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ELECTRICIAN AND MECHANIC

INCORPORATING AMATEUR WORK

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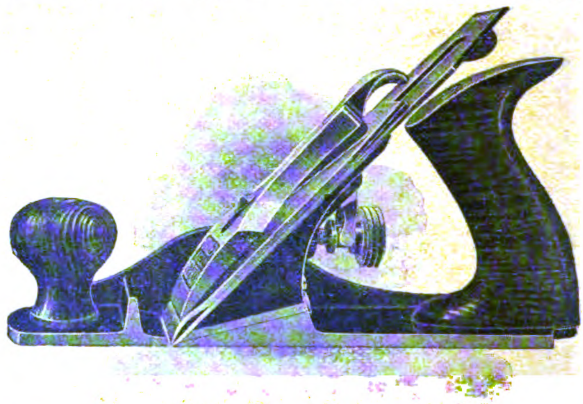

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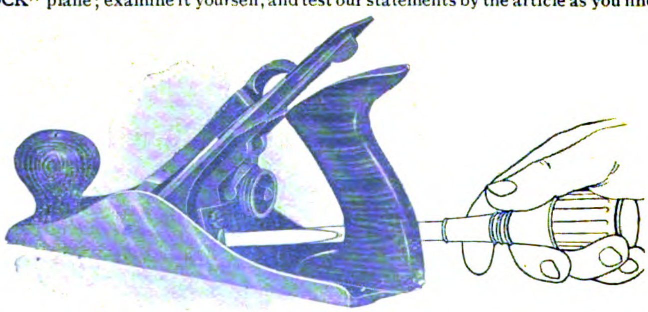

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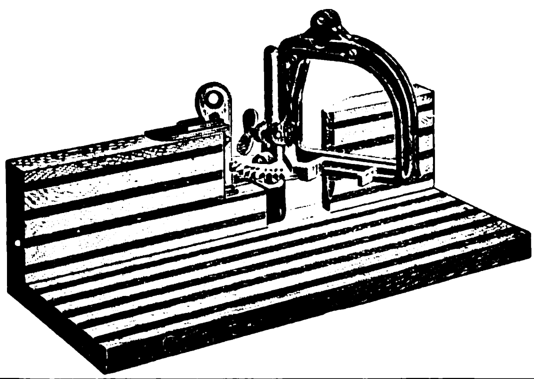

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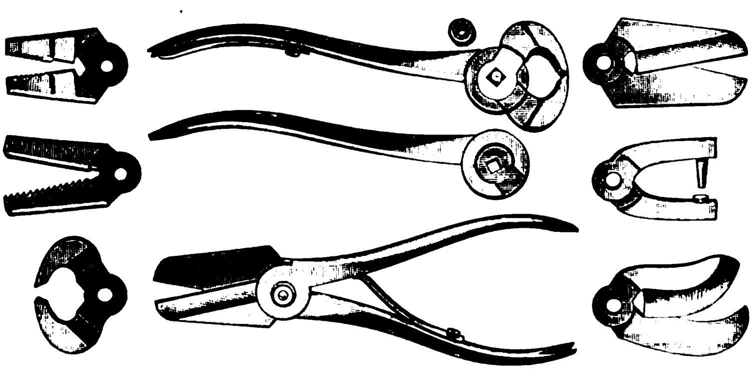

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Mr. Parker on November 1st, 1903, after having been a member of the Examining Corps of the U. S. Patent Office for over five years, resigned his position as Examiner to take up the practice of patent law.

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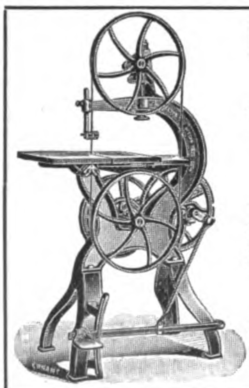

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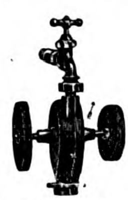

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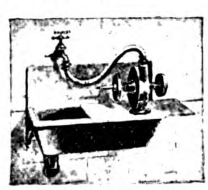

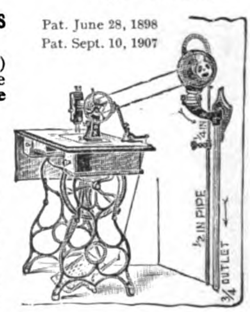

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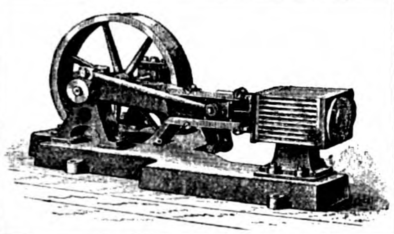

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The Earning Power of Money Invested in Kornit

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

THE STORY OF KORNIT

By President CHARLES E. ELLIS

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

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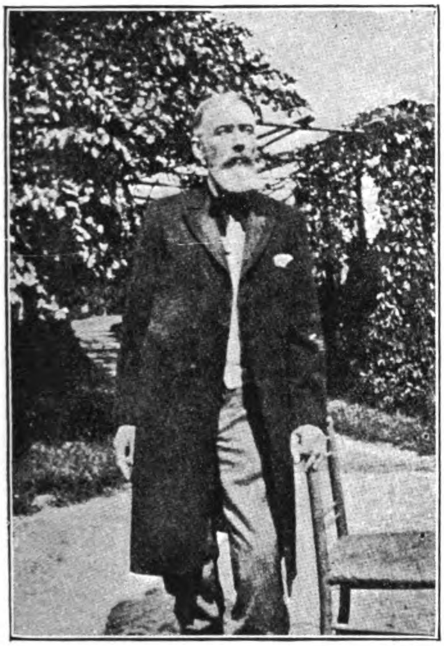
on account of its price. For electrical panel boards, switchboards, fuse boxes, cutouts, etc., there are other materials used, such as vulcanized paper fibre, slate, marble, etc. A piece of vulcanized paper fibre, 3x4x1 inch, in lots of 1,000 brings 20 cents per piece. A piece of KORNIT of the SAME DIMENSIONS could be sold with the ENORMOUS PROFIT OF OVER 100 PER CENT. at ten cents. The absorptive qualities of Kornit render it such that IT IS FAR PREFERABLE to that of vulcanized fibre. It will not maintain a flame. Of all the materials which are now in the electrical market for supplies and insulators there is, as we have stated above, none that are satisfactory. Kornit will fill this place. Its tensile



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

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

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

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

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

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

The Great Demand for Kornit in this Country

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

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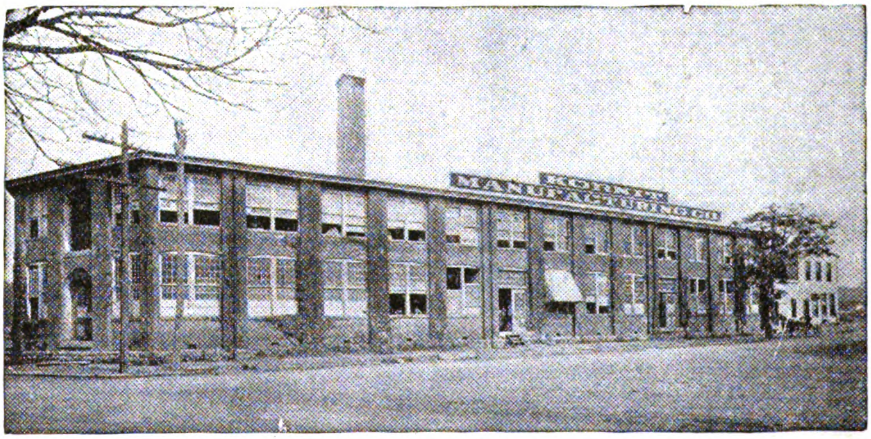
KORNIT ONLY FOR THIS PURPOSE, after having tried all other so-called non-conducting compositions. The electrical trades alone can consume a great many tons of Kornit every day in the year. If only two tons of Kornit is manufactured and sold every working day in the year IT WILL ENABLE THE KORNIT MANUFACTURING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

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

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



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We are Building A Fine Factory

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

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

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

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

My Offer to You To-day

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

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

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

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

Yours very truly,

CHARLES E. ELLIS

President

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ELECTRICAL ENGINEERING—Chapter XIX.

Measuring Instruments For Direct Currents

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

Oersted's discovery, in 1819, that a current of electricity would deflect a compass needle, was at once recognized as offering a means of comparing or actually measuring the strength of the current. Evidence of the activity of scientists in trying to find the law of the current flow is recorded in the writings of that period, and by the actual finding of the law by Ohm, and its publication in 1826.

For 50 years from that time, the "galvanometers" built on Oersted's principle were the only kind, and took on many forms, as can readily be seen by reference to almost any book on physics. For detecting the presence of a current, without any attempt to measure its exact strength, the needle was about the size employed for coarse sewing, and was suspended by means of a few parallel silk fibres so as to swing over or within a coil of many turns of fine wire. Still higher sensitiveness was secured by employing a pair of needles, the north pole of one directly over the south pole of the other; one needle was within the coil, the other above it. By this device, the directive effect of the earth's magnetism was nearly counteracted, and the needle was quite ready to be deflected by indefinitely small currents. Entire independence of the earth's magnetism is impossible, for the reason that no two magnets can be made exactly alike; further, such independence is undesirable, or the needle would have no particular position of rest. When thus nearly neutral in position, the combination is said to be "astatic," or with a Latin rather than a Greek prefix, "non-static."

With such arrangements, the most sensitve sort of instruments can be made, and practically typified by these designed by Lord Kelvin, then Sir Wm. Thomson, for the Atlantic telegraph cables. With the feeble currents alone permissible, direct observation of the needle was impossible, and recourse was had to the movement of a spot of light as reflected from a tiny mirror attached to the needle. In fact, the method of construction was to use a mirror only about three-eighths of an inch in diameter, and to stick the little magnets on the back.

For most purposes such galvanometers are altogether too sensitive, and are so disturbed by the jarring of their mountings or by too strong currents as to have few practical applications. One less delicate form, consisting of but few turns, or often of only one turn, of large wire, with a short and stocky magnet suspended in the centre, is of very great practical value. It is called the "tangent" galvanometer, and until the present constructions of portable instruments were devised, it offered almost the only means of measuring currents of considerable magnitude and in readily computed units. In fact, the present current measurers, or ampere meters, or "ammeters," as they are called for short, depend, for

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their ultimate calibration, upon reference to an instrument of this sort.

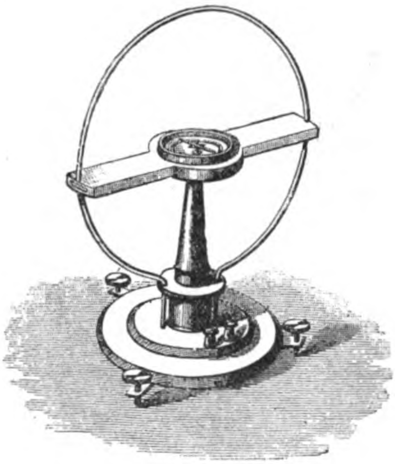

FIG. 9
Simple Tangent Galvanometer

A simple model of the tangent galvanometer is given in Figure 91. A single loop of copper wire has its terminals brought out to binding posts, and in the centre is a short magnetized needle, provided with longer pointers and a scale divided into degrees. Some improvements could be made by letting the coil more nearly complete its circle, and by suspending the needle by a silk fibre from the upper portion of loop. Long and almost weightless pointers can be provided, in a home-made instrument, by use of straws. When current flows in the loop, lines of magnetic force are established in the region of the wire, in curves of increasing radius, but as the centre is approached, the lines act nearly perpendicular to the plane of the coil. If the needle is short, it will be acted upon by these central lines, and the law of the tangent be approximately realized.

To use the instrument, the coil is moved so that the plane coincides with the direction of the needle—not necessarily with that of the pointer. The needle then points directly at the loop. Care must be taken to have no other magnetic fields present, and for extreme accuracy the instrument should be in some structure quite apart from others, and free from iron pipes or beams, The force of the current that would then deflect the needle will depend upon (a) the length of the wire, (b) the distance from the needle, and (c) the strength of the earth's magnetic field at that place. For a single turn of wire, the first quantity will be $2\pi r$ where r is the radius of the coil, in centimeters, (1″=2.54 c. m.) or for n turns, $2\pi nr$; the second will be r, with the force falling off as the square of this distance, and the third denoted as "H," can be determined from magnetic charts, or from enquiry of the government geological survey. For Providence, R. I., and vicinity, the value is about .179, that is, there is a horizontal force of the earth's magnetism amounting to .179 of a dyne. Since the force of gravity acting on a gram, called its weight, is 981 dynes, and a gram is only about one-thirtieth of an ounce, it is seen that the magnetic force is very small. In "absolute" units (ten times as large as the ampere) the equation becomes,

$$\text{Current} = \frac{r}{2\pi n} H \tan a.$$

By this it is seen that the means are provided for making an ammeter, by merely measuring the coil itself and observing an angle of deflection. Reference to a table of tangents is necessary, and a simple multiplication; but if not too great deflections are caused, a reasonable degree of accuracy is possible. Forty-five degrees would be a safe limit, and since the tangent of this angle is 1, the interpretation is very simple.

A numerical example might not be inappropriate. Suppose a coil had a single turn, 10″ in diameter; (for this case the needle should not be over ¾″ long). In centimeters the radius would then be 12.7; $2\pi = 6.28$, and the division indicated will give a quotient of 2.02; multiplying by .179 then gives .361; if a deflection of 45° is produced, the current flowing will then be .361 absolute units, or 3.61 amperes. Any other deflection, say one of 19°, will represent a less current in the relation the tangent of 19° bears to that of 45°: tangent of 45°=.34, and .34×3.61 =1.23 amperes. A tangent galvanomeeter can thus be used to determine a sufficient number of the principal graduations of some commercial or portable ammeter, or at any time to check the divisions of such an indicator.

It is proper to admit that a high degree of accuracy with a tangent galvanometer

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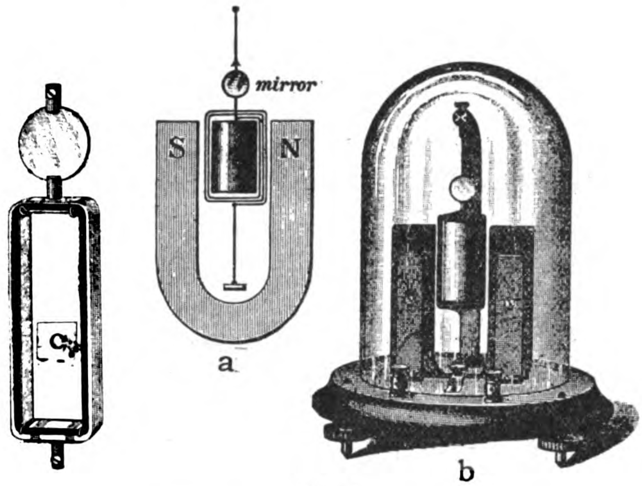

FIG. 92
D'Arsonval Suspended-Coil Type of Galvanometer

involves many tedious corrections in the estimate of the dimensions, the distortion of the earth's field due to the presence of the magnetized needle, and in the errors of observation of the deflections, and consequently in a well equipped laboratory other methods would be preferred; but the instrument just described was the first one for the purpose, and for many years was the only available one. It still has value for its simplicity and cheapness. Amateurs and students would find great educational advantage in making and using one.

In consequence of the serious limitations of the suspended needle type of instrument, principally by interference from exterior magnetic fields and instability of its pointer, another form has been devised that in a high degree fills the conditions of a perfect instrument. This was invented by D'Arsonval, and consists essentially in reversing the arrangement of the earlier types; for instead of suspending the magnet and letting the coil be the stationary member, he made the coil very light, and connected it by delicate conducting wires, while the magnet was strong and of horse-shoe shape, fixed rigidly to the base. Entire independence of the earth's field was therefore obtained, and the movable coil was situated in such a relatively intense artificial field, that even minute currents would produce sufficient force as to twist the suspending wires, and produce readily observed deflections. Figure 92 at *a* shows the scheme. In actual dimensions the straight portions of the magnets are about 4″ long, with the poles 1½″ apart. A cylindrical chunk of soft iron, 1⅛″ in diameter and 1¾″ long, is rigidly attached to a post, and nearly fills the interpolar space, thereby improving the magnetic path. The little coil is wound of several hundred or thousand turns of No. 36 or finer wire, in a belt about ½″ wide and 1/16″ thick, and of such a size as to give internal and external clearances. After winding, the coil is bound with thread, and filled with shellac, so as really to be quite stiff, without any additional support. The terminals of the winding are attached to pieces of sheet metal pinched onto the coil, and thus provide substantial means for soldering the fine flat suspending and supporting wires, of silver or phosphor-bronze. Some little tension is put upon these wires, whereby the coil is kept from swaying and hitting the poles of the magnet. These two wires represent the terminals of the circuit, and are to be connected to the source of the current. The construction is very delicate, and the coil wiil move its entire limit with an exceedingly small current. Figure 92 at *b* shows the complete form, as commonly found in laboratory equipments. Such delicacy has been attained in the making of them for submarine telegraph lines, as not only to detect the currents, but to operate recording receivers. Any skilful amateur could readily make one quite serviceable for a large variety

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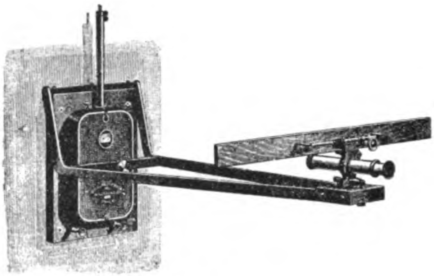

FIG. 93
Wall Form of D'Arsonval Galvanometer, fitted with Mirror and Telescope and Scale

of experimental or commercial purposes. In a laboratory great preference is shown for small angular deflections, and with suitable devices for observation, the readings are then rather more accurate than with simple direct means of looking at a pointer. This is accomplished by mounting a little mirror on the coil, as shown in Figure 92, and observing the image of a scale in a short vision telescope. Figure 93 represents a self-contained form of the D'Arsonval galvanometer, adapted for mounting on a wall, and fitted with such accessories. The scales are usually 50 centimeters in length, and have the centimeter graduations on cardboard or celluloid on the inner face of the wooden strip; light from the windows, or from a specially located lamp, illuminates this scale, and certain figures reflected from the mirror can be seen in the telescope. In consequence of the angle of incidence equalling the angle of reflection, the apparent movement of the figures on the scale, produced by movement of the mirror, is double the actual movement. By dividing the deflection on the scale by the distance of the scale from the mirror, the tangent of twice the real angle is found.

Such instruments are much sooner brought to rest than those having a suspended needle, and the zero point on the scale is readily maintained. Movements that are quite "dead-beat," that is, free from all oscillations, can readily be secured by the addition of "dampers" of sheet copper placed inside or outside the coils; these, being locally closed circuits, will allow, as soon as motion takes place, for the production of induced short-circuit currents, and to maintain their flow energy must be supplied; and as the only source of energy, after the first swing, comes from the inertia of the parts, the motion quickly ceases. In Figure 92 at *c* a coil is shown on a larger scale, equipped with both internal and external dampers. It is the construction used for the galvanometer represented in Figure 93. With such simple provisions, entirely free from mechanical friction, the act of sending a suitable current through the fine wire starts the coil moving with a moderate velocity, but diminishing as the goal is reached, and then without swinging by it gracefully comes to rest at the right place, and at the opening of the circuit, the coil returns to its normal position with a freedom from pendular vibrations as if an actual stop was struck.

With instruments thus responsive to meagre currents, the next thing is so to arrange the apparatus as to measure actual electromotive forces and currents of indefinitely large magnitudes.

A voltmeter is an instrument that measures a current, to be sure, but a small one, and that proportional to the pressure. If the pressure is high it is certain that to connect the galvanometer directly, would mean its instant destruction, therefore the simple expedient is adopted of winding a large external resistance and connecting it in series with the fine wire coil. The greater the electromotive force to be measured, the greater must be this resistance, and the particular value for each instrument must be determined experimentally. The same instrument can be provided with several such resistance coils, and allow for use in measuring quite a range of pressures. Each resistance would mean that the galvanometer reading should be multiplied by a certain number, and the result be a certain number of volts.

An ammeter indicates the full strength of the current, but plainly, the current passable by the fine wire of the little coil is almost infinitessimal, therefore the greater portion must be taken through a suitably low resistance by-pass, or shunt. The case is like that of a river, with a small canal connecting two points quite close together; through the canal there would flow a current proportional to the main current in the river. The electrical case may at first afford grounds for suspicion that the device is not reliable, but entire dependence must be placed upon its accuracy. Divided currents follow

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the rigid law of flowing in paths in measure inversely proportional to the respective resistances. Therefore, however large the current, or however delicate the galvanometer, the measurement can always be made by providing a shunt of low enough resistance and large enough current carrying capacity. Of course accuracy of measurement is dependent upon the shunt keeping a fixed resistance, so that even if heated by the current, it will still take its due proportion. Ordinary metals increase their resistance about .4 of 1% for every degree centigrade rise of temperature, hence recourse has been taken to alloys that are less affected in this particular. German silver was once the favorite material, but experience has proved that this mixture suffers deterioration and change of resistance. Different manufacturers have developed special mixtures, with attempts to keep the composition secret, but chemical analysis always reveals the facts, though not the particular methods of mixing. It seems that zinc is the disturbing element in ordinary alloys, and the best behaving resistances are those made without it. Silver, platinum, manganese and tungsten are to be found in some of the more recent products of the instrument makers.

The description of the laboratory form of D'Arsonval galvanometer, and the principle of the high series resistance for the voltmeter and the low resistance shunt for the ammeter has been carried to an apparently undue length, but only to prepare the way for the highly convenient and practical forms adopted or invented by Weston. Soon after the above form was devised, Weston perceived that it offered the best means of providing portable and station-switchboard instruments. It is hard now to realize the dearth of satisfactory and accurate instruments for following the operation of dynamos until this inventor supplied the lack. Weston was the designing engineer for the United States Electric Lighting Co.,—with a factory in Newark, N.J., — since purchased and largely developed by the Westinghouse Co.,—but he withdrew from that field and devoted himself entirely to the making of this particular type of instruments. Such success attended his efforts, that in spite of their high price, the voltmeters and ammeters from his works were everywhere in demand, and were adopted as standards of measurement.

Weston put the permanent magnet in a horizontal position, fitted its ends with poles, resembling those on a dynamo, attached pivots to the coils, and supported them in jewelled bearings. Aside from the fact that jewels are in themselves insulators, the loose contact of pivots would be intolerable for electrical contacts, hence provision for getting current into and out of the coil had to be found in some other way. This Weston did by fitting each of the pivots with hair springs, and it was the double function of these springs to provide the electric path and the mechanical resilience that constituted the gist of the patent. Though continually contested in the courts, the decisions were finally in Weston's favor, but the patent expired in 1905.

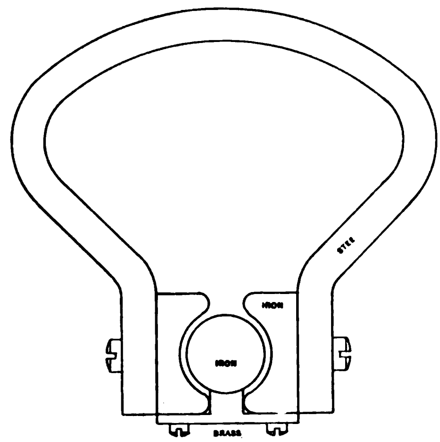

FIG. 94
Permanent Magnet for Weston Form of Voltmeters and Ammeters

A view of the particular shape of the magnet employed by Weston is given in Figure 94. The crevasse in which the little coil moves is only about one-sixteenth of an inch wide, and in such a short air gap, the field of force is so uniform that deflections are directly proportional to the current flowing, therefore giving direct readings on the scale without recourse to tangents or any other functions of angles. The section of the steel is about $\frac{3}{8}''$ x $1\frac{1}{8}''$, and the polar space about $1\frac{1}{8}''$ in diameter and in axial length. In keeping with the principle that long magnets are stronger and

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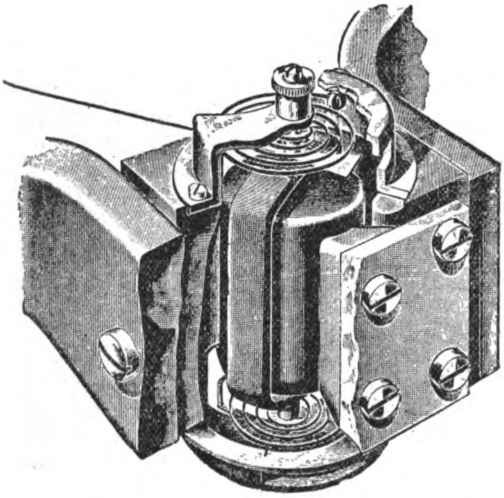

FIG. 95
Moving System of Voltmeters and Ammeters

more permanent than short ones, the shape is purposely spread out, rather than in the simple U form. The short air gap is also conducive to permanency. In order that the instruments preserve their accuracy for a long series of years, it has been found necessary to "age" the magnets by artificial means, and this process is by no means the least important item of the manufacture.

Very old magnets have been found to possess a high degree of permanency. It is certain that there is some connection between magnetism and molecular rigidity, for hardness of the steel is a prime condition of the retention of any magnetism. The tempering of steel tools, after the process of hardening, somewhat relieves the extreme rigidity, and this tempering is done by a moderate heating. Similarly, heating a magnet removes some of its strength, but singularly, the part is left more permanent. By climatic changes, old magnets have been heated and cooled many times, and by the gradual relief of unstable conditions, the part of the magnetism remaining has reached a definite permanency. To imitate these conditions in a short time, the hardened magnets are by some makers plunged first into boiling water then into cold every half minute for a day or two, others merely keep them in boiling water for a day. In either case the result is supposed to give a hundred year-old magnet "while you wait." Curiously, a quicker and apparently as effective a method of artificially ageing a magnet is accomplished by straddling it over a rapidly rotating copper disc. The magnet induces eddy currents in the disc, and these in turn react upon the magnet and by their demagnetizing force remove the unstable elements.

Particular qualities of steel have been found of value, the presence of tungsten being beneficial, while manganese is highly detrimental to permanency of magnetism.

To give stiffness to the movable coil and allow for the damping action of a closed circuit, and yet introduce the minimum weight, Weston made the rectangular frames of aluminium, all in one piece, with edges slightly turned up, thus giving a sort of channel section, and providing for retaining the wire in a substantial manner. For the voltmeters, two or three layers of No. 40 wire were wound on, while for the ammeters a single layer of somewhat larger size was found more convenient. The pivots had rectangular bases, and were stuck directly to the insulated wire by a very adhesive varnish. In consequence of the magnetic pull, steel hair springs would be out of place, hence those of phosphor bronze, such as are employed in non-magnetic watches, are substituted. A view of the coil and hair springs as located in place between the poles of the magnet is given in Figure 95. A pointer made of aluminium tubing only $1/32''$ in outside diameter is attached to the upper pivot, and the outer end flattened, or fitted with a suitable indicator, and moves over the scale.

The sensitiveness of these instruments quite approaches that of the laboratory pattern, and inside the case of the voltmeters about 100 ohms additional resist-

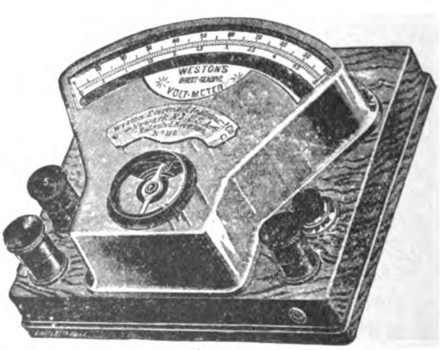

FIG. 96
Weston Voltmeter with Double Scale

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ance for every volt to be measured is inserted. For instance, one reading to 15 volts has a total resistance of about 1,500 ohms, and for 150 volts 15,000 ohms. Two separate resistances are often comprised in the same instrument, with their respective binding posts, and thus make several instruments in one. For laboratory measurements this double scale range is of great convenience and economy. A voltmeter with scales of 0-5 and 0-100 is given in Figure 96; the corner binding posts belong to the higher values, while the extra post on the left is used instead of the one on the corner when the 5-volt scale is desired. Such an instrument is

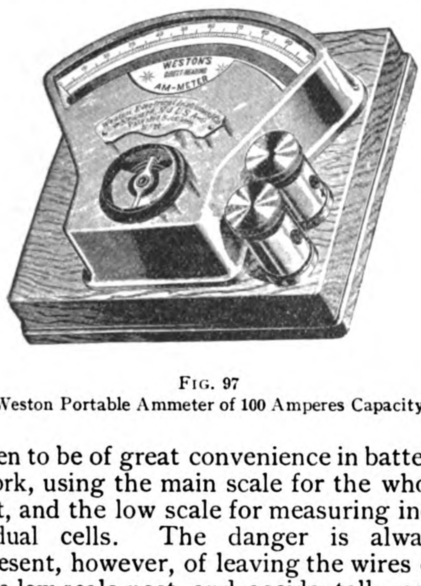

FIG. 97
Weston Portable Ammeter of 100 Amperes Capacity

seen to be of great convenience in battery work, using the main scale for the whole set, and the low scale for measuring individual cells. The danger is always present, however, of leaving the wires on the low-scale post, and accidentally connecting with the full voltage source. In such cases the pointer is usually bent out of shape, and the coil melted.

It will be noticed that the right hand post is marked +; this definite polarity of permanent-magnet type of instrument is one of its most valuable properties, for without its aid the determination of the right connection between different dynamos or storage batteries would be precarious or even dangerous. If the negative pole is attached to the right hand side, the pointer simply tries to go the wrong way. A push button is seen also at the right. By this device, the circuit is closed when desired, for taking a reading, but normally it is left open so as not unnecessarily to heat the resistance coil. The switchboard instruments, however, are supposed to be permanently connected, and the resistance coils are of large enough wire, and sufficiently well ventilated to ensure no danger of errors in readings or of burning out of the wire.

The laboratory style of ammeter has two large binding posts, and in consequence of the stiffness of the wires likely to be used, convenience in removing or connecting, or changing instruments of different scales, is attained by having both posts on the same side, the positive one, by which the current must enter in order to move the needle forward, being still, on the right hand. Up to 100 amperes capacity the low resistance shunts are usually located within the case, but those for larger currents, especially of the switchboard type, have the shunts separate. In use, it is not necessary that these be close to the other part of the instrument, and this opportunity for separate locations is very convenient; for the large bars that conduct the main currents are usually located at the lower part of panels, while the indicating part of ammeters, along with the voltmeters, is desired at the top. The shunts, consisting of thin sheets of the proper alloy soldered into massive blocks of copper, are bolted across an opening in one bar, and ordinary lamp cord led from the two ends up to the little movable coil within the instrument case.

Figure 97 shows a self-contained ammeter of Weston make, of 100 amperes capacity. In both this cut and in Figure 96, there is seen through the watchglass the means of adjusting the pointer to the zero mark; one end of the insulated lever is attached to the hair spring, the other to the circuit. A similar device is at the other pivot, and access to both is obtained by removing the back-board and then the cover.

As evidence of the small amount of energy necessary to operate an ammeter of this type, it may be stated that a thirtieth of a volt only is needed to drive the pointer entirely across the scale.

While the Weston type of direct current instruments is freely recognized as combining all possible good features, to the point of practical perfection, other forms have been made, many of them cheaper, and capable of filling many needs. That by Ayrton and Perry was once largely used, and previous to the pro-

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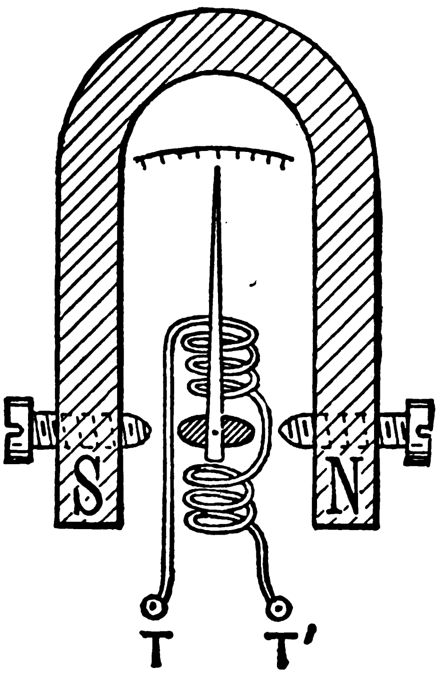

FIG. 98
Ayrton & Perry Ammeter with Fixed Coil and Movable Armature

duction of the Weston, probably the best. It also employs a permanent magnet, but no moving wire. Figure 98 shows the construction. A little oblong piece of soft iron is pivotted between the poles, the latter being somewhat adjustable in strength or position by means of the iron screws passing through them. When current flows through the coil of wire, the movable piece of iron takes a position along the resultant of the two magnetic fields. The scale of the instrument is rather short, and the divisions are not necessarily equal, and the movements of the pointer are sudden and jerky, rather than deliberate and dead-beat. This form of measuring instrument is, however, still made in large numbers, the familiar "battery-tester" being a good example.

By far the largest variety of cheap ammeters and voltmeters have no permanent magnets whatever, but depend upon the current to set up an electromagnetic field; these coils may be solenoids, into which light soft iron plungers, with pointers attached, may be more or less drawn; or the coil may be short, with one fixed and one movable piece of iron, whereby, in consequence of being similarly magnetized by the current, they will repel one another, and the pointer be moved; or a little piece of iron may turn so as more nearly to coincide with the axis of the coil.

Such instruments absorb at least ten times as much energy as those of the other sort, are just the opposite of dead-beat, and are greatly affected by the presence of other magnetic fields. Some appreciable energy is needed to coerce the iron into its initial magnetic state, and therefore, the first part of the scales are not useful, nor often calibrated; also, the extreme portion of scale is usually indefinite. Further, the residual qualities of even the softest iron are such that equal increments of current result in certain positions of the pointer, while the same values with diminishing currents leave the pointer in appreciably different positions. A more serious fault is that such instruments give no indication of the direction of current. In conjoint operation of dynamos, or with storage batteries, indication of the polarity of the circuit is of utmost importance.

The very fact that ammeters and voltmeters of this construction are not concerned in the direction of the current is suggestive of a peculiar field of usefulness for them, and that is for alternating currents. This is so important a subject as to require a special article, and Chapter XX will be devoted to it. In addition to instruments of the indicating type, some of the recording order will also be illustrated. It will be found that certain constructions are quite as well adapted to measuring direct currents, so that the next will really be a completion of this chapter.

The hardest scale can be removed from iron and steel in three minutes by employing an electrolytic process where the metal is the cathode. In this case the acid solution is at sixty degrees C, and has a specific gravity of 1.75. The current density of the cathode is 1.4 amperes per square inch.

With two electric stoves a breakfast consisting of fruit, creamed wheat flakes, boiled eggs, creamed potatoes, toast and French coffee may be cooked at a cost of about five cents for current.

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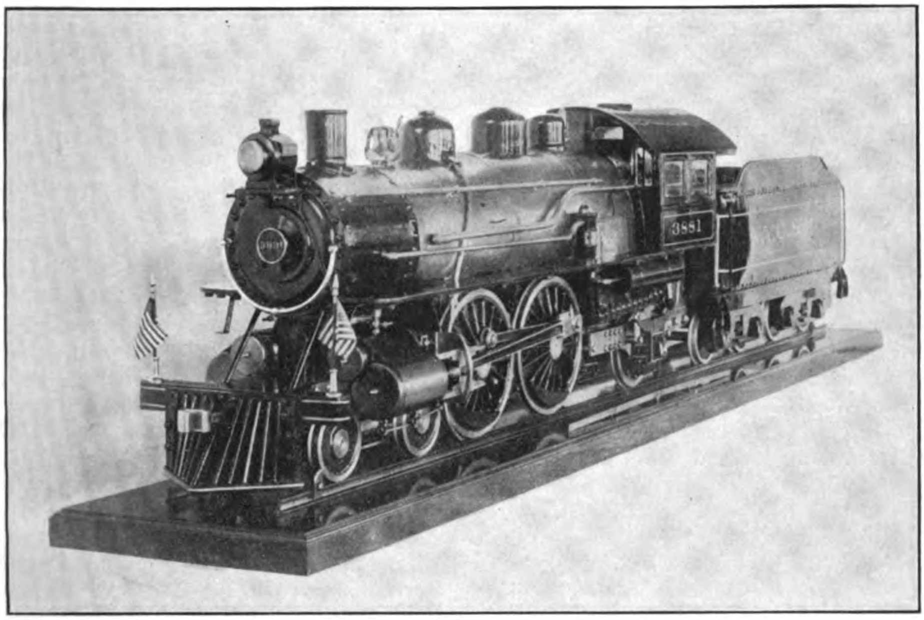

A Unique Model Locomotive for a European Prince

FRANK C. PERKINS

The accompanying illustration shows a unique model locomotive constructed for the Crown Prince Boris of Bulgaria. This engine is practically an exact copy of the locomotives which haul the Twentieth Century and Empire Express on the New York Central Railway. The two-foot rule noted along side the locomotive in the illustration, shows the size of this unique and interesting model, as constructed at Bridgeport, Conn., by the Crane Company.

This locomotive is complete in every respect. Its total length including tender, is 72″, width 11 5/8″; and the height 17″, while the length of boiler is 30″, the diameter of the boiler is 7″, and the number of tubes is 16, while the diameter of the driving wheel is 8″ and the diameter of cylinder 2 1.16″.

It was designed for a gauge of track of 5 3/4″.

The stroke of the cylinders is 2 6/8″, and the working pressure 60 pounds per square inch.

The speed is 480 revolutions per minute, this being the highest taken.

It develops 2.55 horsepower at a speed of 480 r.p.m. and 60 lbs. per square inch pressure. The speed would be one-fifth of a mile per minute, or twelve miles per hour.

This unique engine is fitted with piston (balanced) valves, and it has throttle and reversing levers; and can be run ahead or backwards. It has an electric headlight and burns charcoal for fuel. It is fitted with sand pipes, air brake, whistle, bell, and pump from tender to boiler. It also is provided with drip valves for cylinder and cylinder lubricators, also safety valves, steam dome, steam gauge and blow cocks, in fact everything that it is possible to put on such a small locomotive.

The illustration shows this unique model to be almost an exact copy of the engines which pull the Wonderful Empire State Express daily out of New York City.

A school has been started in New York by the Young Men's Christian Association for the express purpose of training young men in the work of skyscraper building. Instruction is given in structural engineering, structural draughting and detailing, estimating, reading, and general building construction.

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Making and Fixing Electric Bells and Batteries

BY M. COLE

The action of electricity is best understood by considering it a current, generated in a battery, and flowing through a wire to the electric bell which it rings. It starts at one terminal of the battery, flows along a wire to a bell, where it flows through some covered wire lapped round a rod of soft iron, which thereby becomes a magnet so long as the current is flowing, but ceases to be magnetic as soon as the current stops or is interrupted. The bell also contains an arrangement that interrupts the current several times per second. Each time the current is allowed to flow through the wire forming the electro-magnet, the latter attracts a piece of iron (or armature) to the end of which is fitted a sort of hammer, which then strikes against the bell. When the current ceases to flow the electro-magnet is no longer able to influence the hammer, which is forced back by a spring to its original position, and is then ready to repeat the stroke. The part of the bell that does this work is called a contact breaker. The current after leaving the bell flows back by a return wire to the other terminal of the battery. The two wires are called the conductors, and the whole path through which the current flows the circuit. At some convenient place in the circuit the wire is cut and an arrangement (usually a push) is placed for the purpose of bringing the ends of the wires together when it is desired that the bell should ring, and holding them apart by a spring when the bell is not required to sound.

The parts required to fit an electric bell are: 1, The Battery. 2, The Bell. 3, The Conductor. 4, The Push or other interrupter.

The Battery. For bells, this should be either the ordinary form of Leclanche or its modified form of the dry cell. The former is preferable, being cheaper and more reliable, and is easily recharged. It consists of a specially shaped outer vessel of glass (though any jar of suitable size will do instead). In this is a rod of zinc, having a wire fastened to it. This wire forms one of the terminals or poles of the battery. It also contains a jar of unglazed earthernware called a porous cup. This is filled with a mixture of bits of carbon and manganese dioxide. In the middle of the jar, projecting above it, is a plate of carbon, the top of which has a lump of lead cast on it, and is also provided with a screw and nut, so that a wire can be fastened to it. This forms the other pole or terminal of the battery. The space between this porous cup and the outer jar is nearly filled with a solution made by dissolving sal-ammoniac in water, using two ounces to the pint. When the battery is kept in a warm place, the water gradually evaporates, and should be kept up to its proper level by adding more water when required. One of the jars is called a cell, two or more used together a battery, but it is now common practice to call even a single cell a battery.

For a small bell, or on a short circuit of say 20 yards, one cell will do the work, but it is always advisable to have two cells. The same bell gives a louder sound than with one cell, or a larger bell can be used, and the power will be enough for any ordinary house circuit, or up to 100 yards with an indicator in the circuit. The battery should be placed in a dry position in a box, so that no dust or dirt gets to it.

There are two ways of connecting a battery of two cells. First, where one conductor is attached to both zinc terminals, and the other conductor is attached to both carbon terminals. The cells are then coupled in parallel and are equal to one cell of double the size. The battery has then the power of giving double the quantity of current. It will (other things being suitable) cause the magnet to have double the power as compared to using one cell. A second way of coupling the cells, and that generally used, is to connect the zinc terminal of one cell to the carbon terminal of the next one, and connect the conductors to the two free terminals. This is called connecting in series. The battery has then the same quantity of working power as one cell, but has double the intensity of pressure (electro-motive force—or voltage) of one cell, and will travel through a longer length of conductor, and has more power to force

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its way through a bad conductor or through two bells in succession.

Connecting to the Battery. The zinc of the battery has a wire cast in it, the top end of which is tinned so that a binding screw or the conducting wire can easily be soldered to it (see soldering instructions later on). Every joint in the conductor where soldering is possible should be soldered; it is very little trouble, and the efficiency of the bell depends largely on the absence of extra resistance at the joints of the conductor. For temporary purposes the wire may be merely twisted to the wire of the zinc, but the end of the conducting wire must be either scraped with a knife, or cleaned with emery cloth till bright, and then lapped three or four times round the end of the zinc wire, which should also be cleaned. A better method is to solder a binding screw to the wire of the zinc. The carbon terminal will be found to be fitted with a brass screw and nut (binding screw) projecting at the top. The surface of the lead just under the nut should be scraped, and the end of the conducting wire being also cleaned, make a half bend and screw down moderately tight, so as to bring the wire and lead surfaces into close contact.

The Bell. The usual style is the continuous or trembler bell. This has merely to be screwed to a wall by the holes provided for the purpose. Bells as a rule are hung level, but where the current from a battery is feeble, a bell can often be helped by fixing it at an angle, so that the weight of the hammer helps the electro-magnet to overcome the resistance of the spring. This of course, is not good work, and should only be used as a temporary measure. Most bells are covered by a small wood or iron case which is easily removable, being careful not to injure the spring in doing so. Within will be found the wire coils surrounding the soft iron forming the electro-magnet, also the contact breaker. It will be seen that the regulating screw is tipped with a bit of white metal, which is, or should be, platinum. The spring against which it works is also provided with a bit of platinum at the point of contact; this is because the spark, which is given each time contact is made and broken, oxidizes or corrodes most metals, platinum being least liable to it. With inferior makes of bells where a substitute is used, it is often necessary to clean the surfaces of the oxide formed upon them. This is best done with some fine emery cloth. The screw must be so adjusted that the contact is maintained (by the point of the screw touching the platinum on the spring) during the greater part of the stroke of the hammer, but contact must be broken by the spring ceasing for a time to touch the screw, or the bell becomes a single stroke bell, which is useful enough for many purposes, but gives only a single stroke on the bell each time the button is pushed. Bells as sold are usually ready for use, but sometimes it is necessary to regulate them a little by bending the wire of the hammer, which, when the armature is pressed against the electro-magnet, must be just clear of the bell or the sound will be damped by it. The amount of clearance depends on the size of the bell. For small bells the thickness of a post card is enough, for larger ones the distance is sometimes ¼ in., there being enough spring in the wire of the hammer to carry it through the intervening distance.

The Conductor. This should be of copper wire not under 22 gauge. It is quite possible to wire for a bell with uncovered wire, but it is a great mistake to do so, covered wire being cheap enough. The proper sort for indoor use is covered with cotton and well soaked in paraffin wax, which prevents any moisture penetrating the cotton covering. The most convenient is called twin wire, and is composed of two wires, each separately covered with cotton, and then the two covered with a layer of cotton which holds them together so that they may be handled like a single wire. This is much easier to use than separate wires, and as it is well coated with paraffin wax, there is little risk of its short circuiting through accidental moisture. The wire is usually fastened to the walls by staples. Wire staples are cheapest but are difficult to drive in, and do not hold so well. The special flat staples made from sheet steel should be used. They are easier to drive, being flat at the top, and are well pointed; they are wide enough to take in the twin wire conductor. Whenever a staple is driven over a wire the wire should be protected from possible injury caused by the staple cutting the cover. This is

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best done, in case of cotton covered wire, by lapping a strip of paper four or five times round the wire where the staple bridges it. For gutta percha covered wires a bit of thin indiarubber is best. This is easiest obtained by cutting up some ¼ in. rubber gas tube. Where a conductor is exposed to the weather, it should be of copper wire covered with gutta percha, and further protected by a covering of tape. In using this sort be careful not to cut the insulating covering with the staples.

Flexible Conductors are a great convenience, as they permit of a bell being rung from a table or bed, without the trouble of having to approach the wall of the room, but the drawback is that they are of very high resistance compared with the line wire. A bell will sometimes refuse to ring through six feet of flexible, when it will ring freely by short circuiting just above the flexible. To avoid this, if a low resistance flexible cannot be procured, it is best to use two lengths, which must be connected so that the two conductors of each flexible are used as if they had been a single wire. For long lengths it is best to use the quality used for electric lighting purposes.

Wires Under Carpets, etc. Wires can be laid under carpets, but should be kept near the wall where possible. They may be conveniently led round the frame of a door, and to avoid making a hole in the wall, they can be laid from outside to inside a room at the top corner of a doorway, as very few doors fit too closely to prevent this. When this is unsightly or impracticable, lead the wires at the bottom corner of the doorway, and round the door frame to inside the room. Wires may also be placed under the wall-paper. If well stapled to the wall, the wire will not be noticeable under a good paper. If a very thin paper is to be laid over the wire, it is advisable to paste a strip of brown paper three inches wide over the wire, so that the increased thickness is gradual. Along the skirting board is a favorite place for laying a wire. When this is done the wire can be bought of such a color as will match the paint, and when the board is repainted the wire may also be painted without injury to the insulation.

Hole in the Wall. When this cannot be avoided, there is little difficulty in making the hole, provided a proper wall drill is used for the purpose. It is struck with a hammer, the same as if driving in a nail, but giving the drill a quarter turn after each stroke of the hammer. The effect is to reduce the brick in front of the drill to a powder which is easily removed.

Joining Conductors. For temporary purposes merely cleaning the ends and twisting them together will do, but a joint so made is very unreliable. The proper way is to solder them.

Soldering with Copper-bit. The easiest way to solder is using soldering fluid as a flux, and a copper-bit or soldering iron which should not be under 12 oz. in weight. If lighter, it is apt to cool before it is brought from the fire to the job. If the tool is a new one, clean the surface near the point by filing, heat to a little below red heat, and clean again with file; then at once tin the cleaned surface by rubbing on a bit of tin on which is a little soldering fluid and some solder. The copper-bit will now be able to lift and carry some of the solder, which will leave it if the tool touches a surface of clean copper wire, moistened with the fluid. If the bit is heated to redness the solder is burned in, and the point must be retinned just as with a new tool. The ends of the wires to be soldered must be cleaned with emery cloth or by scraping with a knife, and should be twisted together. The solder will penetrate the joint and bind the whole into a solid mass. The joint must then be well washed with a wet rag to remove all traces of the soldering fluid; then, if cotton covered, wind well with insulating tape. Some workers use sal-ammoniac for flux, others use resin, but the soldering fluid is much easier to use, and if the joint is carefully washed, will not injure the wire.

Flexible Conductors should always be soldered. Unlap the covering for three inches and lap the wire conductor round the main wire, solder as usual, and after washing use the unwound silk or cotton to lap round the soldered part of the joint, then tape.

Soldering with Blow-pipe. Where there is no convenience for heating the copper-bit, a candle and a mouth blowpipe can be used. With a little practice it will be found easy to direct a smokeless flame on the joint, which soon causes

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the solder to flow. A small portable spirit lamp is very handy for this purpose.

Pushes and Switches. The ordinary push is both convenient and cheap. The two parts are easily unscrewed by holding the back of the push against the palm of the left hand, and grasping the box of the push with the right hand, then turning the box in the direction opposite to that in which the hands of a clock travel. Inside will be found two pieces of white metal screwed to the base, in which are also four holes. Two of the holes are for screwing the base to the wall, the other two are to allow the wires of the conductor to enter, which they do from the back. Of the two enclosed pieces of metal, one lies flat on the base board, the other is bent so as to be at some distance from the flat one, and can be pushed down so that the two touch, but it has spring enough to return when the pressure is released. A button or knob of porcelain or other suitable material projects through the case when the parts are screwed together, to enable the two to be brought into contact. In good quality pushes, these are provided with bits of platinum where they touch, but the cheaper pushes are sold at too low a figure to allow of platinum being used. Each of the two metal parts is fastened down to the base by one or more screws. By loosening these a little, one end of the conductor can be placed under each and held in position when the screws are tightened again, this being all that is required. In some of the more expensive pushes there is an extra screw for holding the conductor wire. Practically nearly all pushes are made this way, though they differ much in outward shape. For use with the flexible conductor, the push is either pear shape or similar to the wall push, but smaller size. Pushes for outdoor work such as front doors, are usually a variety of the wall push, but of metal, and so shaped that they are easily fitted to the woodwork or brickwork of the door framing. Sometimes an ordinary wood push is screwed on the door itself, the wires being taken through. When this is done, the wires on the door are joined to the wires on the frame by a spiral, formed by winding twelve inches of the wire round a thick lead pencil or other rod, on withdrawing which the wire remains in a spiral form. This spiral should also be used for the ends of the conductor where they join the bell as well as at the battery. It allows of their being joined more easily and gives a finish to the work.

Switches. The simple switch shown in Fig. 2 is used to cut out the bell when it is not required to work, and also forms an easily made substitute for the push.

Secret Push. It is often desirable to be able to ring a bell without having a visible push. This is especially useful on a front door. The simplest way of doing this is to fix two screws in either the panel or frame of the door. They should be of brass with round heads, and placed about half-inch apart. To ring the bell it is only necessary to touch the two screw heads with a coin or other bit of metal. The screws project through the door on the inside, and the line wires are soldered to them. There are many special devices to ring a bell when a door or window is opened or closed, or in walking over a door mat. There is no difficulty in fixing these or the indicators used to indicate which room a bell has been rung from, when the bell is so fitted as to be rung from several places, though when not more than four rooms are so fitted it will be found cheaper and easier to use the different bells, each of a separate tone.

(To be concluded.)

The terms of the concession for the future supply of electricity in the city of Paris, drawn by the Municipal Council, have now, according to the Journal de Débats, been approved by a decree of the president of the republic. The period from November 1, 1907, until December 31, 1913, will thus become one of transition. The committee of the companies which have the sectional monopolies will furnish the entire public and private supply current at a fixed price. In the first six months the concessionaires, after approval of their agreement, will have to form a company, with a capital of $10,000,000, which will assume the name of the Compagnie Parisienne de Distribution d'Electricité. The actual period of the concession will begin on January 1, 1914, and terminate on June 30, 1940, with rights of reëntry on the part of the city at any date after June 30, 1924, on terms stated.

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How to Build a Small Model Undertype Engine and Boiler

HENRY GREENLY

IV.—Steam Port Proportions, Valves, and Valve Spindles.

Although the previous article dealt at considerable length with the construction of the cylinders, one point of importance was omitted — viz., shall the cylinders be cast in iron or gun-metal? Each material has its disadvantages, the only one of moment in connection with cast iron being the tendency of this material to rust when the engine is not being used. No trouble should now-a-days be experienced in obtaining good soft cast-iron or clean castings.

With gun-metal cylinders, iron valves are almost essential to best practice where dry steam is used at a high pressure and temperature. Where brass and brass are working together under such conditions, a sticky deposit made up of particles of brass is formed between the rubbing surfaces and materially increases the friction. The application of oil does not seem to improve matters. The friction is lessened only for the moment; as soon as the oil runs away the old trouble reappears. With iron this drawback is practically non-existent. The writer believes in lubricating cast-iron cylinders and slide-valves. In considering the pistons, cast iron presents certain advantages, of which the writer will speak later.

The accompanying drawings include views of both the cylinder covers, valves, valve spindles, and intermediate valve spindle guides. Figs. 10 and 11, which were published with the last article, show, in addition to the valve chests, the dimensions of the high- and low-pressure steam ports.

In the case of the h.p. ports the usual rule for small engines of medium speed is exceeded. The rule is as follows:

Steam port width = $1/16$ of stroke of piston.

Exhaust port width = $\frac{1}{8}$ of stroke of piston.

Length of ports = $\frac{1}{2}$ of piston diameter.

With a cylinder of the same size as that of the h.p. cylinder of the present model, this would give

Steam ports: $1/16$ of $5/4 = 5/64$ in. wide.

Exhaust ports: $\frac{1}{8}$ of $5/4 = 5/32$ in. wide.

Length of ports: $\frac{1}{2}$ of $\frac{5}{8} = 5/16$ in. long.

Instead of this we have h.p. ports $3/32$ in. and $3/16$ in. by $\frac{3}{8}$ in. long, the idea being to provide as large as possible steam port area for the passage of the exhaust. The l.p. ports conform to the rule as regards length, the width of the ports agreeing with that of the h.p. cylinder. This is advisable, as any difference would necessitate a corresponding alteration in the throw of the eccentrics.

No novel feature is presented in the attachment of the valves to the spindles. The valves are first roughly shaped to the drawings from a piece of drawn brass rod* (where gun-metal cylinders are used), and then the exhaust cavity can be marked and chipped out with small chisels to the depth of $3/32$ in. in each case. Where a vertical slide forms one of the common objects of the workshop, the valve may be mounted in the vice, and with a small home-made end mill the cavity may be milled out to exactly the depth required. The radius of the corners will, of course, vary with size of the end milling tool, but if a hole of about $3/64$ in. diameter is first drilled in each corner of the valve, the maker should find it no trouble to make the corners of the cavity square in the usual way with a small chipping chisel.

When the cavity has been prepared, the slot may be milled, sawn, or filed in the back of the valve, and the value spindle filed to fit in the slot, as shown in the hand sketch herewith. The point to note in fitting the valve to the spindle is that while lateral and longitudinal slackness should not be present, the valve should be capable of rocking slightly, readily falling to the valve face of the cylinder when both the parts wear, and more particularly, of lifting from the face to allow of the escape of trapped water. The lift of the valve need not be more than $1/64$, as indicated in the drawings.

*The use of drawn brass rod provides a slight difference in the materials of cylinder and valves, which is very desirable. German silver is also suggested as a very good material for valves.

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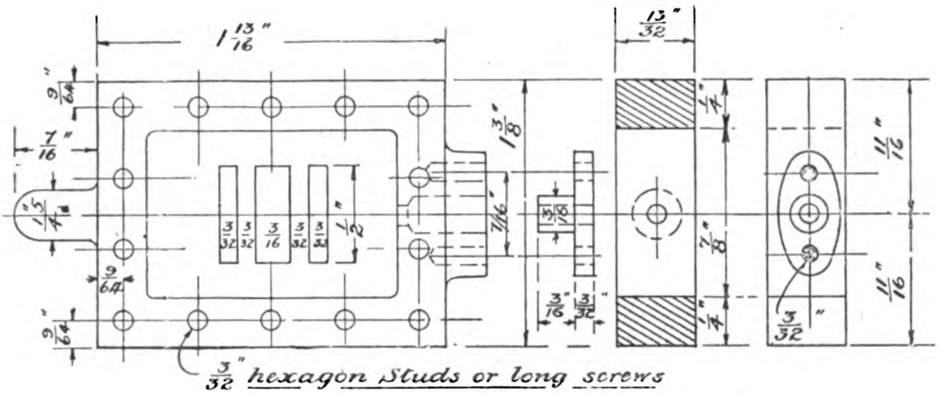

FIG. 11.—LOW-PRESSURE STEAM CHEST AND PORTS.

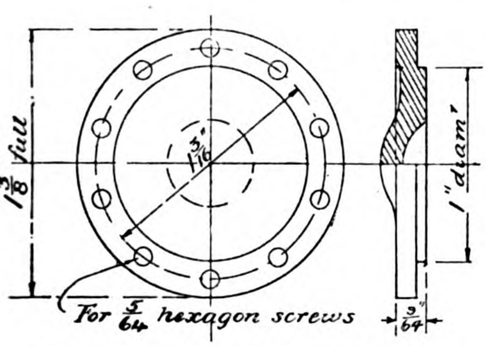

FIG. 12.—LOW-PRESSURE FRONT CYLINDER COVER.

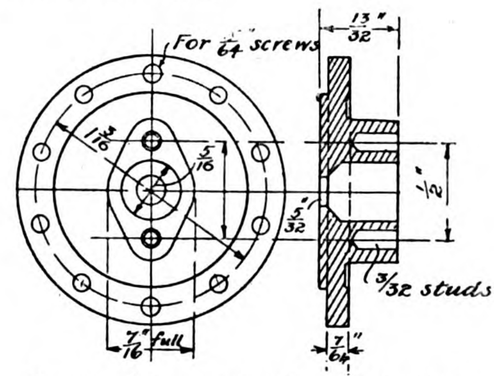

FIG. 13.—LOW-PRESSURE BACK CYLINDER COVER.

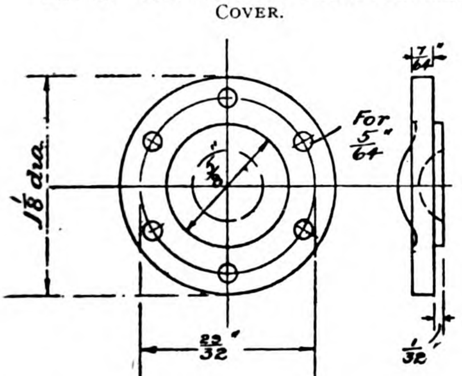

FIG. 14.—HIGH-PRESSURE FRONT CYLINDER COVER.

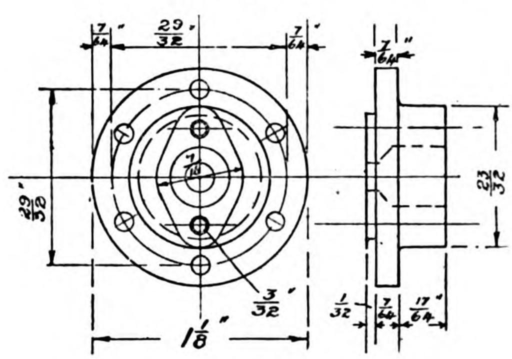

FIG. 15.—HIGH-PRESSURE BACK CYLINDER COVER.

It will be noticed by comparing the two sketches that the lap of the high- and low-pressure valves varies slightly owing to the insertion of the word "bare" after the dimensions. By this the writer intends to convey that it is advisable to provide this valve with less advance, which means, of course, a later point of cut-off and compression on the l.p. side of the engine. The valves may be machined to exact dimensions, and on erection the l.p. valve may receive a couple of strokes with a smooth file, reducing the lap a small amount. No lead need be provided, but the h.p. valve may be set with about 1/100 in. lead. The lap of the h.p. valve is, of course, 1/32 in.

The valve spindles may be made of hard German silver rod, 3/32 in. diameter, with much advantage. As the eccentrics

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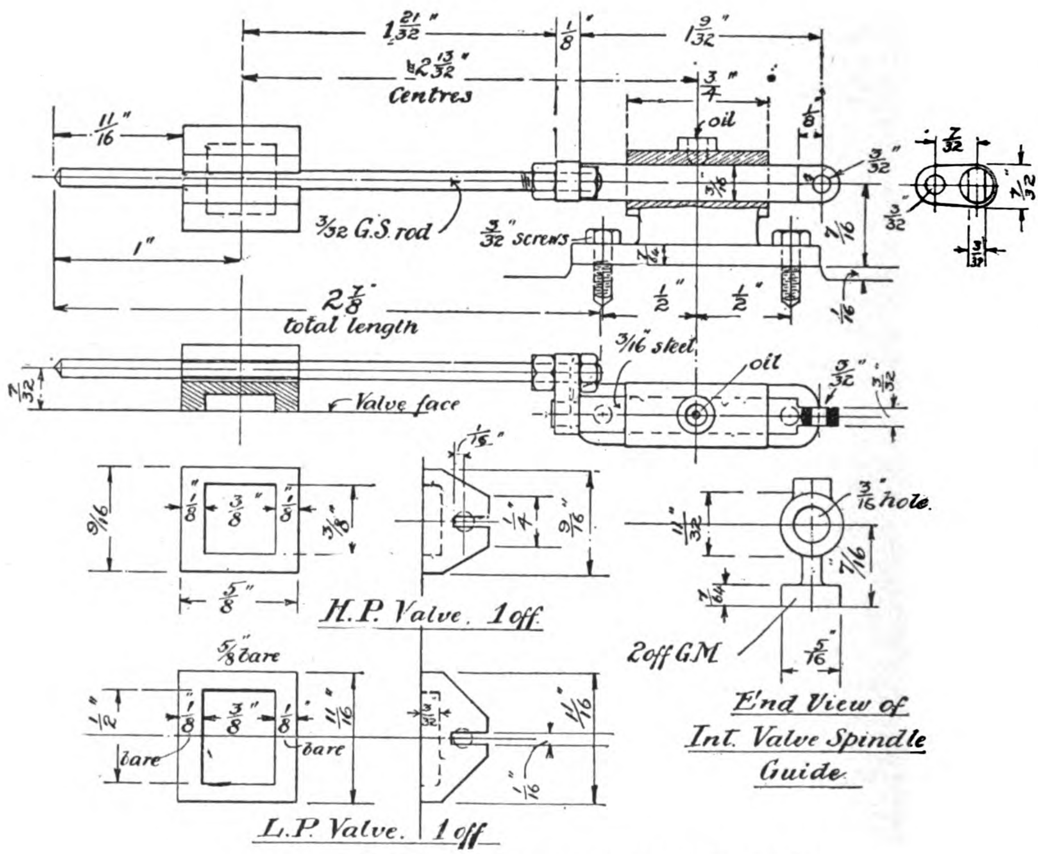

FIG. 19.—VALVES AND VALVE SPINDLES. (*Full size.*)

must be placed nearer the centres of the cylinders than the valve spindle, as a reference to the general arrangement drawing will show, an intermediate valve spindle should be used. This feature makes it possible to employ a good and yet simple form of adjustable joint between the main and intermediate valve spindles. The writer abhors the practice of cranking eccentric rods.

The intermediate valve spindle and guide require little description. The guide may be of gun-metal. The casting should be bored first and the base carefully filed so that it is true with the tool. Several processes might be adopted to ensure accuracy in this direction by machining only, but it is questionable whether many would care to prepare mandrels, etc., for such a simple job. The cranked piston of the intermediate spindle should be faced in the lathe, the chuck holding the spindle portion so that when the nuts are tightened up there is no tendency to twist the spindles out of line. The nuts may also be faced by placing them on a piece of rod, screwed to a shoulder, running in the lathe. To set the intermediate valve spindle couple the two spindles together firmly, and with the intermediate spindle placed in

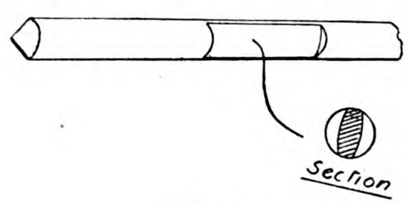

FIG. 20

its guide, fix the latter down to the bed-plate in such a position that it slides freely to and fro. Any slight adjustment may be made by filing the base of the guide, for as long as the bore of the latter is truly parallel to that of the spindle, it does not matter if there is a trifling dif-

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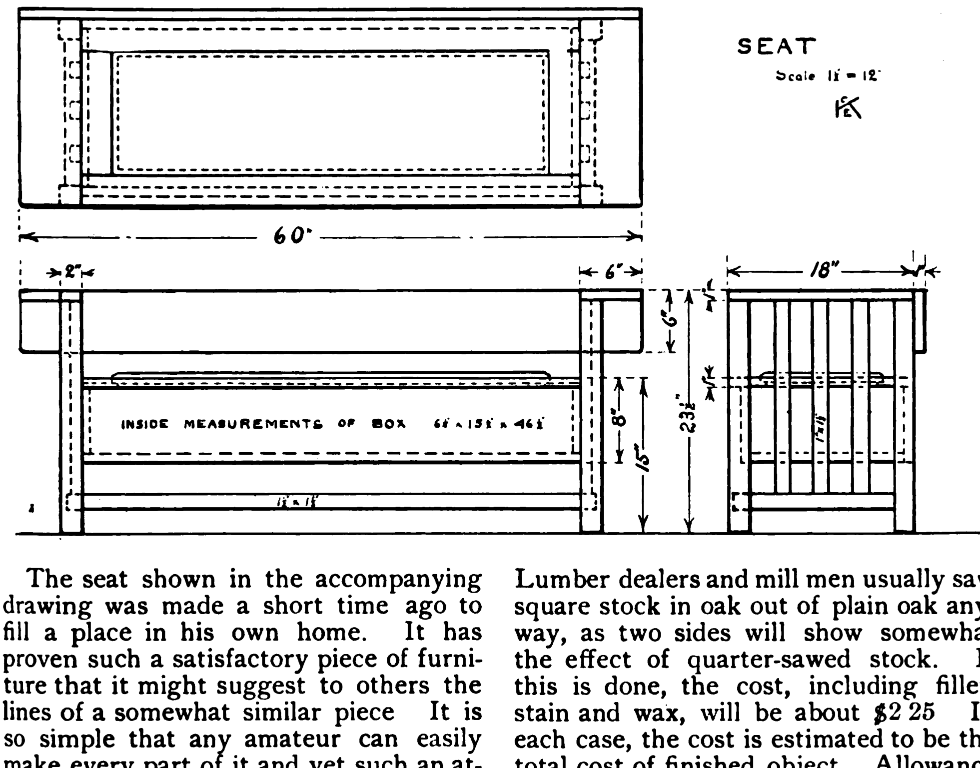
ference in their heights from the bedplate, as the crank lug of the intermediate spindle will allow of this. The lug may be fixed by riveting to the shouldered-down end of the spindle, as indicated in the drawings. Do not finish off the vertical faces of the knuckle joint until the valve spindles have been erected and the eccentric rods and straps are made. When this is done the knuckle may be fitted and the hole reamed out to size.—*The Model Engineer.*

Furniture Competition

Prize Article—Seat

C. E. KARLSON



The seat shown in the accompanying drawing was made a short time ago to fill a place in his own home. It has proven such a satisfactory piece of furniture that it might suggest to others the lines of a somewhat similar piece It is so simple that any amateur can easily make every part of it and yet such an attractive and useful object that a purchaser can easily be found if it should not be needed in the home of the maker. The box in the one originally made has been divided in compartments for photographs and magazines.

COST. Made of quarter-sawed oak throughout, the cost will be about $4.00. This may be cut in half, if whitewood or poplar is used. If the maker really desires to secure a beautiful piece of furniture at small cost, it would be well to purchase quartered oak for the back, two arms and the front board of box. Common or plain oak for the rails, posts, etc. Lumber dealers and mill men usually saw square stock in oak out of plain oak anyway, as two sides will show somewhat the effect of quarter-sawed stock. If this is done, the cost, including filler, stain and wax, will be about $2 25 In each case, the cost is estimated to be the total cost of finished object. Allowance is made for waste.

BILL OF LUMBER

4 2" x 2" x 22½" posts	End Sections.	
2 1" x 6" x 18" arms		
2 1⅛" x 1½" x 14" rails		
6 1" x 1½" x 18½" uprights		
2 ⅞" x 7" x 48" front and back	Box	
2 ⅞" x 7" x 15" ends		
1 ¾" x 15¾" x 47 bottom		
1 1½" x 1½" x 48" rail		
1 ⅜" x 6" x 60" back		
2 1" x 3" x 48" back and front	of framed seat	Seat
2 1" x 3" x 13" ends		
1 1" x 13" x 43" lid		

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JOINTS. All pieces are sawed square. Where nails or screws would show if used, wood dowels are used. In most cases two of the 3/8″ or 5/16″ dowels are used in the end of each piece. The dowels and all joints are glued with hot glue of best quality. Le Page's Liquid Glue will do quite well.

1. The end sections are made first, all pieces being flush on the inside towards seat. The uprights are 1 7/8″ apart.

2. The box is made next. The lower edges of sides and ends are rabbeted on the inside to receive the bottom. Three-eighths inch is allowed for this purpose.

3. The front rail and back should be made ready to be put into place, and then

4. The box should be fastened to one end section. One half dozen 1½″ No. 10 flat head bright screws screwed through the end board into the uprights and posts will make a strong job. The front rail should be fitted and put into place before the other end section is put on.

5. The back may be nailed or screwed on.

6. The seat is made of a frame and a loose raised lid. The lid rests on a rabbet ½″ x ½″, this rabbet having been made on all four sides before frame is put together. The front and back pieces may carry this rabbet their entire length and the end pieces fitted to rest in this rabbet.

7. The seat may be made by using one back piece 7/8″ x 3″ x 48″, two end pieces 7/8″ x 3″ x 15″ and a hinged lid, flush top, 7/8″ x 15″ x 42″.

FINISH. After being scraped and sandpapered, look over the work carefully and remove all glue that may be on the surface. Also all tool-marks. The simplest finish is made by mixing a stain or color into transparent paste filler. For a beautiful brown I have used a small can of Woodhouse's transparent (colorless) paste filler, thinned with turpentine only. Into this, mix a small quantity burnt umber, until the desired shade is secured. The whole mixture should have the consistency of good cream. Apply this with burlap, rubbing generously across the grain. See that every corner receives its share. Leave ten or fifteen minutes, but do not allow to dry, then rub off across the grain with fresh burlap or excelsior. A light coat of shellac or wax will fix the color and leave a finish that will last.

The railroad from Vienna to Baden after a four months' trial was opened for electric traction on May 1 of the present year. The railroad is party operated by means of continuous current, within the city at a tension of 500 volts, and beyond the city limits the pressure of the alternating current is 10,000 volts. Special safety appliances have been rendered necessary at roads and other crossings and in certain sections. Illustrations of these devices, which take the form of light trelli girders containing the conductors, are appended. The total length of this railway is slightly over 18½ miles, and the section worked by low-tension continuous current is 5.58 miles in length, while the high tension section extends over 12.65 miles.

A wood-carver's requirements are summed up as follows by Mr. J. E. Knox, in an old Royal Institute of British Architects' paper: First, a strong, firm bench, the top of which should be of beech at least 4 in. thick, 2 ft. wide, and 4 ft. 6 in. long; there must be secure, but simple, methods of fixing work. Secondly, there must be a good light. Of tools or gouges he requires a very large number, necessitated by the variety of designs that may come to him for execution, nothing being too large or too small for a carver to try his skill upon, let the result be what it may, and naturally the tools vary in size according to the work in hand. Repetition work, as a matter of course, needs only a few tools, sufficient to carry out the design, and a variety of about two dozen would suffice for this purpose. A wood-carver, among his qualifications, should be able in an emergency to make, harden, and temper his tools, and repair a broken or make an exceptional tool he may at any time find necessary for his use. Learning to sharpen a good kit of wood-carver's tools properly, and in good working order, takes the apprentice or novice really longer to acquire than actually learning the use of them. For the harder woods a less acute bevel or sharp is required than for the softer woods, every gouge used by the wood-carver being, by the sharpening, a fine, elongated wedge of innumerable sections.

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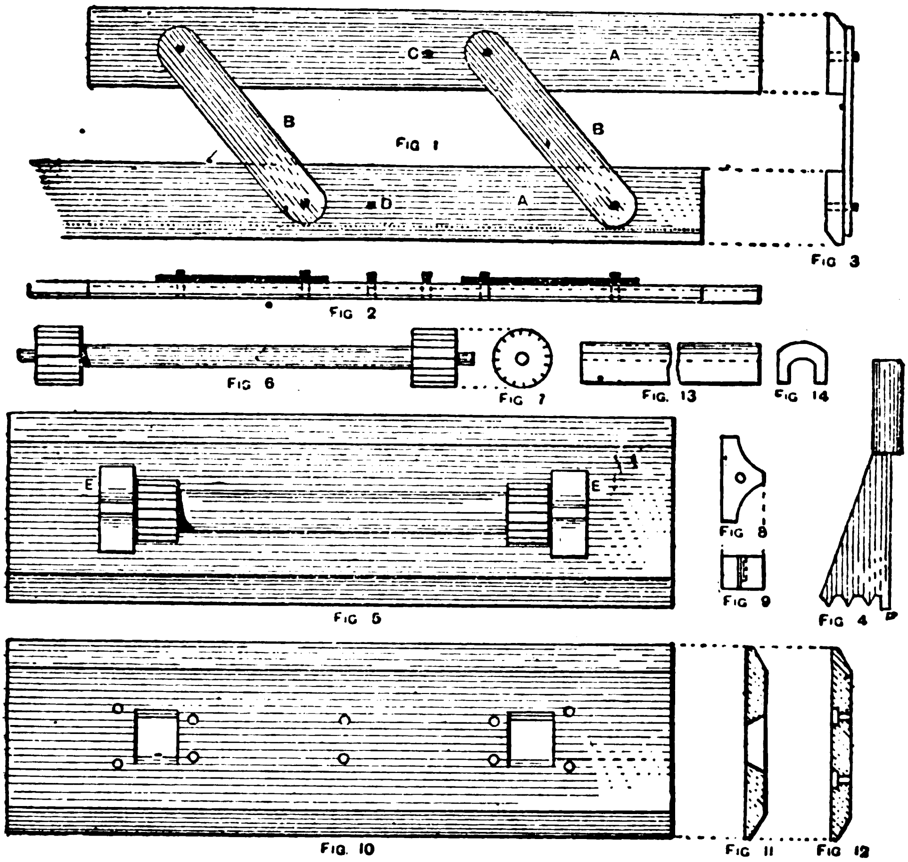
Constructing Parallel Rules

C. T. S.



Parallel rules are of two kinds, known technically as bar parallels and rolling parallels. The former consists of two bars, A, usually of ebony or ivory, connected by two brass strips, B, as in Fig. 1, 2 and 3. The bars are first planed up on both sides to a uniform thickness, the edges shot up, making them quite parallel, one edge of each bar being chamfered. This is usually done in opposite directions, as shown in Fig. 3, the thin edge at the bottom being most convenient for ruling pencil lines, while the thin edge at the top prevents the ink running under the rule.

The brass strips are usually cut or stamped from hard-rolled sheet metal. If preferred, they can be cast and hammered, but sheet brass is better, as, owing to the rolling to which it is subjected in manufacture, it is much stronger than castings. The holes in the brass strips must be perfectly equidistant, or the lines ruled by the instrument will not be parallel. To ensure this, the holes are marked off at the proper distance on one strip and centre-punched. The two strips are then clamped together, and the holes drilled through both; or one hole can be drilled in each, a pin put in to hold them together, and the other hole drilled through the two. Sometimes a series of concentric rings are made round the pin-hole, to relieve the plainness of the metal. This is done with a forming tool shaped as Fig. 4. The tool is fixed in the lathe or drilling machine; the pin F is placed in each hole in turn, pressure is applied, and a few turns com-

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pletes the operation. The strips should then be filed to any desired shape, smoothed up with emery paper, and lacquered. The lacquer consists of shellac and other gum-resins as desired, dissolved in alcohol. The article is warmed until the lacquer just smokes as it is laid on, which is done with a camel-hair brush. If made too hot, the lacquer bubbles up, and the surface is spoiled; if not hot enough, the surface is dull and dead in appearance. See that the brush has no breaks in the hair, or a streaky surface will result.

The holes in the bars to take the pins which fix the brass strips, and form centres for them to work on, are next drilled. The bars are riveted in position, and a small hole is then drilled in the centre of each bar (see C and D, Fig. 1), and a brass pin riveted in each, by which to open and close the rule. The ends are squared off, and the pins filed down flush at the bottom, and all level with each other at the top. The rule is next tested, and if the lines are not parallel, the brass strips must be examined, and the shorter of the two hammered slightly to stretch it.

The bar parallel (Fig. 1) is much simpler to make than the rolling form (Fig. 5), but few people who have used the roller parallel would willingly revert to the bar pattern. Roller parallels consist of the plate, roller, bridge, two poppets, and in the larger forms two lifting knobs. The plate may be of ebony, ivory, brass, gunmetal, german silver or electrum as it is sometimes called. It should be cut slightly longer than the required length, to allow for trimming up at the finish; both sides are planed up, either by hand or machine, and the edges made parallel and chamfered.

The roller (Figs. 6 and 7) is a long steel wire, centred, turned true and slightly taper at each end, on which are placed cylindrical pieces of brass, gunmetal, or german silver, bored through the centre, and broached slightly taper. These are fixed on a mandrel, and turned all over (the circumference of each must be exactly equal, or the rule will not roll parallel). Then a series of slots should be cut round the cylinders, to grip the paper and prevent the rule from slipping. This is sometimes done with a milling or knurling tool, the work being placed in the lathe, the tool pressed hard against it, the lathe is started running, and the tool traversed to and fro until a sharp mill is obtained. The disadvantage of this method is that the corrugations are not very deep. Another method is to cut a slot in the cylinder with a saw, then fix another saw, or a thin strip of metal at the side of the first one, the required distance of the slots away, and, placing the saw or metal strip in the slot already cut to guide it, another slot is cut. The guide is then placed in the second slot, and the process repeated until the cylinder is slotted round. The disadvantages of this method are that the slots are not quite all the same depth, unless a stop piece is fixed on the cutting saw, and, the number of slots may not divide quite accurately into the circumference, so that the last tooth is left narrower or wider than the rest. The best method is to slot the rollers with a small machine of some kind. Having to deal with large quantities of rollers, the writer designed an attachment for a high-speed lathe. In this, the cylinder is fixed on a mandrel, and the latter placed between centres, one of which revolves. A divided plate with the required number of notches is fixed to the revolving centre, and held in position for cutting by a spring catch. A small well-hardened saw is fixed on a mandrel in the lathe and rapidly rotated, and the roller is then passed under the saw, the attachment being moved to and fro by a lever for each slot. The catch is then lifted, and the divided plate turned to the next notch, and by this means the rollers are slotted evenly and regularly. As the rollers become very hot during the operation of slotting, thus spoiling the saw, soap and water is pumped on the saw by a small centrifugal pump. This keeps the saw and roller cool, and also prevents the fine cuttings flying about, to the detriment of the operator and machine. The pump is fed from a small tray underneath the saw, into which the water

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and cuttings fall, and the pump is fixed so that it starts pumping when the saw stops, thus preventing overflows. The water must be covered, as it splashes very much. After slotting, the burrs are removed, the rollers are driven firmly on the steel wire, and, if necessary, finally turned true. The ends of the wire are turned to fit a hole in each of the poppets E, which are small blocks of metal, shown in side and elevation by Figs. 8 and 9, forming the centres for the roller to work in.

Two holes, the exact distance of the rollers apart, and sufficiently large to allow the roller to project through the bottom of the plate, should now be cut in the plate (Fig. 10). The holes can be drilled, and then filed out to fit the roller. Or a better way is to use a revolving cutter slightly larger in diameter than the rollers, and sink this in the required depth. The roller and poppets are placed in position, two or more holes, according to the size of the rule, are drilled in the plate at each end, and corresponding holes drilled and tapped in the poppets, for fixing the latter. Fig. 11 is a section through the roller slots, and Fig. 12 is a section through the screw-holes.

The bridge (Figs. 13 and 14) is a grooved piece of metal, forming a covering for the steel wire of the roller. It is placed in position, and lightly marked round on the plate. A number of holes, according to length, are drilled in the plate, and corresponding holes drilled and tapped in the bridge for fixing it. The lifting knobs, which also form handles to work the parallel to and fro, are screwed into holes, drilled and tapped in the plate between the poppets and the end of the plate. These knobs are, usually, only put into the larger sizes. The ends of the plate are now trimmed up, and the different parts smoothed with emery-paper. If german silver or gunmetal is used it should be left bright and polished, while if of brass it can be bronzed. The better class bronzes usually consist of dilute solutions of the chlorides of platinum and mercury, which, like chloride of gold, have the property of decomposing, in contact with other metals, and depositing a very thin layer of their metal on the articles immersed in them. When the article has reached the required depth of bronze color, it is taken out of the solution and dried off in sawdust, or the latter mixed with powdered blacklead, the latter being used when a very dark bronze is required. The last operation is the lacquering, which is done in a similar way to that described for the brass strips of the bar parallels.

When finished, the parallels are rolled down a perfectly flat surface, and tested on each edge, to see that the lines are parallel. If not, a little must be taken off the larger roller, until the rule rolls perfectly parallel. Parallel rules are usualy made 6 in., 9 in., 12 in., 15 in., 18 in., and 24 in., long, but larger sizes can be had if required.—Work.

A cheap sink for a dark-room was described by a professional photographer—Mr. Stebbins—at a recent convention of an American photographic society. First, a framework of ½-in. boards is built on the supports where the sink is to be placed, and on this a thick layer of cement and sand in the proportions of cement 2 parts, sand 3 parts, is laid, about 1 in. thick. While this is setting, make an inner framework of ½-in. boards, about 2 in. shorter than the outer one, and about 1 in. shallower and without any bottom. When the bottom layer of cement is set, rest this inner framework on it, and keep the tops of the inner and outer framework steady at an even distance of about 1 in. apart by little strips of wood attached at distances at the tops. This forms a mould between the two frameworks and the bottom layer of cement, and into it cement mixture is poured and allowed to set. The whole forms a most permanent form of sink at a cost of about $1.50 for one 8 ft. long. Waste pipes should be put in place before the cement is put in, and set a little below the surface of the cement to allow of shrinkage when the cement sets. To strengthen the sides, corners, etc., of the sink, nails or pieces of steel can be sunk in the cement.

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Constructing a Trunk

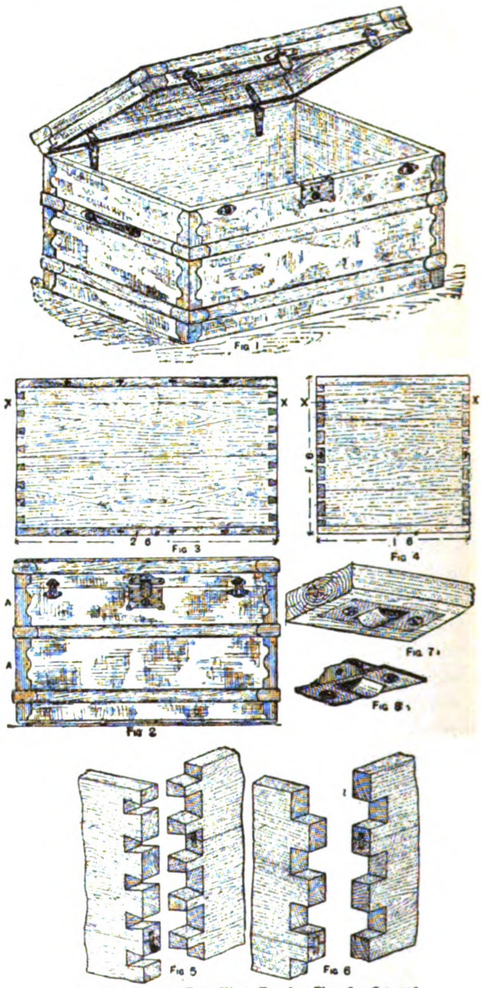
BY C. W. D. BOXALL

Fig. 1 is a general view of a strong traveling trunk made of wood. Fig. 2 is a front elevation. The following are the main particulars of its construction. Useful sizes are given on the drawings, but, of course, these may be varied to meet requirements.

The necessary boarding, $\frac{3}{4}$ in. to 1 in. thick (according to strength required), having been obtained and cut to length for the sides, ends, bottom, and top, it should be jointed and ploughed for tongues. Instead of this, machine prepared grooved and tongued floor-boarding of good quality and well seasoned will answer the purpose admirably. The joints should be glued and cramped close together until the glue is dry. Care should be taken not to have the joints in the sides and ends in the same plane. It is a stronger method to arrange the boards to the top and bottom transversely, as shown at Figs. 3 and 4. The sides and ends should next be set out for lengths, and then the ends set out for dovetail pins. These should be arranged in the portion to form the rim of the lid, as shown at x x (Figs. 3 and 4). After these are sawn and the waste cut out, the pins should be placed on the sides, and the sockets marked out from them. A strong form of dovetail is shown at Fig. 5. Fig. 6 shows the box pin joint, which is rather easier to make, but is not so strong as dovetailing. When ready, the joints should be glued and further secured with a few nails. Then the top and bottom can be glued and nailed to the sides and ends, and planed flush where necessary. The part forming the lid should next be separated by cutting along the lines x x (Figs. 3 and 4).

The whole of the outside can be covered with American cloth or a stout close-woven canvas; in each case the material must be stuck down firmly and evenly to the wood with strong glue.

Two or three battens about $\frac{3}{4}$ in. by $2\frac{1}{2}$ in. should be fixed on the bottom of the box, preferably with screws, and an iron roller should be let in near each end, so that its plate is flush with the surface of the batten, as shown at Fig. 7. Fig. 8 shows the form of roller used. Some



Constructing a Travelling Trunk. Fig. 1.—General View. Fig. 2.—Front Elevation. Figs. 3 and 4.—Side and End Views of Carcase. Fig. 5.—Suitable Form of Dovetailing. Fig. 6.—Alternative Method of Jointing Angle of Box. Fig. 7.—Roller let into Batten. Fig. 8.—Roller.

strips of ash or oak about $\frac{5}{8}$ in. by $1\frac{3}{4}$ in. should be fixed to the sides and ends as shown. These may be secured with screws inserted from the inside, if desired. Some sheet-iron plate or mild steel plate, about $\frac{1}{16}$ in. thick, should be cut into strips 3 in. to 4 in. wide, and bent down the centre at right angles. The outer edges may be straight or shaped as shown at A (Fig. 2). Holes should next be punched and countersunk, so that the plates can be fixed to the angles of the box with screws. Care

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should be taken to file off all the outer arrises of these iron angle bindings. The bindings of the fillets need only be slightly narrower than the fillets. The lid should be fixed with a pair of box hinges, as shown in Fig. 1. A suitable lock, and a staple fastening at each end, should also be fixed.

If the box is covered with strong canvas, this may be painted brown, or any other color desired, and a coat of varnish will improve the appearance of the battens. The iron-work should be japanned or coated with an enamel. The interior of the trunk can be fitted with a movable tray, etc., as necessary. To make the box dust-proof, a fillet should be nailed round the inside, so as to project into the rim of the lid.— *Work.*

The Development of the Wireless Telephone

J. Erskine-Murray, D. Sc., writing for the London Times says that it is a common notion among writers of scientific papers that the publication of the results of a laborious research in the pages of the "proceedings" of some learned society is a publication to the world at large. Unfortunately, perhaps, it is not so, and the public in general remains in ignorance, probably for a decade or so if the research has been a really important one; otherwise for longer. The announcement last week that the United States Government had placed an order for twenty-eight sets of wireless telephone apparatus would appear to be something quite new, but it is merely a step forward to those who have followed the development of wireless telephony from the days of Graham Bell's photophone nearly thirty years ago to the production of the modern electrical open circuit telephone. It is, however, from all points of view an important step: it places the invention on a different plane by bringing it into an arena where its value will be determined by many things besides ingenuity and excellence of design, and where it may have to compete with established methods and overcome the inertia, perhaps the active opposition, of vested interests.

The electric wireless telephone has become possible through the development of methods for the production of a continuous series of simple or complex electrical discharges following one another at the rate of 50,000 or more per second. This somewhat high frequency of alternation is advantageous for two reasons—first, because a low frequency would produce an audible note, and also would not be capable of rendering electrically the higher harmonics which give the sounds of speech their distinctive characters; secondly, because it is only by using a high frequency that it is possible to transmit a large amount of energy while using a comparatively small quantity of electricity.

There are several methods of producing a suitable series of discharges. It is not necessary that these should form a true alternating current, and so long as the frequency is sufficiently high any type of discharge from a rapid succession of oscillating sparks to the uniformly alternating current of an ordinary alternate current generator may be employed. These remarks apply equally to wireless telegraphy, though the latter is not limited by the condition that the spark rate must be high enough to be inaudible. The difference between telegraphy and telephony lies mainly it the manner in which the electric current is controlled. In the former the variations caused by pressing the Morse key are simple and definite, in the latter the motion of the microphone diaphragm caused by speech is almost infinitely complex, and the strength or frequency of the transmitting current must be made to vary in strict accordance. In the wire telephone the concentration of the current along one linear conductor from the speaker to the hearer makes it possible to work with low voltages and with an electric current which is, in all its variations, an exact replica of the sound waves. Quite a large percentage of the electrical energy sent out along the wire arrives at the receiver. This is not the case in wireless working where the transmission is over a plane and not confined to a line, and where, therefore, only a very small fraction of the energy sent out by the transmitter is picked up by the receiving station. It has thus been found necessary to use a current whose true frequency has no direct relation to

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that of the sound waves transmitted by it. Thus the sound of a man's voice, giving, say, 300 vibrations per second, is transmitted by an electric current making 100,000 vibrations in the same time. The ways in which this may be done are simple enough in theory. For instance, the strength or the amplitude of the current may be made to vary in accordance with the sound waves. The result is a current whose frequency remains 100,000, but which varies in strength from a maximum to a minimum and back again 300 times per second. There are thus beats of current, as it were, and these give to the ear at the receiver the desired impression of a sound having a frequency of 300 vibrations per second. Other factors instead of the strength of the current may be varied. Thus a change in the length of the waves emitted may serve the same purpose, and be transformed at the receiving end into a sound wave through the fact that the receiver is influenced more readily by waves of a certain given length than by those of any other length.

In the earliest attempts at wireless telephony an ordinary induction coil with a mechanical or electrolytic interrupter was used. Naturally no success was attained by this method. For the rate of interruption, and, therefore, the number of electrical impulses radiated per second, not amounting to more than a few hundreds, merely produced a harsh, deep note on which it was impossible to superpose the delicate variations which characterize the sounds of speech. By means of various devices, such as those of Majorana, Blondel and Fessenden, the spark rate has been increased until it is now possible to obtain from 20,000 to 30,000 distinct discharges per second. Telephony, of a kind, is possible by this method, though slight irregularities of the sparking produce harsh noises and render the articulation very imperfect. Next we have the methods of producing persistent high frequency currents developed by Elihu Thomson, Fessenden, Ruhmer and Poulsen, in which an electric arc in parallel with a condenser circuit is placed in a strong magnetic field, or an atmosphere of hydrogen, and adjusted until it is no longer a continuous discharge, but becomes a series of intermittent electrical rushes following one another with great rapidity. The frequency of these discharges is controlled by the resistance and voltage in the supply circuit, by the magnetic field about the arc, and by the electrical dimensions of the condenser circuit, and amounts usually to several hundreds of thousands per second. In this case the vibrations are forced and do not depend directly on the natural vibration period of the last-named circuit. If the magnetic field be reduced and the remaining quantities varied so that in the altered conditions the condenser circuit directly determines the frequency of the vibration, a purely alternating current is obtained, without any total extinction of the arc between discharges, the current in the arc merely increasing and decreasing periodically, without ever becoming zero. It is not easy, however, by means of this method to obtain so energetic an action as when the arc is intermittent, the power radiating from the aerial conductor connected to it not being as great. This method is a development of the speaking arc, discovered by E. R. Cram, assistant to Hammond V. Hayes of the American Telephone Company, while experimenting with Graham Bell's photophone in April of 1897 and embodied in an American patent of June of that year. It has been independently rediscovered in Germany by Simon (December, 1897), and Duddell in England (1900). The last, and perhaps most promising, type of current generator is the high frequency alternate current dynamo. Quite a large number of inventors have tackled the problem of designing a machine whose output may be reckoned in kilowatts, at a frequency above 50,000 per second. Among others, the names of Tesla, E. Thomson, Steinmetz, Ewing, Ruhmer, Duddell and Fessenden may be mentioned. The last named has recently constructed an alternator giving more than two kilowatts at 100,000 per second, which seems a very suitable generator for the purposes of wireless telephony and telegraphy.

Turning now to the means by which the form of the sound waves is imposed upon the otherwise uniformly alternating electric current, we find that the methods employed are based on a control of either the strength of current or its frequency. In the latter case it is essential that the receiver should be "sharply" tuned, so

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that a slight variation in the frequency of the current waves arriving at it may cause a considerable change in the current which they excite in it. The practical execution of the former plan may be carried out in several ways. The simplest, in theory, is Fessenden's method of employing a microphone directly in the aerial wire in series with a high frequency alternator. The difficulty here is the construction of a microphone which will control a large output of energy, for a high voltage must be applied and a considerable current must pass through it and be controlled by its action. Another method, which in one of its various forms is suitable when an arc is adopted as generator, consists in controlling the arc current directly or indirectly by a microphone, or by the use of a subsidiary coil forming part of the transformer which couples the power circuit to the aerial. Variation in the frequency of the current may be produced by the use of a condenser, one plate of which is mounted so that it vibrates when spoken to, thus altering the capacity of the system. As receiver any type of continuously acting wireless telegraph detector may be used in connection with a Bell's telephone, possibly the best being some type of electrolytic barretter. It should be noticed that, since the actual electric transmission is done by high frequency current, it is possible to arrange, as in telegraphy, for a large number of non-interfering stations in the same neighborhood. Between pairs of these, independent conversations may be carried out simultaneously.

It is difficult to determine the period at which wireless telephony first became possible. Dolbear, in 1882, claimed to have transmitted speech over about half a mile, and since then ever increasing distances have been attained. In 1900 Fessenden succeeded in transmitting speech a mile or more by a spark method. In 1906, using an arc, he maintained telephonic communication between Brant Rock and a schooner twenty miles off shore, and transmission at much greater distances is now being carried on. During the past year many other workers have advanced the development of the subject. Among other achievements may be mentioned the telephonic communication over fifty miles by the Poulsen system in Germany. The subject is being taken up by several of the wireless telegraph companies, and there are reports of wireless telephony being successfully carried out in many countries. Indeed, it seems to be more than probable that transatlantic telephony may follow very closely on the heels of telegraphy, and that within a time which will seem short when it is past, the New World and the Old may be within speaking distance of one another.

An account is given in L'Electricien of the electric installation at Turin, where two furnaces, each of 1000 horsepower, on the system of Mr. Stassano, are now in operation. In these electric furnaces the special steel needed for the Italian automobile industry will be produced direct from the ore. It will be remembered that Commander Stassano began his experiments in 1900, at Darfo, in a small manufactory on the shores of Lake d'Iseo, with a furnace of 100 horsepower. He first employed a rotary furnace with only two electrodes, supplied by a monophase current. The new furnaces are operated with a three-phase current supplied by the Alta Italia Company, and have two three-phase arcs with six electrodes, the useful effect being, however, only 51 per cent. Of the 1000 horse-power furnaces, one is rotary and the other is fixed. There is only one 200 horse-power furnace, and there are two smaller ones of 100 horse-power each. The tension of 21,500 volts is reduced to a working pressure of 150 volts, and the current for each arc is about 2500 amperes. The 200 horse-power furnace works with a current at a pressure of 100 volts, and the two 100 horse-power furnaces use current at 80 volts pressure.

Architects and draftsmen can turn electric light to advantage for tracing purposes, especially where the original drawings to be traced are on such thick paper that natural light does not come through. A section of a top of an ordinary drawing table can be removed and replaced by a piece of plate glass under which the necessary incandescent lamps equipped with tin shades may be fitted in an inverted position. These will throw the light up through the glass beneath the drawing and the tracing paper.

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How to Build a Sixteen-foot Launch

CARL H. CLARK

II—Getting Out and Setting Up the Frame.

The first step in the actual work of building the boat will be to get out the keel, stem and deadwood. The outline of these several parts has been laid out on the brown paper and may now be used as a pattern. The general plan of the foundation is shown in Fig. 4. For convenience in using, it is customary to make a pattern of the outline from this stock, as it is easier to use and more durable. If it is not desired to do this the brown paper may be used as a pattern directly.

Starting with the sheer plan, a line should now be drawn ¾ in. above the rabbet line and parallel to it: this is the back of the rabbet. Inside of this last line and ½ in. away another line is now drawn; this line is the inside of the keel and deadwood. The line of the inside of the stem is drawn 2 in. inside of and parallel with the rabbet and is joined to the line of the inside of the keel. This line of the inside of keel and stem is the line to which the pattern is to be made. If the brown paper is used as the pattern it may be cut around to the outside line of keel and stem and narrow slits cut at intervals along the rabbet and inside line.

The exact details of the joints between the several pieces of lumber will depend upon the size and shape of the stock obtained. The arrangement shown in Fig. 4 is a good one to follow; the keel being 4¼ in. deep and straight except at the forward end, where it turns up slightly; the stick will need to be about ½ in. wider to make the crook. The stem is a natural crook knee and is scarfed to the keel as shown, with a lock to prevent its being forced forward. The heel of the stem is thickened up to give good fastening. The keel and stem are fastened together with 5⁄16 galvanized rivets.

The deadwood is 2½ in. thick and rests on the top of the keel. Its upper edge is shaped to the inside line of the pattern except at the forward end where it is thickened up to about 1 in. to give stock enough for fastening. At the forward end of the deadwood nails may be driven down into the keel, while at the after end long pieces of 5⁄16 in. galvanized rod may be driven up through the keel into the deadwood. At the after end of the deadwood the stern post is fitted; it is the same thickness as the others, and is locked into the keel as shown, and fastened with 5⁄16 in. galvanized rod. On the upper end the stern post is a lock for the tail piece. In some cases it is possible to get a piece of stock wide enough to cut both keel and deadwood from, but this is rather wasteful of stock.

The tail piece need be only 2 in. thick, about 3 in. deep at the after end, and increasing in depth forward. It locks over the stern post and fits on top of the deadwood, and is fastened with long spikes or rod to both. The difference in thickness between the deadwood and tail-piece should be tapered off, and the whole, keel and stem, planed smoothly.

The shaft centre line should be laid out on the pattern; it is 18 in. above the base line on mould No. 2, and 8 in. above the bottom of the keel on the after side of the stern post.

The pattern should now be laid on and the two rabbet lines marked on carefully. At the same time the mould points should be marked, also the line of the shaft across the deadwood, and the sheer height on the stem. All these lines should be transferred to both sides of the structure.

The hole for the shaft should next be bored; it is 1 in. diameter and the boring of it may give some trouble on account of its length. A ship auger should be used and the direction of the shank of the auger sighted frequently; with care this can be successfully done. The rabbet for the plank should now be cut; it is a sort of groove for the edge of the plank as shown in the small section of the keel. It is cut between the two rabbet lines already drawn in, but at a varying angle, so that it can only be roughed out at this time and finished exactly after the boat is set up.

All parts of the foundation, including the stern board and stern knee should be of oak. The stern board is ¾ in. thick and should be gotten out next. If a

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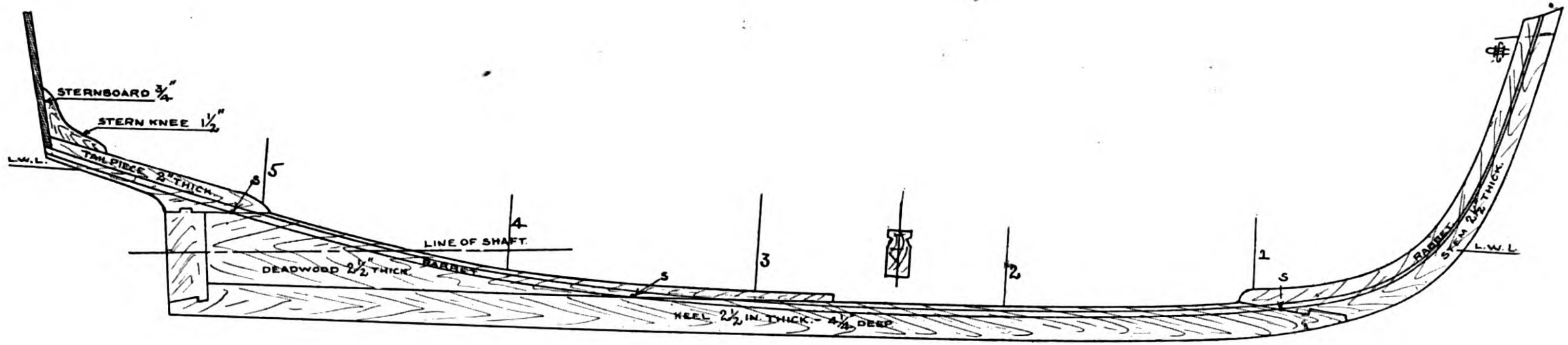

FIG. 4

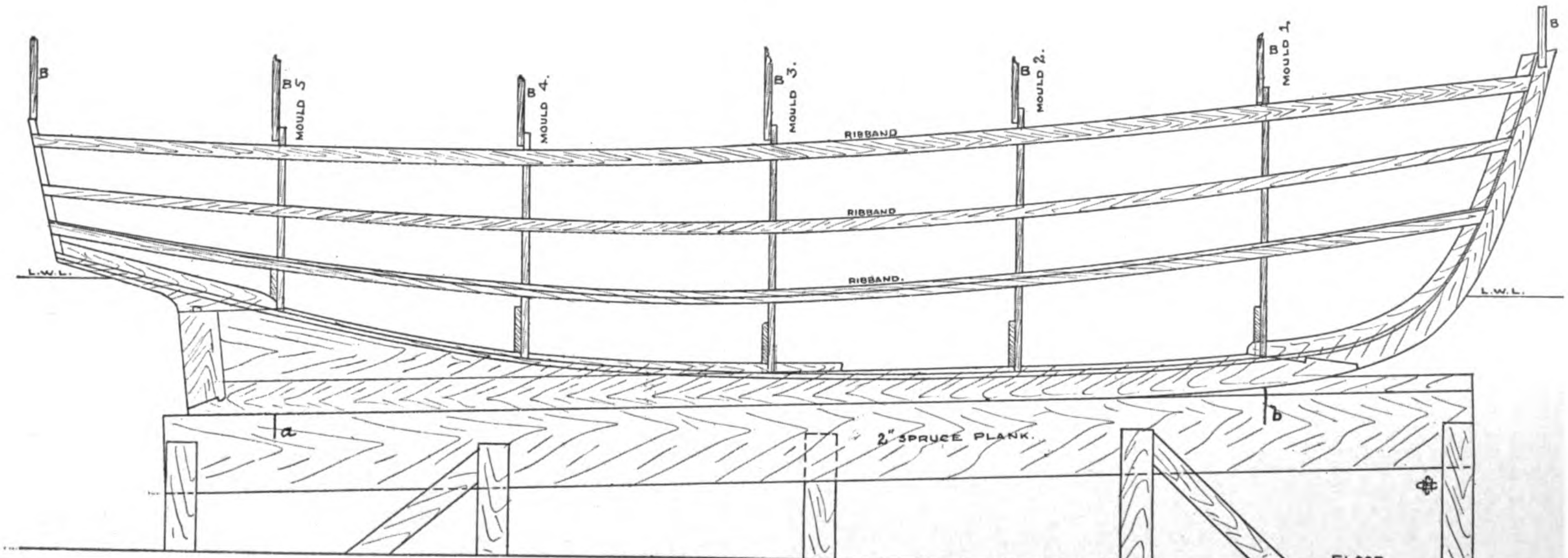

FIG. 6

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board cannot be obtained wide enough to cut it in one piece it may be made of two pieces carefully joined and cleated on the inside. The shape of the stern board is taken from the shape already laid out on the brown paper. As this shape is to the outside of the plank, the thickness of the latter, 5/8 in., must be taken off parallel all around. The outline is then laid out on the after face of the stern board, and the latter cut to shape. At this point note should be taken that the outline of the stern board should not be sawed out square, but should be bevelled, the forward face being the larger; this to allow for the bending in of the planks at the stern. In order to set the stern board at the proper angle fore and aft, the foundation should be laid flat upon the pattern of the sheer plan and the stern knee fitted to the correct angle and position. It is then fastened into place on top of the tail piece. The tail piece should be cut down straight on the line of the stern knee to the upper rabbet line, to allow the stern board to set down even with the rabbet, as shown in Fig. 4. The stern board is fastened with galvanized rivets riveted on the inside. In setting the stern board great care must be taken that its centre line coincides with that of the stern, otherwise the boat will not be in line.

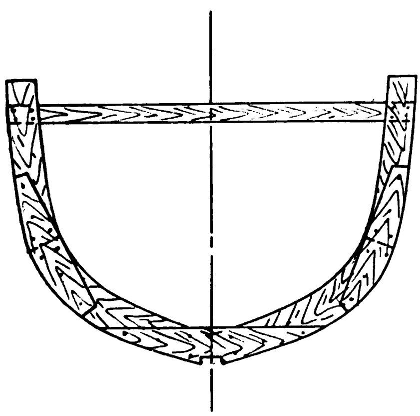

FIG. 5

The next step will be to make a "mould" or form for each cross section. On each section a line must be drawn 5/8 in. inside the outline to allow for the thickness of the plank. The general construction of the moulds is shown in Fig. 5. They may be made of any stock, but must be accurate to shape and strongly put together. The cross brace at the top keeps the mould in shape and should be placed with its upper edge at the sheer point for convenience later.

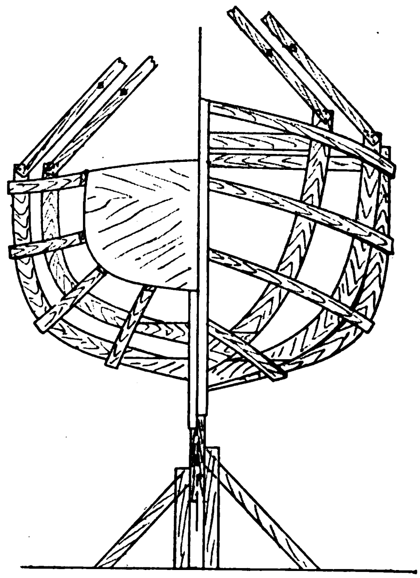

FIG. 7

For setting up the boat a place should be chosen having a wood floor if possible, and with good head room and heavy beams overhead. A bed for supporting the boat while building must now be made from a heavy plank set on edge as shown in Figs. 6 and 7. It must be well braced both fore and aft and sideways If braces cannot be nailed to the floor, the whole may be made self supporting by building it upon timbers set crosswise under the uprights. The bed must be set on an incline the same as that of the keel. The points a and b, under mould points 5 and 1 respectively, are 10 ft. 8 in apart and 1 ft. 6 in. and 1 ft. 10½ in. high respectively. The short piece of bed on top of the main plank is fitted in place later to support the stem.

The foundation is now set up on the bed and held plumb by diagonal side braces extending from stem and sternboard to the beams above. Diagonal braces should also be fitted fore and aft. The keel is held on the bed by chock pieces fastened on the sides.

The moulds are next set up in their proper places on the keel at the marks laid out from the pattern. A notch must be cut in the bottom of each mould

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as shown in Fig. 5, of the proper shape and depth to allow the lower corner of the mould to come even with the other rabbet line. This allows the plank to fit evenly into the rabbet when lying on the moulds. In setting the moulds it should be noted that No. 3 is set on the mould point, Nos. 1 and 2 are set with their faces on the mould point, while Nos. 4 and 5 have their forward faces on the point. The moulds should be nailed to the keel and should be adjusted exactly plumb, and square with the keel; they are held by diagonal braces as in Fig. 7. The centre line of each mould must also be in line with that of the stem and stern board: a plumb-line stretched fore and aft will aid in this adjustment. A board should be fastened on either side of the centre fore and aft along the tops of the cross braces for stiffness. The moulds must be well braced, as there is a considerable strain on them during building.

A series of ribbands or strips about 3 in. by 1 in. should now be bent from stem to stern around the moulds and fastened lightly to each. The general appearance is shown in Fig. 7; the lower ribband is omitted in Fig 6 for clearness. The ribbands now touch the moulds only on the corners; the edge of the moulds must therefore be bevelled until the ribbands bear evenly on the entire edge. If any unfair places appear they should be looked up and corrected, either by trimming off or skimming out the moulds, until the surface is fair in all directions.

The rabbet in the keel and stem may now be trimmed out until the square end of a piece of board resting on the moulds will fit evenly into the rabbet at all points. The edge of the sternboard also should be trimmed down to the proper bevel. At the points s.s.s. in Fig. 4, a hole about ¼ in. in diameter should be bored through the joint, and a soft pine dowel inserted from side to side; this prevents the water from running along the seam and so into the boat.

When these directions have been carried out the boat is ready for timbering and planking, which is the next operation

An Electrical Baggage Truck

For carrying baggage and mail between trains and the baggage and mail rooms of stations, the Pennsylvania Railroad Company has recently built three electrically propelled trucks. Two are in service in the Broad Street Station, Philadelphia, and the third is in Altoona.

Although similar in general appearance, the three trucks are not alike. They are regarded as still in the experimental state, and monthly reports of operation are compiled with a view of developing the best type for general use. The following description applies to the particular truck which has been found to be most serviceable up to the present time.

In general appearance the truck is similar to the hand-drawn type universally used throughout the country. It is operated by one man, who walks ahead of it and steers it with a tongue or handle, in the same way that he would if it were not electrically propelled.

Power is taken from a storage battery contained in a box secured to the under side of the platform near the middle. It consists of fourteen Willard cells and has a capacity of 136 ampere-hours. The batteries are charged about eight hours daily at the rate of seventeen amperes.

Each of the rear wheels is driven by a Westinghouse type AA, four-pole series-wound, twenty-volt motor. Double-reduction gearing is used between the motor and rear wheel, and each motor is provided with a solenoid brake of the multiple-disc type on the end of its shaft. These brakes form an essential element in securing safe operation; for the truck can not start of itself even if it is on an incline, and if it is in motion it stops promptly and automatically as soon as the power is shut off.

Control of the motor is made as simple as possible. Only two speeds forward and two backward are provided. These are approximately four

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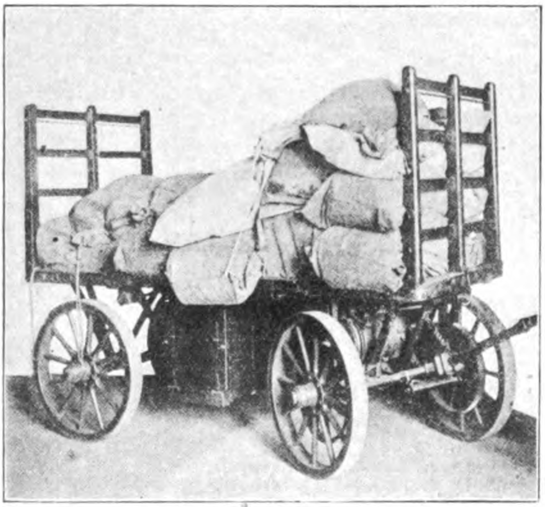

and six miles per hour for the loaded truck, and on the crowded platforms they have been found fast enough.

The two motors are operated in series, and on the low speed a wire resistance is inserted. The motor current is controlled by two single-pole solenoid switches; one for the low and the other for the high speed. The solenoid switches are enclosed in a box directly in front of the storage batteries, and current for operating them is controlled by contacts in a small box on the outer end of the tongue or handle.

The contact box is of metal, cylindrical in form, and operated by a rod which slides axially through it. The rod is provided at one end with a ring, which is readily grasped by the operator. A slight movement of the rod starts the truck forward at low speed; further movement of the rod gives the high speed. The rod is returned to the off position by a spring, so that the instant the ring is released the truck stops. It can not be started by any accidental knock, but only by an intentional pull on the ring. The pole-changing switch for running the truck backward or forward is located in the box with the solenoid switches and operated by a small lever under the front of the platform. The tongue or handle is connected by reach rods to pivoted bell cranks carrying the two front wheels in a way similar to that generally used upon automobiles.

This truck has been in operation about six months and has won the confidence and approval of the men who use it. One man is enabled to handle the immense loads of baggage and mail quickly and without the usual tugging and pulling by several men. —Electrical Review.

According to L'Electricien, there were in France, on Jan. 1, of the present year, 1413 electrical generating stations. From these works, public supplies were furnished to 2912 localities, whereas the total number of gas works in France on the same date was only 824, serving 1209 different localities. Only four out of the 87 departments contained over 100 places with a supply of electricity, viz.: Aude, 176; Isère, 166; Doubs, 103, and Herault, 100. Twelve of the departments had from 50 to 100 places with a supply of current, 51 had more than 10 but less than 50, and only 17 had less than 10 localities furnished with electricity. The department of Isère had the largest number of generating stations, 60 in all; and the Basses Pyrénées comes next with 43. More than two-thirds of all the works generate their current by hydraulic power, either alone or in conjunction with steam or gas engines, but 831 works have only water power. In 942 works, the current generated is continuous, while 256 works generate triphase current, and 157 produce simple alternating current.

The American Journal of Science gives details of the discovery by Professor B. B Boltwood of Yale University, of a new source of radium. Evidence has been obtained of the existence in the uranium metals of a new radio-active element which emits both alpha and beta radiations, which produces no emanation, and which resembles thorium in its chemical properties. It is, without doubt, a disintegration product of uranium and is in all probability the immediate parent of radium. The name "ionium," derived from "ion," is proposed for this new substance, which would seem to be appropriate, because of the ionizing action which it possesses, in common with the other elements which omit alpha rays.

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The Construction and Management of Gasoline Engines

CARL H. CLARK

XIII.—Choice of Engine.

In making a choice of an engine there are naturally many points to be considered, such as: the style of boat into which it is to be fitted, the conditions under which it is to be run, the location, and the amount of money which is available for the purpose.

The engine must, in the first place, be suited to the boat. A light, high speed racing boat should have a light, high speed engine, as weight is of the greatest consequence. The engine, also, is run at its high speed only for a short space of time, and at other times is run at a moderate rate of speed. The wear and tear on the engine is thus not great, and the light engine may be made to give good satisfaction and a reasonable length of service. On the other hand, a heavy working boat should be fitted with a slow speed, heavy type of motor. In this case, where the engine must run continuously at its full power, the heavy engine, with its liberal bearings and strong parts will be found to give the best satisfaction. In this class of boat weight is of little or no consequence, and advantage may be taken of the durability which is added by the extra metal. Between these two extremes are the middle classes, each one of which must be considered on its own merits.

For installation in a sailing boat, as an auxiliary, a fairly light engine should be used, as the weight must be carried at all times, and a heavy engine is a rather bad handicap when under sail. For this purpose the two-cycle engine is very well suited, as it is light in weight and takes up little room. While the two-cycle engine may not be as wholly reliable as the four-cycle, great reliability is not absolutely necessary in an auxiliary, as the power is used only occasionally. Another point which should be borne in mind in fitting the power in this class of boat is that, while a heavy boat can be driven at a moderate rate of speed by a small power, any increase of speed above this point adds very rapidly to the required power. Thus to obtain anything more than a very moderate speed in an auxiliary will require an undue amount of power, and consequently of weight and space occupied. The propeller, also, must be dragged through the water when under sail, which tends to retard the speed; for this reason, also, the power should be kept reasonably low. A speed of from four to six miles per hour should be considered sufficient for the usual type of auxiliary boat.

Launches of the ordinary type will be fitted with power according to their length. For boats under thirty feet long, an estimate of the power may be had by dividing the length by two and subtracting seven, the result being the horse power required; thus: horse power $= \frac{L}{2} - 7$. This is, of course, only a guide, and may be modified by the conditions: if the launch is more than usually bulky, or if greater speed is desired, more power must be added according to the conditions.

The question is many times asked as to the advisability of getting a single cylinder or a two-cylinder engine. As stated in preceding chapters, the two-cylinder engine runs more smoothly and with less vibration than the single cylinder engine and is therefore preferable for light boats where vibration would be objectionable. The two-cylinder engine has lighter parts, and is thus easier to handle and to start. On the other hand, the single-cylinder engine of the same power is cheaper and somewhat simpler to run, and there are fewer parts to look after. For heavy working boats, then, where vibration is less noticeable and objectionable, and where only moderate speed is necessary, the single-cylinder will be entirely satisfactory.

In selecting an engine, close observation should be taken of the general design. An engine should be chosen which is easily accessible in all its parts. While it is not advisable to take down the engine as long as it is

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doing good work, there is always the possibility of minor troubles which necessitate taking the engine down. The user should become familiar with his engine and learn how to take it down and re-assemble it. In this way many small troubles can be located and remedied and the life of the engine greatly lengthened.

The general quality of the workmanship should be carefully observed. The most important part is of course the cylinder bore and piston. It is not always possible to judge of the quality of these; but one can close all the openings from the cylinder and then try the compression, and thus judge of the accuracy of the fit between the rings and the bore. This may not always be a complete indication, as the liberal use of oil may prevent the escape of the air and seem to indicate a compression which does not exist. A little common sense will, however, usually enable one to determine this point.

The bearings should be carefully looked over to make sure that they are of liberal size and carefully fitted. Main shaft bearings may consist either of composition bushings forced into the iron casting, or of babbitt metal, which is run into depressions in the casting. Either way is good when properly done. The former, however, is perhaps somewhat easier to make repairs on, as new bushings may be obtained and the old ones replaced.

The crank shaft, also, is a vital point; it has sometimes been the custom of makers of the cheaper engines to use crankshafts of cast steel. This material is, however, not suited to this purpose, and great care should be taken that the shaft is of forged steel. There is no good way for the amateur to ascertain this fact, and the maker's word must be taken.

The water pump can be examined to see that it is well made, with a good packing gland and good bearing surfaces. If a make-and-break igniter is used, all parts should be substantial and well made, and also have some means for varying the time of ignition.

For coupling to the propeller shaft, the sleeve and set screw coupling before described is suitable for engines of less than three or four horse power; but for larger engines the flange coupling, which is keyed to the shaft, should be used. There is also a form of sleeve coupling used by some engine builders which consists of a split sleeve which grips the shaft and does not depend solely upon the set screw for holding power. This form of coupling is safe on all sizes of engines.

The question of fitting a reversing clutch also depends upon many circumstances. For small launches, especially when fitted with two-cycle engines, a separate reversing clutch is hardly necessary, as the boat is light and easily handled, and the engine can be reversed when needed. In the small sizes, under four horse power, the reversing propeller is fairly satisfactory; but its use can hardly be advised for larger powers. For larger boats the reversing gear is advisable, as it allows the engine to be started without turning the entire shafting and propeller, and of course allows the motion of the boat to be changed at will.

When possible, it is of some advantage to use an engine which is built somewhere near the locality where it is to be used, or at least which has an agency in the locality. Accidents are always possible, and it often saves a large amount of time to be able to quickly obtain some broken part, without the uncertainty and delay of sending a long distance.

As to price, one should buy as good an engine as the means at hand will allow. There are many low-priced engines on the market, many of which will give good service for a time, but which cannot, from their nature, be as durable as the higher-priced ones. In many cases the engine is advertised at a ridiculously low price: but it is found that this price is for the bare engine, with no appurtenances. By the time these have been added to the original price, the cost is about the same as that of the apparently higher-priced engine.

It is better to purchase the engine and fittings complete, as in this way the fittings best suited to the engine are obtained.

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Photographing for Profit

WILLIAM RESTELLE

There are two classes of photographers, namely, those who photograph for profit and those who photograph for pleasure. The former class is recruited almost entirely out of the latter class. Professional photographers, as a rule, began taking pictures for the pure pleasure there is in this very excellent hobby, and, having found their pastime a very engrossing one, decided that they would follow it continuously for a living. They still find considerable pleasure in picture making, but they are now also finding in it something more tangible.

Photography is an expensive hobby, not only in the way it consumes one's pocket money, but in the great demands it makes on one's time. It is not necessary for an amateur to enter the ranks of the professionals in order to make money out of his hobby, nor is it necessary for him to devote much more time to it than he is at present doing. All that he needs is a nose for business and to quit snapping pictures without any definite object in view. There is a very promising and ever-widening field for the amateur photographer who is anxious to make a little extra money in his spare time. It is the purpose of this short article to describe the scope of this field and how one should go about exploiting it.

There are three great subdivisions in which "photographing for profit" may conveniently be divided. They are (1) the press, (2) advertising, (3) work for institutions, groups and private individuals.

The Press. It is only a few years since press photography attained any great importance. Today it is a business of no mean proportions. There are said to be over twenty thousand periodicals of one kind or another published in the United States, and by far the greater number of these use suitable illustrations whenever they can get them. Some of these consider a mere "thanks" sufficient recompense for the privilege of using your pictures; some pay a small price for everything they use, while others, and especially the papers and magazines of wide circulation, pay all the way from one dollar to five dollars and more for timely, interesting and well-done pictures. It is impossible in the limited space of this article to describe the market for photographs, for it is very wide and very diverse. One must, indeed, study it for himself, and there is only one way to do it, namely, by examining every publication you can lay your hands on, noting its nature and kind of material it uses, not only its illustrations, but also the text matter of its articles. On the editorial page of many publications readers are asked to submit pictures, articles and news items which they think suitable for it. As there are hundreds of periodicals which one never sees on the news-stands, it is advisable that you get a magazine catalog and send for sample copies of periodicals of all kinds. It is also a good plan to stack these away for future reference and to make a note of every possible market in a special book. When submitting photos to editors always enclose return postage in case they are unavailable. It is better to mail photos to publishers unmounted, not only because they are more convenient to the engravers in that form, but because it means a great saving in postage. A short description should be sent with each photograph, as a rule, but it is not by any means always necessary. When writing to editors make your letter brief and business-like, giving your full name and address and stating that you should be glad to accept payment for any material used at usual rates.

Advertising. Striking photographs are coming more and more to be used by advertisers in their publicity campaigns. The market as yet is quite limited, but it is an ever-widening one. Large advertising firms and syndicates occasionally purchase really striking photographs that can be used advantageously in attracting attention to their wares. By studying the advertising methods of large business houses suggestions often come to one's mind and a market for pictures occasionally found.

Work for Private Parties. Though there is less glory in this class of work, there is also less disappointment. The market, too, is close at hand and a great deal steadier. Instead of taking photo-

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graphs on a chance of marketing them afterward, you solicit orders from private families, groups of people, societies, churches, schools, the local military regiments, etc. By getting a certain number of any particular body to promise to purchase so many pictures from you of the group in which they are contained, you are sure of covering the cost of printing the photographs if not of realizing a profit from them. There is a good field for competent amateur photographers to make money on the side in this way in almost every village, town and city throughout the land. All that is required is the ability to do fairly good work and a little of our genuine American push and hustle.— *American Photography.*

The Wonderful Flight of an Airship

Yesterday registered an event in the history of human progress. For the first time, men climbed into the car of a balloon, announcing their departure for a given city 187 miles away; went straight to their destination, without even touching earth or suffering accident; and landed triumphantly at the appointed hour in front of the shed where their airship was awaited.

This notable flight was accomplished by La Patrie, the second of our dirigibles. She made the journey from Paris to Verdun in six hours, forty-five minutes. As a rule the railway trains take six hours to do it. Her performance breaks all records; at the same time it proves that dirigibles are capable of being controlled to a nicety during long voyages, and that they have been perfected to a point where they are henceforth to be reckoned with as practical engines. Already valuable as fighting machines, they are destined to revolutionize military science.

Next spring tourist dirigibles will be in operation. Yes, actually! And the trip of La Patrie and the twenty-six flights of La Ville-de-Paris demonstrate that we are upon the threshold of an era of aerial travel.

General Leon Durand, who commands the Sixth Corps, came to Verdun last evening, and returned to Chalons by the 3.42 train today. From the station he witnessed La Patrie's arrival, and immediately sent an officer to carry his warmest felicitations to the commander and crew of the airship.

The date, Nov. 23, which has witnessed this flight of nearly 300 kilometres from Paris to Verdun, will be a red-letter day in aeronautics and a day famous forever in the annals of the French army.

J. du MONTRUT.

When news of it reached Paris this sensational flight aroused immense excitement, for it was not only reassuring, but appealed at once to the sportsmanlike instincts and the patriotic enthusiasm of the Parisians.

La Patrie's journey, favored by the wind, was accomplished under remarkable conditions. Setting out at 8.45 a.m. from the military park at Chalais-Meudon, the dirigible had on board Commandant Bouttiaux, Commandant Voyer, Captain Bois, and two mécaniciens. La Patrie did not cross Paris; she sailed along above the fortifications, crossed the Seine near Chareton, where she stirred up vast excitement, and headed straight for Verdun. She reached Coulommiers at 11, Montmirail at 11 45, and Chalons-sur-Marne at 1.15. There hydrogen tubes were in readiness to fill the balloon if necessary, but La Patrie made no stop; instead she dashed on at twenty-three miles an hour for Verdun.

At 2.10, the war balloon passed over Sainte-Menehould and was cheered by a squadron of cavalry. Then the fog settled and the dirigible kept within a hundred yards of the ground to pick her way. Leaving Clermont to the right and Dombaste to the left, she soared over Verdun at 3.30 and reached its park, where she effected a landing with the aid of a squad of military balloonists who had been awaiting her.

Our correspondent, who witnessed her arrival, sends us the following despatch:

VERDUN, Nov. 23.

When La Patrie came in sight, a prolonged shout of admiration went up from the crowd massed about the shed. Among them were a lot of officers. Colonel Giraud, of the engineering corps, was there to welcome and take possession of the new engine of war, which

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Verdun is the first to honor. The dirigible grew visibly bigger moment by moment, but she could not be made out very distinctly for she was enveloped in mist like a ship in a fog. Just then four automobiles, which had followed the airship all the way from Chalais-Meudon, arrived in front of the shed. MM. Pierre Lebaudy and Julliot (this latter both engineer and builder) alighted. They told of their trip and how, after losing track of La Patrie, they caught sight of her again at Chalons, thence running ahead of her from Clermont-en-Argonne on.

A thrill of patriotic enthusiasm came over the spectators. The dirigible was swiftly approaching. We could hear the roar of her propellers. We could see the passengers in her car. A moment later, the airship descended in a daring and sensational curve to make her wondrous landing. She swooped around her shed as if anxious to inspect her abode before entering it. Shouts rang out — "Vive la Patrie! Vive la France!"

It was an unforgetable moment. Women waved their handkerchiefs, men lifted their hats, officers held out their képis at arm's length. The dirigible went through her evolutions with mathematical precision. As she passed before the shed, the guide-rope was flung out; the army balloonists seized it, and La Patrie halted over the plain at the very point at which Commandant Bouttiaux had decided last Tuesday that he would alight.

A ladder was quickly let down from the car, and the commandant de route, Commandant Voyer, descended first. The crowd surrounded him, storming him with congratulations. Colonel Giraud grasped both his hands warmly. Then in succession descended Commandant Bouttiaux, director of the park at Chalais-Meudon; Captain Bois and the mécaniciens, Neffroy and Gérard. The aeronauts were stiff with cold, but their eyes beamed with delight.

Then followed some genuinely patriotic effusions. Julliot, the engineer, was the happiest man of all. He thanked the crew for the feat they had just accomplished with La Patrie and the splendid record they had established. Their manœuvres had been performed with extraordinary skill and alacrity, for the dirigible was got down by 4.30. Fifteen minutes later she was inside her shed.

Commandant Bouttiaux, with whom I talked, gave me certain details regarding the trip. Over Vincennes and Coulommiers the aeronauts encountered a rather violent headwind; from there on the wind blew gently from the south at an angle of ninety degrees. When the balloon started she had on board 250 litres of essence; when she landed she still had 150 litres. She kept mostly at an altitude of from 450 to 800 yards, but cold and fog made the trip an extremely painful one. As for the throwing out of ballast it was insignificant, barely fifty kilogs. "We might have thrown out ten times as much," said Commandant Bouttiaux. "We met with no accident. The motors worked admirably."

I talked also with Captain Bois. His eyes were swollen and inflamed by the fog that had made the steering so difficult, but "what was that when such results had been achieved?" — Translated from *Le Figaro*, Paris, of Nov. 24, 1907.

The Selection of a Proper Lubricant

ROGER B. WHITMAN

In the early days of the automobile industry a manufacturer was satisfied if his car could be depended on to cover fifty miles without a halt, and points that are now considered to be of paramount importance were entirely overlooked in comparison with the necessity for producing an engine that would run. With the advance in automobile construction has come a constant improvement of detail, until at the present time the designers are giving prominence to points hitherto passed over as too trivial to consider. Improvements in lubricating systems have been marked, for the proper oiling of the various bearing surfaces was early recognized as being essential to the life of the mechanism, but too little attention has been accorded to the selection of the lubricants to be used in them. The owner of a car is usually under the necessity of accepting the statements of the supply

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man, buying the oil that is most strongly recommended, and knowing little of the subject himself, he takes for granted that what he gets is the best that the market offers.

As a matter of fact far more depends on the choice of an oil than is generally supposed, as a lubricant for use in the cylinder of an internal combustion engine must possess certain characteristics in order that the engine may deliver its full power with the least possible wear. To appreciate this it is necessary to understand something of the service that a lubricant is required to give and the way that it does its work. Primarily, the function of a lubricant is to interpose a film between the two surfaces of a bearing, separating them, and acting in a manner similar to a ball bearing. This simile to a ball bearing is not so extreme as it may seem to be at first sight, for the particles of oil may be considered as balls rolling between the two surfaces. Without this film of oil the friction between the surfaces would generate heat, and as heat causes expansion the binding of the bearings would be the result. The first requisite of an oil is its ability to keep the two surfaces of a bearing separated; in other words, it must be of such a character that its particles will be capable of resisting the tendency to squeeze out, caused by the pressure of the bearing. This characteristic, which enables the oil to resist an attempt to separate its particles, is cohesiveness, or, technically, viscosity. The greater the viscosity of an oil, the more its particles will cling together and resist the pressure of the bearing that tends to separate them and squeeze them out. The viscosity of gasoline and kerosene is almost nil as compared with that of a heavy oil, and they would run out of a bearing as fast as they were poured in. It is this characteristic that determines the difference between the grades of light, medium and thick oils, and the selection of one of these depends on the service demanded, a bearing that supports a great weight requiring a heavy oil of high viscosity, in distinction to a bearing carrying a light load, that may be fed with a thin oil.

An oil that forms a film between the the surfaces of a bearing operating at the ordinary temperature of the atmosphere is doing all that can be expected of it, but if the bearing is normally at a high temperature another element must be reckoned with. When any oil is heated it becomes thinner, and the first effect of this is the reduction of the viscosity; its particles will be rendered less cohesive. This need not be considered in the selection of a lubricant for the change speed gear, wheels and axles or similar parts of an automobile, for if these are properly designed their temperature should not vary from that of the atmosphere to any great extent. A much more complex problem is presented in the proper lubrication of the pistons and cylinder walls of the engine.

The intense heat in the cylinder at the moment of combustion imposes a severer duty on the lubricant than can be duplicated elsewhere, and no oil can be made that will not eventually be consumed, passing off with the exhaust. To lubricate the piston and cylinder is similar to supportlng on ball bearings a load so heavy that the best balls will ultimately be crushed, with the necessity of constantly supplying new balls to take the place of those destroyed. The better the material of which the balls are made the longer they will resist the crushing action of the bearing, and, similarly, the higher the burning point of an oil the longer will it continue to perform its duties as a lubricant before the heat decomposes it. The processes of giving an oil a high burning point are well understood, and there are many brands on the market that in this respect offer all that can be desired.

A further and more important distinction, however, must be made regarding the oils that will burn and pass away, leaving the least possible residue. The carbon that enters largely into the composition of oils will, on the destruction of the oil in the cylinder by the heat, enter into combination with any oxygen that is present and pass off as CO_2, but with a properly proportioned mixture the amount of free oxygen present in the cylinder is very small, and the carbon is therefore deposited on the walls of the combustion space. The automobilist knows the result of this only too well, and has had his experience with fouled spark plugs, gummed piston rings, stuck valves and the other effects of this heavy carbon deposit. The parallel of the ball bearing

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supporting the excessively heavy load may be again referred to. If the balls are such a material that when crushed they will be reduced to powder, there will be little interference with the operation of the bearing, but if they break into fragments these will remain in the races and bring the remaining balls to quick destruction. Obviously the lubricant that resists disintegration by the heat for as long a time as possible, and in decomposing leaves the least carbon deposit, will give the best result in thorough and efficient lubrication of the piston and cylinder walls of an internal combustion engine.

The ability to reduce the quantity of carbon contained in a lubricant is the result of a long series of tests and experiments that have been made to prove a theory, but before going into the effects it will be well to understand something of the processes of refining.

The crude oil, petroleum, is placed in a retort and heated gently to drive off the more volatile elements, and these when condensed are known as rhigolene and chimogene. A higher temperature volatizes the various grades of gasoline and kerosene, an increased heat driving off the lightest grade of lubricating oil. A further increase of temperature will volatize the heavier oils, but as the process continues more time is required to free them, and the expense of production becomes greater. For this reason the oil manufacturers prefer to treat the residue left in the retort by other methods that separate the various grades of heavy oils and greases.

While the oils that are distilled contain carbon, it is in less proportion than is found in the oils procured from the residue, and therefore the distilled oil, if the process is continued sufficiently to obtain the necessary viscosity, will be preferable to the other.

Numerous tests and experiments have been conducted on samples of the distilled oils as well as those obtained from the residue, and consisted of extended processes of filtration, each filtration resulting in the production of an oil that was considerably lighter in color than it was previously. The viscosity and burning point, as well as the other characteristics, remained unchanged. These samples of oil, in which the process of filtering had been continued until nearly all of the color was removed, were burned in comparison with samples of the same oils unfiltered. The results were of great interest, for in each case the residue of carbon was decreased, the decrease being in proportion to the loss of color. The samples filtered to such an extent that they were nearly colorless left a residue of carbon so slight as to be negligible.

A knowledge of the fact that carbon and color in an oil are practically synonymous is of advantage in the selection of an oil, but it should not be forgotten that a thin oil will be of lighter color than a thick. The first essential is the selection of an oil that has sufficient viscosity, and of the several brands that comply with this requirement, and have a sufficiently high burning point, that of the lightest color should be chosen. On test it will be found to contain a smaller proportion of carbon, and the results from its use will therefore be better than would be obtained with an oil of a darker color.

The proper viscosity for the oil is determined by the grade of iron used in making the cylinders, and in the number, fit and location of the piston rings. A very close grain iron, which takes a smooth finish, requires a thinner oil than a rougher iron, for which an oil of higher viscosity is required to maintain a tight fit. The manufacturers' hand books furnish information as to the viscosity and this should be used until experience proves that a change will be beneficial.—*The Automobile*.

Whenever a pair of spur or bevel gears have been dismounted from their normal positions for any reason it is of the utmost importance that their security on their shafts be looked to, as well as their mesh. The former precaution insures their running true, and answer for their unity of movement with the parts which they drive, while the latter is of marked effect in regulating their ease and silence of operation.

A new commutator insulation recently patented is hard mica calcined under pressure. The mica is pressed between two plates of suitable material, which are placed in a calcining furnace. The internal structure of the mica is said to be so altered that the mica is as soft as the commutator segments.

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"His First Smoke," by A. N. Terry
First Prize

Our Photographic Contest

We take pleasure in publishing this month reproductions from two photographs submitted in our photographic contest, "His First Smoke," by A. N. Terry, as first prize, and "My Shop," by Joe Cook, given honorable mention.

Many and varied were the photographs which came in to this, our second contest, and it was hard to make a decision. In the selection of first prize we were guided by the photographic excellence of the prints first, then choice of subject. A print might be perfect in quality, yet be entirely lacking in interest and show very poor composition; or, on the other hand, represent a very interesting subject, yet be so poorly made that it had begun to fade and spot before the judging was made.

Generally speaking, the quality of the work was very good, and as we have been requested by many to send criticisms on the prints, stamps having been sent for the purpose, we will do so, and trust they will be of some help.

Hereafter, we will endeavor to criticise in the pages of the magazine, if requested, photographs submitted to our photographic contest, and from our experience know they will not only help the maker of the print, but others as well.

Owing to the popularity of this subject, we will continue the monthly contest and award a prize of one dollar for the best print submitted during the month. We shall look forward with interest to the new work and will take pleasure in watching progress of our contributors.

Any photographic information which we can furnish will be cheerfully given.

It is a fact little appreciated by the average user that a large proportion of the effective gas which performs work in the cylinder of the internal combustion motor is composed of steam. Under the influence of the high heat generated this is partly broken up into its elements, which in turn undergo further chemical changes during the period of combustion. Yet a certain amount of it remains and passes out through the exhaust in the form of plain unsophisticated steam. The importance of the part which water thus plays in the active conversion of latent heat into work is a difficult matter to determine, but the high value which scientists place upon it is shown by the long standing proposition to inject water into the cylinder for the purpose of increasing the power.

"My Shop," by Joe Cook
Honorable Mention

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EDITORIALS

HAPPY NEW YEAR!

The cruise of the imposing squadron of sixteen batteships of the U. S. Navy around the continent of South America to the Pacific Coast has aroused the interest of the whole civilized world, and drawn the attention of the people of the United States to their war fleet as never before in time of peace. The result has been a greatly increased number of enlistments, but still the call is for more recruits.

The question has been asked by a reader as to the chance for an electrician in the navy. Our readers will have noted the advertisement of the Bureau of Navigation which has appeared in this magazine in recent months. Mention is there made of an illustrated booklet which will be sent free on application. A study of this booklet will show that there is a real opportunity in the navy for any young man with mechanical tastes and some knowledge of a mechanical trade.

We may illustrate by an account of the Electrical School maintained at the Brooklyn Navy Yard. Applicants for enlistment as electricians *must be electricians by trade*, must know the names and uses of the various parts of a dynamo and dynamo engine, must be familiar with the ordinary types of switch board and methods of wiring, must be able to write legibly, and must understand arithmetic. Electricians will be enlisted as electricians, third class, at a rate of $30 per month. Students of electricity not sufficiently qualified for this rate may be enlisted as landsmen (for electrician) at $16 per month. In this case they enter the school, where the course is completed in twenty weeks. Then after passing an examination, they are advanced to the higher rate.

The course comprises four weeks in the theory section, one week in the ship's watch section, three weeks in the mechanical section, six weeks in practical electricity, and six weeks in wireless telegraphy. The course is based entirely on individual instruction, and qualifies the student to take charge of any part of the complicated electrical machinery of the modern warship.

As to the inducements of the navy as a career for a young man, we can best refer the reader to the pamphlet mentioned, which is beautifully illustrated in color, and will be sent free on request to Box 38, Bureau of Navigation, Navy Dept., Washington, D. C. We cannot refrain from quoting a paragraph at the close, however, which will show how much an average man may save easily, due of course to the fact that the sailor's pay is over and above all the ordinary expenses of his life, which are met by the government.

"Regarding financial benefits, we will suppose, for example, that a man enlisting at the age of 18, reaches the rank of petty officer by the end of his first enlistment (4 years) and chief petty officer at the end of his second enlistment (4 years more). Any man can do this if he is willing to work. If he saves *half* his pay during 30 years, from the age of 18 to

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the age of 48, and invests it in the Navy Savings Bank at 4 per cent. interest, and re-enlists immediately on the expiration of each enlistment those 30 years, at the end of that time he will have in cash $23,923, and may retire on three-fourths of his pay, which will be $96.94 per month, or $1,163.28 per year. Thus he will have $23,923 in cash which he can invest at 4½ per cent., which will bring him in over $1,000 a year. Add this to his retirement pay and you will readily see that he would have over $2,000 per year income from the early age of 48 for the balance of his natural life. And to do this he only needs to save *one-half* his pay during those 30 years.

"Men in business have dreams of greater success, but they are only dreams. The percentage of men, who, at the age of 48, accumulate an income of $2,000 per annum for the rest of their days, is not large, as everyone knows. Then again, the navy man who retires may take up some congenial work in civil life, should he wish to add to his already comfortable income."

There were a number of entries in our Furniture Competition, several of which were given favorable consideration by the judges. The first prize of $5.00 was awarded to C. E. Karlson, whose article is published in this number. One or two other entries will be published in forthcoming issues. We should be glad to hear of the success of any of our readers who may attempt to build this seat. The drawings are clear, the description is simple, and the cost is not great.

We desire to call the attention of our readers to the advertisement of back numbers and bound volumes of both Electrician and Mechanic and Amateur Work, which appears on another page. At present we are able to fill almost any call for a number to fill broken volumes; but this will not long be the case, as of some numbers but two or three copies remain. Look at your sets and send for what you want to fill the gaps you may find.

To those who are interested in pyrography, we would say that we have just published a new edition with new matter of "Pyrography; or Burnt-wood Etching," by Bolas and Leland, at the low price of 25 cents. This is the most popular book ever issued on the subject, more than 27,000 copies having been sold in this country, and many thousands more in England. Send in your order.

The purchase of the German rights of the Schlick gyroscope by the Hamburg-American line foreshadows the near practical use of this invention for averting the rolling of ships at sea. Experiments made with the device on the Seebaer, a discarded German torpedo boat, proved its practibility, the vessel's arc of oscillation in a rough sea being speedily reduced from thirty degrees to one degree. It is the Hamburg Company's intention to equip its North Sea and Channel boats with the apparatus. If effective there, the time will be brought near when the sea will be robbed of one of its terrors.

The idea of the gyroscope is the familiar principle of the spinning top, which rotates in the same plane and tends constantly to remain upright. As mechanically elaborated the device consists of a heavy flywheel propelled on a vertical axis at high velocity by a turbine mechanism. As the vessel rolls the gyroscope exerts a contrary pull toward the centre, with the effect of keeping the equilibrium fairly stable. In the Seebaer experiments the rolling diminished after a few oscillations to a point where the deck remained virtually horizontal when vessels of larger dimensions rolled helplessly in the sea's trough.

The gyroscope is perhaps a greater wonder than the turbine marine engine, only a few years ago an inventor's dream, and now the propelling power of the greatest ocean liners and the fastest torpedo-boat destroyers. Its usefulness on the sea seems assured. A yet greater future awaits it on land, if its possibilities of revolutionizing railway transit are realized. Is a 200-miles-an-hour railway train running on a single rail, its centre of gravity maintained by a system of flywheels on trunnions, a more chimerical notion than was wireless communication across oceans?

The gyroscope has been applied by Brennan to railway cars travelling on a single rail at high speed, and is the basis of the dirigible torpedo, for the invention of which he received $550,000.

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QUESTIONS AND ANSWERS

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

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

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

457. E. S., Clinton, Ill., has the six-pole field magnet of a fan motor, along with a 12-slot armature core. He asks if the parts can be wound to enable their use as a generator, and give 25 volts and 5 amperes? A. The use of sheet iron alone for a field magnet is not practicable,—it retains no magnetism for enabling the start. You can remedy this by clamping the sheets between two thin plates of cast iron, made in the same shape; this will stiffen the structure, but leave the armature rather too short, though you can minimize this appearance by tapering the polar projections of castings nearly to a chisel edge. You may be able to get 2.5 amp. at 25 volts, but not 5 amp. from so small a machine. Had your armature core an odd number of slots, you could avail yourself of the series winding, that requires only two brushes, but the even number compels you to adopt the multiple sort, and the use of six brushes. Six commutator segments only will be intolerable,—you must quadruple the number, or suffer disastrous sparking. Two poles are really enough for such a small machine, and even then the commutator should have 24 segments rather than 12.

458 W. H. M., Cincinnati, O., asks (1) How is it that a mercury vapor lamp can be utilized to allow for charging batteries from an alternating current? (2) Is there any other way, besides the motor-generator set, to change alternating to direct currents? (3) What is the principle of operation of the Nernst lamp? A. (1) This is described in Chap. XVIII, of the engineering series. (2) With the exception of the "rectifier" just mentioned,—none other is practicable for single phase currents. (3) Some things, such as glass, magnesia, and the rare oxides from which the Walsbach gas mantles are made, are recognized as insulators, but this is true for ordinary temperatures only. When sufficiently heated, they may readily conduct electric currents. The Nernst lamps have filaments made of some one or a mixture of these materials; accessory devices are necessary to provide the initial heat, but after the current begins flowing, this heater is automatically cut out of circuit.

459 G. B., Washington, Pa., has the parts for a dynamo that, with No. 20 wire on armature, are proper for yielding 110 volts. What size should be used for 55 volts? A. No. 17. Also for field winding, use three sizes larger than that specified for 110 volts.

460. **Miscellaneous.** W. E. B., Peoria, Ill., asks (1) What is the maximum pressure in the cylinder of a gasoline engine? (2) What are the leading countries in the manufacture of automobiles, and the value of their finished product? *Ans.* (1) About 70 lbs. per square inch. (2) Address the Dept. of Commerce and Labor, Wash., D.C.

461. **Small Lighting Plant.** A. W., Lakeland, Cal., asks several questions about the feasibility of running a dynamo from a small gasoline engine that is already operating some machine tools. *Ans.* To light 6 110-volt lamps will require about 3 or 4 amperes. Watson's ½ h.p. dynamo is well proportioned for just such use, but the lights may flicker from variations in the speed of the engine. A shunt winding is about the most satisfactory,—series being entirely out of place for operating lamps in parallel. Compound winding may be used, but not if you contemplate the adjunct of storage batteries. You will need to drive the dynamo from the fly wheel, and have the dynamo pulley made to fit the particular engine speed.

462. **Books on Dynamos.** H. G., East Orange N.J., asks (1) What are the best books on dynamo construction and testing? (2) What candle power lamp will 4 Leclanche batteries give? *Ans.* (1) Of the student grade, Franklin and Esty's Electrical Engineering, $3.75, Raymond's Alternating Current Engineering, $2.50, Hobart's and Ellis' Armature Construction, $4.50, Swensen and Frankenfeld's Testing of Electro-Magnetic Machinery, $3.00. (2) About 2 c.p.

463. **Wireless Telegraphy.** A. D. D., Bantam, Conn., asks if it would be practical to put a wireless telegraph outfit on a small sail boat, and to send messages a distance of 1¼ miles? How large a spark coil would be needed, and would the rocking of the boat be detrimental? *Ans.* As far as the engineering was concerned, you could accomplish the result, but we think you would be unable to keep the insulation of apparatus free from moisture. The mast will be high enough, and the rocking of boat will not affect the electric waves. You must realize that wireless messages are best sent at night, a time

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not particularly convenient. A coil that gives a long spark is usually not well adapted for this work; the secondary wire should be relatively coarse, and the spark gap not over half an inch. The quantity of electricity must be large, or there will be only very weak waves. We cannot give you exact dimensions of coil.

464. **Series and Parallel.** Y. K., Chicago, Ill., asks (1) What is the difference in wiring in series and parallel connections? (2) Is there any metal that is a substitute for platinum for the contacts of an induction coil? (3) Will gravity shape of battery zincs be suitable for a a sal ammoniac solution? *Ans.* (1) See Chapter XI, May, 1907, in the engineering series. (2) No. (3) Yes, but you should have some black oxide of manganese packed around the carbons.

465. **Armature for 4-Pole Field Magnet.** A. H. W., New York City, has a small armature 2½″ dia. and 2″ long, with 16 round slots, 5/16″ in dia. He asks for directions for winding it for about 80 watts capacity, and fit a 4-pole field. *Ans.* This can be done, but it will make a poorer machine than if you employed but two poles. Since brushes will be but 90 degrees apart, the whole difference of potential will be across about three insulations. Since there is an even number of slots, you will have to use the multiple winding, requiring brushes in all four places. The winding will be from 1 to 5, leaving the slots half full; then from 2 to 6, and so on, the last half of winding being put on top the first half, as in the case of any drum armature. We cannot advise you very closely as to the size of wire, for you did not propose any particular voltage. Perhaps No. 20 would be good.

466. **Change of Polarity. Air Compressor.** W. L. S., Fostoria, O., asks (1) What would happen to his 1 h.p. Lundell shunt-wound, 220-volt motor, if he should exchange the two wires that lead to the supply circuit? (2) Is there any book describing the construction of a small air compressor, to be driven by a 1 h.p. motor and compressing to 200 lbs.? *Ans.* (1) Nothing would happen that you could readily observe. Directions of current in both armature and field would be reversed, but the rotation would be in the same direction, and under just as good conditions as before. In originally connecting a motor to service wires, no attention is paid to the particular polarity. (2) We do not know of any, but some manufacturers are the Stillwell-Bierce and Smith-Caile Co., Dayton, O., and N. A. Christiensen, Milwaukee, Wis. Such a high pressure would probably have to be obtained in two stages.

467. **Electric Light Wiring.** G. F. K., E. Whitman, Mass., asks (1) Is a license required to do interior wiring, and where can a person obtain a copy of the Regulations? (2) Will contact with both wires of a 110-volt direct or alternating current circuit be injurious? *Ans.* (1) Yes, and after being done, the wiring must be inspected. From the Inspection Department of Associated Factory Mutual Fire Insurance Companies, 31 Milk St., Boston, Mass. (2) No, but considerable of a jarring can be experienced; a great deal would depend upon whether the hands were dry or wet, and how securely you took hold.

468. **Motor Construction.** W. C. R., Chicago, Ill., has a motor resembling the 1 h.p. machine described in the October number, only about one third smaller. It operates well on a 110-volt circuit, in spite of the fact that commutator has only 12 segments. He asks, however, what changes to make in the winding to adapt it for 50 volts? *Ans.* Use wire three numbers larger, —that is, Nos. 18 and 21 instead of 21 and 24.

469. **Induction Coil.** ——— has made an induction coil, the iron core being a bundle of wires 1″ in dia., and wound with three layers of No. 18 copper wire. He states that the results are unsatisfactory, and asks how to improve matters? *Ans.* Perhaps the iron wires are not well annealed; you can remedy such a defect by putting them in an iron pipe during the annealing process. Two layers of No. 14 would be better than the winding you adopted. Use something stronger than dry cells. By following the general directions for making a coil as given on page 23 in the July, 1907, issue, you will be sure of good results. One pound of No. 36 wire properly wound in thin sections will give as good results as twice that amount wound in the ordinary manner.

470. **Telephone Pole-Houses.** A. B. T., Annandale, Minn., asks (1) What are the pole houses for? (2) Is the Navy a good place to learn electrical engineering? (3) Why is it that a single cell will run a small motor while three or four will not? *Ans.* (1) They are for the junctions of aerial with underground wires. (2) No. (3) You probably refer to the cheap battery motors, with three-prong armatures. The brushes may be in the wrong position, or perhaps under the influence of the stronger current, the armature actually touches the field magnet.

471. **Horizontal vs. Vertical Engines.** C. K., Joplin, Mo., asks what are the relative qualifications of the two sorts. *Ans.* Various grounds of comparison could be cited, but the vertical arrangement has the conspicuous advantage in not allowing the weight of the piston to wear the cylinder "out-of-round."

472. **Small Multipolar Dynamo.** F. S., Stamford, Conn., (1) is making an 8-pole dynamo, field bore being 4″ dia. and 4″ long; armature has 24 slots. He asks what winding to use to highest permissible voltage, and what power it would give as a motor. (2) A home made storage cell gives 3 volts, why is this so high? (3) What is the best way to magnetize the bars for a magneto-igniter? *Ans.* (1) If you are interested in getting a high voltage, you should have used only two poles in the field magnet; four certainly would have been the limit; with eight the proportions are good for an alternator, but not for a direct current machine. Having only 24 segments in commutator, there will be only two insulations between adjacent brushes, and intolerable sparking if you try to get over 10 volts. As you did not state size of slots we cannot suggest sizes of wire. (2) Your voltmeter must be in error. (3) Thrust them into coils through which you can send a dynamo current.

473. **Voltage "Drop" in Motor Circuit.** J. F., Paterson, N.J., asks what will be the drop in voltage in a 50-ft. line, in the case of a ⅛ h.p. motor for 5 volts as compared with one for 25? Where can such motors be obtained? *Ans.* The loss of energy in transmission varies as the square of the current. Since at 5 volts you would need five times as much current as with

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25 volts, economy would dictate the advantage of the higher potential. Not more than one volt should be lost in the line, and with the 25-volt motor, and a presumable current of 5 or 6 amperes, you would then have to use No. 16 wire. You might be able to get such motors from the Edison Mfg. Co., 83 Chambers St., New York. Perhaps some electrical supply store might have one of the original Holtzer-Cabot series wound commutator motors designed for use on alternating current circuits; they run with high efficiency on direct currents, and you ought to be able to get one very cheap.

474. **Small Shunt Dynamo.** V. F., Watseka, Ill., asks (1) How is a shunt dynamo made? (2) Where can material for a small armature be obtained? (3) Where can fibre be obtained? (4) What should be the size of wire on a 12-slot, 2½" x 2½" armature, to give the highest permissible voltage? *Ans.* (1) For the case of a small machine, such as you have in mind, let the field wire be three sizes smaller than that on the armature, and connect the ends directly to the brushes,—*i. e.*, to the same points as the external circuit is attached. (2) From the W. & S. Mfg. Co., Worcester, Mass. (3) From the Delaware Hard Fibre Co., Wilmington, Del. (4) About No. 20 on armature, No. 23 on field.

475. **Battery Lamps.** G. H., Fitchburg, Mass., asks (1) How much resistance should be placed in series with 10 gravity cells, to prevent burning out a pair of parallel connected 8-volt, 6-c.p. lamps? (2) How much copper sulphate is needed to set up gravity cells, using 5" x 7" jars? (3) What is the depolarizer used in Samson cells? *Ans.* (1) Far from needing external resistance you will need more cells; the maximum useful output of one of the cells will be ⅙ of a watt, and since the two lamps will require a total of about 30 to 36 watts, you will need 51 to 64 cells, connected 15, 16, or 17 in series, and with three or four such groups in parallel. (2) About 2 lbs. per cell. (3) Black oxide of manganese.

476. **Gasoline-Engine-Dynamo Plant.** F. H. A, New Britain, Conn., asks some questions as to the practicability of an isolated lighting plant, with such a combination, and if the interposition of spring clutches and heavy fly-wheels would eliminate flickering? (2) What make of engine would give good results? *Ans.* (1) A good many such plants are in operation, but we feel sure that without the adjunct of storage batteries, there will be noticeable flickering, and poor regulation. This would depend largely, of course, on how many cylinders there were in the engine. An oil engine will, however, give good service. This operates upon the combustion rather than the explosion principle. (2) Many firms would like to sell you the apparatus. We would suggest the C. J. Jager Co., of Providence, R.I., which deals in the Fairbanks-Morse machines.

477. **High School vs. Correspondence School.** G. B. T., Paterson, N.J., asks if a young person inclined towards electrical engineering should enter some manufacturing establishment, and study under the guidance of a correspondence school, or should he take a regular high school course? *Ans.* If you have the opportunity to attend the city schools, even under some difficulties, do it, and if you find you are more interested in mathematics and sciences than in dabbling in machine tools, continue through college, or some technical school. Get familiarity with machinery, however, by working in shops in the vacations. Aim to be an electrical engineer rather than a wireman. If you dislike study, or are positively denied the chance of attending school, by all means embrace the means of study offered by the correspondence schools, and it may be that perseverence, though accompanied by late hours and diminished vitality, may enable you to win recognition and promotion.

478. **Steam-Jet Static-Electricity.** D. A. M., Sligo, Pa., asks (1) Why the different position of the steam valve in his apparatus should make so much difference in the working? (2) Is it possible to put a special winding on the armature of an alternating current dynamo, suitably connected to a commutator, and thus make the machine self-exciting,—or at least self-contained? *Ans.* (1) In the operative arrangement the valve was horizontal, and probably some water was carried along by the current of steam, so that the issuing jet was wet,—a necessary condition for the production of electricity; in the other case the water passed along down the regular course, and the vertical nozzle emitted dry steam only. You could prove the point by putting some cloths wet in cold water around the nozzle in the latter case, so as to ensure some condensation. (2) This was done in early machines, notably those made by the Thomson-Houston Co. The objection is the difficulty of insulating from the main high voltage winding and from the insufficient number of segments in the commutator between adjacent brushes.

479. **Antenna.** F. W. F., Brooklyn, N.Y., asks (1) Is there any danger of lightning striking the pole of a wireless telegraph outfit mounted upon a roof? (2) How should the connections of such a set of apparatus be made? *Ans.* (1) Yes. (2) One spark-gap terminal is attached to the pole, the other to the ground.

480. **Zinc Castings.** L. C., Kinsman, O., asks if clay can be used for making the molds for small zinc castings? (2) Is this metal suitable for the cylinders of small steam engines? (3) How much power will the electrical engine described in the June, 1907, paper give, when connected to six dry cells? *Ans.* (1) What is called "French" clay is used for making rubber stamps, but for your purpose you will find that plaster of Paris molds, thoroughly baked, will answer very well. Considerable use is made of ordinary foundry molding "sand" in making zinc castings. (2) For a toy it might be tolerable, but there would be considerable difficulty in maintaining the lubrication. Further, there is considerable difficulty in obtaining castings free from blow-holes. (3) At most the motor would just run itself. The machine there described is referred to, and illustrated with a cut, in the January, 1907, issue, in the chapter on electrical engineering. The defects of this construction are there pointed out, and no one would now think of building one for other than purposes of curiosity.

481. **Induction Coil.** T. B. D., Butler, Pa., asks (1) What length of sparks will an induction coil of the following dimensions give? Core 1⅛" dia., 6" long, wound with 5 layers of No. 15, and secondary with 1½ lbs. of No. 31. (2) What

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should be the dimensions of coil and winding to enable messages to be sent 42 miles? *Ans.* (1) Even with more data than you have given, it is almost impossible to predict the output of an induction coil. The degree of softness, and effectiveness of separation from the iron wires, the rapidity of the break piece, the amount of battery power, size of condenser, and quality of insulation all enter, and even with the same materials, no two persons might get the same results. The best we can do is to refer you to the excellent article in the July, 1907, issue, on the construction of a 4″-spark coil; yours would not give so long sparks, but would be rather better adapted for wireless telegraph operation. Do not, however, use more than two layers of wire in the primary,—otherwise the self-induction, which increases as the *square* of the number of turns, will prevent sufficient sharpness in the breaks of the circuit. (2) From the reasons just given, we could not assume to specify any particular dimensions.

482. **Small Steam Boiler.** T. C., So. Chicago, Ill., asks (1) Where can 3/16″ dia. brass tubing be obtained? (2) What size of steam boiler is needed for an engine 1″ stroke, 3/4″ bore, and what sort of fuel would be suitable? *Ans.* (1) Almost any large hardware dealer carries such stock; you could find a host of addresses by consulting the city directory. Sears, Roebuck & Co., in Chicago, undoubtedly could supply almost any size. (2) An excellent boiler for such purposes can be made from a mercury flask; such vessels are made of wrought iron, and consequently are very strong; they hold nearly a gallon. With an allowance of about half an inch of free space all around and a vent at the top, the flask could be covered with plastic asbestos, and heated by gas.

483. **Rheostats.** J. C. H., Hamilton, O., asks (1) What should be the resistance of each of the steps of a starting rheostat suitable for use with the 1 h.p. motor described in the October, 1907, number? (2) When using two such motors on the same circuit, will a separate rheostat for each be necessary? (3) If one is used as a generator, the other as a motor, will two rheostats be necessary? (4) What is the best book on the market describing rheostats? *Ans.* (1) There need be but 5 or 6 steps, with about 10 ohms total resistance, and let each successive step cut out about one half the total remaining; the resistances will then be, between contacts, 5, 2.6, 1.3, .63, .32, and .15 ohm, respectively. The high resistance coils can be of finer wire than the low ones. (2) Yes, one for each motor. (3) Yes, but the one for the field of the generator should be quite different from that used to start the motor. This should have a resistance equal to that of the shunt field winding, of German silver wire of the same size as the winding, but divided into as many equal steps as possible, —not less than 20. (4) We do not know of any book on this subject.

484. **Design of Small Motors.** C. F., Sedalia, Mo., asks (1) How many lines of force per square inch are usually allowed in the design of 25 to 100 watt dynamos? (2) How many circular mils per ampere are allowed in armature and field winding? *Ans.* (1) 8,000 to 10,000. (2) 350 to 400 in armature and twice these numbers in field.

485. **Telephone Bell.** R. T., Topeka, Kan., asks (1) Is there any way a common electric doorbell can be attached to a modern telephone without rewinding the coils? (2) Is there any way to re-invigorate the carbons of a battery? (3) What is the best kind of battery to use for sparking a gas engine? *Ans.* (1) We do not entirely understand your question. If the distance through which the bell is to be operated is considerable, you will not find it practicable to use the common make-and-break bell at all,—too much battery power would be required. The magneto generates about 75 volts, and since the current is most conveniently and reliably alternating, you need a polarized bell to be responsive to it. (2) It is not the carbon that deteriorates, but the depolarizer,—the black oxide of manganese; the carbon itself is so cheap that you can as well renew the entire element. (3) Dry cells are largely used, not so much, we think, from their cheapness, as from their convenience. It is quite likely that Fuller bichromate or Edison-Lalande cells would really be cheaper to run, but for continuous use the sparking should be done by a dynamo.

486. **Magnetic Permeability.** R. J. F., Danville, Ky., asks (1) What is meant by this expression. (2) What is meant by magnetic pressure? (3) A magnetic circuit is made of a ring, 200 centimeters in extended length, of 50 sq. centimeters section; the iron has a permeability, at a flux density of 10,000 lines per sq. c. m., of 1,000; there is an air gap 1 c.m. long, polar faces being of the same area of cross section as bar. What magnetic pressure would be needed to produce a total flux of 500,000 lines across the gap? (4) Three wires, of 2, 6 and 8 ohms resistance, respectively, are connected in series, and to the terminals of a battery that gives a pressure of 2 volts: What will be the potential between the several junctions? *Ans.* (1) The quality, usually with reference to iron or air, that signifies the ability to transmit magnetism, just as the word conductivity is used when speaking of currents of electricity. The scheme is to regard magnetism as flowing in a circuit analogous to the electric circuit. Air is taken as of unity permeability, and the iron you mention is 1,000 times as good for conducting magnetism as the air. (2) The pressure that tends to drive magnetism, just as electric pressure drives electricity. A common name is "magneto-motive" force, — at once recognized as analagous to "electro-motive" force. The numerical value of magnetic pressure is 1.25 times the number of ampere turns. (3) Ignoring leakage, which would somewhat complicate the problem, you would require 81,000 ampere turns. For a practical case you would need to enlarge the faces of the poles so as to reduce the flux density to a much lower value; shortening the air gap would also be proper. (4) You did not state the internal resistance of battery, so no exact computation can be made of the current that would flow, but assuming that the difference of potential was kept at two volts, —as would closely be the case if a storage cell was used, the current would be .125 ampere. Starting from the positive pole of cell and numbering the junctions as 1, 2, 3 and 4, respectively, the difference of potential between 1 and 2 will be .25 volt; between 2 and 3, .75 volt; between 3 and 4, 1. volt; between 1 and 3, 1. volt; and between 2 and 4, 1.75 volts.

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487. **Telephone Transmitter.** I. K., Boston, Mass., asks (1) What is the difference in the construction of a telephone transmitter for use on the central energy system and that on the former, or local battery, system? (2) What number of dry cells should be connected in series with primary of induction coil and the regular transmitter, and give the loudest transmission without heating the carbon filling? Would this number work with the coils for both systems? *Ans.* (1) It is difficult to keep up to date with all the variations constantly coming in with telephone engineering, but our data show the principal differences in the matter of ratios of the coil windings, etc., rather than in the transmitters. With the local battery, the resistance of the carbon plates and granular filling was about 10 ohms, primary of induction coil, .5 ohm; when 4 volts,—from two Fuller bichromate or two or three sal-ammoniac cells,—were impressed, a current of .25 to .3 ampere would flow; under the influence of the speech, the resistance of the carbon would change from the normal 10 ohms to almost any value between 5 and 30. Our information shows that just about that same current is ordinarily allowed on the common battery system. (2) Two or three in series should suffice, but to make the speech still more audible you could put a second or even third set in parallel with first.

488. **Magneto Dynamo.** J. A. H., Attica, Ind., asks (1) What is the matter with his dynamo? It has a 2-bar permanent magnet, and 12-slot laminated armature; it will not generate. How should tests be made to find the fault? (2) Will a Wimshurst influence machine operate a Geissler tube? *Ans.* (1) Quite a number of things may be at fault. Drive the armature at not less than 2000 rev., and shift the brushes to various positions, having them connected together through some resistance, say with a bit of very fine wire. If no current flows, you can be sure that the armature is wound wrongly, and it must be done over. If the winding was right, but some fault was in the commutator, there would be evidence in the form of heat and smell. (2) Yes.

489. **Small Motor.** A. F. M., New Decatur, Ala., has a "Success" Dynamo-Motor, sold by the Arrow Electric Co., but it will not generate, unless the field magnets are excited by a battery current. He asks (1) How can use of batteries be dispensed with, and yet allow the machine to work? (2) Could this machine have its armature short-circuited, and be run as a repulsion motor from alternating currents? (3) Does lightning ever strike the aerial of a wireless telegraph system, and if so, how can that danger be avoided? *Ans.* (1) Perhaps some injury has come to the machine since it left the factory, or it may be that you do not rotate it fast enough. For the reputation of the builders, you ought to communicate with them direct. If the field magnet is built of sheet iron, the chances for its being able to dispense with battery excitation are not good; such material retains no magnetism for starting the building-up process involved in a successful dynamo. Some solid iron is really necessary. For a motor, the entire sheet iron construction is admissible, and for alternating currents, imperative. Still, your machine has two few poles, and insufficient insulation to admit its safe use as a repulsion motor. (3) Yes, but no messages can be sent during a thunderstorm, and the aerial can be left grounded.

490. **Condenser.** A. A., Orange, N.Y., asks (1) How to compute the area of tinfoil necessary for a given size of spark coil? (2) Where can literature be obtained describing coils made of bare wire? (3) Where can castings be obtained for the 1 h.p. dynamo described in the October issue? *Ans.* (1) The essential data are so hard to get that the most practical method is to experiment with various numbers of sheets. (2) They are not freely described, but are made by the Varley Duplex Magnet Co., Phillipsdale, R.I. (3) We do not know of anyone selling them.

491. **Alternating Currents for Induction Coils.** J. H. F., Williamsburg, Va., asks (1) Can an alternating current dynamo be used for operating an induction coil, and give oscillations of high frequency. (2) How are incandescent lamps lighted by alternating currents? (3) Who is DeForrest, and what is his connection with wireless telegraphy? *Ans.* (1) Yes, with special provisions. This is the regular method of operating over long distances. (2) Read Chapter XVII. in the engineering series, in the November issue. (3) Dr. Lee DeForrest is the inventor and promoter of a system of wireless telegraphy that has several highly ingenious and well working peculiarities. The receiver is of most note. He claims ability to operate signals at a high rate.

492. **Civil or Electrical Engineering.** J. S., Webster, S. D., asks what is the average salary obtained by a civil as compared with an electrical engineer? (2) Which of the two lines would we advise him to follow? *Ans.* (1) We do not know, but think there is very little difference. (2) If your entire selection depends upon which will bring in the most money in the shortest time, we advise you to enter neither field. Selection of a life profession should be made upon higher grounds. Unless you are so wrapped in a subject as to have it your principal thought, that though diverted by regular studies and employments, you always think, eat and sleep with that one field of work ever in mind, you will be sure to become a day servant, or mediocre engineer. Success is attained by most people only with a blindness for fixed hours of labor, and a determination to solve the hardest problems. Successful men realize the hard steps by which they have trod, and usually advise younger aspirants to seek some other line of work, but the best a man can do is to find some such person, and persist in entering his employ.

493. **Igniter Dynamo.** S. B., Minneapolis, Minn., asks why his igniter dynamo, fitted with commutator and field winding, will not operate a small motor? *Ans.* Yours is probably a shunt dynamo, and the motor has a low resistance. Just as soon as you connect the latter, the field of dynamo probably loses its magnetism. If this is the case, you can remedy it by inserting a resistance in the armature of motor, until some counter electromotive force is developed. This is the regular method for starting any motor.

Lots of people go to work Monday morning feeling completely worn out by their Sunday rest.

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Correspondence

WINNIPEG, CANADA, Nov. 20, 1907.

Editor Electrician and Mechanic.

SIR: A sample copy of your magazine, ELECTRICIAN AND MECHANIC of October, 1907, came into the hands of the writer the other day, and on looking over it he noticed your column of questions and answers. One in particular, No. 353, Soldering Aluminum, the writer begs to differ with you as to soldering aluminum, and herewith encloses directions for doing so, trusting it may be of use to you.

Use an alloy, consisting of 1 part of aluminum, 1 of phosphor tin, 11 of zinc and 29 of tin.

To avoid the loss of the more volatile of these metals the aluminum is melted first, then zinc is added in small quantities, then tin in small pieces and lastly the phosphor tin.

For the soldering an acid is used, but the surfaces to be joined are first covered with a thin coat of solder (alloy) in the usual way, and then brought together and heated with the soldering copper, blow pipe or torch until solder already upon them is melted, when pressure is applied and the joint made.

Aluminum must be heated to about 660 degrees F. before it can be soldered.

Yours very truly,
W. C. HELLIWELL.

CHICAGO, ILL., Dec. 7, 1907.

Editor Electrician and Mechanic.

SIR: Notwithstanding the immense amount of publicity which has been given to Esperanto, the international language, I find that at this time not more than one-tenth of the people of the United States have even a vague idea of its purpose and scope, and perhaps not one in a hundred has a reasonably definite conception of it. As a sort of counter-irritant to the irresponsible criticism which is occasionally circulated by the uninformed, I have printed for free distribution a second edition of 100,000 copies of a small primer, "Elements of Esperanto," setting forth the grammar, word-construction and purpose of the language, and will mail a copy to any person who requests it, sending stamp for postage. While you may not be personally interested, there are thousands of your readers to whom this movement for an international auxiliary language, which now covers *every country on earth*, will appeal as something more than a fad, and they would appreciate your giving publicity to this letter.

Cordially yours,
ARTHUR BAKER.

CHICAGO, ILL., 1239 Michigan Avenue.

Book Reviews

THE BOY ELECTRICIAN, or the Secret Society of the Jolly Philosophers, by Edwin J. Houston, Ph. D. Illustrated, 326 pages. Philadelphia, J. B. Lippincott Co., 1907. Price, $1.50.

The author, who is well known as having written many excellent text-books on various electrical subjects, has in this interesting volume made a most attractive book for boys. In the form of a story which describes the doings of a group of active and lively schoolboys, it imparts much electrical information. Not only do the boys perform many entertaining and instructive experiments on electricity, but they learn all the great principles of the science, by means of visits to electrical plants and workshops under the guidance of those who are well able to instruct them. The book is never dry, but is a good story, full of boy life and action, as well as scientific interest.

WHYS AND WHEREFORES OF THE AUTOMOBILE. A simple explanation of the gasoline motor car, prepared for the non-technical reader. 102 illustrations. Cleveland, The Automobile Institute. Price, $1.00.

For the benefit of the reader who wishes to know all about the details of operation and the principles of construction of the gasoline car, and is not able to understand the highly technical longer treatises on the subject, this valuable little book has been prepared. It takes as a standard a gasoline car with vertical, four-cycle, four-cylinder, water-cooled motor, multiple disc clutch, sliding gear transmission, and shaft drive, and describes it in detail, first the essential, and then the incidental parts. Every one owning or interested in motor-driven cars should own a copy.

WIRING DIAGRAMS. A Handy and Reliable Source of Information on Circuits and Connections, by E. W. Smith. Philadelphia Book Co., 1906. Price, 25 cents.

This little book is a pocket manual which will help any practical electrician in his every day work. It contains a well-selected list of diagrams on bells, telephones, telegraph, gas lighting, induction coil, electric lighting, storage battery system, dynamo connections, and details.

Catalogues Received

The following catalogues have been received from various sources as indicated below. They will be sent to any interested readers who will apply by letter, including return postage. Do not write on a postal card if you wish your request to be attended to, and mention ELECTRICIAN AND MECHANIC.

Electro Importing Co., 87 Warren street, New York City. Modern Electrics, Catalogue No. 4. List of small electrical apparatus for experimental work, and especially full on wireless telegraphic apparatus. Contains numerous directions for experiments in electricity. Postage 2 cents.

Clauss Shear Co., represented by U. J. Ulery, 7 Warren street, New York City, Catalogue No. 34. An excellently printed and very complete catalogue of a very strong line of edge tools, comprising all kinds of shears, scissors, tailor shears, tinner snips, pruners, razors and strops, automatic safety razors and stroppers, serrated knives, and other forms of cutlery. The goods are furnished at retail or wholesale by the New York agents, and the postage on the catalogue is 7 cents.

Frank Mossberg Co., Attleboro, Mass., Catalogue No. 10. Wrenches, bicycle and automobile bells and gongs, manicure goods, advertising novelties, electrical reels and spools, metal stampings, punches and dies, etc.

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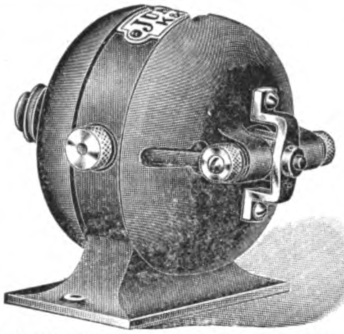
Juno Motor



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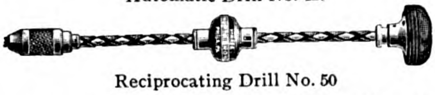

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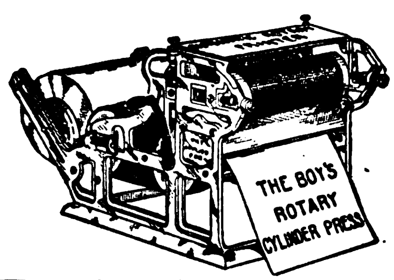

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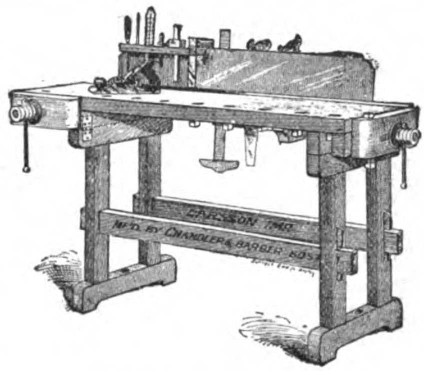

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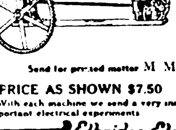

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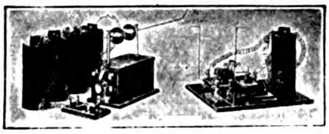

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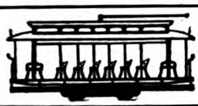

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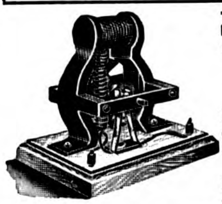

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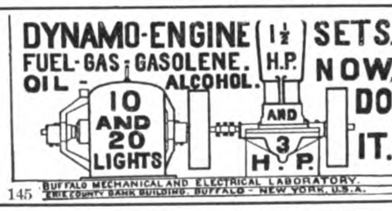

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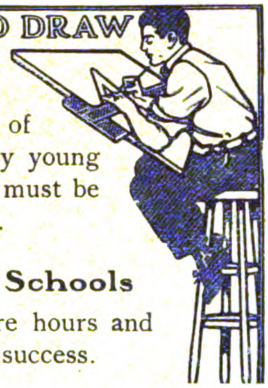

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