Everyday Mechanics

"It Tells You How to Make and How to Do Things"

Vol. 2 — FEBRUARY, 1917 — No. 5

Found—A Title for the Reader

IN the December number I asked my readers for a title that fitted the followers of EVERYDAY MECHANICS; a title that would carry with it the measure of dignity and respect due them. The response has been generous and the letters have shown just the high average of analytical ability and discernment that I expected to find among the readers of our little magazine.

In order to bring forth constructive criticism, I tentatively suggested the word "Handicraft" as being descriptive of our work. Many of our correspondents have in a measure endorsed this but nearly all inject a shade of doubt as to whether the word carries the desired impression of dignity.

Other readers have suggested titles incorporating the words "Scientist," "Physicist," "Investigator," and similar terms, all more or less appropriate when coupled with some qualifying adjective. They have been discarded, however, solely because they do not lend themselves to the popular conception of our class.

Our decision has been made after mature consideration and in making this decision we have permitted ourselves to be influenced by the opinions of an overwhelming majority of our readers. *The name we have chosen is that selected by the reader as a class.* Should you be tempted to criticize at snap judgment, please bear this fact in mind. Before I tell you the new name, I will ask you to read the few letters which follow:

New York, December 26, 1916.

Mr. Thomas Stanley Curtis,
Editor EVERYDAY MECHANICS.

Dear Sir:

I am one of the more or less serious and presumably ingenious readers of EVERYDAY MECHANICS to whom your December editorial refers.

As such I venture to offer my ideas as to the proper title for us as a class.

I am an experimenter, but since my experiments are made with a serious purpose and with all the brains, intelligence, and resources at my command, I must plead "not guilty" on the charge of being a trifler, a dabbler or a "nut." Because my experiments often lead me in unfamiliar paths, covering as they do a wide variety of subjects, I cannot have the specialist's minute and detailed knowledge to guide me. I must therefore know how to find out the things I do not know, to take advantage of the experience of others, to apply the basic principles of science which underlie the solution of my problems. In short, I must know how to go at the problem. In so far as I follow this method, the study of principles rather than details, and the application of principles rather than conventional methods, am I not an *Engineer* in distinction from a mechanic or artisan? Because I do not follow this work for a livelihood, but for love of it, I am an amateur. Your objection to the term amateur, at least in certain connections, is well taken. But how about it when linked with the word Engineer?

An engineer is not a trifler, a dabbler or a "nut." He cannot be. But if he follows engineering as an avocation, not as a vocation, he certainly is an amateur. Why not then an Amateur Engineer?

As this letter is of a more or less personal nature, I prefer that you should not use my name, in the event of publishing. I am,

Very truly yours,

A SINCERE READER.

NOTE: The name and address of this correspondent will be supplied to any interested reader.—Editor.

Philadelphia, Pa., Jan. 2, 1917.

Mr. Thomas Stanley Curtis,
Editor EVERYDAY MECHANICS.

Greetings:

It was with great interest that I read your article: "Wanted—A Title for the Reader" in the December issue of EVERYDAY MECHANICS.

I have been thinking along these very same lines for some months past, and I will give you an idea of how I reasoned the answer out.

If I mentioned to anyone that I was interested in Radio, they would usually ask me, "Are you an operator or just an amateur?" And when they say "just an amateur," they use such a pitiful or sorrowing tone, as though I were a candidate for an asylum or needed a guardian.

But now I say, "I am an Experimental Engineer and am at present experimenting in Radio. (I mean by Radio the wireless transmission of electrical energy—telegraphy, telephony, control of ships and aeroplanes by wireless.)"

Now my reasons for the Experimental Engineer: First—An experiment is the making of a practical test; (someone advances a theory, and we make an experiment); also it is only by experimenting that we find more practical, economical and efficient methods of doing work. Second—An Engineer is one who designs, builds, constructs or develops anything.

Therefore, an Experimental Engineer is one who constructs or makes practical tests (experiments), or one who operates or controls certain kinds of machines or instruments in the interests of or for the advancement of a certain branch of science. Anyone who is interested in finding new and better ways of doing work or advancing the world's knowledge and tries his theory is an Experimental Engineer.

Of course, this does not answer the problem of how to educate the people at large to respect the man or boy who is an amateur.

I think a man must be inspired to work and study some branch of science and give the results of his work and study to the world just because he likes that particular line of study and they usually are amateurs, and are not looking for fame.

Well, wishing you a happy and prosperous New Year, I remain,

Yours very truly,

(Signed) MARTIN P. MORTENSEN.

Watertown, N. Y., Jan. 3, 1917.

The Editor,
EVERYDAY MECHANICS.

Dear Sir:

I suggest as the name of the cult: "Student Engineers."

In one sense, we are not amateurs. Handicrafters implies workers in wood, metals, fabrics, etc. We are not these: we are or should be Engineers, *i.e.*, practical users of engineering scientific knowledge. We are not "Model Makers"; that implies to my mind anything akin to Toy Makers.

"Inventors" would be too indefinite. We *are* "Machinists," utilizing scientific engineering knowledge to produce the results we seek in a mechanical line, hence to my mind the term Student-Engineers. Student Engineering would appropriately designate the field and its devotees.

Permit me to state as one interested in engineering I would enjoy your magazine better were it devoted strictly to mechanical and electrical machinery, tools, designs, handling, etc., and omitting such subjects as How to Make a Morris Chair, A Handy Broom Holder, Black Ant Exterminator, etc., and substituting therefor a Practical Working Model of No. 999 New York Central 20th Century Limited, or Design and Construction of a Hand Operated Planer, Small Vertical Boiler, etc., etc.

I am only "one" but the foregoing are my views; please pardon me if I seem egotistical. My best wishes for the magazine you publish are that it may become in this country what *"The Model Engineer and Electrician"* is in England, and that it may help start the interest here that exists in that country in so-called Model Engineering. In that country, Model Engineering, as you know, is a prized hobby and useful field of industry, whilst here 99 out of every 100 do not know what you mean by Model Engineering or a Model Engineer. So with best wishes for the Student-Engineers and trusting you meet in 1917 with the success I wish for you, I am

Yours very truly,
(Signed) GEO. L. BAKER,
Assoc. M. Am. Society C. E.

You will have inferred from the three letters published above that we have decided to use the word "Engineer" in combination with some qualifying adjective that will serve to denote the peculiar class under which we come.

"Engineering," according to the New International Dictionary, originally denoted the art of managing engines; in its modern sense, however, the word applies to the art and science by which the mechanical properties of matter are made useful to man in structures and machines. In the ultra-modern sense, the term "Engineer" is applied to any specialist in any line of endeavor who devises methods to lessen labor, increase efficiency, decrease cost, conserve energy, etc., etc.

Can anyone question our right to the use of this word? If our work is not engineering in its strictest sense, what is it?

We believe we are right and we have the letters of a multitude of readers to back up our belief. Accordingly we are taking a bold step—a step that usually means success or failure to a magazine—and we rely upon our enthusiastic readers to help us drive home the true meaning of the word we have chosen. The following paragraph shows we are doing our part:

Beginning with the March, 1917, number, the name of our little magazine will be changed to

Everyday Engineering

The Magazine will be the Official organ of the American Society of Experimental Engineers, an association now forming for the purpose of organizing the serious experimenters of the country.

In taking this step, we shall not change the well-established policy of all how-to-make and how-to-do material; we shall not add any news-picture or trade-writeup section and we shall not change the size or appearance of the magazine. It will still be your old "EVERYDAY" in every particular. What we can and will do, however, is to give you better material than you have had in the past, for the plan of the A. S. E. E. embodies an exchange of experiences and reports of work not alone in our own Experimental Laboratory but in that of every member of the Society. Do you see what this will mean?

I hope in the March number to outline the complete plan of organization of the A. S. E. E. Briefly it contemplates the establishment of a main chapter in New York City with monthly or bi-monthly meetings in the Laboratory where the work of members will be discussed and certain experiments performed. This would be followed by the formation of local chapters in various parts of the country. My personal plans contemplate visits to the meetings of the local chapters at certain times during the year for the purpose of explaining the hazy points in the work done by the Laboratory Staff and the members of the New York Chapter.

In the meantime, use your letter paper and tell me what you think of it. I am always glad to hear from you and my present decision is based directly upon suggestions made by some of you. My idea of the matter is that we are about to create a movement that has been "threatening" for years; it has lacked organization, as some of my readers aptly put it, and I believe we are now in a position to bring the members of our family together with such a rush that the country at large will be forced to recognize us as a class and to give us the encouragement and support we deserve.

Sincerely,

Thomas Stanley Curtis

Your Editor.

PATTERN MAKING FOR THE AMATEUR MECHANIC

By H. H. Parker

In Two Parts—Part I

A KNOWLEDGE of the fundamental principles of wood pattern making is of great value to any person who makes or uses light machinery, scientific apparatus, or such miscellaneous fittings as are found about the house or farm. The amateur mechanic or experimenter should derive both pleasure and profit from the study and practice of the simpler operations of the art, for while such work in itself is extremely interesting, the ability to turn out practical wooden patterns will frequently effect a considerable saving of time and money. A motor-car owner, farmer, or "handy man about the house," who is in need of a new casting to replace some important but broken part of his apparatus and, as only too often happens, finds himself unable to obtain a ready-made duplicate, hunts up a shop and orders a special pattern made for him, usually at considerable expense; whereas, had he spent an hour or so constructing his own pattern and taken or sent it to a foundry, a

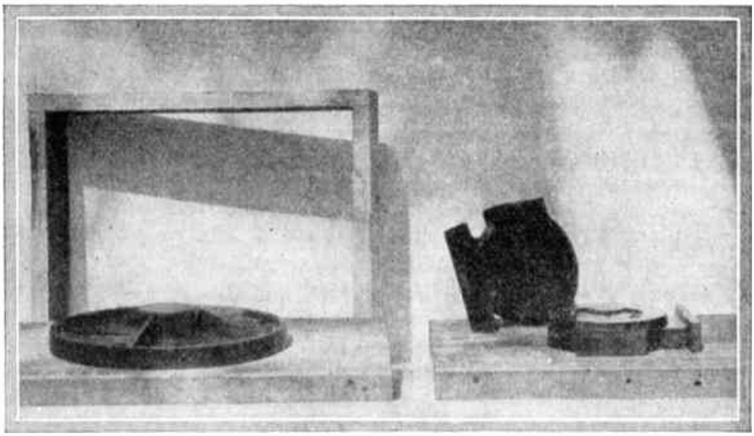


Fig. 1. "A" (left) Pattern on moulding board. "B" (right) Two-piece pattern

new casting could have been obtained for a few cents.

Most iron and brass foundries are willing to handle this class of small work when supplied with the patterns, and the cost is reasonable, being from five to ten cents a pound for iron and thirty to sixty cents for brass and bronze castings, the cost somewhat depending upon the market values of these metals.

Pattern making is an extensive trade, and a man could well spend a lifetime learning its various sides; the beginner, therefore, should not attempt the building of large or complicated pieces without the help and advice of a practical man, but by keeping constantly in mind the elementary operations in the moulding and drawing of ordinary patterns he should be able to turn out satisfactory work, and not suffer the humiliation of hearing it pronounced faulty by the foundrymen.

In this article no attempt will be made to describe to any length the tools of the trade and mode of using them. Ordinary carpenter's tools will answer the purpose for the amateur, and it is assumed that he is reasonably familiar with their use. Many patterns do not require the use of a lathe in making them, but for those that do, even though not expert in the use of turning tools the operator will usually be able to "scrape" to shape and sandpaper his work so that it appears presentable. Screws, nails and brads of various lengths and sizes should be at hand, and glue and shellac must be provided. Generally but a small quantity of glue is required, in which case the ready-made liquid glue will prove more satisfactory than the solid kind, which has to be heated in water and melted. Several sizes of wooden screw clamps would be helpful in holding the parts together after glueing. Shellac is used for the finishing of patterns. Either the white or orange may be bought ready prepared. Several coats are generally required, as the preliminary ones raise the grain of the wood and roughen the surface, requiring the application of fine sandpaper after each coat; the finished surface must be smooth, in order that the pattern may be easily "drawn" from the mould. And right here a caution should be inserted regarding the use of sandpaper; the article must be brought as nearly as possible to its final form and finish without the use of this abrasive, and great care should be taken not to curve supposedly flat surfaces or to round supposedly square corners through employing an excess of zeal in its application.

Almost any fairly soft, evenly-grained wood capable of taking a good finish, and which will not warp or swell to an undue extent

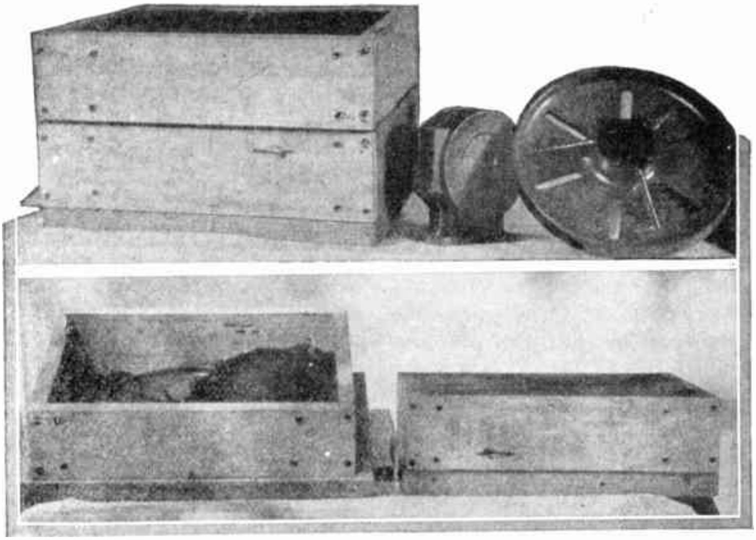


Fig. 2. "A" (lower left) Pattern partly covered with sand. "B" Drag completely filled and smoothed. "C" (above) Cope in position filled with sand.

through coming in contact with damp sand in the mould may be used for this work. Cherry and mahogany, because of their freedom from warping, shrinking and swelling, and because of the fine finish they are capable of taking, are considered about the best for regular commercial patterns, but they are rather expensive, and cheaper lumber, such as white pine or redwood, will answer the purposes of the amateur just as well.

In order to go about this work intelligently it is essential to understand clearly the series of operations by which a casting is produced at the foundry, and the reader's attention is called to the series of photographs representing the process of making a sand mould from a simple one-piece pattern, that of a face plate to be used on a small lathe or drill press. Small castings are moulded in a "flask," which in its plainest form consists of two rectangular frames resting upon a loose piece called the bottom board. The upper frame is called the "cope," and the lower is known as the "drag." A "moulding board," which for our purpose may be considered a duplicate of the "bottom board," is also provided. In the photographs the "flask" is represented by two wooden frames resting upon a bottom board. A regular flask, however, would be larger than this and of more complicated construction, being provided with guide pins between cope and drag, so that they will always fit together properly, cope "bars," handles, etc., and they are often built of iron. For the purpose of simplification all such details are omitted from the pictures. Sections called "cheek pieces" are sometimes introduced between cope and drag for producing complicated castings and a number of pieces are usually moulded in one flask, which is partitioned off for the purpose. While the procedure that follows may not always be adhered to in regular foundry practice, the beginner by so constructing his patterns that they can be moulded by such a series of operations is assured of good results.

Our face plate pattern will first be placed upon the "moulding board," flat side down, as in *A*, Fig. 1, then the drag, shown, on end, behind the moulding board, is placed over it as in *A*. Fig 2, and filled with moulding sand which is "rammed" down and smoothed off even with top of drag. Fig. 2, *A*, shows the pattern partly covered with sand, and Fig. 2, *B*, represents the drag completely filled and smoothed off, the pattern being at the bottom out of sight. Next, the bottom board is placed upon the top of the drag for the moment, and the whole is turned over, the removal of the moulding board exposing to view the side of the pattern which rested upon it, as shown in *A*, Fig. 3. Now the cope is placed upon the drag, the pattern still being in place, filled with sand and rammed, and lifted off again. A "sprue pin," whose purpose is to form an opening through which the molten metal may be poured into the mould, is set into the cope previously to filling in the sand, but this has been omitted from the pictures. Fig. 2, *C*, shows the cope in position, filled with sand.

The cope having been filled and lifted off, the pattern is removed by driving in a "draw pin" and "rapping" to loosen it from the sand. Sometimes considerable rapping is necessary, and it is important to remember that *a pattern should be as strongly constructed as possible in order to withstand this treatment.* *A*, Fig. 4, shows the appearance of the mould after withdrawing the pattern. A "gate" or channel is cut through the sand from under the sprue pin opening to the mould, vents for the escape of air are provided, and then the cope is replaced and all is ready for pouring. Assuming that the reader has these fundamental operations clearly in mind, we will now take up the question of "draft."

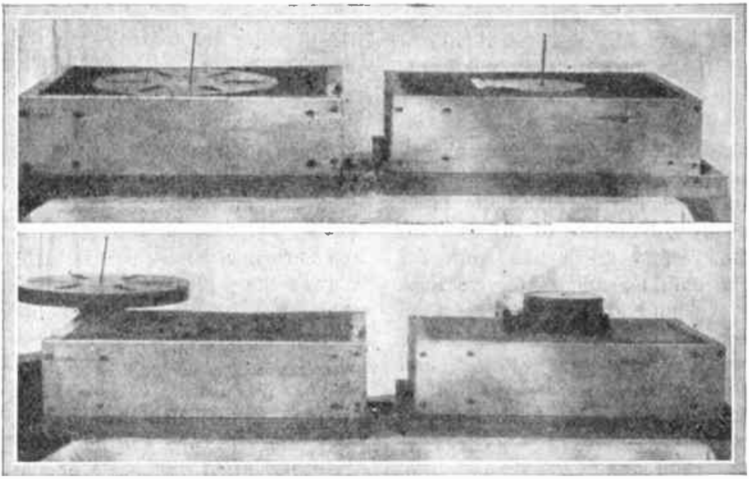


Fig. 3. (above). Pattern exposed and piece moulded in place. Fig. 4. (below) Pattern withdrawn and two-piece pattern held together by dowel pins

"Draft" refers to the tapering of the sides of a pattern so that it may be easily "drawn" from the mould without breaking out the sand. In Fig. 9. *A*, is shown a section of a plain flange pattern in position upon the moulding board ready to be covered with sand. The sides of the pattern are tapered off in order to facilitate its being "drawn," as shown in Fig. 9. *B*. It will be seen that if the sides were tapered in the opposite directions the pattern could not be withdrawn without pulling the sand up with it and spoiling the mould, and that if the sides were made perpendicular difficulty would also be experienced. Note that this pattern is made with a hole in the center, and that the sides of the hole are so tapered that upon drawing a column of sand will be left standing in the center of the mould, so that the molten metal running around it will form the hole in the casting. Such a column of sand formed directly by the pattern is known as a "green sand core." The subject of cores will be taken up later.

Every side of a pattern which in the original design or drawing is shown as perpendicular to the plane upon which the pattern will be moulded, or in other words, every side which must slide through the sand in drawing from the mould, *must be tapered or given draft*, and *this* *taper must be in the right direction.* In Fig. 9 the amount of draft is purposely exaggerated; one eighth of an inch to the foot is usually allowed for small articles, but the amateur could well provide a greater amount, at least enough to make the taper easily discernible to the eye, for this would mean less work for the moulder and better castings. He should always keep in mind the idea of the moulding board, as illustrated in *A*, Fig. 1, and the drawing of the pattern as shown in Fig. 4, *A*, and before beginning to make a pattern of any kind should always ask himself: "How will it be moulded? How will it be drawn? Are there any parts which will not draw without ruining the mould? Upon deciding the direction in which it will be drawn, he will then be able to determine which sides should be given draft and its correct inclination. Imagine the pattern to be placed on the moulding board as in Fig. 1; then the direction of drawing, in the present position, would be downwards; therefore, all outer sides of the pattern should slope *upward* and *inward* and the inner sides, as the sides of the hole in flange in Fig. 9, should incline *upward* and *outward.* This, of course, includes curved as well as straight surfaces.

Keeping these facts in mind, there should be no difficulty encountered in constructing one-piece patterns having one side flat to allow for placing upon the moulding board. It is not necessary, however, that the flat side be made smooth, that is, having no openings or recesses. Fig. 10 represents a pulley pattern set upon the moulding board. The bottom is recessed and a lower hub is formed whose end is higher than the pulley rim in the position shown. This will cause no trouble, provided draft is given the hub and inside rim as indicated; the drag will be filled, rammed and turned over as before, then the cope will be set in place and filled and some of the sand will fill up this recess, now on the upper side, but will be lifted off with the remainder of the cope sand. The pattern is then removed, and upon replacing the cope this projecting part of the sand will extend down into the mould in the drag, thus forming a recessed casting of the same shape as the pattern. Many other patterns fall under this class, such as the base plate of Fig. 11, with its recessed under side and interior bosses and webs. This pattern is also shown at *B*, in Fig. 7, and beside it is shown a bottom view of a similar one (*A*, Fig. 7).

But care should always be taken not to build a pattern which cannot be drawn, such as the pulley of Fig. 12, which is identical with the one of Fig. 6, except that the bottom hub projects be-

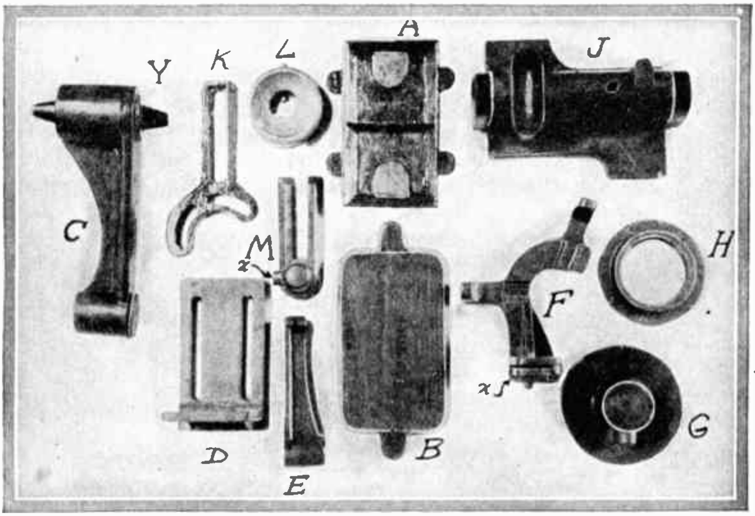


Fig. 7. Typical one-piece patterns

yond the pulley rim, and if moulded as shown the sand between rim and surface of drag would be torn out when drawing the pattern. It is not impossible to produce a casting from a one-piece pattern like this one, but it would not be wise for the beginner to make one of this type without obtaining practical advice upon the subject. The safest and best way would be to make that part of the hub which projects below the rim and interferes with the use of the moulding board, removable, and held in place by dowel pins. This would really form what is known as a "parted" pattern. *All hubs, bosses or other projections upon the side of a one-piece pattern which would interfere with the use of the moulding board as shown in Fig. 1, should be made removable.*

A group of typical one-piece patterns is shown in photograph Fig. 7. *A* is the under side of a base plate similar to the one of Fig. 11, a top view of which can be seen at *B*. *C* is a drill press arm; note that the boss *Y* and boss with tapered "core print," *Z*, are removable, for the pattern would be placed on moulding board with that side down. (Core prints taken up later). *D* is a slotted angle plate; the slots must be given draft and the piece at right angles to slotted base should be given considerable, for this part is down in the drag. Note rounded corner piece, or "fillet." At *E* is a crank handle; *F* a follow rest for a lathe, and would be placed on the board laid flat as shown. *X* is a "loose piece," to be described later. *G* and *H* are flanges; *K* should be specially noted as bearing out what was said in the preface; it was made to replace the broken part of an old lathe for which a new casting could not be obtained. The pattern was cut out by hand in about an hour, and the casting obtained only required a little hand filing and cost about twenty cents. At *M* is the tool rest slide for a speed lathe. *X* being another "loose

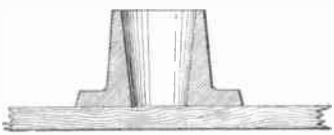


Fig. 9A. Flange pattern showing "draft"

piece." These patterns are all cast like the face plate shown in photographs Figs. 1, 2, 3 and 4, *A*, and the group gives an idea of the great variety of forms under this class.

But many patterns have to be made in halves, or in two or more parts, held together by wood or brass dowel pins, called "pattern pins." Such patterns are known as "parted patterns," and are so made that one part may be moulded in the drag and another in the cope; the dividing or "parting line" of the pattern *coincides with parting line between cope and drag.* If made and moulded in one piece such a pattern could not be removed from the mould without completely breaking up the sand, but the two parts are so con-

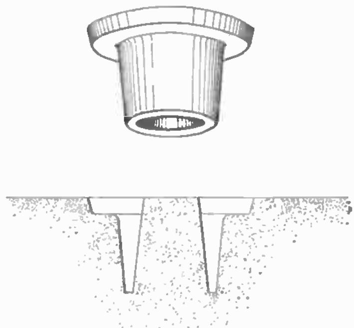


Fig. 9B. Pattern removed, showing core left in sand mould

structed that each may be individually drawn, and then when the cope and drag are again fitted to each other, the mould formed by the impressions of the two pieces will be of the exact shape of the pattern.

Photographs Fig. 1-*B* and Fig. 2-*C* (center) shows a pattern, which, on account of the shape of its base obviously could not be cast in one piece; it is therefore "split" through the middle and moulded as illustrated in the series of photographs 1-*B*,

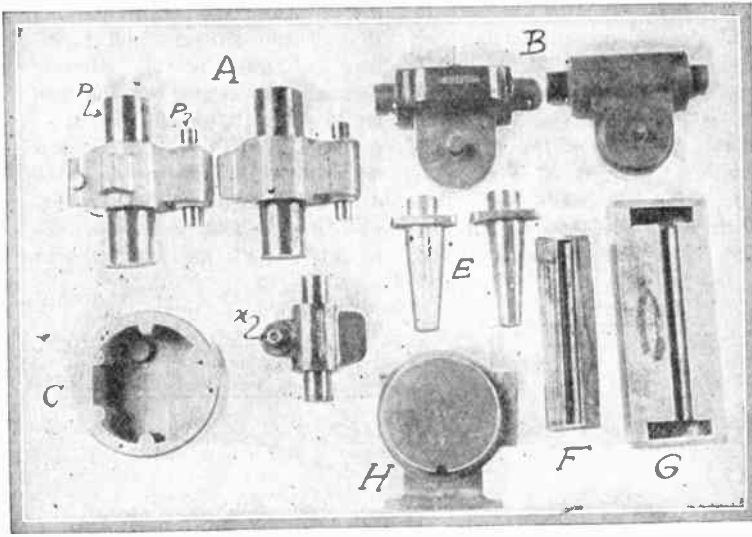


Fig. 8. A few parted patterns

2-*B*, 3-*B*, 4-*B*. One part, that without dowel pins, is laid upon the moulding board as in Fig. 1-*B*; the other part with pins may be seen standing on end. The procedure is the same as the moulding of the one-piece face plate previously described, until the drag is turned over and moulding board removed, exposing the flat side of the pattern to view. Now at this point the second part of the pattern is placed upon the piece still in the drag, the pattern pins holding it in the proper position, see Fig. 4-*B*. Then the cope is set in place, filled with sand as is Fig. 2-*C*, and removed. As the pattern pins fit loosely, the upper part of the pattern comes off with the cope which is turned over, and this part and that in the drag removed by means of "draw pins." Fig. 3-*B* shows the piece first moulded in the drag ready for drawing, with draw pin in place. The cope is now replaced upon the drag after providing gate, vents, etc. (not shown) and the mould is ready for pouring. The important point to remember then, in making a parted pattern, is to provide the flat side of one piece with dowel pin holes, but no pins, in order that it may be laid flat upon the moulding board exactly as though it were a one-piece pattern; therefore *the* *same rules for draft should be applied.* Then supposing that both parts were laid flat, side by side, *the taper or draft given the sides of the two respective parts should be in the same direction.* A study of Figs. 1-*B*, 2-*B*, 3-*B*, 4-*B*, will make this clear, and Figs. 1-*A* and 1-*B* will show how the moulding board is used for the moulding of parted as well as one-piece patterns. By keeping in mind the use of this board one should be enabled to reason out the correct way to go about the building of patterns of either type.

The pulley illustrated in Fig. 12, when provided with a loose end on the lower hub, is a regular parted pattern; but now that this class has been explained a better way to make it will be described; by having the parting line of the pattern, and therefore of the mould, directly through the center of the rim as in Fig. 13, much less draft need be given the rim, since now only half of its width has to be drawn through the sand; this also means less work for the moulder, for the pattern will draw easier and not require so much rapping; a better casting results, and there will be less machine work and waste of material due to its more symmetrical shape.

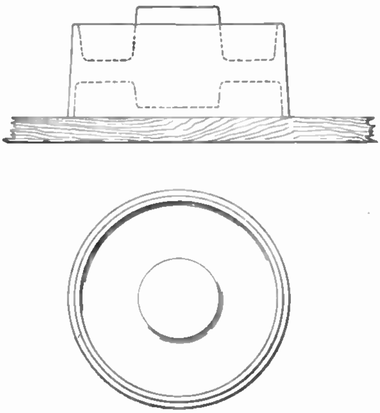


Fig. 10. Pulley pattern

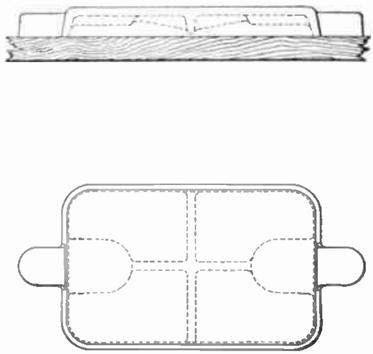


Fig. 11. Base plate pattern

A few parted patterns are shown in Fig. 8. For the moment no attention should be paid to the black projections seen on some of them; these are "core prints" and will be explained later. At *A*, *B*, and *E*, are three pairs, and at *D* half of another. The cylindrical parts of these are lathe turned, and the other pieces fitted and glued. *E* could be made in one piece and cast vertically, for the "nose" has

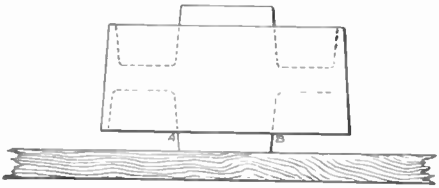


Fig. 12. This pattern can't be drawn

considerable taper, were it not for the cylindrical projection above it (this one is not a core print) which would have to be pinned on so that it could be removed and allow the "nose" to be stood upon the moulding board resting upon its flange. *H*

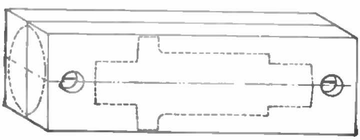


Fig. 14. Parted pattern ready for turning

is a half of the pattern shown as being moulded in Fig. 1-*B*. *C*, *F* and *G* are "core boxes," and will be taken up further on.

It must not be supposed that parted patterns are built in one piece and then sawed in two afterward; Fig. 14 shows two pieces planed and fitted together with dowel pins, the regular pins that remain in the pattern, and temporarily secured by counter sunk screws at the ends. Enough material should be allowed at the ends for the pattern to be

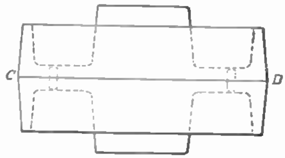


Fig. 13. A better design for the pulley pattern

turned to shape and finished at the ends without running into these screws; the assembled piece must be wide enough to allow of its being turned to correct diameter. Great care is necessary in placing the work between centers, for the centers

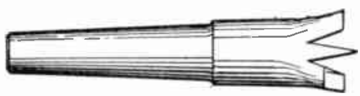


Fig. 15. Steel spur used as "live center"

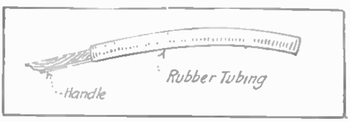
should fit directly into the parting line; otherwise the halves will be found unsymmetrical. At Fig. 15 is a steel "spur center" used as a live center in wood turning; the spur holds the end of the work firmly and no dog or other holder is required. *The dowel pins must always be fitted first, before turning to shape*, for it would be most difficult to put them in accurately afterward. They should fit loosely, so that the parts will fall apart of their own weight, but not so loose that the pieces can shift sideways.

Sometimes it is necessary to make a pattern in three or more parts; on other occasions an irregular parting surface must be made in the mould; often the pattern parting line does not coincide with that of the sand, but these more complicated operations would be beyond the scope of this article, and the beginner is advised to stick to the easier forms for a while. Meanwhile, the subject of "core prints" and "core boxes" requires some attention. This subject will be treated in the next issue.

(To be continued.)

Plier Insulation

To insulate plier handles use hard or soft rubber tubing which is of the right diameter to slip snugly over the plier handles.—Maynard Bodley.

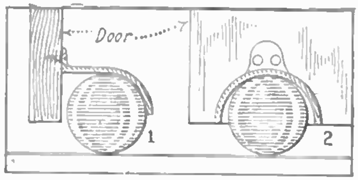


Slip rubber tubing over the handles

Enameled Iron Bedsteads.—Kerosene will remove dirt and finger marks from enameled iron bedsteads as if by magic. Apply with a soft cloth that has been but slightly moistened with the oil.—F. H. Sweet.

Door Stop

This stop is made of a solid rubber ball such as children play with and a semi-spherical case which may be fastened to a flat surface as shown. The case is



The rubber ball will not mar the floor

screwed to the bottom of the door so that it bears on the rubber ball. The door will then remain open at any point desired. This device will not mar the floor and can be used in carpeted rooms.

Contributed by James E. Noble.

Using Broken Hack Saw Blades

When using a keyhole saw, one amateur was bothered with the buckling and breaking of the blades. By drawing the temper of a broken hack saw blade and grinding the end to the shape of a pocket knife blade, he had a substitute far superior to the original blade which was in the handle. Draw to deep blue temper to permit sharpening with a file.

Contributed by H. S. Davis.

ELECTRICAL EQUIPMENT OF THE MOTOR CAR

How To Understand It

By Wm. C. Houghton, M. E.

Part II.

THE heart of the electrical system in the modern automobile is the storage battery. A careful study of the directions given by battery manufacturers will go a long way in the matter of the ordinary care and maintenance of the battery. But a thorough understanding of the principles on which it works will enable the user to avoid many troubles that are sure to arise from lack of knowledge of its construction, limitations and weaknesses. It may be said that while the storage battery is not only a great convenience, but an absolute necessity on the one hand, it is also an unmitigated nuisance on the other. It will work for a time under the worst conditions, indeed, under absolute abuse, but very soon goes to pieces. Under the best conditions it is capable of fairly long and very satisfactory service, but requires careful treatment and constant inspection. It is only tolerated because, as stated, it is an absolute necessity, and with all its imperfections, there is nothing that can take its place.

The first point to be taken up is the exact nature of the so-called storage battery, or accumulator. It is not a reservoir into which a quantity of electricity may be packed, to be let out as needed, like compressed air in a tank. A charged battery does not contain any electricity, any more than a well-filled wood-box contains fire. If that be the case, how can it give out electricity? Very much as the wood in the box can be made to give out heat. The wood is burned in the stove. The chemicals in the charged battery also burn, although in a different way, and in so doing give out an electric current. Where then, does the storage come in? Suppose that after you had burned your wood in the stove, you could apply some form of power to it and reconvert it to wood. It might then be again burned, and the process indefinitely repeated. The wood-box might then be called a heat storage box, even if there is no heat in it. There is only potential heat. In the charged battery there is potential electric current, but no electricity, as such. To make this fact clearer, the reader who likes to study things first hand may try a few simple experiments. If a carbon plate and a strip of zinc be plunged in a glass of diluted sulphuric acid and a wire attached to each, a current will flow from carbon to zinc when the two wires are brought together. The flow of current may be made evident by passing it through an ammeter such as is commonly used for testing dry batteries. Indeed, the so-called dry battery is itself an arrangement of zinc and carbon very much like the one described. As the current flows the zinc is consumed, practically burned, but without heat. Since the zinc burns it will sooner or later be used up. In the case of the dry battery it is usually sooner. And when the zinc is burned up the battery must be thrown away and a new one substituted. If there were some way of, so to speak, unburning the zinc, it could be used over and over again. This is exactly what is done in a storage battery. The process may be carried out experimentally with very simple apparatus. Two strips of common sheet lead are immersed in a glass of dilute acid, just as in the case of the carbon and zinc mentioned above. If an ammeter be connected to the plates, it will be found that no current will flow. One strip is then connected to the carbon pole of a battery of two or three dry cells (two if they are fresh). The other strip is attached to the zinc (negative pole) of the battery. A current will pass from one strip to the other through the acid, which is called the electrolyte. In a few minutes the strip which is connected with the carbon will turn brown, because it has become oxidized. If now the battery be disconnected and the ammeter again connected, a very strong current of electricity will pass from the brown (positive) plate through the meter, to the grey (negative) plate.

This current will be only momentary, however. On repeating the process, the current will possibly last a little longer.

We have a miniature storage battery, which may be defined as a device for converting electrical energy to chemical, and then again giving out electric current at the expense of the chemical force. It is, in short, a reversible battery. In this simple form the battery would be of no practical value, because, even with many large and heavy lead plates, no great amount of energy could be taken up or given out. If the lead plates were deeply scored or cut so as to roughen and greatly increase the surface exposed to chemical action, the capacity would be correspondingly greater, but still rather small and only slowly increasing with repeated charges and discharges. The capacity of the plates being determined by the amount of oxide of lead which is subject to chemical action, someone conceived the idea of applying a quantity of oxide to the plate instead of slowly

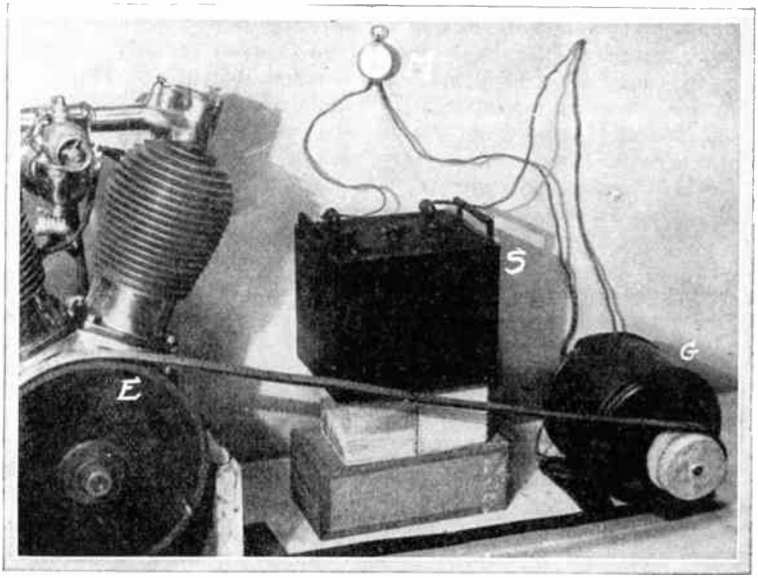


Fig. 1. A photo-diagram of connections

forming it from the plates by repeated charging. This idea was the germ of the modern accumulater. Instead of the plain lead plate, a sort of frame is made, usually by casting, in such a form as to hold the lead oxide as securely as possible. This frame is called not a plate, but a *grid* and, as the name implies, it looks a good deal like a grid-iron. Much ingenuity has been used in devising forms of grids which would hold the active material as securely as possible. All this is of importance to the user of the battery only, as it brings out the cause of its greatest weakness, the tendency of the plates to drop their active material. The chemical changes cause the active material to alternately expand and contract. More or less loosening and dropping follows sooner or later. The active material gradually accumulates in the bottom of the jar.

and when there is enough to bridge across from plate to plate, a short circuit is the result. which, of course, puts the cell out of commission. Any short, whether caused in this way, or by the fool who "sparks" the battery with a heavy wire to see if there is any "juice" in it, is simply ruin. A word in explanation here. In the case of a dry battery, a momentary "short" may do no great amount of harm, because the internal resistance of the cell itself limits the current. The common practice of "using" dry cells is to short circuit them with an ammeter, when the current goes up to 30 or 40 amperes for an instant. But, *under no circumstances*, should this be done with a storage battery. It is really a method of roughly measuring the internal resistance. and hence the condition of the dry cell. But the internal resistance of an accumulator is always low, so low, in fact, that if "shorted," it will work itself to death. Moreover, the internal resistance is no guide whatever to the condition of the cell. There are other methods of determining the condition, approximate amount of charge, etc., which will be taken up in due time. The very great importance of this point, and its bearing on the useful life of the battery justifies a repetition of the caution: *Never short circuit, or connect any apparatus of very low resistance to a storage battery!* The higher the voltage, that is the greater the number of cells in the battery, the more important this caution. It should be remembered that the usual "battery," *i.e.*, box, contains three or even six or more cells.

A single cell consists of a number, usually odd, of plates, assembled in a jar of hard rubber, or sometimes of glass. Plates are sandwiched in alternately, positive and negative, with separators of a thin, grooved wood between them. There are sometimes perforated hard rubber insulators or separators in addition to these. All the positive plates are connected in one group by substantial lead bars. The negatives are likewise grouped, and the whole assemblage, called an element, placed in its rubber jar and sealed, except for a small vent hole, which also serves for filling and replenishing with acid or water.

For charging a battery of this sort, some source of direct current must be used. The usual house service is not suitable for this purpose, being what is known as alternating current.

The dry batteries mentioned in connection with the experiments noted above would be entirely inadequate, as they would be at once exhausted. Indeed, if such batteries were to be used at all, they would do more work if used direct without the storage battery.

The only practical means of charging is by a dynamo, which in turn must be driven by an engine of some sort. Fig. 1 may be regarded as a sort of pictorial diagram of a simple charging plant. The storage battery, *S*, is connected by heavy insulated wires, through the ammeter, *M*, to the dynamo (generator), *G*. The ammeter serves to indicate both the direction and the amount of the current passing through the battery. Note that the current is said to pass *through*, for in no sense does it pass *into* and remain in the battery. In passing, it makes certain changes in the chemical nature of the plates. The generator is driven by a belt from the engine, *E*. The term engine is used here, but may be taken to mean any source of mechanical power. The amount of power needed for the purpose depends upon the size of the battery, the rate of charging, the efficiency of the generator, and various other factors. But in any case, the total amount of power used in charging will be more than can be obtained from the battery in discharging. This rather obvious fact should be kept in mind, as it has a very important bearing on the successful use of the battery for automobile purposes.

While such a simple plant as this one might be used with more or less success for starting and lighting the auto, it would be decidedly inconvenient, involving the periodical removal of the battery for charging. And since the auto necessarily has a powerful engine, which is generally not fully loaded, the generator is built into the engine or attached to it as a part of the electrical equipment. The capacity of the dynamo is usually sufficient to take care of the lighting and ignition, and so may be regarded as the primary source of current. But for starting the engine and also for taking care of the lights when the engine is not running, the battery is a necessity. In addition to this it serves as a sort of electrical balance wheel. In a stationary plant the engine runs at practically uniform speed. The auto engine must run at all sorts of speeds, causing the generator to vary its output accordingly. The current is sometimes not enough to take care of the load, and at other times greatly in excess. The battery is said to "float on the line," and gives out or takes up power as required.

From the foregoing explanations it is to be hoped that certain things have been made apparent. First, the nature of the storage battery and of the processes which go on in it. Second, its relation to the electrical system of which it is a part.

Third, some of its weaknesses and limitations.

No attempt has been made to give directions for the care and maintenance of the battery, as very full and explicit instructions are to be found in every manufacturer's catalog, and also in the operating instructions sent with the auto.

It must be constantly kept in mind that the accumulator can only give out the energy that is put into it. As one manufacturer puts it: "The battery lives upon electricity and water," and it must have both. The motorist must be sufficiently familiar with his machine to know whether his battery is well fed or starved.

(To be Continued.)

Holes Through Watch Springs

One way of putting holes through watch and clock springs which is much easier than annealing and then retempering is as follows:

Place the spring on a soft block of iron and punch with a sharp center punch, this will make a dent in the spring without breaking it; the portion of the spring raised by punching it is now ground off on an emery wheel, leaving a small hole. If a larger hole is necessary simply punch from opposite side and grind off; care is necessary only that the center punch marks are not too deep or the spring will break instead of bending.

This method is good for all kinds of small flat springs, such as those of watches, clocks and phonographs.

Contributed by L. E. F.

Simple Method To Bore a Hole in Glass

Lay your pane of glass over a hole in the bench where the glass is to be bored. Cover the entire space about the hole to be cut with wet clay. Wipe your glass clean at the bottom of the hole, which you must make in the clay just the size of the hole to be made in the glass. Pour melted lead into the hole in the clay, the hot lead and glass falling through the bench to the floor. Melt your lead in a large spoon so it can be easily poured into the clay hole.

Contributed by H. G. Frank.

New Secret Writing Fluid

Dissolve some sulphate of quinine in water and write with the solution on a piece of white paper. The sentence or design will be absolutely invisible. Illuminate the piece of paper by the light of a vacuum tube and the writing will appear.—H. Frank.

CONSTRUCTION OF A MODEL SUB-SEA TRANSPORT WITH SELECTIVE RADIO CONTROL

By the Editor

Part II. Ballast Tanks, Storage Battery, Driving Motor, Transmission and Propellers

THE ballast tanks in *EM2* serve a two-fold purpose. Primarily they are intended to partially or completely submerge the submarine while she is at the "wharf." Their secondary purpose is to "trim" the craft when she is placed in the water for the first time. The necessity for this latter procedure will be obvious to every veteran model builder. He will know from experience how nearly impossible it is to so distribute the load inside the hull that the craft will float on an even keel when first she is launched. The tanks enable the operator to trim the submarine both fore and aft, causing her to assume not only the desired depth in the water, but also to overcome any pronounced tendency to ride lower by the bow than the stern, or *vice versa.*

As described in the opening article, the "tanks" are built into the lower part of the hull. Theoretically, they should be lined with zinc or copper. In practice, however, we have found that this is unnecessary. A very liberal use of good waterproof paint over the interior of the hull serves the purpose without the need for a very complex piece of sheet metal work such as the tank would represent.

Fig. 6. Cross section of the hull to show water ballast compartments

The tanks are completed through the addition of a decking of ½ in. wood thoroughly coated with the paint or cement described in the first instalment. This decking is to be literally cemented in place first of all and then, to add strength, it is nailed every inch or so to the step in the hull shown in the illustrations. Fig. 6 gives a section through the hull with the tanks completed. The water is kept from surging back and forth by means of bulkheads which divide the tanks into compartments represented by W in the drawing. These bulkheads are perforated so that the water entering the openings indicated in the bottom of the hull can find its way readily into all compartments.

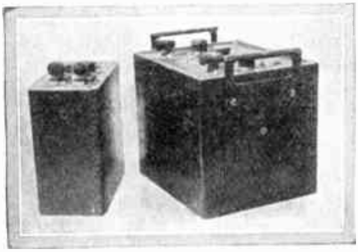


Fig. 7. The storage battery

The intake holes through the keel are left wide open at all times. The water is permitted to enter by opening air cocks on the superstructure of the submarine; as the air in the tanks is permitted to escape through these cocks, the water enters. To discharge the ballast, compressed air is sent into the tanks through the cocks, thus driving the ballast out. This operation is the only one not performed through the medium of the radio control. It could be done, of course, while the craft is running, but the delicacy of the adjustment and the tendency of the craft to plunge to the bottom under such circumstances render such a plan inadvisable.

The details of the air cocks and their location will be taken up in a later article after the superstructure has been covered. To give such details at this point would necessitate repetition later.

The Storage Battery. The storage battery is divided into two units; one is for the motor which drives the craft while the other is for the controller and the various control devices. The motor battery is a 6-volt, 80-ampere hour automobile lighting battery, while the control battery is of 40-ampere hour capacity at 4 volts. The dimensions given in the hull drawings in the preceding issue are suitable for a number of standard automobile batteries on the market. See Fig. 7.

The battery compartment has been described. Suffice it to say here that no attempt should be made to fasten the battery in its place. The two units should be easily removable for repairs or for charging in the event that the whole model cannot be taken to a place where current is obtainable. See Figs. 8 and 9 for views of the battery in the hull.

The connections to the batteries will come in a later article.

Motor and Transmission. The motor selected for *EM2* is of a standard type obtainable in the open market. The motor has practically all of the desirable features found in commercial machines of large size. Radial gauge brushes, mica insulated commutator, adequate oiling facilities, form wound coils, and a liberally designed frame, are among its excellent features.

The transmission has been added solely to permit the motor to run at relatively high speed with moderate propeller speed. The arrangement of the gears is such that a speed reduction of 2 to 1 is obtained with the shafts for the propellers running in opposite directions. This, of course, necessitates the use of a left- and a right-hand screw.

with this gear is a 96-tooth gear, 2 in. diameter, mounted upon one of the transmission shafts. Meshed with this gear is a second 96-tooth gear mounted upon the second shaft. The layout drawing in Fig. 11 will make this clear. The gears are represented by pitch circles. The operation is obvious. The motor gear *A* turns the first large gear *B*, which in turn operates the second large gear *C* in the opposite direction.

While on the subject of trans-

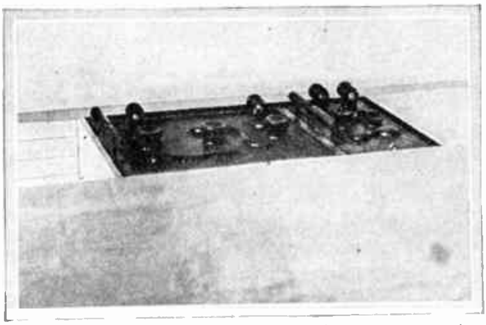


Fig. 8. The storage battery in its compartment

The motor with its transmission is well shown in Fig. 10, which gives a front and rear view of the power plant. These photographs, together with the detail drawing, Fig. 11, should make clear the entire scheme of the transmission.

The reader will note that a 48-tooth brass gear is secured to the motor shaft. This is a stock 1-in. gear of 48 pitch. Meshed

mission, it may be well to suggest how the bearing plates are laid out and fitted to the motor frame. The first operation is to locate and drill the holes in the upper part of the plates, drilling clearance in the front plate and tap size for 8/32 in the rear plate. Place screws in the holes to grip the plates together. Next locate the center hole at the bottom and drill No. 9 to clear a

10/32 screw, which may be inserted and held with a nut. The plates may then be filed up square and true to each other. All holes will thereafter be drilled through *both* plates at the same time to insure alignment.

The ¼ in. hole for the motor shaft will be next in order. This hole is located near the letter *A* in the layout drawing. When the hole has been drilled, remove the 10/32 screw from the center hole at the bottom of the plates and slip the motor shaft through the hole. Clamp to the motor frame with the distance piece shown in all views between plates and frame. Square up with motor base and run a No. 9 drill through the lower hole to spot into the motor base. Follow with tap drill for 10/32 and tap out.

After this, remove the plates and replace clamping screw in the lower hole. Next lay off the center for the gear *B* by scribing with dividers set to 1½ in. radius from center of motor shaft hole. Strike a vertical line 15/16 in. to right of center and spot for the ¼ in. hole for *B* gear shaft. Now set dividers to 2 in. radius and swing from the *B* gear hole to the left on a horizontal line. This will give the spot for the *C* gear hole. Drill *B* and *C* holes with ¼ in. drill, making sure the drill is ground true so as to insure that it will not cut oversize. The plates may now be separated and the rear plate replaced on the motor shaft with a short 10/32 screw temporarily placed in the center hole to clamp the plate to the motor base. The holes for the flat head countersunk screws may then be drilled and tapped and the plate permanently se-

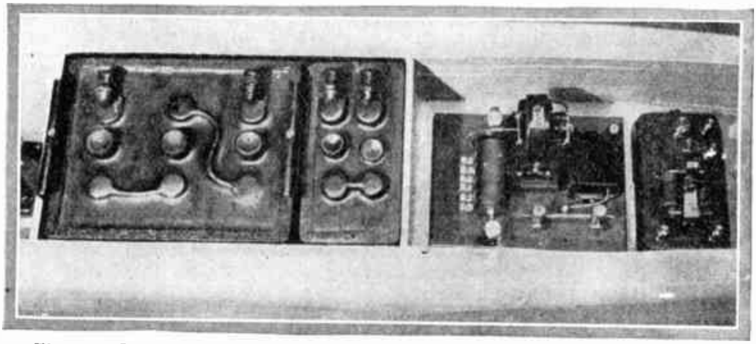


Fig. 9. Looking down on the storage battery and central control device

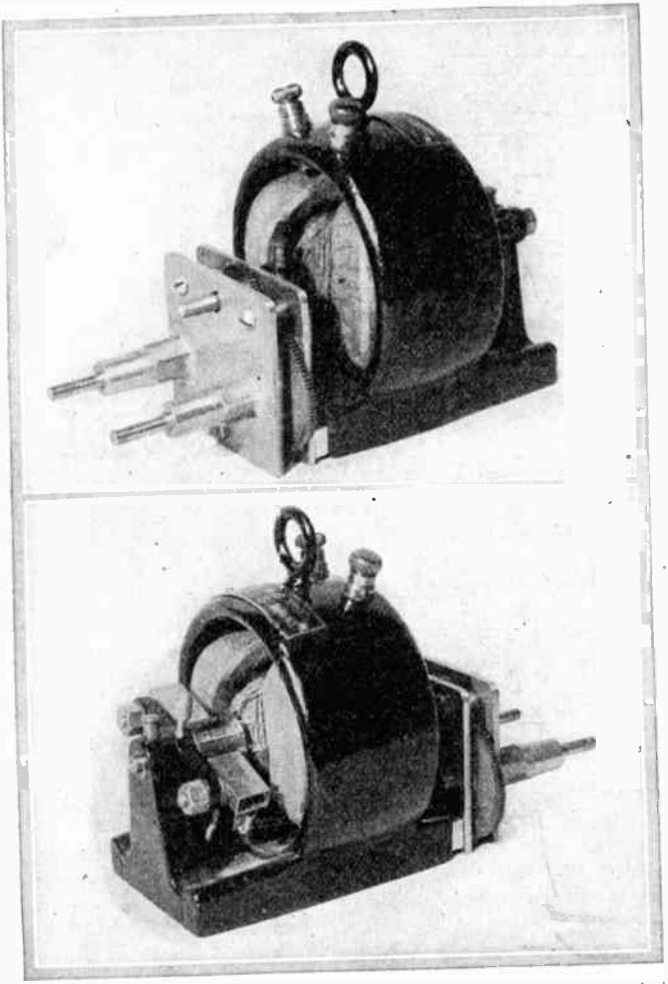


Fig. 10. The driving motor and arrangement of gears for transmission

cured to the motor frame. If the work has been done carefully, the motor shaft will turn without any bind when the plate is secured.

The bearings for the transmis-

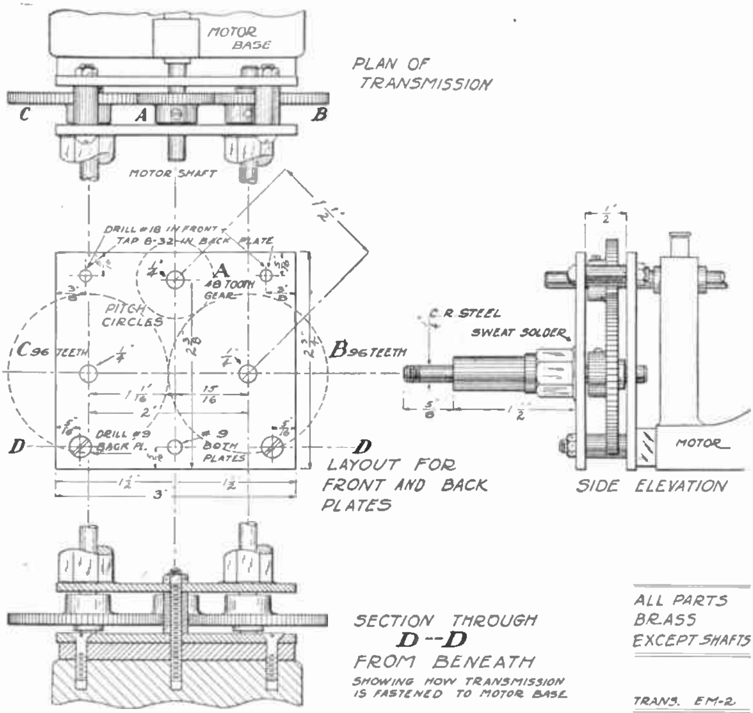


Fig. 11. Details of the transmission

sion shafts next require attention. These are turned up from ¾ in. hexagon brass stock and sweated to the front bearing plate. For this operation, a ¼ in. wooden dowel was placed in the plate and bearing holes to line them up, and the surface of the plate and the under side of the bearing coated with soldering paste. A very hot soldering copper was then used to flow solder around the joint, care being taken to see that the solder actually sweated into the joint between the bearing and the plate. The plate was set up on three brads to keep it away from the bench for this operation. When the job cooled, the bearing plates were found to be in perfect alignment, thanks to the dowels, although the latter were badly charred at the point of union. An oiled rag run through the hole cleaned the bearing sur-

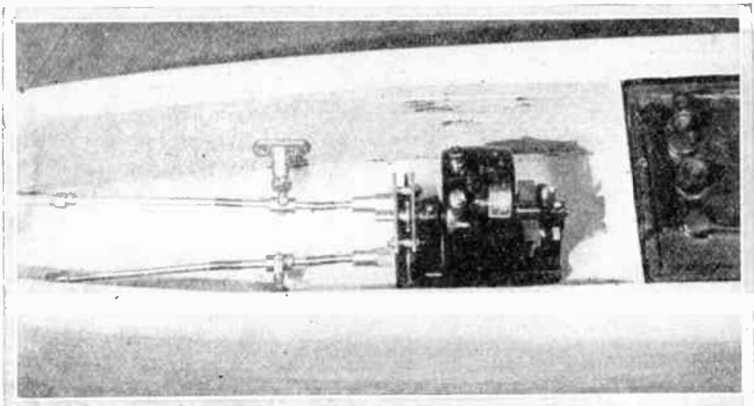


Fig. 12. The motor in place showing spring coupling

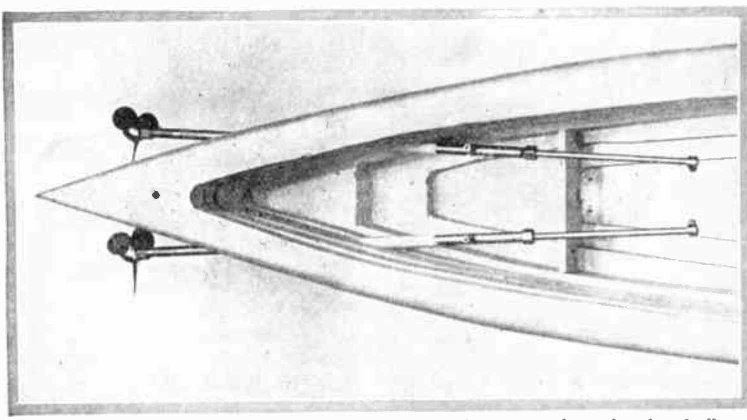


Fig. 13. Showing how the propeller shafts pass through the hull

face of the trace of carbon left by the burned wood.

The *A* gear is secured to the motor shaft with a pointed set-screw, while the *B* and *C* gears are fastened to their shafts by means of brass escutcheon pins driven into holes drilled through gear boss and shaft. The ends of the transmission shafts are threaded 1/4-20 to take the steel springs which provide flexible couplings to the propeller shafts.

All that remains is the assembly. The spacing collars are self-explanatory in the drawings.

The reader will note that the 10/32 screw temporarily placed in the rear plate is displaced by a long stud, which passes through both plates with a spacing collar or sleeve between. These sleeves were made by cutting off the desired lengths of 1/8 in. brass pipe in the lathe. An additional feature not shown in the illustrations might well be a simple oil cup in each bearing of the transmission.

threads of the transmission and propeller shafts, where they will stay put until removed by main force. The propeller shafts were cut off close to the shaft housing shown at the extreme left in Fig. 12, and much more clearly in Fig. 13.

Little need be said of the shaft housings. They are merely lengths of 1/8 in. brass pipe fitted with a standard brass cap at either end. The caps are, of

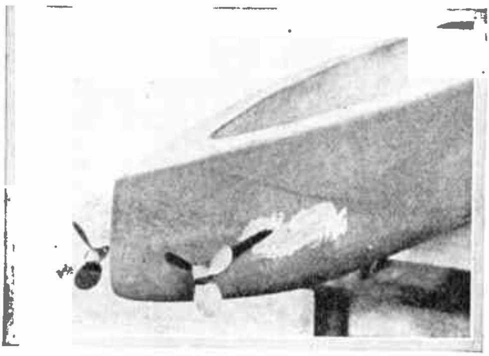


Fig. 15. The stern end, showing propellers

Fig. 12 shows the motor and transmission mounted in the hull. The method of coupling shown has been simplified and improved upon by removing the shaft hangers and substituting long, tightly-wound steel springs of the door-spring variety. So stiff and so tightly wound are these springs that they afford an almost perfect flexible coupling to the propeller shafts. The ends of the springs are forced on the

course, drilled for the shaft. The space between the end of the pipe and the cap is ample for the lampwick and tallow packing necessary to exclude water. Incidentally, need we remind the reader that 1/8 in. brass pipe actually has an inside diameter of something more than 1/4 in.? Why call it 1/8 in. pipe? You have just as many guesses as we have!

We have not given a drawing

for the propellers. The size and shape is well shown in Fig. 14, where a hand is included to give an idea of the proportions. We believe the average builder will want to take advantage of a stock propeller rather than make patterns and have just a single casting made from each. The

Fig. 14. One of the propellers

Service Department of this magazine will supply manufacturers' names if difficulty is found in securing the desired size and shape. The relation of the propellers to the hull is shown in Fig. 15. They are secured to the shafts by a simple screw thread and pinned to prevent loosening. This threading operation was easily accomplished by chucking the propeller in the three-jaw chuck, facing off, centering, drilling and tapping ¼-20.

(To be Continued.)

Indestructible Blackboard

A good blackboard can be made by grinding or sandblasting one side or surface of a piece of plate glass ¼ in. thick and then applying two coats of drop or coach black paint to the other side. Write on the ground surface with ordinary "chalk."

The glass may be ground with powdered emery or carborundum. Lay the glass flat on a solid surface, sprinkle on the emery and rub with a circular motion, using either another piece of glass or a smooth emery stone.

Contributed by E. E. Wilson.

Blackening Brass

Dissolve 1 cmc. of arsenic acid in 2 cmc. of hydrochloric acid, add 0.5 cmc. of sulphuric acid and dilute the whole with 40 cmc. of distilled water.

Dip the brass in the liquid previously heated to 122° Fahrenheit, wash it good and then dry. A piece of zinc put into the liquid in contact with the brass will quicken the black deposit.

Contributed by V. Carouso.

Blackening Zinc

Dissolve 4 grs. of double sulphate of nickel and ammonium in 40 cmc. of distilled water. Then add 1 cmc. of concentrated sulphuric acid.

Dip the zinc previously cleaned in the above solution for a few seconds, take it out and wash it with plenty of water, then dry it in warm sawdust.

Contributed by V. Carouso.

HOW TO MAKE A WOMAN'S WORK BOX

By Charles Alma Byers

A WOMAN'S work box of the kind shown in the accompanying photograph constitutes a very desirable household convenience. As a receptacle for holding darning cotton, needle books, unfinished embroidery or other fancy work, and so forth, it is especially to be appreciated, and when properly made and attractively covered with cloth, as this one is, it also comprises a very handsome piece of furniture, for use in either the sewing-room or a bedroom. Moreover, such a box is very easily and inexpensively constructed.

The wood material for the box will be obtained, of course, from any planing mill, already cut to dimensions. The stock should be mill-planed, but it need not be sandpapered. It may be of any soft wood, preferably of pine, fir, maple, or something of the kind. The following is a complete bill of material, the dimensions specified being for the finished sizes:

Legs—4 pcs. 1⅛ in. x 1⅛ in. x 27 in.
End Braces—2 pcs. 1⅛ in. x 1⅛ in. x 15 1/16 in.
Cross Brace—1 pc. 1⅛ in. x 1⅛ in. 13¾ in.
Sides—2 pcs. ⅝ in. x 10 in. x 17 in.
Ends—2 pcs. ⅝ in. x 10 in. x 13¾ in.
Bottom—1 pc. ⅝ in. x 15 in. x 17in.
Top—1 pc. ⅞ in. x 20 in. x 20 in.

The bottom and top may be composed of two board widths each, instead of one as here specified. If two widths are used for the top, it will be necessary to use cleats on the under side, to hold the widths together. In fact, such cleats, to prevent possible warping or splitting, can be used advisedly even if but a single width of material is obtained. These cleat pieces—two in number—should be of material about ⅜ in. thick, 1¾ in. wide and 12½ in. long. They are spaced about 7 in. apart, between inside edges, not on centers, and are then nailed to the under side of the lid or top with equal margins at their sides and their ends. Afterwards, the edges and ends of the cleats may be rounded off with a knife, to make a smoother-appearing job.

The assembling should be begun by firmly nailing the sides *to* the ends, being careful to form an even-edged corner. The inside measurements of the box so formed will be 10 in. deep, 13¾ in. wide and 15¾ in. long.

It is presumed that the box is to be both lined and covered with cloth, as it should be to make it maximumly attractive. Hence, the lining cloth, of both the inside walls and the bottom, should be fastened in place *before* the bottom board, or boards, is nailed on. The cloth for the walls should comprise a single piece 11 in. wide and about 61 in. long,

This work-box was covered with cloth

The start toward lining the walls is made by tacking the cloth along one end to the walls so as to extend beyond and round one of the corners. The edges are then drawn, reasonably stretched, over the top and bottom edges of the sides and ends, progressing in this manner until the whole inside is circled, when the edge of the loose end of the lining will be turned under so as to fit exactly into the corner at the starting point. As the lining progresses around the inside, the edges of the cloth are, of course, firmly tacked, with ordinary carpet tacks, to the top and bottom edges of the box's sides and ends. No other tacking will be necessary, except at the starting point, and these tacks will be covered by the turned-under edge of the cloth at the finish—the cloth at the finishing point being held sufficiently firm without its requiring tacking into the corner.

The piece of cloth for lining the inside surface of the bottom should be about 16 in. by 18 in. in size. The edges of it are drawn over and tacked to the end and side edges of the bottom board, or boards. If two widths of material are used for the bottom, the pieces may be temporarily held together for lining by the use of cleats on the under side, which may be removed when the box is finished.

The bottom is now nailed to the already finished sides and ends, which will complete a cloth-lined interior in which no tacks are to be seen.

Next comes the matter of covering its exterior. The cloth for this should be 12 in. wide and about 66 in. long. The start with it is made on either of the 17-in. sides at a point about 1 in. from the corner, where the cloth will be tacked along its end edge. The side edges are then drawn both over the bottom and top edges of the box, the edge at the top being turned under and fastened with brass-headed tacks, covering the carpet tacks used along this edge to hold the lining. Since the bottom of the box will not be seen, the edge of the cloth here need not be turned to conceal the frayed edge, and it may be fastened underneath with common carpet tacks.

The lid also is covered, on both sides, before it is fastened on. The top surface is covered first, and the piece of cloth for this purpose should be about 24 in. square. It is drawn around and under the edge and tacked, with common carpet tacks, to the under surface about 1 in. beyond the edge. The cloth for the under surface should be approximately 20 in. square. Its edges are turned under all around, so as to leave an underside margin of the top covering of cloth of about ½ in., and is tacked along the four edges with brass-headed tacks. The lid, which extends quite a little beyond the box on all four sides, is next fastened on with two small cabinet hinges at the back.

Finally comes the matter of the legs and braces. Two legs are nailed to the cloth-covered box on each of its 17-in. sides, being spaced 13¾ in. apart and their top ends reaching to the top edge of box's sides. One of these legs will cover the lapping point of the cloth covering. The three braces form the letter H, and are placed about 4 in. above the floor. The two longer pieces reach the narrow way of the box—the extra 1/16 in. being allowed to overcome the thickness of the cloth covering—and the short piece is centered between the longer ones. The legs and braces are first painted white and then given two coats of white enamel.

Individual taste may be shown in selecting cloth for lining and covering the box. As a suggestion, however, it may be stated that silk of light blue, green or old-rose is very effective for the interior, and that flowered cretonne is especially attractive for the exterior. Straps of the lining cloth should be used to prevent the lid, when raised, from falling back so far as to strain or loosen the hinges. Pockets, made from the same material as is used for the lining, may be sewed to the sides of the interior to hold smaller articles, such as needle books, and so forth.

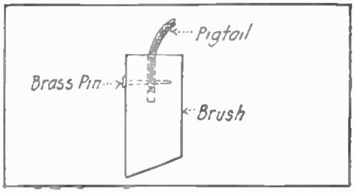
A work box of this kind is not only convenient for holding various sewing and fancy work articles, but it also comprises an excellent little table. In fact, any number of uses for such a piece of home-made furniture will suggest themselves.

Attaching the Pigtail to the Brush

It is the usual practice to attach pigtails or flexible cables to the carbon brushes used on motors and dynamos. It is sometimes quite a problem to connect them firmly and permanently when special brushes are made up for repairs.

The writer solved the problem in the following manner: A hole was drilled in the top of the brush for ¾ in. with a 42 drill. Another hole was drilled at right angles to this as illustrated.

The pigtail, consisting of finely stranded copper wire, is inserted in the first hole. A pointed wire is inserted to spread the strands of copper and a small brass pin is driven in, wedging the pigtail in position. The pin is cut off and filed flat with surface of the brush.



How the pigtail was fastened

This method has given entirely satisfactory results and the first pigtail has still to pull out when once fastened in the above manner.

Contributed by T. W. Benson.

Alloy That Expands by Cooling

Melt together: lead 6 parts by weight, antimony 9 parts by weight, bismuth 1 part by weight. This alloy is very useful in fastening metallic pieces in stones, etc.

Contributed by V. Carouso.

If you do your own housework, by all means get a pair of rubber gloves. Get them good and strong. Use them for scrubbing up the bath room and things like that.—M. F. Scott.

AUDION CIRCUITS AND APPARATUS

By M. B. Sleeper

With Drawings by the Author

As pointed out in previous articles of this series, simplicity in the apparatus and circuits used with the Audion detector means ease in operation and the maximum of efficiency. The two loose couplers described in this article can be used with the ordinary crystal detector, but are intended particularly for Audion work or the reception of undamped waves. The larger coupler will receive Nauen without the use of extra inductances or elaborate auxiliary apparatus.

A 3,000 Meter Loose Coupler

The details of a loose coupler for the reception of transmitters up to 3,000 meters with a 200 meter aerial are given in Figs. 16 to 18. The base provided is unusually long, but this is necessary for the reception of undamped waves. To allow for the most convenient method of control, the switches are mounted so that the instrument can be placed at right angles to the length of the table. As Fig. 16 shows, the primary switch handle is at what becomes the front of the instrument when it is placed as suggested. The secondary switch is also easily reached.

The primary tube is 4¾ ins. long and 4 ins. in diameter, wound with Number 28 single silk wire. Since there are 60 turns per inch of this wire, there will be 236 turns in the complete coil. Taps start at the right, with the fortieth turn, and continue as follows: 52, 64, 76, 88, 100, 110, 120, 130, 140, 150, 158, 166, 174, 182, 190, 196, 202, 208, 214, 220, 224, 228, 232, 236.

The beginning of the winding, at the right-hand end of the coil, is connected to one of the primary binding posts; a wire soldered to a bow-shaped spring under the nut on the contact rod inside the coil head, is fastened to the other post.

Fig. 18 shows the way in which the supports for the primary coil are cut out. A piece of wood 5½ ins. square and ⅜ in. thick is bored at the center with an extension bit, to make a hole 4 ins. in diameter. Then the piece is sawed diagonally, and two of the sections shaped to the form shown by the lined portions of the drawing. The space left on the tubes allows the tube to be nailed to the supports.

Dimensions for the coil-head are also given in Fig. 18. It is intended that the builder use switch points 3/16 in. in diameter, as this allows room for

25 points. The other end may be left plain, or fitted with a wooden ring, as in Fig. 16.

The secondary tube is 4 ins. long and 3½ ins. in diameter, wound with No. 30 single silk covered wire. This allows for 260 turns, tapped at the 60th, 100th, 140th, 180th, 220th and 260th turns. Details of the construction of the coil head are given in Fig. 18. A cross-sectional view of the switch shows the construction of the bearing. The other coil head is the same size as the one in the drawing. However, it is only bored for the ¼-in. holes through which the rods pass.

Every experimenter has his own ideas as to the minor details of a loose coupler. For this reason, no further details of the construction will be given. Moreover, the drawings show all the features of this coupler. Experiments and circuits for this instrument will be described later.

A 15,000 Meter Loose Coupler

The ordinary horizontal type of large loose coupler is rather awkward, particularly on a small operating table. For this reason the design in Fig. 19 has been adopted. The primary coil is mounted on a round base, which also supports the square, vertical shaft on which the secondary slides. This coil is raised or lowered by means of a string and pulley. Controls for the primary, secondary, and coupling are all mounted on the hard rubber panel.

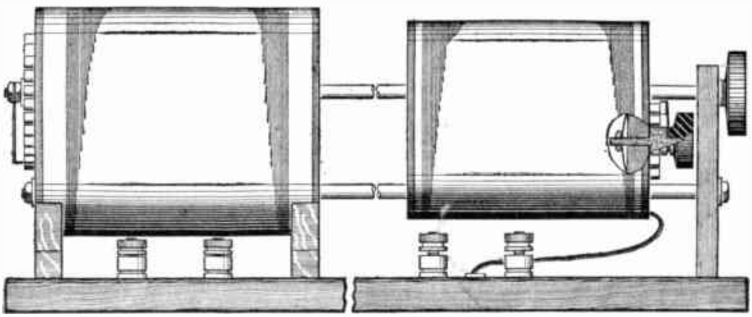


Fig. 16. This 3,000 meter coupler has a 24-in. base, yet all controls are within easy reach

The primary tube is 14½ ins. long by 7 ins. in diameter, wound with No. 28 single silk covered wire. The winding starts at the upper end of the tube, and continues to the 245th turn. There the taps start, continuing every 25th turn until 20 taps have been

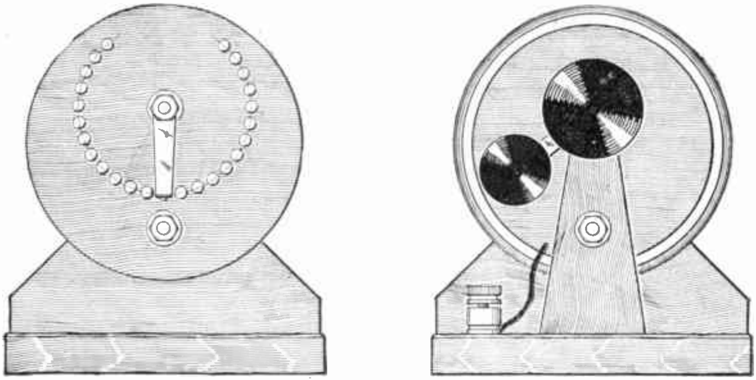


Fig. 17. The primary switch, at the left, and the primary and secondary controls, at the right

taken off. A space of ⅜ in. is left for the coupling control handle, beginning 11 9/16 ins. from the top of the tube.

When the coil is wound, the base must be turned out, 12 ins. in diameter by 1 in. thick. A groove for the primary tube is cut ½ in. deep, and a hole 1 in. in diameter bored in the center of the base. Another hole is bored ⅜ in. in diameter, 2½ ins. from the center. The larger hole takes the supporting rod; the smaller, the square brass rod which turns the secondary switch.

A rope and pulley arrangement is used to raise and lower the secondary; that is, a piece of fish line is fastened to the coil head, passed over a pulley on the supporting rod, and down to a pulley on the shaft of the controlling handle. Since no counterweight is provided, some means are required to hold the coil in place. This consists of a stiff brass arm on the controlling shaft. A round screw head engages in a series of holes in the hard rubber piece mounted behind the arm, as shown in Fig. 21. All dimensions are given in the drawing. The pulley is turned from wood, 3⅛ ins. in diameter in the groove. To allow the pulley to protrude through the vertical shaft, part of the shaft is cut away. The coil must also be cut for the handle of the secondary switch. In Fig. 19, the handle is shown. The white lines correspond to the points of the switch. The handle may be turned by the thumb.

The primary coil is not put on until the mechanism inside has been put in place. Then the coil

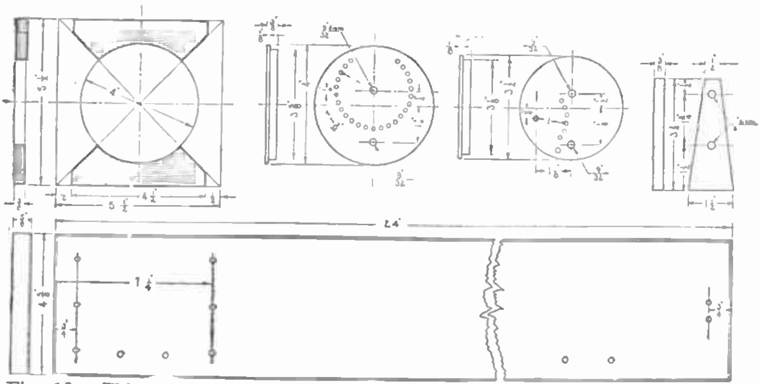


Fig. 18. This shows an easy way to cut out the primary supports, and gives the details of the other parts

is put over the coupling handle shaft and the coil glued in place.

Two coil-heads are used to keep the secondary on the shaft. These parts are shown in section in Fig. 20. The upper head is flanged to fit in the tube, and drilled for the switch shaft and switch points. A 7/16-in. hole, 2½ ins. from the center, takes the square brass tube which slides over the square rod. In Fig. 20 is a large, sectional view of the switch. It consists of a square tube 1 in. long and ¼ x ¼ in. inside. Over the upper end of the tube is a brass washer, 3/16 in. thick by ⅝ in. in diameter, with a square hole filed out to fit tightly on the tube. The switch contact is soldered over the washer to the tube. Then the tube is slit at each corner with a hack saw, and put into the coil head. Another washer, thinner than the first, is put on the under side of the head, and the sides of the tube are bent back to keep the washer from coming off. By this method it is possible to move the coil up or down, yet turn the switch contact at any time.

When the secondary has been wound and tapped, the upper coil-head is put in place, the string fastened inside, and the other head put inside the tube. Then the completed coil is set on the vertical shaft, the square brass rod put through the square tubing of the secondary switch, and the pulley mounted at the top of the wooden shaft.

The switch panel is the last part to be assembled. This consists of two side pieces and a top, the backs of which are shaped to fit closely to the primary tube. Screws from underneath the base hold the frame of the panel in place. The general

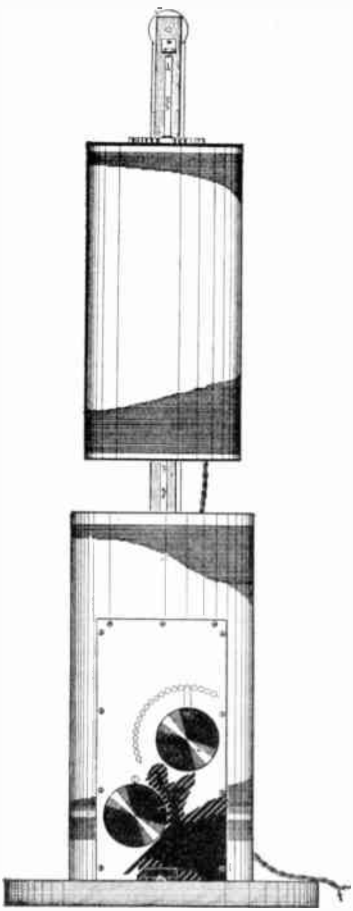


Fig. 19. A 15,000 meter coupler taking a square foot of table space

lay-out of the panel is given in Fig. 19. Above the coupling handle is a short brass post with a mark on it. By noting the relation of the white line on the handle to this post, the same degree of coupling can always be found. At the bottom, a section of the panel is cut away for the secondary switch handle. A small pointer at the front indicates by the lines on the handle the position of the switch.

Connections from the primary secondary are made by stranded, flexible cables. No binding posts are provided; the cables are to be soldered to leads to the other instruments. All connections *must be soldered.* This is not as important in damped wave reception, but for undamped waves it is a necessity.

Some criticism may be made of the lack of close adjustment of the inductances. There is a reason for this—it is impossible to adjust the loose coupler exactly for undamped wave reception. The effect of the hand near the coils is such that when the inductances are adjusted to the signals, removing the hand from the switches will make the signals go out. Therefore, a separate case is provided with variable condensers to give the sharp tuning necessary.

Condenser Case.

Fig. 22 illustrates the case and controls for the variable condensers, one to shunt the primary, and the other for the secondary. The dimensions of the case will vary with the type of condensers used. They should have a ca-

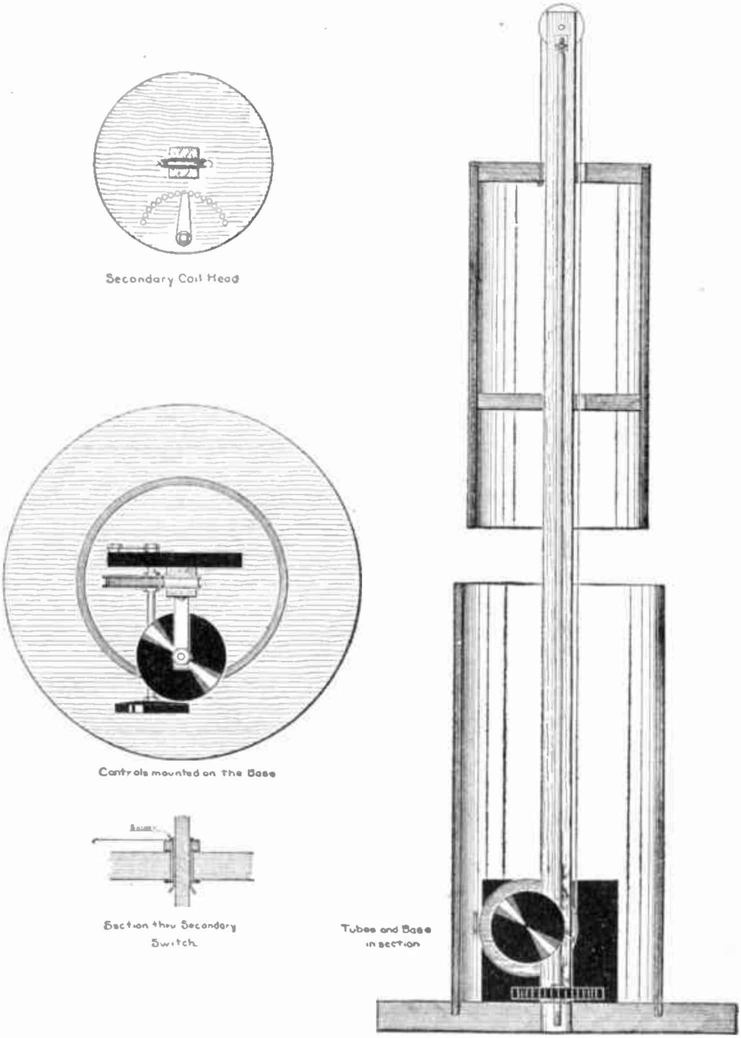


Fig. 20. Details of construction, at the left; tubes in cross section, at the right. This shows the secondary switch control

pacity of 0.001 (mfd.) Extensions are put on the shafts of the condensers, and 2 in. hard rubber handles are put on them. These handles allow a rough adjustment. The verniers consist of inverted U supports, soldered to brass tubes, 2 ins. long and 3/16 in. inside diameter. Through the tubes are brass rods, fitted at one end with 1¼-in. hard rubber handles, and at the other end with wooden discs, ½ in. in diameter and ¼ in. thick. The U supports are just high enough to allow a clearance of 1/32 in. between the discs and the handles on the condensers. When the vernier handle is pushed forward and turned, the wooden disc, which should be covered with a wide rubber band, engages with the handle, and rotates it a very slight amount. The vernier handles are far enough

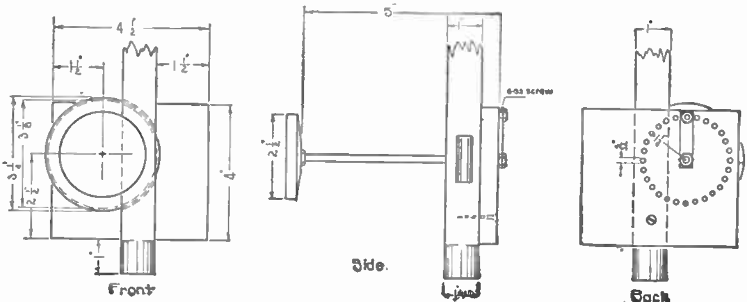


Fig. 21. Details of coupling control, showing section cut from upright post, and method of holding secondary in place

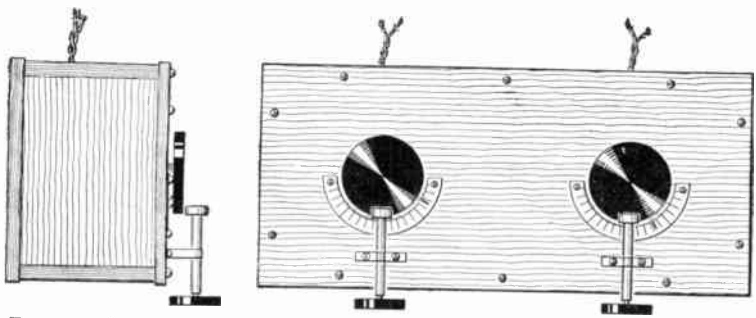


Fig. 22. Condensers with verniers and extension handles for undamped wave reception

from the plates to prevent any interference with the adjustment. This is important, for the oscillating Audion is so sensitive that any movements near the instruments change the tone of the signals. For example: if an operator, sitting at the instrument table, touches an iron radiator, the signals are affected.

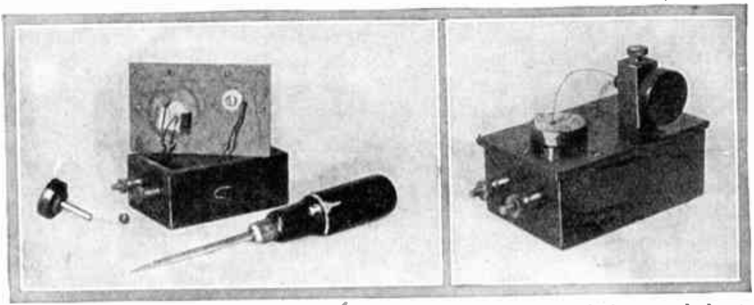
Further details of apparatus and connections for the reception of long wave, undamped transmitters, will be given in the next installment of this series of articles.

A DETECTOR CUP

With a Universal Adjustment

By Gordon Crothers

THERE is one fault common to almost all detectors sold by wireless companies or built by experimenters—the mineral cup is stationary, making it impossible to reach more than one point of the crystal with the contact point.



A spring beneath the base of this detector holds down the cup as it is moved about within the limits of the hole in the base

The detector shown in the illustration was built to show the operators an easy way to overcome this difficulty. Any point on the crystal can be reached, for the cup may be moved in any direction, or rotated, if necessary.

The detector is mounted on a wooden box, about 3 in. long, 2 in. wide, and 1½ in. high, with a hard rubber top ⅛ in. thick. A square brass post, ½ in. on a side and 1¼ in. high, supports the handle carrying the contact wire. This handle and the small screw which holds the wire are shown at the left of the illustration.

The detector cup is 1 in. in diameter, and deep enough to hold the crystal. If no alloy is used for the crystals, put two or three screws radially through the side of the cup. Bore a hole in the bottom, and tap it for an 8/32 screw. Instead of making a hole in the hard rubber top just large enough to take the screw, make a hole ½ in. in diameter. Then cut out a piece of spring brass 1¾ in. long by ½ in. wide. Turn up the ends as in the figure, and drill a hole at the center to slip the 8/32 screw. Finally, solder a short length of stranded wire to the spring for connections. To assemble the cup, put a ¼ in., 8/32 screw through the spring and the base; then turn the screw into the threaded hole in the cup. The spring holds the cup to the base, for it is large enough to reach beyond the edge of the hole. This makes it possible to move the cup to any position.

A condenser can be fitted in the base, with binding posts like those for the detector at the other end.

Extracting Silver from Old Silverware

Cut the silverware, old coins, etc., into small pieces, put them in a porcelain or glass receptacle and cover with nitric acid. Heat very slowly to facilitate the dissolution, dilute (after the dissolution is complete) with water and slowly pour in hydrochloric acid, stirring the whole with a glass rod. Continue adding hydrochloric acid till all the silver is precipitated as chloride of silver. Filter and wash the precipitate many times with distilled water and then transfer it into a glass receptacle, cover it with dilute hydrochloric acid and add a small piece of pure zinc. This metal attacks the hydrochloric acid, seizing the chlorine and liberating the hydrogen, which in turn combines with the chlorine of the chloride of silver and silver in form of powder is freed.

Filter, wash good with water and melt it on a piece of charcoal (if the quantity is small) with a small piece of borax.

Contributed by V. Carouso.

CONSTRUCTION OF A GAS ENGINE

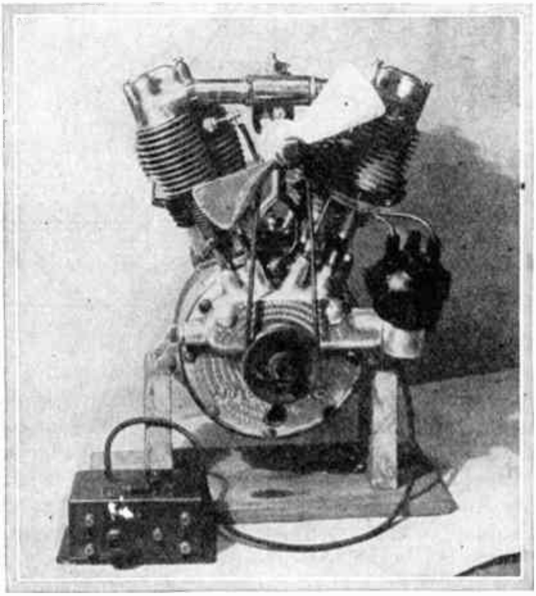
Owing to the crowded condition of this number, the fourth installment of Prof. Houghton's popular series has had to be held over for the March issue.

HOW TO BUILD A MOTOR SLED

Part II. Propulsion, Steering and Finishing

By Wm. P. Langreich, of the Laboratory Staff

THE drawing of the engine and the scale in the upper left hand corner of Fig. 6 will give the reader an idea of the size of our driving plant. The size of the bearing supports was governed by this, as our shaft had to clear the motor. These may be built according to the drawing if your engine is of our type. If larger, higher supports may be necessary, but if smaller, stick to dimensions given, as our propeller must clear the ground. Both frames are of the inverted V type, and are built of two by three stock. The same is used in bracing them, as shown by the dotted lines *A* in Fig. 6. These braces prevent the forward thrust of the propeller from forcing the two frames for-



The driving motor

ward, and are bolted in place to clear the driving motor. At the apex is a small block which also holds the bearing. First procure two blocks, 2 x 3 x 6 in., and with an extension bit bore 2-in. holes through from face to face. 3 x 3 in., and in the centers bore holes so that they may slide over the shaft, as shown at *E* in Fig. 10. These are used to keep the babbit (or type metal) from flowing out until it cools. As we are to have split bearings, however,

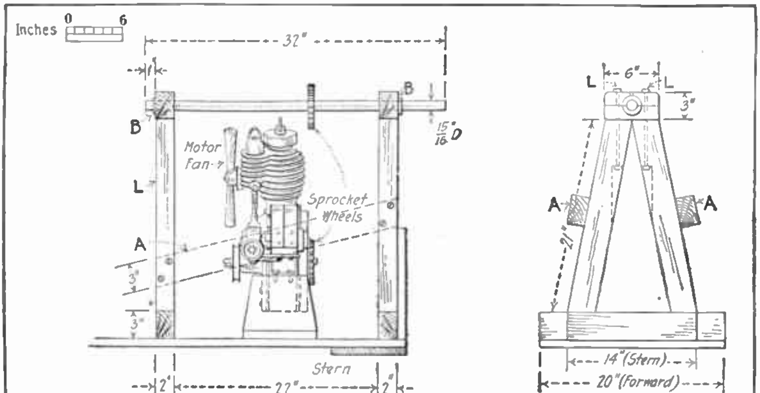
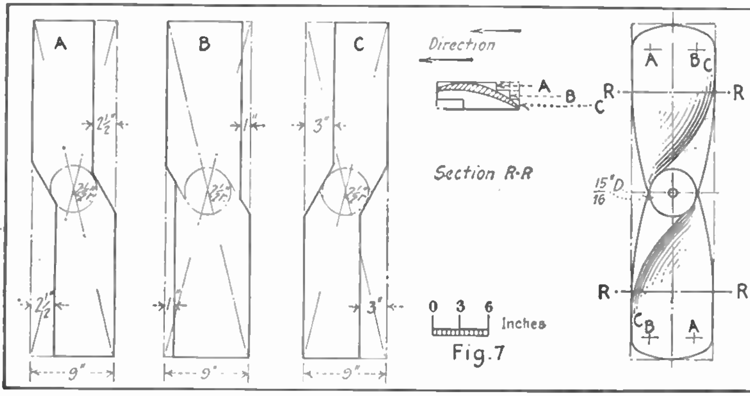


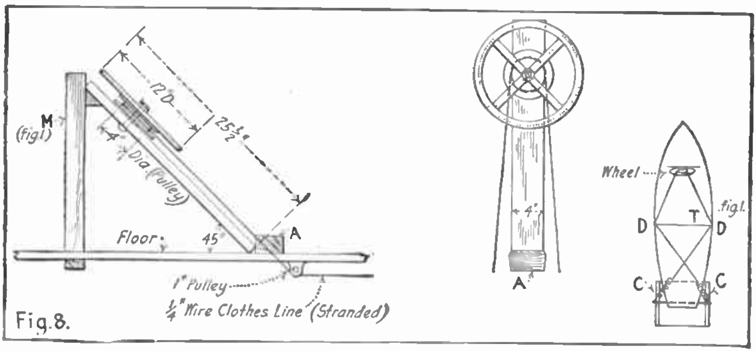
Fig. 6.

Transmission details

With a rip saw split them as at *C*, Fig. 9. Then bore a hole ½-in. in diameter from the top surface at right angles to the 2-in. hole. From the walls of the latter bore holes ¼-in. in diameter to hold the bearing in place when it has been poured and is hardened. Then mount the two blocks on the uprights, after boring for the bolts marked *L*, (Fig. 6). Our shaft is a 32-in. length of cold rolled steel, 15/16-in. in diameter. This is used as part of the mould for its own bearings. First cut four pieces of ½-in. wood about some arrangement must be made for them, and the best method is to insert two pieces of cardboard as shown by *G*, Fig. 10. The edges next to the shaft must be notched to allow the metal to flow into the lower half when poured down through *B* (Fig. 10). Then fasten the *E* pieces in place and pour the metal until it is up to the top surface of the block. Remove the *E* blocks and the cardboard and run a table knife through the slit left by the latter to sever the little nicks joining the two halves which



The propeller



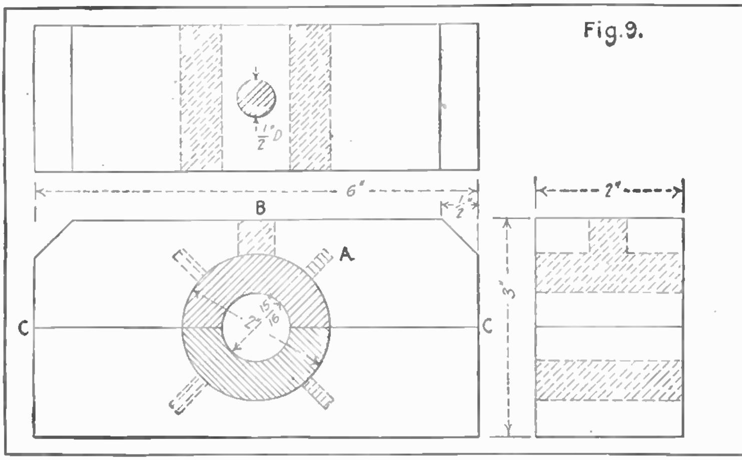
Steering arrangement

were formed by the notches through which the metal passed. Drill and tap *B* (Fig. 9) for oil cups, and finish the top corners of the block as shown.

Our motor is fitted with a sprocket wheel about 6 in. in diameter, and one similar to it is fastened to the shaft to permit a chain drive. It is rated 9 H.P., at a speed of about 1500 R.P.M. On the shaft as shown by *B*, Fig. 6, are collars which are secured by means of set screws. These keep the shaft in place. The gasoline tank may be placed where convenient, preferably at *L* (Fig. 6).

We are now ready for the construction of the propeller. This is built up of three ⅞-in. boards, 3 ft. long by 9 ins. wide. The stock may be of mahogany or cedar. These are cut and assembled as shown in Fig. 7. and then worked down with a drawknife and a spoke-shave. The process is very much similar to that of the construction of our submarine hull. This is fastened to the end of the shaft by means of collars.

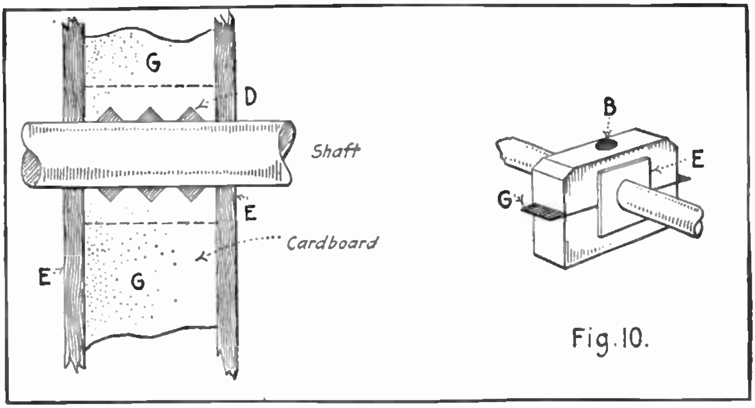
The steering arrangement is detailed in Fig. 8. A 4-in. board, stranded wire cable, which passes around the pulley two or three times and then goes through holes in the floor, over 1-in. pulleys, and is arranged as shown in the little diagram in Fig. 8 It is not fastened to the axle-pipe direct, but to spiral door springs, which serve to lessen the task of the driver when the rear runners hit a bump. To prevent the line from slipping, fasten the



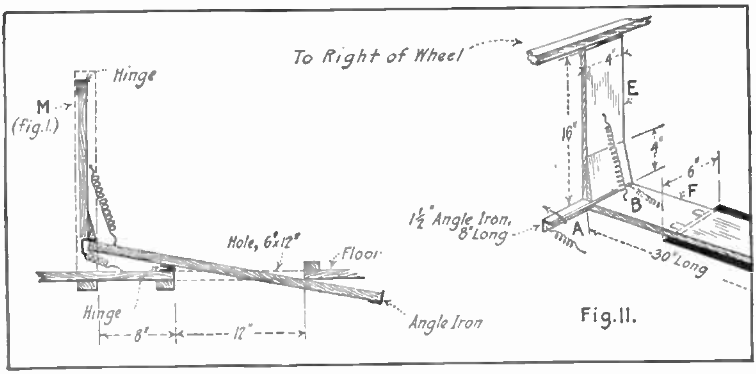
The babbitt bearing is indicated by cross-hatching

25½ in. long, is secured at 45 degrees to the floor. On this is a stud which holds the wheel in place. The wheel may be of the 12-in. wire spoke type, which is easily obtained where perambulators or bicycles are sold or repaired. To this is fastened a flanged pulley 4 in. in diameter. Steering is facilitated by a middle turn to the pulley by means of a staple. Now, when the wheel is turned to the left, the lines will swerve the rear runners to the right, causing the whole sled to make for the left—the direction in which the wheel was turned.

The details of a simple brake or "drag" are given in Fig. 11.



How the bearing is spiit



The "drag" or break

The principle of its operation may be clearly understood by referring to the perspective sketch on the right. The board *E* is hinged to the crossbar, and a little to the right of the steering arrangement. Then when the driver wishes to stop, a pressure of his foot on the projecting length of the angle iron (*A*) disengages the end of the board, *F*, which is drawn up by a spiral spring, and the other end drags along the ice. To disengage the dragging device, pressure is put upon *B*, which lifts the board and springs the lock into place again. A frame of 2 x 1 stock is nailed around the hole through which the board projects, to strengthen the flooring.

We are now ready to build the seats, and most of the detail will be left to the fancy of the individual builder. The forward passenger, or steersman, will have to straddle the steering upright. For construction of the rear seat, comfort may be the keynote. No steering apparatus is there to interfere with a "seventh inning" stretch of the legs. The rear seat is placed between the uprights *P* and *Q*, shown in Fig. 1. The sides and back may be completely covered with sheet iron or "tin," but for the top, openings must be left between *M* and *N* (Fig. 1) for one seat, and *P* and *Q* for the other. From *Q* back no covering will be possible, as the driving mechanism is installed here. Before nailing the sheets in place on top, insert such pieces of 2 x 1 as at *S* and *T* (Fig. 1) to hold up and prevent their buckling. We are now ready for a few coats of "outside" paint and, incidentally, some of our readers are capable of explaining why gray is the color generally used to indicate "speed." With cast iron runners this sled should go fast enough to make mileage overbalance the short winters our sages predict.

American Society of Experimental Engineers, see page 257.

How to Clean a Ruling Pen

It frequently happens that India ink will dry and cake upon the ruling pen in spite of any care which may be exercised, and the caked ink will impair the efficiency of the pen. To use a knife to remove the dried ink, or to scrape the pen in any way, will damage it by scratching the nibs.

A good way to remove the dried ink without damaging the pen is to allow the point to stand in hot water for a few minutes, but taking care that the water does not come more than two-thirds of the way up to the screw. Then wipe the pen off with a rag. It may be necessary to repeat the process once or twice if the pen is in a very bad condition.

It is advisable to occasionally remove the screw and put some thin oil on it, which will make it screw easier and also tend to prevent rust.

Contributed by E. Abrart.

Chamois leather is rather expensive, so it is well to know how to clean it. Put it into a weak solution of soda into which you have thrown some grated soap. Leave it for two hours and then rub it until clean. Finally rinse the leather in a linen cloth and dry quickly. It can also be rubbed dry and brushed until soft.

Contributed by Mary F. Scott.

HOW WE BUILT A LEAN-TO

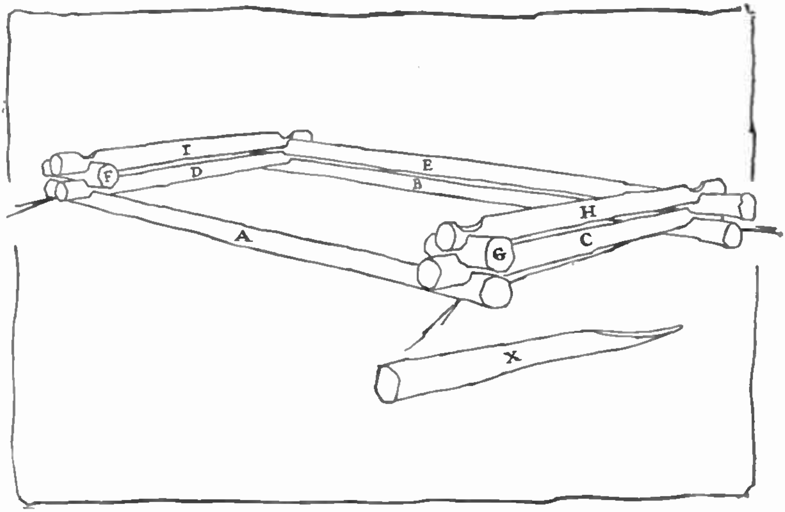
By Waller Parker

(With Illustrations by the Author)

Part II—Conclusion

Dead wood, or trees that are dead but not rotted, make the best working material. They are lighter and work easier. Furthermore, the cutting of them on State land is allowed. Spruce is the most desirable for log construction purposes, although any soft wood, such as pine or hemlock, can be used. Great care must be exercised in selecting straight trees.

The front and rear foundation logs are first placed in parallel position. The distance that these two are apart from each other determines the depth of the structure. The accompanying drawing will explain the procedure of construction clearly. Let *A* and *B* represent the two logs mentioned. These should be sunk slightly into the ground. Matching them can be done at this stage, and this is a matter where some care must be exercised. The notch may be made with an axe and should be made to a depth slightly more than half the diameter of the log itself. In width it should be



How the logs were placed

slightly greater than the log which it is to fit. All logs are notched on top after exactly this manner. *C* and *D* can now be placed in position and will lock the enclosure. *E* merely represents the next log to be placed. *F* and *G* are short logs used to lock the front portion of our structure. *H* is the next log to be laid, and from this point to the laying of the top rear log, the procedure is identical.

Logs cut as shown by figure *X* in the illustration can now be placed atop the sides of the lean-to, the sloping side on top and tapering to the rear. The angle at which this log is cut determines the pitch of roof, but will have to be cut in relation to the size of the front or ridge log. Spikes will have to be used to secure this log in the rear, as no notch lock is used in the rear for this log.

Placing the ridge log will complete the walls of the lean-to and securely lock the structure.

Roof timbers placed upon the rear wall top log and extending across and out over the ridge log complete the support for the roof. These should be not more than three inches in diameter and nailed in place about two and one-half feet apart.

Rough ⅞-in. pine boards nailed atop these timbers form the roof. These need not be placed closely together, as they are used only to make secure the tar paper finish.

It will be found, no matter how much care has been used in construction, that cracks remain. Small saplings nailed in these interstices, however, make the place fairly tight.

Moss that has been wet can be easily caulked in the remaining chinks, and when dry will remain where placed. This caulking should be done both on the inside and out of the structure.

There remains now only the banking of the foundation with dirt or sand, which need only be done where there still remains a few air holes. The lean-to is completed now save for the laying of balsam on the floor.

The cutting and carrying of balsam was originally a problem to me. I was, therefore, much interested in the simplicity and facility of the method adopted by Sweeney. He felled two balsam trees of twenty or thirty foot in height, and stripped off the upper branches with a small axe. These afforded sufficient balsam to cover the lean-to floor. He then cut a branch from a tree which had, near the place of cutting, another fair sized branch extending out at an angle of about 40 degrees. This he cut some eight or ten inches from the jutting place. Trimming the one remaining stalk took only a minute, and this stalk he allowed to be about six feet in length. The stick at this stage somewhat resembles an enormous fish hook. Branches of balsam can be laid around the long stalk by catching a twig of the same around the stalk. The hook keeps the load from slipping off the end. A great quantity can be carried in this fashion.

When winter weather sets in a lean-to can be made a very comfortable living cabin by nailing strip of canvas over the front. The front base log and ridge log are used for this purpose. Also a stove can be placed in the structure if desired by removing the balsam at its base and allowing it to rest on the sand floor.

In front of our lean-to and about fifteen feet away had been made a great open fireplace. And some of the most pleasurable moments of any stay at camp were spent on crisp chill nights lying on the balsam in the lean-to, before me burning the huge camp fire, its warmth reaching back to me, its spirit tingling the blood in me, and its picturesqueness thrilling my soul. Here was the place to tell yarns, and many a night did I dream over the tales of encounters with lynx, bob cats, and bears.

Iron Nickeled Without Electricity

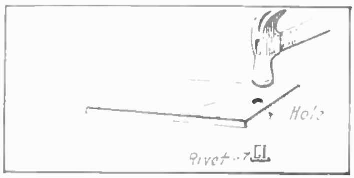
Weigh one ounce of chloride of nickel and one ounce chloride of zinc. Dissolve them in one pint of distilled water and boil the solution for five minutes.

Hang the iron to be nickeled into the liquid (after it has been cleaned) put a small piece of zinc in contact with it and boil for 15 minutes. Then dry in clean, warm sawdust.

Contributed by V. Carouso.

Handy Rivet Set

Being in need of a small rivet set and not having one on hand, I conceived the idea of making one by taking a small piece of iron about 1 in. wide, 3 in. long and 1/8 in. thick and drilling a hole the size of my rivet in the center, ½ in. from the end. By hammering over the hole in the



How rivets can be set

piece of iron and then around it, you will be able to draw the rivet through nicely without spoiling the metal. All sizes of rivets can be made by using other holes.

Contributed by Samuel Bloom.

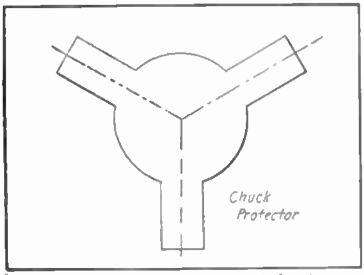
Grease from silk: Take a lump of magnesia, rub it wet on the spot, let dry, and then brush off the powder.

Contributed by H. Frank.

PRACTICAL MECHANICS FOR EVERYDAY MEN

Chuck Protector

Where a number of pieces of steel had to be turned out on a lathe, steel filings were carried to the chuck jaw threads and screws by the oil. This made it necessary to take out and



Cut this from a piece of leather

clean the chuck frequently, causing much delay and annoyance.

By cutting a piece of belting large enough to cover the central opening and jaws of the chuck, this difficulty was overcome. The drawing shows the shape of the covering used.

Contributed by Herbert S. Davis.

Improving the Compression

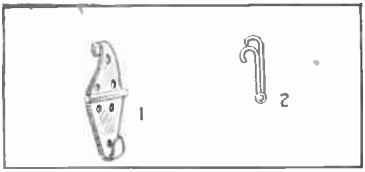
Poor compression in internal combustion engines is ofttimes due to scratches on the cylinder walls which allow the gases to get past the piston. This condition may be remedied by pouring a mixture of graphite and oil into the crankcase.

The graphite will be carried up into the cylinder and, filling the cracks or scratches, will soon have the cylinder walls as smooth as glass.

Contributed by Thos. W. Benson.

A Folding Paint Pot Hook

The house painter, who is continually losing his paint pot hook will appreciate the folding hook pictured herewith. It is made of a light weight strap hinge, bent



Bend the hinge as shown

as shown. When not in use it may be folded and conveniently carried in one's pocket.

Contributed by T. H. Linthicum.

Mirrors

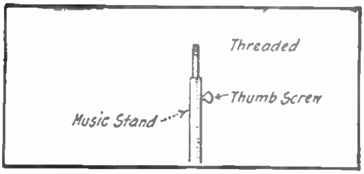
Spirits of camphor rubbed over the surface will brighten mirrors. M. F. Scott.

A Camera Support

I made a good camera stand, for use around the house, out of an old music stand and a short length of 1/4 in. rod.

The music stand was of the type where the adjustment and clamping is done by means of a thumbscrew.

I threaded one end of the rod



Thread the top of the rod

with a 1/4 in. die to fit the tapped hole in my camera.

The adjustment is made as on a regular music stand.

Contributed by L. H. Anderson.

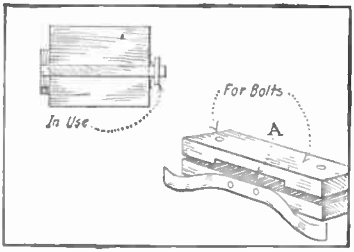
A Leak On a Tin Roof

The brown spots appearing upon the ceiling during a rain storm indicate a leak upon the roof, which must be attended to as soon as possible as most cases of falling ceilings have been due to the rain soaking into the plaster and causing it to fall away from the laths. These leaks occur mostly upon a tin roof and in between the joints of the tin. After having located the leak cut a piece of canvas or ticking (these being the strongest goods) larger than the leak. Now paint the surface around the leak and place the canvas or ticking patch over it, then painting over the patch. This dries out hard and will last if painted over every year. Roof paint must of course be used.

Contributed by J. Bausch.

T-Square Attachment

If your T-square is longer than your drawing-board, the attachment illustrated will greatly facilitate the drawing of parallel lines. All that is necessary are two blocks of wood, 3 in. x 1 in. x 1/2 in., two stove bolts, a piece



This keeps the T-square against the board

of spring brass and two wood screws. Assemble these parts as shown, and cut the groove to a depth slightly less than the thickness of the T-square.

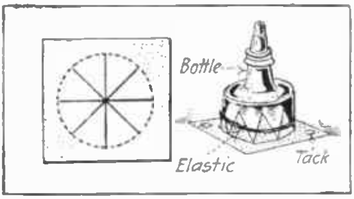
Contributed by J. F. Grece.

A handy dishpan for camp or picnic use may be made by cutting a five-gallon gasoline can in half from top to bottom, turndown the sharp edges and rolling the ends over to serve as handles.

Contributed by Mary F. Scott.

To Hold Drawing Ink Bottle

The accompanying sketches describe a simple, non-spillable device for ink bottles. Thick cardboard is a suitable material, and when assembled is bound by a



How the ink bottle is held

rubber band. Two thumb-tacks will hold it securely to desk or table.

Contributed by C. H. Biron.

An Improved Hammer

When putting a new handle in a hammer do not saw off the part which projects through the head, as this may be used to

Do not saw the extension off

provide increased leverage in removing nails.

Contributed by C. C. Wagner.

An Auto Kink

If you own a car, no doubt you have had occasion to grind the valves. After grinding the valve you have had difficulty in compressing the valve springs sufficient to place the pin in the valve stem. Much time and temper can be saved if, when you are removing the valves, you also remove the springs. Place each spring in a vise and compress it. While compressed, run a string through the spring on each side and tie them so that when you remove spring, the string will prevent the spring from expanding. When finished grinding, it is a simple matter to slip the spring over the valve stem and replace the pin. When you have all the valves in place, cut the strings on the springs and they will spring into place.

To Remove Stains in Tables

Wash the surface with vinegar and then rub the stains with a rag dipped in spirits of salts. To repolish, proceed as you would with new work. If the work is not stained, wash the surface with clean spirits of turpentine and repolish it with furniture oil.

Contributed by H. G. Frank.

Polish for Brushes

New brushes must first be sandpapered properly to fit the commutator. A good polish can then be secured by rubbing lightly over the surface of the brush with the curved part of the plier handle.

A Chat With the Editor

SHALL WE USE STANDARD PARTS IN THE CONSTRUCTION OF HOME-MADE APPARATUS?

EVERY once in a while we get a request for an article describing the construction of this or that device. Many of the suggestions we receive in this manner are acted upon. Occasionally, however, a reader wants an article covering some device or instrument that can be purchased in the open market cheaper than it can be constructed in the home shop.

A case in point is the familiar variable condenser used so generally in radio receiving outfits. This instrument, in the approved rotary plate type, has been commercialized to such an extent that the amateur cannot begin to compete with the manufactured article in point of cost. The task of cutting from twenty to forty semi-circular plates of aluminum or brass in such a manner that the finished article will be perfectly flat is alone a formidable and tiresome one; add to this the "fussy" job of making the separators, supporting mechanism, etc., and you have a piece of work that is worthy of an instrument costing more than the three or four dollars asked for the modern variable condenser.

There are cases wherein the amateur, whose pocketbook is limited, is justified in constructing the instruments of a set; the manufacturers as a rule encourage this for they wisely appreciate the fact that the home-made apparatus of one worker may stimulate sales for ready-built instruments among the many visitors who will see the product of the home workshop.

However, we believe there are exceptions even in the case of the financially-embarrassed amateur engineer. For instance, suppose he is building a transformer. True he can go to the tinsmith's and buy stovepipe iron in sheets at a price per pound that seems attractive when compared with the twenty or more cents per pound charged for silicon steel. Then the charge of fifty cents per hundred pieces for cutting usually charged may seem high. But let him remember that for a given efficiency, he will require more stovepipe than transformer iron in a given core; this means a larger core—longer windings—more copper—greater labor—uncertain results. For a difference of a few cents per pound he would secure efficiency, save labor, and copper wire; for a small charge, he could have his steel cut into perfectly accurate and flat pieces and be saved the hand-breaking job of cutting up sheets with tinner's snips.

You get the point? The object of this magazine is to encourage construction above all else. But with this, we believe it is equally as essential to apply certain engineering principles just as the manufacturer does when he sets about to build the first sample of a new product fresh from the drafting board of the designer. Every stock part and instrument he can utilize in the construction of the sample reduces the cost of the latter just that much.

Therefore, in the preparation of articles, we endeavor to assist the constructor by suggesting the use of stock parts or instruments in all cases where our experience tells us this is the more satisfactory or economical way.

How a Physician Built His Own Electrical Apparatus

The present-day physician is essentially a practical man. Still more so is the surgeon and perhaps also the surgeon dentist. The very nature of the profession makes it imperative that its followers be men who are quick to act in an emergency—quick to improvise where necessary.

Granting this, it is not surprising that a very large number of medical men are owners and enthusiastic users of fairly well-equipped amateur work-shops. In the belief that Everyday will find its way into the hands of a goodly percentage of these physician-engineers, we have decided to tell how one physician of our acquaintance constructed an electrical equipment for his office that is second to none of the commercial outfits in point of convenience and operating efficiency.

This outfit incorporates all of the more important applications of medical electricity. High frequency, the X-Ray, and cautery are fully developed with a degree of power that places the outfit in the first class.

This outfit is a shining example of the utility of stock parts and instruments. The transformer, condenser, spark gaps, and X-Ray tube were taken from the catalogs of wireless manufacturers and the oscillation transformer (high potential, high frequency coil) was easily constructed without the use of elaborate tools. The mechanical work is easily within the reach of the average man who uses tools as a hobby. The full details with photographs of the apparatus will constitute the feature article in the March number.

THE TECHNICAL ADVISER

The object of this department is to answer the questions of readers who may experience difficulty in the construction or use of apparatus described in the magazine. The columns are free to all readers whether they are subscribers or not, and questions pertaining to matters electrical or mechanical will be answered in the order in which they are received. If the reader cannot wait for an answer to be published he may secure an immediate answer by mail at a cost of 25 cents for each question.

In order to insure prompt attention, readers should adhere closely to the following rules which have been formulated with a view to expediting the handling of the mass of correspondence. Questions should be written on one side of the paper, enclosed in an envelope addressed to The Technical Adviser, care of Everyday Mechanics, Æolian Hall, New York City. The letter should state plainly whether answer is to be published or sent by mail; in the latter case the fee of 25 cents per question should be enclosed in coin, one-cent stamps, check or money-order. The envelope enclosing questions should not contain matter intended for any other department of the magazine.

63. **N. J. K., Dubuque, Ia.** This correspondent's question was published in the September, 1916, issue under No. 29, and two answers from readers were published in the November, 1916, issue under No. 42. The following letter received by the Editor presents another man's views on the subject: I believe I have had more or less correspondence with you in years past, and in any case I am at least known to you by reputation. I have been interested in your storage battery troubles as told in your letter to EVERYDAY MECHANICS magazine. I am writing in the hope that I may, to some extent at least, help you out of your difficulties.

In the first place, let me say that I am not one of the chaps who write magazine articles without trying out their stuff. My articles, though not numerous, are all the fruit of careful work in the laboratory and shop. I have built hundreds of storage batteries of all sizes, and all with a few exceptions successful. I am building them to-day and so are many men and boys under my direction.

For my positive plates I use a stiff paste, as stiff as it can be worked, made of pure red lead mixed with dilute sulphuric acid. I take battery solution of 1200 gravity and dilute with an equal quantity of water, which, as you doubtless know, must be pure, distilled or rain water. Rain water if collected carefully from a clean slate, gravel or wooden roof, *not* from a metal roof, is as good as distilled water.

I think the use of a *little* ammonia toughens the paste, but have very good luck without it. There is a difference in red lead, even when perfectly pure. Some lots are much coarser, *i. e.*, the particles are much larger than in other specimens. The coarser the better. The surface of the paste should not be troweled too smoothly. The acid and consequently the electrolytic action seem to get through a fairly rough surface better. I do not use any chloride of lime forming baths. They will form all right, and quickly, but the chlorine is too hard to get rid of, and very destructive if not thoroughly eliminated. You might experiment with a bath of sodium hyposulphite, common photographic hypo, in saturated solution. That has given me very good results in forming plain lead plates.

Now as to putting the pasted lead plates in the electrolyte. I have never had any trouble. I do not dip to get them "used to the acid," but get everything ready to begin charging at once, fill jars or set plates in jars already filled, and fire away, at rather a low rate, however, for the first time or two.

If as you say your positive grids are mechanically in good shape you can use them again, merely brushing off the loose oxide, but not scraping them. The layer of oxide formed on them will help bind the new paste.

I will frankly say that I am not sure as to the cause of your trouble, but I believe it to be due to that dipping stunt. I have never before heard of it, and it is directly contrary to my successful practice.

I hope the above suggestions will be of some use to you. In any case, you may rely on the fact that such as they are, they are the result of experience. If you get any benefit from this dope, or if you need any further explanation, I trust you will call upon me. I will only add that there is no charge for the above.

I am, very truly yours,

WM. C. HOUGHTON.

64. **P. E. N., Fort Smith, Ark.,** writes: Please give (1) dimensions of the secondary tube of a Tesla coil which will give a 24 in. spark. Ans. Wind a tube 30 in. long and 10 or 12 in. in diameter with No. 24 D. C. C. wire. Enameled wire cannot be used, even though the turns are spaced, for sparks will occur between the turns.

(2) How many turns are needed for the primary, and what size should the wire be? Ans. This coil requires a primary of 9 turns of brass strip ½ in. wide and 1/64 in. thick, or 9 turns of edgewise wound copper strip. (3) What size condenser should I use for this coil on a ½ k. w., 13,000 volt Packard transformer? Ans. Use a moulded or glass plate condenser of 0.01 mfd.

65. **F. H. F., Brooklyn, N. Y.,** wants to know the capacity of a condenser composed of 60 sheets of tinfoil, 8x5 ins., separated by paraffined paper. Ans. The formula for calculating the capacity of plate condensers was given in the Technical Adviser of January, 1917. The dielectric constant of paraffined paper is 3.5.

66. **R. S., San Francisco, Cal.,** asks (1) if switches can be used on the primary of the Transatlantic Receiving Set, and how many turns apart should the taps be? Ans. Taps can be used in place of sliders on this set. Take off 30 taps, and shunt the coil by a 0.0005 mfd. condenser, to give a close regulation of the wavelength.

(2) Will a carbon sector potentiometer of 7,000 ohms resistance work as well as a B battery switch? Ans. A potentiometer of this resistance will work as well as a switch. Be sure that the one you buy has a carbon button on the contact lever. If

it is metal, the filings will soon reduce the resistance of the sector.

(3) Will a rotary, porcelain base rheostat give as good results as the type described in EVERYDAY? Ans. Yes, if the resistance is 10 ohms, the porcelain base type of rheostat will serve the purpose.

67. **O. T., Little Rock, Ark.,** sends a description of his radio receptor, and says he seldom hears signals on it. Ans. There is nothing much more difficult than to advise an operator about his set when we cannot see it. So many small faults are found in sets that will not work. It is impossible, therefore, to give you any advice. The best we can do is to suggest that you have someone who has had more experience in wireless work go over your set to locate the trouble.

68. **P. V. Z., Weehawken, N. J.,** wants to know (1) if copper plates may be substituted for aluminum, in making the variable condensers described in the article on a three-slide tuner in November issue of EVERYDAY. Ans. (1) Copper, brass, or aluminum plates may be used. The chief consideration is that the metal be non-magnetic.

(2) Does enameled wire give a condenser effect in the coils? Can it be used in place of silk? Ans. (2) Enameled wire does give a greater capacity effect than silk. For the benefit of those who are puzzled by distributed capacity, the following explanation is given:

The resistance of a single turn of wire is great enough to cause a difference in potential between the beginning and the end of the turn. That is, the resistance makes the pressure of the voltage lower at the end of the turn than at the beginning. The adjacent turns, separated by the thin insulation, have, therefore, a difference in potential between them. The same condition exists in a condenser—there are two conducting plates, separated by a dielectric, with a difference of potential between them. If the dielectric is made thicker, the capacity is reduced. The same is true in a tuning coil, for the capacity effect is decreased if the separation, or insulation on the wires, is increased. Since enamel is the thinnest of insulation, it causes the greatest distributed capacity.

(3) Do you think a detector built like a coherer, with powdered galena instead of filings, will work? Ans. (3) We have made no tests of such an instrument. Why not try it? There is one detector on the market built along such lines, but the material used in place of filings has not been made public.

(4) What is the approximate capacity of the variable condensers used in the three-slide tuner set, described in the November issue of EVERYDAY? Ans. (4) The capacity is about 0.0005 mfd.

69. **H. E. R., Lansing, Mich.,** asks if it is practical to drive a shaft at right angles to the driver, and at the same speed, by spiral or helical gears, instead of bevel gears. Ans.—There are many considerations in choosing the type of gears for your transmission. We suggest that you write to The Gleason Works, Rochester, N. Y. They specialize in bevel and helical gears, and can give you more authoritative advice than we.

WHERE TO BUY MATERIALS

This is a new department in EVERYDAY MECHANICS

The aim is to show the reader where he may obtain any part, material or finished instrument needed for the construction of apparatus described in each issue.

On receipt of each inquiry, it is at once referred to our advertisers. If the material needed cannot be obtained from any of our advertisers, the Service Department of EVERYDAY MECHANICS, 33 West 42d St., New York City, will endeavor to supply same without loss of time.

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Ideal Aeroplane & Supply Co.

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Audion Bulbs
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Correspondence—International Correspondence
Draughting—Chief Draftsman Dobe
Electrical—New York Electrical School
Moving Picture Business—Capital Mdse. Co.
Shop Practice—American Technical Society
Signal Engineering—Dept. of Signaling
Wicks Elec. Institute
General—International Correspondence Schools
Music—U. S. School of Music
Physical Culture—Lionel Strongfort

Gasoline Engines
Frisbie Motor Co.

Gasoline Engine Castings
Service Dept.

Gears, etc.
Service Dept.

Gibraltar Cloth
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High Frequency Apparatus
Service Dept.

Insulating Materials
Oiled Paper—Service Dept.
Oiled Linen—Service Dept.
Red Rope Paper—M. W. Dunton Co.

Tape—Mechanical Rubber Co.
Tape—M. W. Dunton Co.
Vaseline—Service Dept.
Wax—Service Dept.

Kerosene Engines
Frisbie Motor Co.

Knobs (Hard Rubber)
Service Dept.

Lathes and Lathe Tools
Goodell-Pratt Co.

Lead
Service Dept.

Litzendraht
Manhattan Electrical Supply Co.

Machine Steel
Service Dept.

Mercury.
Service Dept.

Motors
Service Dept.

Nuts—Hexagonal
Service Dept.

Oiled Paper and Linen
Service Dept.

Paints—Waterproof
Service Dept.

Patents
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J. R. Kelly
Lancaster & Allwine
Munn & Co.
R. B. Owen
Robb & Robb
L. L. Sargent
A. M. Wilson
Victor J. Evans
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Phonographs
F. K. Babson

Pipes—Smoking
S. M. Frank

Propellers
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Razors
Week

Receivers—See Wireless Apparatus

Rubber Panels
Service Dept.

Silicon Steel
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Soldering Paste
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Soldering Irons and Kits
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Transformers
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Typewriters
Galesburg Writing Machine Co.
Royal Typewriter Co.

Variometers
Wm. B. Duck

Variometer Parts
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Wire
Service Dept.

Wireless Apparatus

Receivers
Brandes
Wm. J. Murdock Co.

Detectors
Lenzite Crystal Corp.
Micropho Detector Co.
Nat. Elec. Mfg. Co.

Wireless Magazines
QST
Pacific Radio News

Wireless Sets
M. K. Burckett
Wm. B. Duck Co.
Handel Elec. Co.
Manhattan Elec. Supp. Co.
J. M. Arnold
Radio Dist. Co.

Wireless Parts and Materials
M. K. Burckett
Wm. B. Duck
Manhattan Elec. Supp. Co.
J. M. Arnold
Radio Dist. Co.

For Transatlantic Set
Service Dept.

White Lead
Service Dept.