2.12	2.00	.56	.19	.28	.09	2.50	2.25	1
1¼	1.15	2.34	3.61	2.06	2.50	2.89	1.31	.31	1.00	2.06	2.37	1.94	2.56	2.37	.62	.19	.31	.12	2.62	2.75	1¼
1½	1.80	2.82	5.74	2.46	3.00	3.46	1.44	.37	1.06	2.46	2.87	2.37	3.06	2.87	.75	.25	.37	.12	2.87	3.31	1½
2	1.80	3.44	7.54	3.06	3.75	4.33	1.50	.37	1.12	3.06	3.50	2.87	3.75	3.50	.81	.25	.37	.19	3.06	3.93	2
2½	1.80	3.94	9.00	3.54	4.25	4.91	1.62	.44	1.19	3.54	4.00	3.25	4.25	4.00	1.00	.37	.44	.19	3.62	4.43	2½

Fig. 2

tions of 1¼ in. and 2 in. columns we find in the lower middle one $B = 1.05$ in. This would be a tight fit, so the next section is chosen where $C = ⅜$, $B = 1.17$ and A — the distance required between the 2 in. and 1¼ in. conduits, is 3 3-16 in. Where the crossing conduit be of such size or the required clearance between pipes be greater than covered in the tables, the spacing of centers can readily be determined by taking any particular section value of B, deduct it from the clearance required, and add that difference to A. The resultant is the center spacing. Thus, say the clearance required in this case is for a 2 in. pipe. Fig. 2 gives $K = 2.37$. Any table, say the lower left hand one gives $B = .92$ and $A = 2$ 15-16 in., $K - B = 2.47 - .92 = 1.45 =$ 1 15-16 in. approximately. This remainder plus 2 15-16 and allowing a little extra clearance gives the spacing of centers as 4⅝ in. With a little thought these tables can be used for every possible combination and arrangement or conduits, special cases being laid out to full size scale from the dimensions given. Of course simple arrangements are the rule in 99 out of every 100 cases, and consequently the table of Fig. 1 will be found a great time-saver and the use thereof means better and neater conduit jobs. It is recommeded that drilling data sheets be always made up giving the desired spacing between centers, as the shopman otherwise uses his own discretion, often very poor, as to the spacing and arrangement desired, thus resulting in ugly looking pipe jobs, and sometimes the necessity of reaming holes so as to get the conduits with their locknuts and bushings into place. All box manufacturers supply drilling data sheets easily adjusted to this purpose.

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Trans-Pacific Commnnication Established

On Nov. 15 by the exchange of congratulatory messages between the President of the U. S. and the Emperor of Japan, communication by radio-telegraphy was established across the Pacific Ocean. This completes one more link in the project of girdling the globe by a chain of radio stations in which the Marconi Wireless Telegraph Company has a large part. Stations now are in operation at New Brunswick and Belmar, N. J., to work with stations in England; at Marion and Chatham, Mass., to work with Narbo and Stavanger, Norway, and at Bolinas and Marshall, Cal., to work with Kahuku and Koko Head, in the Hawaiian Islands. The Japanese station, at Funabashi, was built by the Japanese Government.

Each of the Hawiian stations has two aerials and it is possible to receive with one while sending with the other. Messages between the Marconi stations are transcribed on a perforated tape, transmitted by an electrically operated key, and recorded on a dictaphone at the receiving end. The records are then run off at lower speed and typed. Business with the Japanese station is handled in the usual manual way.

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A Home-Made Tester

An interesting feature of one of the exhibits at the recent New York Electrical Show was a device which showed the comparative starting current and torque of single-phase motors of the split-phase and repulsion types. As will be seen from Fig. 1, this consisted of a box in which were mounted a spring-balance and an ingeniously constructed ammeter. A motor of each type of the same rating was placed under the spring-balance. A hole was drilled in each pulley and a stout hook was inserted so as to form a lever-arm of the same length for each motor. By changing the hook of the spring-balance from one

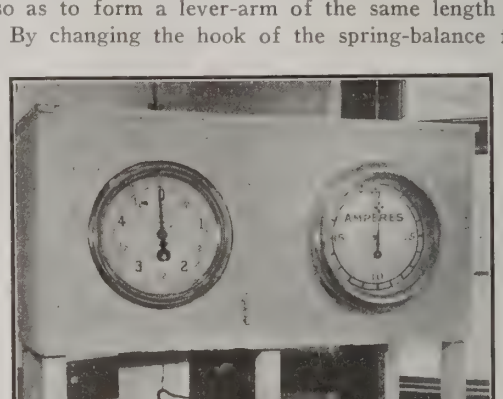

Fig. 1—The Tester Ready for Use

to another and operating a double-throw switch, either motor could be placed on test. Approximate results were:

Split-phase motor, 17 amp.; 1.5 lb. pull.

Repulsion motor, 8 amp.; 6.5 lb. pull.

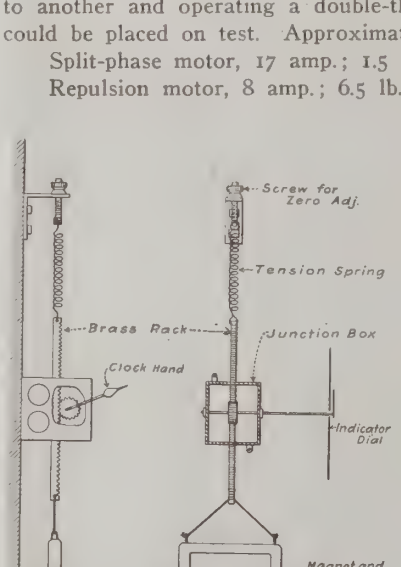

Fig. 2—Elevation

Reference to Fig. 2 shows how the ammeter was constructed. According to Mr. James Larkin, the manufacturer's salesman, who designed the appartus, it was impracticable to secure a suitable ammeter of the usual type in the time available. So the series solenoid of an arc lamp was secured from the United Electric Light & Power Company, a rack and pinion from a dealer in machinists' supplies, and the other parts from various sources. The apparatus was mounted on a board, the guides for the rack and pinion being holes drilled and filed in a junction box. A spring was selected of a size to give the desired range of current values, and when the apparatus was assembled the meter was calibrated by a standard portable meter loaned by the Light Company. The ring holding the cover glass in place was picked up in a junk shop it having been part of an automobile headlight.

Short Cuts and Minor Methods

What have you done this month that looks new to you? Pass the hunch along to the other fellow who may need it. There's money as well as satisfaction in it for you.

Helps For The Man Who Works Alone

A short-cut for "fishing" is to connect two dry batteries in series with a bell, and the other side of bell to a bunch of copper wire or wire gauze placed in the hole which snake is to reach. When the head of the snake has "arrived" is will touch the wire or gauze and cause the bell to ring. This idea is very useful for an electrician who has to do "fishing" alone.

To find location of hole to be bored in the floor above, a large magnetic file can be driven into ceiling below, and its location "picked up" by taking a small compass and passing it over the floor. The needle will be violently agitated when it is just above the file.

If two dry-cells taped together are connected by 20 ft. of flexible cord to a miniature tubular lamp, you have a very useful method of exploring partitions and floors. In fishing partitions, if the lamp is let down inside the wall at the same time as the fishing cord, it is easier to locate the latter.

W. R. Linz, New York City.

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Water For Drilling Concrete Floor

When boring into concrete floors I have found to use water is a great assistance. Fore instance if a dry hole is made the dust has to be got out, which is a great trouble with a small hole, whereas if water is used the water turns dust to a paste which works into grooves of star drill, enabling person to bring dirt up with ease. W. R. Linz.

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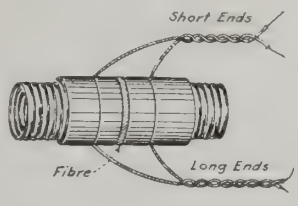
Connections For a Handy Testing Outfit

A very handy and durable testing outfit can be made with two electric light sockets, about 15 feet of No. 18 B & S gauge twisted lamp wire (stranded) and some tape. The metal sheathing is removed from the sockets before connecting together, as it is not needed and might probably cause an annoying short circuit by chafing the wire. Cut off about a foot of the wire. Connect an end of the longer piece of wire to one binding post on each socket and to the other binding post of each socket connect an end of the shorter length of wire. When the wires are connected the two sockets are placed together end to end with a piece of fibre or other insulator between them as in the diagram.



The insulating lining is taken out of the metal sheath and after being placed over the sockets the whole outfit is taped over to make secure and firm. The reason for using two lamps is so as to be able to use them on either 110 or 220 volt circuits. In using them the ends of the long wires are hooked on to the switch clips and the light can be taken to where the trouble is located. Or with the short ends joined together a handy portable light can be made. A useful addition to these testing lamps can be made with a pair of spring clip clothes pins. The tips of the clips are covered with metal and the ends of the long wire soldered to them making a pair of handy clips for hooking to the switch with. The drawback to these however, is that with rough wear they are liable to break off: Keyless sockets are the best to use in making the testing outfit, but if key sockets are used, the keys are first turned on and the projecting part of the key is cut off.

Arthur G. Canfield, New York City.

Questions and Answers

Ratio of Voltages on a Rotary Converter

Q. On a 3-phase rotary converter the alternating current input per terminal equals 0.943 times the direct-current output, and on a 6-phase double-delta converter the ratio is 0.472. How are these ratios derived?

A. Assume for convenience a two-pole converter with a winding uniformly distributed over the face of the rotor. The d. c. brushes would make contact with coils at diametrically opposite points of the winding so that the d.c. voltage would be represented by the length of the diameter. Now if the machine is connected for 3-phase operation there will be three taps spaced equally around the windings, leading to the three slip-rings, and the maximum voltage across any phase will be represented by the chord of the circle drawn between the tap-points. Each of these chords is one side of an equilateral triangle inscribed in a circle, so that by geometry, the ratio $\frac{\text{chord}}{\text{diameter}} = \frac{\sqrt{3}}{2}$. But the length of the chord = a.c. maximum voltage = $\sqrt{2} \times$ a.c. effective voltage, or $\sqrt{2}E_a$ while the diameter = d.c. voltage or E_d. We have then

$$\frac{\sqrt{2}\,E_a}{E_d} = \frac{\sqrt{3}}{2} \text{ or } E_a = \frac{\sqrt{3}\,\sqrt{2}}{4} E_d \quad \ldots\ldots\ldots (1)$$

Assuming further that the converter has 100 percent. efficiency, the power output is equal to the input, or $\sqrt{3}\,E_a\,I_a = E_d\,I_d$ (2) where I represents the amperes per terminal, the subscripts indicating whether a.c. or d.c Substituting in (2) for E_a, and reducing we have

$$\frac{3}{4}\sqrt{2}\,I_a = I_d, \text{ or } \frac{I_a}{I_d} = 0.93.$$

Considering now the six-phase converter, it will be evident from an inspection of one of these machines that on a two-pole model the a.c. taps will be taken off at six points equidistant around the armature, or at the corners of a hexagon, inscribed in a circle of which the d.c. brushes mark a diameter.

The ratio $\frac{\text{chord}}{\text{diameter}} = \frac{1}{2}$ in this case, and as before we substitute, chord = $\sqrt{2}\,E_a$, diameter = E_d; hence

$$\frac{\sqrt{2}}{E_d} E_a = \frac{1}{2}, \text{ or } E_a = \frac{1}{4}\sqrt{2}\,E_d \quad \ldots\ldots\ldots\ldots\ldots (3)$$

In a 6-phase delta-connected system the power is $6\,E_a\,I_a$ where E_a is the voltage between adjacent lines and I_a is the current per line. Assuming 100 percent. efficiency as before, we have $6\,E_a\,I_a = E_d\,I_d$ ..... (4)
Substituting from (3) in (4), we have

$$2.122\,I_a = I_d$$

$$\frac{I_a}{I_a} = \frac{1}{2.122} = 0.472$$

W. K. J.

Note—A 2-pole machine was assumed because in it electrical degrees correspond to mechanical degrees.—Ed.

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Standard Wiring Diagrams

For the benefit of new subscribers since last month, we reprint the first four of Standard Wiring Diagrams on the following page. Sections 5 to 8 inclusive appear on page 44; these cover three- and four-way switch combinations for multi-point control. It must be remembered that in all the diagrams shown in Sections 6, 7 and 8, only one side of the circuit is opened. These circuits therefore cannot be used where the National Electric Code requires both sides to be opened, as for instance with motors and devices consuming more than 660 watts.

—CONVENTIONS—

Wires always alive

Wires alive with Switch as shown

All other Wires

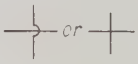
Switch Blade


Single Contact Push Button


Double Contact Push Button


Open Circuit Battery


Tap of one Wire onto another



Jump of one Wire over another


Bell or Buzzer


Single Pole Snap Switch (off)


Single Pole Snap Switch (on)


Double Pole Snap Switch (on)

1

—CONVENTIONS—


Double Pole Snap Switch (off)

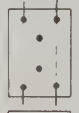

3-Way Snap Switch Position 1


3-Way Snap Switch Position 2


4-Way Snap Switch Position 1


4-Way Snap Switch Position 2


White button always on top
Single Pole Push Button Flush Switch


Double Pole Push Button Flush Switch


Bridge
3-Way Push Button Flush Switch
Both white or both black

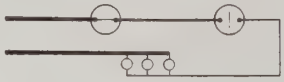

4-Way Push Button Flush Switch

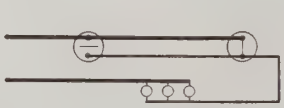

1-2-3 Off and on Electrolier Switches are all special, see mfrs catalogs

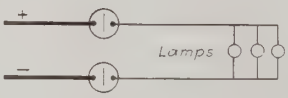
2

—SINGLE POLE SWITCH CONNECTIONS—

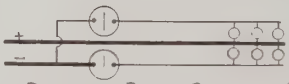
Single pole snap switch (on) Common single pole switching


Two single-pole switches in series


Lamps may be turned on at either switch but both switches must be open to extinguish them.



Single pole snap switches to open each side of the line


Single pole switching using one wire as a common return

—DOUBLE POLE SWITCH CONNECTIONS—


A double pole snap switch reverses the polarity of the wires after the current flows thru the switch

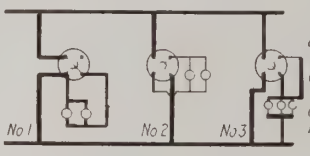

How to connect double pole switches parallel


How to connect double pole switches in series

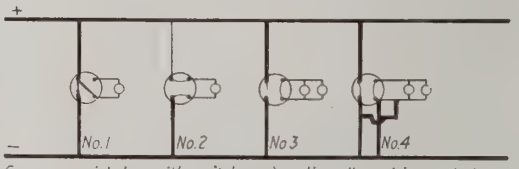
The proper way to install double pole snap switches when they are to control battering charging sets or other devices where proper polarity is essential

3

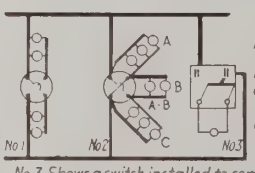
—DOUBLE POLE SWITCH CONNECTONS—
(CONTINUED)



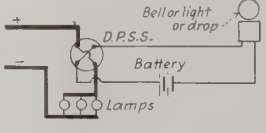
Common mistakes with double pole switching
No.1 Switch will open only one side of line.
No. 2 and 3 Switch when closed will short circuit line



Common mistakes with switches when the attempt is made to use 3-way and 4-way switches as double pole
No.1-3-way as double pole will not work.
No 2-4-way as double pole will short-circuit the line as shown in No.3
No.4 If the wires are connected as to a 4-way switch, the switch when turned will not turn the lamps out but will simply reverse the direction of the current thru them



Different ways to connect double pole switches
No.1 Shows a way to save wire or how to control two circuits with one switch
No. 2 Shows how a circuit controlled by a double pole snap switch may be divided. A B & C are in series when switch is off.
No.3 Shows a switch installed to comply with the Code Rule so that gravity will tend to open rather than close the switch also complies with the suggestion made by the Code, that all knife switches be wired so blades will be dead when open..



Shows how one double pole snap switch may be used to control two circuits. This will not be approved by the Code.

4

Commercial

Business Practice and Methods of Central Stations, Contractors and Manufacturers

Working Through the Children

By H. A. Lemmon

Human interest that works through love of children turned the trick when a carefully planned campaign had failed.

To paraphrase a well-known fiction philosopher "a man never knows just how a woman's mind is going to work until it's too late to do him any good." The new sales manager believed he was an exception until bitter disappointment and quite a bit of his company's money finally reduced him to a proper state of humility.

He had purchased a hundred toasters, which he proposed to unload in a very short time, to prove his theories. Having fifteen thousand people in his home town to sell them to the task seemed trivial. With more faith in himself than subsequent events seem to have justified, he had no hesitation in boasting that he would dispose of them all by printed advertising only—that he would bring the buyers into the company's office.

The newspaper campaign was prepared with considerable care. Attractive pictures were depended upon to catch the eye and they were followed by arguments so conclusive, to their author, that he seriously considered another hundred toasters to care for the riot of sales which he was confident would ensue.

"The trouble with advertising generally is that it has no appeal to women," he said impressively to his defenseless sales force of two. "The average man treats them as though they were children. Naturally this attitude is resented. Let an advertising campaign be staged which appeals to the intelligence of womankind and it will be successful."

So his advertisements not alone stated that electric toasters made better toast, but told why. They related how the very best toast would deteriorate if carried up-stairs to the sick-room, and gave the reason; explained that toast-making is not the simple hit-or-miss operation generally supposed—and proved it; told why toast must be crisp to be palatable and digestible; how it was at all times within the power of the operator of an electric toaster to vary the product to suit the individual taste, and told just why the very best toast could be made in no position save vertical. All through were interspersed such expressions as "golden brown," "crunchy," "dainty crispness," etc.

A Letter to Women Customers

To a select list, in addition to the newspaper advertising, went first a personally signed letter about as follows:

Dear Mrs. Brown:

You can take a lid off the kitchen range and, by holding a slice of bread on a fork near the fire, make good toast—if the fire is just right. It it is too hot your toast will be soggy in the center, and if is is not hot enough it will simply dry out; but long experience will teach you so that you will know when the fire is just right.

Of course you may toast yourself at the same time you toast the bread, but a little ingenuity will overcome that; gloves will protect your hands, and you can hold a newspaper in front of your face. It is true that you finish but one slice at a time and may become discouraged because the family devours it as fast as you toast it. You are unable to sit with them at the table but this cannot well be avoided for, as you know, toast made in advance is not real toast. You also know that toast made on top of the stove or in the oven is not real toast either—that toast, simple as it seems, is one of the most difficult things to make properly.

There is another way—the electrical way.

You sit at the table and enjoy the meal with your family; your toaster before you, and make it—two slices at a time—just as it is used. Delicious, golden brown, crisp, perfect toast—better than you have ever tasted unless you have experienced the delights of electrically-made toast. The slices must stand upright to make perfect toast—there is a scientific reason.

Next to the electric toaster the best way is to take the lid off the kitchen stove.

Which do you prefer?

Yours truly,
Sales Manager.

The sales manager was very proud of this letter, more so when the publicity bureau of the manufacturer wrote complimenting him highly and secured permission to use it in the "canned" campaigns supplied, all ready for use, to dealers and others who might not care to plan their own assault on the public.

This was followed in a few days by another, offering to send a toaster on ten days free trial, and accompanied by a coupon for ten cents to apply on the next light bill. This amount, the coupon stated, would more than pay for the current consumed, and thus is served to emphasize the inexpensiveness of operation. If at the end of the trial period the lady of the house wished to keep the toaster she would fill out still another coupon which entitled her to an additional forty cents discount on her lighting bill, making a toaster actually cost three dollars, or, fifty cents less than list price.

The letters adoped as a dominent theme improvement in the quality of toast turned out, and the coupons appealed to woman's well-recognized proclivities.

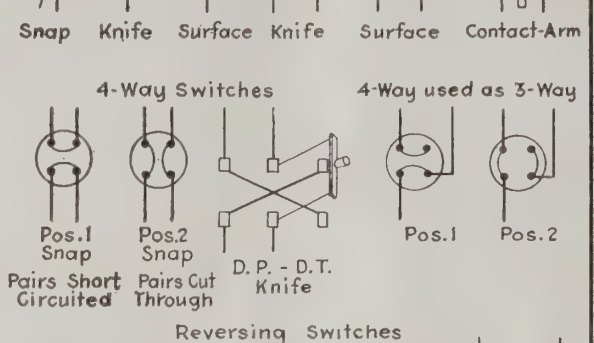
Sound Psychology, but—

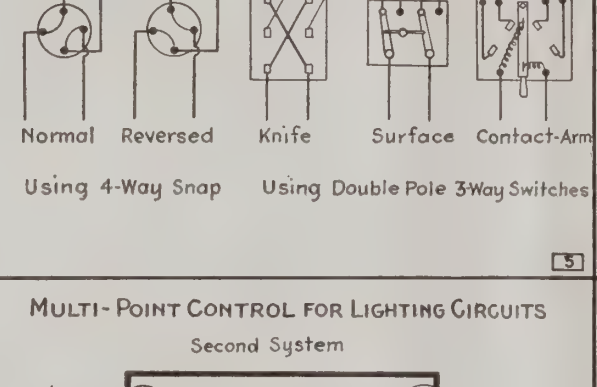
The pyschology of making the discount apply on the lighting bill instead of to the toaster, seemed sound. To sell a toaster, listed at $3.50, for $3.00 does not convey to the purchaser such a sense of actual gain as it does to sell the toaster for full price and with it give coupons good for fifty cents on a light bill. The light bill is a concrete obligation.

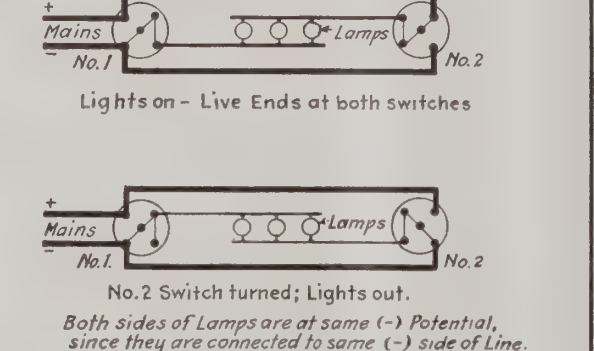
The advertising campaign was launched with a great hurrah, much window-dressing, mimeographing, envelope addressing and anticipation. It was scheduled to last ten days.

3-WAY AND 4-WAY SWITCH CONNECTIONS

The Following are all 3way Switches





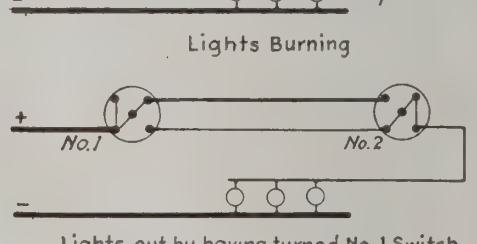


Using 4-Way Snap Using Double Pole 3-Way Switches

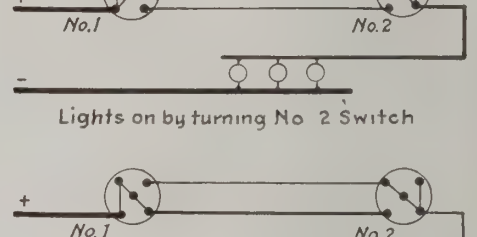
5

MULTI-POINT CONTROL FOR LIGHTING CIRCUITS

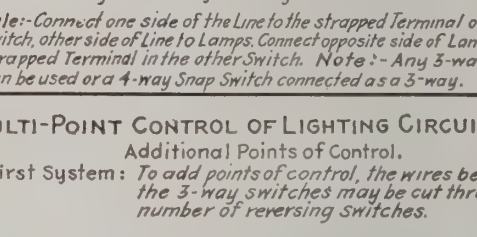
First System



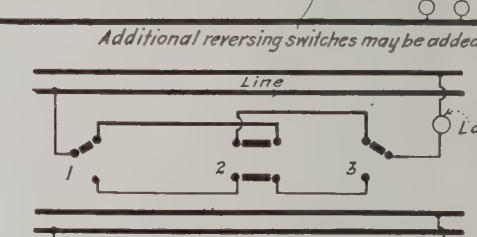
Lights Burning



Lights out by having turned No 1 Switch



Lights on by turning No 2 Switch



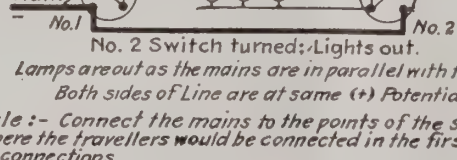
Lights out by turning No. 1 Switch

Rule:- Connect one side of the Line to the strapped Terminal of one switch, other side of Line to Lamps. Connect opposite side of Lamps to strapped Terminal in the other Switch. Note:- Any 3-way switch can be used or a 4-way Snap Switch connected as a 3-way.

6

MULTI-POINT CONTROL FOR LIGHTING CIRCUITS

Second System



Lights on - Live Ends at both switches

No. 2 Switch turned; Lights out.

Both sides of Lamps are at same (-) Potential, since they are connected to same (-) side of Line.

No. 1 Switch turned; Lights on.

Lamps are burning as they are connected accross the mains

No. 2 Switch turned; Lights out.

Lamps are out as the mains are in parallel with the mains Both sides of Line are at same (+) Potential.

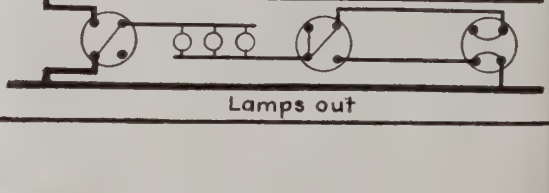
Rule:- Connect the mains to the points of the switches where the travellers would be connected in the first method of connections. Connect the strapped terminals to the Lamps.

7

MULTI-POINT CONTROL OF LIGHTING CIRCUITS

Additional Points of Control.

First System: *To add points of control, the wires between the 3-way switches may be cut through an number of reversing switches.*



Additional reversing switches may be added here

These diagrams show how the reversing switch (2) opens the circuit. For any position of (2), Switches (1) and (3) have the same control over the Lamp as if (2) were not in circuit.

Second System: *To add points of control, one or more reversing Sw are cut in between either or both 3-way Switches and the line*

Additional Reversing Switches may be added her

Lamps Burning

Lamps out

8

Waiting For The Orders

At the end of the sixth day three return postals had come in and the period ended with 93 of the original 100 toasters still in stock. During the last three days, in a frantic effort to pull success out of failure, some half-page advertisements were run, which brought the total expense of the campaign, apart from labor, up to $323, or just $23 more than would have been received from the sale of all the toasters. The new sales manager was not a victim of chronic pessimism but even he could not believe that a selling cost of $47.00 for each three dollar toaster was an effective means to clinch an old-age pension with his company. He still believes the campaign was good insofar as it went, but it lacked vitalizing. The entire plan probably presented an excellent foundation for the salesmen to work upon had they been sent out to do so, but they were not. It was a performance in which the sales manager had set the stage very carefully with attractive scenery but neglected to bring on the actors. Undoubtedy a follow-up with canvassers would have given it life. He is going to try it all over again some day.

He told his wife of his trouble and she interrupted twice during the melancholy recital to relate some thing their boy had done in school that day. She was intensely sympathetic about those toasters, but if her boy was like that Smith boy she would do things to him. The sales manager was disappointed, until finally he caught the flash of an idea. An idea that is as old as mankind—and older; one that had been before him all his lifetime, and yet one that he had not grasped. It is that the normal female of any species is more interested in matter relating to her young than in anything else.

With all the enthusiasm of the discoverer he went to work to capitalize this idea. "From now on we sell to the kids," he exclaimed in glee. The result of what he flattered himself was thinking, bore fruit in the shape of two letters.

The first was again addressed to the lady of the house, but it disposed of the excellencies of electrically-made toast in just one sentence. It was short but carried the suggestion that little daughter could make toast at the breakfast table; that she would enjoy doing so and that the responsibil'ty, trivial as it might seem, was a character builder. A day or two later the young daughter of the household received a letter like this:

Dear Little Friend:

What do you think of the wonderful visit I had with your little schoolmate, Margie Jones on Granite street. Every morning she made toast for the whole family right at the breakfast table with an electric toaster.

I thought of you so many times and how your dear mamma burned her face and her fingers, and many times the toast, on the kitchen range. What a comfort it would be if your mamma could sleep when she had one of her dreadful headaches and not have to worry about cooking breakfast.

A dear little girl like you would love to make toast and see her papa off for the day on time.

Sometimes after school Margie Jones has toast which she makes herself, and a glass of milk. It is just like a party and do you know I heard her papa say—now this is a secret—that a little girl that could make such good toast really should have the prettiest doll in town.

Your Friend,
Miss ————

How The List Was Made Up

It was very easy to make these form letters fit. A list of two hundred families each containing a little girl was made up the first day from information supplied by collectors, meter-readers and other office employees. It was necessary to use the names of but five little girls in different parts of the city and who were known to use toasters. The change of the words "mamma" to "mother" and "papa" to "father" covered the necessary ranges in ages within the doll period, and no lady complained regarding the inference that she occasionally, at least, indulges in the luxury of a morning headache—while "asleep."

The surprising—and gratifying—thing brought out was how completely residents of the little city could be catalogued as to children, etc., by consulting various employees of the company. It appeared that quite likely not ten per cent. of the population could escape some sort of classification by company employees, and the sales manager was quick to appreciate how important this information was as a foundation upon which to build future campaigns with a personal touch in them—more so than a mere knowledge of what electrical appliances they had. He was working on a rather elaborate card system at the time, but he had abandoned it since, freely admitting that without it some duplication of effort will result, but convinced that duplication is cheaper than a card system of connected appliances kept up to date when a half-dozen dealers are selling every day. He is more interested in family characteristics and environment than anything else just now.

And This Time, The Message "Got Across"

But to get back to the toaster campaign. The 93 remaining toasters were sold in a short time and with an actual cash outlay of about $18, but no coupon or other discount appealing to the bargain instinct.

His company, being a combination gas and electric, had not decided that it would enter the electric cooking field. Electrical Prosperity Week won the day for electric ranges however, and in a rather unforeseen manner. Included in the stock ordered for this occasion was a couple dozen minature electric ranges. The ten-year-old daughter of one of the salesmen is a famous cook. A little kitchen was built for her in one of the show windows on about the scale of a very large doll-house, and eight-year-old assistant engaged, and cooking began. All sorts of pastry, bread, cakes and other appetizing products were turned out by this little girl in plain view of a crowd which first remained to see and then came in to taste.

A Little Cook Works in the Window

Through it all the little cook proceeded calmly as though cooking at home. Nothing distracted her attention from the work at hand. This self-confidence was readily translated into an impression of each operation. Word passed quickly and for the entire week interest in that little city centered in the show window where the two minature cooks turned out far better products on a minature range than nine of every ten housewives could do in their own kitchen, and apparently without effort or failure.

It was a most entertaining week. Ladies refused to believe that the children were really cooking on those toy ranges and many of them remained for an hour at a time to watch a batch of biscuits or a pie in the making and through the oven. Then they asked for the recipes, apparantly unable to account for the uniformly good results obtained save by some magic in the formula.

And that display created an interest and a desire in popular mind for electric cooking. It is true that this desire did not, and has not, made itself manifest by such a volume of business that range manufacturers have had to work night shifts to turn out the ranges but it resulted first in leading the company into a serious consideration of electric cooking and secondly in the installation of about forty ranges and three large bake ovens, which was considered very satisfactory for the first season.

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A Christmas Sales Letter

The sales letter is now in quite common use among retailers—especially at Christmas time. The Christmas sales letter is just a little different from ordinary mail solicitation. In this case the appeal is not to the individual to buy something for himself, but for someone else, so the angle of approach varies somewhat. For illustration, take the suction sweeper. This is logically of interest to the woman, but in this case the appeal must be direct to the man.

Here is a letter that should prove productive to the man who is thinking—"What shall I buy my wife for Christmas?"

What shall I buy my wife for Christmas?

"This is a question you've doubtless given much consideration to at this time.

"Naturally you don't want to throw away your money—you want to present her with something that is useful and that will be a constant source of pleasure and satisfaction.

"Nothing would please her more than a Hoover Suction Sweeper—the modern cleaning machine that has become a necessity because of its convenience and thoroughness.

"A woman owning one of these efficient, time-saving articles is happy in the knowledge that her household can so easily be kept spic and span, and that her husband is interested in her pleasure and well-being.

"Think what it means to her on cleaning day to be able to clean the rugs and carpets *on the floor* without raising dust.

"In case of operation and thoroughness the Hoover is unsurpassed. That quality distinction so apparent in all our lines is strongly in evidence here.

"You'll also find here many other articles that make excellent gifts.

"See us at once and get this Christmas problem off your mind.

This letter has been suggested by the Hoover Suction Sweeper Company, for use in connection with its Christmas campaign. Newspaper advertisements are also provided for local use by Hoover dealers.

* * *

The Utility Holding Corporation

An excellent statement of the functions and advantages of the public utility holding organization, such as the Doherty, Byllesby, Stone & Webster, and Barstow companies, is given by Lucien H. Tyng, vice-president of W. S. Barstow & Company in a recent interview in the *New York Commercial*. Mr. Tyng said:

"Our theory of a public utility holding company is that it is essentially a securities company, holding the securities of various subsidiary operating companies. In these days practically all operating companies are subject to the control of various public service commissions so far as the issue of their own securities is concerned. We feel that each operating company should be put in such shape that it can finance itself; that is, raise money for necessary construction expenditures, etc., without assistance from the holding company. Our policy has been, therefore, to have each of our operating companies financed with an issue of bonds; first mortgage, if possible, with sufficient bonds reserved in the hands of the trustee to take care of the proper proportion of improvements, extensions, etc. That each operating company should, in addition to this, have an authorized issue of preferred and common stock to provide the additional capital required, which cannot be provided from bonds.

"The holding company then becomes the owner of the stocks only of these companies. The holding company, of course, can sell its own preferred stocks or collateral trust securities to raise funds for the financing of its subsidiaries. We believe this, however, to be more or less of an emergency measure to perhaps take care of its subsidiary until it can get into strong financial shape itself.

"The holding company, as a securities company, operated on this plan has the advantage over any single operating company, in that its receipts are based upon the operations of properties in different localities and with a proportionate distribution of risk. If any one property suffers a temporary setback in earning power, this need not affect the dividends on the holding company's securities, as sufficient earnings can generally be received on the other properties to cover such a period.

"As a securities company we believe the holding company should aim to make itself entirely a stock corporation without collateral trust obligations. We have departed from this theory in the acquisition of additional properties for the General Gas & Electric Company, but our policy is to work back towards it and replace our collateral trust obligations by gradual sales of preferred stock of the holding company.

"The advantages of concentrated operation have often been discussed, but one feature that has been somewhat overlooked is the advantage that accrues from a varied experince with public service commissions in different states. We have found that this experience has led us to take up all matters with public service commissions entirely on a business basis, and believe that the companies we operate have profited thereby much more than if we tried to treat matters before public service commissions as necessarily matters of controversay.

"We believe the holding company for public utilities is essentially a proper financial vehicle, as it gives investors a chance to assure themselves against loss by the distribution of risk, and profit by the growth of earning power of the various companies controlled. We think the chief danger of the holding company method of financing arises from complexity of financial structure and temptation to lack of fairness in presenting the exact earning power of the holding company and its subsidiaries. With each subsidiary, however, financed as here outlined, and the controlling stocks held by the holding company, we think the actual earning power accruing to the holding company can be so clearly and simply presented that it can be appreciated by any investor and he can judge of the security accordingly. We feel that the holding companies that pursue this policy will gain the advantage that they should in the market price of their securities."

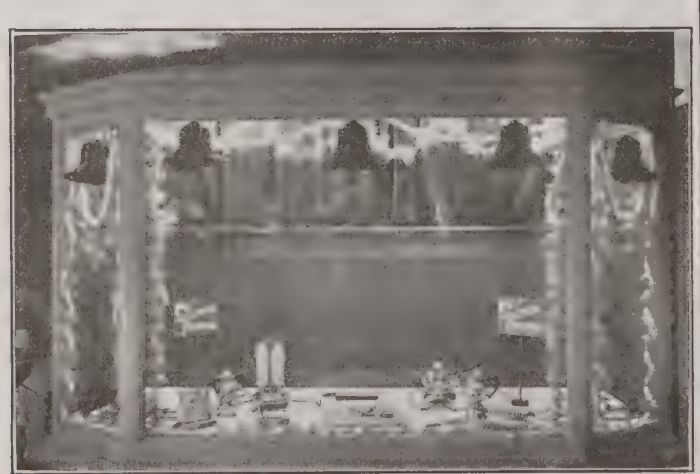
* * *

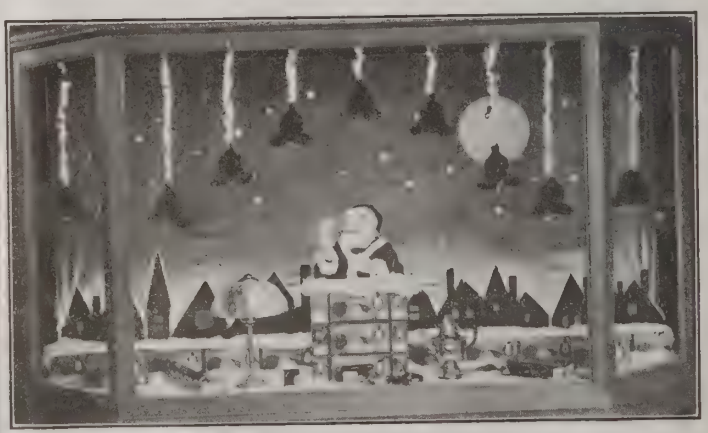
Westinghouse Electric Grants Employees a Bonus

Announcement has been made by the Westinghouse Electric & Mfg. Company of an extension of its present bonus system to include salaried and office employees on hourly rates by which they will receive a bonus of 8 per cent. of this salary each month providing their total excusable time absent and late during the month does not exceed six hours incurred on not over three occasions.

An additional four per cent. will be given each month to the employee who has not lost any time from work during the month through absence or tardiness thus enabling those affected to obtain an increase in earnings of twelve per cent. for a 100 per cent. attendance.

Our Monthly Window Display





Kris Kringle, snow, Christmas greens and stockings suggest that some piece of electrical apparatus in the foreground would be the most welcome gift for each member of the family. Photographs by General Electric Company.

TRADE LITERATURE

Catalogs and Books

A Review of the Latest Publications

Stow Flexible Shaft, Bulletin No. 102 of the Stow Manufacturing Company, has been reproduced in vest-pocket size and is being sent out to the trade.

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Electric Hoists, of ¼, ½ and 1 ton capacities, are listed and dimensioned in Bulletin M-1 of Shepard Electric Crane & Hoist Company, Montour Falls, N. Y.

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National Electric Safety Code, prepared by the Bureau of Standards, has just reached its second edition. Copies may be had, post-paid, at 40 cents each, from the Superintendent of Documents, Washington, D. C.

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Handy Electric Wiring Devices, a pocket size booklet, is Catalog No. 24, 1916-1917 of Pass & Seymour, Inc.; Solvay, N. Y. This lists shells, bodies, caps, bases, sockets and specialties. Illustrated charts make it easy to locate the particular combination desired.

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Buildings Consructed by Stone & Webster Engineering Corporation are illustrated in the Second Edition of a 60-page book. Of interest to electrical men are the interior of the Electric Garage of the Boston Edison Co. and the Keokuk hydro-electric plant of which last four views are shown.

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The Automatic Reclosing Circuit Breaker Company, in its bulletins Nos. 8, 10, 11, 12, 13, 14 and 20, recently sent out, tells of the uses of its various types of apparatus. An important feature of the line is that the restoration of service after an interruption is entirely independent of the presence of an operator.

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Facts About Gears is the well-chosen title of a 40-page booklet issued by The Van Dorn & Dunton Company, Cleveland, Ohio, as a reference book for gear buyers. Rules for figuring gears, specifications for ordering, comparative sizes of teeth, and tables of general use make the book very desirable for mechanical men.

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"How-I-Did-It," the monthly publication of the Westinghouse Lamp Company for salesmen of Mazda lamps, has recently sent out its third issue, dated November. The stories of live-wire selling methods show that the rendering of real service, not spectacular "stunts," is the way to the prospect's confidence and desire to purchase.

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The Jovian Order has recently prepared a manual of that order which is being sent to members, and also on request to persons interested. This book has been made up for the purpose of answering specifically and in detail all questions relating to the important matters in connection with the organization and operation of The Jovian Order, with special reference to the changes in the Jovian constitution.

✣ ✣ ✣

"Facts About Water-Power," a pamphlet published by the Water Power Development Association, Washington, D. C., is a careful analysis into the widely condemned "Merrill" report on electric power development presented to congress during the last session. As is so often the case with reports in Government investigations. Mr. Merrill seems to have considered that he was preparing a partisan document instead of reporting in an impartial manner the findings of a thorough systematic research. As a result the report is shot through with the most obvious inaccuracies, and on even genuine facts there are serious errors in drawing conclusions. We recommend every one interested in the subject to secure a copy of this analysis, which may be had on application to the association.

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Book Reviews

THE PRINCIPLES OF ELECTRICAL ENGINEERING AND THEIR APPLICATION, by Gisbert Kapp. 356 pages. New York: Longmans, Green & Co.: $4.25.

"This book is intended as a text book for all engineering students and as a handbook for the general engineer. With these ends in view, the author has covered, in Vol. I, the fundamentals, leaving the application to Vol. II. The general style of the work is such as to make it easy reading; the print is good, and only so much of mathematics is used as is necessary to understanding of the principles. The chapters on the measurement of resistance and on potentiometric measurements are good. Alternating currents also are treated in a manner quite thorough as far as the treatment goes, which is quite far enough for men other than experts in a.c. theory. We can recommend the book as a whole as a text book. It is to be regretted that the pages are not cut, if only for the sake of the busy reviewer.

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MECHANICAL ENGINEERS' HANDBOOK. E. S. Marks, Editor-in-Chief. 1836 Pages. New York: McGraw-Hill Book Co.: $5.00.

The names of fifty-one men, prominent in their respective fields, appear as contributors to this handbook. That their work has been well done, even a casual perusal of the text will show. Divided into sections which treat in its entirety one general subject, the book makes it easy to find all the material bearing on the point under investigation with a minimum of "looking up" in the index. Several sections are worth special mention. That on mathematics, which is perhaps more elaborate than necessary for the general user, should prove a godsend to an engineer who suddenly, far from his library, has need for some half-forgotten formula. The section on heat, comprising 85 pages, is one of the most complete treatments of the general subject from an engineering point of view to be found. A desirable feature of the book as a whole is the amount of cost information given; this is particularly true of the costs of power generation, and of electrical apparatus. At the present time these figures are only relative, but they should be of much assistance in selecting the type of drive to be adopted.

The section on Electrical Engineering, compiled by Messrs. Beebe and Kartak of the University of Wisconsin, occupies 104 pages. It would be needless duplication to devote more space than this to a subject which is so well handled in the "Standard" and "American" handbooks. Even to electrical men, however, the material from its very compact form, should have much value. Electricity touches upon so many of the mechanical fields that an electrical man never knows

when he will be called upon to know something about strength of materials, machinery, heat, power generation, hoisting and conveying pumping, transportation, or shop practice. Every wide-awake man should familiarize himself with the contents of this handbook so that he may be able to turn to it at once when the need comes.

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Important Rate Case Pending

(*Continued from page* 30)

not included in the companies' proposal. It offers to pay 0.85 cents for power, taking 25,000 kw. for 1½ years, 15,000 kw. for the next two years, and 10,000 kw. for the next two years. These figures assume that the city's hydro-electric plant would be developed in 5½ years to meet its demands, and that the cost of power, generated by this plant would be 0.6 cents.

While these propositions are widely at variance, it is felt that both sides are willing to make concessions, and hence that competition can be avoided.

A new element of contention has been added by the company's proposal to lower its rate from 5.5 to 5.0 cents in certain parts of the city in which the city is now supplying power at 5 cents. This plan has been approved by the Railroad Commission of California, which holds that this does not constitute discrimination.

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Of Personal Interest

Mr. F. B. Gleason, formerly in charge of the Western Electric Company's business in the Far East, with headquarters at Tokio, Japan, has been appointed Manager of the Southern District, with headquarters at Atlanta, Ga. He will succeed Mr. E. J. Wallis, who, on January 1st, will take up his new work as Manager of the Pacific Coast District, with headquarters at San Francisco. Mr. Wallis will succeed Mr. F. H. Leggett, who, after three years on the Coast, returns to the company's executive offices at New York City.

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L. H. Haight has been appointed New York City sales representative of the Ward Leonard Electric Company. Mr. Haight was for ten years in the New York sales office of the Westinghouse Electric & Mfg. Company.

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E. H. Jacobs has been made chief engineer of the Electrical Engineers Equipment Company, of Chicago. He is a graduate of the University of Michigan, and specialized for many years on station control apparatus with the General Eelctric Company.

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Glenn M. Wilson, formerly in charge of the Cutler-Hammer Manufacturing Company's specialty department, will cover western New York for the Franklin Electric Manufacturing Company, makers of incandescent lamps. His headquarters will be at Buffalo.

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Frank Houston, formerly commercial manager of the Lockport (N. Y.) Light, Heat & Power Company, is now associated with E. Z. Wallover in power development work in Oklahoma City.,

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Edward Wray, formerly editor of *Railway Electrical Engineer* has resigned to enter the service of the Sangamo Electric Company.

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Emile Hemming, one of the pioneers in molded insulation, has been elected president of the American Insulator Company, of New Freedom, Pa.

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An alliance has been formed between the consulting engineering firms of Vaughn & Meyer, of Milwaukee, and the Chas. L. Pillsbury Company, of St. Paul. The business of the firm will be conducted at the former offices under the old names: Messrs. Pillsbury and Meyer will make their headquarters at Minneapolis, and Mr. Vaughn at Milwaukee.

C. E. Scribner, for forty years with the Western Electric Company and its predecessor, and for many years Chief Engineer of the Company, has at his own request been relieved of his executive duties, and has been appointed to the position of Consulting Engineer.

F. B. Jewett, Assistant Chief Engineer of the Company since 1912, has been appointed to succed him. Mr. Jewett is a graduate of Throop Polytechnic Institute, class of 1898.

In 1904, he became connected with the American Telephone and Telegraph Company, and for nearly eight years had charge of transmission development work for the Bell System.

In April, 1812, Mr. Jewett became Assistant Chief Engineer of the Western Electric Company, having charge of development and research work.

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Obituary

Edward West Hammer

The electrical industry lost one of its most widely known engineers and manufacturers on Tuesday, November 7th, when Edward West Hammer, after an illness of three weeks passed away at his home, 47 Allandale Avenue, East Cleveland, Ohio. The cause of death was a sore which became infected, developing into an inwardly discharging abscess back of the eye.

For the past two years Mr. Hammer had been manager of the Business Efficiency Department of the National Lamp Works, at Nela Park, Cleveland, having instituted this department and through its means introduced many plans of great value from an efficiency standpoint to the organization as a whole.

Mr. Hammer was born on July 25, 1867, near Des Moines, Iowa. He was educated in electrical and civil engineering at Iowa State College, Ames, Iowa. His earliest connection with the electrical business was with the street railway company at Des Moines, where he quickly rose to the position of General Superintendent.

About twenty-five years ago, in common with Mr. Harry Cutler, he organized the Cutler-Hammer Company, which very quickly reached a position of recognized importance, particularly in the manufacture and sale of controllers. Mr. Hammer was a

great hand to "reminisce," and often entertained his friends with personal recollections bearing on the slender amount of capital—only a few hundred dollars—with which the Culter-Hammer Company was started.

Mr. Hammer's business activities were surprisingly variel. He had owned and operated a hotel in Chicago; had managed factories for Mr. F. S. Terry and for Mr. Samuel Insull, and was President of the General Engineering and Construction Company, Chicago, which installed automatic telephone systems in Chicago, Lincoln, Nebr., Butte, Mont., and other places in the West and Middle West. About five years ago he was consulting engineer on an electric traction project in Salt Lake City, Utah.

Mr. Hammer's business success was due largely to his exceptional faculty for handling, analyzing and retaining facts and figures, and in drawing accurate conclusions from them. Withal he had a most kindly and sympathetic disposition, and his untimely death will be felt as a personal loss by hundreds of his former associates. He is survived by Mrs. Hammer and by his twin sons, Richard B. and Donald S. Hammer.

The funeral was held in Chicago, with interment at Oakwood Cemetery.

Other Deaths of the Month

John M. Connelly, advertising manager of the Denver Gas & Electric Light Company, died on October 31, aged 42 years. He was a graduate of Dartmouth, and had been in the service of the Denver Company since 1903.

John T. Brady, treasurer of the Denver Gas & Electric Light Company, died on November 22 of tuberculosis. Mr. Brady was well known to all the old-timers in the Doherty organization, and although not known outside of Denver to any great extent, he was one of the bulwarks upon which the local company has attained its present success. Mr. Brady started with the Denver Company as a bookkeeper back in 1900, and has passed through all its vicissitudes.

Arthur C. Eastwood, president of the Electric Controller & Mfg. Co., of Cleveland, Ohio, died on October 17. Mr. Eastwood was one of the pioneers in the application of electricity to the steel industry and was largely responsible for the development of the lifting—magnet.

John A. Barrett, telephone engineer, died on November 17, aged 58 years. Mr. Barrett started with the Western Electric Company, and was later connected with the Okonite Company, and with the Bell System. He was the father of the transposition system used on open-wire lines, and had much to do with the development of the present paper insulated, lead sheathed telephone cable.

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News of the Associations

Association of Railway Electrical Engineers

Industrial trucks, headlights, yard and engine illumination, and car lighting systems weres discussed at the Association's convention held Oct. 31 to Nov. 3, at Chicago. Officers elected for the ensuing year are: President, C. J. Causland, Pennsylvania Lines; senior vice-president, J. E. Gardner, Chicago, Burlington & Quincy; junior vice-president, L. S. Billau, Baltimore & Ohio; secretary-treasures, J. A. Andreucetti, Chicago & Northwestern; new members of the executive committee, F. J. Hill, Michigan Central, and A. Voight, Santa Fe. The next annual meeting of the association will be held in Chicago.

Electric Power Club

At Hot Springs, Va., the seventh semi-annual meeting of this organization of manufacturers of motors, transformers and control apparatus was held on Nov. 15, 16 and 17. Reports of various committees and discussion on them occupied the time of the convention.

American Institute of Electrical Engineers

The committee on Economics of Electric Service had charge of the program at the meeting on Nov. 10, at New York. Papers on valuation, inventories, and depreciation were presented. One point of interest was that it is unnecessary to take a complete inventory on a certain date in order to get most of the benefits of this information. A company might start a record of all new property added, and all old property withdrawn from service, and when all of the uninventoried property had been withdrawn the books would then show the value of the recorded property only.

Southeastern Section, N. E. L. A.

A royal welcome was given by electrical men of Tampa, Florida, to their fellow-members of the N. E. L. A. when the Southwestern Section met, November 15-17 at that place. Among the speakers were men prominent in the industry, including Arthur Williams, Commercial Manager of the New York Edison Co.; T. Commerford Martin, Secretary of the N. E. L. A.; J. C. McQuiston, Advertising Manager of the Westinghouse Companies, and John H. Finney, manager of the Aluminum Company of America. Accounting, maintenance of instruments, advertising, steam turbines, municipal ownership and electrical heating were treated in well-prepared papers and discussed. Delegates and guests attended a dinner and general jollification at which many unique "stunts" were pulled off. The following officers were elected for the following year: President, W. E. Mitchell, Alabama Power Company, Birmingham; First vice-president, H. A. Orr, Southern Public Utilities Company, Anderson, S. C.; Second vice-president, C. I. Day, Southern Utilities Company, Jacksonville, Fla. Birmingham, Alabama, gets the convention next year.

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Coming Conventions

American Society of Mechanical Engineers. Annual meeting, New York City, December 5-8. Secretary, Calvin W. Rice, 29 West Thirty-ninth Street, New York City.

Kansas Public Service Association. Annual meeting, Topeka, Kans., December 7-8. Secretary, E. A. Wright, Manhattan, Kans.

American Institute of Electrical Engineers. Monthly meeting, Boston, Mass., December 8. Secretary, F. L. Hutchinson, 29 West Thirty-ninth Street, New York, N. Y.

American Association for the Advancement of Science, Annual meeting, New York City, December 26-30. Permanent secretary, L. O. Howard, Smithsonian Institution, Washington, D. C.

American Institute of Chemical Engineers. Annual convention, New York City, January 10-13. Secretary, J. C. Olson, Cooper Union, New York, N. Y.

New Mexico Electrical Association. Annual convention, Albuquerque, N. M., February 12-14. Secretary pro tem., E. A. Thiele, Roswell, N. M.

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New York Metal Prices

November 29, 1916.

Copper, prime Lake*	33.50	@34.00
Electrolytic*	34.50	@34.75
Casting*	32.25	@32.50
Wire, base*	40.00	@41.00
London std. spot	150—0/0	
Lead	7.00	
Nickel	45.00	
Zinc, sheet, f. o. b. smelter*	21.00	
Tin, straits	45.00	
Aluminum, No. 1 Virgin, 98@99%	63.00	@65.00
Spelter*	13.175	@13.30

Old Metals

Copper, strictly crucible*	28.00	@29.50
Brass, heavy*	16.00	@17.00
Brass, light*	12.50	@13.00
Lead, heavy*	6.25	@6.50
Zinc, new scrap*	9.75	@10.00

*Nominal.

New Products And How to Use Them

A Monthly Review of New Apparatus, Equipment and Specialities of Known Value

The Names of Manufacturers of the Products in This Section Will Be Gladly Supplied on Request

Automatic Heating Pad

There are several ways of adjusting and regulating the temperatures of electric heating pads for application to the human body. The usual manner is by a three-heat switch which allows the connections of the resistance elements to be varied. A pad recently put on the market has a novel control scheme which should be both sensitive and reliable.

Interposed in the flexible cord is a small box which contains a bi-metallic strip like certain kinds of flashers. Here, however, the fixed contact point is readily adjustable by a small indicator which may be set at any point on an arbitrary scale. The nearer together the contacts are set, the longer will the circuit be held closed, and vice-versa. At the same time for any setting, the thermo-element will hold the pad at a constant temperature, provided the resistance wire will take enough power from the line to make up the heat losses.

The further advantages claimed are ruggedness, due to the regulating element being enclosed in a rigid block, and uniformity of temperature all over the pad on account of there being only one circuit in it, instead of two or more as in the other adjustable-heat pads. Contact-points of liberal size are provided which will break the operating current without destructive sparking. Anybody can understand the means of adjusting the temperature.

Two sizes, 8 in. by 50 in., and 14 in. by 18 ins. are made in a number of attractive color schemes at the list price of $8.00 A heating blanket under the same control is marketed at $25.00 retail.

* * *

"Always Vertical" Supension

It frequently happens in factory buildings (especially those of concrete construction) that the outlet box is not set in perfectly straight and it is difficult to make fixures suspended from it hang perpendicular. A Chicago manufacturer has recently developed a suspension fixture by which the stem is always vertical without the necessity of bending pipe or relocating the box.

This suspension consists of a liberal sized cast iron canopy with screw holes to fit a standard 4 inch outlet box. It therefore allows ample room for making all connections. It has a ball joint—the lower end of which is tapped for ½ inch conduit. This ball joint permits the fixture to swing through an angle of 25 degrees in any direction should it be struck by a moving object; yet it is so arranged that it cannot turn in a horizontal plane and thus twist off the fixture wires. With this suspension the stem of the fixture will always hang vertical, thus improving the appearance of the installation and bringing the lighting units and lamps into their most efficient position.

The use of this patented fitting makes a stud, crow foot, hook and box cover unnecessary. The market price of the fitting is so little in excess of the parts that it replaces, that it readily pays for itself in the saving of labor in installing.

The suspension has been thoroughly tested and is approved by the National Board of Fire Underwriters.

* * *

Portable Conduit Bench

"A complete conduit shop" is the not inaccurate designation of the device illustrated herewith. It consists of a head on one side of which is mounted a pipe vise, and on the other a conduit bender. Four pipe legs support the head; these are bent near one end. To set up the bench, the straight ends of the legs are put into holes on the lower side of the head, and a turnbuckle attached to the strap as shown is hooked through a screw-eye set in the floor. By tightening on it, the stand is made extremely rigid, yet it can be taken up and moved in a few minutes. The legs can be turned to allow a die stock ample clearance.

The bender shown is intended to bend pipe largely by the weight of the workman as the pipe is fed in. There are several advantages to this method; the bending is by easy stages and the pipe is not flattened or kinked; the workman does not have to strain his muscles in awkard positions, and as he can see the pipe at all times he can do a neater job. The side outlet is also a great convenience in placing or re-

moving pipe. The manufacturers claim that it is economical to provide each workman with a portable bench as the time saved which would otherwise be wasted in setting up a pipe

vise or waiting for others to finish working at a centrally-located one will soon pay for the individual tool.

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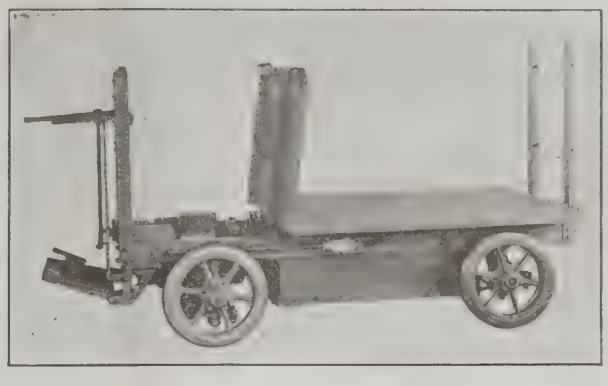
"Crescent" Industrial Truck

Some interesting features have been incorporated into a new industrial truck known as the Crescent which has just been put on the market. Profiting by his previous experience in truck designing, the designer of this truck has striven for accessibility of all running parts and ease of replacement of every element which is likely to get out of repair. This possibility itself is precluded as far as possible by unusually rugged construction.

The frame of the Crescent Truck is made of heavy channel steel strengthened with cross bracing, and the floor is of 1½ in. oak planking. This is hinged so as to allow of either of two sections being turned up to give access to the battery or driving mechanism. The motor, which is rated at 36 volts, 35 amperes, 1,000 r.p.m, drives the front wheels through a worm gear differential which is enclosed in a housing and runs in oil. This entire driving mechanism can be removed as a unit in a few minutes for repair, or overhauling, and another unit substituted. Thus a truck is not tied up by any breakdown, which is more likely to happen when operators are trying to carry overloads during a sudden rush of work. The brake wheel is part of the driving unit and is of the internal expanding type held set until released by the operator's foot.

Either a lead-plate or Edison storage battery is furnished at the option of the purchaser. The charging plug is of the flat type, arranged to break the circuit to the controller while charging. There are three speeds forward and reverse. Sufficient battery capacity is furnished to do a day's work of ten hours without recharging.

Ball bearing steering knuckles on all four wheels allow of a turning radius from a point six feet from the center line of the truck. The wheel base is 4 ft. 10 in.; overall length



9 ft. 3 in.; platform 7 ft. 6 in. by 48 in. and 23 in. high; capacity 4,000 lbs. and weight 2,100 lbs.

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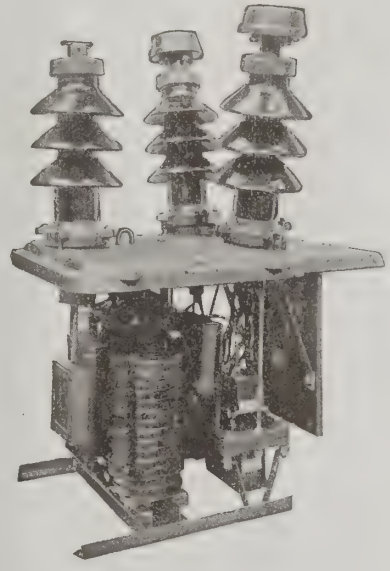
Outdoor Metering Equipments

The supplying of service from high tension transmission lines, where the expense of a substation is not warranted, has prompted an electrical manufacturer to develop a line of metering equipments enclosed in weatherproof casings, of which the one illustrated is typical. These outdoor metering equipments have been developed so far for 60-cycle, polyphase service, for current ratings not exceeding 200 amperes and for voltage ratings from 11,000 volts upward.



Each equipment consists of a standard polyphase watt-hour meter, two current transformers, a polyphase voltage transformer, and three choke coils, all enclosed in a sheet steel case with cast iron cover supporting three high tension outdoor type terminals. The sheet steel case is subdivided into two compartments, one of which is filled with oil in which the transformers and choke coils are immersed, while the other serves to enclose the meter and meter panel. On the meter panel are also mounted two fuses to protect the voltage circuit of the meter and two calibrating links located in the current circuit of the meter. These calibrating links consist of fuse clips with a brass tube inserted instead of fuses. The meter may be read or checked upon opening the hinged door which covers the entire

front of the meter compartment. The arrangement is such that the entire outfit, including meter panel, can be raised out of the tank without disconnecting meter leads.

Three primary outlet terminals provide the necessary primary connections, one of the terminals serving as the common connection of the voltage transformer windings, while each of the other two terminals provide connection for one current transformer and one end of one of the voltage transformer windings.

The current transformers each have two primary windings which may be connected in series or in parallel by connecting links in the weatherproof cap at the top of the outlet terminals. The polyphase voltage transformer consists of a three-phase core having windings on the two outer legs only, and is therefore equivalent to two single-phase voltage transformers connected in open delta.

Choke coils are inserted between the voltage transformer windings and the outgoing leads, to protect the transformer windings against high-frequency disturbances.

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A New Disappearing Footlight

The accompanying cuts illustrate a new design of disappearing footlight, which is especially suited for stages and platforms of high schools, auditoriums, halls, churches, theatres, also show rooms, show windows or wherever a footlight is required that must be out of the way when not in use.

These footlights are made up and furnished in complete finished sections, 3 to 5 ft. in length which can be mitred to fit any curvature of the stage, or in longer sections for straight footlights. They can also be provided for a single or double row of lamps with two or more color combinations.

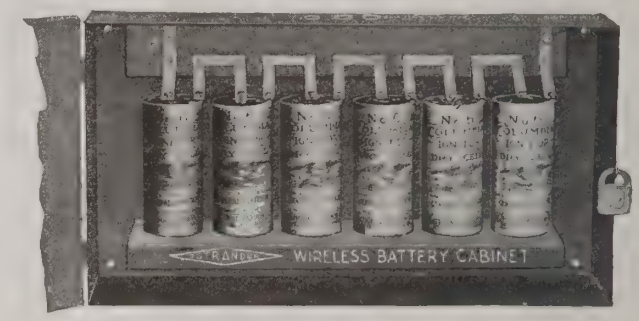
The structural simplicity of these footlight units is especially noticeable as compared to older designs of disappearing footlights with elaborate raising and lowering mechanisms. Each section as furnished consists of a top, frame and door made of one-inch hardwood to match the flooring so that for installing, all that is required is to provide a space in the floor of sufficient depth and width to receive the unit, and the top of the footlights is inserted flush and floored in to form a part of the stage floor.

The footlights are mounted on the lower side of the door and conforming to the Underwriters' rules, are set in a galvanized iron reflector trough. Connections are made through an iron splicing box, which can be placed either in the center of the section or at the end, as is necessary for clearance between studs or beams. The door or cover of the footlights is hinged on a special heavy iron bracket supported on the top frame, and each cover is provided with a flush ring and lock at the center, as shown in the illustration.

To raise the footlights, the doors are simply swung open by means of the pull rings. A small spring catch shown in the line drawing in the open section holds them in the raised position, and when raised, the footlights extend 3½ inches above the floor level. When closed, the doors turn down flush with the floor and rest against heavy iron supports, such that the covers are as strong as the floor itself, and will not sag when dancing or moving heavy objects over them.

Wireless Battery Cabinet

Many an annoying interruption to service on bell circuits has been traced to a loose jumper in the battery cabinet. The installer may have made everything tight and snug, but some careless person wanting to put some article on the battery shelf has moved the cells enough on several occasions to at last break a wire. All such occurrences have been avoided by a cabinet recently put out.



As shown in the illustration, the cabinet is of sheet steel, of a size to accommodate the number of cells desired. The hinged door is provided with a padlock, and there are knockouts in the sides for ½ in. conduit. The cells stand on a strip of hard wood thoroughly saturated with an insulating compound and paraffine. Connections can be either in series or in multiple, and are made through phosphor-bronze springs which bear down strongly on the terminals of the cells. The standard cabinet is made for the No. 6 size of cells, but special cabinets can be made up to meet any requirements of size or number of cells.

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Condensite-Cellulac

A new form of electrical insulation, of wide and general interest and application throughout the electrical industry, is now being placed on the market under the name of Condensite-Cellulac. This new form of insulating material is entirely different in physical and chemical characteristics from any other form of fibre, hard rubber, mica or synthetic insulation now available. It is not merely built up of coated paper in laminations, nor is it a coated or veneered fibre, but is a product which is homogeneous throughout. It combines in great part the stable physical and chemical properties and high dielectric resistance of the well-known Condensite molding preparation, which is employed in its manufacture, and the good qualities of the best grade of vulcanized fibre.

Condensite-Cellulac is permanently anhydrous and non-hygroscopic, and is impervious to the action of oil or ordinary acids or solvents. It is infusible and is not affected by the action of heat within the range of temperature ordinarily encountered and hence can not break down setting free substances which may attack and corrode conductors or connections. It is not fragile like some other insulating materials but is very tough and will stand considerable vibration or shock.

The application to service of this material in locations exposed to the weather is not only a possibility but will undoubtedly comprise a considerable part of its fild of application as it is strictly weather-proof. It may also be used advantageously in apparatus which is to operate under unfavorable conditions of moisture, or subject to splashing with oil, such as isulation for automobile ignition systems, or where exhaust steam is used in industrial processes.

Condensite-Cellulac is furnished to the trade in merchant-

able shapes—sheets, rods, tubes, etc., and is readily machined. It may be formed into very thin sheets (.015 in. or less) with remarkable accuracy to gauge, thereby furnishing an excellent diaphragm material. It is also supplied shaped to customers' specifications. The work as thus supplied is ready for use, having been hardened and made insoluble and infusible by the application of heat.

A unique feature of Condensite-Cellulac of considerable general interest is the possibility of supplying it in the soft uncured state, permitting of its being hardened in the place where it is to be used and thereby formed to fit in spaces or locations with an accuracy not otherwise possible. Thus, for instance, gaskets for hot lines, steam, hot water, compressed air, etc., may be accurately fitted to rough flanges and cured in place by the heat of the line.

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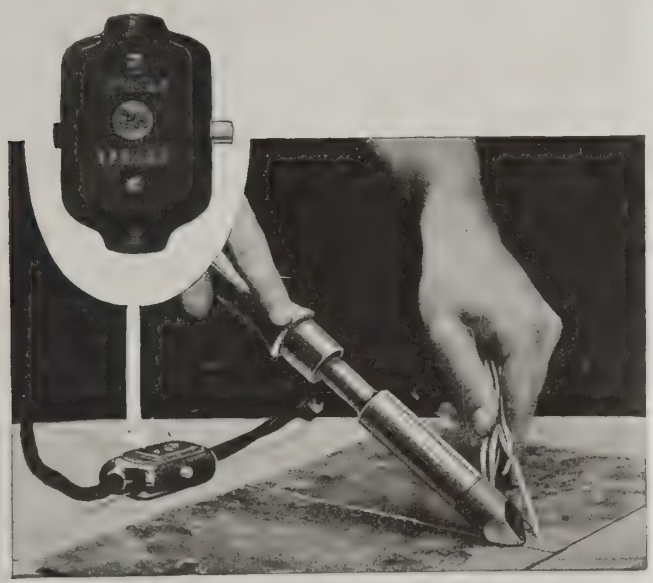
New 6-Ampere Feed-Through Switch

A new feed-through switch has just been added to the line made by a manufacturer of wiring devices. This differs from the polished nickel and brass shell types, in that moulded insulating material forms the body of the switch enclosing the push button operating mechanism. The new switch is approved by the Underwriters' Laboratories for the same high rating as the brass



shell type, 6 amperes, 125 volts; 3 amperes, 250 volts. It may be located at any part of the cord used with electric appliances and its use eliminates wear on the socket, brings the control to the point desired by the user of the appliance and with such devices as are used at the table makes it unnecessary to pull out the plug in order to cut off the current. The accompanying illustration shows the application of this type of switch.

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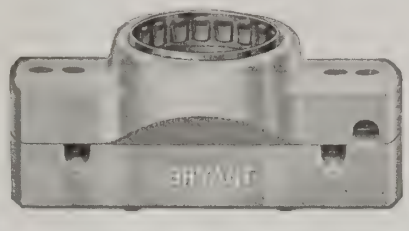
A New Porcelain Cleat Base

There has recently been put upon the market a new porcelain cleat base of the receptacle character for knob and tube work and other exterior wiring. This device is particularly valuable for use where the local rules require covered connections. As will be noted from the illustration the "BY" base, by which name it is known, is made in two parts, one of which can be fastened directly to the ceiling beam overhead, and permits of the wiring being fastened to the terminals before the other part of the device is attached. Furthermore, as will be noted, the device is so made that it is possible to use with it practically any one of the manufacturer's twenty-seven bodies (sockets, switches or receptacles).

A regular "ring" or cap collar is permanently fastened in the opening of the base, which makes it possible to readily attach the New Wrinkle bodies by means of the novel spring clip fastenings in the corrugated ends of the standard New Wrinkle shells. By means of this base it is possible to not only make a more convenient job—more readily installed—



but a neater, more finished job and one that complies with every requirement for this class of work. As will be appreciated, this device is also particularly desirable where exposed wiring is used for temporary or permanent decorative purposes.

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A Handy Box Cutter

The usual way for making an additional hole in a cabinet for accomodating a piece of conduit, or for making a hole in metal lockers or enclosing cases has been the source of considerable trouble. A new easily operated tool has been invented (Pat. applied for) by a Milwaukee man, and now is being marketed by a concern in that city. This device can be used for cutting all sorts of metal, fibre and slate, and can be adjusted so as to cut holes of various sizes with little effort and in but a few momnets. To use the tool, all that is necessary is to drill a pilot hole through the material through which the stud is passed. A flange-nut is then secured on the opposite side of this stud and a few operations of a ratchet-wrench cut out a neat hole. A test conducted recently showed that for a standard conduit cut-out box (wall about 0.1 inch) 14 revolutions of the knives sufficed to cut a hole and the time required was less than a minute. The attached photograph shows one of the uses of this appliance.

The knives which may be adjusted for cutting holes of several diameters are held in a swing chuck and are automatically fed by means of the spring shown between the swing chuck and the sham-nut. This device does the work of a six inch drill-press and it is particularly desirable because it can be taken to the work, rather than having the work brought to it. In the case

of a tank where the flange-nut cannot be secured to the stud on the inside it is only necessary to tap the pilot hole and insert the stud into this hole. While but a few of the uses are mentioned above, the inventer claims that this tool is useful in the automobile garage, boat building plant and in fact in every industrial works.

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"Safety" Warming Pad

The need for heat to be applied to the human body quickly is one which can seldom be foreseen, and whatever means is used must be ready for service at all times. On this score, as well as upon convenience and economy the electric heating pad is replacing the hot-water bottle with gratifying rapidity. In addition to the obvious advantages indicated above is the fact that the pad can be placed over or under the patient without danger, and left there indefinitely without the slightest inconvenience.

In a new pad known as the "Safety" a number of excellent devices have been included. Chief of these are the regulating switch. This consists of a fiber block as shown on which two

small rings slide. When each is pushed into the center of the block they close a circuit which admits current to the resistors. One of these alone gives low heat and the other, medium heat. Operated together they give the highest degree of heat.

Within the pad itself are a sensitive thermostat and a fusible link which protects the pad and the user. The pad takes less than 50 watts. It comes in eiderdown or cretonne, packed in an attractive black-and-white box. The list price is $5.00.

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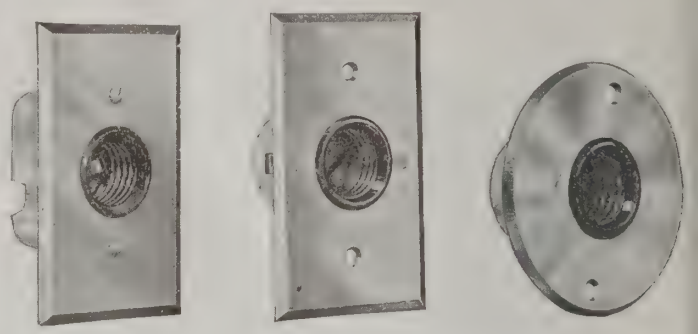
Safety Screw Base Flush Receptacles

A screw base receptacle is the only type which will accomodate all makes and styles of attachment plugs. The principle objection to such a receptacle as commonly known, is the possibility of shock by accidental contact or the short circulating of contacts, and excessive arcing with the danger of short circuits on removing the plug with the circuit closed.

Children too, are not unlikely in their play to insert fingers or coins into these convenient and attractive hiding-places. This danger, however, has been obviated by a new line of sockets invented by a manufacturer of switches.

Both contacts are normally dead and become alive only upon screwing the plug home. The center contact has to be pressed solidly inward. The outer or shell contact becomes alive only when drawn outward. In removing a plug with the current on, the circuit is broken at three points in series, thus greatly reducing the possibility of serious arcing.



Two forms are supplied. (1) An elongated receptacle for use in rectangular flush boxes; (2) a round receptacle with concealed binding terminals that will pass through an opening 1¾-inch in diameter. This round receptacle can be furnished with round brass plate 3⅝-inch in diameter or with the usual rectangular plate.

The devices are easily wired. The elongated receptacle is provided wtih wire grooves extending across the face to facilitate gang wiring. Buildings equipped with them will receive any of the standard plugs supplied with portable devices whether solid, swivel or separable.

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Lowering the Cost of Distribution

The illustrations accompanying this article picture a new line of wall brackets designed to reduce the cost of service connections without in the least impairing safety or service.

Figures 1, 2 and 3 show one, two and three point brackets

Fig. 1

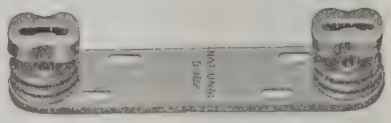

Fig. 2

Fig. 3

Fig. 4

Fig. 5

respectively. Each bracket consists of a sherardized stamped steel base plate on which are mounted high grade porcelain insulators of unique design. The insulators are secured to the base plates by means of sherardized U-bolts and nuts as shown in the phantom view of the one-point breacket (Figure 4.) The round transverse holes, shown in the insulators, are for the purpose of securing the wires; the U-bolts pass completely around these holes. In other words,

the insulators are "iron bound," the construction being very similar to that of strain insulators. The peculiarity of this design results in a bracket having not only great tensile strength, but also a bracket which can be installed with great ease and rapidity. For example, the necessity of using tie-wires has been entirely eliminated. On the other hand, the design of the insulators is such that the wires may be secured with tie-wires, in the regular way, if so desired.

Figures 8 and 9 show two typical installations; Figure 6 is a photograph of an actual installation on a frame dwelling. From the latter, it will be noted that the service wires, leading from the pole, are merely threaded through the holes in the upper bracket and dead-ended, by looping, at the lower bracket. The weight of the wires, between the pole and the building, always keeps the short vertical spans, between the upper and lower brackets, taut; this feature eliminates complaints on account of "noisy wires." It will further be noted, by reference to Figure 9, that, by removal of the center insulator, a three point bracket may be used in making a right angle turn with two wires and the wires kept parallel; insulators on the two point brackets are on 9 inch centers and on the three point brackets on 6 inch centers.

The design of these brackets is such that their use is practically universal, as they may be installed in either a vertical or horizontal position, or at any angle. This is an especially important feature, as the necessity of carrying stocks of a large variety of brackets for different types of service connections is eliminated. With the one, two and three point brackets, and the corner chairs, almost any type of connection may be made. As the brackets are shipped complete with insulators, it is not necessary to handle separate shipments of brackets and insulators; a considerable economy results from this fact. Fig. 5 shows a corner chair, designed to secure the brackets at corners, as shown in Figure 8.

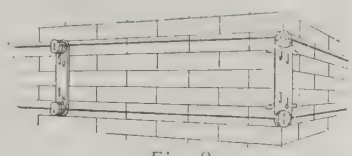

Fig. 8

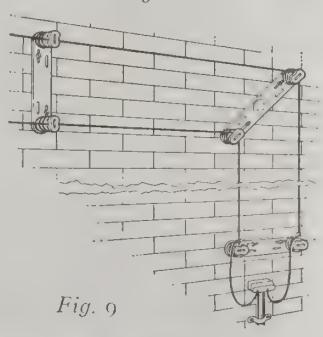

Fig. 9

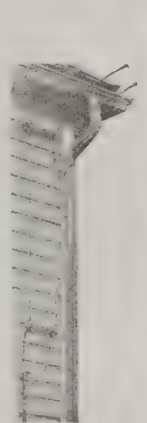

Fig. 6

Fig. 7

A comparison of Figures 6 and 7, both photographs of actual installations and in the same proportion, will show the improved appearance of service connections made with this new type of bracket over those made with wood brackets. Cost, installed, will compare favorably with those where wood brackets are used. It will be noted further that the stress from the weight of the wires leading from the pole is almost directly from the point of support; practically no leverage obtains as is the case where either wood or set "pin" type brackets are used. These brackets will also be found to be admirably adapted for supporting open feeders in industrial plants, mills, warehouses, etc., and can readily be attached to steel girders.

"Midget" Cloth-Cutter

The use of motor-driven cloth-cutting knives has been universal in the garment trade for many years where a great number of thicknesses were to be cut. On account of their weight and expense, it has not been found practical to cut single thicknesses with one of these cutters. A manufacturer of cutters has therefore designed their "Midget" machine, which is an exact reproduction of the regular size machines except that it is on a very small scale. As illustrated, the "Midget" weighs only 4¾ lbs. It is equipped with a motor that will operate on either direct or alternating current, which drives a circular cutting knife 3 in. in diameer, the knive being positively driven by worm gears.

There is an automatic sharpening device, and the machine is also equipped with a device which enables the knife to be lowered into the plate of the cutter, as it is worn away by the use of the sharpener. This device makes it possible for the knife blades to be used down to a very small diameter, which greatly reduces the expense of the operation of the machine.

It has been proven in actual tests in a number of factories that an operator with one of these Midget Eastman cutters can cut up as much work in an hour's time as he can cut in four hours cutting by the old hand method. The list price is $75.00 and in even such shops as merchant tailors and dressmaking establishments it will soon save more than that amount.

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Timing Device for Motor Starter

The use of the usual type of hand-operated motor starter sometimes results in hasty and improper starting of a. c. motors, because the speed of accelerating and cutting out the resistance from the motor circuit is left entirely to the judgment of the operator. With the new starter shown in the illustration the operator merely closes the motor circuit by throwing the lever up and the subsequent acceleration is automatic and the time can be adjusted as desired.

This controller consists essentially of two square shafts; the upper one carrying the main contacts and provided with a handle for operation, and the lower one carrying six fingers arranged in such a manner that they make contact with the stationary contacts in rotation; that is, one closes after the other, the time of closure being determined by a dashpot which prevents improper and hasty starting.

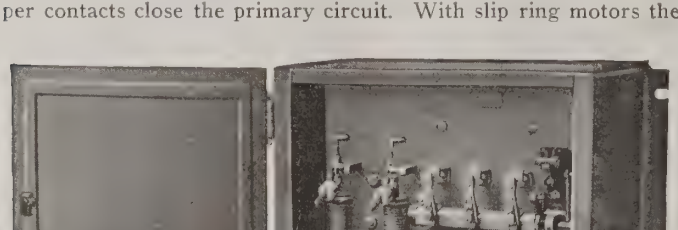
For the control of squirrel-cage motors, resistance is inserted in the primary circuit of the motor. After the closure of the main contacts on the upper shaft, the resistance which is in circuit and in series with the these main contacts is gradually cut out by the drum fingers on the lower shaft, and when all the fingers are closed, the resistance is short-circuited and the motor is directly connected across the line. As soon as the main contacts are closed, the no-voltage release is energized, and it then holds the main shaft in the closed circuit position. In case of failure of voltage, this no-voltage release releases the upper shaft and this opens the motor circuit completely.

If desired, a push button may be installed in this no-voltage release circuit so that the motor may be stopped from any convenient point, or relays may be connected in this circuit to open same and to automatically protect the motor against excessive load. The motor may also be stopped by pushing the operating handle to the extreme lower position, in which it engages the upper shaft and pulls it away from the no-voltage release, thereby opening the main contacts.

It will be noted that in the "off" position, the lower contacts are all closed and therefore the starting resistance is short-cir-

cuited, but these contacts are open before the upper contacts are closed so that the motor is always started with all the resistance in circuit. On the other hand, this arrangements allows the main motor circuit to be opened without first re-inserting the starting resistance into this circuit, an arrangement which is common on other types of manual starters and which is to some extent objectionable as it causes some sparking on the contacts while the resistance is inserted.

In case of slip ring type motors, the lower contacts control resistance in the secondary circuit of the motor while the upper contacts close the primary circuit. With slip ring motors the



fact that the resistance is not re-inserted in the secondary circuit of the motor before opening the primary circuit is particularly valuable as the sparking due to the opening of the primary is greater the higher the resistance that is inserted in the secondary circuit.

The current breaking capacity of the apparatus is large and the spacing of the primary contacts and their opening is such that no additional knife switch need to be installed for the complete separation of the motor from the circuit. This controller may be combined with such protecting devices as fuses or time limit overloads, which can be mounted directly on the same panel with the operating mechanism, making a self-contained unit.

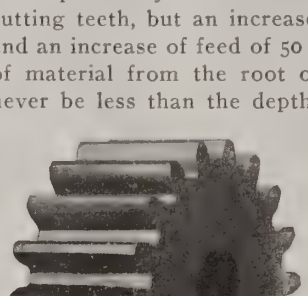
❖ ❖ ❖

Bakelite-Micarta Gears

Steel meshing with steel at high speeds produces vibrations that result in a loud piercing sound. Brass meshing with steel gives a less piercing sound of a lower pitch that is not so abjectionable. A non-metallic material mashing with steel results in a still further reduction in vibration and consequently of noise. Non-metallic material, however, to be suitable for gears must possess a mechanicadl strength sufficiently high to withstand the stresses involved without increaing the width of the face of the gear to abnormal limits. It must be hard enough to wear well and must not shrink or swell from oil or moisture, nor deteriorate in storage. The teeth too, should be able to withstand the service requirements without metallic reinforcement of their ends, so that the two mating gears can be made of equal width of face to obtain uniform wear over the entire wearing surfaces of both. A non-metallic gear is quiet in operation and will outwear many classes of metal gears. In addition, a non-metallic gear is slightly elastic and will aborb shocks that otherwise would result in broken teeth or severe vibration.

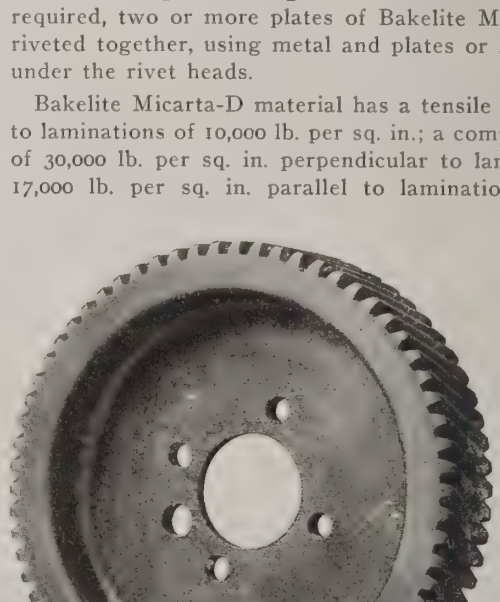
A non-metallic gear material which successfully meets all of these requirements has recently been placed on the market under the name of Bakelite Micarta-D. This is a product of heavy duck bonded together with Bakelite by heating while under an enormous pressure. It is as strong as cast iron, is unaffected by atmospheric changes, is vermin proof, and can be stored indefinitely without shrinkage or other deterioration. It can be used for gears that have to operate in oil, without any signs of swelling. In most cases neither bushings or shrouds are required as the material is self supporting. Where, however, the requirements are unusually severe or where the diameter of the gear is several times the width of the face, end plates may be advisable, but even in such cases the teeth need not be shrouded, and the width of the gear is determined only by the power to be transmitted.

Bakelite Micarta-D machines readily, and takes a good polish, machining best at high speed and with plenty of rake to the tool. It can be machined in any direction and drills and taps readily. The same tools are used as for steel when cutting teeth, but an increase in cutting speed of 25 percent. and an increase of feed of 50 percent. may be used. The depth of material from the root of the tooth to the bore should never be less than the depth of the tooth. In other words from bore to tooth should equal or exceed the distance from root of tooth to face of gear. And, if rivets are used the diameter of the hole must be subtracted from the distance from bore to root of tooth. Thus a smaller pinion or larger bore gear can be manufactured than with any other-non metallic gear material. At present this material is not made in thicknesses over two inches. Hence, when gears having a face of more than two inches are required, two or more plates of Bakelite Micarta-D must be riveted together, using metal and plates or standard washers under the rivet heads.



Solid Spur Gear

Bakelite Micarta-D material has a tensile strength, parallel to laminations of 10,000 lb. per sq. in.; a compression strength of 30,000 lb. per sq. in. perpendicular to laminations, and of 17,000 lb. per sq. in. parallel to laminations; a transverse



Gear for Automoblie Engine Timing System

strength of 17,000; a coefficient of expansion per inch per degree Centigrade, of 0.00002 inch in the direction parallel to laminations and of 0.000085 inch in the direction perpendicular to laminations. It has a specific gravity of 1.4, weighs 0.05 lb. per cu. in., and has a water absorption of 0.25 to 2 percent by weight, depending upon the relative amount of edge surface exposed. Shrinkage and oil absorption is practically zero.

Gears made of Bakelite Micarta-D can in general be substituted for steel, cast iron, or bronze gears, and with the same dimensions as the metal gears which they are to replace.

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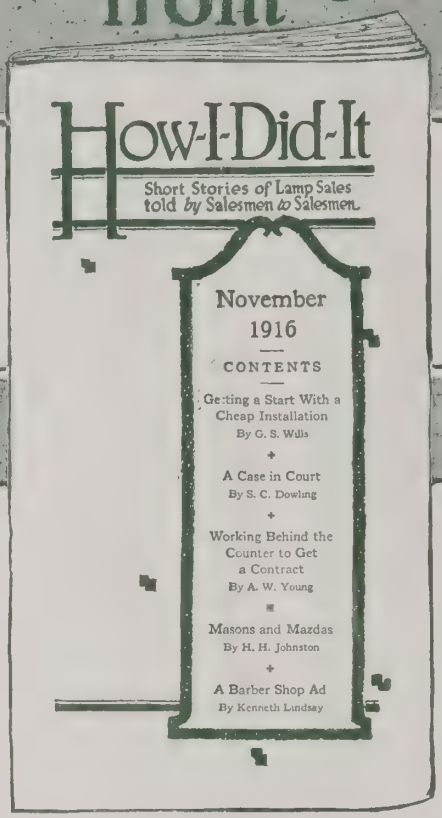

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