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June, 1908

ELECTRICIAN AND MECHANIC

INCORPORATING AMATEUR WORK

CONTENTS

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The Earning Power of Money Invested in Kornit

Our Own New Modern Up-To-Date Factory Just Completed

HERE is a Financial Opportunity to make an investment in an up-to-date, energetic, money-making, industrial manufacturing company, which owns its own factory, 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

CHARLES E. ELLIS

KORNIT was invented by JOHANN GUSTAV BIERICH, a subject of the Czar of Russia, residing at Menkenhof, near Livenhof, Russia, 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.

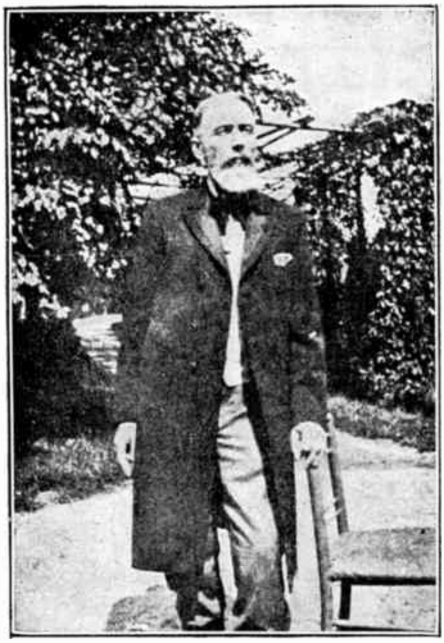
The average price of hard vulcanized rubber for electrical purposes is to-day considerably over one dollar per pound — at the present writing something like $1.25 per pound. KORNIT CAN BE SOLD AT TWENTY-FIVE CENTS PER POUND, and AN ENORMOUS profit can be made at this price, so that it CAN EASILY BE SEEN 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, cut-outs, etc., there are other materials used, such as vulcanized paper fiber, slate, marble, etc. A piece of vulcanized paper fiber 3 x 4 x 1 inch in lots of 1000 brings 20 cents per piece. A piece of KORNIT of the SAME DIMENSIONS could be sold with the ENORMOUS PROFIT OF OVER ONE HUNDRED PER CENT at 10 cents. The absorptive qualities of Kornit render it such that IT IS FAR PREFERABLE to that of vulcanized fiber. 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 strength per square inch averages from 1358 pounds to 1811 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 to-day 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 $3000. 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 five years. In Riga, Russia, which is the largest seaport town of Western 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,



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

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 pen-holders, ink stands, pen racks, medical instruments such as syringes, ear trumpets, etc., etc.; pieces for games, such as draughts, chess men, 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, automobile supplies 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 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 SIXTEEN PER CENT DIVIDENDS EVERY YEAR. Of course, if four tons a day are sold the dividends would be thirty-two 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 within one year from to-day.

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.

A New Factory Just Completed

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 have completed OUR OWN Factory. It was finished and in complete working order on the 15th of last month (May). We have purchased the land and erected the building for which we paid cash. All of the machinery is paid for. Money is now needed to establish sales depots. After this money is obtained there will not be any shares sold at the present price.

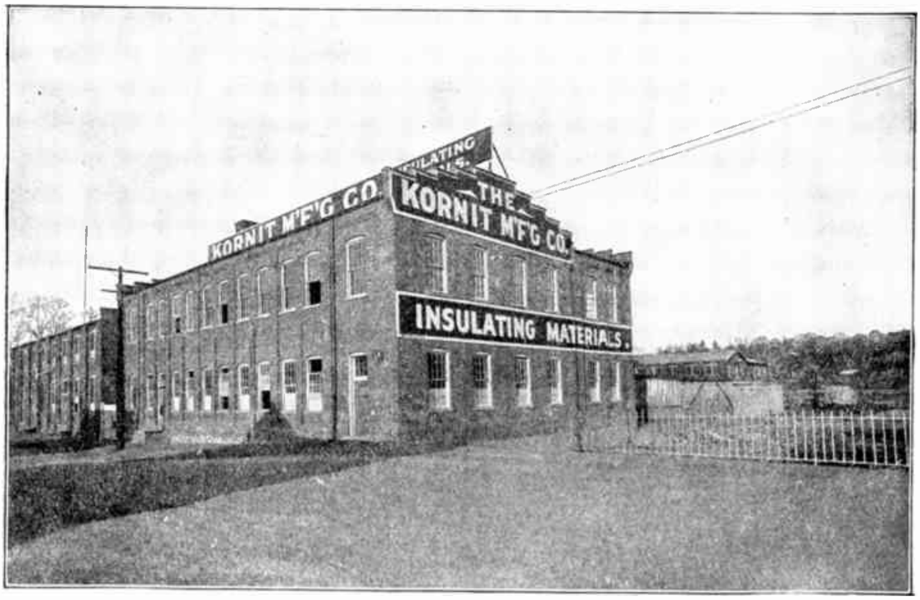
A few shares obtained now may be the foundation for a fortune of the much-desired income for support in the unknown years that are to come. We leave it to you if it would not seem good judgment to take immediate advantage of this opportunity. Anyway, please write me at once and let me know just what 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 While It Lasts

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 at this time to sell only a limited number of these shares at the par value of $10 each. We have paid cash for our Factory and all of the machinery, which was in the majority of cases built to our special order. It is now necessary for us to establish sales depots all over this country. This will take quite a considerable sum of money. And this is the reason I am willing to sell these shares at their par value. In my opinion they are worth much more and just as soon as our sales departments are in good working order not a share will be sold at this price. Now is the time to get into this concern, which has already spent thousands of dollars in Land, Factory Building and Machinery. You will get quick results. Every dollar which the Kornit Manufacturing Company receives from the sales of these shares will be put into the treasury of the company and used for development purposes. 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



NEW KORNIT FACTORY, NEWARK (BELLEVILLE STATION), N. J.

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 satisfactory 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 shares 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

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 hundreds of thousands of dollars. Any bank or mercantile agency will tell you his guarantee is as good as gold. This is the successful man who wishes you for a Co-partner as a Shareholder and Dividend Receiver in his company. Remember, you will do business personally with Mr. Ellis in this matter.

Invest in KORNIT

Electrician and Mechanic

Incorporating

Bubier's Popular Electrician, Established 1890
Amateur Work, Established 1901

VOLUME XVIII — JUNE, 1908 — NUMBER 12

ELECTRICAL ENGINEERING — Chapter XXIV

ELECTRO-CHEMISTRY

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

THAT chemical action is often allied with electricity is one of the most common and yet inscrutable phenomena of nature. The simplest illustration is afforded by the primary battery. In this, zinc is dissolved and a current of electricity generated. With some solutions it is even necessary that electricity be allowed to flow as a criterion that the zinc be acted upon. The Leclanché cell is, for example, quite inert except when the electric path is complete. In a still wider sense, the storage cell is one in which the chemical action and the electric current are reversible and unavoidable.

With the recognition that as the result of the chemical action there remained within the cell a new set of compounds, Faraday, in about 1840, conceived the idea that by sending a current from some exterior source backwards, as it were, through such a solution, the compounds should be split up, not necessarily into their original form, but into even more elementary substances. He examined a large number of metallic solutions, with the astounding result of discovering the two metals, sodium and potassium, and a quantitative law of action that has proved one of the most rigid and fundamental yet known to science.

To this process of electric analysis he gave the shortened and now well-known name of "electrolysis." The solution he called the "electrolyte," and the submerged terminals the "electrodes." He tried the same solutions with different kinds and also with dissimilar electrodes, and upon the result of some of his original researches modern commercial processes of electrolytic production and refining largely depend. Other allied names are "anode" and "cathode," meaning, respectively, the electrode by which the current enters and leaves the solution. The passage of the current is imagined to break up the electrolyte into "ions," or material carriers of the current. In a given inorganic, or metallic solution, the hydrogen or metal is swept along with the current and appears at the cathode, while the rest of the elements pass in the opposite direction to the anode. In case the solution is a salt of one of the electrodes, the metal may be bodily removed from the anode and deposited upon the cathode, as is the familiar experience in electroplating. In other cases, as in a storage battery, there may be merely an oxidation at the cathode and a reduction to the metallic state at the anode. With solutions not aqueous, but with the materials in a fused state, and the current maintained through the mass when at red or white heat, a great extension to the possible combinations has been found.

The law discovered by Faraday was that in different cells, through which the same or equal currents were flowing, equivalent weights of any metal were deposited. He defined equivalent weights from purely chemical standpoints as meaning the atomic weight divided by the valency. For instance, with hydrogen taken as having an atomic weight of 1 and valency of 1, and consequently with equivalent weight of 1, chlorine with atomic weight of 35.5 and valency of 1 will have an equivalent weight of 35.5; copper with atomic weight of 63.5 and valency of 2 will have an equivalent weight of 31.75; aluminum with atomic weight of 27 and valency of 3, an equivalent weight of 9, and so on for all the elements, as may be gathered from any textbook on chemistry. The electricity being measured in amperes per second, or in "coulombs," as this unit is often called, the law reveals just how much metal may be realized from the passage of the current for any desired length of time. Careful determinations have been made of all the important metals, with the result that for one coulomb the figures for a number of these are, in milligrams, as follows: Aluminum, .093; copper, .329; nickel, .303; silver, 1.119.

Another expression, or unit, that has been found convenient is the "gram-equivalent"; by this it is meant to consider a weight of the given substance, in grams, numerically the same as the equivalent weight. For instance, 1 gram of hydrogen, 35.5 grams of chlorine, 31.75 grams of copper, and 9 grams of aluminum would all be electro-chemically equivalent. Usually, when chemicals unite to form other compounds, there is a production of heat, as is well illustrated by the explosive violence with which hydrogen and oxygen unite to form water, or by the more simple burning of anything combustible, by which carbon and oxygen are brought together. Conversely, it is found that just as much heat energy must be expended in tearing these new compounds apart as was evolved in their formation. For gram equivalents of compounds the same amount of heat energy is always required, and this has been found to be 96,540 calories. (A "calorie" may be defined as the amount of heat necessary to raise 1 kilogram of water 1° C. Sometimes the unit is based on a quantity of 1 gram, but here the larger unit is taken.) For instance, the equivalent weight of common salt, sodium chloride, $NaCl$, is 58.5, and in the production of that number of grams of the substance, 96,540 calories of heat were evolved; likewise, to separate it again into its component elements, that same number of heat units would need to be expended. Since heat is a form of energy that can readily be expressed in electrical units, the computation of the number of volts and amperes and the time required for any given reaction can be predetermined. Thus, while there may be some doubt as to the correctness of the theoretical speculations advanced, there is no opportunity of avoiding the rigidity of the numerical computations. As various illustrations of electro-chemical operations will next be given, emphasis will be placed upon this commercial aspect.

One of the very first applications of electric currents was in electrotyping and plating with copper. With the principle extended to a large scale, and employing powerful currents from dynamos, the business of electrolytically refining copper has assumed very large proportions. In addition to the extreme purity of the product, the quantity of silver recovered from the deposit in the bottoms of the tanks goes a long way to pay the cost of the process.

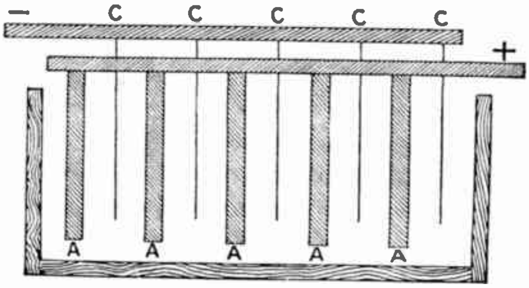


Fig. 126. Arrangement of Plates for Electrolytically Refining Copper

This particular application is somewhat of a departure from the topic aimed at in the introduction, for copper is put into the cell, and copper taken out, and the solution is also a salt of copper. No new product is formed, hence, on the face of it, no energy might be thought needful. Still, the solution and the assemblage of bad contacts in the sets of plates make some resistance, so that about .2 volt per cell is the minimum found practicable. In order to allow a practicable dynamo, a large number of cells are connected in series, and voltages varying from 30 to 80 are employed.

Copper pigs as produced by the smelting furnaces are cast into plates of about the shape common for large storage batteries, and ¾ inch in thickness, and, interspersed with similar shaped sheets of pure copper, but only about 1-20 inch in thickness, are assembled in wooden tanks as diagrammatically shown in Fig. 126. The thick plates marked A are the crude anodes, while those marked C are the pure cathodes. Current is supposed to arrive at the + pole, remove metal from the anodes, carry it through the copper sulphate solution, and deposit it upon the cathodes. Any impurities in the anodes, as they are reached, are supposed to fall by their weight into the mud or

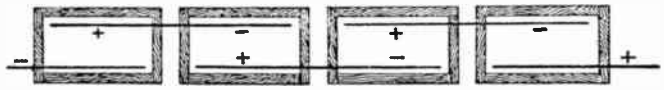


Fig. 127. Diagram showing Method of Connecting Copper Refining Tanks in Series

"sludge" that accumulates in the bottom. A plan showing the arrangement whereby any desired number of cells may readily be joined in series is shown in Fig. 127. The lugs from which the plates hang are made in slightly differing shape so that the anodes make contact with the + bar only, while the others touch the − only. The different plates are removed and new ones substituted one at a time, hence no interruption to the process need be tolerated except such as may be needed to care for the dynamos.

It has been found impracticable to start with metal of lower grade than ninety-eight per cent purity, else the impurities find their way into the product. A current density of more than 10 to 15 amperes per square foot is likely to give an irregular or granular deposit. A few other precautions need to be observed, *i.e.*, to have plenty of sulphate of copper in the solution, yet not enough to crystallize out, to have enough sulphuric acid present to prevent formation of hydrated copper oxide, yet not so much as to be decomposed by the current and carry hydrogen rather than copper to the cathode; the solution is best kept warm say at about 95° F.

As an example of the high attainments of the electrolytic method of refining copper, it may be stated that it is now common to exceed the famous standard established by Matthiesen, in 1865, and specifications are often written demanding a quality of conductivity of one hundred and one per cent or one hundred and two per cent, as based on that standard.

Means have been devised, and even perfected, by which other metals may be refined, but they are not largely employed, the reason being that sufficiently good and often cheaper chemical processes are already in use. In some cases, notably that of zinc, the reverse of the conditions that pertain to copper may be found, for this metal may be obtained from its ore advantageously by electrical means, and then the refining carried on by chemical means, such as fractional distillation. Gold, silver, and lead are satisfactorily worked by old methods.

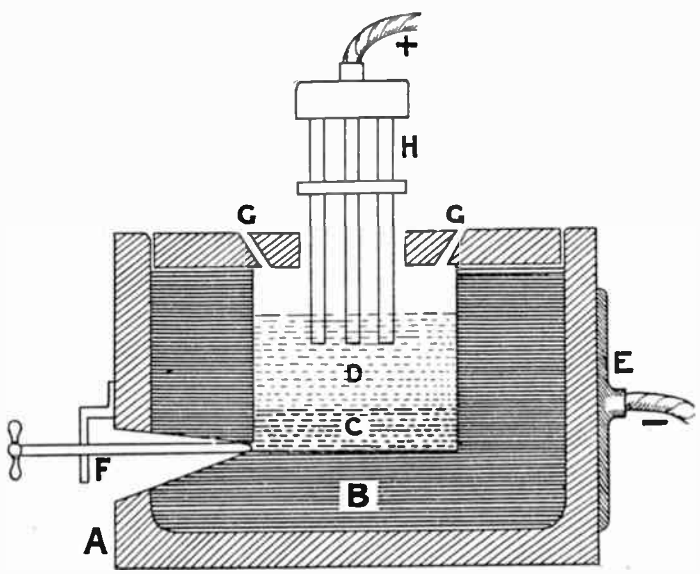


Fig. 128. Héroult's Furnace for Producing Aluminum

With igneous solutions, as already mentioned, an extensive, and somewhat undeveloped field has been entered upon. Not only have compounds been broken up and others formed quite beyond the reach or feasibility of chemical means, but some products not found in nature have been realized, and in this field of synthetic compounds the metallurgist may find his work approaching that of the organic chemist. In these fused solutions the result may be due to the action of heat alone, in which cases alternating current may be more available than direct, or in the solution there may be needed the electrolytic action, demanding, of course, direct current. Underlying the development of these processes is the scheme of the electric furnace, first made upon a practical scale by the Cowles Brothers in this country and by Moissan in France.

For many years it was recognized that aluminum formed quite as large a constituent of the earth's crust as did iron, and was as valuable for many commercial applications; yet in trying to employ blast furnace methods for its reduction from its ordinary form in common clay, no furnace could produce or withstand the degree of heat needed, — 3500° C., or 6330° F., which is the temperature of the electric arc. Aluminum bronze, an alloy of copper, had been found to be a tenacious and durable metal, and the present successful methods of producing pure aluminum only aimed to produce this alloy. It is worth noting, too, that while the Cowles's process proved too expensive and too unreliable in its product, it did show the way to the construction of a suitable electric furnace. Also, it was a historical accomplishment when Brush designed and built for this process his famous "Great Dynamo" with an output of 80 volts and 3000 amperes.

The process closely followed by manufacturers of aluminum is that devised by Héroult, and a diagrammatic representation of his furnace is given in Fig. 128. An iron box, A, is lined with fire clay, and a space left within in which a mass of copper or aluminum, C, may be placed and electrically connected with the negative pole of dynamo. A bundle of carbons, H, forms the positive electrode, and the material to be fused is introduced at the top. In recent practice, the box is hollow, and through it water is kept circulating, so as to prolong the life of the casing, while the lining is somewhat protected by the congealed crust formed from the electrolyte itself. The process is continuous; for as fast as sufficient metal is produced, it may be drawn off at the opening shown, while fresh material is introduced at the top. To start the furnace, the carbons are brought into momentary contact with the lower electrode, with the result that some metal is melted, and as the vapor is formed, the separation may be still greater. As the temperature increases, the liquid aluminum runs down through the fused mass. At the temperature required it is to be supposed that the carbons would be short lived. This is true, and with the requirement that they be pure in order not to contaminate the metal, the cost of this item is not to be overlooked.

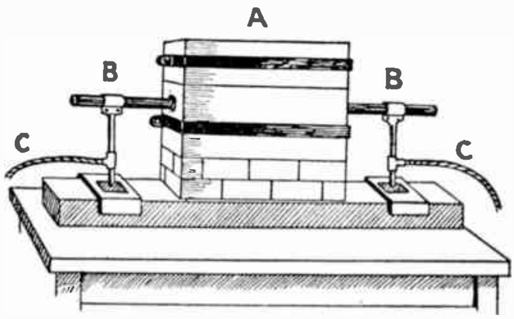


Fig. 129. Laboratory Pattern of Moissan's Electric Furnace

The material needed for the production of aluminum by these means is pure alumina, Al_2O_3, and it is best prepared from the particular kind of clay known as "bauxite." In this country large deposits are found in Georgia, and one of the largest manufacturers, the Pittsburg Reduction Co., obtains its supply from that source. The clay is sent to New Kensington, Pa., and there refined, the principal impurities to be removed being iron and silicon. The final condition of the material is a powder thoroughly dried by roasting and mixed with "cryolite," or the double fluoride of aluminum and sodium. This latter does not at all enter into the chemical reductions in the furnace, but merely acts as a solvent for the alumina, just as in the case of the copper refining apparatus, where the water acts as a solvent for the copper sulphate. Of course no trace of moisture must be allowed to find its way into the furnace, or a disastrous explosion would result, and ordinary metallic impurities would contaminate the aluminum resulting from the process. These preparations are rather expensive, representing about one third of the total cost of the production.

In consequence of the fact that metal is to be deposited out of a solution on to the molten cathode, the current of electricity is needed not alone for generating the fierce heat, but also for effecting this deposition. Direct currents are therefore needed, and for the Niagara plant which was erected in 1894 and receives the two-phase alternating currents from the Power Company, large rotary converters were designed, being the largest of this class of machines the General Electric Company, up to that time, had designed. They have twenty poles, and an output of 400 kilowatts apiece; but to fit the frequency of 25 cycles used at Niagara, the speed is seen to be only 150 revolutions per minute. Later converters are designed with fewer poles and run at higher speeds.

The reduction in price of aluminum from that of forty years ago, when the metal was a curiosity selling at eight dollars per pound, to its present profitable rate of thirty cents, is one of the most notable accomplishments of the electric and commercial arts. If only the metal could be readily soldered, its usefulness would be immensely increased.

Among other products of the electric furnace calcium carbide may first be mentioned. This substance seems to have been first known to science in 1862, but was not of practical value until 1894, so the whole development of the industry that has been created for its manufacture and extensive adoption for artificial illumination dates from very recent times. It will be recognized that in consequence of the explosive violence with which this chemical is attacked by water it could not possibly be found in nature, and artificial production must ever be its only source. Before the electric furnace was utilized for this purpose, predictions were freely made and believed that the chemical and its product with water,—acetylene gas,—would always be too expensive for practical use. Though now quite reasonable in price and largely used for portable and isolated lights, still greater adoption of this dazzling white illuminant is inevitable.

The chemical formula of calcium carbide is CaC_2, and therefore it is seen that the simple ingredients of lime and coke should be able to produce it. The favorable conditions are a sufficiently high temperature, say 3000° C., and means for closely controlling it. As heat alone and not electrolytic action is needed, the alternating current answers quite as well as the direct and ordinarily is more available. Figure 129 shows the construction of the furnace used by Moissan, and by many investigators since then, and commonly found in laboratories. The body, A, is made of blocks of lime scooped out in the form of a small dish, and

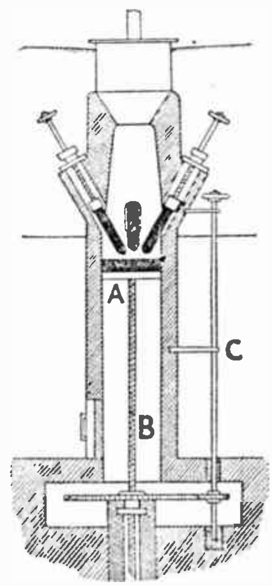


Fig. 130. Calcium Carbide Furnace for Operating with Three-phase Alternating Currents

into which the carbon electrodes are directed. Some space is left around these carbons to make room for the torrent of flames that emerge during the action of the furnace; and for the same reason the copper cables are attached to the lower ends of the columns where they may not so readily be melted. Lime is far better than fire clay for the receptacle; for in addition to its being more refractory, it is less of a conductor of electricity when highly heated. It will be remembered that, as illustrated by the principle of the Nernst lamp, some bodies that are complete insulators when cold quite lose that quality when sufficiently heated.

A commercial form of furnace for semi-continuous operation and adapted or three-phase alternating currents is shown in Fig. 130. In this a cast iron disk is represented on the upper end of a screw and capable of being raised and lowered by movement of a hand wheel. The top surface is protected by a layer of graphite, and entering from above are the three carbon electrodes between which the arc plays and heats the surrounding mass. With the plate initially in contact with the carbons, the arcs are started, and then the mixture of purified lime and coke is slowly poured in at the top. As the reduction takes place, the disk is lowered, and more material added, until by the time the disk has reached its lowest position the bottom of the mass has cooled sufficiently to permit its removal by the opening shown in the side.

An estimate of several years ago shows the actual cost of 1 ton of calcium carbide ninety per cent pure to be twenty-eight dollars. One kilogram of the pure substance yields about 350 litres of acetylene gas at atmospheric pressure, but the ordinary grade may not exceed 300 litres. The commercial value of the carbide should be based upon this estimate of its gas-producing qualities.

A second product of the electric furnace, purely an artificial one, is known in the trade as "carborundum," and this highly effective abrasive has largely displaced emery. As the result of experimenting with a small furnace, Acheson, in 1890, produced what he thought was a compound of carbon and corundum (emery or crystallized alumina), and gave it this name. Difficulty was experienced in analyzing it; but when finally accomplished, the true constitution was found to be a union of carbon not with aluminum but with silicon. The present symbol is simply SiC, or by name, silicon carbide. A large furnace is required for the production of this article with rebuilding after every heat. The arc, however, is not directly present, but the large currents heat the entire poorly conducting mass to high temperatures. Figure 131 gives a sectional view of the method of construction.

The furnace is about 15 feet long, 7 feet high and wide. At each end are copper castings, to each of which are attached sixty carbons 3 inches in diameter and 2 feet long. A central core of coke about 9 feet long and 2 feet in diameter connects the two groups of carbons so as to give an initial path for the current. Around this core is packed a mass consisting of about thirty-four per cent coke, fifty-four per cent sand, ten per cent sawdust, and two per cent common salt, weighing in all about 10 tons. If the entire mass was sufficiently heated to make the chemical change complete, upwards of 4 tons of carborundum should result; as a matter of fact, only about 2 tons is actually realized, but that is not a bad outcome. The furnace is put together without mortar, and for the first two hours of the heating large quantities of

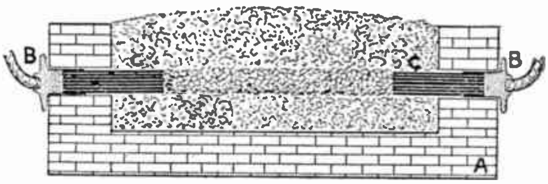


Fig. 131. Furnace for Producing Carborundum

carbon monoxide are evolved, and are allowed to burn over all the crevices in the walls. In twelve hours' time the entire furnace is red hot, but the current is kept on for twelve hours longer, when the current is turned off and the furnace is allowed to cool. About 4000 amperes at 185 volts, alternating, are used, representing about 1000 h. p. When opened the product of the furnace is found to vary with the nearness to the central core. That on the outside is merely slag; the next, concentric with the core, is insufficiently formed for use as an abrasive, and is worked into the next charge; then comes the layer, or ring, of desired carborundum, about 16 inches thick. The crystals are small on the outside but increase in size as the core is approached. The core itself has been changed into pure graphite.

For utilizing the yield of carborundum, the crystals are broken up and crushed between rollers, washed with water and acid, dried and graded by sieving, or when left in water, by the settling process. The by-product, graphite, has been found of great use in the arts as an effective substitute for the natural qualities. Diamonds or pure crystallized carbon have been sought in this furnace; but if produced there at all, they are of microscopic size and lacking in transparency. The concomitant condition of great pressure with high temperature is believed to be essential, and Moissan is now working in this direction.

In the alkali group of metals a new field for separation by electrolysis has been found, but curiously not essentially different in action from the simple arrangements devised by Faraday. The production of caustic soda, bleaching powder, and pure sodium, on a large scale, is carried on at Niagara Falls by the Castner-Kellner and allied processes. Common salt, mined at Saltville, Va., is sent there for separation by the action of the electric current. Of course the direct sort is needed, and is taken through the medium of rotary converters.

The precise method of working is kept secret, but an idea can be gained from some

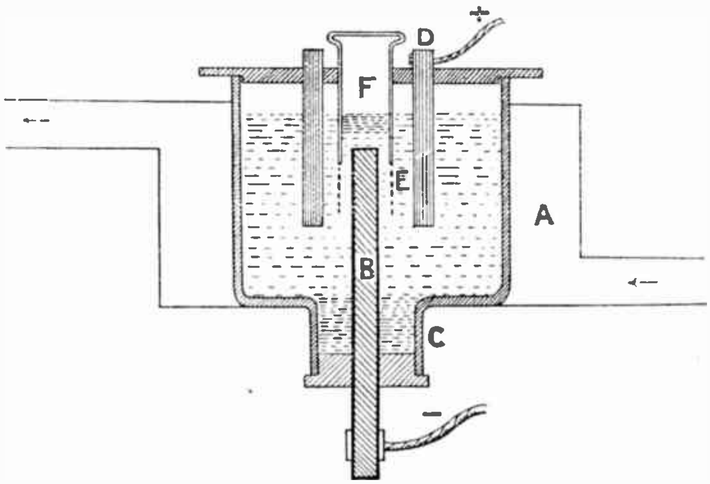


Fig. 132. Castner's Electrolytic Method of Producing Metallic Sodium

general publications of the company. The work is done in a tank having three compartments, the two outer being alike fitted with a carbon anode, while the central one has an iron cathode; the partitions are of slate, and enter grooves at the bottom which are filled with mercury. The liquids on the two sides of the partitions are therefore effectually trapped, but the electric current can readily pass from one to the other through the mercury. Salt and water are placed in the outer compartments; but water only, in the central one. By means of supporting the tank on a knife-edge at one end and resting on an eccentric at the other, a slight rocking motion is imparted for keeping up some agitation.

The chemical action can readily be followed. At the anodes salt is decomposed, liberating chlorine gas and delivering metallic sodium at the surface of the mercury. An amalgam results, but the current now tears the sodium out of the mercury and directs it towards the iron cathode. Sodium, however, reacts at once with the water, forming caustic soda and liberating hydrogen. After a sufficient degree of concentration of the caustic solution has been reached, it is drawn off, and the process repeated. The chlorine which was liberated is not allowed to escape, for in addition to its poisonous qualities it has commercial value. It is conducted away and absorbed by slacked lime, forming ordinary bleaching powder, — chloride of lime. Indeed, the demand for the caustic soda and metallic sodium gives a yield of bleaching powder rather in excess of the market demand, and the manufacturers are now seeking to create artificial demands for it.

By evaporating the water from the solution, the solid caustic soda is obtained, and sold either in the form of pencils or coarse granules. Cans of the latter are ordinarily labeled "Potash or Lye." It is a common adage that the name is really a "lie," for the contents are not potash but soda. An investigation would show that sodium compounds, on account of their cheapness, have largely displaced the corresponding ones of potassium for use in the arts.

The actual demands for metallic sodium are small, but the electrolytic method devised by Castner is the only one now in commercial use. The diagram given in Fig. 132 represents the arrangement. An iron pot is set into a flue through which a blast from a fire is kept in the direction shown by the arrows, so as to bring the dry caustic soda to about red heat; at this temperature it is very fluid, like melted lead. Iron electrodes are used, both having their clamps well out of the direct range of the fire. The upper electrode is in the form of a cylinder with slots to allow circulation. Within this is a cylinder of wire gauze, E, hanging from the inverted collecting pot, F. When the current of electricity flows, fused sodium separates out and passes in the direction of the current towards B, and then rises into the pot, the gauze preventing it from actual contact again with D.

The decomposition of caustic soda, $NaOH$, necessarily liberates hydrogen; and when the cover of F is lifted for periodical balings out of the sodium, there are likely to be slight explosions, but they do not seem to be dangerous. The Electro-chemical Company at Niagara uses about 700 h. p. in this sodium process, and the yield from this expenditure is about 360 tons per year. The metal is used in the manufacture of sodium peroxide, for the production of cyanides, for "quickening" mercury for gold amalgamation, but has no other considerable uses. Its great affinity for water, with consequent production of gas, may suggest interest in developing its possibilities for storage of energy for power purposes.

While it has not been considered necessary to include electroplating in this chapter, a few words may be said in explanation of the recent modification of that art known as "coloring." The color in general is supposed to be that of gold in various shades. Such infinitesimal thinness of gold is put on as to be unworthy of the name "plating," but the principal intention is to produce something that will last long enough to sell. For such articles as receive no actual wear, this color effect may often be sufficient. The art consists in using anodes not of pure gold, but of its alloys, and solutions containing things other than gold. Instead of very small electromotive forces which are suitable for depositing the pure metal, say not over 1 volt, 6 to 10 volts, or even higher values, are given, and the articles immersed for not much longer than an instant. The momentary rush of current carries along the base portions of the alloy and deposits them along with the precious, the results imitating in highly deceiving manner the common effects known in the trade as "Roman" gold, "green" gold, etc. For genuine plating, gold requires the lowest strength of current of any of the metals, — this coloring process utilizes the highest.

Motive Power From the Sun

A NEW power has entered, or threatens to enter, the arena, and, according to the opinion of its discoverer, gasoline at least is doomed. This epoch-making discovery is nothing less than the utilization of the heat of the sun by means of hotbeds.

The inventor of the system is Frank Shuman, an engineer and chemist of Tacony, Penn. On his property he has a big hotbed, 18 x 60 feet, made by letting a wooden box into the earth. It is covered by a double top of ordinary hothouse glass, having an inch air space between the two roofs. It is filled with coiled iron pipes, painted black, which form the generating plant of the system.

In this climate the pipes are filled with ether, but in the tropics ordinary water is to be used. The circuit is a closed one; that is, the ether in the pipes is converted into vapor, passes through the engine, thence to a condenser, and back again to the hotbed. In its passage through the engine it develops 3½ h. p.

No fuel is used, the accumulated heat of the sun being the only power used to convert the ether into vapor. Mr. Shuman claims that he gets a temperature of 350° to 500°, and that in the tropics he would get about 1000°, and that the cost of maintaining his plant is practically nil.

But this is not all, nor the best. Recognizing that his system is open to the charge of only being able to run while the sun shines on the spot, Mr. Shuman has planned a scheme of vast and thrilling possibilities, by which he will use solar power for liquefying air, making liquid air so cheap that it will drive gasoline out of the market.

He says that liquid air is recognized as the best storage power known, but its cost keeps it out of general use. He purposes to bring the cost down to a few cents by building plants in the tropics, where heat is high and humidity low.

He has communicated with twenty of the largest manufacturers of liquefied air in the world, and he has engineers looking over sites in Arizona, Cuba, and Florida, while his son is in Egypt. The son hopes to secure an order for the construction of a trolley line in which his sun-power device will be laid as an auxiliary.

The engineer claims that the sun power can be run all day, and the fires banked for night use, thus cutting the fuel bill in half.

AMONG the answers to questions at a recent school examination were the following interesting examples of youthful misinformation: "Gross ignorance is one hundred and forty-four times as bad as just ordinary ignorance." "Anchorite, an old-fashioned hermit sort of fellow who has anchored himself to one place." "The liver is an infernal organ." "Vacuum is nothing with the air sucked out of it put up in a pickle bottle — it is very hard to get."

AERIALS FOR TUNED CIRCUIT WIRELESS TELEGRAPH SYSTEMS

W. C. GETZ

In this article, and others to follow, I shall explain the construction of tuned circuit wireless telegraph apparatus, similar in character to that employed by the commercial and government stations, and suitable for all experimental installations.

The first things to consider are our aerial wires — technically known as antennæ — and their method of suspension. In the country, where tall trees are at hand, the matter is greatly simplified, but in town the proposition is somewhat difficult, unless handled in the right way.

I will first give some general notes on antenna construction that will be well to bear in mind later on. There are innumerable plans and systems in arranging the mast and antenna, but in my experience, for general purposes, the plan shown in Fig. 6 gives a wiring scheme equal to any. It is simple to construct, and will permit various combinations, without much trouble in making changes. This plan may be modified to suit the particular station, and it is advisable that the amateur experiment with the different methods of connecting given in diagrams of standard tuned circuits, thereby perhaps attaining better results.

Where it is possible to get the use of a couple of tall trees, about 100 feet apart, and to suspend the wires about 50 or 60 feet in the air, by making cross-arms similar to that shown in Fig. 5, these to have a length of 3 feet, thereby spreading wires a foot apart — an aerial can be constructed that will give excellent results.

It has been found that stranded phosphor-bronze wire made up of 7 strands, No. 22 B. & S. gauge, is best adapted to wireless work. Some stations also use 7 No. 22 tinned copper wires. However, as either of the above styles of wire is rather expensive, No. 16 B. & S. gauge bare copper wire will answer almost as well. This size wire runs about 128 feet to the pound.

For guy-wires, No. 14 or No. 16 B.W.G. galvanized iron telegraph wire is suitable. No. 14 wire runs 18 pounds per 1000 feet, and No. 16 is 11 pounds per 1000 feet.

If the antenna is to be suspended between trees, the cross-arms should be placed at least 10 feet from shrubbery, and porcelain insulators put in the guy-ropes supporting them. Pulleys may be fastened to the tree-tops, thus affording a means to raise and lower antenna, in making changes, etc. It may be also found necessary to put spreaders, made of ½ x ½ inch wood, equipped with insulators similar to cross-arms, in the center of the span.

For the benefit of those readers who are not so fortunately equipped thus by nature, and especially the ones residing in town, I will describe the construction of a mast suitable for a receiving radius of 50 miles.

Get two pieces of round timber, one to be 15 feet long, 2 inches diameter at butt, and 1½ inches diameter at top; the other to be 11 feet long, 1½ inches diameter at butt, and 1 inch diameter at top. If you can get a single piece about 25 feet long, 2½ inches diameter at butt, and 1 inch diameter at top, such as a flag-pole, this is to be preferred.

However, considering only the two lengths first mentioned, place the 1½ inch ends of each parallel for the distance of 1 foot, as shown in Fig. 1, and bind at points A and B, with two pieces of ⅛ inch strap iron. This strap iron is to be bent, as shown in Fig. 2, and have holes drilled through it (and also through the poles), to permit a ¼ x 2 inch bolt to be driven through the center of each pole. The remaining space at the joint should be tightly bound with marlin or wire.

At the top of the short length fasten a pulley, having a clearance sufficient to allow a piece of ¼ inch sash cord to run easily in it. Care should be taken to see that the sash cord runs perfectly free, and does not bind.

Now give the mast two coats of good weather-proof paint — black being the best color. At the splice A–B it would not hurt to give an extra heavy coating.

Assuming that the mast is to be erected on a flat tin roof, such as the majority of houses in the city have, it will be necessary to provide a support for the base of the mast. Get a piece of 2 x 4 inch scantling, 2 feet long, and bore a hole in the center, as shown in Fig. 3,—this hole being as large as the butt of the mast, and extending into the 4-inch face for a distance of 1 inch. Bore two other holes, each ¼ inch in diameter, and 3 inches from ends, clear through 2 inch face of scantling, on line with center.

Now referring to Fig. 4, which shows a plan common to most roofs in the city, if it is desired to have the receiving apparatus in the rear of the house, the mast should be erected on the front part of the roof. I will say at this point that the rest of this article is more to show the proper manner of erecting a mast than to give specific directions for individual cases, inasmuch as the changed conditions of guy-points, slope of roofs, etc., will require a different arrangement of guying than that set down herein; but the reader can readily grasp the essentials required in mast and antenna construction from this description, and should therefore be easily able to engineer his individual plans.

For this case, it would be advisable to place the piece of scantling about 4 feet from the front edge of the roof, in the center of the house. From the ½-inch holes run a couple of pieces of wire to two strong nails driven in the edge of the roof (where the tin is nailed down), the nails about 20 feet apart, and equidistant from the mast. The wires must be made fast to the scantling, so that there is no slipping motion, and under no condition are the nails to be driven in the top of the roof, as it would be impossible to prevent the roof from leaking, were this done. Furthermore, nails driven in the edge of the roof will support a great deal heavier weight, and stand more strain, than nails driven in the top.

From the other end of scantling run two more wires through the other ½-inch hole, securing them fast to scantling, and carry them to any convenient points, such as chimneys, trap door, etc. The object is to have scantling perfectly rigid, and as immovable as possible.

The mast proper should be guyed from four points as near 90° apart as possible. It is very rarely, though, that there are sufficient suitable points from which to bring these guy-lines in a symmetrical manner. However, so the guy-lines are from four different points, and on opposite sides, they will be as good practically, if not so from the artistic standpoint.

Select four guy-points and provide some good method to hold wire. If the point is a chimney, or a trap door, several turns of No. 14 galvanized iron wire, wrapped and drawn tight around base, will be all right. Do not attempt to guy from a point above base of chimney, as there is danger in pulling it over, if this done.

If the edge of the roof is to be used, nails or screw-eyes may be driven in, as previously described. The screw-eyes should be heavy, and penetrate the roof at least 2 inches. Referring again to Fig. 1 of mast, it will be necessary to fasten four guy-wires at point A–B and four at point T, fastened in such a manner that they each face one of the respective guy-points when the side H of the splice of mast faces front of roof. The guys to A–B should be of No. 14 galvanized iron wire, and those to T of No. 16 galvanized iron wire. The latter should be fastened at a point about 6 inches below pulley. It is of the utmost importance to have these wires in the proper positions on the mast, relative to the guy-points, and to have them fastened perfectly strong. Make all guy-wires of sufficient length to reach from mast to point of guying, with plenty of slack.

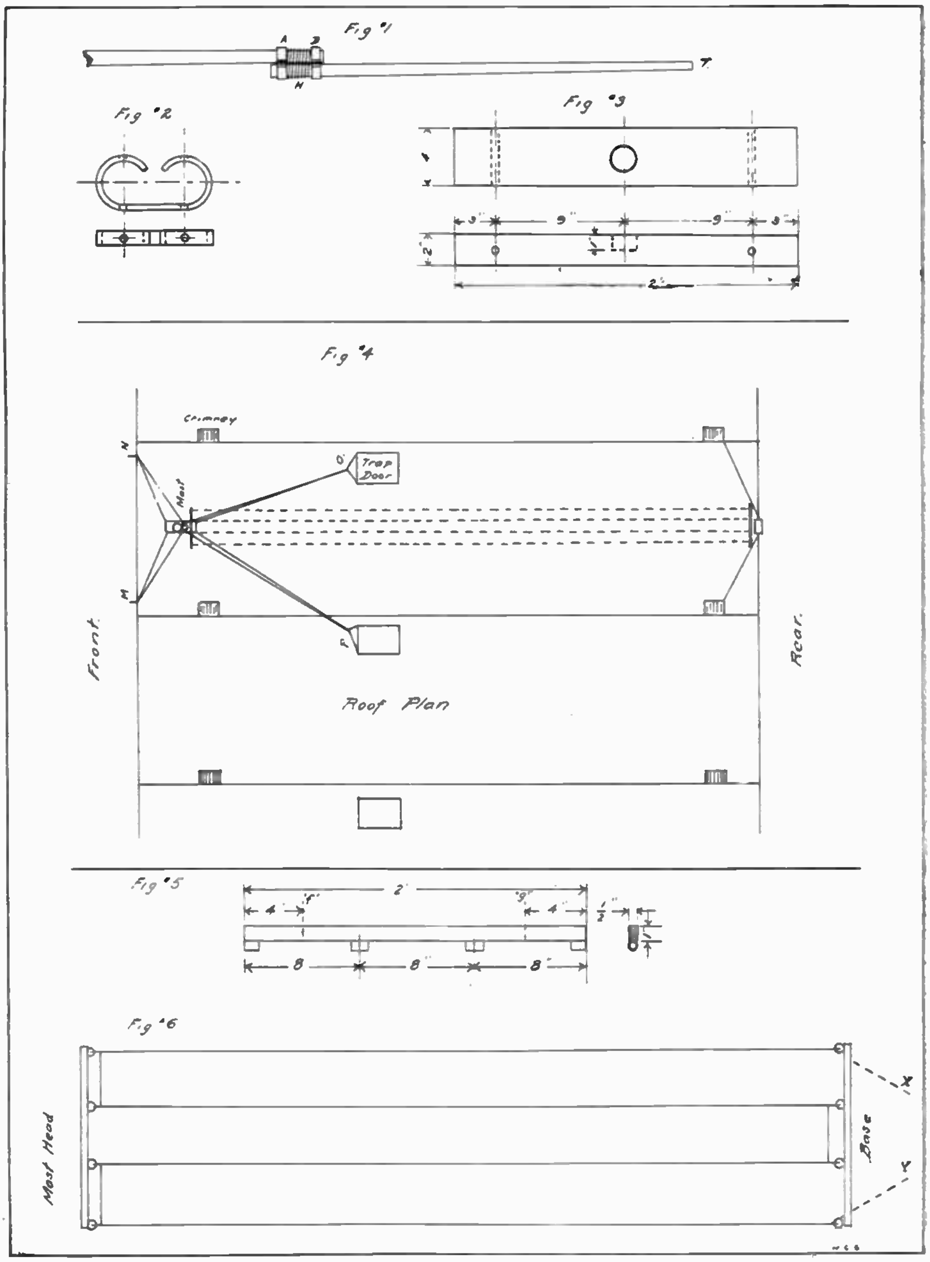
Before raising the mast, carefully inspect the guy-wires, splice, etc., and make sure that everything is all right. Get about a 50-foot length of sash cord, and slip through pulley, tying ends together so that they cannot come loose.

If you can get any friends to help you, it will be an easy matter to raise mast. In this case, place the mast butt near hole in scantling, with masthead towards rear of roof. Distribute guy-wires to proper points and make them fast, temporarily.

Place one of your friends at each guy-point m and n in front, and one in the back at either o or p, to keep slack out of wires.

Get your remaining friends to grasp the mast itself, at the base, and raise it as high as possible by hand, meantime working butt of pole into hole in scantling. If necessary, get some long sticks of wood, with V-shaped cuts in the ends, and use these to raise the pole in a manner similar to that employed by linesmen raising a telegraph pole.

When the mast is past an angle of 45° with the roof, your friends at m and n should begin to pull on the guy-wires going to A–B, while the man at o slowly lets out slack, and keeps a tight hold to prevent the mast from keeling over. Meanwhile the men at base of mast should be giving as much help as possible, and should try to keep mast steady. When the mast is nearly perpendicular, fasten guy-wires one at a time, starting with those going to A–B. After all guy-wires have been fastened to proper points, and the men at the base have let loose, it may be found necessary to take in some slack on some of the guys, and let out a little on others, until mast is perfectly perpendicular. Paint all the guy-points, and wherever the wires have been tied or spliced.



The mast having been erected, we will now turn our attention to the antenna. Get two pieces of well seasoned wood about 1 x ½ inch, and each 2 feet long. Fasten porcelain insulators to them, as shown in Fig. 5. These knobs can be tied to the wood with short pieces of wire running around groove on surface. The wood should then be given several coats of good paint.

At points f and g fasten a piece of rope about 2 feet long. Tie one end of the sash cord that is run through the pulley to one of these cross-arms, seeing that the short rope ends are fastened to sash cord, to give arm a perfect balance.

Tie the other cross-arm to a piece of 2 x 2 inch scantling, that has been made fast to rear of roof. Then get sufficient quantity of No. 16 B. & S. gauge bare copper wire, to run from masthead to rear of roof four times.

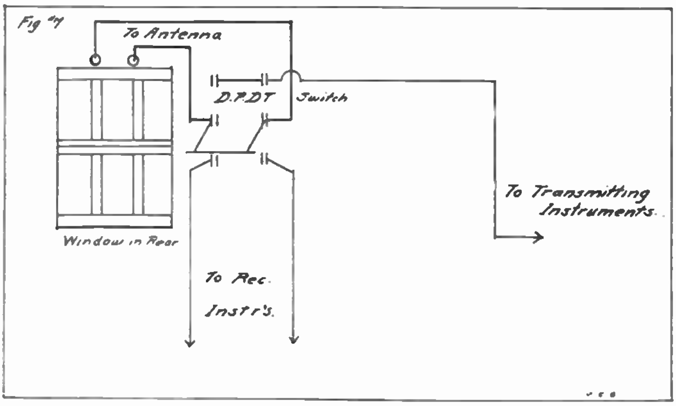


Fig. 7

Referring to Fig. 6, run wires to cross-arms, through insulators as shown, making the required cross-connections, and soldering all splices.

Wires x and y should be of No. 14 B. & S. gauge, rubber-covered wire, and should be carefully insulated from scantling, roof, and building. Wherever they have to touch building, they should be carried on heavy porcelain insulators. Where they enter the building, they should pass through porcelain tubes having a wall of at least ⅜ inch, and should extend beyond 4 inches on either side of wall. They should be provided with drip loops, and conform in all other respects to rules of Underwriter's Code, on high-potential wires.

Figure 7 shows arrangement of wires on entering room, and double pole switch for transmitting and receiving circuits. The object of this switch is to prevent any danger of the high-tension discharge of the transmitting side entering the receiving instruments.

Figure 8 is a photograph of mast and antenna recently built by me, for the Voltamp Mfg. Co., of Baltimore, who have gone extensively into the manufacture of wireless goods. This mast is 40 feet in height, and is built of four lengths of pipe, each length reducing in diameter as it goes up. The antenna consists of five wires having a span of 88 feet and connected in a manner similar to that shown in Fig. 6. From the top of the mast, the two lead wires drop down the light shaft to the ground floor, the distance being about 80 feet. The instruments are located in the office on the ground floor.

Figure 9 shows the mast and antenna at

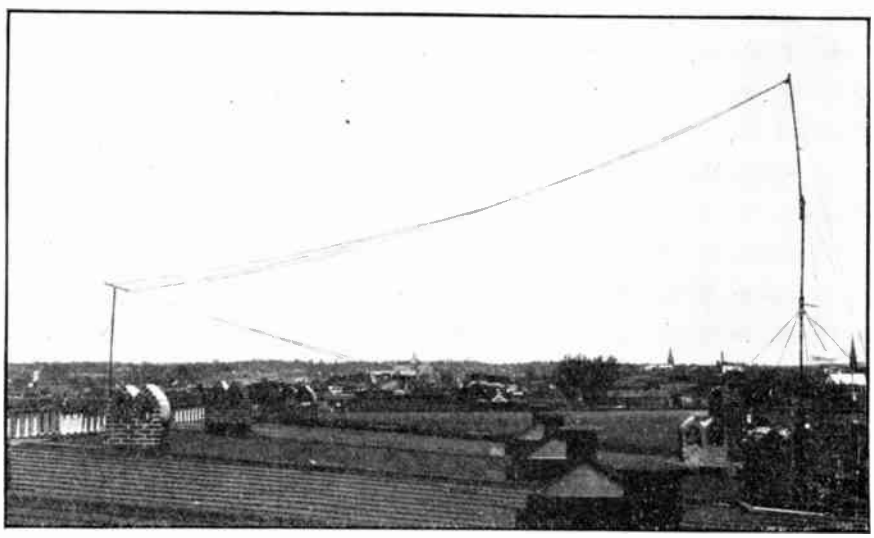


Fig. 9. Mast and Antenna of Testing Station on Fulton Avenue

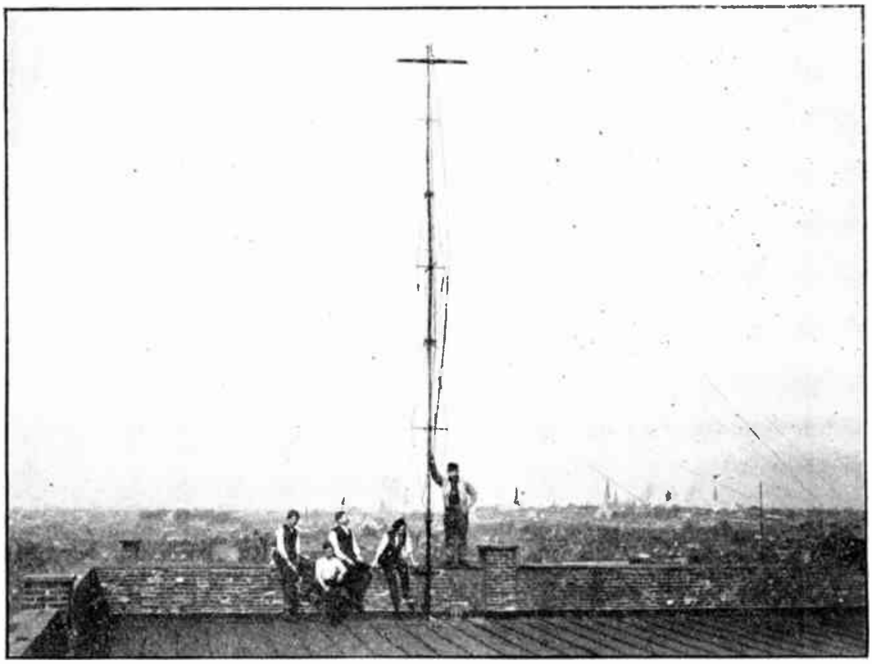


Fig. 8. Mast and Antenna of the Voltamp Mfg. Co.

my testing station on Fulton Avenue, Baltimore. The back mast is 21 feet high, and the front mast is 8 feet. The four wires drop from the cross-arm at the top of the back mast to the front mast, and two continue from there to the base of the back mast — making an overturned V-shaped arrangement, the wiring being similar to Fig. 6. From the base of the back mast the wires enter light shaft to instruments in center room, third floor. This station has a receiving radius of about 70 miles.

Before finishing this article, it would be well to say a word regarding protection from lightning. No lightning arrester similar to that used on any telephone, telegraph, or power system, would be of any service. If an iron mast is used, the best protection is to make a good ground for the mast, with special lightning wire running to it. If it is easy to let down the antenna, when a lightning storm is near, do so. In all cases, disconnect antenna from lead wires entering building. This is best done by having regular wire connectors on antenna, that can be unscrewed, and thereby allow disconnection to be made.

Where it is not convenient to let antenna wires down, ground same to some good ground wire *that does not enter the building at any point!* And when there is a storm near, it is not advisable to try any stunts with the instruments.

There is little to fear from a wind storm if the mast is properly guyed, as there is so little wind surface exposed that the force exerted does not amount to much. It is necessary, though, to regularly inspect the mast about once during a month, and take up any slack that may appear in the guys, as they must always be perfectly taut.

In conclusion, would state, that unless the reader has had experience in pipe work, he had better not attempt to put up a mast of pipe sections, because it is necessary to brace the pipe in many places, and raise it in a different manner from the way I have described the erection of the wood mast.

THERE is nothing better than asphaltum to protect metals from the corrosive effects of acid fumes from a storage battery. When it gives out, put on another coat.

ECONOMY no more means saving money than spending money. It means spending and saving, whether time or money or anything else, to the best possible advantage.

HOME-MADE JEWELRY

CHARLES B. DYER

Both in America and Europe, many of the most successful workers in artistic jewelry have taught themselves, picking up here and there the little points which go to make the craft. The technique of every art or craft is exacting, but the technique can in time be mastered if the essentials are there. These papers will attempt in a small way to give a few essentials of the jewelry work, and some hints which may be taken as ground-work on which to build. Each worker will then have to follow his own thought and individuality as far as the restrictions of the metals and jewels will allow; remembering at all times the dignity and value of good design, the necessity of sobriety and restraint, of ordered arrangement, of due regard for the relation between the form of an object and its use, and of the harmony and fitness in the decoration put upon it.

As few workers have access to well-equipped shops, it need not keep them from starting a small bench at home. Starting with a few tools, more can be added from time to time. With the following outfit the beginner can make a very creditable showing:—

1. A gas lamp. (Duplex gas lamp is best.) (Where workers do not have access to gas, a large adjustable alcohol lamp will answer.)
2. A plain brass blow-pipe, 9 or 10 inches long.
3. Two ounce chaser's hammer with ball end. (Be sure and do not get a cheap hammer.)
4. Four-inch saw-frame and round back blades, No. 1 and No. 1½.
5. Charcoal block.
6. Borax block and slate.
7. Pointed tweezers.
8. Steel-pointed pencil.
9. Three-inch spring dividers with handle.
10. One drill stock and set of drills.
11. Two pairs flat pliers.
12. One pair cutting pliers.
13. Wax block and polished steel block.
14. One set punches.
15. One pair shears.
16. Pin vise.
17. One set files.

The gas lamp must have a burner with a wire screen over the top to spread the flame. For this reason a Bunsen burner, though useful and nice to have around the shop, is not good for soldering, as the flame is not broad enough. Do not get a fancy blow-pipe, but a plain brass one about 10 inches long. This length is best for lady workers, to keep from burning their hair. The small hole should be enlarged slightly to give a larger flame. Silver solder comes in small sheets. Be sure and do not get the kind made for steel. The borax is used for all hard soldering. The best kind is the "Prepared Borax," and comes in small round cakes. These should be soaked in water for twenty minutes before using the first time. An old flatiron with the handle broken off makes a good steel block and anvil. The wax block must be made at home, as the material houses do not handle them. Take equal parts of rosin and fine brick-dust, about ½ pound of each, and a lump of tallow the size of a walnut. Melt the rosin over a slow fire, then add the tallow. The brick-dust is then sifted in slowly and stirred well until thoroughly mixed. Pour this upon a block 6 inches square by 1 or 1½ inches thick, and allow to cool. If in using you find that the wax gets hard too quickly after being heated, there is too much brick-dust in it. If, on the other hand, it is too sticky, there is too much rosin in it. If it spits and splutters, catching fire easily on being heated, there is too much tallow. Experience will be your best teacher in this matter. Pitch may be used, but is more sticky and disagreeable to handle and harder to remove from the metal.

A set of tool-maker's small files, a flat file No. 4, a flat file No. 2, an oval file No. 4, and a barrett file Nos. 2 and 4 are needed. You can add other sizes and shapes as the work progresses. The best way to make a set of punches is to start a piece of work and make the shapes and sizes necessary to complete that piece. If this plan is followed with each piece of work done, before long you will have a fine set of tools sufficient for any design attempted.

Get a rod of 11-64ths inch or 5-32ds inch octagon tool steel. Cut into 6-inch lengths. Each of these will make two punches, but it is easier to file and work them in the longer piece. Work up a punch on each end, and cut into 3-inch lengths. When worked into the shape desired, and nicely polished, they

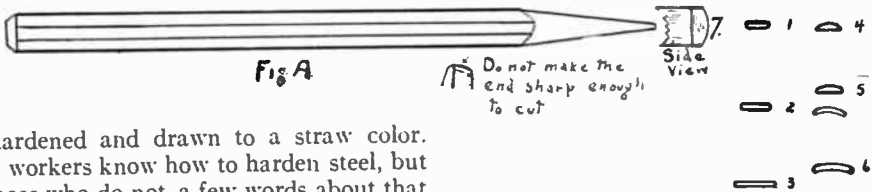


Fig A

are hardened and drawn to a straw color. Most workers know how to harden steel, but for those who do not, a few words about that process may be helpful. Small pieces of steel may be hardened in water, in quicksilver, in lard oil, or a very weak solution of citric acid. If lard oil is used, the pieces will come out bright and will not have to

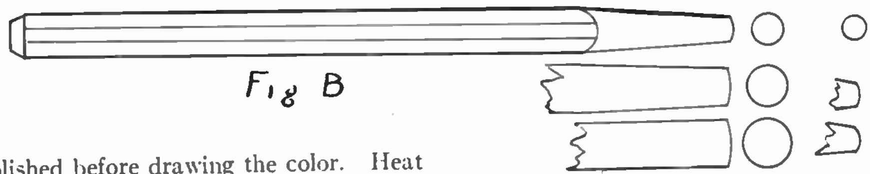


Fig B

be polished before drawing the color. Heat the end of the punch, for about 1 inch from the end, to a nice cherry red, then plunge quickly into the oil. Be sure to carry it deep enough to cover the whole punch. When cool, the oil may be removed with a

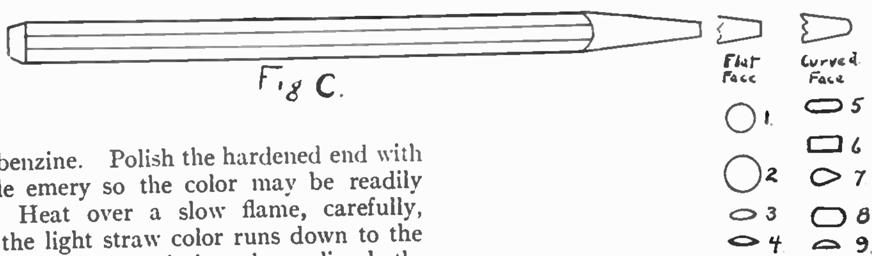


Fig C.

little benzine. Polish the hardened end with a little emery so the color may be readily seen. Heat over a slow flame, carefully, until the light straw color runs down to the end, then plunge again into the cooling bath. Care must be taken not to draw the temper too far, because if too soft the working end will soon batter out of shape. If too hard, it will break off.

The first punch needed is the outline tool, and should be made in several sizes and shapes. Those to make straight lines have flat straight sides with different lengths of face. Figure A, Nos. 1, 2, 3. The larger sizes are time savers where you wish to run long straight lines. For running curves, the small tools are flat on one side and slightly curved on the other, the larger ones slightly curved on each side. Figure A, Nos. 4 and 5 are for small curves, Nos. 5 and 6 for larger ones. The tools used to make the representation of hammer marks are round with a curved face, Fig. B. The depth of the mark depends upon the curve of the punch face.

In Fig. C are shown several shapes for depressing surfaces. They should be made in both the flat face and the curved face. There should be several sizes of each shape, but these can be made as needed, and will be taken up later on. The outline tool and the one to make hammer marks are the only ones used on the first exercise.

LIFTING magnets are coming into increasing use in British iron works. Castings weighing two or three tons are lifted by electromagnets. Much time is saved in comparison with the use of hooks, slings, and other devices, as the mere throwing of a switch energizes the magnet.

THERE is no chemical like water for washing plates and papers.

IT is estimated the power which could be generated at Victoria Falls in South Africa exceeds 200,000 h. p.

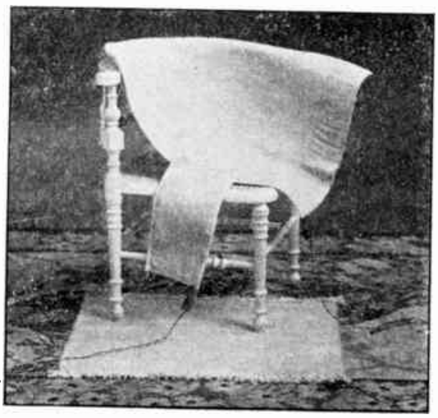
THE washing of prints is hastened very much by squeegeeing them face downwards on glass between each change of water.

ELECTRICAL HEATING FABRICS

FRANK C. PERKINS

THE accompanying illustrations show the construction of some most interesting forms of French electric heating devices known as thermophile fabrics, designed and constructed at Belfort, France, by M. C. Herrgott. These thermophile heating fabrics include carpets, rugs, coverings and coverlets, which produce gentle heating effects and can be utilized for home use as well as industrial and medical purposes.

It is well known that electricity, the transmitting agent of power and light, is also an excellent producer of heat. By causing a certain density of current to pass through a conductor of determined resistance, the energy contained in the electric current can be almost completely transformed into heat.



Electrically Heated Fabrics and Rug

It will be noted that this action is immediate; further, it produces neither smoke nor combustion, consequently there is no disengagement of injurious or troublesome gaseous products. Finally, by observing very simple rules regulating the value of the current to be employed, the amount of heat can be regulated with astonishing facility, without risk of bringing about the incandescence of the conductor or any danger of fire.

These special properties have been utilized for electric heating for a long time, but have not yet been applied largely to domestic uses in a practical and economical way.

Metallic webs forming rheostats have been manufactured and asbestos fabrics used for heating; but such fabrics were intended particularly for high temperatures by radiation and their employment was necessarily limited; they were not very well constructed and were wanting in flexibility. Such a means of heating could admit only of certain applications and could not be introduced into modern houses in a practical manner.

The French thermophile fabrics, it is maintained, are constructed by special processes; very simple precautions are taken to avoid too great heating of the conducting wires and to escape the risk of deteriorating these fabrics intended for warming at mild temperatures, particularly by contact.

In order to give these fabrics great flexibility and suppleness it was necessary in the first place to have a textile conducting thread which was suitable for all fabrics and all weaving looms.

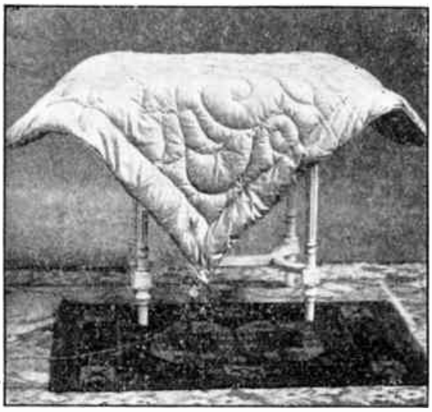
This French electro-thermic fiber is a thread composed in such a manner that its textile part alone extends when stretched, and that its conducting part is subject to no tension and presents a large heating surface in proportion to its small section. This thread is very pliable and does not buckle in weaving. It can be made in all sizes, and of all textile materials according to the use for which it is designed; in all kinds of fabrics, heavy and light, of hemp, cotton, wool, or silk.

It is held that such thermophile fabrics can be applied to all the uses of similar fabrics, but have the additional property of heating.

The French thermophile fabrics are electrically auto-resistant exactly like an incandescent lamp; consequently, as they are employed under a determined electric tension, they can, when entirely spread out, only give the uniform temperature for which they are made, without any abnormal heating or dangerous electric current.

The woven electro-thermic threads are, it is stated, sufficiently fine to become their own cut-outs in case of too great current, and the thermophile fabrics are so constructed as to avoid any short circuiting in their use.

The great number of electro-thermic wefts composing a circuit permits of having



Electric Coverlet

between two neighboring wefts a difference of potential of only from half a volt to one volt at the most. Further, in the case of multiple circuits, these various units receive the current by specially insulated collector wires, one pole of which is placed in each selvage of the fabric. Finally, the various circuits of the same fabric are branched in weaving in such a manner that the difference in potential is *nil* between the neighboring wefts of two successive circuits. There is, therefore, security against short circuits to such a point that these fabrics may without danger be wetted and then caused to dry by the current itself, thereby permitting humid applications.

All danger is, therefore, absolutely removed. The only possible accident is the stoppage of the current, and the causes of breakage have been reduced to a minimum. First, the electro-thermic wires are perfectly buried and almost invisible in the fabric: they are so completely imprisoned in it that they remain intact in spite of the manipulations to which they are subjected; they never reach quite to the edge of the fabric; and are thus protected absolutely, so that they cannot be affected by wear.

In this way there is permitted easy mending of a weft accidentally broken. It can be readily found and the circuit can be very rapidly closed again.

At the selvage the collector wires can be provided, if desired, with an external rheostat, in order to couple at will multiple circuits for the purpose of obtaining various desired temperatures.

Wherever the electric current is already used for lighting, we may have self-heating of carpets, coverings, coverlets, and lace fabrics which by their suppleness, elegance, and comfort are adapted to all the exigencies of the most luxurious modern residence.

In the house a flexible wire and an electric coupling with suitable switches and fusible plug are sufficient to safely convey the current to the thermophile.

In the bedroom it is the cleanest method of heating, in fact, it creates neither dust nor odor, and requires neither reservoir nor fuel, merely the carpet, which is a necessary element in the most simple furnishing and harmonizes with the business office as well as with the elegance of the most luxurious drawing-room.

In the dining room or parlor it presents no danger of fire or of accident when the fitting, which is very simple, is undertaken by a competent person. It cannot give a greater heat than that for which it has been arranged, provided that when in use it is completely spread out in the free air and is working at the tension arranged.

The electric thermophile is generally made so as to give a temperature 85° to 95° for carpets and 70° to 80° F. for coverlets. It can be made for all temperatures, but those mentioned are the most agreeable. If these temperatures appear low at first, particularly to the simple touch, use for a few moments is sufficient to fully demonstrate that these temperatures are sufficient to be comfortable.

For medical purposes the backs of chairs or shawls of knitted electro-thermic threads are very practical for warming the back, arms, and loins of rheumatic subjects. Electric coverings and electric carpets are very

Electric Arm and Leg Coverings

useful in winter to preserve and continue the good effects of thermal cures made during the summer, especially in cases of arthritis and sciatica.

The mean consumption of electricity in dry calm air per square meter of the thermophile is as follows, degrees Fahrenheit above the surrounding temperature being given: —

Oriental, Gobelin, or Moquette carpets in offices and private rooms give 45° per hectowatt, or 4 hectowatts for 85° to 95° F. The double thick fabrics, such as carpet incubators and filters, give a heat of 50° F. per hectowatt, or 3 hectowatts for 75° to 80° F. when bare, and when covered 60° F. per hectowatt or 2 hectowatts for 75° to 80°. The simple light fabrics, such as coverlet compresses, when bare give a heat of 50° F. per hectowatt, or 2 hectowatts for 65° to 75° F., and when covered 70° F. per hectowatt, or 1 hectowatt for 65° to 75°.

AN ELECTRIC WATCH ALARM

STUART K. HARLOW

THIS is an electric alarm in which an ordinary watch is used. I employed an Ingersol Eclipse watch.

The principle the alarm works upon is that the circuit closer is placed in a very delicate position of unstable equilibrium so that the least touch lets the circuit closer drop, thus connecting the circuit and ringing a bell. For our purpose we use the hour hand on a watch to trip a trigger that holds the circuit closer off its contact.

The crystal is taken off the watch, it is then placed in the watch holder and the apparatus set at the time it is desired that the alarm shall go off. The hour hand is the one that sets the alarm working. The manner of setting is to turn the watch holder or raise or lower it until the trigger is in front of the hour at which the alarm is to ring. Of course the position varies with different lengths of hour hands; in the case of short ones the trigger must be placed a little above the hour mark. I took off the hands on my watch and fitted hands made from No. 16 spring brass wire, hammered flat and filed to a point, the other end soldered to the same rings that remain when the old hands are broken off, — that is, the part of the old hands that push on the running spindles. The hour hand may now be made of a length to just come to the circle on the dial, in which the hour and minute marks are placed.

Now, since we see the principles this alarm works on, I will proceed to describe the construction of one as illustrated by the photograph Fig. 1 A.

Figure 1 is a plan. The base may first be taken in hand. It is a ½-inch board, of any of the hard woods, of the dimensions shown. It is chamfered or beveled ¼ inch to add to its neatness in appearance. A hole is bored ½ inch diameter, clear through, 1½ inches from left end for watch pedestal (Fig. 2); 2 inches from center of this one a mortise through the board is made ¼ inch square for trigger support (Fig. 4).

The watch pedestal is a piece of curtain pole ⅞ inch diameter, bored the entire length with ⅜-inch bit, the lower end cut away until ½ inch diameter, a set screw fitted ⅜ inch below top, then glued in the hole provided for it in base. The standard is a piece of ⅜-inch diameter iron rod; a saw cut, with a hack saw, is made in upper end and a piece of $\frac{1}{32}$-inch brass drilled with ⅛-inch drill, soldered in rod as shown; a binding-post from the carbon element of an old dry battery, with head filed as thin as possible, as in drawing, fits in this hole in the piece of brass. This is for the purpose of locking the watch holder in different positions.

The watch holder (Fig. 3) is cut from a piece of hard wood ½ inch thick, to a size in which the watch fits tight, so as not to fall out. It may be sawed out with a compass saw, a piece of veneer or cigar box wood being glued on to form a back. When the glue is thoroughly dry and hard, the lower and middle portion is sawed out to the back; two mortises are made to receive the tangs of a piece of iron bar curved to radius of watch-holder ring, and the channel for the battery binding-post of the standard to slide in, drilled and filed out. This piece in my alarm was filed from the same piece of iron rod of which the standard was made, being barely the inscribed square in the rod. This curved bar is fitted to the ring of watch holder with any good cement. I used one composed of equal parts of pitch and gutta-percha.

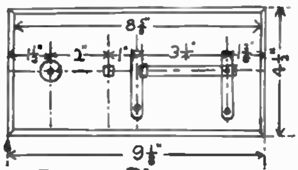


Fig. 1 Plan.

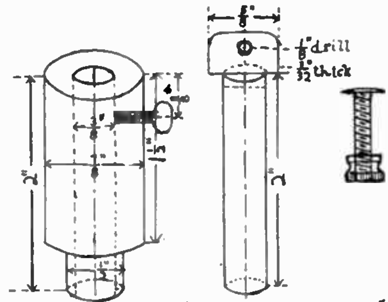


Fig. 2. Watch Pedestal and Standard.

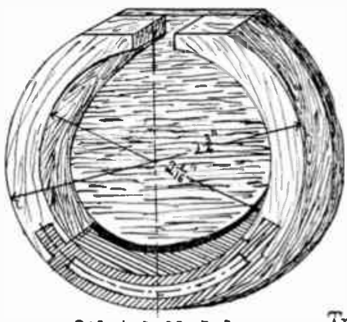


Fig. 3. Watch Holder.

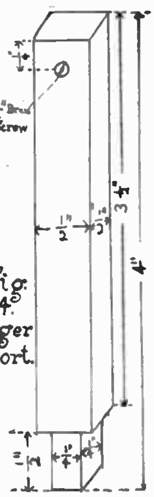


Fig. 4. Trigger Support.

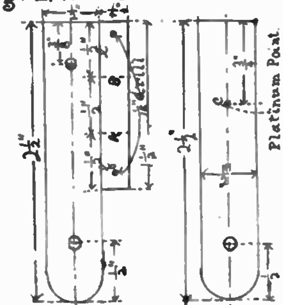
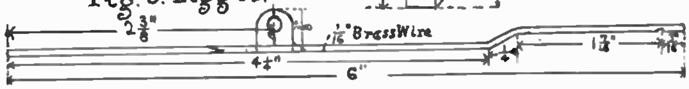


Fig. 7. Connecting Plates.

Fig. 5. Trigger.



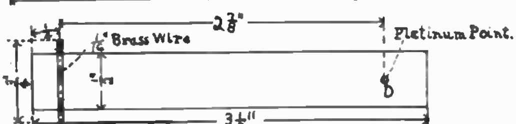


Fig. 6. Circuit Closer.

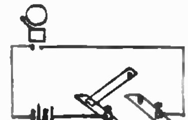
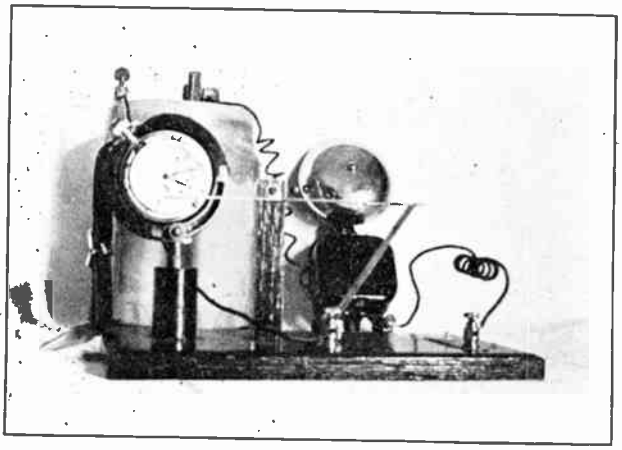


Fig. 8. Diagram of Connection.

We next make the trigger support, Fig. 4. and glue it in the mortise we have previously made in the base. The wood part is now finished, and after thorough sand-papering, may be varnished.

While we are waiting for the varnish to dry we proceed with the trigger, Fig. 5. It is a $\frac{1}{16}$-inch brass wire $6\frac{1}{4}$ inches in length; the end to the left is filed flat until $\frac{1}{32}$ or $\frac{3}{64}$ inch thick, so that the minute hand may readily pass over the trigger without setting alarm going. At $2\frac{3}{8}$ inches from end a piece of $\frac{1}{32}$-inch brass with a $\frac{1}{8}$-inch hole drilled in it is soldered. At $4\frac{1}{4}$ inches it is gripped in a pair of pliers, $\frac{1}{4}$ inch bent at an angle to bring the end in the center of the circuit closer; the remainder is bent in a parallel line with the other end. A small nick or notch is filed $\frac{3}{16}$ inch from right end to engage in the upper edge of the circuit closer and hold it in a position of unstable equilibrium.

The circuit closer is a piece of $\frac{1}{32}$-inch sheet brass, $3\frac{1}{2}$ inches long and $\frac{1}{2}$ inch wide; $\frac{1}{4}$ inch from left end is soldered a piece of $\frac{1}{16}$-inch brass wire $\frac{3}{4}$ inch long; at $2\frac{7}{8}$ inches from center of wire is soldered a platinum point, D. This platinum wire is $\frac{1}{16}$ inch in diameter or less. It may perhaps be obtained from a burnt-out incandescent lamp,



holes are drilled ⅛ inch from each end, as shown. Cut along lines e and f, bend up the ends at right angles on dotted lines A and B, so as to act as bearings for the brass wire on the circuit closer. Two ⅛-inch holes are drilled in the main part of the connecting plate; one, ⅜ inch from the upper end, to receive a small brass screw to hold it to base, the other to receive the screw of the binding-post. The next connecting plate is 2½ inches long, ½ inch wide; a platinum point is soldered at ¾ inch from upper end on top of a small brass screw which holds down this end, at the other end is drilled a ⅛-inch hole for a binding-post.

The binding-posts may be of the bottom connection type or with wood screw tang, as in either case it makes the necessary electrical contact with the connecting plates.

The connecting plates are screwed in position on the base and the binding-posts placed at other end, holding them securely to the base.

In Fig. 8 is given a diagram of connection. Leclanche or dry batteries are best to use for this alarm. A single Leclanche cell works my alarm.

—the wire that is sealed in the end of the glass tube. Platinum is of a silver-white color, and so do not mistake the lead in copper wires of the glass tube for platinum wires, as they are very short and sealed in the glass, because the coefficient of expansion of the platinum is the same as that of glass. We use platinum at this point for the purpose of having a clean electric contact, as it does not corrode or oxidize under sparking as fast as other metals.

The connecting plates, Fig. 7, are cut from the same sheet brass as the circuit closer. One piece, the one in which the circuit closer is to swivel, is cut with an extra portion 1½ inches long, ¼ inch wide; and two $\frac{1}{16}$-inch

A RETROSPECT

PROF. ELIHU THOMSON

In this age of special tools, highly developed machinery, and processes of construction, when materials are available with properties covering the widest range, it may possibly be useful or instructive to turn back to the time of the inception of the electrical engineering art and review the conditions as they existed approximately thirty years ago. Such a retrospect may assist those who have not had an opportunity to acquire a just perspective, and may help towards the appreciation of the better conditions which now exist for accomplishing work on a satisfactory basis, or for embodying ideals which, even if existent in the early days, were not accompanied by the means for execution.

One has only to visit the shops of a large electric manufacturing concern of to-day, and to notice the great variety of stock or material found in store in its stock-rooms, to be impressed with the fact that modern results come about by a combination of highly developed organization and methods. As an example, one may watch the elaborate machinery in the form of punch presses and the like, which have to deal with the manipulation of sheet iron or steel entering into the armature cores of dynamos and motors, without realizing that all of this development is but recent. There was a time in the art when it would have been futile to have made a design, however meritorious it might appear, involving the use of punched sheet metal in complex forms, for neither the material of proper quality existed, nor was the machinery for giving it the proper shape available.

In the early days of the electric industry the cores of dynamo armatures were commonly made of iron wire wound up into rings on cylinders; or, in other cases, of plates or forms of cast iron. When sheet iron was used it was generally in the form of heavy plate, cut out by crude machine processes or laboriously worked out by hand. The iron wire itself was not especially adapted to the purpose, and varied widely in its qualities, whereas about the only available sheet iron was stove-pipe iron, or the sheet iron from which sheet-iron utensils were made, and, of course, the existence of magnetic losses was not taken account of in its manufacture. The early worker had to put up with what he could get instead of what he wished he could have. He had to bend his designs and constructions to the use of such materials as were available, and the selection being a most restricted one, it will easily be understood that there was little freedom in designing in those early days. At the time referred to, cast iron was mostly used for magnet frames, although occasionally wrought material was employed. One had to put up with simple forms of the latter and with whatever quality of iron the foundry (generally a separate organization) happened to furnish. Steel castings now enter widely into electrical construction.

Even in the case of copper wire the limitations were severe. It was not obtainable in long lengths without joints or the necessity for making them. It was imperfectly drawn, frequently having slivers projecting through the insulation, and often varied in shape of section from round to oval; and the amount of the section varied. Round wire only was available for use. There were no square or rectangular sections to be had. Fine wire was not then drawn through jewels, and a coil would vary in section from one end to the other, owing to the wear of the dies. With the shunt magnets of series arc lamps it was sometimes quite necessary, in order to obtain any definite resistance in the coils with a given number of turns, to combine wires which varied in such a way that a portion of the coil would be of smaller section and another portion of the coil of larger section, so as to get somewhere near the desired average section.

The designer or constructor was equally limited in the insulation which was available. Generally, he found that he had to rely upon paper or cloth for insulation, with shellac varnish. The paper itself was liable to be defective, as it might contain particles of iron or other metal, or bits of carbon, in case the paper mill was near a railroad. Mica was not at first available, its use being practically limited to clear and relatively very expensive sheets for stove doors, and the forms of colored and soft mica now so commonly found in use were not then mined, as there was no market for them. Flakes of mica, pasted upon paper by shellac and overlapping each other, were first used in the Lynn Factory in 1883 or 1884 and formed the first built-up mica employed. The sheets so built were used to separate the coils of arc light dynamo armatures. Insulation between commutator segments was originally shellaced paper, vulcanized fiber, or some similar substance, afterwards replaced by mica. The mica cone insulations for commutators came later, being some of the first mica pieces which were built up from flakes or out of small pieces, all of which were held together by varnish and heated in forms.

Very early commutators and other parts of machines were insulated with red fiber or vulcanized fiber, even then a manufactured product. It varied greatly, however, and was treacherous, as the process of production did not always remove the acid of chloride of zinc used in the treatment of the fiber. Defective material of this kind was the cause of many breakdowns. Reliance had to be placed upon wood, even for such things as switch supports and fuse boxes—as there was no electric porcelain manufacture; and even slate itself was not used, being unavailable, or not to be found readily on the market in suitable form.

At the time of the early introduction of arc lamps for street lighting and for interior lighting, the arcs were frequently burned bare, without globes or any other enclosure. Sometimes clear globes were used, and occasionally opal ones; but thin opal glass could not be obtained then, and the globes were made of heavy dense opal glass and absorbed about sixty per cent of the light. The globes were also frequently misshapen and varied greatly in thickness. The carbons used in the working of the arc lights were also very imperfect at the start, many of them being so crooked that they would not stand opposed to each other without sliding by one another. The methods of manufacture had not been so fully developed but that a large proportion of the product was defective in straightness. Similarly in the chemical constitution of carbons, and in the heat treatment or baking, great variations occurred. Very often there were impurities present which caused the arcs to flame and sputter or hiss at intervals, while some carbons would burn out in much shorter time than others. For a time, indeed, the question of getting satisfactory carbons was a very vital one in the development of arc lighting.

Twenty-five to thirty years ago the only lines outside of telephone and telegraph lines, which extended any distance away from the station, were those for series arc lighting, and were generally of bare copper mounted on telegraph insulators. One of the first high-tension experiments, and one which ended with some disastrous consequences, was the coupling of seven 40-light Brush arc-light machines in series on a single bare wire circuit in Cincinnati, at the inception of the arc station there. The idea of high voltage apparently had not penetrated the consciousness of the people in charge of the installation, for it is said that immediately on starting up, several of the machines burned out. The total potential of the line would have been some 14,000 or 15,000 volts, and no special precaution had been taken to insulate for this relatively high pressure.

Wherever, in the early years, the factory building was not badly suited to the purposes of the business (as was too often the case), it generally happened that the engine power was either deficient or badly governed, or that the boiler capacity was much too small for the engine; while frequently the testing of dynamos had to be made at a distance from the engine itself, involving several belt transmissions. It will be readily understood that, with a slow-moving engine, badly governed, and such belt transmission, testing, under anything like standard conditions, was practically impossible. The modern engine of comparatively high speed did not then exist, and the governing, which was good enough for most of the ordinary factory uses, was, of course, very defective for the demand of steady driving of electrical machinery. Along with the development, therefore, of electrical applications, it was a matter of necessity that engine power should follow and become more and more refined.

Not only was there difficulty in obtaining the proper power conditions in the manufacturing plant, but oftentimes the early electric station was in a building already existing and with an engine which had been given up for some other use and applied to the new demand, as an economy. Those were the days when arc-light machines had frequently to be loaded up in the stations by lamps, making up for the deficiencies of the external or outdoor load; and it was not unusual to see fifty or sixty lamps or more burning in a station, consuming carbons merely as idle load to fill up circuits that did not have their full complement of commercial lamps. It was the unsatisfactory engine power and transmission by belts and the variations of load conditions which led us early to the adoption of means of regulation for constancy of current in arc machines or circuits, — a remedy which practically accomplished all at one stroke. It made the circuit independent of the variations of engine or of its governing, and independent of the variations of load external to the machine.

At the inception of what is now the modern electrical industry, it was practically impossible to find suitable instruments for measuring the values of current or potential; the only measuring instruments to be found were those of the cabinets of natural philosophy and of the telegraph systems. Such instruments of measurement as tangent galvanometers, astatic galvanometers, etc., depending upon the strength of the horizontal component of the earth's field did not work very satisfactorily when masses of metallic iron were near by, or when, as in one instance within my knowledge, locomotives passed by on adjoining railway tracks or loaded cars stood on the tracks not far away. Even the instruments themselves were not adapted to the currents or potentials in use, and it was necessary, therefore, for the pioneer to construct his instruments to obtain such information as was needed. In fact, many of the early workers evidently got along without any information obtained from measurements of current and voltage. It may be said truly that it is not more than thirty years ago since any consistent investigation of measurements of the currents, voltages, and efficiencies of dynamo machines were made. In view of this fact, it is even in a measure extraordinary that some of the early work succeeded as well as it did, especially in the field of constant current generation which, as is well known, demands certain dynamo characteristics in order that the current shall be stable or not subject to surging or oscillation. The data for design was very meager, and the work had to be done by a sort of sense of what was needed; a feeling, as it were, that certain proportioning between armature and field would be required to make a successful machine.

PANORAMIC PHOTOGRAPHY WITH A CIRKUT CAMERA

CHESTER F. STILES

PANORAMIC photography dates back to the earliest days of the science. In fact, the first attempts to record panoramas by photography were made when daguerreotype plates were the only available sensitive medium, and much inventive genius has been brought to bear on the problem since that time.

Many amateurs have made attempts to build up sectional panoramas by making successive negatives which overlap, and then joining the various prints together; or in some cases, recopying the matched prints on one negative from which an enlargement or print can be made with all joints retouched out. The chief difficulty in making this class of panorama is to expose equally on each section and develop accordingly, so that the prints for copying may have the same density and color.

A lesser difficulty is the matching of the lines, which is overcome to a great degree by using long-focus lenses, and placing the axis of rotation of the camera under the diaphragm instead of at the regular tripod socket. Even when this is correctly done, all lines do not match exactly.

The advent of the roll film made panoramic photography an easy possibility. Cameras had been built to use curved plates, but these were clumsy and inconvenient in the after processes. The roll film allowed the use of a type of camera known as the Panoram Kodak. Here we duplicate the optical conditions mentioned before. The rotation point is correctly placed at the node of the lens which is in practice almost identical with the diaphragm. A narrow chamber, in height equal to the width of the film employed, reaches from the lens nearly to the film, with the result that the image is laid upon the film in the manner of the focal plane shutter.

Obviously the angle possible with a Panoram Kodak is not quite 180°, as the lens would interfere with extremities of the film. Also the width of the camera box must be the focal length of the lens used and the camera length equal to the double focal length. The dimensions of such a camera with an 8-inch focus lens would be 16 x 8 inches inside measurement, and the result produced by this bulky camera would be but 24 inches maximum length.

The perspective effect produced by such cameras is known as "panoramic" in distinction from "plane" perspective, which is the effect produced by taking wide extents of territory with a wide-angle lens. Panoramic perspective is that produced by a lens directed axially towards the sensitive surface at every moment of exposure. When a panorama is made sectionally, the perspective is called "composite." The name panorama should never be applied to exposures of 40°, 50°, or 60°, such as a village made from a hilltop, but should be reserved for the wider angles from 80° to 100° and above.

The correct way to view panoramic perspective is to bend the print to a cylindrical form and view the picture from a point near or at the center of the curve. Individual portions may be accurately viewed from a point immediately in front of such portion, when the view is laid out flat, giving rise to apparent distortion when the panorama is made with an extreme short-focus lens, the use of which is a necessity in the foregoing types of panoramic cameras.

Plane perspective produced by wide-angle lenses is erroneous, as even the casual observer knows. There is but one point from which the image can be viewed with absolute accuracy, and that is opposite the center of the picture, and at a distance from that center equal to the focal length of the lens. Note the impossibility of conforming to these conditions with a wide-angle 8 x 10 exposure, taken with a lens of about 5-inch focus, when the normal distance for average eyes to view a picture without strain is much greater.

The distortion effects disappear as the focus of the lenses is lengthened, but, as explained previously, the bulk of the instruments makes them unwieldy and unpractical. The camera which should allow not only the use of a long-focus lens, but the interchangeable use of lenses of any focal length at will, and also the production of any angle of exposure even up to complete circles, was a difficult one, and is yet solved completely by the Cirkut Panoramic Camera, in which distortion is reduced to a minimum.

The Cirkut Camera abandons all panoramic principles as commonly known, and the result is a camera which employs any focus lens within limits, and makes panoramas of any angular measurement up to com-

In those days, too, the functions of the designer, inventor, engineer, or electrician were very widely varied. He might partake of the work of works manager, salesman, patent expert, head draftsman; be engaged in construction and testing, and have various other functions more or less accidental or necessary. Also he had frequently to work under very great stress as to speed in getting work in shape. It might even be necessary that the plans and designs for a new size of dynamo should be ready within a day or so, and this frequently led to his work being continued through the day and night. The only system that then existed was to get the thing done as promptly as possible, and anything which would in the least have interfered would have been swept out of the way ruthlessly. The important consideration was that a certain thing was needed at a certain time, as vital to the business, and therefore conditions should be controlled to obtain the desired result. Experimental or new work had frequently to be done in the open shop. There were no special experimental departments, and, of course, such work was carried on often to the detriment of the actual commercial work. This was also a necessity of the case.

Oftentimes the machine equipment was — as in lathes, planers, etc., — so restricted that the designs had to be adapted, as it were, to the restricted manufacturing equipment. For example, work that ought to have been taken with one cut on a large planer was very frequently made on a small machine by turning the work about to make the separate cuts; and the designs of apparatus were frequently made to avoid the use of tools which did not exist, or which existed in very restricted size or number. This aspect of the subject can hardly be realized to-day unless one has had practical experience under the conditions. Doubtless some of the products of the early work seem from present standpoints to be very crude, and perhaps unnecessarily so, but this was often to be explained by the very fact that the equipment could not have met the demands of more perfect designs.

Dynamo armatures in the early days were mostly of the smooth-core pattern, as these seemed to work more satisfactorily than forms which were made with projections. How completely conditions have changed in this respect may be seen by examining any of the forms of modern machines. In fact, the materials and means for using them were so imperfect and crude in the early days that armatures with projections obtained the reputation of giving bad commutator sparking, and so were avoided as the plague for a time. Since the projections were generally coarse, they would also produce considerable heating and losses with solid pole pieces. With the growth of lamination in other directions, lamination of the pole pieces was the natural remedy.

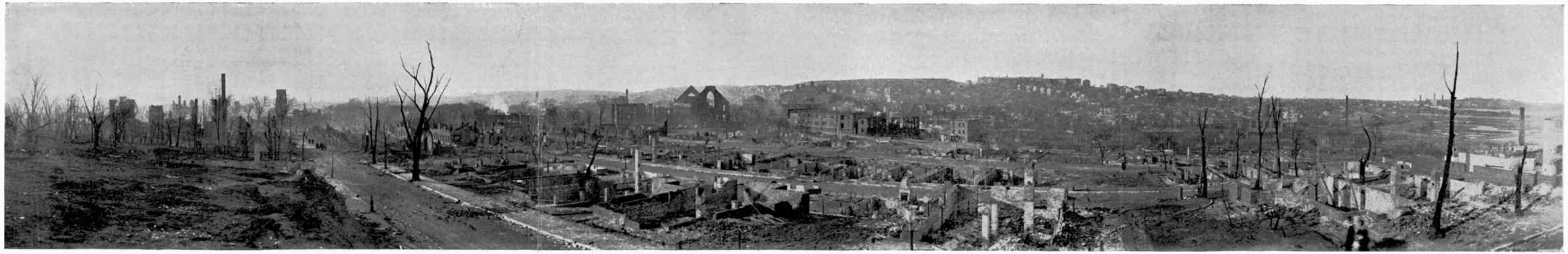
Some of the vagaries of design in dynamos and other machines were due to certain ideas which acted as fetishes, and which have since disappeared. Such, for example, was the idea that a drum armature should be of very great length, so that the idle wire on the armature,— that is, the wire over the ends, — would be small in amount in relation to that which was along the side of the drum. Other variations were due to patent conditions, preferred construction now open to all being subjects of patents then in force.

The brief outline given above could be amplified to almost any extent in the direction of showing the very great handicaps under which the early constructors labored, and the disadvantages which had to be met at every turn. The only advantage, perhaps, was the entire abandon with which new work could be undertaken and pushed to a conclusion, unhampered by matters or conditions which now sometimes complicate the process. — *General Electric Review.*

A SURPRISING amount of ignorance about the proper method of adjusting spark or induction coils exists among users of motor cars, and some of the troubles commonly attributed to weak coils or a poor mixture are due to improper adjustment of the coil. A very little turn of the adjusting screw often enormously increases the amount of current required by the coil. In fact, this increase will amount in some cases to from fifty to five hundred per cent, and causes batteries to be rapidly exhausted. The vibrator spring and hammer should be adjusted so as to stand about one sixteenth of an inch from the end of the coil when in normal position. The vibrator screw should touch the platinum contact on the vibrator spring. The engine should then be started up and if it misses, the screw should be tightened, a trifle at a time, until the engine will run without missing any explosions. When this point is reached, the set screw should be tightened up.

CIRKUT VIEW OF THE TOOL WORKS OF THE BROWN AND SHARPE MANUFACTURING COMPANY, PROVIDENCE, R. I.

WILLIAM MILLS & SON



CIRKUT VIEW FROM SUMMIT OF BELLINGHAM HILL, CHELSEA, MASS., AFTER THE CONFLAGRATION OF APRIL 12, 1908

CHESTER F. STILES

plete circles. Yet all this is accomplished in a camera which, complete, is hardly more in bulk or weight than an 8 x 10 view outfit. Every exposure can be accurately focused, and if a longer or shorter panorama is desired, this can be governed by a proper selection of lenses.

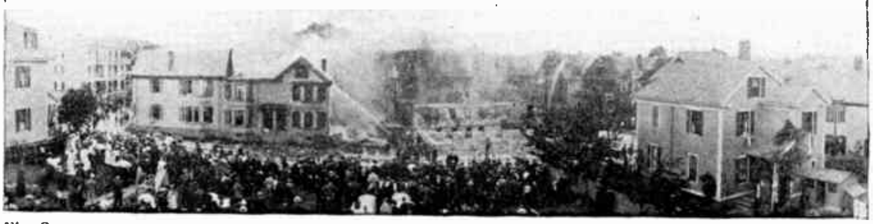
The Cirkut tripod top differs from the ordinary tripod head in that it is about a foot in diameter, and is in reality an accurate gear wheel. A smaller gear wheel travels around the tripod head, and since the head is rigid, the camera itself must rotate with perfectly regular speed. A spring motor inside the camera furnishes the power. This motor also draws the film from the supply spool to a winding drum and past a slot which is exactly opposite the lens. The only way the image can reach the film is through this narrow slot. The object of the variable gear wheel is to govern the speed of travel of the film in relation to the image. Several gears may be used according to the extension of the camera bellows demanded by the lens, which gears are indicated automatically by the focusing scale. That is, if the lens, when focused by the eye, gives a scale reading of gear 53, this gear, and this gear only, must be used. When the proper gear is attached, the film and image are (relative to each other) at perfect rest, although the camera itself is in constant rotation. The penalty for using other than the indicated gear is a picture with vertical lines out of focus and fairly sharp horizontal ones. It should be needless to say that any interference with the fan rotation will be fatal to success.

The camera is loaded and unloaded in daylight. The amount of film needed for any exposure is indicated by a computing scale upon the tripod head. Obviously an exposure with a long-focus lens will take a longer film to cover the same angular measure, and *vice versa.* This computing scale gives us a means of telling how long a film is necessary for a certain exposure, and we can alter the lens to fit the film length at hand or reload with a longer or shorter film if the focal length of the lens cannot be changed on account of restrictions on the view-point. When the camera exposure is made, an automatic counter registers the film used and serves as a check against the computed values. So accurate is this counter, that a film may be partly exposed, removed and another substituted, and then the first one replaced and wound to former count, and the remainder exposed without fear of overlap. In practice, the Cirkut is focused on a distant object, and the rising front adjusted, swinging the camera from side to side so as to include all portions. The rising front has an extreme vertical range. The lens is then stopped down to give depth and to bring the foreground into focus. The extreme left of the picture is located on the ground glass, and the zero of the computing scale, which is a movable strap encircling the tripod head, is matched up to the camera. The camera is then swung to the extreme right, and the film reading noted so that we may stop the rotation when the camera arrives at this point.

The film box, loaded and wound up for use, is now attached to the camera body. We have attached the proper gear to the gear spindle, as indicated by the focusing scale, and by the illumination of the ground glass or by exposure meter we have estimated the necessary exposure. Suppose the stop to be f. 22 and the exposure one fifth second for a plate. For the Cirkut exposure we attach the retarding fan marked $\frac{1}{5}$ to the film box instead of setting the lens shutter at $\frac{1}{5}$, as we would ordinarily do. The shutter is left open and the film slot opened. This last operation takes the place of pulling a plate holder slide in ordinary photography.

The release is operated and the camera revolves. When the end point on the scale is reached, another pressure on the release stops the camera. A button on the back controls a puncher, which shows where the film is to be cut in development. The operations indicated above can be done with considerable speed when one has mastered the details of the camera.

The Cirkut is furnished with a very high tripod. The object of making a panorama is to photograph distance, and there is no need of near foreground. The middle ground of the ordinary photograph takes the place of foreground in a panorama, especially as we work in general with long-focus lenses. By placing the lens high above the ground, we elevate the horizon in our photograph. It is a photographic axiom with the Cirkut that everything on or near the horizon line will be rendered absolutely without distortion, and also that the vanishing point will be upon this line. We can therefore form a few general rules to govern architectural panoramic work, selecting this subject because of its possibilities. There is, of course, no great trouble for any one when making panoramas



Fire Scene — Chester F. Stiles

of landscapes with broken foregrounds, provided objects are kept out of the immediate foreground.

If several buildings in a group of factories are being photographed, we select a view-point which will show side and end of the various buildings. Imagine a line projected on the ground in the direction of the end of one of the buildings. Do this also on the second building. Where they intersect is a point common to both, which will show the sides of the buildings with proper perspective. A slight change in view-point will show ends of buildings in addition to sides. An elevated view-point will further improve results. The same general method will indicate how to handle more complicated problems.

In photographing buildings as above, the main thing to remember is that the horizon is always at the level of the camera lens. Thus if a building is photographed at the level of the second window sills, this line will come horizontal even if the mill is a thousand feet long, and the vanishing point will be on this line horizontally projected. For this reason a high view-point is to be desired and near foreground should be ruthlessly sacrificed by a high position of rising front.

There is a large field open for the panoramic photographer. Long mills and large manufacturing plants present difficulties that the ordinary photographer cannot overcome. The matched picture is not satisfactory to the manufacturer. They are not attractive, and while a lot of care may be bestowed upon such a picture, the patchwork result is yet a bungling makeshift. A manufacturer wants a picture that is right, and will pay well for that which is satisfactory, as evidenced by bills of $200 to $500 which are paid to concerns making bird's-eye sketches for reproduction by the gelatine process. The Cirkut makes it possible to substitute direct photographs, which many people prefer, in place of wash drawings reproduced by heliotype processes, and there is a further economy where small editions only are required.

The use of the camera for photographing large gatherings, such as fairs, or street railway amusement parks, and similar advertising possibilities suggest themselves. Some railroads use numbers of enlargements for display purposes, and the Cirkut appeals strongly to them. Tracts of land for sale and mining properties can be very effectually illustrated by the panoramic photograph.

The use of the Cirkut in accident suits against railroads is an interesting one. The illustration shows the scene of an injury to a boy trespassing on the railroad right of way. The photograph embraces so wide an angle that it also serves as a plan and the argument of the lawyer is not nullified by constant diversions to explain the relation of the photographs to the ground plans. As a matter of fact, only two Cirkuts are usually submitted by the railroad company. One shows the view as the engineer saw the scene of accident and the other the reverse view from the point where the victim was injured. On account of the extreme wide angle covered, the question of trespass and proper fencing of right of way is disposed of without argument.

In making a group the Cirkut has wonderful possibilities and a large group can be handled with the greatest expedition. Considerable time is lost before an exposure can be made in the ordinary methods of group photography. The group has to be compressed, and rearranged so that stragglers on the ends may not be omitted, and in many cases it is necessary to go to the expense of a staging so that all may be seen.

When a big group is made with a wide-angle lens, the back rows are usually poor prospects for sale purposes because they are so small in relation to the front rows. The

Scene of a Railroad Accident — Chester F. Stiles

corners and the ends suffer commercially because the photographer is forced to use a wide-angle lens, and in many cases tries to cover too much angle, with consequent distortion because he cannot afford the proper focus lens. The price of a group lens for 11 x 14 work only, with anastigmatic corrections, is actually more than the price of a Cirkut outfit suitable for group and panoramic work combined.

The Cirkut way is to place the subjects in the arc of a circle of which the camera is the center. The diameter of the circle is governed by the size of the figures desired, and can be determined ahead by focusing on an assistant. If the group is very large, a complete circle can be formed. As no grouping is necessary, the picture can be arranged quickly. The subjects being approximately equidistant from the camera, their relation in size will be far more natural than in wide-angle groups.

The Cirkut is an ideal camera for military organizations. Every man can be shown with military precision. Contrast the usual military group, in which the few men on the end nearest the camera are of huge size and the rest in disappearing perspective to pinhead size. With the cooperation of the company commander, the line of men is bent into an arc, and the officers placed in front, but each looking square at the camera along the line of an imaginary radius. The Cirkut will then show the military effect as seen by the reviewing officer.

Groups of Masons and Odd Fellows pay well in Cirkut groups. The little apron and other insignia show up well, and each person shows as a full length portrait. There are no bad prospects for sale purposes in a Cirkut group.

A curious paradox is the ability of the Cirkut outfits, like the 8-inch size, to make 8 x 10 exposures, although the camera itself is but $6\frac{1}{2}$ x $8\frac{1}{2}$ size. Another anomaly is the use of a long-focus lens to make a wide-angle picture. You simply swing till the camera reels off 10 inches, which on 8-inch film gives an 8 x 10 picture. The greater the swing the wider the angle, and a better wide-angle picture than with wide-angle short-focus lenses, on account of their inevitable violent perspective.

Developing Cirkut exposures demands long trays with a liberal quantity of developer, although films up to 36 inches long may be developed by hand in a 14 x 17 tray by running the film up and down so as to develop evenly. The printing is done on developing paper, using a frame with heavy plate glass, and heavy powerful springs on the several sections of the pressure backs. Heavy paper is used in printing, as it insures the photographer against loss in the developing processes. The prints are usually for framing, so that mounting is unnecessary.

SPLIT shot, sold at the fishing tackle shops, and split corks make the task of washing roll film in lengths very easy. Three or four corks are fastened at intervals along one long edge, and three or four shot along the other. The shot are attached very easily by nipping them with a pair of pliers, or between two coins in the fingers. In this way the entire film can be made to float vertically just below the surface of the water in a bath or pan.

A BAG of two or three thicknesses of flannel tied over the nozzle of the tap is a certain preventive of iron spots on negatives and prints. It is also an excellent splash preventer. The stream from it will fill a bottle without waste, when the direct unchecked stream is too wide and violent.

MISSION FURNITURE CONSTRUCTION

V. — MISSION BOOKCASE

WILL B. HUNT, 2D

In the library proper the most economical and suitable bookcase is of the built-in or the sectional styles, as the latter can be added to and still keep its uniform shape; but in many houses there are not rooms enough to admit of one being devoted entirely to literary use.

This is especially true of apartment houses, which abound wherever the law permits them to be built; and were it not for these apartments many a family would be among the homeless, for boarding is rarely homelike.

So then, for the flat dweller, or the cottager, or the householder in whatever sphere a bookcase which is artistic and of moderate size is always in demand.

The case described in this month's Electrician and Mechanic can be varied in size to fill a certain space, or to suit the individual taste of the builder. This also is true of any of the designs here given; for, be it known, that actual beauty follows no hard-and-fast rules, and while the dimensions are given here for each article, they are all adaptable for different sizes, always, however, with the proper proportions being kept in mind.

This Mission bookcase is, in the first place, sanitary, in that it has no back, — no lurking place for dust behind the books. Those who love books as companions, as comrades, may perhaps be pardoned by their more practical neighbors if they feel that here is a place where a volume may rest and breathe, having light and air on both sides.

The shelves may be placed at unequal distances from each other, to accommodate the different sized books, and perhaps the magazines may be allowed to take possession of the two lower shelves.

This design calls for a drawer, which is not a necessity and may be omitted, the space required for it being used as an extra shelf; but often there is a thin pamphlet, or a clipping, or a reference pad, or a manuscript, which has no special niche, and then the drawer becomes useful as a repository.

The top of the bookcase is broad and flat. On it may be placed a few volumes of special interest or late issue, at close hand. A suitable ornament for this shelf is a stuffed owl, the personification of wisdom.

Above all things, have your bookcase look as if it were part of your daily life, — *use* it, not merely to hold the copies in a set row, as if they were on sale, but as if each one meant something to you, and taking care to select helpful, interesting works, really have them for associates. Change their order on the shelves occasionally, — it will make the piece of furniture look renovated, besides giving you a chance to see your books in a different light. It may be they will bring help, not only to yourself, but to some one who may enter your home.

If you are already equipped with book accommodation, you may have a child — a growing boy or girl — who would have renewed interest in the collection of choice works had he or she a place in which to take pride.

To build this month's model requires 20 running feet of kiln-dried cypress, 18 inches in width.

Saw out the parts according to diagram, gluing boards firmly, if necessary, to obtain proper widths.

Nos. 2 and 3 are the sides, to which the top is to be fastened with plugs of ½-inch doweling. This top has an overhang of 3 inches on front and sides.

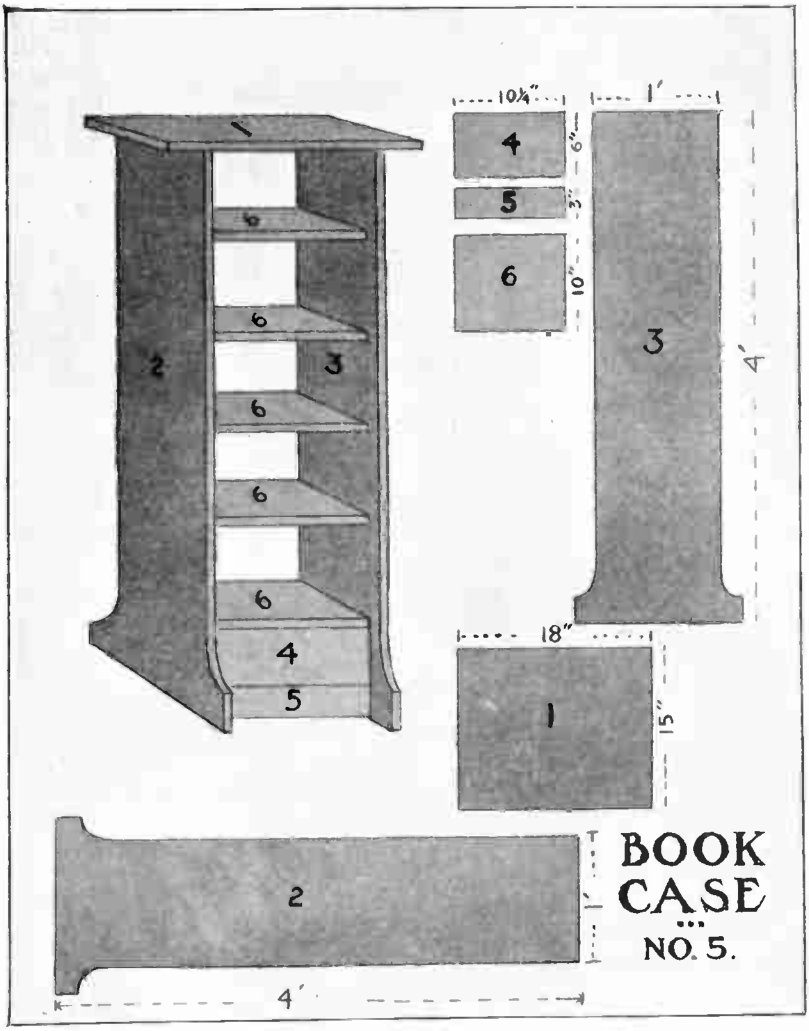
The bottom is also to be fastened to the sides, sizes of bottom No. 6 and shelves (all marked No. 6) are the same.

Glue shelves into place, firmly, at whatever heights desired.

No. 4 is the front of the drawer, which may be made any size to suit spare space remaining between lower shelf and floor of the bookcase. Supply drawer with small brass knobs for handles and use any suitable stain for a finish.

MISSION FURNITURE

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



BOOK CASE
NO. 5.

A DESIGN FOR A SMALL MODEL UNDERTYPE ENGINE

HENRY GREENLY

IX. — The Alternative High-pressure Simple Cylinders

As mentioned in one of the earlier chapters, a reader who intends building this model as a twin-cylinder high-pressure engine instead of a compound has asked that drawings should be included for cylinders arranged in this way. Figures 53, 54, and 55 give the necessary particulars, and all other details may be obtained from the drawings in earlier chapters.

The cylinders are $\frac{5}{8}$ x $1\frac{1}{4}$ inches, placed $1\frac{1}{4}$ inches apart, so that except for main cylinder casting no further patterns will be necessary. The steam chests are identical with the l. p. steam chest of the compound engine, and the pistons may be made from castings supplied for the h. p. side of the original engine. The covers are made 1-16th inch larger in diameter, but most probably castings for the h. p. covers of the compound cylinders will be found to turn up to the enlarged diameter. By increasing the diameter of the covers a better lap is obtained, and the studs can be placed on a slightly larger pitch circle (15-16ths inch instead of 29-32ds inch).

The steam ports should be the same as the h. p. ports of the compound model, viz.: Steam ports, $\frac{3}{8}$ x 3-32ds inch; exhaust port, $\frac{3}{8}$ x 3-16ths inch; port bar, 3-32ds inch wide; and the valves may be made from the h. p. valve drawings (Fig. 19), the cavity being made $\frac{3}{8}$ inch (bare), and the angle of advance of the eccentric increased slightly, so that the engine will work more economically. The length of the valve may be on the full size of $\frac{5}{8}$ inch, rather than be $\frac{5}{8}$ inch bare.

To reduce the number of connecting pipes to the minimum, only one steam pipe is used. This is screwed into the cylinder casting in the left-hand front corner, as in the compound engine, and the two steam chests are connected by a $\frac{1}{8}$-inch horizontal passage, drilled right through the main casting from valve face to valve face. . A channel connecting the ends of this passage with steam chest may be chipped in the valve face, or the walls of steam chests may be cut away in the manner shown in the drawing (Fig. 53), to allow the steam a free passage. The two exhaust pipes should be beat and joined together at their upper extremities, so that they form a breeches or Y pipe. The joint should be made with silver solder, and the upper part — where the two pipes merge into one — screwed for a nozzle which should not be larger than $\frac{1}{8}$ inch diameter. If the pipes fit well, there is no need to make them a permanent fixture in the cylinder casting. They may be prevented from serious leakage by a little red lead. The union for the steam pipe should, of course, be inside the smoke-box.

Of course, the boiler pressure maintained will be lower with an equally well-made compound engine, but it should not fall below 40 pounds, and as a simple high-pressure engine, the model should be found more suitable than the compound for use as a model winding engine, or for any purpose requiring a more even turning movement. The steam should, of course, be superheated, as in the case of the original engine.

X. — Lamp, Tanks, and Pump

Although this chapter is, officially, the conclusion of the series on the construction of the small model undertype engine, a further suggestion may be made at some later date on the subject of installing the plant in a suitable model engine-house. At present we will consider the making of the water tank and pump proposed for the model. Before going into details, however, it may be mentioned that two boards are used for the base of the model. In the first outline drawing (see Fig. 1), the upper one was arranged to represent a masonry plinth, the board underneath being extended to any desired distance in either direction. If, however, it be thought that this raises the engine too high off the "ground," then a single baseboard of any required over-all dimensions may be employed, this being screwed down on the top of another plank, or, better still, on to a jointed frame, the space below being utilized to hold the water tank and pump, as indicated in the general arrangement drawing. Of course, a deeper and longer belt race will have to be made in the baseboard, but where the whole is forming a floor in a proper engine-room, this will not matter in the least. If the engine is simply mounted on a baseboard, and the idea of the proposed engine-room, with three walls, water-tower, engine-room, coal bunker (which may hold the spirit), engine-room clock, dynamo, and

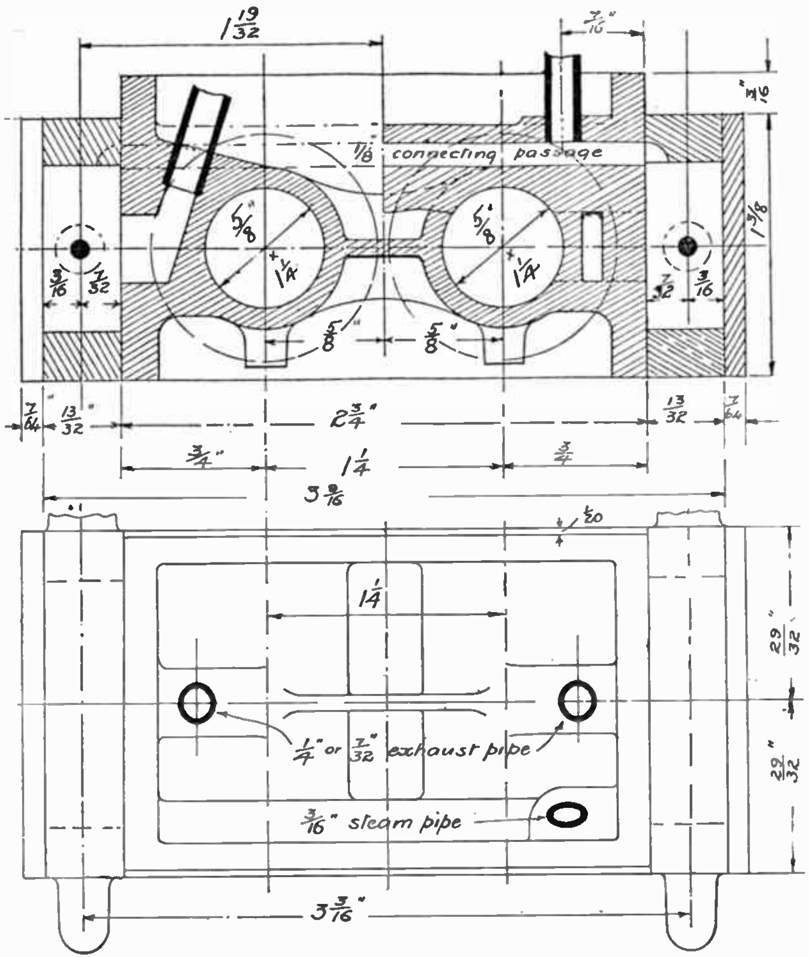


FIG 53.—CROSS-SECTION AND PLAN OF ALTFRNATIVE TWIN HIGH-PRESSURE CYLINDERS FOR SMALL MODEL UNDERTYPE ENGINE.

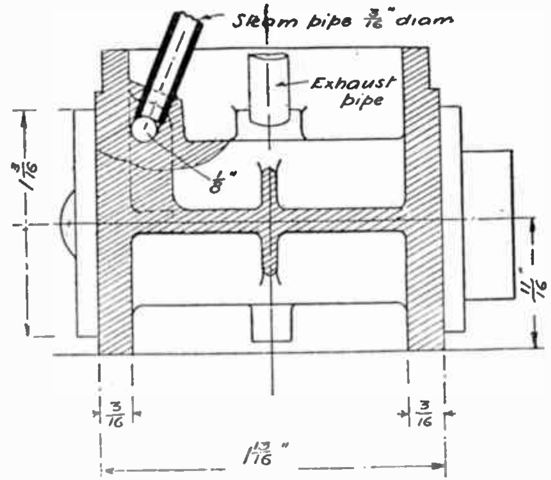


FIG. 54.—LONGITUDINAL SECTION, SHOWING THE CONNECTING LIVE STEAM PASSAGE.

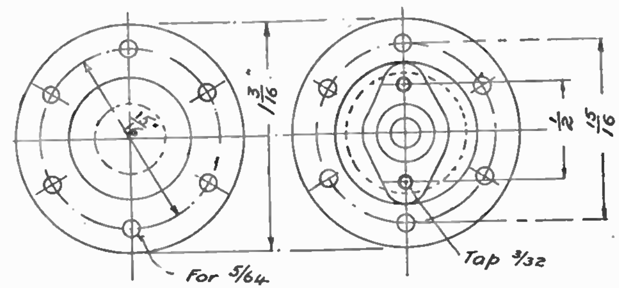


FIG. 55.—COVERS FOR TWIN HIGH-SPEED CYLINDERS.

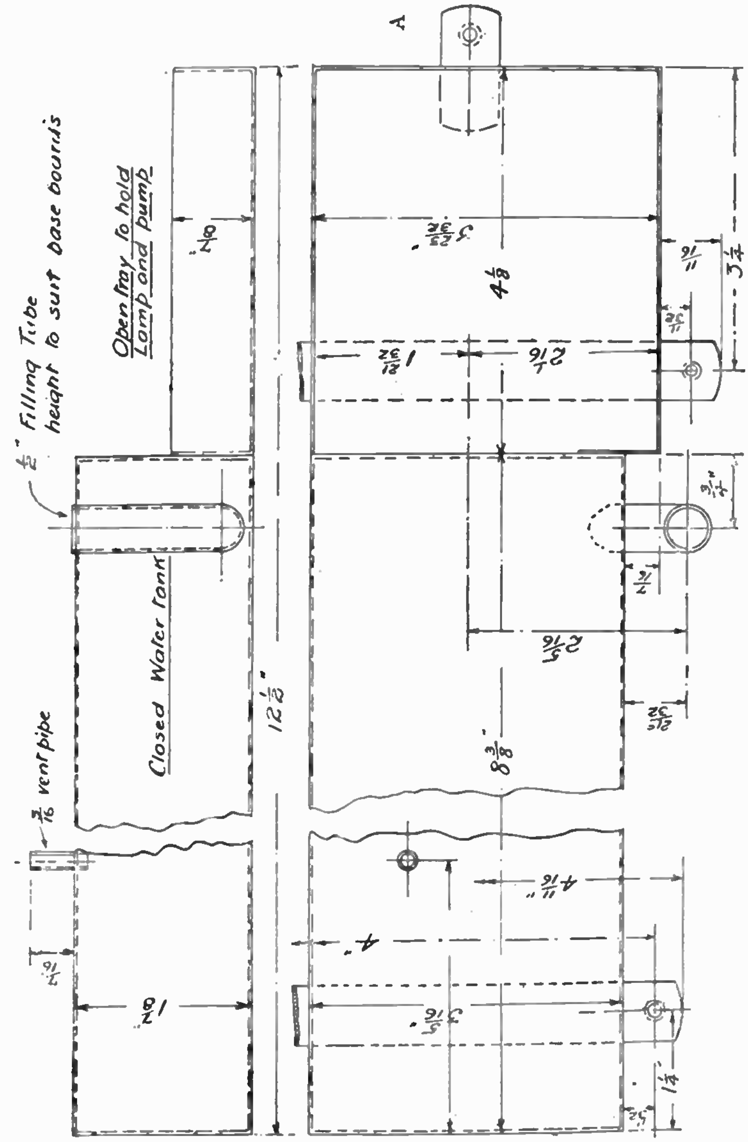


Fig. 56.—Feed-water Tank and Lamp Tray for Small Model Undertype Engine.
(*Half full size.*)

switchboard is vetoed, then the small plinth board, and the sub-baseboard, consisting of a paneled frame, may be adopted with advantage. In any case, however — subject to a better scheme — the spirit supply will be right away from the model and the water tank placed under the bed, as shown in the original drawing.

The feed tanks are shown to a scale of half full size, and comprise a closed water-container and open tray in which the pump and wick-holders of the lamp are placed. This tray is designed to catch the drippings from both, and may have a small overflow pipe (say ⅛ inch diameter) arranged in any convenient corner of it and led away to any convenient receptacle. The work to this is purely a tinman's job, and the writer has to confess no great knowledge of the art of the snips and shears. Hot-plates with square edges, sharp, straight flanges, and a hot soldering iron will, however, result in a clean job if the plates are carefully marked out. The tray, it will be noticed, is wider than the tank, to allow for the pump and the vertical member or side of the tray can be strengthened at the pump corner by allowing an ample amount of lap on the back end of the closed water tank.

The water tank should have a small vent pipe, as shown, and this should be arranged to clear any webs or other projections on the under side of the bed. Then comes the question of a filler. One idea — which is more particularly applicable where the plinth is not used — is shown in Fig. 57, and where it is, the simpler device placed at the front end just under the cylinders (shown in Fig. 58) may be used. The filler in Fig. 57 is made from a piece of ½-inch tube, the elbow-joint, if possible, being silver-soldered. This tube is splayed off at the end of the horizontal member, so that a more firm joint is obtained with the tank. The orifice at the top should be filed off to the proper level, according to the exact thickness of the wooden base, and a stopper fitted to it, as indicated. This stopper is intended to represent a flush grid in the floor, and may be made by turning a flanged cap in the lathe with a sinking in the center. The cap is shown chequered, and has a piece of wire soldered across the sinking to form a hand-

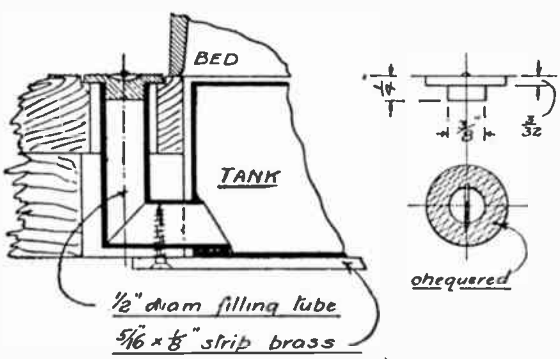


Fig. 57.—Filling Tube and Stopper for Water-tank. (*Half full size.*)

hold. The chequering can be done in one or two ways, and the writer thinks might, in any case, be done before the sinking is turned in the top face. The diagonal lines may be hand-engraved, cut by using the lathe as a planer, or by squeezing the disk of brass out of which the cap or grid will be formed against a coarse file in the vise. The latter procedure will not give diagonal lines, but will be found to produce a very pleasing result.

In addition to the vent pipe, some means of holding the tanks to the baseboard must

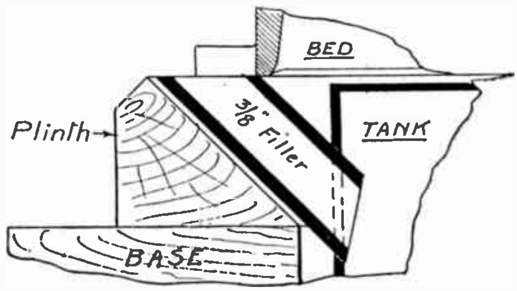


Fig. 58.—Alternative Design for Filler, where Plinth Board is used. (*Half full size.*)

be provided. The drawings show a piece of strip brass soldered on to the under side of the tank and tray, the ends of which project on either side and form lugs through which screws may be driven up into the baseboard. Should there be any tendency for the thrust of the pump to lift the open tray, a small lug, as at A, Fig. 56, may be added at the back.

Submarines made Safer

The danger of sailors being caught in a trap when a submarine sinks will be removed in the future, thanks to Commander Hall and Staff Surgeon Rees, of the British navy. They have devised an apparatus to enable men to escape from a vessel, even if it is filled with water or poisonous gas.

The invention resembles a diving helmet, with a jacket attached. It contains an ingenious oxygen generator, the chief feature of which is that the oxygen may be breathed and rebreathed repeatedly several hours, because the carbonic acid in the respired air is absorbed by a special substance called oxylithe.

The apparatus also has the qualities of a life buoy, and the wearer, when under water, can, by a simple manipulation, rise to the surface rapidly and float until rescued. The apparatus can be hung handily within the submarine boat and can be donned in thirty seconds.

Even in the most poisonous fumes of chlorine gas, which the sea water generates when it comes in contact with the batteries of submarine boats, the wearer can live for an hour and twenty minutes.

A single-phase electric road is about to be built, connecting Baltimore and Washington.

A GOOD BOX FOR DRAWING TOOLS

RALPH F. WINDOES.

ALL draftsmen and students should own a box in which to carry their drawing tools, and store the same when not in use, and the one here illustrated has proven excellent for those purposes. The outside is constructed of oak, walnut, or any other hard wood, and the partitions of most anything, as the box is to be lined. Figure 1 gives a perspective view of the outside of the box as it should appear when finished, with the exception of the brass handle and padlock, these being left out for the sake of clearness.

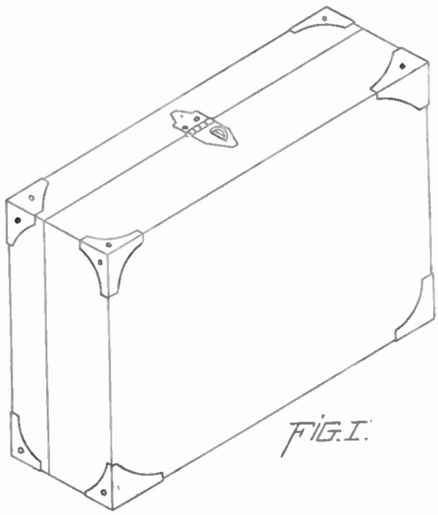


FIG. I.

As to the amount of lumber needed for the outside of the box, a piece 4 feet 6 inches long, 10 inches wide, and ½ inch thick will be sufficient.

Figure 2 gives a plan of the box with the cover removed, to show the location of the partitions. Figure 3 is an end elevation with the cover in place, leaving out all trimmings and hinges. Now we are ready to construct the box.

The best method is to make it solid and saw it in two afterward, thus you get a much better fit on the cover than if the cover was made separate.

Glue all parts together, using no nails, brads, or screws, except on the corners, where, when the box is completed, they will be covered from view by the brass corners. But if you have no furniture clamps in which to hold the piece while the glue is drying, a few small-headed nails, well counter-sunk and puttied, will make no great difference in the finished article.

Now that the body of the box is put together, saw it in two for the cover and put in the partitions. The method given here for the partitions is only a suggestion, the maker arranging these to suit his own convenience. The space for the instruments, lettered A, is for a case whose outside dimensions are 8½ x 4 inches x ¾ inch, but this arrangement can be changed according to the size of your case. The cleats, F and G, are put in ⅝ inch from the bottom, and are made to hold the board, H, on the top of which the instrument. case lies. Below this board a space is left in which

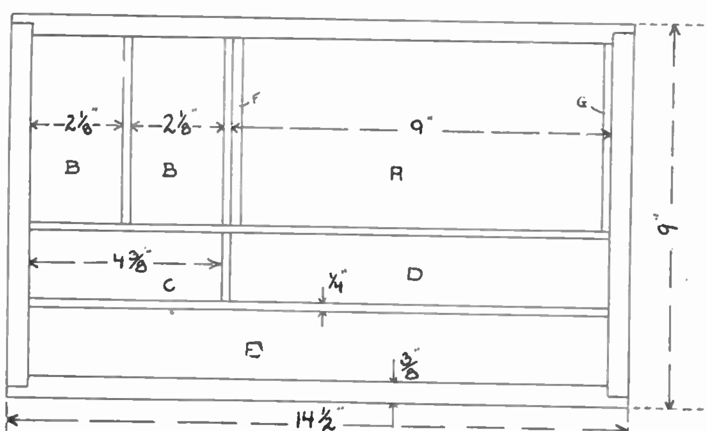


FIG. II.

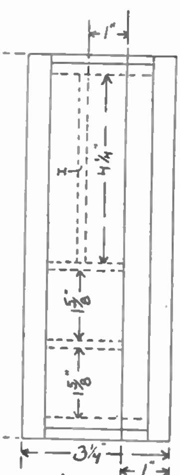


FIG. III.

any special instruments outside of the case may be kept. As to the remaining spaces: B, B are for the reception of bottles of ink; C is for erasers, thumb tacks, etc.; D is for pencils, penholders, and brushes; and E is for scales. On the underside of the cover triangles may be fastened by means of small blocks of wood, screw-hooks, or screw-eyes.

As has been mentioned before, the inside of the box is to be lined. Light green felt is very good for this purpose, as it is soft and is rather easy to glue in place.

Now we are ready to finish the piece. First scrape and sandpaper the box until all rough spots and glue spots have disappeared. Then fill it with some good prepared wood filler, and apply the varnish or wax. Wax is preferable because it will not show scratches or finger marks as readily as will varnish. After the finish is thoroughly dried, put on the brass trimmings. These consist of eight corners, two hinges, one hasp and shackle, one handle, and a small padlock. Attach them, by escutcheon pins, as shown in Fig. 1, putting the handle above the hasp on the main part of the box, and the hinges on the opposite side.

If these instructions are faithfully carried out, you will have a box that will more than repay you for the time and money put into it.

New Microphone Transmitter

A NEW form of microphone transmitter has lately been invented by the Italian engineer, Quintana Majorana, of the government telegraph department. It differs entirely from the ordinary carbon microphone which is in common use, and is based upon the capillary contractions which the sound vibrations are made to produce upon a liquid jet. The principle upon which this action is based was observed by Chichester Belt some twenty years ago. The contractions of the liquid vein rise to corresponding variations in the electrical resistance of the circuit. Using an induction coil, we are able to obtain telephonic currents, which, under favorable conditions, may reach, for sounds whose vibration is five hundred periods per second, an intensity of 100 milliamperes. This is a much more powerful effect than can be produced in the telephone at present. Besides the loud-speaking telephones, we may remark the Bailleux microphones, which are used on the government lines in Italy, and give only a current of 20 or 25 milliamperes, which is among the highest figures. In the new instrument it is claimed that the sound is clear and sharp. The construction is not as simple as a carbon microphone, but there is a great gain in power which will give it the advantage. — *Scientific American.*

The Necessity of Trade Schools

IN a paper read before the Master Painters' Association of Boston, William E. Wall devotes himself to the trade school question. "Fifty years ago it was the rule for a young man to serve his apprenticeship to his chosen calling before he considered himself competent to receive the wages of a craftsman. To-day he wants the wages of a craftsman without serving an apprenticeship, and too often, if willing to serve, is unable to obtain employment as an apprentice, because the average master mechanic has little time to teach him, and wants to secure workmen who have learned the trade in all its branches and can turn out large quantities of finished work.

"It is undoubtedly true that the average master mechanic does not care to be bothered with apprentices, nor does the average boy care to learn a trade, and his parents seldom insist that he shall. Yet without doubt this great country of ours was built up industrially by intelligent mechanics, and the high industrial standard set by them cannot be maintained unless we have some opportunity provided for those who wish to learn a trade, but are prevented from doing so by lack of trade schools. It is time that our municipal, State, and United States authorities should consider this matter, and make provision for instruction in trade schools to the end that the next generation of American mechanics will be larger and better fitted for the tasks to come.

"To train boys and girls in merely literary accomplishments to the total exclusion of industrial, manual, and technical training," says President Roosevelt, "tends to unfit them for industrial work; and in real life most work is industrial."

WE shall begin next month the publication of a series of photographs of amateur wireless stations. They will show how various experimenters connect and arrange their sets, and should prove of great value to all interested in wireless. We solicit photographs of this nature for publication.

Electrician and Mechanic

Incorporating
BUBIER'S POPULAR ELECTRICIAN
Established 1890
AMATEUR WORK
Established 1901

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VOL. XVIII. JUNE, 1908 No. 12

EDITORIALS

WILL the person advertising in our classified column in our May issue, under the initials O. H., kindly communicate with us at once, giving his name and address?

* * *

WE were much interested in looking over the large number of letters sent by our readers in response to our request last month. Our query as to what articles and departments could be added to make our magazine more attractive and serviceable seems to have set all our very large family of readers to thinking hard. We have read each letter over carefully and thoughtfully, and while we cannot show the results of this reading immediately, we will guided by it in our selection of matter.

Our pages would indeed have to be very elastic should we try to get in all the new ideas given us. Some of them, to be sure, are quite impossible, while others are particularly well thought out and practical.

We give below the names of twelve of those sending in the best ideas, and have taken pleasure in entering their names on our subscription list for another year.

RALPH A. BROWN	L. H. LOVETT
PAUL COCHRAN	C. A. PITKIN
CHARLES COLE	JAS. W. PRYOR
PHILIP M. EAMES	B. B. RODMAN
STUART K. HARLOW	GERHARD SELCK
H. D. KRUG	NORMAN R. STEPHENS

* * *

MANY of our readers who are enthusiastic over wireless matters will be pleased to hear that we are to form a club, and all those who are interested or are experimenting along these lines can become members by sending in name and address and stating a desire to be enrolled. A membership card will be issued, giving a membership number, which will entitle the member to all the rights and privileges of the club.

The first hundred names which we receive will be considered charter members.

We believe that this club will put many who are unable to get in close touch with other workers on the right track, so that they may be able not only to receive benefit, but to give it also.

Judging from the interest already shown, we feel confident this will be a very popular organization, and we predict a large enrollment.

* * *

As many of our readers are doing considerable wood work, we are thinking of establishing, for the benefit of all interested, a club or organization devoted to this class of work. Will all those who favor such an undertaking on our part communicate with us regarding same, and give us their opinions.

We might also add that a club for model makers would be in line also, and we should like to hear from them.

* * *

OUR photographic department is crowded out this month by the long article on the Cirkut camera, but will be resumed next month.

A diversity of opinion seems to exist on the subject of our department of photography. Some readers desire more, some readers desire less, and some desire the contest confined to mechanical subjects. Our convictions on this point are very firm. We feel that even though photography, as practiced by the ordinary amateur, may seem to be entirely outside the electrical and mechanical field, that this is not really the case. To every scientific man, to every engineer, photography is or should be an indispensable tool. As a convenient, simple, and truthful method of recording natural phenomena or observations, it has no equal. We feel that every experimenter and every person engaged in mechanical construction of every kind, should own and know how to use with the utmost facility, a camera. He will find it of the greatest value for preserving permanent records of his work. Facility in photography, however, would hardly be obtained if the objects photographed were confined entirely to practical and mechanical subjects. The photographer who possesses a camera in all instances has to go through the same general experience. He photographs the things which interest him, and by photographing these things he learns to become master of his art.

* * *

Our purpose in giving instruction in photography is to enable our readers to become competent photographers, and we cannot quarrel with their selection of subjects in our prize competitions. We shall, however, give a preference to good technical photographs. We are not looking wholly for artistic pictures or pretty subjects, and the basis of judging in our competitions will be strictly technical excellence. This is illustrated in the award of prizes last month, where the first prize was given to an extremely good technical photograph of the interior of a workshop. This, of course, cannot displease our readers who desire mechanical photographs. The other picture reproduced is also a technical photograph, but has no mechanical or electrical significance, although the contributor who has made this excellent animal picture could get a satisfactory photograph as well of an engine, a locomotive, a wrecked building, the progress of some construction, or any other technical subject which might be presented to him. The articles which we shall publish on photography will in no case be artistic, but strictly technical, and will give valuable hints for all owners of a camera, which will help them to increase the value of their work.

* * *

OUR Photographic Department is conducted for the benefit of our readers. If any reader has a photographic question, it will be answered, and pictures will be criticized. A monthly prize of $1 in cash or one year's subscription to ELECTRICIAN AND MECHANIC will be given for the best photograph submitted. The rules are as follows: Any reader may compete and send in as many prints as desired, mounted or unmounted, and made by any process except blue-prints. Prints must be received before the first day of the month to be considered for the number of the following month. Prints will not be returned unless sufficient stamps are enclosed when sent. Prints will be criticized if requested. We prefer prints of mechanical subjects. Prizes will be awarded for photographic excellence and interest of subject.

* * *

DON'T get too busy to think. If a machine goes wrong a "think" or two will generally fix it.

* * *

Beginners with the Gas Engine

No doubt there are thousands and thousands of farmers all over the country who would like to have a convenient power to do the heavy work and drudgery of the farm, but who are afraid they can't run the machine.

They lack confidence in themselves, and are easily discouraged if they make a mistake. The really simple principles of the gas engine look mysterious to them, and they are afraid to try it. After the few easy principles of operation are mastered, the novice wonders why he didn't know it before, and he goes on finding useful work for the machine, relief and pleasure for himself.

One thing should give the beginner much encouragement; there is little danger of serious damage, even in inexperienced hands. Generally if something goes wrong the engine stops, just as a sensible man would do. An exception to this rule is loose connecting rod boxes, but late improved constructions have practically removed this danger. Ninety-nine times in a hundred the beginner with gas power finds that his fears were groundless and wonders why he didn't know it sooner. — *Gas Power.*

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.

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.

622. **Model Boiler.** M. N. S., Luling, Tex., is making a model steam boiler 4 inches in diameter and 10 inches high, material being No. 24 galvanized iron. Fire-box is 5 inches in diameter, and pressure to be carried is 20 pounds. He asks if three ½-inch tubes will be sufficient, and where can small safety-valves and other fittings be obtained? Ans. — We would advise you to make the boiler of a wrought iron "mercury-flask." The dimensions are a little larger than you propose, but the flasks will stand several hundred pounds' pressure. The number of tubes determines the rapidity of producing steam, and as you did not state the size of engine we cannot judge the required capacity Address L. H. Wightman & Co., 130 State Street, Boston.

623. **Armature Winding.** E. S., Menomine, Mich., asks (1) How to wind a drum armature for 16 spaces and 16 commutator segments? (2) What is the output of the dynamo proposed in an accompanying sketch, and how should it be wound for 10 volts? Ans. — (1) In Watson's "How to make a 1 h. p. Dynamo" you will find exactly such a winding described. (2) About ¼ h. p. Use ½ pound of No. 18 wire on armature, and 3 pounds of No. 20 on shunt field.

624. **Rectifier.** C. E. G., St. Johnsbury, Vt., asks (1) Why such a device will change alternating currents to direct, and how he can increase the current output of his home-made model? (2) Where can tin car track be obtained for model railways? Ans. — (1) The theory is very complex, and while a description of the mechanical arrangement was given in Chapter XVIII, of the Engineering series, the theory was not advanced. The properties of the device can at best be stated as belonging with other mysterious natural phenomena like gravitation, production of electricity, etc. (2) The Carlisle & Finch Co., Cincinnati, Ohio.

625. **Arc Lamp Rheostat.** H. S., San Mateo, Cal., asks if iron wire is suitable for this purpose; and if so, what size and length would be proper? Ans. — Yes, provided it is galvanized, so as not to be too readily rusted out. About 500 feet of No. 14 B.W.G. will be needed.

626. **Igniter Dynamo.** J. W. P., Manchester, Va., sends a sketch of a dynamo having a field-magnet of the sort first described in the *Scientific American Supplement*, No. 161, but with a 12-slot armature 2 inches in diameter. He asks what sizes of wire to use. Ans. — For armature use No. 18 wire, four wires wide and four layers deep, — two layers for each half, and connect to a 12-segment commutator. Use 5 pounds of No. 14 wire on field-magnet.

627. **Battery Trouble.** J. S., Pittsburg, Pa., asks (1) Why his Daniell cell so diminished its current after it had been set up a few days? (2) Why does the presence of a tube over the secondary of an induction coil diminish the output? (3) What mathematics are necessary for a good understanding of mechanics and electricity? Ans. — (1) Such cells must not be left on open circuit; even if not used, a current must still be allowed to flow, say through a 50-volt incandescent lamp, else the solutions will mix, and copper will be deposited on the zinc. (2) The presence of a tube anywhere amounts to a single turn of conductor, and the current induced in it somewhat determines the flow of current in the other coil. The ordinary location of tube between primary and secondary coils is fully as wasteful of battery power as any other. The case is really complex, the relative amounts of self-induction and angle of lag of the secondary and the tube being controlling factors. (3) If you mean to include alternating currents, then you must know trigonometry, analytical geometry, and calculus.

628. **Tantalum Lamps.** A. E. N., Britt, Iowa, asks (1) Some questions as to the sizes and prices of such lamps. (2) What are the outside diameters of D. C. C. magnet wire, of sizes Nos. 21, 23, 27, 30, and 36? Ans. — (1) Address the General Electric Co., Schenectady, N. Y. (2) .036, .031, .022, .018, and .011 inch respectively.

629. **Slate.** M. K., Passaic, N. J., asks (1) How is slate marbleized? (2) How to copper plate rolls? Ans. — (1) Such preparation of the slate is for the purpose of rendering it non-absorbent, and of more artistic appearance, and is usually done by japanning the surface and baking on this varnish. The marbleizing or other graining must be done in the ordinary cabinet maker's way. (2) While copper sulphate solution will answer, rather better results are obtained in plating iron or steel by use of the cyanide of potassium solutions. You will find a variety of receipts in various books, but only practice can make perfect in this trade.

630. **Rewinding Motor.** A. L. S., Norwich, Conn., has a ½ h. p. Crocker-Wheeler 500-volt motor; each armature coil has six hundred turns of No. 26 wire. He wishes to rewind it for 110 volts, and asks what size of wire to use, what will be the capacity, and if a resistance coil taken

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Incorporating

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Electrician and Mechanic

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from an old electric car will do for a field rheostat? Ans. — One hundred and twenty turns per coil of No. 16 wire will suffice, but if room allows, put in more turns; the armature should be good for 10 amperes, but you may have to drive it at a speed somewhat higher than the present 1300. If you wish to retain the latter figure, use No. 17 wire, which will of course allow for more turns in the given space, but will reduce the safe current to 8 amperes. You should rewind the field-magnets with wire nine sizes larger than the present. We cannot judge what sort of resistance you have, but should think it probably inappropriate.

631. **Induction Coil Phenomena.** K. W. A., Kansas City, Mo., asks how it is that the secondary of an induction coil can supply an alternating current when the primary is operated by battery currents? Ans.—This is an old ground of discussion, with the different solutions in agreement, as in most cases, when the same facts are viewed. The article in the July, 1907, magazine, on the "Principles of Alternating Currents," can be compared with the portion of the text covering Fig. 4, in the August, 1906, magazine. It is rigidly true that if the lines of force increase within the coil, from any cause whatever, there will be an e. m. f. induced in that coil; also, quite as inevitably, if the lines decrease in number, an e. m. f. will then be induced, but in the opposite direction from the other. Now, if this change in the number of lines be produced, not by a permanent magnet moved in and out, but by the current around an iron core being varied or interrupted, the same results will follow. It is true that at the break of the primary current the secondary e. m. f. is much greater than at the make, — especially if the break is rendered all the more sudden by the action of a condenser. The sparking distance may be made so large that only the higher of the two e. m. f's. sends a current across the gap, but the other direction is not to be ignored. Some good curves of induction coil operation were given by F. W. Springer, in the *Electrical World* for December 14, 1907.

632. **Wire Sizes.** C. F. McC., Hamilton, Ont., asks what numbers in the Brown & Sharpe gauge most nearly match Nos. 18 and 24 in the English standard, now designated as S.W.G.? Ans. — In the latter gauge the decimal diameters are, respectively, .048 and .022 inch; in the B. & S. gauge, No. 16 is .050 inch and No. 23 is .0226 inch, and these are the nearest.

633. **Edison Chemical Meter.** E. S., Clinton, Iowa, asks how to prepare a standard solution for this kind of meter, and how to compute the readings? Ans. — Distilled water and pure zinc sulphate must be used, in the proportion of 3 pounds of sulphate to 15 pounds of water, but the hydrometer test must be carefully applied to insure a specific gravity of 1.11. The zinc plates themselves must be amalgamated with redistilled mercury. This preparation is repeated monthly, and fresh sulphate solution used. To compute the readings, or rather the weighings, reliance is placed upon the physical determination that one ampere-hour will remove 1224 milligrams of zinc from one plate and deposit it on the other. Comparison of weights at beginning and end of month gives the necessary basis of computation. It will be recognized that the bottles are placed in a shunt circuit, so that only about .001 of the total current passes through them.

634. **Lightning.** A. B. T., Annandale, Minn., asks (1) Some questions about the function of lightning rods. (2) What is the theory of a "knife-edge" detector for wireless messages? (3) What is a choking coil? Ans.— (1) On this subject one man knows about as much as another, and after a well-devised theory or piece of apparatus has been devised to fit the assumed conditions, the lightning may play quite erratic pranks. You seem, however, to ignore the fact that the earth may be charged as well as the clouds, and that a bolt is as likely to strike upwards to them as for one to come down. Side discharges may take place between clouds charged with opposite kinds of electricity, but the ordinary discharges are vertical. The presence of points on the rods allows the earth to discharge a stream of electricity into the air so as to equalize matters without an actual rupture. You might find that a candle flame was violently blown by the current of highly charged air from the sharp points. (2) The action of the waves breaks down the film of air separating the knife edges, much the same as in the case of the coherer. (3) A coil of copper wire inserted in a circuit in which the current may be alternating. For electric lighting circuits iron is usually within the coil, but for lightning "choke-coils," the inner space is quite empty.

635. **Deflection Experiment.** W. G. Z., Camden, N. J., asks (1) Why the current from an induction coil will not readily deflect a compass needle? (2) Does a continuous current motor generate a current, if tried as a dynamo? (3) Will a 6-volt 6-ampere dynamo charge storage batteries? Ans. — (1) The current reverses so rapidly that the relatively heavy needle cannot follow the changes; still, the currents are of unequal strengths in the two directions, so the needle does show some preference in its movements. With the primary battery current the deflection will be vigorous, and in a direction quite perpendicular to wire. (2) Yes, for such machines are used interchangeably as generators and motors. Every time a shunt-wound motor is stopped, the principle is illustrated, for with a piece of iron you can prove that the field magnet still retains its strength, and the release magnet on the rheostat still holds its armature for some moments after the main switch is opened. As long as momentum keeps the armature rotating, current is being supplied from it to its field circuit. (3) Yes, two cells.

636. **Miniature Lamp Operation.** J. B., Branford, Conn., asks (1) If 10 or 15 volt lamps can be operated from the ordinary 110-volt circuit without putting them in series? (2) How are transformers made for reducing the pressure? (3) Can a 6-volt 60-ampere-hour storage battery be made to light more than one lamp at a time? Ans. — (1) If you have direct current, the series method of connection is the most practicable; a motor-generator set or various combinations of storage batteries would be the only alternatives. With alternating currents you could use a special transformer, but not so economically as taking the current directly from the mains. (2) See Chapter XVII, of the Engineering series, in the November, 1907,

magazine. (3) Yes, connect the lamps in parallel.

637. **Dynamo Potential.** R. F. A., Carmine, Tex., asks (1) If there is any difference of potential between the terminals of a self-exciting direct current dynamo driven at normal speed, but on open circuit? (2) What is the usual price for 4 x 5 and 5 x 7 mounted photographs? Ans. — (1) By open circuit is ordinarily meant that the field alone is connected, and therefore excited, so the dynamo then still generates its full voltage, ready to supply a current the moment a lamp is connected. If you mean that the shunt field circuit is not connected, there would still be a feeble e. m. f. generated by the residual magnetism of the field. (2) 25 cents each, and 35 to 50 cents each, respectively

638. **Battery Voltage.** R. D. F., Cleveland, Ohio, asks what is the voltage of a gravity battery as compared with that of the Fuller bichromate style, and which is better? Ans. — About 1 volt from the former and 1.8 from the latter. For long telegraph lines the gravity is good enough, but its high internal resistance unfits it for uses where any considerable strength of current is required. You will find the Fuller very good for general experimental work.

639. **Rheostat.** J. B. K., Louisville, Ky., refers to the rheostat described on page 202 of the January, 1907, magazine, and asks (1) if it would be safe to use it on a 110-volt lighting circuit, and what current can it safely carry? (2) Why is it that direct current so drops in voltage, while alternating current does not, though for an equally long transmission? Ans. — (1) Using the length and size of wire stated, the total resistance will be about 48 ohms; and if this is connected directly across the 110-volt supply, without the introduction of any other apparatus, a current of about 2.3 amperes will flow. While the article states that the wire will carry 6 amperes, it should not be kept at so high a figure for more than a moment, else the wire may melt or the wooden frame be set on fire. The safe current for any length of time would be not over 3 amperes. About No. 18 wire would be needed for carrying 6 amperes continuously. It is a good idea to graduate the sizes of wire in a rheostat, beginning with the fine, and through use of increasing sizes provide for the increasing current, as resistance is cut out. Your only criterion will be to observe whether the wires get dangerously hot. (2) For the same conditions alternating current will fall off more in voltage than the direct, — due to the inductance of the circuit, in addition to the ohmic resistance. You are probably comparing quite dissimilar cases.

640. **Latin for an Electrical Engineer.** F.P.R., Gilman, Ill., asks (1) If this is necessary? (2) A "little hustler" motor has a three-prong armature, and it looks as if both ends of the same armature coil were attached to one segment of the commutator. Is this correct? (3) If the current be reversed through a motor, the direction of rotation is not changed. What is the reason? Ans. — (1) English grammar is meaningless without a knowledge of Latin, and Latin prefixes and terminologies are so common in scientific language that an engineer cannot well leave this language out of his course of study. Then again, an engineer should aim for executive positions, in which considerable correspondence, the ability to write and speak with dignity and credit, may be needed. Just because a man aims to be an electrical engineer is no reason why he should be willing to get along with a one-sided education. (2) These ends belong to different coils. (3) This is correct, and the reasons were fully explained in our Engineering series. You must reverse current in either armature or field, not in entire machine.

641. **Lighting Plant.** F. B. H., Inwood, Iowa, proposes to install an isolated lighting plant, using power from a 7 h. p. gasoline engine. He asks (1) Which would be the more economical, 55 or 110 volts, storage batteries being used? (2) Where can fine platinum wire be obtained for making miniature lamps? Ans. — (1) If the length of circuits is not of consequence, you can perhaps use a 55-volt installation, thus requiring only half as many storage cells as for 110 volts. However, the 110-volt apparatus is now so standard, and the other is largely obsolete, that we think the slight extra cost of batteries would be offset by a saving in the rest of the equipment. Smaller line wires could be used, and smaller batteries. You will find a great deal of practical information in Watson's new book on "Storage Batteries." (2) Do not waste time and money on such lamps when those with carbon filaments are cheaper in first cost, require less energy to operate, and will withstand higher temperatures. Address the General Electric Co., Schenectady, N. Y., or any of the other lamp manufacturers.

642. **Gas Igniter.** S. M., Phil., Pa., asks, How is this kind of device made? Ans. — In this construction a dry battery and small jump-spark induction coil are placed in the base or handle, and one of the secondary wires carried through a rubber tube within the brass neck, while the other terminal is the neck itself. A ratchet wheel operated by the thumb or finger suffices to make and break the primary circuit.

643. **Graphite.** R. E. S., Great Barrington, Mass., asks (1) Where he can obtain plates of this substance? (2) Can aluminum be substituted for tin-foil in making a condenser? Ans. — (1) The Dixon Crucible Co., Jersey City, N. J. (2) Yes.

644. **Electrostatic Charges.** H. J. W., Springfield, Ohio, asks (1) What is the cause of the static discharges on a high-tension transmission line? (2) Why cannot three single-phase Y connected transformers be as readily used for general purposes as when delta connected? Ans. — (1) When potentials of 10,000 volts are used, the static effects produced by the dynamo itself become quite comparable with those of many atmospheric disturbances. With still higher voltages, actual sparks of measurable length will be produced, as if from some electrostatic machine. If 50,000 volts produced by friction or induction will produce a spark, why should not similar manifestation be realized from a dynamo of equal electromotive force? (2) Aside from the fact that delta connected transformers allow standard voltages to be used, the breaking down of one transformer does not entirely interrupt the service; for by somewhat reducing the load, the remaining two will continue to supply the current. If Y connected, the removal of one transformer and transferrence of this leg of the circuit to the neutral will

result, as you can see by drawing a diagram, in allowing but one of the three circuits to receive normal voltage. Lamps connected to the other two circuits would show barely red.

645. **Telephone Construction.** A. D., Oriskany Falls, N. Y., asks (1) How is the magnet made for a telephone receiver? (2) Will ferrotype iron do for the diaphragm? (3) What is the function of an induction coil in the telephone set? Ans. — (1) The single pole form of receiver is the easiest to make, and you will get good results by using two strips of flat tool steel, 4½ inches in length, ⅜ inch wide and ⅛ inch thick. Drill a rivet hole in each end before hardening. Provide two pieces of soft round iron about 1½ inches long and ¼ inch in diameter hammered flat for about one half their length, so as to be pinched between the ends of the bar magnets and riveted in place. The spool is to be slipped over one of these protruding ends, the other threaded for two adjusting nuts. (2) Yes. (3) To minimize the line current and economize battery power.

646. **Small Dynamo.** H. R., Parkersburg, Iowa, sends a perspective sketch of a single-coil dynamo or motor he is making and asks if the design and winding are suitable for an output of 35 volts and 6 amperes, or for ¼ h. p. at 3000 rev.? Ans.—It is a pleasure to see such a well-made sketch and withal excellent design. You have, however, underestimated the output, for it will readily supply 10 amperes and 50 volts. When used as a motor, you will need to reverse the connections of the series coil from what is correct for a generator.

647. **Induction Coil.** C. H. B., Chicago, Ill., has made an induction coil using No. 16 wire for primary and No. 31 for secondary. Sparks only 3-32ds inch long can be obtained. What is the reason for this small result? Ans. — Considering the small size of coil and relatively coarse wire on the primary, you have succeeded very well. The only direction in which we could suggest procedure for getting longer sparks would be to use but two layers in the primary, thereby bringing its self-induction to about one half the present value, and using No. 36 wire for secondary. Your present construction is the better of the two for wireless telegraph experiments.

648. **Battery Tanks.** I. H., Cherry Valley, Mass., has found a recipe for making a reliable lining for wooden battery tanks; it consists of twenty to thirty parts of roll sulphur and twenty-four parts of glue or pumice. He asks how these substances should be mixed and applied? Ans. — You must melt them together in some sort of a kettle, care being taken to use no more heat than is absolutely necessary. Apply hot, using a stiff brush. This is a very old device to utilize wood, but at the present time glass jars are made of the proper dimensions, and there is no longer the excuse to use wood, except for the very largest storage cells. These latter are always lined with sheet lead.

649. **Leyden Jar, Condenser.** A. A., New York, N. Y., asks upon what principle these electrical devices work, and for what uses are they adapted? Ans. — Some gain in getting the idea may be obtained by considering what devices produce electrically opposite results. You ought to be familiar with the appearance and perhaps the applications of a reactive coil. At any rate they have been constantly referred to in the engineering articles. Such a coil not only chokes the current so as considerably to lessen it to a value much below that computed by application of Ohm's law, but further delays the phase of the current; in other words, the current is made to lag. The condenser consists of tin-foil sheets separated by glass, mica, or paper, and while acting as a complete blockade to direct currents, apparently passes without difficulty high rates of alternating currents. Further, the currents lead rather than follow the electromotive forces that produced them. In consequence of this opposite peculiarity of the phase, condensers are often used to offset or overcome the undesired effects of unavoidable inductance in a circuit. Physically the explanation is that the condenser stores a force, like a compressed spring, and that at a favorable opportunity exerts enough direct electromotive force to overcome the counter electromotive force of self induction. Condensers are used in common-battery telephone sets, forming selective circuits. The ringing current, being alternating, will act properly, but the condenser is unyielding to the direct current used for the transmitter.

650. **Large Rheostats.** J. N. R., Quebec, Can., asks for various information as to the proper size and lengths of German silver wire suitable for rheostats in connection with the operation of 35, 40, and 50 ampere hand-feed arc lamps on 110 and 220 volt direct and alternating currents. Ans. — You ask for an amount of engineering data that would require a week's services of a competent designer and draftsman. Such large rheostats are on the market, but are the result of considerable experimenting and calculating. In general, wire is not the best form of the resistance, and unless light weight is imperative, German silver is unnecessarily expensive. Thin cast iron zigzag grids are largely used for such currents, notably in resistance units for street cars and for field rheostats of large generators. If lighter weight is desired, use hoop iron. By such shapes you will get relatively large radiating surfaces for passing off the heat. We should think alternating currents for open arc lamps of the size you have in mind would be intolerable in action in consequence of the noise they make. We should have to charge a fee for more explicit directions.

651. **Small Steam Boiler.** M. T., West Unity, Ohio, asks where can such be obtained? Ans. — Address L. H. Wightman & Co., 130 State Street, Boston, Mass.

652. **Electric Disk Heater.** H. D. H., St. Louis, Mo., asks what size of eighteen per cent German silver wire to use for a heater in the form of a disk about 6 inches in diameter? Ans. — The temperature such a device will attain is quite dependent upon what you are heating. With a dish of water, the temperature may readily be quite insufficient, while with small metal articles, such as bookbinders' type, the heat may be near the limit; and with nothing at all on, the resistance wire may melt out. Under such a wide variation of possibilities we cannot assume to give you the exact data you request. We would advise you, however, not

to use German silver at all, — the zinc which it contains rapidly deteriorates under the high temperature, — but try pure nickel, and this in the form of a very thin ribbon, wound like a clock spring, with a somewhat wider strip of asbestos paper or mica in between for insulation. The size and length of strip will have to be found by experiment.

653. **Patents.** F. E. N., Hookstown, Pa., refers to the article on "How Inventions are Conceived," and asks by just what means can a person have protection of his alleged invention during the early years of its development, and before the formal patent is issued? Ans. — This is by means of the document known as a "caveat," definite explanation of which can be obtained by addressing the Patent Office. It was Bell's famous caveat that finally gave him the patent instead of Gray, who had really filed an application for a patent before Bell.

654. **Flash Spark.** E. N., Hartford, Wash., asks of what use is the coil on the igniting device for a gasoline engine, and what size of coil would be needed for a 4½ h. p. engine? Ans. — The battery voltage alone would give an insufficient spark, so the principle is adopted of storing up energy in the magnetic field within the coil, then at the break of the current an additional electromotive force of self-induction largely increases the flash. No larger size of coil is needed for this size of engine than for one of considerably larger or smaller size. A bundle of annealed iron wires ¾ inch in diameter thrust into a wooden spool 8 inches long, and wound with 2 pounds of No. 16 wire ought to suffice.

655. **Telephone Magneto-dynamo.** M. J. B., Kalamazoo, Mich., asks (1) If a telephone magneto can be put to any other useful purpose? (2) Can an "Ajax" motor be used to generate a current? Ans. — (1) You might alter it into an experimental machine as described in the March, 1907, magazine. (2) Unless you are willing to excite the field-magnets from a battery or other dynamo the output will be very small.

656. **Choke Coil.** F. R. C., San Francisco, Cal., asks for some data for computing or making a choke coil to insert between the 50-ampere lamp used for a moving-picture apparatus and the 110-volt alternating current supply. Ans. — With such a large current it is possible that you do not have a difference of potential between the carbons of more than 30 volts. Still, you may have an arc long enough to require 50 volts. If this higher figure is the correct one, you must encounter considerable noise from the arc. To allow desired range of control, we would suggest that you get a 2 kw. transformer, — one that has been burned out, — and remove its wire and rewind it with No. 4 stranded wire, using about three fourths as many turns as you would find in its regular 110-volt secondary. Of course you can also occupy the space previously taken for the primary. Bring out taps from every other turn of the last half of winding, and lead them to contact blocks. Be careful to have the space between the blocks about twice as wide as the end of contact arm, or at the moment of bridging there will be some melting of metal and undesired fire works.

657. **Battery Motor.** J. F., Paterson, N. J., asks where one for 6 volts and of ⅛ h. p. can be obtained, and if four Fuller batteries will operate it? Ans. — The K. & D. machine advertised in our columns will fit the number of cells you propose, and will run well, but not give ⅛ h. p. For that output you would need a larger motor and about twenty cells.

658. **Armature Winding.** J. W. P., Rusk, Tex., asks (1) How to wind an eleven-slot armature for a two-pole field-magnet? (2) What horse-power will a 2 x 2 inch steam-engine give? (3) What sort of boiler will be suitable for such an engine? Ans. — (1) Number the slots in a progressive manner, and with an end left out in slot 1, wind this and slot 5 half full, and leave out a loop between slots 1 and 2; without cutting the wire, continue the winding and occupy one half the space in slots 2 and 6; leave out a second loop, this time between slots 2 and 3; then a third loop and slots 3 and 7; a third loop, and slots 4 and 8; a fourth loop and slots 5 and 9. Since slot 5 already was half full, these turns will now completely fill it. Provide a fifth loop, and wind slots 6 and 10. In regular order successive loops will be obtained, and slots 7 and 11, 8 and 1, 9 and 2, 10 and 3, 11 and 4, will be completed, and the very end of wire is to be twisted to the beginning for the 11th loop. (2) About ⅛ h. p. (3) Use two wrought iron mercury-flasks.

659. **Battery Current.** C. E. R., Jonesboro, Ark., asks (1) How many volts will six bichromate cells give? Will it not be 11.4? (2) Will a steam-engine with cylinder 1½ x 1 inch and 50 pounds pressure give power enough to drive the experimental dynamo described in the March, 1907, magazine? (3) Where can parts of model engines be obtained? Ans. — (1) About that number, but only in case you are taking no current; as soon as you do draw current, some of the voltage — and usually a very considerable part — is wasted in overcoming the internal resistance of the cells themselves. (2) Yes, but you must observe that the bearings of this machine are not designed for continuous use. You ought to have those of the ample and self-oiling type. (3) From Wightman & Co., 130 State Street, Boston, Mass., or Parsell & Weed, 129 W. 31st Street, New York.

660. **Varnish, Shellac.** G. S., Sioux City, Iowa, asks (1) How such varnish can be thinned? (2) Where can experimental telephone apparatus be obtained? (3) Where porous cups? Ans. — (1) Use alcohol. This sort of varnish is made by dissolving the flakes of dry shellac in alcohol. Grain alcohol should first be used, but the solution can be diluted with the denatured sort. (2) The Ohio Electric Works, Cleveland, Ohio. (3) The same company, or from almost any general hardware dealer.

661. **Induction Coil.** N. V., Rockland, Mass., has made one, using four layers of No. 18 wire and 2 pounds of No. 30. He gets sparks only 1-16th inch long, and asks what is likely to be the trouble? Ans. — We think it is all right. Had you used two layers of No. 16 and 2 pounds of No. 36, and attached a condenser, you might have obtained considerably longer sparks. Why do you want longer ones?

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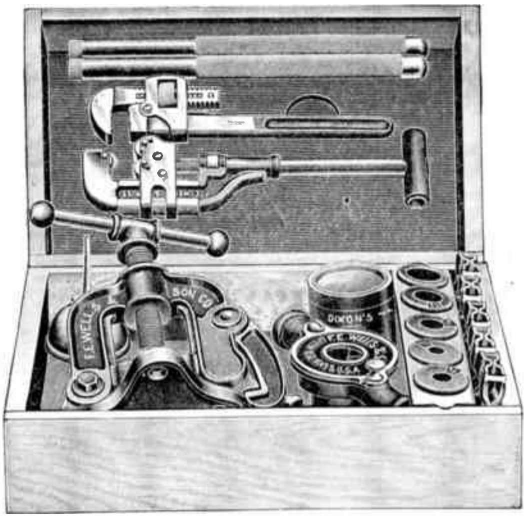

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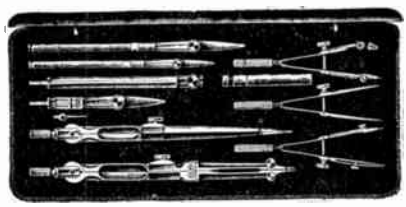

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