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March, 1908

ELECTRICIAN AND MECHANIC

INCORPORATING AMATEUR WORK

CONTENTS

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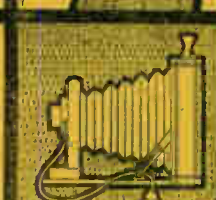


The Earning Power of Money Invested in Kornit

Most Satisfactory Progress Being Made At Our New Factory

HERE is a Financial Opportunity to make an investment in an up-to-date, energetic, money-making industrial manufacturing company, which owns all the United States patents, processes and exclusive rights for producing Kornit, a product never before manufactured nor sold in this country. The demand for Kornit is great and the profit of manufacturing and selling is ENORMOUS. Read every word of this announcement and ACT AT ONCE.

THE STORY OF KORNIT

By President CHARLES E. ELLIS

KORNIT was invented by JOHANN GUSTAV BIERICH, a subject of the Czar of Russia, residing at Menkenhof, near Lievenhof, Russiar and is a homogeneous Horn or Hoof substance. Kornit is produced by grinding horn and hoof shavings and waste into a palpable powder and then pressing under heavy hydraulic pressure with heat into a homogeneous slab. This slab produces a substance which can be sawed or turned the same as ordinary wood. It is of a beautiful black consistency and IS EXTREMELY VALUABLE as a NON-CONDUCTOR FOR ELECTRICAL SUPPLIES. It is a matter of record that the electrical industry in this country AT THIS TIME DOES NOT HAVE a satisfactory material for heavy or high insulating purposes. A slab of Kornit one inch thick was tested in Trenton, New Jersey, by the Imperial Porcelain Works and was FOUND TO HAVE RESISTED 96,000 VOLTS OF ELECTRICITY. It may be interesting to note here that the heaviest voltage which is transmitted in this country is between Niagara, Buffalo and Lockport, New York. The voltage transmitted by this company is between 40,000 and 50,000 volts. Kornit is equally as good as a non-conductor for electrical purposes and supplies as is hard rubber.

The average price of hard vulcanized rubber for electrical purposes is to-day considerably over one dollar per pound—at the present writing something like $1.25 per pound.

KORNIT CAN BE SOLD AT TWENTY-FIVE CENTS PER POUND, and AN ENORMOUS profit can be made at this price, so that it CAN EASILY BE SEEN that where Kornit is EQUALLY AS GOOD and AS A MATTER OF FACT, in many instances, a BETTER non-conductor than hard rubber, it can compete in every case where it can be used with great success on account of its price. For electrical panel boards, switchboards, fuse boxes, cutouts, etc., there are other materials used, such as vulcanized paper fibre, slate, marble, etc. A piece of vulcanized paper fibre, 3x4x1 inch, in lots of 1,000 brings 20 cents per piece. A piece of KORNIT of the SAME DIMENSIONS could be sold with the ENORMOUS PROFIT OF OVER 100 PER CENT. at ten cents. The absorptive qualities of Kornit render it such that IT IS FAR PREFERABLE to that of vulcanized fibre. It will not maintain a flame. Of all the materials which are now in the electrical market for supplies and insulators there is, as we have stated above, none that are satisfactory. Kornit will fill this place. Its tensile

MR. JOHANN GUSTAV BIERICH, THE INVENTOR OF KORNIT, IN HIS SUMMER GARDEN AT MENKENHOF, RUSSIA.

strength per square inch averages from 1,358 pounds to 1,811 pounds, which the reader can readily see IS MORE THAN SATISFACTORY. This test was made by a well-known electrical engineer. who is now acting in that capacity for the United States Government, with a Standard Reihle Bros. Testing Machine.

Waste horn and whole hoofs are being sold by the ton today principally only for fertilizing purposes. There is one town alone, Leominster, Mass., where they have an average of eight tons of horn shavings every day. These waste horn shavings are now only being sold for fertilizing material. These eight tons of horn shavings manufactured into Kornit and sold for electrical purposes would easily bring $3,000. At this price it would be selling for less than one-fifth of what hard rubber would cost, and about one-half what other competitive materials would sell for, even though they would not be as satisfactory as Kornit.

Kornit has been in use in Russia about four years. In Riga, Russia, which is the largest seaport town of Eastern Russia, the Electrical Unions there are using Kornit with the greatest satisfaction, finding it preferable to any other insulating material.

The expense of manufacturing Kornit from the horn shavings is not large, as the patentee, Mr. Bierich, has invented an economical and satisfactory process which produces an article that in the near future will be used in the construction of almost every building in this country.

Besides electrical insulators Kornit can be used for the manufacturing of furniture, buttons, door handles, umbrella, cane, knife and fork handles, brush and sword handles, revolver handles, mirror backs, picture frames, toilet accessories, such as fancy glove boxes, jewel cases glove stretchers, shoe lifts, etc., office utensils such as paper knives and penholders, ink stands, pen racks medical instruments such as syringes, ear trumpets, etc., etc., pieces for games, such as draughts, chessmen, dominoes; checkers, counters, chips, cribbage boards, etc.; telephone ear pieces, stands, etc., piano keys, typewriter keys, adding machine and cash register keys, tea trays, ash trays, scoops, mustard and other spoons, salad sets, cigar and cigarette cases, cigar and cigarette holders, match boxes, and hundreds of other useful and ornamental articles, all at a large and remunerative profit

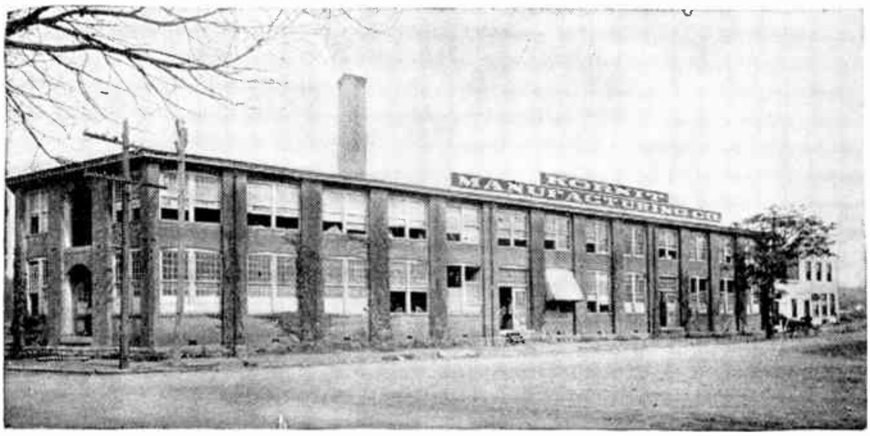
The Great Demand for Kornit in this Country

THERE is one manufacturer ALONE here in New York that uses 60,000 square feet of insulating material for panel boards every year. He is now using slate and marble, but IT IS NOT SATISFACTORY, for the reason that in boring and transportation IT BREAKS SO EASILY. KORNIT WILL ANSWER THE PURPOSE OF MANUFACTURING PANEL BOARDS VERY MUCH MORE SATISFACTORILY. On 60,000 square feet of Kornit there would be a net profit of over $30,000, or 50 cents for every square foot used. THIS ONE EXAMPLE is cited to show you THE ENORMOUS PROFITS which can be made. There are a great many other panel and switchboard manufacturers in this country. You may be interested to know that a panel board is a small switchboard. There is one or more on every floor of all large buildings where electricity is used. They each have a number of switches mounted on them, so that those in charge can turn certain lights on or off, and by these panel boards all the electrical power in the building is controlled. They must be of a reliable non-conducting material. Kornit can be used for this purpose almost exclusively. The largest electrical manufacturing concerns in Riga, Russia, ARE USING

KORNIT ONLY FOR THIS PURPOSE, after having tried all other so-called non-conducting compositions. The electrical trades alone can consume a great many tons of Kornit every day in the year. If only two tons of Kornit is manufactured and sold every working day in the year IT WILL ENABLE THE KORNIT MANUFACTURING COMPANY TO PAY 16 PER CENT. DIVIDENDS EVERY YEAR. Of course, if four tons a day are sold the dividends would be 32 per cent. per year. THIS IS NOT IMPROBABLE. AN EXPERT ELECTRICAL ENGINEER who holds one of the most responsible positions here in New York City, made the statement, after thoroughly examining and testing Kornit for electrical purposes, that in his most conservative estimation there can be ten tons of manufactured Kornit sold every working day in the first year. This would mean that the Kornit Manufacturing Company would pay a dividend out of its earnings the first year of over seventy-five per cent. (75%). This is probably more than will be paid the first year, but there certainly seems to be a good prospect of paying a large dividend the first year.

THERE WILL BE SUCH AN ENORMOUS DEMAND FOR KORNIT AFTER IT BECOMES INTRODUCED THAT FROM YEAR TO YEAR THE DIVIDENDS EARNED WILL BECOME LARGER AND LARGER. THIS IS THE BEST OPPORTUNITY TO MAKE AN INVESTMENT THAT YOU HAVE EVER HAD.

It is a well-known fact that THE MOST LEGITIMATE and PROFITABLE way to MAKE MONEY is by manufacturing some product that is "NECESSARY" and ONE THAT CAN BE FULLY CONTROLLED so that nobody else can manufacture the same article. Look at Sugar (which is protected by a high tariff); at Standard Oil, the Telephone, the Telegraph, and we might go on and enumerate many more monopolies. THEY ARE THE BIG MONEY MAKERS OF TO-DAY. KORNIT CANNOT BE MANUFACTURED BY ANYBODY IN THIS COUNTRY EXCEPT OURSELVES OR OUR AGENTS. We own all the patents issued by the UNITED STATES GOVERNMENT to the inventor, MR. JOHANN GUSTAV BIERICH, IN RUSSIA. These patents HAVE BEEN BOUGHT from Mr. Bierich, and ARE DULY TRANSFERRED TO THE KORNIT MANUFACTURING COMPANY, and the same is DULY RECORDED IN THE PATENT OFFICE OF THE UNITED STATES.



KORNIT FACTORY, NEWARK, N.J. (BELLEVILLE STATION), ENTIRELY CONSUMED BY FIRE, MARCH 1, 1907.

We are Building A Fine Factory

ON March 1, 1907, our Factory, which had just been thoroughly equipped and completed, was burned to the ground!

Since that time we have purchased the Real Estate and are now building OUR OWN Factory. It is promised that it shall be finished and in working order during the present month. All our machinery is ordered and the greatest part is already completed ready to install as soon as our new Factory Building is ready.

A few shares obtained now may be the foundation for a fortune of the much-desired income for support in the unknown years that are to come. We leave it to you if it would not seem good judgment to take immediate advantage of this opportunity. Anyway, please write me at once and let me know just what you will do. If it is not possible for you to take shares now, write me and tell me how many you would like and how soon it will be convenient for you to do so, provided I will reserve them for you. As soon as I receive your letter I will answer it WITH A PERSONAL LETTER AND WILL ARRANGE MATTERS AS YOU WISH TO THE BEST OF MY ABILITY.

REMEMBER, I HAVE A GREAT MANY THOUSAND DOLLARS INVESTED IN THE KORNIT MANUFACTURING COMPANY, and the minute you buy a share or more in this Company, we become CO-PARTNERS, as CO-SHAREHOLDERS. It is for our mutual benefit to watch and guard each other's interests. I WILL BE GRATEFUL IF YOU WILL WRITE ME TO-DAY, so that I may know just what you will do.

I know you will agree with me that you have never had presented to your notice a better opportunity to make an investment where such large profits can be made because of the exclusiveness of control and the great demand and the low cost of the raw material, which is now almost practically thrown away. Join me in this investment, and I assure you that it is my sincere belief that in the near future you will say, "That is the day I made the most successful move in my whole life."

My Offer to You To-day

THE KORNIT MANUFACTURING COMPANY is incorporated under the laws of New Jersey, and is capitalized with 50,000 fully paid non-assessable shares at $10 each. It is my intention to sell a limited number only of these shares at the par value of $10 each. Ten dollars will buy one share. Twenty dollars will buy two shares. Fifty dollars will buy five shares. One hundred dollars will buy ten shares. One thousand dollars will buy one hundred shares, and so on. After you have bought one or more shares in the Kornit Manufacturing Company you may feel, as I do, that you have placed your savings where they will draw regular and satisfactorily large dividends.

I should not be a bit surprised if these shares paid dividends as high as one hundred per cent. in the not far distant future. Consequently, a few dollars invested now in the shares of the Kornit Manufacturing Company will enable you in the future to draw a regular income from the large profits of the Company as they are earned. The dividends will be paid semi-annually, every six months, the first of May and November of each year. This is one of the best opportunities you will ever have presented to you in your whole lifetime. I have invested a great many thousand dollars in the Kornit Manufacturing Company, and I feel sure it is one of the best investments I have ever made. I can truthfully say to you that I fully believe that you will be more than pleased with your investment and that you will never be sorry. Remember, that you have here an opportunity to become interested in a large industrial manufacturing concern manufacturing a product with an exclusive monopoly, which has never before been manufactured or sold in this country.

Remember, that it is by no means an experiment, as it has been successfully manufactured and sold for over four years in Russia at a large profit, and the manufacturer and inventor recently wrote that the demand is increasing every day beyond the capacity of their manufacturing facilities.

Now is the time for you to take advantage of this magnificent opportunity to make an investment in these shares. I EARNESTLY BELIEVE that in a few years THESE SHARES WILL BE WORTH FROM FIFTY DOLLARS TO ONE HUNDRED DOLLARS each on account of THE LARGE DIVIDENDS which the company will earn and regularly pay each and every six months. It is a well-known fact that shares that pay fifty (50) to one hundred (100) per cent. dividends will readily sell in the open market for $50 to $100. THE OUTLOOK FOR THE KORNIT MANUFACTURING COMPANY is such that it seems impossible for the earnings to fall far short of these figures. If the company only makes and sells two tons of Kornit a day for the first year and made a profit of only $200 per ton it would mean a profit of over sixteen per cent. (16%) the first year. If this business were doubled the second year, of course the earning capacity would double and the dividends would be over thirty-two per cent. (32%). Prominent and well-known Electrical Engineers assure me that this product cannot help and is bound to make enormous profits. I would recommend that you send for as many as you wish at once. You, in my conservative opinion, can safely count on the large earning capacity of these shares. I will at once write you a personal letter with full information, and send you our illustrated book "A Financial Opportunity," containing a score of photographs of the Kornit industry, taken in Russia. Please let me hear from you.

Yours very truly.

CHARLES E. ELLIS

President

607a West 43d St., New York City, N.Y.

Mr. Ellis, besides being President of this company, is also President of two other large and successful companies. owning shares therein valued conservatively at over $250,000. Mr. Ellis has other investments in New York City real estate, bonds, stocks and mortgages to the amount of many more hundreds of thousands of dollars. Any bank or mercantile agency will tell you his guarantee is as good as gold. This is a successful man who wishes you for a Co-partner, as a Shareholder and Dividend Receiver in this company. Remember, you will do business personally with Mr. Ellis in this matter.

ELECTRICIAN
AND
MECHANIC

INCORPORATING

BUBIER'S POPULAR ELECTRICIAN, ESTABLISHED 1890

AMATEUR WORK, ESTABLISHED 1901

VOL. XVIII MARCH, 1908 NUMBER 9

ELECTRICAL ENGINEERING — Chapter XXI.

Protective Apparatus

A. E. WATSON, E.E., PH.D.

Electric circuits are peculiarly subject to disturbance from accidents. Naturally associated with delicate and sensitive apparatus, interference from almost any untoward source is at once felt, often in violent degree, alike dangerous to person and apparatus.

Interference with the normal working may come from within the dynamo machinery itself, due to the breaking down of the insulation, from accidental or mischievous tampering with the exterior circuits, or from the action of elements. From the first cause, if the accident is in the original source of the currents, there is little remedy. If an armature is overloaded to an excessive amount, there is no reason why the abnormal heat should not burn out the insulation and destroy the winding. Once the trouble is away from the machine, various protective devices can be inserted that will localize or minimize its disastrous effects.

The necessity for some such devices was apparent from the very first installations of electric lamps on the constant potential, or "Edison" system. In this, every lamp was directly connected across the two main wires, and any defect in the lamp socket or in the wiring, or from malicious or curious meddling with the wires, means a direct short-circuit through which the entire dynamo power might try to send an unlimited current. Aside from the flash and consequent danger of burning the person, the wires leading to the fault might be quickly heated to such a degree as to constitute a real fire risk, and if the trouble was between sufficiently large conductors, to derange the entire system, and also endanger the dynamos and switchboard apparatus. Relief from such troubles, — increasing naturally with the size of the installation,— was found in the insertion of "fuses" at proper intervals,— wires or strips of readily fusible metal, composed of a mixture of lead and tin about the same as fine solder; the current for every branched circuit was made to pass through a suitable piece of this alloy, and in case of an abnormal demand, the fuse would melt, and prevent the trouble from spreading further. A regular rule is now insisted upon to put fuses wherever the size of wire changes, thereby protecting the smaller wire. As the distributing mains reach further and further from the station, the amount of current for any locality diminishes, and it is economy to reduce the size of the conductors. By apportioning the fuses to fit the current carrying capacities of the different sizes of wire, as determined by the result of years of practical experience, derangement and danger are reduced to a minimum. Also in the house wiring, main fuses are found in the entrance cabinet, so that an accidental short-circuit there will merely "blow" them, but not interfere with the neighbors' service. Smaller fuses are placed in each individual circuit to the different rooms or fixtures, so as to localize faults in each, without leaving the entire house in darkness. Formerly it was the practice to fuse every lamp, but this practice interferes with artistic features and is not now common. From five to twelve ordinary lamps can be connected on the same circuit without violating insurance rules or good engineering practice.

The house cabinets make convenient and appropriate locations for these final fuses, and when comprised in the familiar Edison "screw-plugs," make a combination destined to be well-nigh final. As compared with the earlier preposterous plan of putting the fuses on the ceiling, in boxes far from fire-proof, often requiring the use of a screw-driver, and frequently in the dark, at the top of a rickety step-ladder, the present orderly method can be the better appreciated. This allowance for convenient and safe "fusing," was one of the most perfect details of the Edison system. To provide against danger of destructive arcs forming after the melting of a fuse on 220 and 250-volt circuits, the fuses are now commonly enclosed in paper tubes filled with plaster, but the original form, merely covered with a brass cap, is entirely sufficient for low voltage circuits.

In their original development of the underground system of conductors, the Edison Company devised very effective and complete varieties of junction and service boxes. These were made of cast iron, their covers level with the pavement, and strong enough to withstand the heaviest vehicular traffic. Below the upper cover was a water tight one, and in the enclosed space were the various fuses tying together conductors of the same polarity. From these junctions the individual customers were also supplied, of course through separate and properly proportioned fuses. Within the customer's premises were in addition somewhat smaller fuses, so that in cases of ordinary accident, these accessible ones would be the ones to melt, reserving the function of the outdoor ones to care for more unusual conditions, especially the failure of the insulation of the service wires in the street.

A fuse, however, is a safety device that like the fusible plug in the bottom of a steam boiler, is there for emergency, but not expected to be of frequent necessity. It is merely a sort of insurance against serious accident. There are circuits of another sort that may be in need of control from excessive currents, and the demands for momentary large current so frequent as to make the repeated renewal of fuses inconvenient, slow, and even dangerous. Such are power circuits, especially of the railway sort. If an injudicious motorman tries to start a car too quickly, or to go up a grade at too high a rate, the demand for current may exceed the safe capacity of the motors, and the necessity for a fuse or its equivalent is always needed. Then too, there may be some break-down of the motor or the controlling devices, and precautions against accidents of this sort must be provided. To prevent the formation of the destructive arcs that would readily follow the rupture of such energetic currents, the fuse boxes are made of the "magnetic blow-out" type. In this the fuse lies between the poles of an electro-magnet,—energized by the current sought to be broken, and in consequence of the action of the magnetic field, the arcs are forcibly swept away.

The principle of the magnetic blow-out is merely the motor rule as illustrated by the fingers of the left hand, and explained in Chapter VII. The experiment is strikingly carried out by means of a strong permanent magnet held flatwise close to the arc of an electric lamp. With the current flowing down through the carbons, and the north pole of the magnet on the right, the arc will be strongly deflected away from the person. Turning the magnet over will allow the arc to come nearer. Too close a holding of the magnet will completely extinguish the arc, though by the automatic action of the feeding mechanism the arc will form immediately after each extinction. Prof. Thomson patented the application of the magnetic blow-out to uses in apparatus for effectually and safely breaking powerful currents, and thereby for a time monopolized one of the most useful principles of controlling electric circuits. The applications of this principle were not limited to ordinary working circuits but extended to a highly serviceable form of "lightning arresters." One of the most trying conditions for a railway power

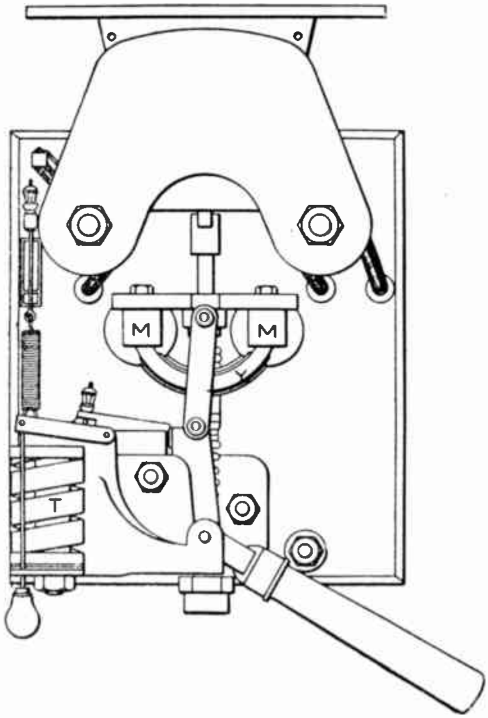


Fig. 108
Circuit Breaker of the Magnetic Blow-out Type

house occurs immediately after a street blockade, — of frequent occurrence in cities, — for then the whole line of cars may try to start at the same instant. The demand for current may exceed the safe capacity of the generators or of the particular feeders. The supply must momentarily be withdrawn, but to break a current of say a thousand amperes under a driving force of 500 volts, without injury to the switch or other device, is no simple matter. When the coming-off the wire of an ordinary trolley, breaking a current of 50 amperes is attended with a flash a foot long, what will the larger current do? Without suitable precautions to prevent the flash or arc, the destruction of an entire switchboard would be invited.

Prof. Thomson's circuit-breaker, as made for currents as high as 3,000 or even 5,000 amperes, is shown in front view in Fig. 108, and a diagram of the connections in Fig. 109. In the lower left-hand corner is seen the tripping coil T, through which all the current passes. It is made from a copper spiral of few turns, and no small ingenuity has been displayed by the builders in devising means for winding it of the large size of copper needed. Over the iron core within this spiral is an armature, pivoted as seen, and restrained by an adjustable spiral spring just over it. Extending from this armature to the right of the pivot is a trigger, and when the "breaker" is set, the toggle joint in the middle of the figure is so engaged as to be prevented from opening. A stiff spiral spring, just discernible behind the toggle, has its lower end fastened to the bottom casting, but its upper to a vertically sliding rod that carries at its middle a semicircular bridge Y composed of a large number of thin copper sheets, and at its upper end a solid copper wedge that fits between a pair of "blow-out" contacts. The lamellar copper bridge is normally pressed into firm contact with the two flat contacts M, its separate edges providing a joint of almost no resistance. At the top of the figure is seen a curved casting, but in reality there are two such, each about half an inch thick, connected together with two iron cores about three inches long, around which are the coils for producing the magnetic field. These coils are of wire about a quarter of an inch in diameter, but do not carry appreciable current for more than an instant.

In operation the current normally flows through the coil T to the left-hand contact M, through the bridge Y to the other contact M, and then to the outer circuit. With so good a path at the bridge there is little current flowing in the magnet coils at the top. If now an abnormal current flows, the armature over T is pulled down, thereby releasing the toggle,

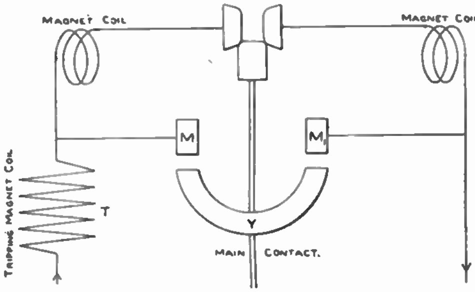


Fig. 109
Connections of Magnetic Blow-out Circuit Breaker

which, under the pull of the spring, is jerked open towards the left, and the connection between M and Y is broken. If this was all, however, the current would still flow across the relatively small gap, to the destruction of the instrument and the failure to protect the apparatus in the desired manner. Although Y has separated from M there still remains for an instant an alternative path through the magnet coils at the top. The abnormally large current magnetizes the pole pieces to high degree, and when the final break does take place, at the separation of the wedge from the blow-out contacts, the arc finds itself in a powerful magnetic field, and is blown violently upwards through the fibre-lined chimney. With large circuit breakers the rupture of the arcs is accompanied with a crack like that of a pistol-fire. The circuit is quickly and safely closed again by an attendant pulling down the handle. In case it is desired to open the circuit purposely, and not endanger the main switch on the switchboard, or to produce a blinding flash, the circuit breaker is the device to use, by pulling down the armature by means of the knob shown at the lower left-hand corner.

So successful have been these circuit-breakers that they have been copied in various sizes and styles and used on various other sorts of circuits. On the railway cars themselves, especially the large ones, they have very properly displaced the simple fuse. Aside from the convenience of again closing the circuit, after the fault has presumably been removed, there is the extra advantage of greater exactness in the point at which the circuit will be opened. An ordinary fuse is quite erratic or indeterminate in this respect. The length of the fuse, the form and mass of the blocks to which it is attached and the opportunity for radiating its heat all interfere with an exact prediction as to the particular strength of the current that will produce fusion. The present approved forms of enclosed fuses are largely free from these interfering influences, but their cost renders their use prohibitive for places liable to frequent service.

The magnetic type of circuit-breaker is not the only possible form, for other constructions, more nearly resembling ordinary switches, are somewhat cheaper, and have demonstrated their worth. In these the current normally flows through copper contacts, but when tripped by the action of the electromagnet or solenoid, this contact is broken, but the final break takes place from carbon blocks at the top. Though somewhat burned by continued use, these blocks are of inconsequent expense and are readily renewed.

For storage battery use, a circuit breaker is needed that will open under reversed conditions, i.e. when the charging current from the generator gets below a certain minimum. This is needed to prevent the batteries from needless discharge, and especially in case a compound-wound generator is employed, for then an accidental discharge of the battery would mean a reversal of polarity of machine, with opportunities for serious accident. For such a contingency, it would be hoped that the over-load circuit breaker would be able to open the circuit, and protect the apparatus from actual injury, but in some cases the violence of the discharge of the battery,—with the dynamo in series conspiring to magnify the disorder,—is such as to destroy the protective apparatus itself, and burn out the armature.

One of the first troubles experienced with aerial electric lighting circuits was from lightning. When the wires were struck, the discharge would reach the windings of the dynamo, then rather than pass through the coils, would jump to the iron cores, and then the dynamo current itself would follow the path of the rupture and complete the destruction of the insulation. To devise means for protecting the dynamos from such untoward influences would seem almost impossible. Yet the means have actually been found, remarkable in simplicity and efficacy. The principle of the magnetic blow-out was really first invoked to provide the immunity desired. Following earlier phraseology adopted in telegraph matters, the devices were curiously denoted as lightning "arresters." This is really a misnomer, for of all things, a person would not try to "arrest" lightning. The opposite is the real intention, that is, to let it go, and that by the most direct route to the ground. Perhaps lightning "deflectors" would have been a more correct expression.

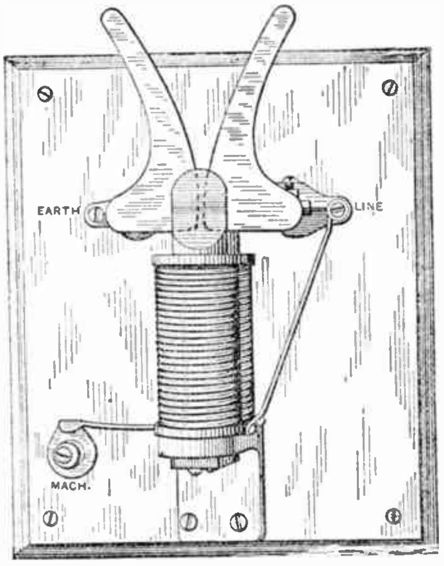


FIG. 110
Magnetic Blow-Out Lightning Arrester for Arc Circuits

The simple form of arrester devised by Prof. Thomson for use on series arc lighting circuits is shown in Fig. 110. A vertical electro-magnet is attached to a board for fastening on the wall or switchboard; a space of about an inch and a half intervenes between the poles, and in the middle of this space two brass "horns" are fixed, with their nearest edges about a thirty-second of an inch apart. Of these the right hand one is attached to one end of the winding, while the other horn is "grounded." The other end of winding is brought out to a third terminal. In actual use one of these devices is inserted in each of the line wires, the winding being of a sufficient size to carry the entire current, which however never exceeds ten amperes. The iron is therefore always magnetized, and if any lightning discharges come in on either wire, the inductance of these coils is such as to incourage the jumping of the spark or flash over the small gap, and to pass at once to the ground. In times of storm it is expected that considerable leakage of current from the regular line insulators or from contact with trees, so that as soon as another ground is provided by the lightning jumping the narrow crevasse, the dynamo current will follow it and maintain a destructive current after the original cause had passed by. Especially would this be the case if the jumping at the gaps in both arresters took place simultaneously, for then the double ground would leave the dynamo operating directly upon a short-circuit. The magnetic field embracing the horns, together with the natural tendency of heated air to rise, urges the arc to higher portions of the horns, until at length the distance is too great, and the arc breaks. Actually the whole performance is rather rapid, the arc or flame quickly passing up and off like a momentary flame.

Similar constructions of arresters are commonly placed on street cars, directly in the circuit between the trolley and the controller. It is worth noting, however, how simple an expedient made their operation quite reliable as compared with previous erratic performance. Violent discharges of lightning are usually of the oscillatory character, that is instead of one single passage of the current, there are many, in successively opposite directions, with a frequency approaching millions per second. These discharges therefore behave like alternating currents of extremely high frequency, and a coil of even a few turns of wire may offer serious impedence to their passage. To compel the lightning to jump the small gap rather than enter the motor and there puncture the insulation, four or five turns of wire wound on a wooden core for stability, entirely suffice to secure the desired protection. To an ordinary observer these "choke" coils appear useless and meaningless, but to the expert engineer or scientist they speak silently of a notable triumph of man over some of the most mysterious and dreaded forces of nature.

Alternating current circuits present special problems in the matter of protection from lightning. Due to the great area embraced, especially in long distance transmissions, where the storms are protracted and severe, such circuits are particularly subject to collecting heavy static charges or to be struck by direct bolts. The magnetic type of arrester has been found unsuitable for alternating currents, and recourse to other constructions has been compulsory.

Without trying to describe all the various styles that have been tried, it will be sufficient to mention one sort, that with various modifications to fit the de-

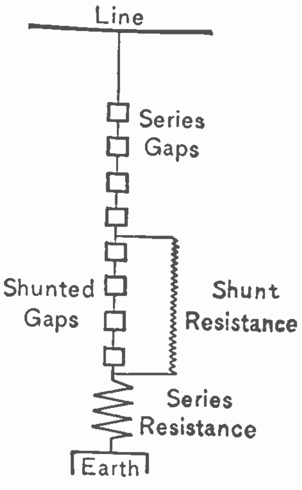


FIG. 111
Arrangement of Lightning Arresters for High Voltage A. C. Circuits

mands of higher and higher voltages of generators embodies the most successful features.

Almost by accident, Mr. Wurts, of the Westinghouse Company, found that alternating currents would not sustain arcs between balls or cylinders of cadmium, or certain cadmium alloys. Lightning could jump across the narrow gaps, but the dynamo current could not follow. Of course the actual number of such gaps to interpose in a given circuit was a matter to be found out by experiment. For circuits not exceeding 1,500 volts, seven cylinders were found insufficient, and these were arranged in a row in porcelain holders placed in an iron box and mounted on the poles. The end cylinders were attached directly to the two line wires, and the middle one to the ground.

For high potentials, 10,000 volts or more, further gaps and resistances of other sorts have been tried with success, each of the factors serving to contribute its qualities to the proper working of the entire apparatus. These comprise (a) series gaps,— a number of the sort of gaps just described; (b) other gaps shunted through resistances or by paths; and (c) series resistances. A diagram of the arrangement is given in Fig. 111. One such arrester is attached to each line wire at each end of a given transmission line. When sufficient accumulation of electricity has taken place on a wire, or if the line has been "struck," the discharge takes over the series gaps, and for ordinary disturbances may flow then through the shunt resistances and then the low series resistance to the ground. A heavier discharge will meet such opposition in the shunt resistance as to be compelled also to jump the shunted gaps. The arc formed by the dynamo current following the lightning flash will be quickly eliminated by the continuous path afforded by the shunt resistance, and then this resistance to-

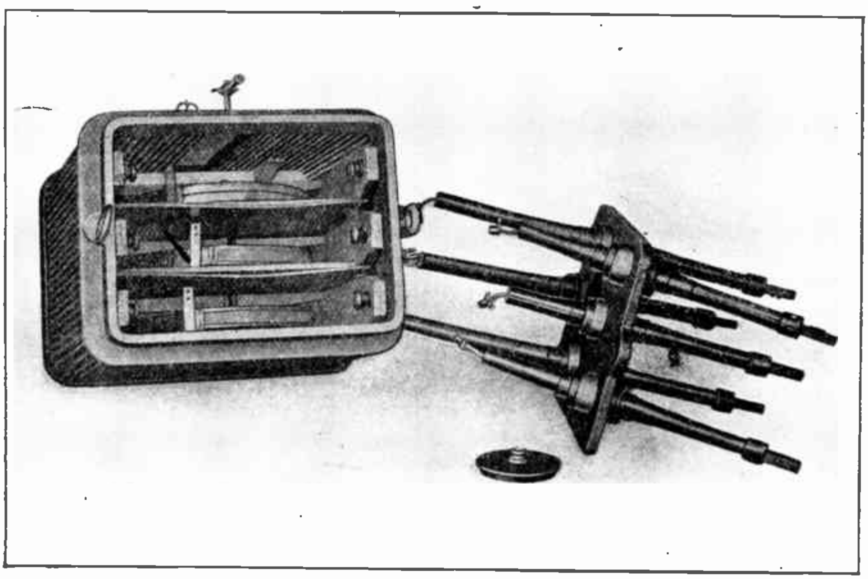


FIG. 112. Choke Coils

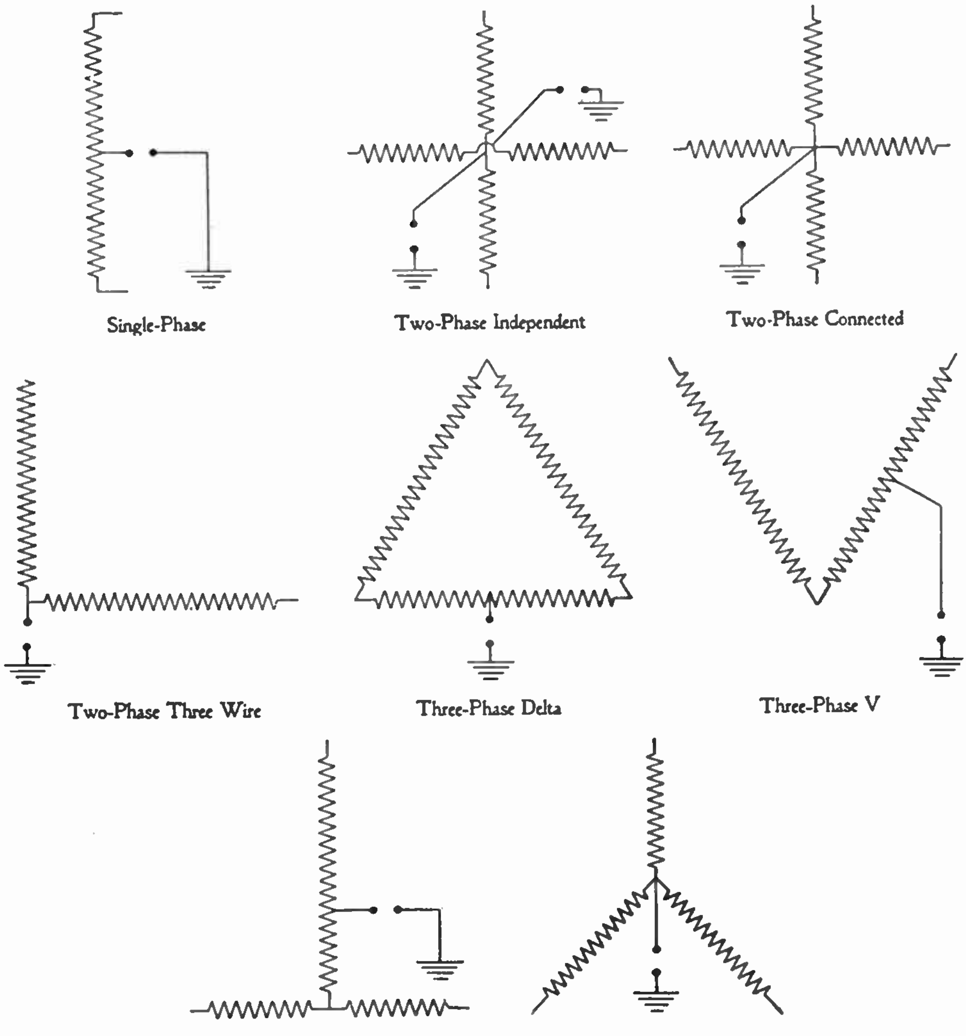


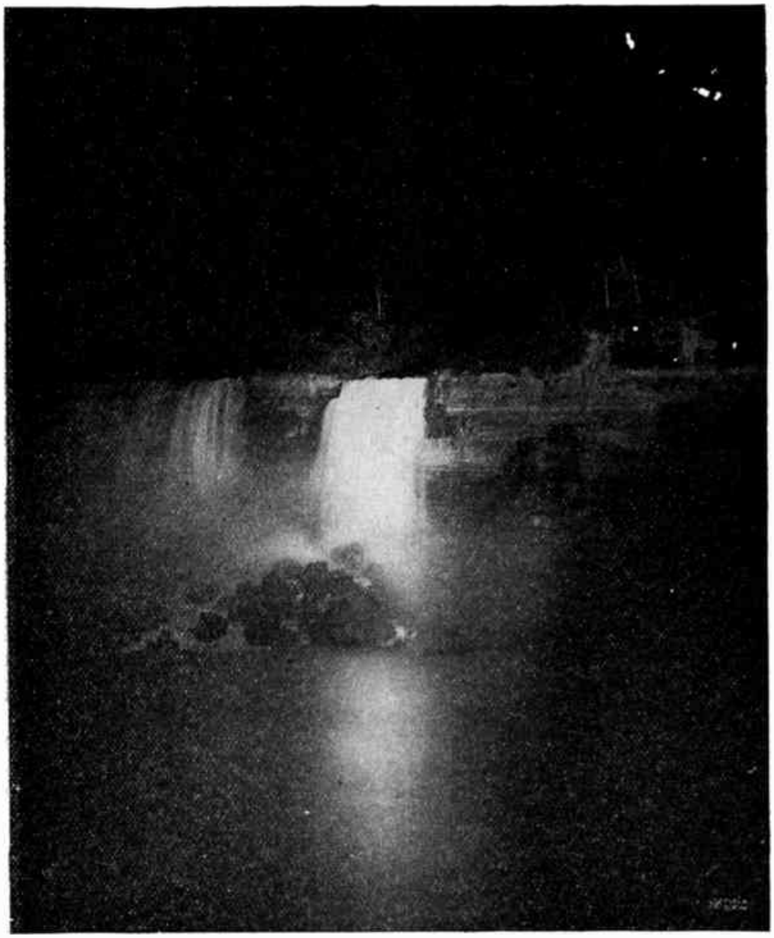
FIG. 113
Location of Spark-Gap or Ground Connections for Various Arrangements of Transformer Secondary Circuits

gether with that of the series portion and of the series gaps will completely suppress the entire flow to the ground.

To make the operation still surer, and protect the generators from even minor discharges, choke coils are inserted in each of the mains, between arresters and switchboard apparatus. Such coils need to be extremely well insulated, and though often suspended on brackets in some open place behind the switch-board, are better submerged in tanks filled with paraffin oil. Fig. 112 shows a triple-pole device of this sort, adapted for high potential three phase circuits. The long leads are covered with hard rubber, the design being to remove the opportunity of side-flashes. The arresters are usually placed on the outer walls of buildings, but considerable favor is found in placing this part of the auxiliary apparatus in separate and small structures adjoining the main power houses. Destruction by lightning of such buildings is of small consequence compared with that of the loss of the main works.

For the various methods of grouping the circuits of alternating current generators, particular methods of attaching the arresters should be followed, with the idea to allow disturbances from lightning produce the least derangement of the system and freedom from personal danger. When transformers, too, are to be protected, the possibilities of variations are quite numerous, and a representation of eight standard groupings with proper locations of grounds is clearly given in Fig. 113. These windings are on the low tension side, as the primaries are supposedly protected by their own arresters. For these low voltage windings a single spark gap is sufficient, and in case the voltage is not over 250, actual permanent grounding of these points is not only permitted but encouraged by insurance regulations. While such grounding invites danger of breakdown of the insulation between primary and secondary windings by providing a nearly metallic path from line to ground, it also forbids the existence of any other ground anywhere in the wiring. Should such be encountered, the fuses would immediately blow and require repairs before again establishing the service.

With grounds thus purposely provided, there is not the need that was formerly felt for "ground-detectors." Some can still be found, however, in isolated plants. The simplest form consists in putting two lamps in series across the main bus-bars of the switchboard. The wire that connects these two lamps is connected to ground. Every day, or as often as desired, the current is turned on, but normally the lamps burn very dim. If a ground is actually encountered in the wiring, it short-circuits one of the lamps, thereby allowing full voltage to be impressed upon the other, at once raising it to normal incandescence. The ground is then to be looked for on the wire to which the extinguished lamp was connected.



Bridal Veil Falls Illuminated by Searchlight

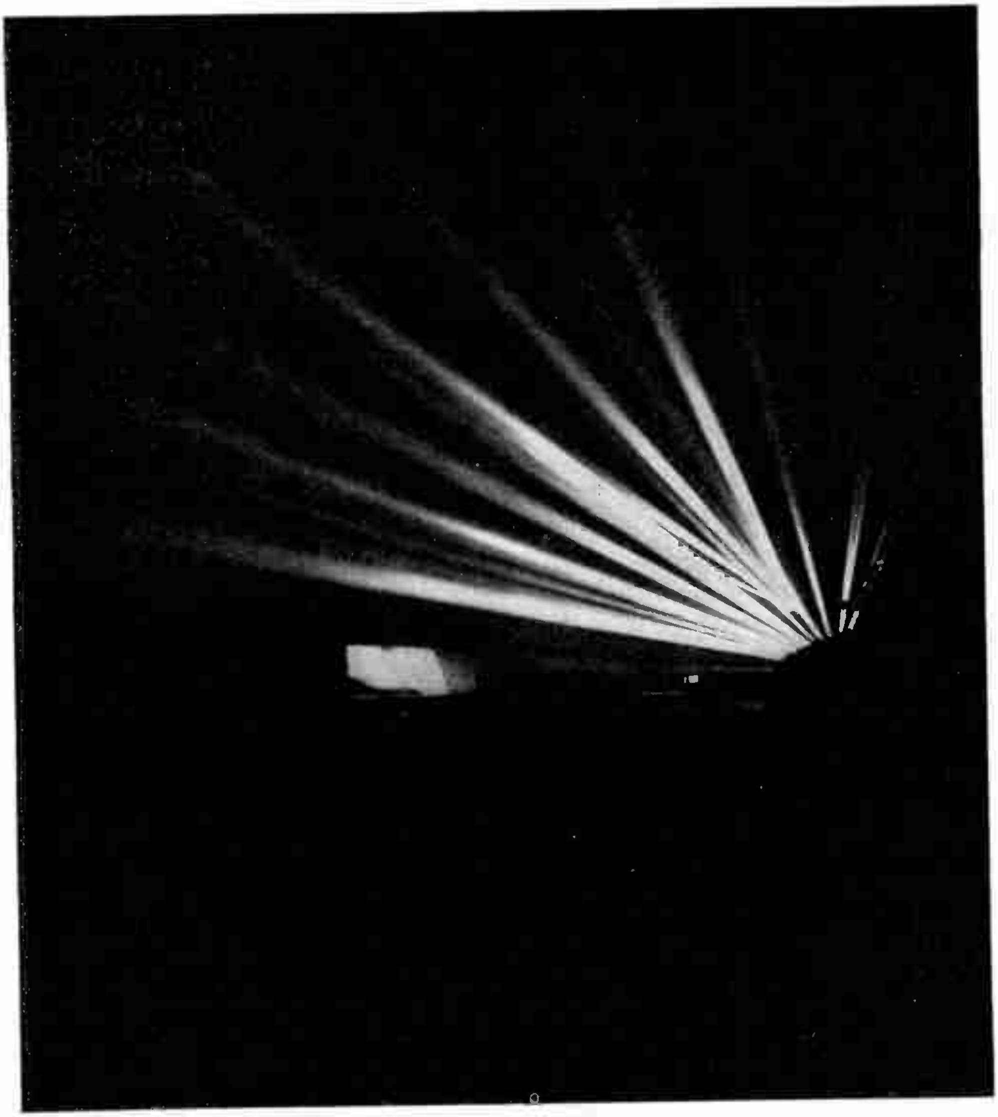
Illumination of Niagara Falls

W. D. A. RYAN, in *General Electric Review*

The accompanying photographs illustrate some of the effects recently obtained at Niagara Falls under the rays of three powerful batteries of projectors.

to the representatives of the various railroads centering in and around Niagara.

The estimated cost of the permanent installation was approximately $40,000.



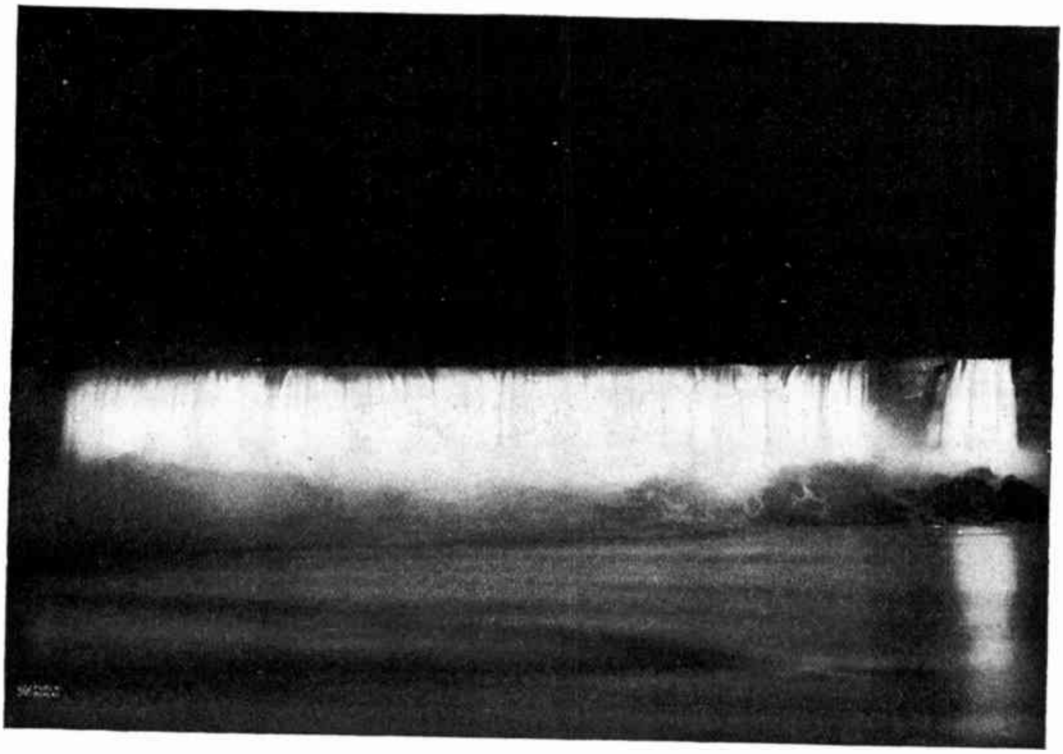
Electrical Illumination of Niagara Falls, Concentrated Aurora

Plans and specifications for the illumination were prepared and submitted to Mayor A.C. Douglass and a sub-committee of the Niagara Falls Board of Trade. Subsequently the project was presented Considerable apprehension was expressed as to whether or not it would be possible to illuminate the Falls in the manner represented. Furthermore, the universal censure which would naturally follow failure or unharmonious effects approaching desecration was a serious consideration.

In order to minimize the elements of chance, the Marine Department of the General Electric Company agreed to accept a nominal rental for a thirty days trial, during which approximately one-half the proposed battery would be used, with the understanding that if the experiments were satisfactory, the balance of the apparatus would be included in a permanent installation.

projectors placed on what is known as the "spillway" of the Ontario Power Company, approximately 3500 ft. from the American Falls. These two batteries received current from a 300 kw. motor-generator set installed on a steel car stationed near battery No. 1. The generator delivered 110 volts, and was driven by a 500 volt motor drawing current from the trolley circuit.

Battery No. 3 was made up of eleven 18 in. projectors located in Victoria Park, about 1500 ft. from the centre of



Illumination of Niagara Falls from Canadian Side

Mayor Douglass personally accepted the offer, and financed the required amount by local subscription.

The projectors were installed on the Canadian side, and located in three batteries.

Battery No. 1 comprised eleven 30 in. and ten 18 in. projectors installed on a platform 250 ft. long, located in the Gorge at a point midway between the American and Horseshoe Falls, 20 ft. above the water's edge, and approximately 1200 ft. from the centre of Goat Isand.

Battery No. 2 consisted of four 30 in.

the American Falls. The projectors at this point were arranged for series operation, and obtained current directly from the trolley circuit.

The lightning effects were controlled from battery No. 1, which was connected by telephone to the generator car and smaller batteries. The sub-division into three batteries was for the purpose of securing a wide sweep over both the cataracts, with a rising and a plunging light.

The Falls were illuminated every evening during the month of September, and while the volume of light was, as previously stated, only half the proposed strength, very good results were obtained, particularly on the American Falls. It was not possible, however, to properly illuminate both Falls simultaneously.

Under normal conditions, approximately 50 per cent. of the light was scattered or absorbed by the mist, and it was rarely that any discomfort was experienced in looking directly into a thirty-inch projector from Prospect Point, which was not over 2500 ft. distant. On one occasion, for a period of fifteen minutes, the light was completely shut out by the mist and rain, so that neither the Falls nor the light beams were visible. With this element to contend with, in conjunction with the enormous area over which it is necessary to evenly distribute the light, one can readily appreciate why a battery of searchlights giving approximately 2,000,000 candle-power, or practically double the amount of light used in the experiment, will be necessary to properly illuminate the American and Horseshoe Falls simultaneously.

It is the writer's opinion that the most beautiful effects were obtained by the use of white light. On this point, however, there appeared to be considerable difference of opinion. There is no question that the introduction of soft clear colors through suitable screens did not detract from the beauty of the Falls, but lent a pleasing variety of effects which appeared to be greatly admired and appreciated by the thousands of people who thronged the parks on both sides of the river every evening. An additional variation was introduced by noiselessly exploding loose giant powder in front of the main battery. This formed a blanket of pure white smoke, appearing as a cloud into which the colors were introduced. The sunset effects thereby produced in the water were beautiiul beyond description.

Judging from the general comment and press reports, Niagara did not suffer from the experiments, and so pleasing were the results, as well as successful from a purely commercial point of view, that arrangements are being made to complete the permanent installation, which is expected to be in operation early next summer.

How to Build a Small Model Undertype Engine and Boiler

HENRY GREENLY

VI. Eccentrics and Eccentric Rods.

Although for the purposes which such a model as the one now under consideration would usually be employed reversing motion would not be required, there is no reason why the shifting eccentric type of gear should not be fitted. Nothing will be lost in the matter of efficiency, as the slip eccentric contains no feature which is likely to go wrong or cause trouble. Therefore, the drawings show this well-known device. The form of slip eccentric adopted is the best that has come within the writer's experience, as it not only is easily made, but has the merit of being readily adjusted. The eccentric sheave may, however, be fixed, and then would be cast with a projecting boss, placed next the crank web, as shown in Fig. 30. The patterns may provide for either method of construction.

The eccentric strap and rod is intended to be cast in one piece — gun-metal or phosphor-bronze. The pattern should allow for the sawing off of the back half of the strap. When sawn in two, the facings should be filed up and the joint sweated with soft solder in the usual manner. The strap and rod may then be mounted on the faceplate, with the flat side touching the faceplate, and the strap bored and faced. To enable the tool to make a clear bore, parallel packing pieces —sheet metal of a given gauge, say about 3-32ds in. thick would do — should be placed behind the casting to lift it off the faceplate to the required amount, which, by the way, will depend on the proportions of the tool used. The other side of the strap may be faced by either turning the strap the other way round on the faceplate or by gripping the strap on a $\frac{3}{4}$-in. mandrel by means of the bolts, at the same time providing lateral support by

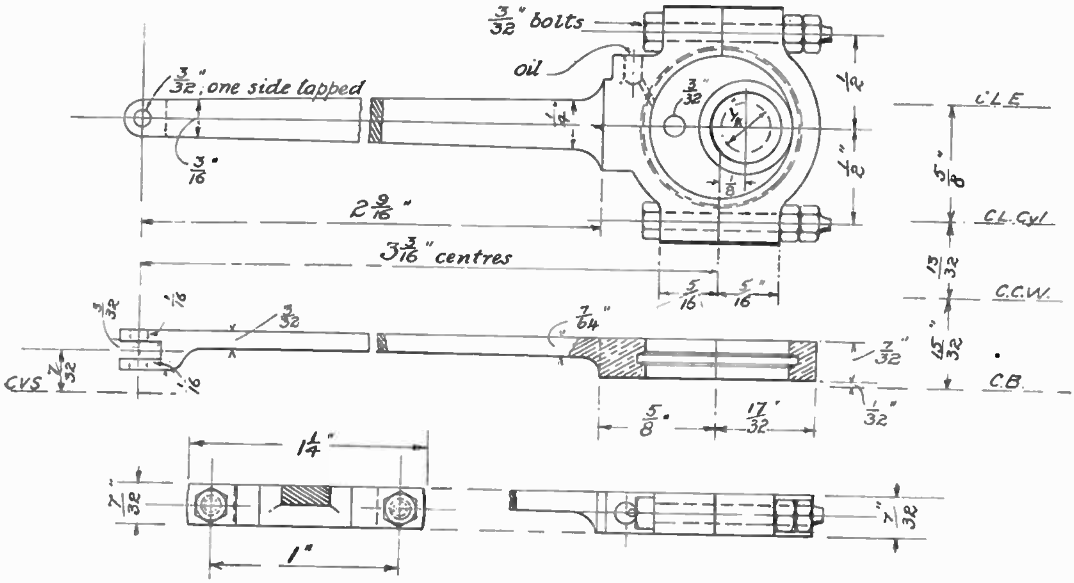


FIG. 26.—ECCENTRIC STRAP AND ROD FOR SMALL MODEL UNDERTYPE ENGINE.
(*Scale: Full size.*)

NOTE.—*C.L.E. = Centre line of engine; C.L.Cyl. = Centre line of cylinder; C.C.W. = Cheek of crank web; C.B. = Cheek of bearing; C.V.S. = Centre of valve spindle.*

butting the strap and rod up against the faceplate. In this way a considerable proportion of the rod may be accurately machined—more than could be done at one operation if the strap and rod were simply clamped on to the faceplate.

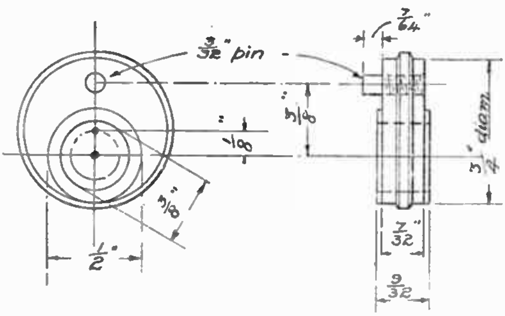


FIG. 27.—ECCENTRIC SHEAVE.

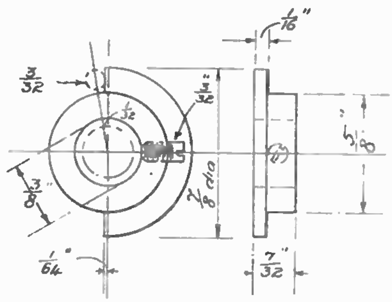


FIG. 28.—STOP COLLAR FOR REVERSING.

It will be noted that the sheave has a central flange, and to machine the strap a specially shaped hook tool will be required. In any case, the chase in the strap should be slightly deeper than the flange, so that as the strap is taken up the flange does not bear on the top edge.

The forked end of the eccentric rod should fit the intermediate spindle without appreciable side shake, and as it is always better to fix the pin or bolt in the forked portion, one fork of the joint should be tapped and the other drilled with a clearing hole. The bolt should be tapped only at the end with a plain portion, 5-32ds in. long, and if a locknut is screwed on the projecting portion of the bolt no trouble should ensue. It is a very bad (although common) practice to simply put a screw which is threaded all the way down in such a joint, with the result that the amount of lost motion due to slackness soon becomes considerable.

The eccentric sheave should be made of cast iron, or, at least, some material different to that of the strap. Wrought iron or steel would, of course, make a very good wearing combination with the bronze strap. The sheave for the lip

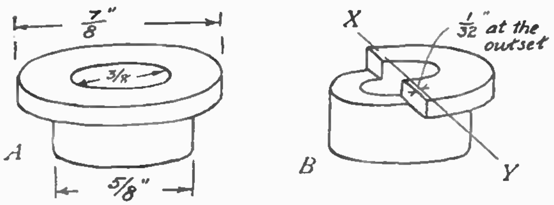


FIG. 29.—HOW TO MAKE THE STOP COLLAR.

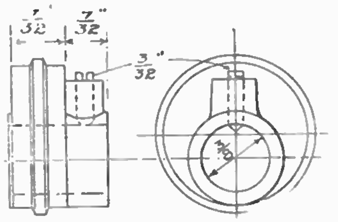


FIG. 30.—ORDINARY ECCENTRIC FOR NON-REVERSING ENGINE.

eccentric gear is quite plain, and has a rubbing face on each side ½ in. diameter and projecting 1-32d in. The bore should be a running fit on the crankshaft. To provide for reversing, a pin should be screwed into the outside face of the sheave. This should fit tightly and may be riveted over at the back to prevent any possibility of its coming loose. The exact position of the pin in relation to the throw is immaterial, but that shown on the drawing (Fig. 27) is the most suitable. The diameter of the pin may be 3-32ds in.

The stop collar is shown in Fig. 28. This is a plain flanged collar made as shown at A, Fig. 29. It should be a reasonably tight fit on the crankshaft and when turned up to the required circular shape the face of the large flange should be scribed with a centre line, as at XY, in view B, Fig. 29. The flange should then be filed off, as at B, to within 1-32d in. of this line at first and the gear tried. It will, no doubt, be found that after the movement of the valves over the surface of the steam ports has been equalized by means of the adjustment nuts provided at the intermediate valve spindle, the H.P. valve has a little too much "lead," and the L.P. valve (which has less lap) has much too great an amount of this same commodity. The stop collar may then be filed down to something less than 1-64th in. (the normal dimensions as shown in Fig. 28) in the case of the L.P. valve, and to full 1-64th in. on the high-pressure side. With the pin placed in the position shown in the drawings, the XY line of the stop collar will stand in a truly vertical direction when the crack-pin is on either dead centre, or, which to the same thing, with the crank webs vertical the XY line of the stop collar will be in the horizontal plane. Should any difference in the size and disposition of the steam and exhaust ports have been made during the process of cutting them, the valves should then be arranged to suit such accidental or intentional alterations and be either lengthened or cut down according to requirements. If this is done, the eccentric gear may be made exactly as shown on the drawings without any further modification.

In Fig. 26, the letters C.L.E., C.L. Cyl., C.C.W., etc., are intended to indicate the relative positions of the other portions of the engine in respect to the eccentric strap as viewed in plan.

(To be Continued.)

Telephone connection with ships in harbor is easily made, nowadays. "Electricity" says that a few years ago, when an ocean liner was stranded for a few days on the New Jersey coast, a man rowed out to the vessel, with a telephone set attached to a twisted pair of waterproof insulated wires. These wires served as a submarine cable, which was connected to a telephone line on shore, and officers and passengers used the line until the boat was pulled into deep water and continued her voyage. It is the custom to anchor vessels in the lee of the coral reef which forms one side of the harbor of Honolulu, in the Sandwich Islands. When a vessel comes to her moorings, the local telephone company attaches a branch cable at one of the many taps of a telephone cable which runs along this reef, and passes it over the stern of the vessel, and also a telephone, which is installed in the cabin, and in this manner provides facilities for transacting much of the ships business by telephone.

From this was but a step to the present custom of connecting steamers by telephone while they are lying at dock, and this may have been anticipated by the practice of connecting fire-boats by telephone when they are moored.

Mission Furniture Construction

II. Cabinet for Photographers

WILL B. HUNT, 2D

There are few families in these days which do not number among their members one amateur photographer, and no doubt this member often wishes he had some special place for his outfit.

In the accompanying sketch he will find a convenient and at the same time beautiful cabinet for this purpose.

The lower part consists of a closet divided into compartments, the lowest one sufficiently large to hold the bottles of developer, hypo, graduate glasses, etc., with side racks for trays.

Above this are pigeon holes the size of the negative the photographer uses, each compartment to be marked alphabetically so that the plates may be assorted according to subject, thus making them easy of access.

The upper part of the cabinet consists of a small space for photo albums, and text books, and a compartment enclosed with a door, which may be locked, in which to keep fresh negatives and printing paper.

The lower part closes with two doors, each of which is decorated with a design in stained glass, or an imitation of it. These imitations are obtainable from the Artcrafters of Milton, Mass., who produce some beautiful effects. Upon application they will furnish, at reasonable prices, any desired monogram, initial or design.

To make:

Saw out two pieces like No. 1, to form the two sides. Then cut No. 2 and screw it to the tops of these sides with six screws, also glue it,—leaving an overhang of three inches on front and sides, the back being flush.

Cut No. 3 as outlined in diagram and screw into place one foot from top. Notice in the plan the shape of No. 3 and cut No. 7 and No. 8 to be placed where dotted lines show on No. 3 in diagram, thus forming the middle shelf. Cut No. 5 and place between No. 2 and No. 3 to form closet, and cut No. 4 for door which will be any size according to how large or small you desire to make the closet.

Cut a board to make the floor, which may rest on cleats with screws through the sides, sinking screws deep enough to allow for filling the holes with half inch doweling, allowing it to protrude one half inch from the sides; or brass screws may be used, having them even with the sides.

Saw No. 6 for the doors, and if glass windows are desired, mortise place for them, leaving sufficient edge of wood to hold them in place before puttying.

Racks and pigeon-holes for interior may be made any size to suit the builder, depending upon the dimensions of his plates, trays, etc.

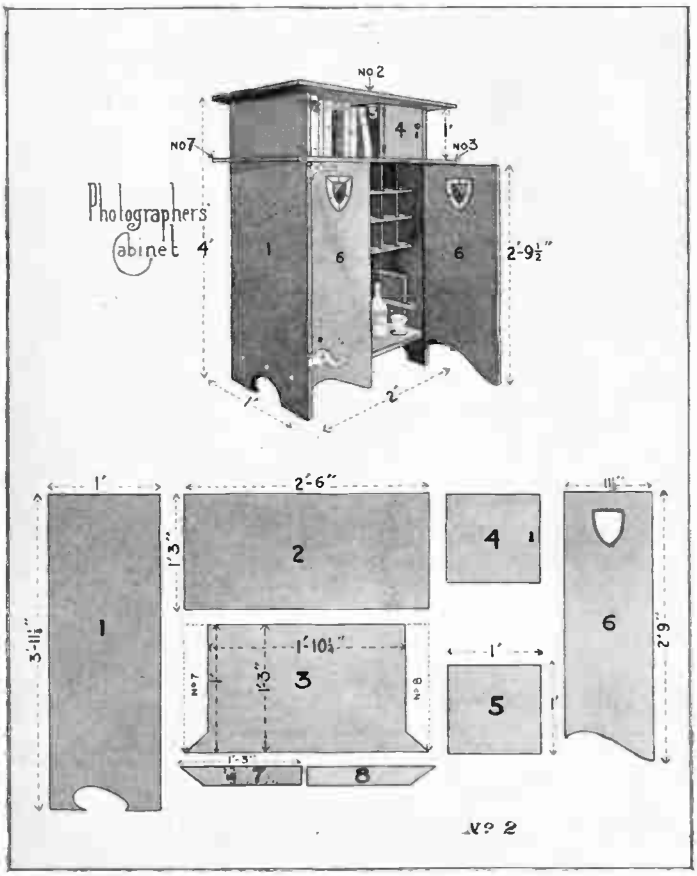
For back, $\frac{1}{2}$ inch oak may be used, and for pigeon-holes and the remainder, $\frac{7}{8}$ inch oak, or any preferred wood. In all it requires about thirty-five running feet, one foot wide.

Stain to suit taste, or wax and polish. The doors are held in place by fancy brass hinges and open by means of brass knobs.

In a lecture delivered by Count Arco it was stated that the practical difficulties experienced in producing electrical oscillations by an arc-lamp had been overcome. The new arc oscillator, once started, will continue, it is claimed, to work steadily for hours without requiring attention. It absorbs six kilowatts, and has been largely used of late for wireless telephony. The first successful demonstration of this latter art took place in December last, the distance covered being 36 kilomètres. The receiving apparatus was coupled to a mast 328 feet high. With the improvements since effected, wireless telephony is practicable over a similar distance using masts only 55 feet high. Last month, using masts 86 feet high, excellent speech was maintained over a distance of 75 kilomètres. In spite of the success above exemplified, Count Arco expressed a doubt as to whether the arc oscillator would come into general use for wireless telegraphy, the expenditure of energy being much greater than when a spark oscillator was used.

MISSION FURNITURE

DRAWINGS · AND · TEXT · BY
Will · B · Hunt 2nd



On Photographic Backgrounds

If we may judge from the thousands of competition and other prints which pass through our hands during the course of a twelvemonth, the management of the background is not one of the least of the difficulties which workers have to surmount. In many instances the clever way in which advantage has been taken of points which in some hands would have been unpleasing and distracting is worthy of much praise, but a few suggestions may be helpful to those who contemplate taking up portraiture, figure-study, or still-life work.

PORTRAITURE

In early efforts the background is usually not considered at all, all the attention being concentrated on the face or figure. When the plate is developed and printed this is noticed, if not by the worker, then by his more observant friends who pose as critics—the background resenting the lack of attention, loudly proclaims the fact. What the worker should aim at is, that the background may fail to attract attention—not when the picture is being made, but when it is an accomplished fact. Thus, the face is predominant, but this predominance is not to be secured by merely making the background a negative feature. The neutral grey or a light or dark ground may be free from spottiness or strong contrasts which will be distracting, but something in the way of positive qualities is required, and without attracting attention to itself the background should emphasize the face. One of the most valuable features in a background is that it shall relieve the contour of the head and figure alternatively by light and dark, while in some places the outline will merge into the ground and be lost. In this way figure and background are one complete whole—a scheme of light and shade and atmosphere, or a sense of space behind the subject is suggested. The greatest amount of relief is obtained by having the darkest parts of the background against the lightest parts of the figure; but this method of treatment is sometimes, and for certain subjects, too forcible, and softer effects, coupled with richness, may be obtained by adopting Sir Joshua Reynolds' method of relieving the light side of the head against a tone of background not quite so light, and the dark side against a tone not quite so dark.

OUTDOOR PORTRAITS

In outdoor portraiture there is less control of the background, and more must be done by suitable selection. Spotty lights through trees must be watched for and avoided, as also bright leaves which will reflect spots of light. By using a large stop in the lens, F-6 or F-8, the figure will be sufficiently sharp, and if the subject be placed well away from the background a pleasing diffusion will be obtained. If, however, there are any light spots these will be more unpleasant if the background is out of focus, for they will become well-marked circles of confusion or round blobs of light overlapping each other. One of the most unsatisfactory outdoor backgrounds is a light distance or the sky. The flesh tones are relatively much darker, and the suggestion of complexion is most unflattering. Further, there is likely to be halation unless the plate is a backed one.

FIGURE STUDIES

With figure studies in the open air the background must retain its landscape character in a way which is neither necessary nor desirable with head and shoulder portraits. The background now becomes an important part in the decorative scheme, and is often something more than a setting for the figure. Harmony between the figure and its dress or drapery and the natural landscape or seascape must be observed, thus harmony being not only a question of suitability of surroundings, but also of climatic conditions and lighting. For example, a child or young girl in light draperies would be quite out of place on a gloomy seashore with black precipitous rocks, whereas a stretch of open, sunlit, flowery meadow would provide a harmonious setting.

INDOOR FIGURE STUDIES

It sometimes happens that quite suitable settings for figure studies may be found in some of the modern houses, houses where many of the old conventional ideas have gone by the board. The charming child studies produced by E. T. Holding, which have been reproduced from time to time in these pages, will illustrate this point. As a rule, light tones of plain paper or distemper are advantageous, the softened shadows and always interesting play of reflected lights giving additional charm to the pictures. With light surroundings direct sunlight may often be employed without any great danger of spottiness becoming unpleasantly apparent.

STILL-LIFE AND FLOWER STUDIES

Here the background is required to relieve the flowers or objects included in the picture, and to suggest in many cases space between the flowers and the background, while the ground is in reality fairly close to the objects. It is important to avoid showing any pronounced texture of background, and such a material as brown paper with its tendency to show creases or buckling is not very suitable. One of the best-known workers in this branch recommends smooth, dull-surfaced cards of various tints, and those workers who possess, or have access to, an aerograph may readily get a little suitable gradation on such cards. Failing the air brush, some powdered black lead or *conte* may be rubbed on to the card with either a tuft of cotton wool or a pad of wash-leather, taking care not to put on too much and to keep the gradations very soft and delicate.

THE QUALITY OF MYSTERY

All backgrounds, whether in portraits, figure work, or flower and still life studies, should have a certain quality of mystery, that is, it should not be perfectly obvious what the background is. This is one of the advantages of using in portraiture a space filled with darkness—if such a term be allowable, though the method is not quite satisfactory from the point of view of gradation and relief. Though dark grounds are usually chosen where the mysterious is aimed for, there is no reason why the same quality should not be obtained with quite light backgrounds, for there is just as much mystery in light as in shadow. The shimmering sunlit haze may half enshroud and half reveal quite as satisfactorily as shadow, and the choice must naturally depend on the character of the subject and the strength of its tones. The saturnine features of an anarchist might demand the mystery of shadow, while the wood sprite or the dryad would certainly require that of light.—*The Photographic News.*

The Man to Keep.

If you have a workman in your employ that is a little slow—slower than you like—but he does his work well, is always looking after your interests, doing his work methodically, picking up and caring for little things, careful that his time is occupied in your service, does not object if he works a little overtime, if any emergency arises—in fact, approves of it—never grumbles at his task, but does it with care, whatever is set apart to him—never encourages the insubordination of others, but rather discourages it, keep him. You might get a better man, but ten to one you will get a worse one when all the little things are taken into account.—*Exchange.*

Electric traction is safer than steam traction is the conclusion of Messrs. Stillwell and Putnam, who recently read a paper in America. With an equipment properly designed and installed: (a) In the case of a rear-end collision—the most frequent form of accident—the energy propelling the electric train can be shut off promptly; whereas the steam locomotive carrying in its fire box from 1,500 lbs. to 2,000 lbs. of coal heated to incandescence, invariably sets fire to the train. (b) The elimination of boiler carrying steam at high pressure means the removal of an element of risk. (c) Absence of smoke in tunnels, so that signals can be seen clearly at all times. (d) Electric heaters allow of ideal control of the temperature of the cars, and almost eliminate risk of fire. (e) Substitution for the gas tank and the oil lamp of electric lighting implies greater safety. (f) Danger of derailment of an electric locomotive is far less than that of a steam locomotive, the former not possessing any unbalanced reciprocating parts. (g) Electrification of railways where high-speed passenger traffic is involved allows of improved methods of protecting trains by signal systems, automatic or other. (h) Ability to cut off power at will from a given section of the railway may be availed of to prevent accidents.

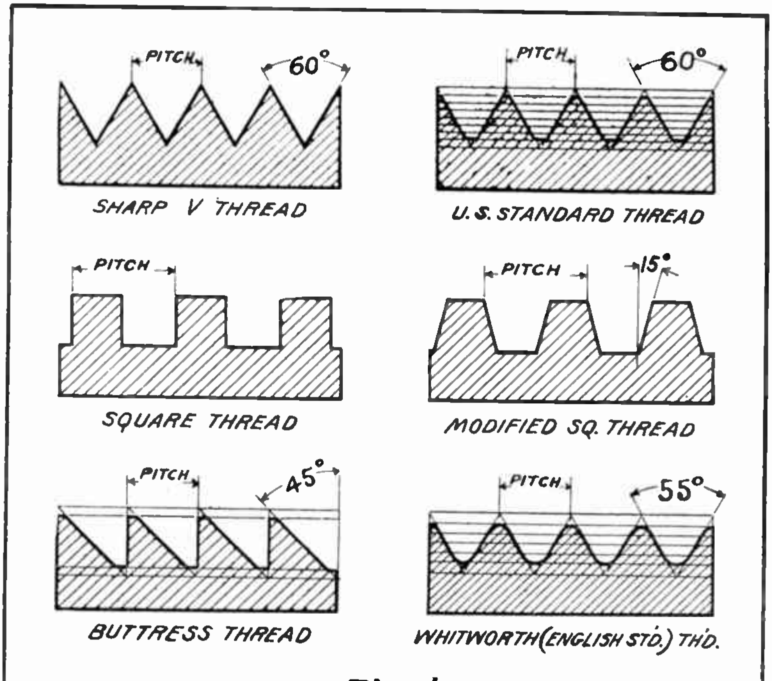

PITCH
60°
SHARP V THREAD
PITCH
60°
U.S. STANDARD THREAD
PITCH
SQUARE THREAD
PITCH
15°
MODIFIED SQ. THREAD
PITCH
45°
BUTTRESS THREAD
PITCH
55°
WHITWORTH (ENGLISH STD.) THD.

Fig. 1

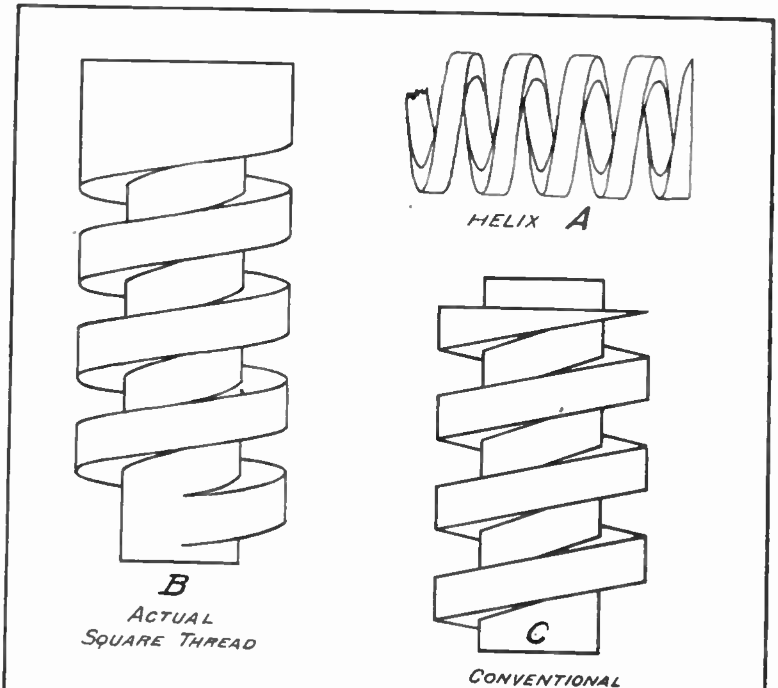

HELIX A
B
ACTUAL SQUARE THREAD
C
CONVENTIONAL SQUARE THD.

Fig. 2

Mechanical Drawing

WILLIAM C. TERRY

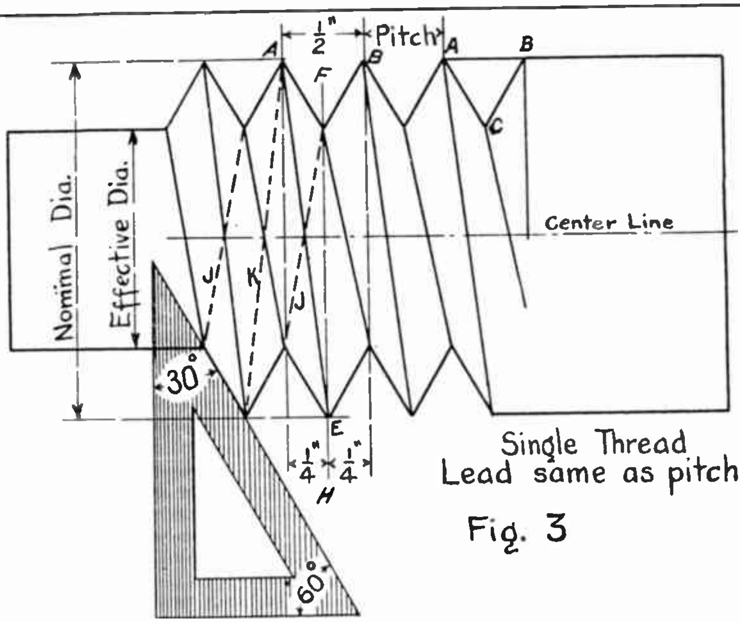
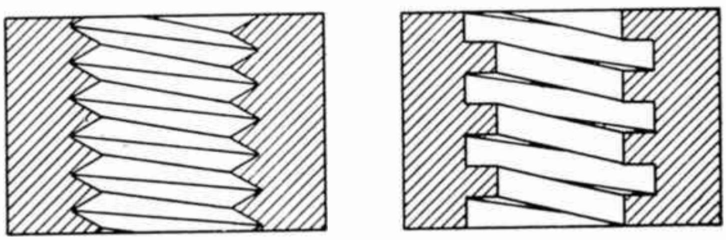


Fig. 3



Right Hand Nut
Single Thread

Right Hand Nut
Single Thread

Fig. 4

Screws and Bolts. — The screw is a cylinder, upon which has been formed a helical projection or thread. The screw fits into a hollow corresponding form called a nut.

The pitch of a screw is the distance from the centre of one thread to the centre of the next thread, measured parallel with the axis of the screw.

The lead of a screw is the distance its nut would travel along its axis in one turn of the screw.

Examples:

Single threaded screw — pitch ½″; lead ½″.

Double threaded screw — pitch ½″; lead 1″.

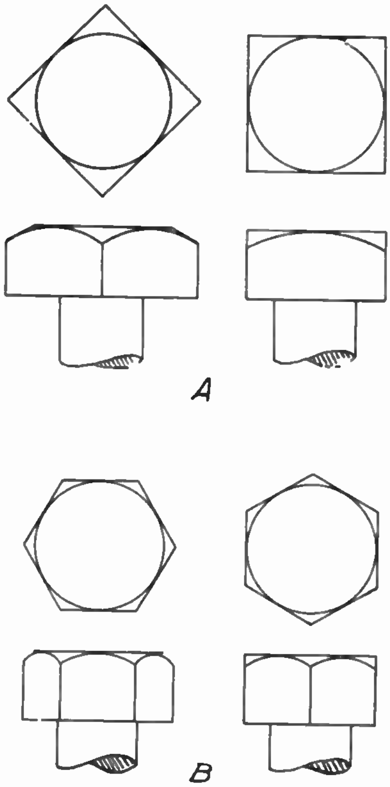


Fig. 5

Triple threaded screw — pitch ½"; lead 1½".

The nominal diameter is that of the cylinder upon which the thread is cut.

The effective diameter is the diameter at the bottom of the threads.

Fig. 1 represents, in section, the common forms of screw threads.

The sharp V thread is cut at an angle of 60 degrees if made standard, and the U.S. standard is cut 60 degrees, with each point dulled, making the effective depth of thread only three-quarters the height of the sharp V thread of the corresponding pitch.

The square thread section is self-explanatory. The depth is equal to one-half of the pitch.

A slope of fifteen degrees is used for the modified square thread.

A special form of thread is seen in the buttress, where an angle of 45 degrees is chosen and the top and root are dulled, similar to the U.S. standard thread.

The Whitworth or English standard thread is cut on an angle of 55 degrees and the top and bottom of the thread is rounding.

There is no connection between the shape of thread and the pitch or lead.

It is the practice to use the sharp V thread for small screws used for fastening and the other forms for power transmitting screws.

A screw thread is a true helix, which is a curve traced upon the surface of a cylinder by a point which moves at a uniform rate around the circumference, and at the same time travels uniformly in a direction parallel to the axis. But though both motions are uniform, their rates are independent of each other; while going once around the cylinder the point may advance in the direction of the axis to any distance, great or small, at pleasure, and this distance between the successive coils is called the pitch. The direction of the two motions are also independent of each other, and thus the helix may be either right-handed or left-handed.

A clear idea of the square threaded

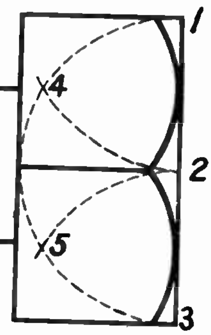


Fig. 6

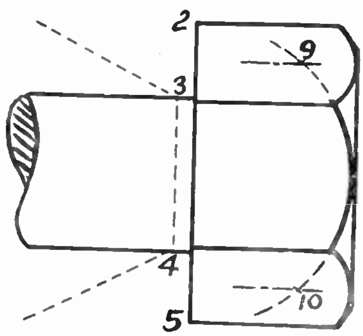


Fig. 7

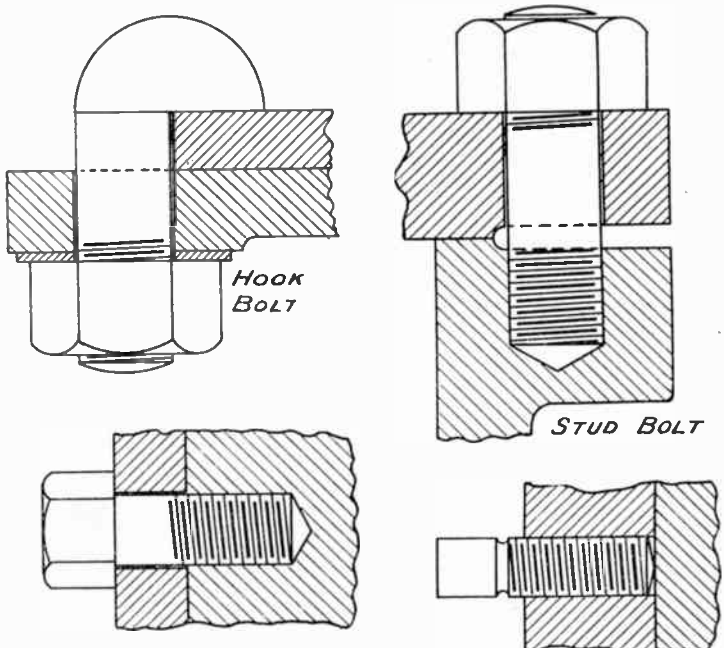


Fig. 9

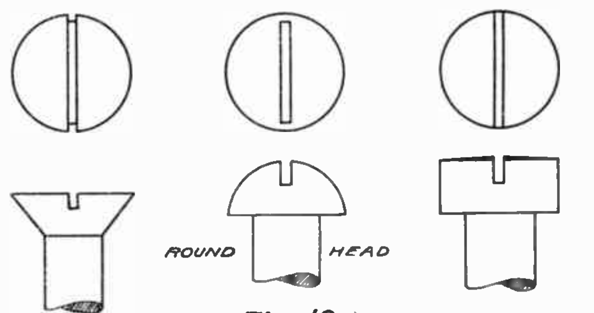


Fig. 10

screw may be formed by imagining a square rod of lead to be coiled around a cylindrical core, like a string around a stick, leaving a space as wide as the leaden bar itself between the adjacent coils. A in Fig. 2 represents a left-handed helix; B a right-handed helix about a core or cylinder forming a square-threaded screw and represented or drawn accurately; C a conventional representation of a right-handed square-threaded screw. B and C are single threaded screws.

To draw the V threaded screw lay down on each side of a centre line lines representing the nominal or outside dia. of the screw and space off the pitch on one side, as A–B, Fig. 3. If the screw is to be single threaded bisect space AB and draw line to the opposite side, as F H, calling points A, B and E points of the thread. Use the 30 x 60 degree triangle and complete the threads. A horizontal line through point C will give the effective diameter or diameter at root of threads.

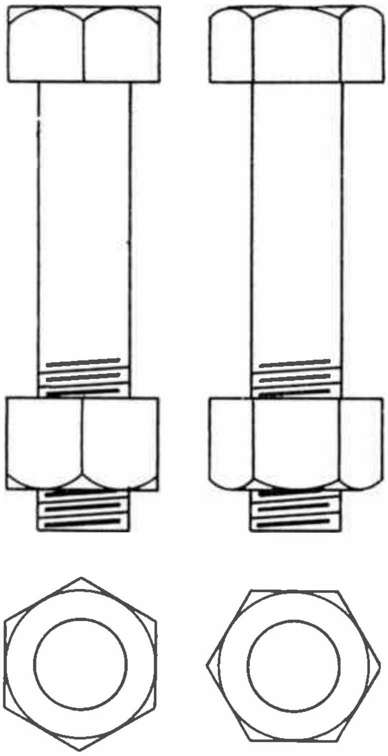


Fig. 8

Dotted lines J K show the thread on opposite side of screw. For a right-handed screw we connect points A and E; if the screw was to be shown left-handed we would join B to E with a line.

Fig. 4 shows V and square threaded nuts in section; the lines run in the direction of a left-handed screw.

Screws and bolts have various shaped heads, the common form of head for bolts being either the square or hexagonal. See Fig. 5, A and B.

The projection of bolt heads requires some attention to the matter of chamfer. Referring to the left-hand bolt head at A, Fig. 5, it will be seen that two faces are shown in the lower view owing to the fact that a view across the corner is chosen and clearly shows the chamfer in the elevation or lower view.

The view at the right-hand side shows but one face in the elevation or bottom view, and upper corners are not beveled off, but the side lines extend to the top face.

The same remarks apply to the hexagonal bolt head shown in B, Fig. 5.

To draw the chamfer lines for a hexagonal nut or bolt head when two faces are shown: take centre at 2 (Fig. 6) and with radius 2–1, draw arc 1–3; with centres at 1 and 3 draw arcs 2–4 and 2–5; with 4 and 5 as centres, draw lines tangent to line 1–3.

When three faces are shown, take centre on the centre line of bolt and radius equal to 3–4, draw an arc tangent to line representing the top of nut or bolt head; bisect lines 2–3 and 4–5 at 9 and 10, and take as centres the intersecting of the large arc with 9 and 10, draw arcs tangent to one top face of nut, and complete the chamfer by lines at 45 degrees, tangent to these arcs. See Fig. 7.

Fig. 8 represents a machine bolt with hexagonal head and nut.

In Fig. 9 is seen four common forms of bolts and a set screw. Fig. 10 represents machine screw heads. Take special notice of the screw head slots in the upper or plan views.

An Electrical Immersion Heater

HIRAM B. CARPENTER

An electrical immersion heater may be made at a cost of from five to ten cents in thrice as many minutes with easily obtained material. It proves a convenient means of heating liquids in small quantities, and it must be tried to be appreciated by anyone who has access to electric current. A traveller might carry one in his coat pocket, and by simply screwing the plug connection of his heater into any lamp socket he would be able to heat water for making beverages, for shaving, or for any other use to which a small quantity of hot water could be put. In the home this should prove acceptable for similar services, but it should, of course, be understood that for general cooking it is impractical.

To be specific this heater uses one ampere at 110 volts, costing about one and one-half cents per hour to use. It will boil one-half pint of water in ten minutes. From this we find that we may boil a cup of water with this heater at a cost of one fourth of one cent.

To make the heater a glass test-tube, a porcelain insulation tube, some fine german silver wire, and a small sheet of asbestos paper are necessary. The test-tube may be obtained of any druggist, and the other material of an electrical supply dealer. The porcelain tube is used in electrical insulation and probably has a head on it. This head should be cracked off with a hammer, first ringing it with a sharp file, and taking care not to break the other part of the tube. The glass test-tube should be about 1" long, inside diameter ⅞". The porcelain tube should fit into the test-tube with about ¼" diameter to spare. It must be somewhat shorter than the glass tube. Beside these a small length of insulated wire may be needed.

Having obtained our material let us first wind a layer or two of asbestos paper on the porcelain tube, pasting the edge of the last layer down. On this core 110 ohms of the fine german silver wire must be tightly wound taking pains to keep every turn distinctly separated from its neighbors by a uniform distance. If the maker of this heater does not have the means to determine resistance of wire, he may simply ask for 110 ohms of fine german silver wire when he buys it. It is important that the resistance wire be very small in diameter. It is impossible to tell the exact number of turns or feet necessary, but a general rule is that the turns should be about ⅛" apart. Having wound the 110 ohms of resistence wire on the core fasten the ends by tying them. We now have the heater proper finished and it only remains to put it into a convenient form for immersion in water.

This is to be done by securing it in the glass test-tube. Before placing it in the tube, however, join insulated wires to the two extremities of the resistance wire in the coil. These wires are to receive rough treatment and they should be suitable in size. The insulated wire joining the lower extremity of the coil may be brought up through the centre of the porcelain tube. Place the core covered with wire into the test-tube, the connecting wires protruding from the mouth. To keep the heater water-tight a rubber cork should be tightly inserted in the mouth of the glass tube, through which the connecting wires may be carried.

To use the heater immediately it is only necessary to connect the two protruding wires to a 110 volt electric light circuit. For convenience a flexible cord and plug may be attached to the heater wires by which electricity may be taken from any lamp socket. To heat liquid with this tube heater place the liquid in some receptacle which is deep and narrow. These heaters in a slightly different form are on the market, and are advertised as being the most economical way of heating liquids by electricity. The reason for this is that all the heat generated is used or should be. To receive the benefit of this coil, therefore, it is necessary to immerse it nearly to the top in water, not over one pt. should be heated at a time. Another thing for the user to remember is that old hard fact that hot glass and cold water put together results in damage to the former, therefore, have the tube perfectly cold when immersed in a liquid, and turn the current on later.

If properly made and used this heater should and will be entirely satisfactory in its scope of work.

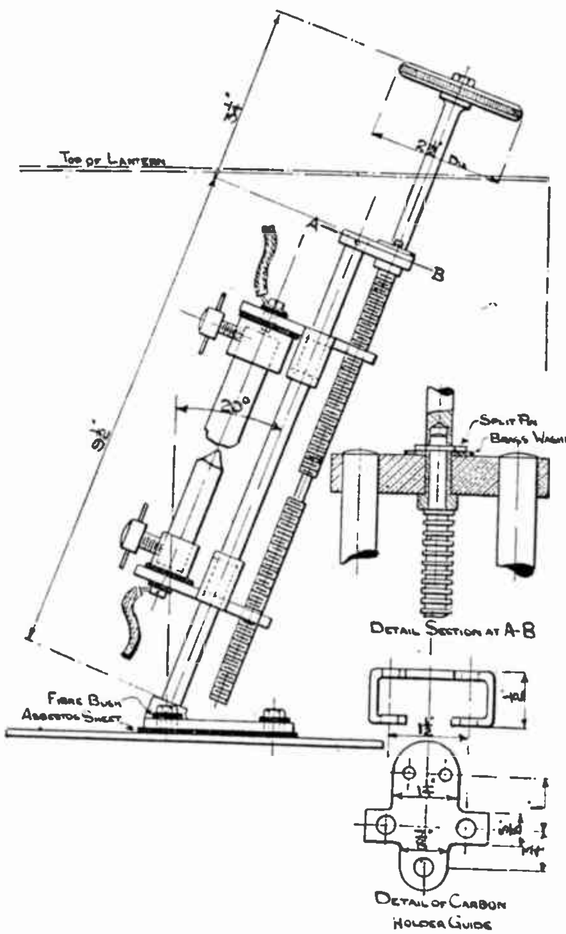
It is always a problem in a large business concern how to handle the daily mail. One of the troublesome details is the opening of envelopes and any scheme for facilitating this work is always welcome. A novel and efficient device can be easily and cheaply made by the use of the ordinary fan motor, removing the fan part and putting in its place what is known as a sand wheel, making it about nine inches in diameter to accommodate all sizes of envelopes. Starting the fan motor of course makes the sand wheel revolve even more rapidly than the fan. Then shake the envelopes down together so that the edges are even, grasp a package of suitable size firmly in the hands and hold against the disc. It takes but an instant to grind off the edges of a hundred or more envelopes, leaving them ready for the easy removal of the contents.

A HAND-FEED ARC LAMP

For Lantern and Cinematograph Work

A. M.

The following is a description of a hand-feed arc lamp of the inclined type which I made some time ago, and is now running satisfactorily. It is designed to take a current of 10 amps., with an arc voltage of fifty; carbons, 18 mm. positive and 12 mm. negative.



General Arrangement and Details of a Hand-feed Arc Lamp for Lantern and Cinematograph Work

The baseplate (which also serves as an ash tray) is made of ⅛ in. sheet brass, to which is clamped, by means of No. 1 B.A. studs and nuts, a casting of three-cornered design, which carries the brass side rods of ⅜ in. diameter. This casting is insulated from the base by means of a sheet of asbestos cut to the shape of the casting, and fibre bushes to the clamping screws. The carbon holder guides are shaped as shown in the sketch, and are made from 3/16 in brass sheet. The purpose of the turned down lugs is apparent, as it will be readily understood that there would be trouble by the guide sticking on the rods were it not for this extra bearing surface. The carbon-holders themselves are made from brass rod, 1⅛ ins. diameter in the case of the positive and ⅞ in. diameter in the case of the negative, and are bored ½ mm. larger than the carbon size and tapped to take tommy-screws for clamping the carbons. They are fastened to the carbon-holder guides, and insulated therefrom by means of two brass screws fitted with red fibre bushes and a mica-plate.

The current is brought to the carbon-holders by two asbestos-covered leads, and it is essential that they should be insulated thus, as the heat soon destroys all forms of ordinary insulation.

The feed-screw is made of brass rod 5/16 in. diameter and cut with a square thread, one half right hand and the other left hand, though an ordinary V-thread would be quite as efficient. The apparently complicated arrangement at the top of the feed-screw is necessary, so as to allow the top carbon-holder to be got into position. The feed-wheel is made of ebonite, and is fixed by a nut clamping it against a shoulder on the spindle.

It gives excellent light for five hours on a 100-volt circuit of suitable resistance.

An electric broiler will cook a steak in 10 minutes at a cost of three cents. The broiler may also be used for the cooking of chops, oysters, fowl, for baking potatoes, toasting bread, etc.

How to Build a Sixteen-foot Launch

CARL H. CLARK

IV. Fitting the Deck and Inside Work.

The boat is now ready for the deck framing, and the deck, which is the next step in the work. A "clamp strake" is first bent in; this is a piece of spruce 2"x2" which runs the full length of the boat fore and aft, on the inside of the frames, and is bent in place parallel with the sheer and ¾" down from the top edge of the top streak. It is shown in the cross section Fig. 10 just below the deck. A clamp is of course fitted on each side of the boat; the fastening consists of a galvanized iron rivet about 3/16" diameter driven through each frame and the plank and riveted on the inside of the clamp. At the bow the clamps should be fitted neatly to the stem and be joined by a "deck knee" of 1" board fastened on the top of both as shown in Fig. 9. At the stern a somewhat similar knee is fitted on the top of the clamp and fastened to it and the stern board. The clamps thus hold the boat firmly in shape and stiffen the whole construction.

The bilge strake, shown in Fig. 10 at the turn of the bilge, should next be fitted. It also is of spruce and is 3"x¾". It should be sprung into position so that it will lie fairly along on the inside of the frames; and is fastened with galvanized nails into each frame, or with copper rivets driven through plank and frame. As this bilge strake is in sight the edges should be beaded or at least bevelled. There will be a considerable twist to this bilge streak so that braces to the ceiling above will be found of help in springing it into place.

The tube for the rudder post should next be obtained and screwed into place; it is a piece of 1" galvanized iron pipe 12" long with a long thread on one end. The hole is bored in the tail piece just forward of the last frame and the pipe screwed down into place with a pipe wrench after smearing the threads with paint or oil.

The deck beams are the next in line, they are of spruce, cut from ¾" stock and are 1¼" wide at the middle and 1" wide at the ends. The longest beam at the bow is about 3 ft. and it should have an upward curve of about 4" in this length, or a "camber," as it is termed of 4"; in other words, the middle of the beam is 4" higher than the ends. The remaining three beams for the forward deck should be cut by the same pattern, but the ends should be left 1¼" deep, the beams thus being parallel section. These forward deck beams may now be set into place as shown in Fig. 9; the aftermost one being 3½" aft of No. 1 mould point, and the others spaced equally forward, 8" apart centre to centre. The beams should be let down slightly into the clamp to secure them and held by one or two long galvanized nails driven down into the clamp. The upper surfaces of the beams are then dressed down until a board will lie evenly upon them, and the upper edge of the top streak also is bevelled so that the board will lie evenly upon the beams and fit neatly on top of the top streak.

The beams for the after deck are laid in the same manner; they are of the same size but have a "camber" of only 3" in the 3½ ft. width. The forward beam of the after deck is fitted in place just forward of the frame on No. 5 mould, and the other three beams in corresponding positions as shown in Fig. 9. They are fastened in the same manner as the forward ones, and dressed down, the top plank being bevelled to suit and the top edge of the stern board also being dressed off. The edge of the top streak in the way of the standing room should also be bevelled to the same angle. To support the side plank of the deck at the sides of the standing room, small blocks are fastened on top of the clamps at intervals of about 8" as shown in Fig. 9.

The corner pieces at the round of the cockpit forward should now be fitted. They are fastened to the clamp and the last deck beam, and must be curved in both directions, not only for the standing room rail on the inside, but on the upper surface to match the curve of the deck beams. These are necessary to support the ends of the deck plank and also the standing room rail. They are fastened on top of the clamp streak and against the after side of the deck beam. A short beam is fitted across between the corner piece and the clamp.

The deck may now be laid on the beams. It is ⅝″ thick and may be of either pine or spruce or mahogany. The outer strip, or "covering board" as it is called, should be about 2″ wide amidships and taper to about 1¾″ at the ends where the curve is more abrupt. This covering board may be of oak, or if a mahogany deck is laid, it may be of mahogany. The covering boards are bent around the outside of the deck, lapping over on top of the top streak. At the bow the covering boards are to be fitted neatly around the stem and fastened through the edge to it. If necessary the forward ends of the covering boards may be steamed to make them more flexible. As they are bent around they are held in place by clamps and finally fastened by nails driven down into the deck beams and into the edge of the top streak. The "king planks" shown in Fig. 9 are now to be fitted; they are about 4″ wide and of the same stock as the covering boards. The forward one is fitted neatly into the angle of the covering boards, while the after one fits on top of the stern board. Short pieces of the same stock are fitted across the stern, between the king plank and covering board to take the ends of the deck plank.

The deck plank is laid in strips about 2″ wide bent around inside of the covering board. Only one strip is needed around the edge of the standing room, as this, with the covering board will make a deck 4″ wide. The strips of decking should be fitted neatly between the king plank and covering board at the bow and bent around, being nailed to beams and the blocks fitted for this purpose. The remainder of the deck is laid in short pieces, allowance being made for the curve of the standing room foward. Short pieces of ⅞″ board may be nailed along the edges of the king planks between the beams, projecting about ½″ to support the ends of the deck plank. The same may be done across the stern.

The remainder of the deck may now be laid, working from the piece already laid toward the middle of the boat. In fastening the deck planks, nails about 1¼″ long with small heads should be used and they should be "set" below the surface of the deck. The foward deck should be laid to the edge of the curved corner piece and the ends of the plank trimmed off to the same curve as the corner piece. The after deck is laid to the edge of the last beam and trimmed off even with it.

The coaming is the next part to be fitted. It is of ½″ oak, and extends 4″ above the deck on the outside, and about 2″ below the deck on the inside, making the total width 6″, although on account of the sheer a considerably wider board will be necessary to cut it from. Each coaming is in two pieces, joined in about the position shown in Fig. 9 by a block on the outside. The long after part will be easy to fit as it is nearly straight. It extends out on top of the after deck in a sort of "ogee" curve as shown in Figs. 1 and 8, and the end is held by one or two long slim screws driven through it edgewise into the deck. Elsewhere it is fastened by brass screws driven into the edge of the deck and also into the ends of the blocks which were fitted on top of the clamp. The forward part of the coaming is rather more difficult to fit on account of the rise of the deck, and it will be best to use a piece of thin stock for the first fitting. A very wide board will be necessary for this piece, although it can be made somewhat easier by allowing the coaming to slope forward, as shown in Fig. 8. It also need not be as high at the forward end as it is amidships, but may taper gradually to 3″ high as it approaches the middle of the deck. The edge of the deck around the curve should also be bevelled to the same angle to suit that of the coaming, so that the latter may lie evenly against it. After the thin pattern has been carefully fitted, the final piece may be cut out. It should now be steamed until thoroughly limber and then bent into place. Care must be used not to split it in bending in, and this may be helped by nailing a few cleats across on the inside temporarily. It also is fastened by brass screws into deck and corner piece. The joint between the two parts is made by the block shown in Fig. 9, of the same thickness as the coaming, fastened on outside by copper rivets. At the forward point, the two coamings are held together

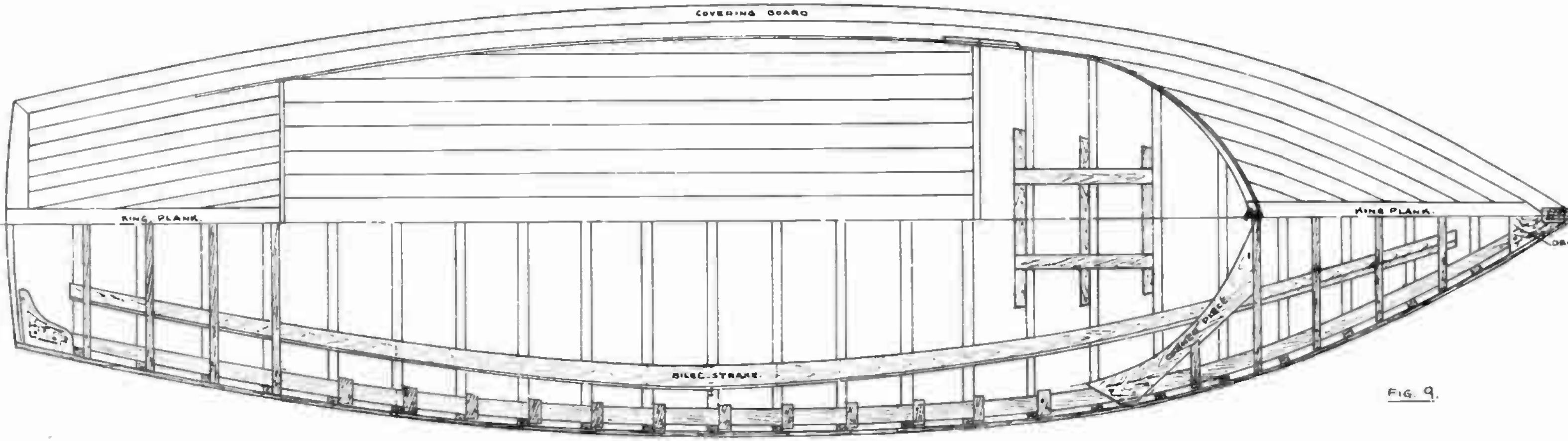

COVERING BOARD
KING PLANK
KING PLANK
DECK KNEE
BILGE STRAKE

FIG. 9.

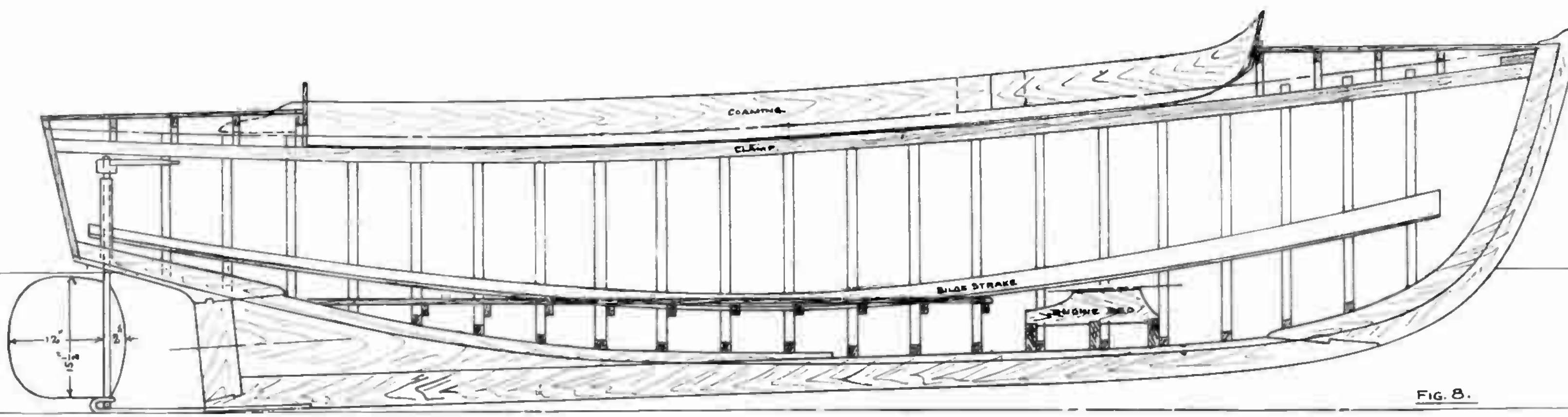

COAMING
CLAMP
BILGE STRAKE
ENGINE BED
12"

FIG. 8.

by a corner piece as shown, to which both are fastened. Another piece of coaming is fastened across the after end of the standing room; the lower edge is curved to fit evenly with the under side of the beam and the upper edge should carry the height of the side coamings across the deck. Corner blocks are fitted between it and the side coamings and screws may be driven through the side coamings into it. When the coaming has been all fitted in place the upper edge is bevelled and the whole smoothed up with sand paper.

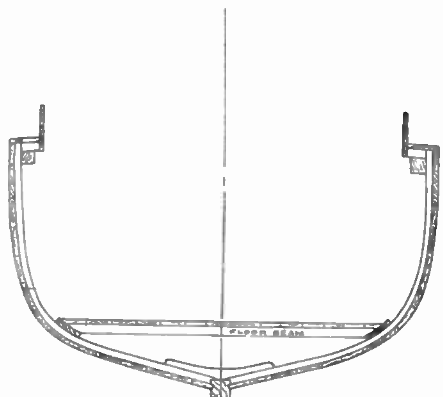


FIG. 10.

The engine bed or foundation should be built next, provided that the dimensions of the engine base are known. If these are not known this part may be left until later. The construction of the bed is well shown in Fig. 8, and although the actual shape will depend upon the design of the engine base, the general construction will be about as shown. It consists of a pair of fore and aft members which support the flanges of the engine bed and which are in turn supported by three heavy cross floors. These cross floors are on the after side of the frame at mould point No. 2 and of the two frames just forward of this one. In laying out for the bed a wire or cord should be passed through the shaft hole in the deadwood and fastened at the centre of the hole in the stern post. It is stretched fore and aft across the position of the bed; this wire then represents the shaft centre. The position of the fly-wheel of the engine can be found approximately, and if the diameter is known the wire is so adjusted that the lower rim of the fly-wheel clears the keel by an inch or more. The wire is then strung tightly and fastened to an upright, taking care to always keep it over the centre line of the keel. The width of the flanges of the engine base and the height of the flanges relatively to the shaft centre are measured on the engine; the bed must now be built in the same relation with the wire representing the centre. The entire height of the bed above the keel should be about equally divided between the fore and aft pieces and the cross floors. The floors should be about 1¾″ thick and be fitted neatly to the inside of the plank; they are fastened in place by nails driven down into the keel and by nails driven through the plank. The fore and aft pieces are 2″ thick and are long enough to take hold of the three floors, but on the upper edge are shortened to the length of the engine base. The fore and aft pieces are notched down between the floors and are stiffened with cross braces where possible. This foundation must be strongly built in order to prevent vibration.

The boat is now ready for the interior work and the final finishing.

Wireless Treaty Ratified

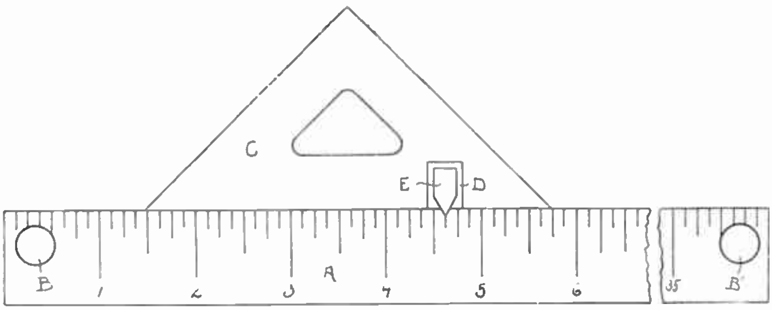
The treaty proposed by the international conference held in Berlin recently has been ratified by Belgium, Denmark, Mexico, Norway, Holland and Roumania. Great Britain, Argentina and Brazil are ready to ratify it, and France is only awaiting the action of Great Britain. Bills are now before the United States Senate and the German Reichstag.

The treaty provides for an interchange of messages between the various systems of wireless telegraphy, of which there are now at least twenty in use. The formulating of the treaty was largely brought about by the refusal of ships equipped with one system to receive and transmit messages from ships and shore stations equipped with other systems. The Marconi Company contends that its patents would be infringed if the ships of all nations should exchange or forward messages regardless of the systems operating them, and is therefore opposed to such a treaty.

There is no waste so wasteful as economy overdone.

An Easily Made Section Liner

RALPH F. WINDOES



Every draftsman needs a section-liner, but few care to purchase them, as good ones cost considerable. The accompanying illustration will help anyone, old or young, to make one with very little effort or expenditure. A is a yard stick which anyone can have for the asking, and C is a triangle. A hard rubber triangle is preferable, because it is the least likely to warp. D is a piece of very thin wood, glued securely to the triangle and nearly flush with the yard-stick when the triangle is put in position. The arrow shaped piece, E, is made of bristol board, or gummed cloth tape, and is glued to D in such a manner that the pointed end overlaps the lower edge of piece D just a trifle. The thumb tacks, B and B1 serve to hold the yard-stick in position to allow the draftsman the free use of his hands. If your drafting board is not 36″ wide, the stick may be cut down to fit, as it is the smaller dimensions that concern us now. Little more need be said, as the manner of operating is as simple as the instrument itself. If the lines are to be drawn $\frac{1}{2}$ of an inch apart, move the pointer to the nearest division and draw a line, using either edge of the triangle, this depending on the way the lines are to run. Now move it to the next division and draw your line, then to the next, and so on, till the end is reached. It will soon be found that this method is much easier than to space all of the lines with the dividers, and much neater than to do it by eye.

Isolated Plant Switchboard Panels with Circuit Breakers

In many isolated plants the conditions make it desirable to use a circuit breaker in the switchboard in place of the combined lever switch and fuse which has been generally used on this type of panel in the past. This demand has caused the General Electric Company, Schenectady, N.Y., to standardize a line of panels for small plant work of this character, and these panels are described in Bulletin No. 4558, recently issued. The well known Type C, Forms G and P circuit breakers and the Thomson Feeder-Type measuring instruments manufactured by the General Electric Company are used on these panels. The equipment of feeder panels and the combination generator and feeder panels are described, details of the instruments, circuit breakers, switches, mounting of rheostats, etc., are given, and the dimensioned drawings with diagrams of connections and tabulations of the various capacities included. The panels provide for controlling 125-volt generators of from 5 to 120 kilowatt capacity, and 250-volt generators of from 10 to 240 kilowatt capacity, and are made for controlling from two to six feeder circuits. Among the advantageous locations for these panels are mentioned — plants where the load is fluctuating and the protective feature is often called into service; the easy replacement of the circuit breakers obviating the necessity of new fuses.

Tempering Steel, Annealing and Case Hardening Iron

M. COLE

Pure iron is a soft, bright metal, not liable to rust, but is only known as a scientific curiosity, as the expense of removing all impurities is too great to allow of its being used for commercial purposes. Iron in ordinary use is of the following varieties:

1. Best charcoal iron, which is the best in ordinary use, is smelted with charcoal instead of coal, thus avoiding one of the main causes of impurity, the sulphur, etc., contained in the coal.

2. Ordinary bar and sheet iron, produced by the ordinary process. This is pure enough for all mechanical purposes, and can be worked hot, forged and welded. It is converted from cast iron by puddling, a process by which the carbon is burned out of it.

3. Cast iron, a mixture of iron and carbon, the carbon being added to enable the iron to be melted so as to be poured into moulds. The quality varies with the nature and quantity of impurities present.

4. Malleable cast iron. This is a good quality of cast iron that has been kept at a heat but little below fusing point, until the carbon is burned out of it and the iron is almost pure.

Steel, a mixture of iron and carbon, with other minerals present in small quantities. Steel differs from cast iron in having a smaller proportion of carbon, and in having the peculiar property of tempering. The proportion of carbon in steel varies from ¾ per cent. in steel suitable for dies, etc., to 1½ per cent. in razor temper steel, while in cast iron it varies from 2½ per cent. upwards. Iron in any of its forms is hardened by being heated to redness and rapidly cooled. Castings intended to have a very hard face are cast in iron moulds, which chill the casting quickly; others, intended to be turned or bored, etc., are cooled as slowly as possible, and are from iron free as far as possible from impurities. Steel is, before being turned, bored or otherwise cold worked, heated to redness and cooled very slowly, which anneals or softens it. If the finished tool is required to be very hard, it is again heated and cooled quickly in water or oil, but if required to be tough as well as hard, some of the hardness must be removed by tempering.

Case hardening is a method of converting the surface of iron to steel. The case hardened part can be tempered. Steel can also be case hardened, so that one part of a tool can have a higher percentage of carbon than the remainder, so combining hardness near the surface with toughness in the body of the tool. Until a comparatively recent date, many tools were made from wrought iron, case hardened, on account of the high price of steel.

Tempering steel. Tempering is a process of softening, not as is generally supposed of hardening steel. Before steel can be tempered it must be hardened, then a portion of the hardness removed. Tempering is a process peculiar to steel, and other forms of iron cannot be tempered. This is the feature distinguishing steel from iron, some forms of cast iron having very little more carbon than some of the steels. Other forms of steel, as some of the mild steels, will scarcely temper at all, being nearer to iron than steel in their composition. Other brands of steel, as tungsten steel, do not temper nor can they be either hardened or annealed, but are rolled hot to suitable section, and ground to required cutting edge. They are used in small pieces fixed in a tool holder. For some reason that has never been explained, when a piece of steel is heated to redness and quickly cooled, it is hardened, so much so that it will break like glass if dropped on a stone, but if the same piece of steel is reheated to a lower heat than before and cooled, it is no longer so brittle, but more or less springy, being then tempered. If it were not for its brittleness, a drill that is dead hard would be an ideal one for cutting, as it would keep its edge. As it is, we are compelled to use a tempered drill, which though less hard, is tough enough to stand working. Steel changes color with the degree of heat to which it is subjected, but it should be remembered that while the degree of temper denoted by a certain color is always the same for the same quality of steel (provided it has previously been equally hardened) the same color would show various degrees of temper for different qualities of steel. Again, color does not prove steel to be tempered. If a piece of soft steel be heated to straw color and quenched, it will not have the same temper as if it had previously been hardened. The color is caused by a thin film of oxide. The proportion of carbon in steel varies so much, that the efficiency of a tool depends greatly on whether the steel it is made from is suitable for the purpose. What is suitable for a razor will not do for an axe. If the proper steel is not used, the result is never satisfactory, and the workman who tempered the tool is blamed, while the fault lay with the one who selected the steel. Another cause of unsatisfactory tools is when the steel is overheated or burned in working. Steel tools, whether knives or turning tools, etc., must be well hammered while at the right heat, gradually using less force as the metal cools. Tempering, however carefully done, will not replace the hammer work required to make a good tool. The steel should not be heated above a blood red, and the fire kept clear of sulphur fumes. Charcoal is the best fuel for heating tools for tempering, good quality coke is the next best. Gas flame, though very useful for small tools, contains a good deal of sulphur. Where possible, a length of iron pipe should be used in the fire to keep the steel clean. Frequent reheating of steel spoils it just as overheating does, in both cases some of the carbon is burned out of it. When this happens the end should be cut off and another forged on it. Cracks (apparently insignificant) and sharp bends, cause tools to split in tempering.

Process of tempering. Heat the tool to blood red when looked at in a dark corner, then dip in cold water, holding the tool perfectly straight, point downwards and keep there till cold; it will then be quite hard and brittle; now clean up one of the surfaces with a flat stone, and reheat till it shows the desired color, at once dip in water and hold there till cold, keeping the tool perfectly straight; it is then ready for grinding. It is as well to rub the surface that is to show the color with a piece of stone while hot to clean it.

Hardening and tempering at one operation. Grind a smooth place on the body of the tool and another on the head, heat to red and then dip the head till the body shows light blue color, lift out of the water and hold till the heat of the body spreads to the head and shows the right color, say light straw, then quench the whole tool. Once in the water a tool must not be lifted out till cold. The steel is white when dead hard and cold. A good process of tempering much used in United States: heat the tool in a clear fire and while hot rub on some common yellow soap, then heat to cherry red, and quench off in some petroleum. Keep away from the fumes. Every one thinks his own method of tempering the best. Below are opinions of practical men on the best way to do it, they are all useful though contradictory:—

"Boil the water before using."

"Spray the water on the drill."

"Use water heated to 100° F."

"Put a little oil on the surface."

"Put plenty of salt in the water."

"Use pure clean water quite cold."

"Keep the drill perfectly still in the water."

"Move the drill gradually lower in the water till cold."

"Dip the head and hold 10 seconds before dipping the remainder."

Tempering taps and dies. The taps, dies, and plates having been made require hardening and tempering. First fill the threads with hard soap to avoid scale and keep them clean; heat a large block of iron in fire to nearly white heat, remove and place the tools on it, when they reach cherry-red lift off and, keeping taps in an upright position, plunge in water—if slanting they will twist. Dies must be dipped flat. When cooled, clean up a surface with emery or fine stone (pumice does well) place again on hot block till the head of tap shows light blue, dip the head only in water, quickly remove and replace tap on hot block, allow to heat till the cutting part is a *light chestnut brown*, then quench in water. Dies are treated the same way as taps. Dark straw color gives a good temper with some grades of steel. It is convenient to hold the head of taps in tongs while reheating. A tap bent in tempering can be straightened by heating and careful pressure with hard wood — should not be heated high enough to show any color.

Dipping the tool for hardening and tempering is by no means an easy operation. If rod-shaped, and to be of equal temper throughout the length, it must be dipped vertically, lowering it slowly in the water until the whole is immersed. Where the end only is to be used as in drills or turning tools, only a small part is immersed, the remainder being out of the water cools slower and is softer and tougher, so less liable to break. With tools or articles of irregular shape, it is sometimes as well to shape a bit of iron, wire it on to the thin or slender part, to prevent it cooling sooner than the heavier parts, and so cause warping. Another and perhaps better way is to wire the tool on a block of iron, so as to give greater mass to it, and so cause it to heat and cool more regularly than it would have done alone. Using the bath of melted lead or oil of course renders this unnecessary.

Circular cutters having holes through them (as is usually the case) are difficult to heat and cool regularly. The hole is by some workers plugged with iron, or with a mixture of clay and iron filings or scale. If the hole does not go all the way through, the cutter must be dipped with the hole upwards, otherwise the steam formed in the hole will prevent the water entering it, and probably cause the cutter to split. A spray of water is better than dipping for tools having a large surface, but the tool must be moved about so that the water touches every part of it. This method has the advantage that all the water touching the tool is cold, whereas in dipping a film of steam or hot water is in contact with the metal, in fact steel can be softened by heating to full red and dipping in boiling water if not moved about, and left in position until the water gets quite cold; it can be suspended by a wire. Cutters of small bulk, and having a hole large in proportion to their size, can be heated for hardening or tempering, by inserting in the hole a rod of iron of white heat. In a similar manner, a large block of hot iron, having a central hole, may be used to heat small tools, which need not touch the iron, and are so less liable to scale.

Tempering soft back hack saws. These last longer and are less liable to break if the edge only is tempered, the remainder of the blade being left. Heat the blade to cherry-red, then dip the edge only in cold (raw linseed) oil, holding it till the whole blade has cooled; then clean the surface and re-heat till dark blue color, and dip the whole blade in the oil, edge downwards. All small tools are best heated for tempering by being placed on a piece of iron heated red or white hot. Very small tools can be treated by being placed on a piece of sheet iron that is heated from below by a gas jet. If the heat is at one corner of the sheet iron, the tools can be moved from the hottest corner to a cooler place with a bit of wire. One cause of tools not being able to keep a good cutting edge is that they are frequently forged too near the finished shape and size, a great mistake. The golden rule is "*Forge thick, grind thin.*" After forging steel, no matter how well it is done, the metal for a distance (more or less) below the surface is deprived of part of its carbon. There is no way of avoiding this, the remedy is to leave the tool so that there is enough to grind off to get rid of the surface metal.

Dead hard steel is sometimes required as for cutting glass; if a suitable steel is used, mercury (quicksilver) should be used for dipping.

Tempering springs. This is best done by a method known as "blazing off," which gives a very tough result. Heat the spring to red, quench in cold water to harden. Now dip in raw linseed oil, and hold in the fire till it blazes up, allow to burn till the oil is burned off, and quench in cold oil. Another method is to heat the spring, quench in cold oil bath, and temper in a bath of proper heat. Mercurial thermometers can be had graduated to over 600° F., the heat at which oil boils; this gives steel a pale blue temper, low enough for any article, and used for spectacle frames, etc. If required lower temper than this, melted lead may be used, a bath of which is convenient for heating tools for hardening. The tool can be dipped and withdrawn until the right color is obtained. The lead bath is used for softening the tangs of files without drawing the temper of the body, which is left hard and brittle.

Tempering small springs. Heat the spring slowly and carefully (to avoid unequal expansion) to a low red, quench them in luke-warm water. Place the springs in an iron ladle with enough tallow to cover them. Heat till the tallow melts, adding more if required so that they are well covered, continue the heat until the tallow blazes up in a large flame, then set aside to cool. Some workers use a mixture of tallow and resin.

Temper and tempering. The word temper is also used to denote the proportion of carbon contained in steel, or quality of steel, for instance: steel sold as "razor temper" means steel suitable for razors, *not* steel that is already tempered.

Tempering brass. This cannot be done in the same sense as steel is tempered, but brass, copper, and many other metals can be hardened by hammering. Brass springs are used for many purposes and they are made of a suitable brass, rolled or hammered till springy. Most forms of brass will bear this hammering, but bronze (tin and copper only) is most suitable for this purpose. It can be softened again by heating red hot and quenching in water; the reverse of the treatment of steel.

Annealing. Glass and most metals are hardened by being cooled suddenly from a high temperature, but are softened by slow cooling. As a general rule, the slower the cooling, the softer the result. All articles of glass are annealed by being placed in an oven and raised to a high temperature. The oven is then slowly cooled, usually for several days. Wire is hardened during the process of drawing, and as the smaller sizes are drawn through a good many holes, it is necessary to anneal the wire during the operation several times before completion. Even gold, the most malleable of all the metals must be annealed before the processes of coining or of wire drawing.

Copper, like most other metals, is annealed by heating to redness and allowing to cool slowly. If quenched in cold water while red hot, it becomes brittle, but if dipped for a moment and then allowed to cool, it becomes hard.

Brass is softened by being heated to redness and quenching in water. As brass and other tubes have frequently to be quenched in this manner, it is as well to point out that if the end of a tube is heated and put in water, steam forms in that part of the tube and rushes out at the upper end, so that *unless the end is held away from the face or body, serious scalding may take place*. The heat from the hot end also travels in the steam or hot air, and makes the upper end unpleasantly hot.

Iron and steel, to soften, must be heated to a greater heat than when last worked, and allowed to cool as slowly as possible. The slower the cooling the softer the result. For small tools or other articles, a good method is to use two fire clay bricks both made red hot. Heat the steel to redness, place between the bricks and cover all over with hot ashes. Leave until quite cold throughout, which will probably be 24 hours or more. Another good method for small articles is to pack them in a sheet iron box with charcoal, lime, or whiting powder. Close the box air-tight and heat until red hot all through. Then cover the whole with hot ashes to a good depth.

Cast Iron. For small articles, place in a charcoal fire until heated to a dull red heat, then cover them over with powdered charcoal or sand, and allow to remain till cool. Larger castings require a special furnace, and take several days or even two or three weeks to anneal, but if of good quality they are then so soft that they can often replace copper so far as malleability is concerned.

Case Hardening. This process, largely used when steel was much dearer than now, gives a thin coating of steel to wrought iron, or to describe more correctly, converts the surface of iron into steel for a small depth below which the iron is not affected. The depth to which the carbon penetrates depends upon the length of time to which it has been heated with those substances that give up their carbon to the steel. Charcoal gives the best results, burned leather or bones ground to powder and charred are also good. Quick effects are got by a chemical treatment, but the effects are not so good. With the carbon process it is very important that no air is allowed to get to the work during the process of heating. This is usually done in iron boxes of some kind. Very small work can be done in tubes of gas or steam pipe, the ends either plugged or closed with screwed caps. Larger work is put into boxes of cast or sheet iron, the lid fastened down with wire or by other means, and luted with clay so as to prevent any air entering. The articles to be hardened are packed in the box in such manner that they do not touch the sides of the box or each other. There should be at least one inch thickness of the carbon or bone surrounding the articles. A small vent must, however, be left in the clay luting to allow the gas generated from the charcoal or bones to escape. If bones or leather cuttings are used, they should be charred or partly burned first. If nuts or screws or any similar work is to be hardened, some of the powder should be worked into the threads so as to insure contact with all the surface. It is important that the box should be uniformly heated all over its surface, raised to an orange color heat, and kept at that heat 15 to 24 hours. The box should be opened as soon as it is removed from the fire, and the contents at once dropped into cold water. If the work touches the water before any air can get in contact with it, the result will be a bright surface. If the air gets to them, they will be dark or black. If a good color of surface is required, it is important that no oil should be on the work. A thinner coating of case hardening can be produced by heating for a shorter time, say three or four hours.

Heat the steel to the lowest heat it works well at. Hammer as much as possible while hot, but not much after the color has gone. In hammering give many light blows rather than a few heavy ones. Colors mentioned are those seen in the dark. Colors vary to the eyes of various people. Light red to one is dark red to another. Do not harden the tool by the same heat used to forge it; allow to cool and reheat. If your steel is too low in carbon for the tool, case-harden it. To get the mottled effect on case-hardened work, quench in urine. To prevent the edges of tools being burned in heating, rub with a mixture of soap and lamp-black.

Straightening Hardened Steel. Files are not tempered after hardening. They are heated in melted lead and quenched in salt and water. Before the interior of the tool has time to chill they are removed, and if bent are straightened between iron bars, and at once dipped again till cold. Any tempered tools can be bent or straightened in this manner if heated, but not so much as to show color. Tools tempered blue need only be warmed.

Tempering Steel Pens. These and other small articles of steel are tempered in large numbers at the same time. Put in an iron pan and heat till full red, stirring them about so that they heat equally to a good red. Empty at once into tank of cold oil, then lift on to wire netting and allow to drain; wash well with soda and water till all oil is removed, and dry — then place in drums of wire netting revolving over gas flames (Bunsen) until the right color — remove at once, and allow to cool in air. They can be done on a metal plate instead, if there are means of heating it.

Bluing Clock Hands and Spectacle Frames. Use a piece of sheet iron forming a small table, with a powerful gas burner under corner. Spread the work on the plate so that it gradually heats, then push one at the time to the hot part, but as soon as it shows the color required, remove it to the cooler part or push on to a cool plate. Some clock hands are blued with a colored varnish.

Drop Forgings. Some scissors and other tools are now made in dies, the hot metal being inserted between a pair of them, and squeezed to the shape. These are tempered just as other goods are, but the absence of hammering during the process prevents good tools being made by this method even when good steel is used.

Case Hardening Small Screws. Dissolve in hot water two ounces of prussiate of potash, and four ounces of common salt, using very little water so as to make a thin paste, add powdered charcoal to make a thick paste. Put a good layer of this at bottom and sides of a sheet-iron box or old sauce-pan. Put in the screws so that they do not touch, then put on a good layer of the paste and press well down so that the paste is well in contact with every part of each screw. Raise to a red heat, and keep so for five minutes or more; then put box and contents in cold water.

Don't make chisels too long, they are

more liable to "broom up" than shorter ones. When the chisel head "brooms up" do not attempt to forge it again but cut off or grind off — in any case get rid of the spoiled part before it causes an accident. For a similar reason the top end of a chisel must be left soft. The hammering will in any case make it brittle and fragments are liable to fly off. When grinding the edge give a little attention to the other end.

Hard or Soft Temper? A tool tempered hard and of high carbon steel breaks at the edge much sooner than one tempered low or of low steel, but it does much more work in the same time, and is a saving of time in the end.

TABLE A.—Compiled 100 years ago and still unsurpassed.

430°F.	Faint Yellow	Lancets
450 "	Pale Yellow	Razors
470 "	Full Yellow	Pen Knives
490 "	Brown	Scissors, Cold Chisels
510 "	Brown, with Purple Spots	Axes and Planes
530 "	Purple	Shears and Table Knives
550 "	Light Blue	Swords and Watch-springs
560 "	Full Blue	Small Saws
600 "	Dark Blue	Hand Saws

TABLE B.—Colors of finest tool steel at various heats.

430°F.	Very Pale Yellow	Gravers, Drills Light Turning Tools
455°F.	Straw Yellow	Paper Cutters, Milling Cutters
495 "	Brownish Yellow	Taps, Punches, Reamers, Twist-drills
528 "	Light Purple	Plane Irons, Wood Tools
535 "	Dark Purple	Wood Chisels
570 "	Clear Blue	Screw-drivers, Springs
600 "	Dark Blue	Saws for wood
610 "	Pale Blue	" "

Tools of awkward shape should be heated in Linseed Oil which boils at 600°F. so that the tools cannot be overheated.

QUALITIES OF STEEL FOR TOOLS, ETC.

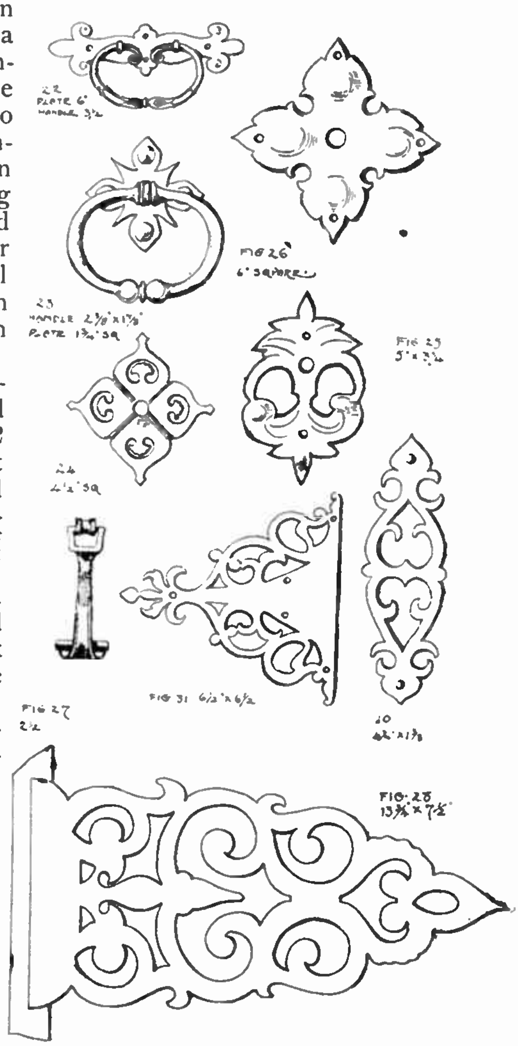
TEMPER.	CARBON%	PURPOSE SUITED FOR, ETC.
Razor	1½	Difficult to work, easily burned by overheating, makes best metal-turning-tools if well made.
Saw-file	1⅜	Requires careful working, not to be heated over cherry-red.
Tools	1¼	Usual for tools — difficult to weld.
Spindle	1⅛	For milling cutters, taps, dies, mill picks, can be welded. (This is *not* the steel used for wool or cotton spindles).
Chisel	1	Best all round steel where only one sort is stocked. Best for cold chisels — welds easily.
Sett	⅞	Best for setts, stands hammering well. Welds very easily.
Die	¾	For large tools, stands heavy blows well. Welds very easily.

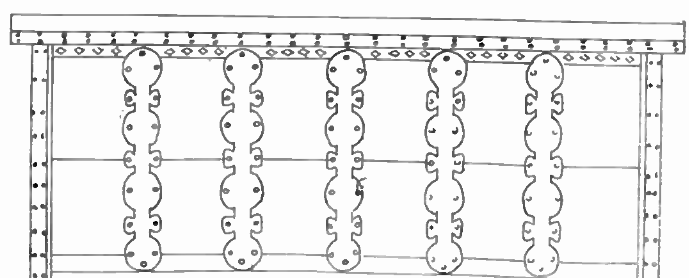
Metal Fittings as Applied to Furniture

ETHEL WILLIAMSON

Having planned the design for a cabinet, linen chest, or cupboard, the question arises as to the fittings, *i. e.*, keyhole and hinge plates, handles, etc. It is very easy to spoil a good piece of workmanship by incongruous fittings—one sees many such every day. To guard against this, every craftsman should make as many studies as possible of good old examples for reference. Those fortunate individuals who live near historic centres or good museums have ample opportunity for so doing. But for those who, either by reason of inconvenient locality or lack of time, are unable to do so, I felt these articles might offer some suggestion for future designs. With the exception of Fig. 21 and 28, all the examples are taken from the Victoria and Albert Museum, South Kensington.

KEYHOLE PLATES.—There are seven examples shown. Excepting Fig. 7, which does duty on a Spanish coffer, early seventeenth century, the rest are German sixteenth century work (iron), Figs. 5 and 6 being rather elaborately carried out in cut tinned iron. With Fig.4 is given some varieties of shield form frequently met with in old work. Before leaving the subject of keyhole plates, I should like to draw your attention to Figs. 8–11. These were taken from an oak desk, English sixteenth century, and form the decoration between the iron bands, placed on the desk at intervals of about 1½, in. Fig. 9 is the centre ornament on





SKETCHES OF METAL FITTINGS.

lid, which with Fig. 10, placed between the iron bands to left and right, makes a band of applied ornament across the centre. Fig. 11 is one of four small angle plates. Stout and strong, it formed no doubt, a safe resting place for many important documents. When it is borne in mind that such ornament as the foregoing was often applied over some rich colored material, such as velvet of crimson or green, the beautiful effect can be well imagined—the outlines of the design only enhanced by the color over which it was placed.

HINGE BANDS.—To the small cupboard or cabinet door, a well designed hinge-band is a great ornament. Fig. 12 is an iron band, of which a pair ornament either of the two doors of a carved Gothic sideboard, German fifteenth century; Fig. 13, 14 and 15 are varieties of termination. Although Fig. 15 is of exceptionally heavy iron, a hinge band or angle plate moulded on these good and simple lines, together with a lock plate designed to match, ought to make a very presentable piece of work. A French hinge band, late fifteenth century, is shown in Fig. 16. The termination in the form of a fleur-de-lis, Figs. 17 and 18, forms part of the decoration from a German window shutter, about 1550, which in itself is an object lesson in beautiful fittings. Fig. 17 is a double hinge band to allow shutter to fold back, and Fig. 18 is a small angle plate. Fig. 19, together with the bolt plate, Fig. 29, appears upon some fine oak panelling from an old house near Exeter; while Fig. 20 is a hinge of tinned iron, German sixteenth century; and Fig. 21, English, formed part of the decoration on an old church door, the nail heads which secure either end being driven through the centre of the small volutes. Fig. 22–27 show handles and handle plates such as are required on small pieces of furniture in the home, Fig. 27 being a dainty "drop" used to pull out the drawers from an elaborate French oak cabinet, late sixteenth century.

BOLTS AND PLATES.—For small cupboards or cabinets, or indeed, if one wishes to replace the doubtful productions of the "jerry builder," small bolts, such as those shown in Figs. 28–31, may offer some suggestions. Fig. 31 is a bolt plate from the window shutter mentioned above (Fig. 17). Fig. 30 is French, and more especially interesting, having

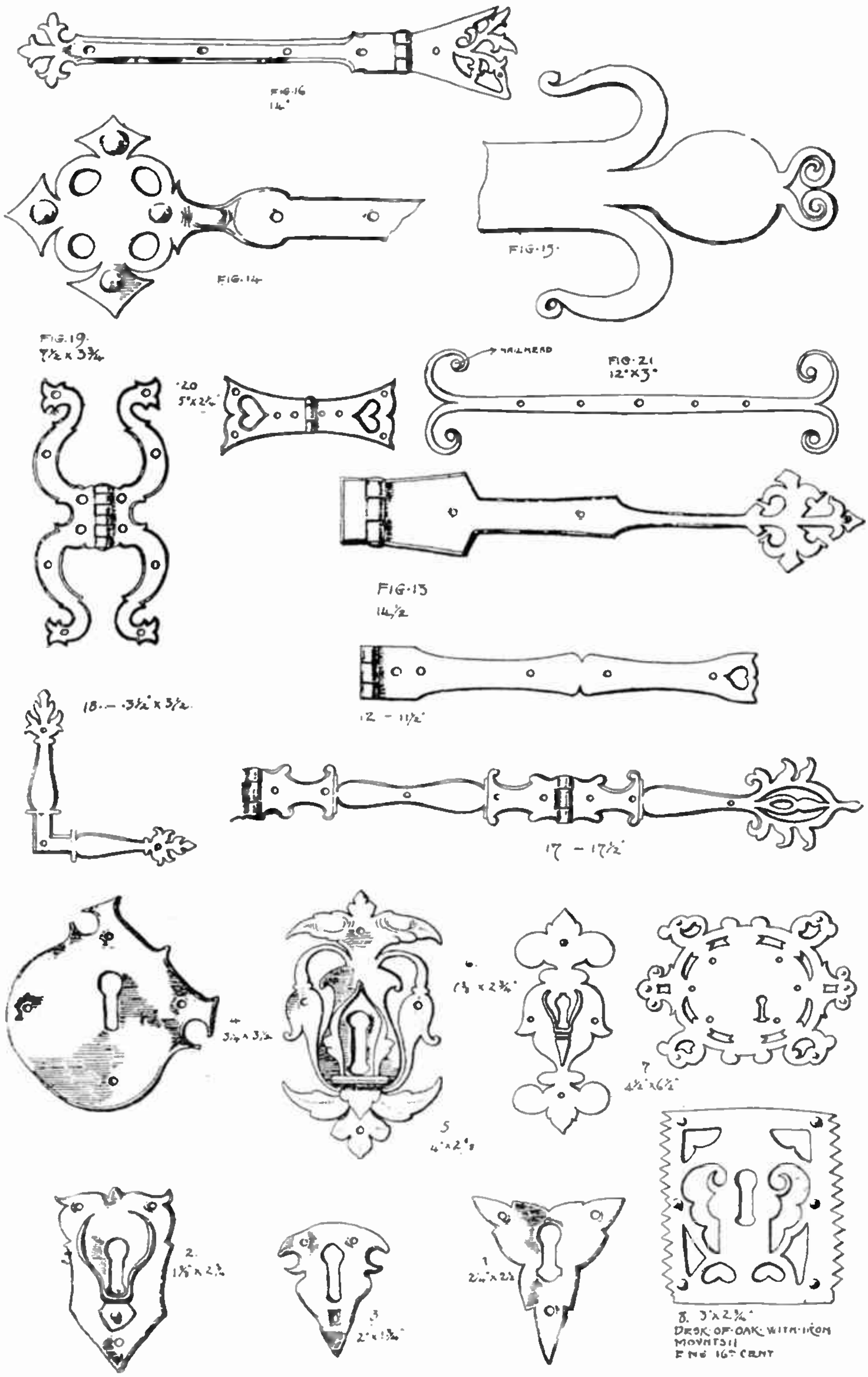


FIG. 16
14"
FIG. 14
FIG. 15.
FIG. 19.
7½ x 3¾
20
5"x 2¼
NAILHEAD
FIG. 21
12"x 3"
FIG. 13
14½
12 – 11½"
18 – 3½ x 3½
17 – 17½"
3¼ x 3½
5
4"x 2"
6
1¾ x 2¾
7
4½"x 6½"
2
1⅞ x 2½
3
2" x 1¾"
1
2¼ x 2½
8. 3"x 2¾"
DESK OF OAK WITH IRON MOUNTS
END 16TH CENT

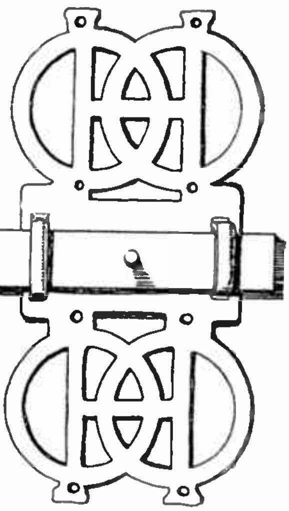


FIG. 30. 5"x3½"

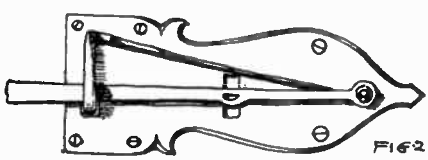
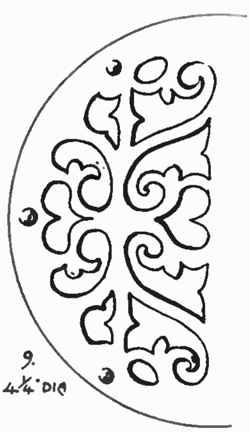
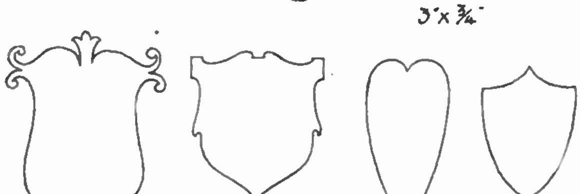


FIG 29. 7¼"x 2¾"



9. 4¼" DIA

11 3"x¾"



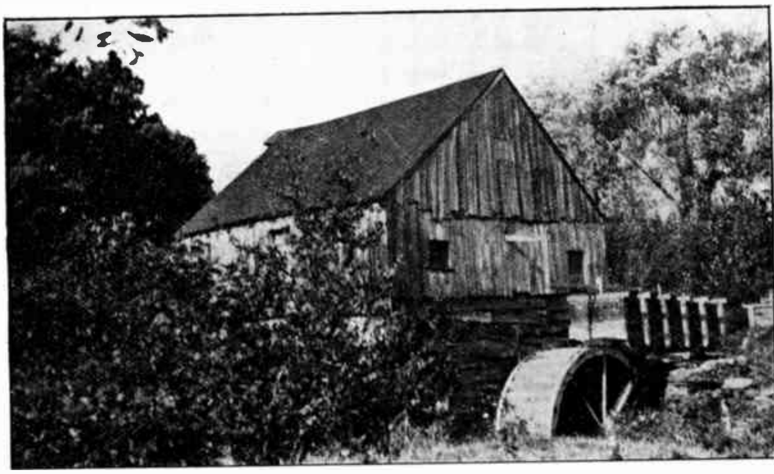
VARIOUS SHIELD FORMS

the plate cut above and below, with the monogram of Henri II of France and Diana of Poictiers. Regarding it apart from the monogram, the design is out of the common floriated variety, and very pleasing in its simple geometric form. Although Fig. 28 was in use as an old English window fastening, some such design would be equally adaptable either as a hinge or angle plate.

The oak chest formerly used for storing the much prized household linen is still an object of admiration to this generation. Such a chest, made on the lines of some good old example, would be a useful addition to any home, especially in these days of limited cupboard room. I have in mind a fourteenth century Italian marriage coffer at South Kensington. It is made of walnut wood, the sides and lid being divided into panels, decorated with figure subjects in stucco, and banded together between the panels with metal bands of simple and effective design. An illustration of one side is given in Fig. 32 (thin gauge metal being, of course, used). There are in the above museum several Gothic oak sideboards, coffers, chests, etc., where the lock plate alone is a study of Gothic tracery, in miniature, and must be seen to be appreciated. I am indebted to the authorities at South Kensington for permission to give illustrations of the foregoing examples.

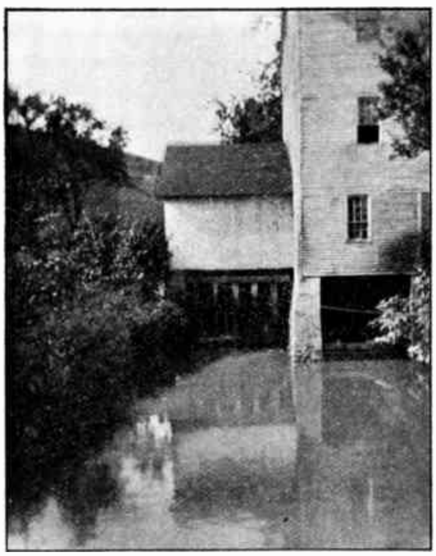
It may not be out of place here to say that ample encouragement for study is given, both at South Kensington and Bethnal Green Museums, which are open free three days in the week from 10 a.m. to 10 p.m., and I hope these sketches may be the means of bringing them to the notice of young craftsmen who have as yet, to make their acquaintance.
—*The Wood Worker.*

Our Photographic Contest



"Ye Old Mill," by G. C. Stortz

Our contest pictures for this month were very interesting, and it was rather hard to make a selection for the prize picture from so many. From a photographic standpoint perhaps they are the best prints we have had. The first prize is awarded G. G. Stortz, for "Ye Old Mill." Honorable mention is given to Gillmore Bigler for "The Mill Race" and to G. J. Kollock for "Bang." All three pictures are reproduced and we offer our congratulations not only to these whose work we have shown, but to many others whose prints we do not find it possible to reproduce.



"The Mill Race," by Gillmore Bigler

Prints of those not winning will be returned if postage is sent.

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"Bang," by G. J. Kollock

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EDITORIALS

We will pay ten cents cash for copies of July, 1907, issue, which are wanted to fill orders now on hand, as the edition is entirely exhausted.

Unless we can procure some from our readers who have read the number and have no further use for the same, we will not be able to supply the demand.

If our readers will advise us the article or articles they were particularly interested in, in this particular, it may soon be possible to reprint same at once. Possibly it will be more satisfactory to allow the ten cents to go towards the price of a book, or to exchange for some other ten cent number.

We are preparing a new book list, and many of our readers who have found the books they have purchased to be of great service to them will be interested in some of the newer books which we have added. If you want us to get you some more advanced publication, or one higher priced than those listed, we will be glad to get them for you, if it is possible.

The article, on page 350, entitled "A Hand-feed Arc Lamp," should have been credited to *The Model Engineer*, of London, from which it is copied.

We would be glad to mail our new book list, just issued, to any interested reader.

We offer each month a prize of one dollar for the best photograph sent in by any reader.

Book Reviews

SLOYD for the three Upper Grammer Grades, by Gustaf Larsson. Boston, 1907. Price $1.25.

To quote from the title page of this excellent book, "Sloyd is tool-work so arranged and employed as to stimulate and promote vigorous, intelligent self-activity for a purpose which the worker recognizes as good." To be more specific, Sloyd is tool-work done simply for its educational value in training mind and body, as distinguished from manual training, which aims rather at the acquirement of dexterity as an end. Sloyd has distinct educational value as well as being useful for any one who desires interesting and useful physical employment for leisure hours. The lessons here given form the best course of Sloyd exercises yet published and have been very extensively adopted in schools already. They comprise enough exercises to give good facility in the use of all the simple tools. While designed primarily for younger pupils, they are proper to be used by anyone who wishes to experiment in the beginnings of wood work. Besides being published in book form, the different exercises may be had on separate sheets for use as working drawings at fifty cents a set.

By the same author is a useful little pamphlet on "Wood Carving" at twenty-five cents. An excellent book of designs, with elementary instructions, for geometrical or chip carving.

QUESTIONS AND ANSWERS

Questions on electrical and mechanical subjects of general interest will be answered, as far as possible, in this department free of charge. The writer must give his name and address, and the answer will be published under his initials and town; but if he so requests, anything which may identify him will be withheld. **Questions must be written only on one side of the sheet, on a sheet of paper separate from all other contents of letter, and only three questions may be sent in at one time.** No attention will be given to questions which do not follow these rules.

Owing to the large number of questions received, it is rarely that a reply can be given in the first issue after receipt. Questions for which a speedy reply is desired will be answered by mail if fifty cents is enclosed. This amount is not to be considered as payment for the reply, but is simply to cover clerical expenses, postage and cost of letter writing. As the time required to get a question satisfactorily answered varies, we cannot guarantee to answer within a definite time. Neither do we guarantee that the answers will be satisfactory for any special use or purpose required.

If a question entails an inordinate amount of research or calculation, a special charge of one dollar or more will be made, depending on the amount of labor required. Readers will in every case be notified if such a charge must be made, and the work will not be done unless desired and paid for.

524. **Telegraph Relay — Rotary Converter.** S.K.H., Morristown, N.J., asks (1) What is the object of winding relays to such high resistances? Is it to balance that of the line? (2) What are the proportions for making storage battery plates of the pasted sort of any desired capacity? (3) Are toy gas engines made? (4) If a "Wonder" dynamo that gives 12 volts and 2 amperes is fitted with two collector rings in addition, what would be the voltage of the alternating current? Could both kinds of current be taken off simultaneously, and what would be the frequency? *Ans.* The resistance is incidental, undesirable, but unavoidable. Due to the high resistance of the line and the ground circuit, the current is very small, yet for energizing the electromagnet of the relay a certain number of ampere-turns must be used. Since the current is so small, there must be a large number of turns: in order not to make the device too bulky fine wire must be used, and that is sure to have a high resistance. The redeeming feature of the case is, that although this winding has considerable resistance, it is not much as compared with that of the rest of the circuit, and the insertion of it in circuit does not materially reduce the strength or rather the weakness of the current. (2) Each plate should have .5 to .8 oz. of active material, besides the weight of the supporting grid, per ampere-hour capacity. (3) Yes, address the Carlisle & Finch Co., Cincinnati. O. (4) About 8 volts. Both kinds of currents can be taken provided their sum does not much exceed 2 amperes. At 3,000 rev. per min., 50 cycles.

525. **Toy Water Driven Dynamo.** F.A.J., Cambridge, Mass.. asks (1) Has a Carlisle & Finch No. 16 dynamo that is advertised to give 18 volts and 2.5 amp. when water pressure is 50 lbs., but although the pressure registers 55 lbs. on a new gauge, the dynamo fails to light a 10-volt lamp. What is the reason? (2) Where can parts for a toy railway be procured? *Ans.* Did you measure the pressure when the water motor was running? That is the crucial test. To get the full pressure you will probably have to run a special pipe directly to the main in the street, and have no elbows. (2) The Carlisle & Finch Co., Cleveland, O., are the principal dealers in these novelties.

526. **Armature Construction.** E. C. B., —— asks (1) How can the direction of rotation of the armature of a motor be foretold? (2) What general proportions are there between the armature and field of a dynamo? (3) When there are more commutator segments than armature coils, how are the connections made? *Ans.* (1) If you know which pole is north and in what direction the current is to flow in any given wire of the armature, you can apply the left-hand rule, described on page 197 of the Jan., 1907, magazine. (2) For toothed drum armatures and two-pole fields, let diameter and length of armature be equal; for four poles let diameter be twice the length, and for six poles, three times the length. Some manufacturers would make the lengths about 50% in excess of these proportions. but these variations are the limits of good design. Proportion the magnetic circuits so that about three-fourths of armature is covered by the polar faces and that the weight of wire on field is about three to four times that on armature. (3) There are really as many coils as segments, only two or three coils are taped together and placed in one slot. Three coils per slot is the regular practice for railway motors.

527. **Water Resistance.** D. G. B., Point Pleasant, W.Va., asks (1) What should be the separation between two copper electrodes 1 sq. cm. each, in water, so that a resistance of 10,300 ohms will result? (2) Describe an electrolytic interrupter for use with an induction coil on alternating currents. *Ans.* (1) This is quite indefinite, and the question impossible of answer. Absolutely pure water is believed to be a perfect insulator, but whenever electricity seems to pass through it, the conduction is entirely due to impurities, called "ions," or carriers. Such may be present in almost any proportion in ordinary water: distilled water may be fairly free from them, but the act of introducing the copper plates would at once supply a large number; salt, sulphuric acid, or almost any inorganic compound is known as highly effective in improving the conductivity. (2) Such are adapted for use with direct currents only.

528. **Babbitt Metal.** C. A., City Mills, Mass., asks (1) What is the yellow metal used for lining the crank bearing of a gasoline engine? Is it Babbitt metal? (2) What is such metal? *Ans.* (1) Probably bronze. You will have to work such a piece from a casting. Babbitt metal resembles silver or tin. (2) This is an alloy composed of tin, copper and antimony, the quality of the mixture depending largely on the quantity and quality of the first ingredient. Cheap mixtures masquerading under the name of Babbitt metals, are composed largely of lead, and can readily be distinguished by their greater weight, and lower price. The genuine mixture cannot

be purchased lower than 50c per pound, while some of the substitutes may be as low as 20c.

529. **Bipolar Dynamo.** F. W. J., Lincoln, Neb., is making a bipolar dynamo with field bore 4⅜" dia. and 3" long. Armature has 18 slots and is wound with 18 wires per slot of No. DS wire. He asks various questions as to the field winding and the operations of the machine. *Ans.* With the No. 22 wire you propose for the field you will need about 14 lbs. to provide the requisite resistance. The ampere turns with that quantity will probably suffice. The pole pieces of the dynamo ought, however, to be more stocky. The armature ought to supply 7 amperes to the useful circuit in addition to the field circuit. A 2-cycle gasolene engine will suffice to run the dynamo fairly steady, as long as the load remains constant; but a 4-cycle engine, though consuming far less fuel, needs the adjunct of a storage battery, or the lights will intolerably flicker. A 2 h.p. engine will be needed. Cast iron is not melted in crucibles, but in a blast furnace, or "cupola"; the melted iron may be carried in fire-clay lined ladles, but the outer portion is not subjected to melting heat.

530. **Sizes of Drawings--Spark Coil.** E. M. K., Buffalo, N.Y., asks (1) What are the standard sizes of drawings used by engine and electrical manufacturing concerns? (2) Why are not ⅜ and ¾ size scales used for machine design instead of the usual full and half sizes, when the latter are often inconveniently large? (3) Why is not the iron core of a spark coil made with a complete magnetic circuit like a transformer? *Ans.* (1) Each concern adopts its own standards. One large company has sizes 12"x18", 18"x24", 21"x33", 28"x36", and 33"x42". These sizes were originally adopted as giving the most economical cutting for standard 36"x48" sheets, with some allowance for margins. (2) While some such scales would be possible in the drafting room, the pattern shop could not readily follow them. (3) Iron has too great residual effects. With the alternating current, the change in magnetism is forcibly made; but when the mere taking away of a current, rather than the reversal, is made the active principle, only an open magnetic circuit will release its lines of force.

531. **Home-Made Speed Counter.** O. W. E., Portsmouth, O., sends a sketch and description of a home-made speed counter, and asks our opinion. It is made from the bobbin winder of a sewing machine. *Ans.* This is novel and quite effective. If the disc has 100 teeth, the instrument will be as convenient as the purchased ones. We do not understand your reason, however, for filing off all the threads from the worm except one. It would be better to get the wearing qualities of all.

532. **Electric Telephone.** C.F.W., Dayton, O., asks (1) Can a 110-volt direct current dynamo be so changed as to operate on alternating currents? (2) What is the advantage of the Edison 3-wire system? (3) What book explains the working of the Bell telephone system? *Ans.* (1) No. (2) Only about three-eighths as much copper is required in the wiring as with an ordinary 2-wire system. The principles were explained in Chapter XI of the engineering series. (3) For a popular treatment, Houston & Kennelly's Electric Telephone, price $1.00, is a good one.

533. **Jump Spark Coil.** C. A. F., Cornwallis, Ore., asks if 2 lbs. of No. 36 s.c.c. wire will suffice for making a 2-inch jump spark coil? *Ans.* Yes, if you are judicious and careful in the use of the materials. We would advise you to follow the directions for making a coil in the July, 1907, magazine. In general you must put no dependence whatever in the cotton covering, but proceed as if the wire was bare.

534. **Metal for Armature Cores.** J. W. Y., Bemus Point, N.Y., asks if any other metal than iron can be used for the field and armature cores of dynamos? *Ans.* If you include cast iron and cast steel under the general name iron, and we may state that there is no other or even desirable substance.

535. **Dynamo-Bridging Generator.** K. B. A., Chittenango, Sta. N.Y., has tried to make an experimental dynamo, following the directions given in the March, 1907, issue of the magazine, but the efforts are a failure. What is the reason? (2) How is the winding done on a "bridging" generator? *Ans.* (1) If you had followed the directions exactly, you would have been successful, for many such machines have been made. Try the insulation, by removing the wire from the shaft, and see if there is accidental contact anywhere. Perhaps you have the commutator in the wrong position. Send a battery current through the winding to see if the circular iron surfaces are magnetic. Perhaps you have the current in one half of the coil opposing that in the other half. Exchange the ends of coil. (2) One end is attached to the iron and the other to the insulated pin.

536. **1-4 Inch Spark Coil--Covered Iron Wire.** E. H.F., Council Bluffs, I., asks (1) Will a ¼" spark coil suffice to charge a Leyden jar? (2) Where can silk-covered iron wire be procured? (3) Must a resistance be connected across the terminals of a gravity battery when not in use? (1) Yes, for small charges. (2) It is not practicable to use such wire, for by action of dampness the insulation would be destroyed, and for induction coils iron wire is quite out of place, in consequence of its magnetic effect. The winding would be too inductive. (3) Yes, else the two solutions will mingle. A 110-volt lamp makes a good resistance.

537. **Compound Motor.** C.B., Schenectady, N. Y., asks if there is any book describing winding of dynamos and motors so a person could change a series motor to one with a compound winding. *Ans.* No, we do not know of any that would clearly lead you to the particular facts desired. Most books describe methods of calculating such special cases, but you might not recognize the actual working conditions. In general, a compound motor is seldom used. Cumulative windings are preferred. We will figure your problem for the special fee of $1.00.

538. **Wire for Induction Coil.--Wireless Telegraphy.** A.B.T., Annandale, Minn., asks (1) How much No. 36 wire is needed for the secondary of an induction coil to give ¾" sparks? (2) How many Leyden jars connected in cascade will such a coil charge? (3) What is meant by "tuning" in wireless telegraph nomenclature? *Ans.* (1) About one pound, if properly used. (2) Only

one jar. (3) Such an adjustment of receiving apparatus as to respond to the waves emanating from some particular station.

539. **Alternating Currents--Induction Coil.** H. P., Providence, R.I., asks (1) Does a transformer change alternating current into direct? (2) In speaking of magnet wire, what does d.c.c. mean? (3) What is the use of an intensifying coil in wireless telegraphy? (4) How can the spark of an induction coil be lengthened? *Ans.* (1) No, the secondary is also alternating. (2) Double cotton covered. (3) It makes the spark much more sudden and energetic. (4) By using more battery power.

540. **Gasoline Engine.** H.W.B., Hollis, N.Y., asks our advice as to the selection of the 2-cycle or 4-cycle sort of gasoline engine, to be used for both stationary and marine purposes. *Ans.* This is rather out of our line, and we would do wrong to assume the responsibility for the selection. Any reputable builder will honestly state which of the two kinds will the better fill your needs. Anyway, do not limit your request for advice to any one builder. The 2-cycle is lighter, less complicated, and of inherently better regulation of speed than the other; still the 2-cycle gives less trouble in starting, and is more economical in fuel.

541. **Wireless Telegraph.** N. W. M. & Santa Rosa, Cal., asks (1) What changes should be made in the construction of the 4-inch induction coil, described in the July, 1907, magazine, to adapt it to use with wireless telegraph apparatus? (2) What effect would it have on a person to receive the full force of the output of such a coil? (1) For wireless work, the sparks must be short and thick. Use secondary wire three sizes larger, that is No. 33 instead of No. 36. (2) A person might be stunned, but not dangerously hurt.

542. **Manchester Field Magnet.** D.P.H., N. Beverly, Mass., has a dynamo with "Manchester" type of field magnet, each of the cores being 1$\frac{3}{16}$" dia. and 3" long, wound with No. 18 wire. Armature is 2½"x2½", has 12 slots and wound with No. 22 wire. He asks what should be the output of such a machine, and how fast to drive it to get 8 to 10 volts? *Ans.* As you do not give all the dimensions for the magnetic circuit, we cannot tell just what the voltage should be. Perhaps the 10 volts you suggest will really be the maximum. A speed of 2.500 rev. will be needed. Even at that speed, or any other, there will be no voltage unless the exterior circuit is closed through some resistance. Being a series wound dynamo the field cannot get its strength until some current is allowed to flow in some connected circuit. In case the field was shunt wound, as is best for most experimental purposes, there would be the maximum voltage when the exterior circuit was absent. The armature is good for 4 amperes.

543. **Transformer.** K. T., Anarillo, Tex., (1) has a No. 7 Carlisle and Finch dynamo, listed at 12 watts. What should be the winding to give 8 volts? (2) What should be the construction of a transformer to change the 75 to 100 volts of a telephone magneto to 8 volts? *Ans.* (1) As we do not have one of these machines at hand nor informed as to the present winding, we should think it best for you to write directly to the builders. (2) The frequency of the alternations is a matter of as much importance as the voltage, and you cannot get the requisite frequency for ordinary working from a 2-pole machine. There should be 10 to 12 times as many turns of the fine wire as coarse, and they could be wound, for an experimental transformer, upon a ring wound from annealed iron wire. Try a ring 2½" inside dia. and 3¾" outside. Let the bundle be of circular section. Insulate with paper and tape, wind on one layer of No. 18 wire for secondary, insulate again and wind on the primary of No. 33 wire.

544. **Conjoint Operation of Dynamos.** E. P. M., Pintwater, Mich., (1) refers to Chapter XII of the engineering series and asks why it is that when the voltage of the second dynamo is made just equal to that between the main bus-bars, and the main switch then closed, that no current will flow? How can this machine remain idle when connected to the live wires? (2) If in a shunt circuit the flow of current is inversely proportional to the resistance, why does not an increase of resistance in the dynamo circuit increase the reading of the voltmeter, for that resistance remains the same? (3) When Fleming's right hand rule is applied to the case of determining the direction of the electromotive force in a ring armature, why does not that induced in the inside conductors, nearest the shaft, oppose that in the outer conductors? *Ans.* (1) If the armature of the second generator had absolutely no resistance it would at once assume a portion or indeed, all of the load. As a matter of fact, the winding does have resistance and current cannot be said to flow in that winding unless some volts are employed for that purpose. By turning the rheostat to raise the potential, extra voltage is actually generated, but does not show at the voltmeter,—it is used within the winding. (2) We do not wholly understand your premises, but imagine that you are confusing constant potential and constant current ideas. The dynamo does not have to generate a fixed number of amperes, but when one circuit is increased in resistance, the current in that circuit alone may be affected. The case is like that of a water system. The act of varying the size of opening in one faucet does not necessarily affect the pressure of the system as a whole. No water at all may be drawn, and the pressure still remains the same. (3) If any lines of force do pass through the interior of the ring they do produce an e.m.f. directly opposed to that in the outer conductors. This fact has been stated as one of the defects of a ring winding. Still, in a well-designed machine the leakage through this region is very slight, and well offset by some advantages, so the ring armature is largely used for arc dynamos. Once the lines of force are within the iron of the ring, they travel in the circular path to the next pole. We are glad to receive such questions as these, for it gives evidence that the articles are being read and subjected to critical analysis.

545. **Direct Current Motor.** C. E. T., Hamilton, Ont., asks (1) If any of the parts of an ordinary direct current motor can be used for making one to run on alternating currents? (2) Where is the "Globe" iron clad motor? (3) If Nos. 30 and 34 wire are used on a 70-volt motor what sizes should be used for 20 volts, and

what number of amperes would safely be allowed? *Ans.* (1) If field is laminated, yes, but poorly. (2) We do not recollect the name; perhaps our readers could tell us. (3) Nos. 30 and 26; that is, use the present series field wire to rewind the armature, and wind field with No. 26. About one-half an ampere.

546. **Voltmeter.** G. H. N., Hacketstown, N.J., (1) sends a sketch of the castings for a small dynamo, for which has the castings, and asks various questions as to the proper winding and possible output. (2) How is it that a voltmeter can have a resistance of 15,000 ohms, as stated on page 241 of the engineering series, therefore requiring upwards of 3 miles of copper wire, if No. 40 is used, while the *Scientific American* states that 2½ oz. will suffice. *Ans.* (1) This design of dynamo is one of the most primitive, before the form originally devised by Siemens for his famous shuttle armature. The particular dimensions you show were given by the *Scientific American* over 25 years ago, and it still serves to interest beginners. You can get slotted punchings for the armature from the W. & S. Mfg. Co., Worcester, Mass. Wind it with all the No. 20 wire you can get on, and put the size of which you sent a sample, No. 22, on the field. Put about ¾ lb. on each limb. An output of 3 amperes and 8 to 10 volts should be secured. (2) You are comparing two different constructions of instruments. It is true that a 150-volt voltmeter of the "Weston" type has about 15,000 ohms resistance, but it is not necessary or convenient to wind this of copper wire. The little movable coil is of that metal, but its weight is insignificant. The real resistance is in German silver wire or of other alloys of much higher resistance and permanency. The spool containing it is not larger than that for a spool of thread. On page 284 you will find data regarding the other sorts of instruments quite in keeping with those referred to in the other publication.

547. **Polarized Relay — Induction Coil.** H. D. K., Erie, Pa., refers to the article in the December, 1907, magazine, regarding the making of a polarized relay, and asks if two telephone ringer coils of 2000 ohms resistance will answer? Should they be connected in series? Where can directions be found for making a Tesla coil? *Ans.* In series the coils will have 4000 ohms resistance, but when in parallel only 1000. We should try them both ways. You need not expect that two dry cells will have much effect on them, but if you use sufficiently delicate springs and free movement, the armature should respond. In the July, 1907, magazine, you will find a good description of an induction coil of this order.

548. **Dissolving Rubber.** R. W. H., Lavelle, Pa., asks (1) How can rubber be dissolved so as to be used for filling bad spots in automobile tires? (2) In what way can the positive pole of a battery be found? (3) Is there any way to electrocute fish under water by use of an induction coil? *Ans.* (1) Heating rubber is rather detrimental to its elastic qualities. You can dissolve it in bi-sulphide of carbon. This is a very inflammable liquid, and considerable caution must be used in its handling. (2) The simplest method is by use of the water voltmeter, a description of which you can find in almost any dictionary or encyclopædia. The hydrogen appears in the tube where the current leaves the water. (3) We do not know of any.

549. **Toy Locomotive Storage Battery.** C. S., So. Chicago, Ill., asks (1) If the "Wonder" motor, for $3.75, will run the toy locomotive described in the November, 1907, magazine? (2) Where can small flanged wheels for cars be obtained? (3) What capacity would there be in a storage battery consisting of 2 plates of lead, 4″x6″? *Ans.* (1) Yes, we think so. (2) From the Carlisle and Finch Co., Cincinnati, O. (3) Better use three plates, one positive and two negatives: if upwards of ¼″ thick, of grid and paste, and properly formed, about 10 ampere-hours.

550. **Vapors of Metal.** R. F. A., Carmine, Tex., asks (1) What was the reason for the cloud of red smoke when an iron telephone wire was vaporized by a lightning stroke? (2) When an incandescent lamp or other circuit is turned off, what happens to the current that was flowing? *Ans.* (1) Colors of vapors of metals, as well as those of ordinary temperatures, are regarded as accidental properties, and usually unexplainable. From the color you observed, we should have suspected the wire to be made of copper. A very small quantity of material can make a great deal of smoke. (2) That much less current is generated by the dynamo.

551. **Tin-foil.** C. O. M., Los Angeles, Cal., asks if thick tin-foil, such as is used for lining tea chests, is suitable for making condensers for induction coils? *Ans.* Yes, for the capacity of the condenser does not depend upon the thinness of the metallic part, but upon that of the insulator. You will simply have a heavier structure than otherwise. It is our experience that the lining of tea chests is lead, not tin, but this makes no difference to the electric qualties.

552. **Electromagnets Permanent Magnets.** R. M., Cambridge, Mass., asks what quality of steel should be used for making the cores of make-and-break electromagnets and for permanent magnets? *Ans.* For electromagnets steel ought not to be used at all, but the softest grades of wrought iron; bundles of annealed iron wires or sheet iron would be better than solid masses. For permanent magnets, special qualities of steel have been produced, from which manganese has been removed and into which a small trace of tungsten (wolfram) has been introduced. Leslie & Co., of Montreal, Can., are the agents for such brands.

553. **Induction Coil.** A. L. A., Santa Cruz, Cal., asks if an induction coil that regularly operates on a 10-volt battery circuit can be made to work on a 110-volt alternating current circuit, lamps being interposed for resistance, and if so, should the interrupter be retained? *Ans.* No, it will not work at all satisfactorily. At any rate you will need to keep the interrupter, for the natural decay of the alternating current is altogether too slow to correspond with the suddenness of the break of a battery current.

554. **Shunt Wound Dynamo.** F. P., San Francisco, Cal., has a small shunt wound dynamo and wishes to know how to rewind it so as to be able to use it on alternating currents. *Ans.* It cannot be done.

SALE AND EXCHANGE

Advertisements under this heading, without display, two cents per word, cash with order, minimum 50 cents. Black-faced type, 4 cents a word, minimum $1.00. Exchange advertisements will be inserted for subscribers once in 12 months without charge, subsequent insertions one cent a word.

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Make your own Furniture from our full size patterns. New plan. Simple and easy. Send ten cents for sample pattern of bookrack or candlestick, and illustrated catalogue showing other pieces. The Home Furniture Pattern Co., 1616 First National Bank Building, Birmingham, Ala.

For Exchange - One motor; overland coaster; roller skates; telescope 23 inches long; batteries; 60 copies of interesting papers for 1907. Will exchange for anything in electric line. Write for further information. Amos Knudstad, Box 333, Argyle, Wis.

For Sale or Exchange — One book on Modern Machine Shop Tools by Vandervoort, price $4.00. Will exchange for best offer. Address Wm. J. Petzendorf, 1163 E. 58th St., Cleveland, Ohio.

For Sale — One bicycle fitted with Goodyear cushion pneumatic tires, in good condition, or will exchange for a good metal working lathe; also a 12-gauge shotgun. J. L. Jones, 339 Hillside Ave., Edwardsdale, Pa.

For Exchange — 350 U.S. and foreign stamps, catalogued over $10.00, for .22 rifle, Bristol steel brassrod, or 80-watt dynamo. H. F. Wheeler, 69 Capitol St., Watertown, Mass.

Working Drawings for making ten different articles in pyrography or woodcarving. Send 15 cents and two cent stamp to C. E. Rett, 895 So. Main St., Akron, Ohio.

Will Exchange anything which can be procured in the Philippine Islands, including unused postage stamps, for anything electrical, or small steam or gasoline engine. Dr. B. Altman, Mauban, Tayabas, Luzon, Philippines.

New German Silverplating Process (no mercury), no electricity, no machinery, not in book print, directions in German and English. Price 10 cents. Address Paul M. Janke, Dept. X, Mt. Carmel, Ill.

Complete construction data for the manufacture of tuned wireless instruments. Set of 12 blueprints, $1.00. W. C. Getz, 645 N. Fulton Ave., Baltimore, Md.

New Cell—Don't throw away your old dry batteries. New Cell is a preparation which positively renews dry batteries at a cost of 2 cents each. Trial package and catalogue 10c. Adams Electrical Co., Dept. M. E., Kewanee, Ill.

Wide Angle Lens with speed, Darlot Anastigmat wonderful definition on 4¼-6½, but will cover 8 10 wide angle. Focus 5⅞ in., list $45,60, will sell for $25.00, Address J. A., care ELECTRICIAN AND MECHANIC, Boston, Mass.

$55.00 buys a Series II Collinear — No. 3, speed F6.6, mounted in Imperial shutter, which gives exposures from three seconds up to 1/100 seconds. Focus 5⅞ in., covers 4¼-6½ at speed F5.6, and is wide angle for 6½-8½ when stopped down. List $73. Address J. B. M., care ELECTRICIAN AND MECHANIC, Boston, Mass.

Copying Lens for Photo-Engravers — Goerz Series IV, No. 7, 14 in. focus. Will cover 18-22 in copying, and 12-15 when used on groups. Lists at $141.50, will sell for $110.00. Address J. F. F., care ELECTRICIAN AND MECHANIC, Boston, Mass.

$6.00 for Darlot Planigraph 4-5 — Excellent hand camera lens. Six in. focus. Lists $36.00. Address C. G., care ELECTRICIAN AND MECHANIC, Boston, Mass.

For Exchange — Toy steam engine and boiler, small printing press, cast alloy "T" rail for model railway and complete paper patterns for several pieces of furniture. Wish in exchange 4 by 5 folding camera, spark coil or other electrical apparatus. R. L. Bugbee, 17 Stevens St., Methuen, Mass.

Stanley 12 Inch Auto Boiler — fitted with 14 inch "National" kerosene oil burner, water gauge, steam gauge, blow-off and pop valve for $55. All of these are new, reason for selling, have larger outfit. R. E. Caldwell, 564 Cabot St., Beverly, Mass.

Shop Agents Wanted — 60% to 100% profit is being made by shop men selling "Tat's Grit Soap." This opportunity is open to any bright hustling fellow who is anxious to earn a little "extra money" without working overtime for it. Write today how to get a dozen free. State occupation. Tatlock Bros., Inc., Rochester, N.Y.

For Sale —1¼ h.p. bicycle engine castings, also ¼ h.p. dynamo castings. Roy A. Crifield, 225-3d St., Lincoln, Ills.

A Bargain for Sale — ¾ of a pound of number 36 D.C.C. copper magnet wire, already wound in sections for an induction coil and waxed, $2.00. Also one year of *Popular Mechanics*, all except the November number, in good condition, 50c, or will exchange for anything electrical. Raymond Bevier, 702 Alice Ave., Spokane, Wash.

Blacksmiths — Young men who wish to become master mechanics and expert tool workers may do so in a very short time by using Toy's treatise on new steels, explaining how to work them, with 75 new methods for working all difficult jobs. Ten receipts for making your own compounds for welding different kinds of steel solid. Thermite welding fully explained; also two colored tool tempering charts; chart A explains all annealing and hardening; chart B explains both scientific and plain tempering to a standard. Neatly arranged in pamphlet form for the small price of $1. Valuable samples free. W. M. Toy, Sidney, Ohio. P.S.— Get in line for big salaries later; good blacksmiths are scarce.

Exchange —A Wonder dynamo, worth $3.50, for a one half or three quarter spark coil, or something electrical. Write to Christ. Swanson, 8924 Superior Ave., So. Chicago, Ill.

Let Us Show You — How to build a 3 h.p. stationary 4 h.p. marine, 5 h.p. automobile, two-cycle gasoline engines and save your money. Easy, simple, practical. Can't go wrong; hundreds satisfied. Castings and full set of drawings. Simplex Mfg. Co., Box 60, Newburgh, N.Y.

For Sale or Exchange — One two-inch spark coil. This coil is in excellent condition, giving, as it does, a spark over two inches in length, when used in connection with storage battery. Original cost $15.00. Write to me boys, and find what a ridiculously low price I will make you on it. Geo. H. Fox, West Lafayette, Ind.

Fine Violin — Value $25.00, sell or exchange for lathe or something electrical. Address P.O. Box 51, Northbridge Center, Mass.

Lens for Graflex — 8¼ in. focus, F 63, Zeiss Series II, covers 5 x 7 plate. Excellent for copying and is wide angle lens when used on 8 x 10 plate. List $64.50, sell for $25.00. Address M. A. D., care ELECTRICIAN AND MECHANIC.