April, 1924

RADIO IN THE HOME

TWENTY CENTS

Conducted by HENRY M. NEELY

Grimes Writes Exclusively for Us

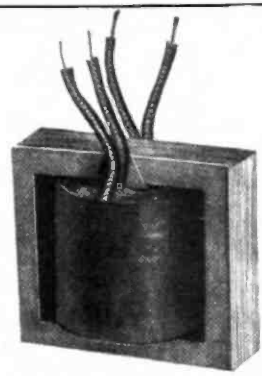
Radio in the home of Mr. and Mrs. John Wilkins, Jr., of Winchester, Mass. The set is an Amrad Inductrola

In this Issue:

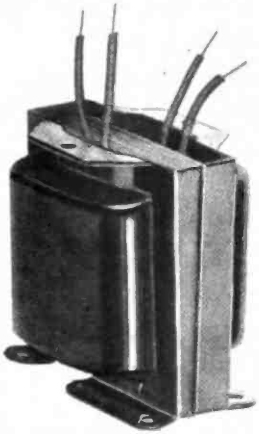
A Transformer of Real Merit

Amplification of Entire Musical Range Free from Distortion

The winding that Kellogg developed, was found to be most efficient for audio frequency transformers. Its problems involved the finding of the proper thickness of paper, the proper kind of insulated wire to provide the proper number of ampere turns, and impedence.



The one-piece laminations of silicon contain no punched holes, which in many other transformers causes eddy currents and losses. The one-piece lamination is exclusively a feature of the Kellogg transformer. It provides an exceptionally true electro-magnetic core.



To correctly shield these transformers that they may be mounted in any position desired without losses, this brass shield was designed. It is so arranged that both sides are interchangeable, locking together at the base. They are finished in a handsome maroon enamel.

The wires extend through the Bakelite top, which affords perfect insulation, and are soldered to the terminals in plain sight, where they may be inspected. This also eliminates any possibility of breakage of transformer leads.

The finished job, of which we are mighty proud. The leads are soldered to tinned terminals, which are under nickel plated nuts over which are placed knurled nuts. Each binding post is plainly marked so that it is impossible to make incorrect connections.

Amplify the pleasure of your radio set by installing Kellogg audio frequency transformers. Second to none in volume, clarity and freedom from distortion.

No. 501—Ratio 4½ to 1. No. 502—Ratio 3 to 1. Only $4.50 each

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1066 West Adams Street, Chicago

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Large production allows us to offer Crosley Instruments and parts at very low prices—the greatest values in radio, we believe. Read the descriptions of the Crosley Sets illustrated here. Decide which kind you would like to have. Then go to your dealer and purchase it.

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CROSLEY TYPE 3-C—A beautiful Consolette Model, adding greatly to the interior decoration of any home. It is an Armstrong Regenerative set, containing the same units as the Crosley Type 3-B.

The Crosley Regenerative Receivers described above are manufactured under Armstrong U.S. Patent No. 1,113,149

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Gentlemen:—Please mail me free of charge your complete catalog of Crosley instruments and parts.

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Editorially Speaking

By HENRY M. NEELY

RADIO is apparently being swept off its feet by a super-heterodyne hysteria.

Wherever you go among radio fans today, the conversation is bound to switch around to a discussion of eight and ten tube sets and their possibilities.

It looks as though we will all have to admit that for some time to come this new business is going to be a succession of hysterias of this kind. Much as all of us would like to see the industry settle down to some standardized and sane basis, I personally do not yet see it in sight for several years. I look for continuing waves of hysteria to follow each other, each wave to carry to its crest some particular circuit or particular device.

In spite of all this, I think I do detect a growing body of the more conservative element which is not demanding distance as a prime requisite of a radio set. With these people, the entertainment value of radio is uppermost and they demand first quality of reproduction and dependability of operation with distance-getting as an entirely secondary consideration. These people are going to be the fine, continuing and loyal radio audience as time goes on and it is most gratifying to see their numbers increasing steadily. The average manufacturer is impatient at the present situation. He feels that something should be done to stop this mania for great-distance reception, because he realizes that there are limitations to all sets beyond which the science cannot go at the present time. Neither can engineers see very much of an increase in distance possibilities beyond the powers of the present sets.

And yet I see no reason to be disturbed by all this. Radio appears to me to be so vast in its possibilities that I should think there would be ample business in its limitless fields for everybody, whether he be catering to the DX fan or the man who wants good entertainment in his home. There are something over 12,000,000 talking machines owned in the homes of the United States at the present time and I personally have not the slightest doubt that the number of radio receiving sets will be very much greater than that. Now, as the industry is organized at the present time, the total output of really standard sets from all the manufacturers could not possibly supply the demand even if we include the manufacturers of standard parts. Why, then, start to worry about the trend of the business when we are not able even now to do all of the business that is in sight?

I am glad to see these super-heterodynes coming on the market. They are going to bring an added impetus to the study of the theory of radio and they are going to increase the number of radio fans very decidedly. There is, however, one tendency in this mania, or rather one phase of it, which seems to me t obe rather unfortunate. That is the wrong impression that the general non-technical public is getting of the super-heterodyne.

If you will go around among the beginners in radio, you will, if you question them, soon learn that their impression is that there is nothing whatever in the world that the super-heterodyne cannot get. You will hear them speak of super-hets in almost a tone of awe. You will detect a note of envy in their voices, much as you will detect it in the voice of the owner of a little second-hand flivver when he speaks of somebody he knows who owns a Rolls-Royce.

To these people, the vast number of inexpert listeners-in who have never had a chance to handle a super-het, there is nothing which it will not accomplish. And so, when the real truth of the super-heterodyne becomes known, I am afraid that they are going to have the feeling that they have somehow been buncoed and that radio is not after all the wonderful thing that they have been led to think it.

There are several aspects of this super-heterodyne hysteria which it seems to me it is wise to bring out quite clearly right here and now before everybody starts to plunge wildly into an attempt to receive China on the theory that all they have to do is to add tubes to their outfit to get it. First, let me say, that my own impression, after working with a number of super-hets is that it is a somewhat better distance getter and will give distance somewhat more consistently than most of the other circuits on the market. Right there I think its advantages stop.

The super-het, being more sensitive than other sets, suffers from the inevi-

(Continued on Page 44)

TUBES

You'll hear a great deal of grumbling these days because you can't buy 201A tubes. But why?

SUPPOSE THAT YOU were a great corporation and that you owned the exclusive right to manufacture tubes, and

SUPPOSE THAT YOU also had been trying to sell receiving sets and that you had been doing a pretty fair business with them when along came a guy you had never heard of except as a laboratory scientist, and this guy invented a circuit which was so good that the whole country stopped buying your sets and started to buy his and then

SUPPOSE that some bright lad in your organization said to you:

"Here, Mister, this guy's sets are all balanced and neutralized for the 201A tubes. They won't stay balanced or neutralized with dry-cell tubes. If people couldn't get anything but dry-cell tubes, they'd use 'em in this guy's sets, and the sets wouldn't work and the people wouldn't realize why, and they'd say this guy was a faker and he'd lose his reputation and people would buy our sets again."

WOULDN'T YOU raise that lad's salary, and then wouldn't you

(1) Bring out an entire line of sets built only for dry-cell tubes, and then

(2) Stop making A tubes entirely and flood the market with dry-cell tubes?

And then, of course, people would stop buying that guy's sets because they'd say:

"What's the use buying those sets when you can't get the tubes for 'em?"

Isn't that just about what you'd do? And you'd think it was pretty good business, too, wouldn't you? But — monopoly? Restraint of trade? OH, GOOD GRACIOUS, NO!

RADIO IN THE HOME

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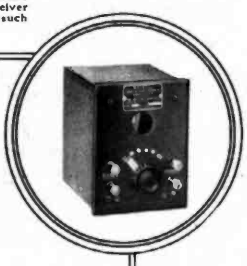
Bristol Single Control Radio Receiver

USING GRIMES INVERSE-DUPLEX CIRCUIT

The Bristol Single Control Radio Receiver is completely equipped to use Loud Speaker. The Bristol One Stage Power Amplifier is incorporated as the last stage of amplification.
This set is designed to give satisfactory results with Antenna or Loop, and in most cases Short Antenna.
The case is solid mahogany with walnut finish, a suitable piece of furniture for the finest home. The price for Bristol Single Control Radio Receiver is $190.00. This does not include accessories such as tube, batteries and loud speaker.



The Bristol One-Stage Power Amplifier.

Bristol One-Stage Power Amplifier

Designed to use with any good receiving set to build up amplification so that, when a loud speaker is used, the distant stations will come in like the locals. It is the same Power Amplifier incorporated as the last step in Bristol Single Control Radio Receiver. However, in this convenient single unit form, it can be instantly connected to and used with other receiving sets. A third stage of amplification without howling. No "C" Battery required. Price $25.00.

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A Real Reproducer of the Original Broadcasting

It is easy to listen to the Audiophone reproductions because they are so perfect. The speech, songs, and instrumental music are not blurred or disguised by mechanical distortions. You get all the fine shadings and every inflection. In fact, the very personality of the artist seems to be present as you listen.

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The Bristol Junior Audiophone

The Bristol Senior Audiophone

RADIO IN THE HOME

To the left is David Grimes in his home posing like a regular radio expert. Below—Stepping into his Inverse-Duplex flivver, so-called because it gets him all the way down to our place at Delanco and back again. Getting back again is the Duplex part

GRIMES
Writes Exclusively for Us

By HENRY M. NEELY

SEVERAL months ago, when I announced that David Grimes, inventor of the Inverse-Duplex circuit, was going to write regularly for *Radio in the Home*, I expressed a gratification and a pride which I felt was very justifiable.

Now I feel even more pride in being able to announce that hereafter Mr. Grimes will write *for this magazine and for no others*. He is now a regular and exclusive member of the staff of *Radio in the Home*, and his work will be to develop his wonderful Inverse-Duplex system and to apply it to the modern multi-tube sets such as the super-heterodyne in order to reduce the number of tubes necessary to achieve the desired results. Both Mr. Grimes and myself have felt for some time that it was inevitable that he should ally himself exclusively with some radio magazine rather than scatter his writings among all of the periodicals and newspapers as he was doing. The result of the old system was that he and I were both constantly getting letters from readers asking questions about various circuits which he had mentioned and investigation showed in a number of cases that these circuits were published in some other periodical and so did not lie within the jurisdiction of this magazine to answer. I have no doubt that other magazines were confronted by the same problem and so the officers and directors of the Grimes Radio Engineering Company held a special meeting for the purpose of debating the problem of which magazine was the best one to use for the exclusive presentation of all future development of the Grimes System. When I learned that their choice had fallen upon *Radio in the Home*, I had a little thrill of pride and joy which I am not at all ashamed to admit.

With the whole radio world plunging madly into eight and ten tube receiving sets, it is time for some one to devise some system by which these wild expenditures can be cut down and the results achieved brought into some sane relation to the expenditures made. Mr. Grimes' system of inverse duplexing is about the only thing in sight to bring the more elaborate modern systems within the range of the man of somewhat limited pocketbook. His first job will be to tackle the eight-tube super-heterodyne set and see if he cannot make four or five tubes do the same work. This means a saving

(Continued on Page 46)

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Grimes Designs a Portable Inverse-Duplex

By DAVID GRIMES
Chief Engineer Sleeper Radio Corporation; Consulting Engineer to Bristol Company and Mercury Radio Products Co.

ALONG about this time of year we radio fans, like market gardeners, start our plans for the summer crop. We never plan on going to any special spot until we have determined by the most careful search whether or not the place will produce an abundance of concerts minus the speeches. We oil up our tools and decide that this year at least we will not take with us one of those piano-type portable sets that we struggled with last year.

The general prospects for the coming summer are encouraging. It is a presidential year with the political conventions, most of which will be broadcast. This broadcasting will be done by the larger high-powered stations, insuring good reception over moderate distances even with adverse weather conditions. This will be of great interest to all of us, no matter what our party affiliation.

Accordingly, I set about to build myself a portable set suitable for the summer camper's use. It was decided, first, that the set should operate on an aerial rather than on a loop. This means that for the weight carried, the strongest possible signal and the greatest distance will be received. Loop reception is ideal where there is difficulty with aerial installation, or where extreme selectivity is desired. Loop reception also clears up reception from atmospheric noises and telegraph; but it requires more tubes and batteries for successful loop operation than for aerial operation.

In most camps there will be no difficulty with installing an aerial, and as such locations are off in the wilderness, selectivity is no object. So far as atmospheric noises are concerned, experience last summer taught many of us that they are serious on only a very few days of the summer and that most of the vacation the reception was well worth the effort.

So work was started, bearing in mind the above mentioned things, and a consistent effort was made to keep down the cost of the complete unit as well as its weight. Of course, the Grimes Inverse Duplex was employed because here above all places the saving of tubes means the saving of batteries and weight.

Above is Mr. Grimes' portable set; to the right are the details of his coil and below is the schematic wiring diagram

Three stages of radio frequency amplification and two of audio amplification were installed. A crystal was used for the detector and last year's experience told us that this had better be of the fixed variety and so placed in the set that several spares might be inserted in an emergency. The three radio and two audio were chosen in preference to the conventional two radio and three audio, because never again will a loud speaker be carted around on a vacation tour. They are too bulky and too easily damaged.

The three radio stages insure reception on an aerial even in the most unfavorable spots, thus giving you some success. Some spots were discovered last year where the two radio was not sufficient to pick up anything and then, naturally, the three steps of audio were useless. So phones it is and reception it is, this year!

Most of the camping locations, as before mentioned, are in out-of-the-way places.

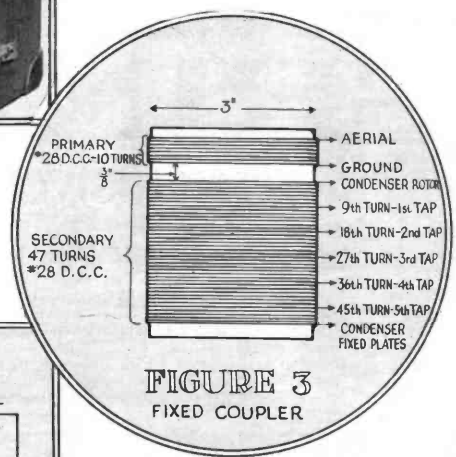


FIGURE 3
FIXED COUPLER

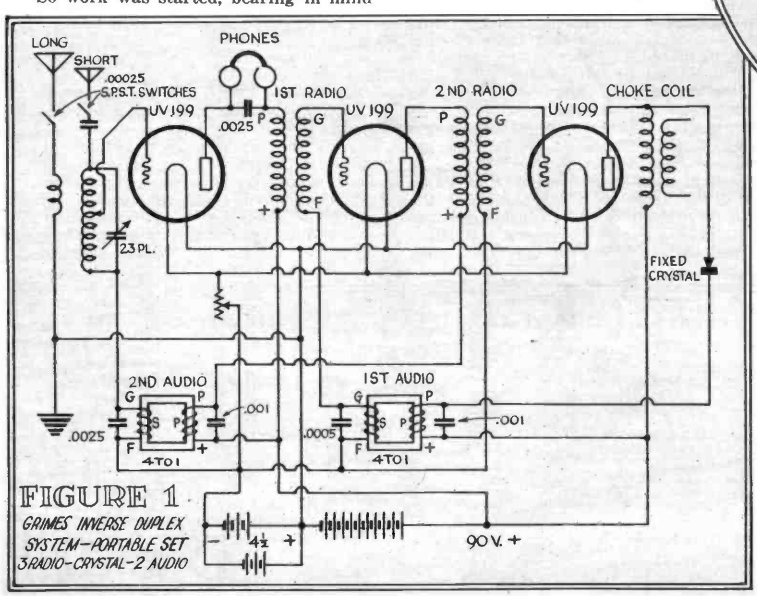


FIGURE 1
GRIMES INVERSE DUPLEX SYSTEM—PORTABLE SET 3 RADIO-CRYSTAL-2 AUDIO

These are generally nowhere near a broadcasting station. Sharpness of tuning, then, is not necessary and only complicates the issue and adds to the weight. The three stages of radio were accordingly made of the fixed transformer type. All tuning is accomplished with one control, which operates the tuning condenser across the secondary of the fixed coupler. The three UV-199 or C-299 tubes are controlled by means of one rheostat of about ten ohms resistance. The fixed or adjustable crystal is located on the front of the panel. The control arrangements are shown in the photograph of the front view of the set.

The trouble most frequently encountered in working with the small dry cell tubes is the "microphonic" difficulty. This is the tendency for the set to be noisy whenever it is touched. Sometimes this builds up into a roar with gradually increasing intensity. The microphonic effect is most noticeable when telephone receivers are

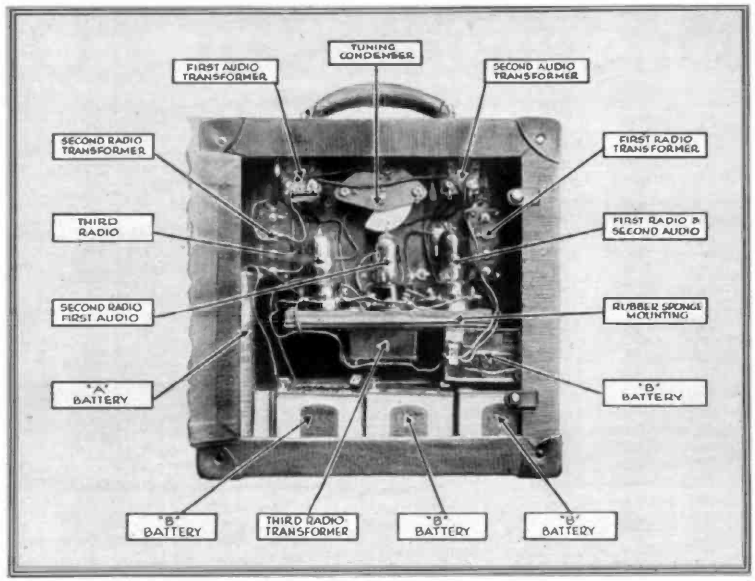
used, and as this portable set is to be used with receivers some means must be taken to overcome the difficulty. This is done by mounting all of the tubes on sponge rubber, as seen in the rear view photograph.

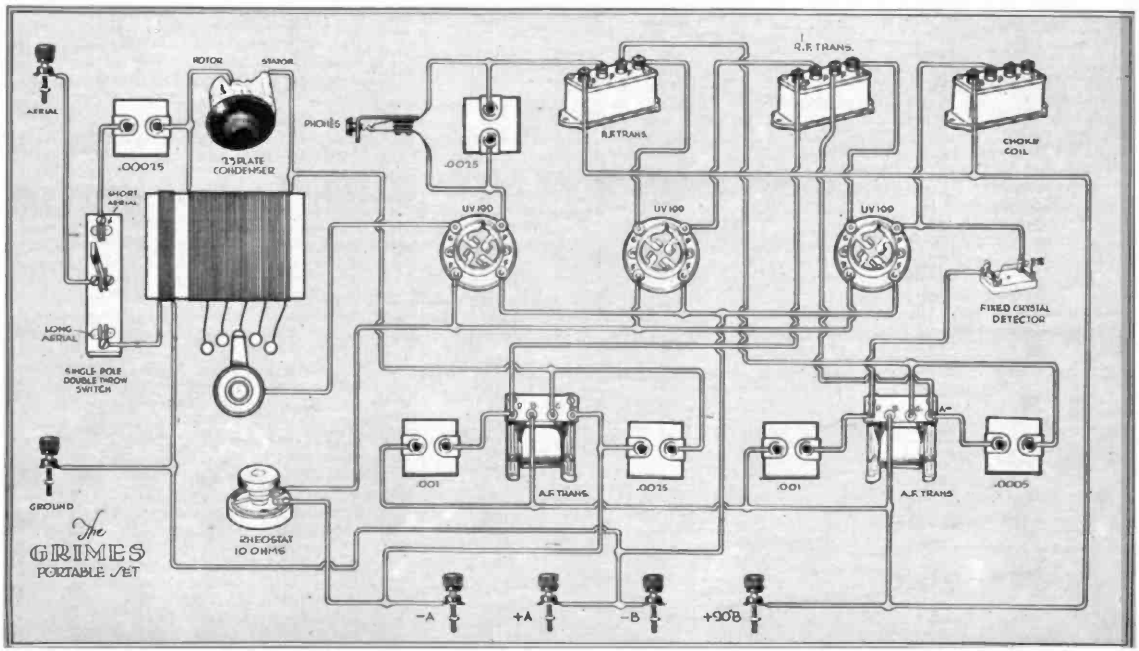
The arrangement of the circuit is shown in Figure 1. It is in general the standard Grimes Inverse Duplex System employing three tubes and fixed crystal for aerial operation. The three radio stages of amplification are obtained by means of standard transformers—the last one either acting as a "choke" or a straight transformer.

Figure 1 shows the choke coil arrangement. The choke coil is obtained by using one winding only of the transformer. The other is left open. Experiment will determine which winding will be best. The open winding is indicated in the drawing. The transformer circuit is shown in Figure 2. In this case both windings are utilized.

As only two stages of audio amplification are in the circuit, the liability of howling is greatly reduced. Three audio stages are somewhat of a job to install correctly. It requires low ratio transformers mounted just right with respect to each other. With two stages, however, higher ratios may be used and less care need be exercised in their assembly. In case an extra stage of power audio is desired, it may be added in the place of the phones in Figure 1. The primary of the third audio transformer is substituted for the telephones and the phones placed in the plate circuit of the extra tube. The last audio should preferably be of low ratio, such as three to tone.

The set is connected to the aerial and ground by means of a fixed coupler. The design of this coupler is shown in Figure 3 and is similar to the fixed couplers that I have shown in previous articles. It consists of a primary of ten turns of No. 28 double cotton-covered copper wire and a secondary winding of forty-seven turns of the same kind of wire, tapped as shown in the sketch. These coils are wound on a length of bakelite tubing three inches in diameter. The length of the tubing works out to be about two inches. In the set in the photograph, the fixed coupler was wound in the spider web fashion on a flat piece of cardboard and mounted above the 23-plate variable condenser. It is better, however, when room permits, to wind the coupler in the regular manner, as shown in Figure 3. When a short aerial or ground alone is used, it is connected as shown in Figure 1—labeled "short aerial." This sketch does not mean that both long and short are required simultaneously. The filaments of the dry cell tubes are run by two three-cell tubular batteries ordinarily employed in flashlights. The three cells in series give a voltage of four and one-half volts, which is reduced to the proper operating voltage of 3.1 by means of the filament rheostat controlling all three tubes at once. This rheostat should be about ten ohms resistance. The two three-cell batteries are connected in "multiple" for longer life. The filament cells are shown at the left of the cabinet in the rear view. The plate or B bat- (Continued on Page 45)





Three Tubes in a Corona Case

EVER since the beginning of this magazine I have had a great many letters from traveling salesmen asking me if I could not design for them a really efficient and genuinely portable radio set that they could take around on their trips with them.

Now this presents two difficulties. First, there may be considerable difference of opinion as to what the words "really efficient" mean. Second, as I heard a speaker say not long ago, you can call any set a portable set; you can even put a handle on a Steinway piano and call it a portable instrument.

It has puzzled me a good deal to get the exact combination of instruments which I felt would satisfy these commercial travelers, and I had not come to any conclusions until last month, when I received the following letter:

My Dear Mr. Neely:

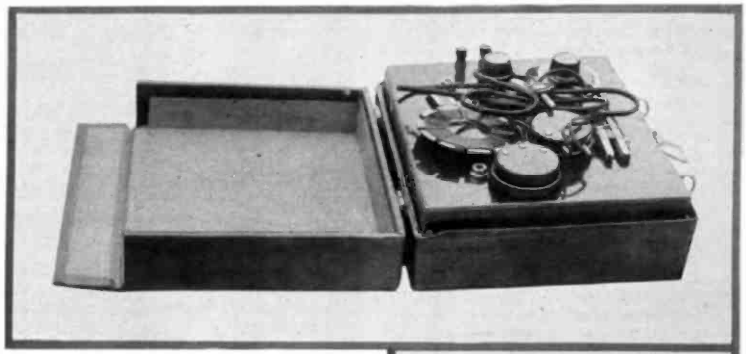
I have been watching the various radio magazines for some time for complete plans for one to build a small one or two-tube dry cell portable set, such as a commercial man could take out on the road with him, but I have not seen one.

The sort of set I refer to is one that could be built into a small fiber suitcase about five or six inches by fourteen inches by ten inches, and I am hoping that in some future issue of your excellent magazine I will see such a set shown with picture diagrams. I personally know several in these parts who are also watching out for similar plans.

Yours truly,
G. K. BAGOT,
1011 Chestnut Ave.,
Moose Jaw, Saskatchewan.

Mr. Bagot's letter was not, as I say, the only one that I have received, but one little item in it gave me the idea that I had been looking for. It was the mention of a small fiber suitcase. The reason this impressed me is that I daily carry just such a case. It is a case which I bought for $2.50 and was made for a Corona typewriter. These little cases can be bought in almost any city in the country, and I use mine for carrying Dictaphone cylinders back and forth between the laboratory and the office.

It struck me upon receipt of Mr. Bagot's letter that this case was the ideal one for the traveling man. It also gave possibilities to the radio man because there is a fair amount of room inside the case, and it was then merely a matter of hitting upon the smallest instruments that could be considered really efficient in such an outfit.



Here is the whole set packed away ready to close the case and go on your travels

The photographs which accompany this article show quite clearly how we solved all of the problems connected with this set. It is a genuine three-tube set and will work a loud speaker if within a short distance of a good broadcasting station. It will bring in all of the desired distance on head phones, and is really not a set for which one need make very many apologies.

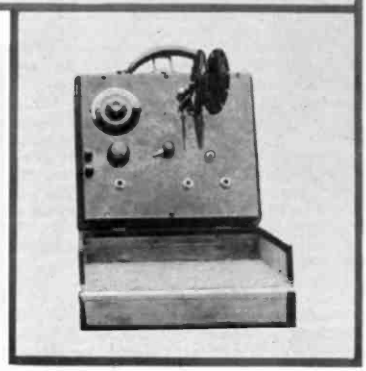
Absolutely everything is contained in the case, even including the phones and batteries.

We used, as you can see, three UV199 tubes or C299 tubes, and to light them we use one of the ordinary batteries made for C batteries.

For B batteries we use two blocks of 22½ volts each of the smallest size B battery that can be bought.

Now you must understand one thing about this arrangement of batteries. First, this C battery was never intended for the lighting of the filaments of tubes. That is a drain upon it such as its designers and makers never contemplated, and so, as you are asking it to do something which is totally beyond its purpose in life, you must not expect it to show very great endurance.

I think it would probably be conservative to say that if this one battery lasts you for four hours of continuous reception, it is doing about all that its makers intended it to do. If you are going to listen in only a couple of hours one night and a couple of hours the next night, the same C battery may do you for an A battery, but you must not expect a great deal more from it.

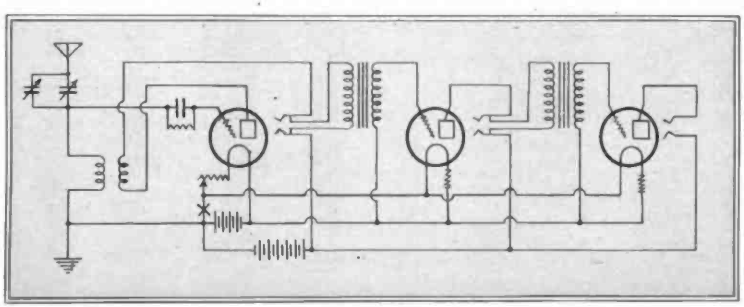


When the set is opened and the spider-web coils are in place, it looks like this and everything is ready to plug in your phones and get the concerts in your hotel room

The B batteries will last for considerably longer, but the 45 volts will not give you loud signal reception. They are ample for head phones, but if you insist upon being able to sit back in your room and listen comfortably without the ear muffs on, you must add at least one more block of these batteries and then you will unfortunately not be able to get them into the Corona case.

For any use beyond just that for which this set was intended you must make provisions to carry three regular size dry cells in your other suitcase to use as A batteries and one or two more of these small B batteries. If you do that you will get sufficient volume on your head phones to be able to place them in the wash bowl face down and you can then give a very satisfactory imitation of a loud speaker.

It must be understood that everything that is included in this set is put there because of the necessity of saving all the space possible. This is the most ordinary hook-up in the world; in fact, it is the original hook-up and has long been known simply as the "single circuit regenerative"



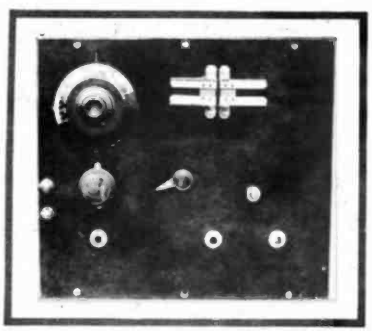
hookup. We adopted this one because it lent itself very well to the use of the spiderweb coil outfit, which we have also used for the sake of space saving.

The mountings which we show on the front of the panel for these spiderweb coils are the well-known Goodman mounts. Of course, when you buy the set of Goodman coils with their mounts, you will find mountings for three coils, one of them being fixed and the other two being hinged so that they can be moved to one side or the other. We simply eliminate the fixed mount entirely, take the two hinged mounts off and insert them on this panel. This is done for a very practical and necessary purpose. When the user has finished his reception and wants to pack up his case for his next move, he takes out his spiderweb coils, folds back the two mounts against the panel, lays his coils and his phones upon the front panel and the whole thing folds up nicely into the Corona case.

Most men will want to use either the brass bedstead or the electric light for an antenna. This set works extremely well with a Ducon plug inserted in the electric light socket. It is necessary, however, to rewind the Goodman coils, as they are made for outdoor aerials.

I think that you can buy this mount and the coils unwound and if that can be done I would advise the purchase of three coil forms. Wind one of these with about seventy or eighty turns of No. 28 single cotton-covered wire, the other with about sixty turns and the other with about fifty turns.

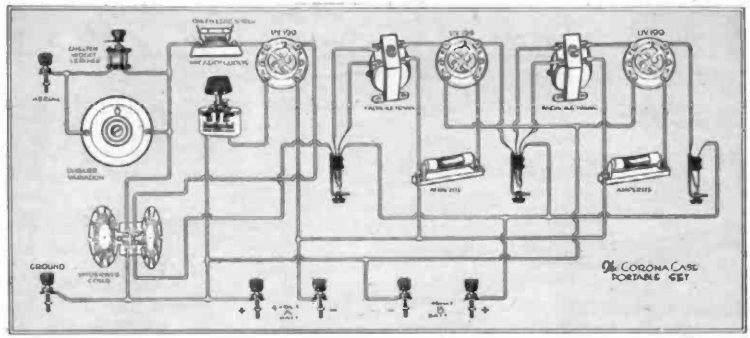
Do not forget in counting spiderweb coil turns that, as you count the wires on one side of a spoke there are just as many



When the coils are taken out, the mounts are folded back against the panel and the set is ready for packing away

wires on the other side, so that a seventy-turn spiderweb coil will count thirty-five turns of wire on one side. In order to save as much space as possible, we first used the little tube known as Amperite on all of the bulbs, so as not to have to put a rheostat on the panel, but we found that it was well worth while to use a Bradleystat on the detector bulb and use the Amperite only on the two audio amplifying bulbs. This very much improved results, and it will also compensate for the gradual dying down of the strength of the little C battery which we are using as an A battery.

We use the Dubilier Variadon condenser, which is perfectly flat and not much bigger than an ordinary dial, and the C battery fits into a wire framework up against this condenser. For sharp tuning we insert a Chelten or a Marco midget condenser,

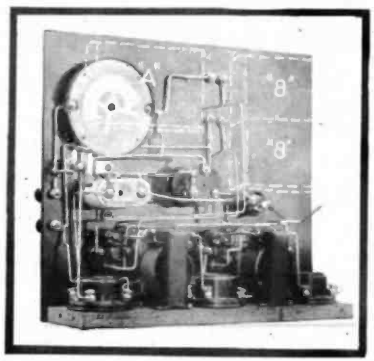


which is connected to the Variadon in what we call parallel—that is, one side of the midget is connected to one side of the Variadon and the other two sides are connected to each other.

This midget is a very essential part of this circuit. The single circuit regenerative set is guilty of a great deal of body capacity and, when you tune in a station with your hand on the Variadon you will find that when you take your hand away it will need a certain amount of re-tuning.

These little midget condensers run so easily that it is possible to take a stick six or eight inches long and move the little pointer around and thus do the fine tuning with the hand far enough away from the set not to interfere with its operation.

The two audio frequency transformers that we used are the well-known Fadas. The grid condenser is the standard micadon with a five megohm Daven grid leak. Let me just say one word here about these Daven leaks, and that is that I have been carrying on tests with them over a long period of time, and I have yet to find one which was as much as 10 per cent. off of the exact resistance that was marked upon it. This is extremely important to know,



A back view of the set showing the placing of all the instruments. The dotted line enclosing the upper left-hand corner shows where the B batteries are placed and in the upper right-hand corner the dotted line shows where the filament lighting battery is placed

because many of the modern complicated circuits require the most exact resistances, and it is always well to know just where this exactness can be depended upon.

There is one feature of this set as we show it in these photographs that I want to be especially careful to warn you against. We wired the whole thing up with square turns and used bare wire. This was because we had got into the habit of using this kind of wire, and it also makes the details of a photograph show more clearly. We very shortly found, however, that in this one set you cannot have your wiring look too fancy and, above all, *you must not under any consideration use bare wire.*

In the limited space of a Corona carrying case, the wires must inevitably come very close together at places, and as this is a portable set and subject to a good deal of rough usage, you will be almost certain to push two of these wires into contact, and if the wires are bare you are likely to have a short circuited battery, if not, indeed, a genuine blaze in your suitcase.

Do all of your wiring on this set with ordinary bell or annunciator wire and wherever you have to scrape the insulation off make the bare part just as short as you can and cover it over with some sort of insulating dope such as the red dope that is called Kellogg's "Wilbur" Radio Cement. Every radio fan should have a bottle of this stuff anyway, as it is a genuine liquid insulation.

You will find it impossible to use the ordinary full-length jacks in a circuit mounted in so small a space as this, and so we are showing three of those very clever Marco jacks which have quite short blades and which also have the added advantage of making soldering unnecessary, as all connections to the wires are made by means of screws.

We also show a filament switch, and this, of course, is absolutely essential in a set of this kind. The switch can be any of the standard makes, such as the Bradley-switch, the Marco, the Cutler-Hammer, or any of the others which are put out by reputable manufacturers. In tuning the circuit, you will have to

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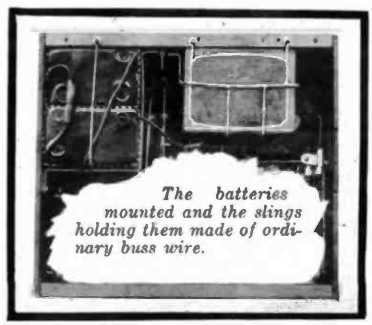


The batteries mounted and the slings holding them made of ordinary buss wire.

SEVENTH LESSON

The Radio Kindergarten

Little Ralph Fallen Coleman is an ardent radio fan like his father. A photograph of his father's studio was shown on the February cover of this magazine

THIS little kindergarten class has now progressed far enough to permit the teacher to talk a little bit at this time about the most wonderful single piece of apparatus which we have in our radio set. This is the vacuum tube.

In fact, I think it is not too much to say that not only is this the most remarkable piece of apparatus in our set, but it is the most wonderful single scientific device that the mind of man has yet produced. I say this not entirely because of what it is already doing, but more particularly because of the indications it is giving of the marvelous truths which it is going to reveal to us in the future.

So miraculous are some of the promises that it might even be said that the vacuum tube holds out the hope of doubling our scientific knowledge within a comparatively short time.

Of course, this kindergarten class is not yet ready to talk of these more complex phases of the vacuum tube. All we are prepared for with the slight foundation which we have is to find out just what it does in our receiving set and how it performs its functions.

We know already that the radio signals which reach our aerials are extremely minute and very weak. They are not strong enough to accomplish very much, and the limit of their possibilities is just about reached when we operate a simple crystal set. We have already learned that these signals come to us in the form of waves. They are alternating currents—that is, the wave takes the form of first a positive charge and then a negative charge and so on hundreds of thousands of times a second.

Now these waves have considerable power when they first leave the transmitting aerial. In fact, it is perfectly possible right under a powerful station's aerial to operate a loud speaker on the strength of these waves alone, merely using the crystal detector for what we call "rectification"—that is, the process of changing these alternating current waves into pulses of current, all going in the same direction or all positive or negative, as the case may be.

Now we have all studied in our school days the effect of light from such a source as a candle, for instance. We know that right within an inch or so of the flame, the light given by a candle is quite intense. We also know that as we get farther and farther away from this flame, the light becomes weaker, not in the same proportion as the distance that we remove from it, but in the proportion of the square of the distance. That is to say, if we move twice as far away, the light is only one-fourth as strong, and as we move four times as far away the light is only one-sixteenth as strong. For that reason, we very soon get to the place where the light is not strong enough to enable us to read even a large-sized type.

Very much the same thing holds good with a radio signal and it is easy to see why.

As the signals spread out over the earth in constantly widening circles, that original amount of energy has got to supply energy to every single square inch over which it is going and this constant subdivision of the energy means that, as the signals spread outward, there is less and less of it left to operate on an aerial and we soon get to the point where the strength of the signal is so slight that it is almost impossible to detect it.

In building a modern radio receiving set, therefore, we are confronted with the problem of somehow or other taking these extremely weak signals, and, while still keeping the exact form of waves as they were when they left the broadcasting station, to build them up in their strength to such an extent that they will operate our loud speakers and give us strong signals all through our homes.

Of course, there is not sufficient strength in the signals themselves to do it. Consequently we must in some way or other furnish a source of power in our homes and then arrange things in such a way that these very weak signals will serve in some way as a trigger to operate this local source of power.

We have, as a matter of fact, two sources of power in our homes. One is the battery which lights the filament of our tubes. The other is the battery which we call the B battery. As a matter of fact, the B battery is the one which gives us our signals.

You all know that you will get louder signals if you use 90 volts of B battery than if you use only 30 or 40, and that should be perfectly clear to you, because 90 volts furnish a great deal more power than 30 or 40. Consequently, if we can arrange things in such a way that these tiny little signals coming in from our aerials will in some way control our very strong currents from our B batteries, we are accomplishing what we set out to do—that is, we are keeping the wave form of the original signal, but we are building it up in strength by means of our B batteries to such an extent that we can operate our loud speakers.

Now let us see just how this marvel came about and as we go into it let us once more recall the things that we have already learned about that very tiniest mite that the mind of man knows—the electron. Let us remember also that electrons are always negative electricity and then recall the fundamental facts that negative repels negative but attracts positive. In other words, like kinds of electricity repel each other, but unlike kinds attract each other.

With these facts recalled from our previous lessons, let us now go back to the day when Edison first brought his electric light to such a state of perfection that it could be used commercially.

In those days, the electric lights were burned almost entirely by direct current. Edison, in his long experimentation, noticed what has been noticed by many of us whose memories go back to the early days of electric lighting—that is, that as a bulb grew old, it began to discolor. There gradually formed upon its surface a rusty or reddish brown deposit and Edison started to study this. His studies led him to notice that there was always a definite relation between the intensity of this deposit with reference to the positive or negative side of the filament, and this led him to make still further experiments because it indicated that the filament was causing this deposit in some way.

One of Edison's experiments was to place inside of the bulb a metal plate and bring out a connection so that it could be wired to other pieces of apparatus. The plate was not connected to the filament in any way.

Edison then experimented by connecting this plate to a battery. His filament was lighted by one battery, and as that was

(Continued on Page 42)

How Often Must We Pay?

IN the February issue of "Radio in the Home," Mr. E. C. Mills, one of the high officials of the American Society of Composers, Authors and Publishers, told our readers the society's viewpoint of the important question of licenses for broadcasting stations.

Here we have the broadcaster's viewpoint. This is a complete and an official statement written by the executive head of the association formed by the leading broadcasting stations of the country.

This matter of licenses for performing music by radio is one which is being fought out by the broadcasting stations themselves, but it is a vital question to the listener in, and the readers of this magazine should keep fully informed of it and take an active part by writing either to Mr. Mills or to Mr. Klugh, depending on which side they find their sympathies allied. H. M. N.

By PAUL B. KLUGH

Executive Chairman of the National Association of Broadcasters

AN ASTOUNDING imposition in the matter of multiple taxes on music, collected many times from an unsuspecting public, has lately come to light. We say "unsuspecting," for the manner of making the public pay, not only once, but time and again for its music is so subtle, that not only is it unknown, but really unsuspected.

This taxation of music centers around the American Society of Composers, Authors and Publishers, a small organized group of some three hundred out of a known list of six thousand five hundred composers, authors and publishers.

The American Society dictates that no music belonging to its members may be played in public, unless license fees are paid to its organization. In all justice to the authors, composers and publishers belonging to the American Society, or any other society, or detached from all societies, it is no more than fair that a suitable remuneration should be theirs. The members who contribute through writing, composing or publishing should be paid for their work — their creations. They should be paid well, but they should be paid ONCE, and not a dozen or more times for the same thing.

Just how often does the American Society and its members receive fees for the same composition?

Let us take an abstract case and cite by way of illustration the manner in which this forced multiple taxation on music is brought about.

A business man who lives in a hotel, on his way to his office in the morning, passes a street piano grinder to whom he gives a few pennies. Part of this money is used to purchase new music cylinders for the street piano, upon which a tax is collected by some publisher and song writer.

At the midday respite from work, the business man pays another tax if he lunches where music is played, because it is a fact that the customer pays his part of the American Society tax in the price of the food.

This next tax may be an extreme case, but, nevertheless, we are interested in making our picture complete; therefore, if our business man goes out later for a cup of coffee, and in the lunch room there is a coin-operated musical instrument, then a tax has been paid on the music roll by the manufacturer. In addition to this tax, lo and behold, the American Society claims that the lunch room proprietor must pay for public performance, all of which toll falls upon the customer, and in this case, our much-taxed and tired business man pays again.

On the way home from his office, another tax is paid by our business man if he buys a phonograph record, another if his daughter buys a sheet of music, still another if his wife buys a player-piano roll; and the family frequently does buy all three.

In the evening our business man pays another tax for the music played in the dining room of his hotel, another if he should drop in to see a motion picture where music is played, another if he goes to the theatre which employs an orchestra, to see a play or musical comedy, and if he should attend a midnight cabaret he pays still another tax for the music necessary to the entertainment as well as for music incident to the dance.

When his hotel bill is presented he pays another tax if the hotel has an orchestra which plays on the mezzanine floor—and on top of all this, if our business man should tune in a station on his radio receiving set, and hear a composition belonging to a member of the American Society of Composers, Authors and Publishers, the American Society insists that *still another tax be paid.*

The same piece of music may have figured in each instance named—*HOW OFTEN HAS A TAX BEEN PAID?* And this is repeated day after day by millions of citizens who do not realize that they have even been taxed once.

More taxes are demanded—and still more may be imposed. Mr. E. C. Mills, the shrewd executive head of the American Society of Composers, Authors and Publishers, states that multiple taxes can be collected upon a song belonging to his members when mechanically reproduced, in the following manner.

PAUL B. KLUGH

It is a fact that when a citizen purchases a good player-piano word roll of one of Mr. Mills' songs, a tax of 12½ cents cash goes directly from the citizen purchasing the roll to a member of the American Society.

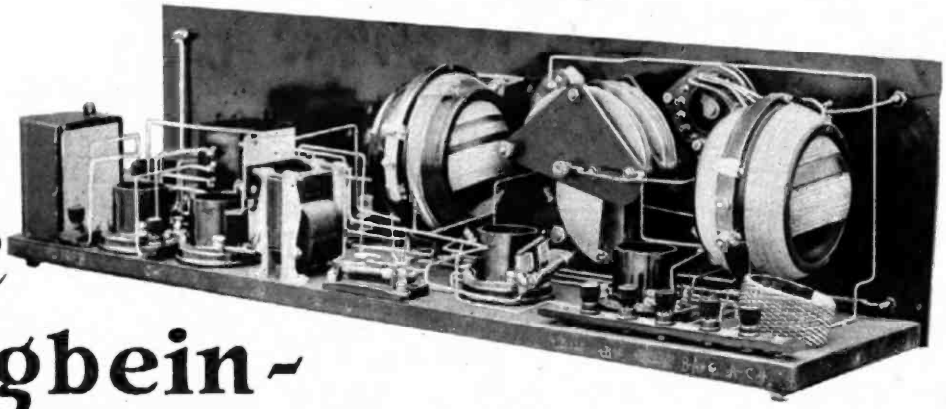
If this citizen takes this roll over to a broadcasting studio and plays it on a player piano, and it is sent over the air, then an additional tax must be paid. Furthermore, if this broadcast player-piano performance should be picked up in a place where people are publicly dancing, then another tax must be paid.

Thus Mr. Mills actually demands three taxes upon the same roll, under the conditions described, and we have no doubt that if he were asked to devote his ingenious mind to this subject, he could think of several more.

Now let us take as an example a phonograph record. If a citizen buys a double-faced record, a tax of 4 cents is paid by the citizen, but according to Mr. Mills' reasoning, this tax of 4 cents has purchased little or nothing in the matter of freedom in what use is to be made of the record. If, for instance, the citizen takes his phonograph down to the beach and entertains surrounding bathers, he is in fact giving a public performance, and according to American Society reasoning, this may not be done.

This multiplicity of royalties demanded, of course, must be paid by the public one way or the other. Now is it possible that after sheet music, rolls or records have been bought and paid for, the Copyright Law is to be so interpreted that the purchaser has only the right to use it in a certain place—that is to say, within the privacy and almost within the secrecy of his own domicile? Must his property be under definite restrictions and regulations by a small group of men? Must these taxes be paid again and again? Did Congress ever intend such iniquitous procedure as this?

The restrictions on music which the American Society is endeavoring to enforce are not only (Continued on Page 42)



The Langbein-Kaufman Circuit

A three-quarter view of the set from the rear

IN THESE days of public mania for super-heterodyne and other ten-tube circuits, I am very glad to be able to present an extremely efficient and simple circuit for those who either do not want or cannot afford to join the procession into the realm of multi-tube hookups.

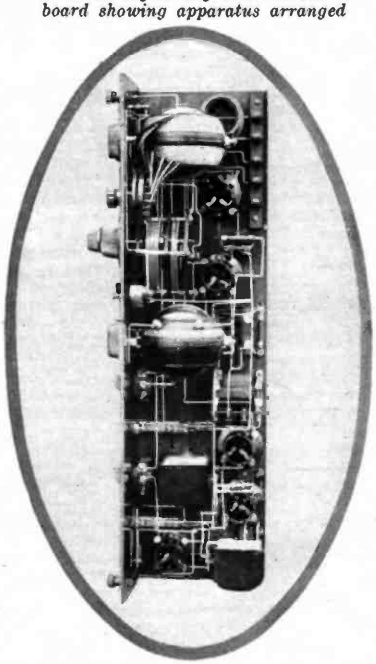
It seems to me that this new tendency is likely to be very discouraging to the average man who has no desire to go so deeply into radio and so I am particularly glad to have recently run across a very efficient circuit using some new apparatus that has just been put on the market.

The photographs and the diagrams accompanying this article show the Langbein-Kaufman circuit as we built it at Station 3XP. We found that it had all of the desirable elements of a circuit easy to tune, very satisfactory as a distance getter, ample in volume even on stations a thousand miles or more away and particularly good on the quality of music reproduced, especially as we inserted one step of push-pull amplification.

The circuit itself with straight audio frequency amplification would require only four tubes. As we show it here, we use five tubes because the second step of amplification, being the push-pull system, requires two tubes for the one step. This is well worth while, however, because of the greater clarity of signals produced by this method.

Summarized, this circuit consists of one stage of what we call "tuned plate" radio frequency amplification, detector, one stage of straight audio frequency amplification and one stage of push-pull amplification.

Below—Looking straight down on baseboard showing apparatus arranged



The circuit just as given here will work with any of the tubes now on the market. I am presenting it with special recommendation for the man who lives twenty-five miles or more away from a powerful broadcasting station, where extreme selectivity is not so essential as uniform performance and dependability coupled with beautiful reproduction and ease of tuning.

For the farmer or the man who is spending his summer in the country or at the seashore this is an ideal circuit to use with the so-called dry cell tubes, using the Edison primary cell instead of the dry cells.

I speak of this feature because so many farms and camps are at considerable distance from even the country stores and it is not always convenient to replace worn out dry cells.

The Edison primary cell is totally different either from the storage battery or the dry cell.

This cell is in a glass jar and the solution is easily made by anybody by merely emptying a tin can of powder into water and letting it dissolve. This gives a fine strong current over the entire length of the life of the solution and when one solution is dead, it is simply dumped out, fresh powder is mixed in with fresh water and the cell is ready to begin its life all over again. This makes the Edison cell ideal for use on the farm or in the camp because the powder can be shipped by parcel post and the problem of charging is entirely done away with. It also has the great advantage of being just as good and as strong and as steady in its flow of current during its last hour of life as it is during its first hour of life.

These cells are particularly adapted to the 199 or 299 tubes, the 11 or 12 tubes or the A tubes. Any of these tubes can be used in this circuit with no change whatever in the hook-up or in the apparatus, providing the correct voltage of battery is used on the filament.

The new piece of apparatus which this circuit introduces is a very beautifully made tuning unit which the Langbein & Kaufman people call their VT-25. This is virtually a variometer with an untuned coil of wire bank-wound on the outside of it. This untuned coil is connected in the

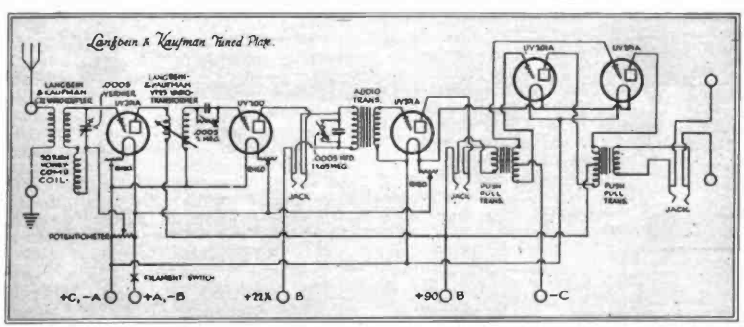


plate circuit of the radio frequency amplifying tube and really becomes a tuned circuit because it is so closely coupled to the variometer that the tuning of the variometer really tunes the plate circuit also.

The first instrument used is a variocoupler. We show in these photographs the "space wound" rotor put out by Langbein & Kaufman, but we found that on the higher wave lengths, using only a .0005 condenser, there was not quite enough wire on the rotor and so we inserted a 35-turn honeycomb coil in what we call series with this rotor. That is to say, we connected the binding post of the rotor which would ordinarily go to the variable condenser and the potentiometer to one side of the honeycomb coil and we connected the other side of the honeycomb coil to the variable condenser and the potentiometer. This gave us an added lot of windings in the circuit with the rotor and made the Kellogg condenser cover the entire brand of broadcasting wave lengths beautifully.

If you use the standard variocoupler, which has more turns on the rotor, you will not need this honeycomb coil.

The inclusion of a potentiometer in this circuit is not absolutely necessary, but we found it desirable on certain distant signals, as a slight adjustment of it seemed to bring them in with greater strength and to clear them up. This potentiometer will not often be used. Once you have it set at the place where it brings in the majority of signals with greater strength, you will not have to touch it much except every now and then a slight movement to clear up the signals.

This circuit as we give it here introduces another very beautiful bit of radio apparatus which is new to the market. I refer to the Calvert knock-down cabinet. I am showing it in the illustration in the form in which it came to us, all taken apart and folded up neatly in tissue paper in a box, and I am also showing it put together with a screw driver ready to slip the set in.

This box can be put together merely by inserting screws in the nickle strips, which are all cut to fit the corners and hold them together, and the result is a cabinet not only of most pleasing appearance but of great ruggedness and strength.

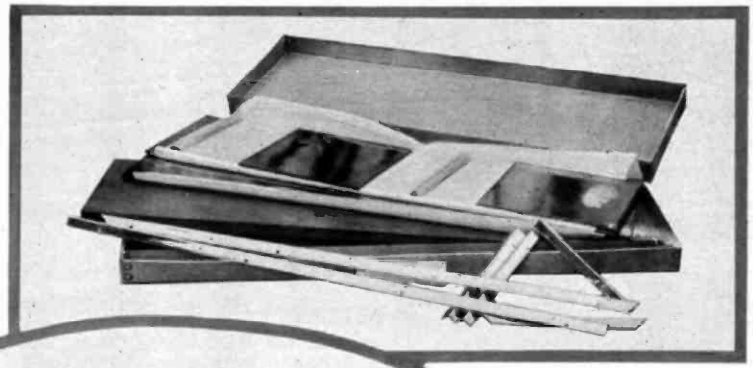
With a Mahoganite panel for the front and Mahoganite dials, set off by the well-known Pacent rheostats and potentiometers, this makes about as fine looking an outfit as we have yet put together at Station 3XP.

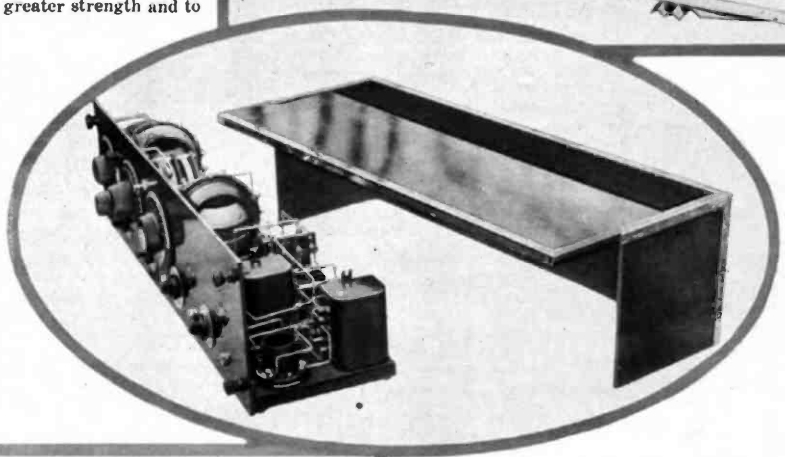
For the push-pull stage of amplification in this particular set, we used the Como push-pull transformers. Any of the other standard push-pull transformers which we have previously described in this magazine can be used, however. These transformers are the All-American, the Modern and the Rubicon. The hookup is the same for all of them.

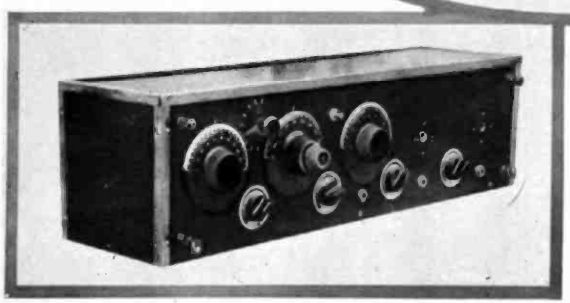
You will notice that there are two places in this set where a fixed condenser is used with a variable leak. One of these places is in the grid circuit of the detector tube and the other is across the primary of the first audio frequency transformer.

Not knowing just which tubes you are going to use, I would advise you to put in both of these places the new Daven double mount which has clips for the easy removal and insertion of various leaks and condensers. This will make it perfectly easy for you to change condensers and leaks and experiment until you get the best results for the particular tubes and transformers that you are using. If you are going to use 199 or 299 tubes in this circuit, the B battery voltage for the detector should be 45 instead of the 22 shown here and for the amplifiers it should be 60 instead of the 90 shown here. The C battery should be variable from 4½ to 9 volts.

You notice that we have two binding posts for the C battery and the B battery in this set, but this was merely for convenience and to avoid the necessity of having a very long lead of wires inside the set.







Above — The Calvert cabinet as it comes knocked down. Center— The cabinet ready for the set to be slipped in and how the lid slides out. Below—Completed set mounted in its cabinet

WHAT IS—WHY IS A GOOD CRYSTAL?

NOT long ago, I happened to tune in Station WFI, Strawbridge & Clothier, Philadelphia, and caught one of the best talks on crystals that I have ever heard. It was given by W. M. Foote, and I immediately wrote and asked him if he would not let me have a copy of the talk for publication in RADIO IN THE HOME.

Mr. Foote has very kindly complied and I am printing the speech here. H. M. N.

THROUGHOUT all ages the pleasures and entertainment of man have come to him from many sources. In the days of our remote ancestors the music-lover went to the surging waters for his symphonies or his jazz. Our nearer forefathers made friends of their books, and found their sermons in stones.

It is left for us of the twentieth century to receive at least some of our gaiety, beauty and inspiration through certain stones which we call crystals. It has been the work of our laboratories in the last couple of years to collect and test something like one and a half million crystals.

from which have been selected a round half-million for use in radio.

These crystals have performed the friendly service of making many friends for us. The fan who has devotedly washed his dearly beloved crystal oftener than he has scrubbed his baby brother will surely sympathize with my sentiments. But it is not all sentiment either, for scientists tell us that if we really knew all about atoms, we might find differences in the sulphur atoms of our crystal, just as we find differences among folks.

The best and most widely used kinds of crystals are natural pyrite and natural galena. Pyrite is sold under a dozen different trade names. It may, however, be easily recognized by its hardness as it cannot be scratched with a knife. It is very shiny and is always of a brassy or golden yellow color. It is a mixture of ordinary sulphur and iron.

Galena is easily recognized by its softness, being very easily scratched with a knife. It is often of flat squarish shape and is always glistening bluish black in color. It is a mixture of sulphur and lead.

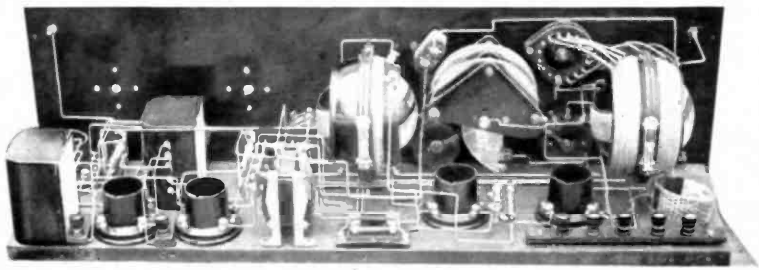
The element silicon is an artificial product, being made in the electric furnace. It looks like galena, except that it is never in perfect squares; also it is very hard. An extra-thick cat-whisker must be used on silicon and it is not as loud as pyrite or galena. Different pieces of crystals, like metals or persons, tire more or less easily. We have proved that the most sensitive galena very noticeably weakens in five or six minutes of scratching with a cat-whisker. This effect is probably due to two causes. The first cause is the electrical charge sustained, and may be a sort of electrical fatigue. Give the tired crystal the rest cure for a day or two, and it will partly recover. The other cause of desensitization is due to abrasion, or permanent wearing away of the crystal surface. The extra large crystals introduced last year have the real merit of larger area, and therefore longer life. When two galenas are equally sensitive over their entire surface, their electrical endurance varies according to their area.

Which is the best, pyrite or galena?

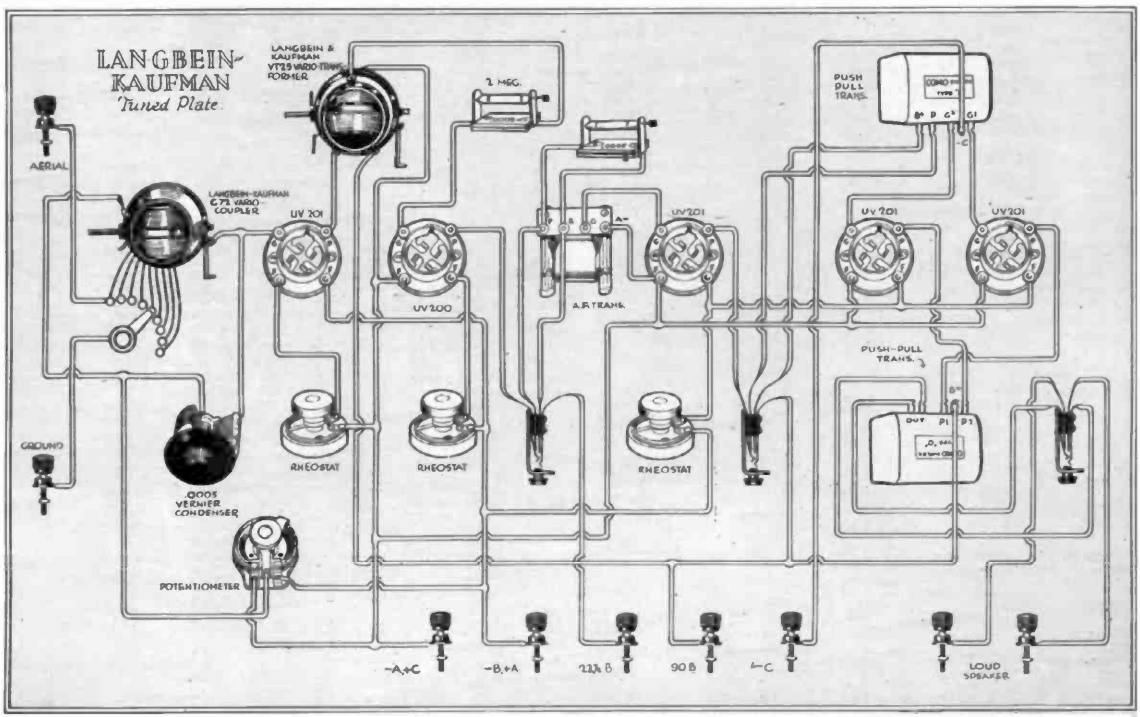
It is much a matter of taste, provided a cat-whisker is used. Certainly there is nothing louder in volume nor purer in musical tone and clarity of speech than a light contact on the best galena. But galena tires much quicker than pyrite. Its soft surface may wear out in time, whereas pyrite is hard, and seems to have greater electrical endurance.

It is significant that all the best fixed detectors contain pyrite. For such devices the superiority of pyrite is very marked, because it withstands the high B battery voltages of reflex circuits most satisfactorily. Fixed detectors are usually designed to hold a metal contact firmly and permanently on the crystal. This is another reason for using pyrite in fixed detectors, as it rectifies well under a relatively thick contact with a spring pressure, whereas galena works best with the most slender contact and lightest pressure. The radio school's audibility tests, which I shall speak of again, showed eight makes of pyrite to average 50 and ten makes of galena to average 64 on the audibility meter. This confirms the general knowledge that galena is louder than pyrite.

If constant dropping of water wears a stone, so a constant electric discharge through a single microscopic spot on a crystal fatigues it more quickly than if you shift the contact to another point. If the fixable or adjustable type of detector is used, the spot may be changed. The popularity and efficiency (Continued on Page 39)



Looking at the Langbein & Kaufman set directly from the rear showing the placing of the apparatus on both baseboard and panel



GOODREAU'S SPIDERWEB PORTABLE SET

Here is the whole Goodreau Portable Set with batteries, phones and everything

By W. FRANCIS GOODREAU

Here is a set which Mr. Goodreau has designed particularly for the vacationist this summer. It is adaptable to the automobile or the camp. Mr. Goodreau himself will soon start out in an automobile on a special mission for RADIO IN THE HOME making some investigations for us in the farming districts, and he is going to take this set with him. We felt that it was so ideally adapted for the needs of the average summer vacationist that it was well worth printing this far in advance so that the reader can get it ready for the summertime. H. M. N.

WITH the coming of spring, the dyed-in-the-wool radio fan is on the lookout for a good portable receiver. Having received entertainment via radio all through the winter months, he is loath to give it up with the approach of warm weather, even though there are many other pleasures in which he can take part.

Spend the day as he will, in boating, swimming or fishing, when evening comes he turns to radio for entertainment. Springtime, evening and radio! What a wonderful combination!

Having settled the question as to whether or not radio will be used on his vacation, the decision usually being that it will be used, the fan turns his attention to the type of set that will be most suitable. For summer use the portable set is the only thing, but there are many types of portable sets. Which shall he use?

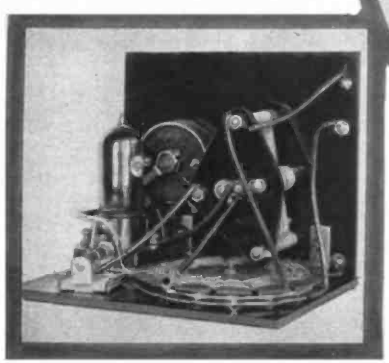
A loop receiver is usually selected by those who intend to use radio in boats or machines, but the camper prefers something different if possible. With this in mind, I have designed and built a portable receiver which I now describe. The set is a complete receiver, and though it is only six inches by five inches in size, it is not a toy. It will work on antenna alone, ground alone, or antenna and ground together. It is selective, and receives well on distance.

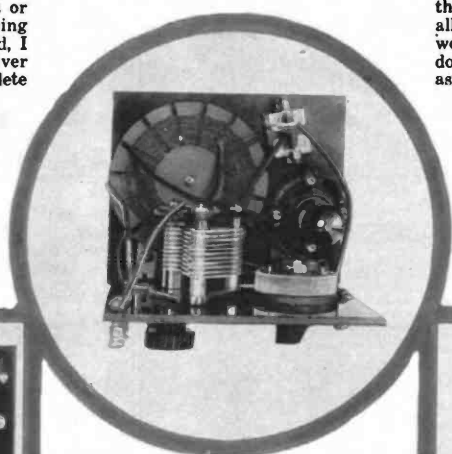
During tests of this receiver, I have heard on antenna alone or ground alone Station KDKA, which is over 600 miles from Providence, R. I., where the set was tested. With antenna and ground together, have heard Station WTAM at Cleveland, Ohio, and Station WDAP at Chicago. The music was clear, but not as loud as it would be on a full-size receiver. To build this receiver you will need the following parts:

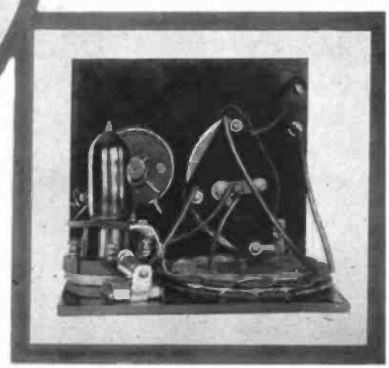
1 Radion panel, size 6x5x3-16 inches.
1 Base, same size, may be of wood or hard rubber.
1 Variable condenser, capacity .0005 mf., 23-plate.
1 Pacent or other 30-ohm rheostat.
1 Socket for UV199 tube.
1 UV199 tube.
1 Dubilier grid condenser, type 601-G, capacity .00025 mf.
1 variable grid leak.
1 Spiderweb coil, 100 turns.
2 Spiderweb coil frames.
5 Binding posts.
2 Brackets for mounting panel.
1 C battery to light filament.
1 Small size B battery, 22½ volts.

Having secured all the parts needed, we will now start the construction of the receiver.

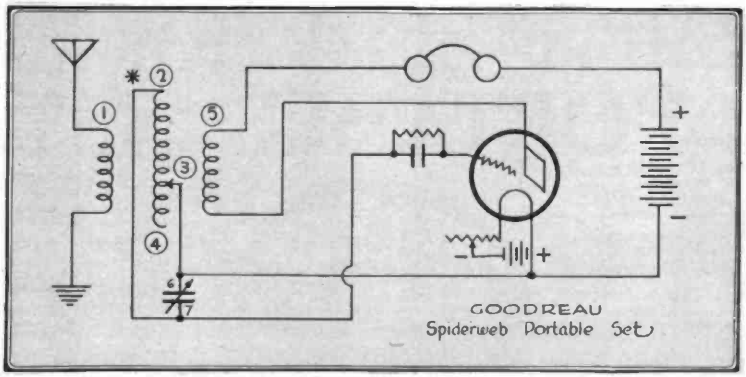
The first thing to be done is to prepare the spiderweb coils, of which there are three. The 100-turn coil can be purchased all ready wound; the other two must be wound by hand. As there is nothing we can do with the 100-turn coil, we will set that aside until needed and start winding the other two coils. The first coil will consist of twenty turns of wire, the wire being No. 26 D. C. C. This D. C. C. means simply double cotton-covered wire. To wind this first coil place one end of the wire in one of the slots in the coil frame, leaving about six inches of wire free, then wind twenty turns of wire on the frame close together, after which cut the wire, leaving six inches free as you did before. As you count







Above is a view looking directly down upon the baseboard showing how the spiderweb coils are placed so that part of them come underneath the variable condenser. To the left and right are rear views showing the placing of the various instruments on both panel and baseboard



When using antenna or ground alone, connect at this point. When using both antenna and ground, connect as shown to primary coil

1 Twenty-turn coil.
2 Sixty-turn coil.
3 Tap at twentieth turn.
4 Inside end not connected.
5 One hundred-turn coil.
6 Rotor plates.
7 Stator plates.

Here is a full size form which will enable you to cut out your spiderweb coils. It is given because very few people know how to divide a circle into an uneven number of spokes. To use this form, simply trace it with a piece of tracing paper and then transfer this tracing to the heavy piece of cardboard or insulating material which you are going to cut out as a form for winding the spider web

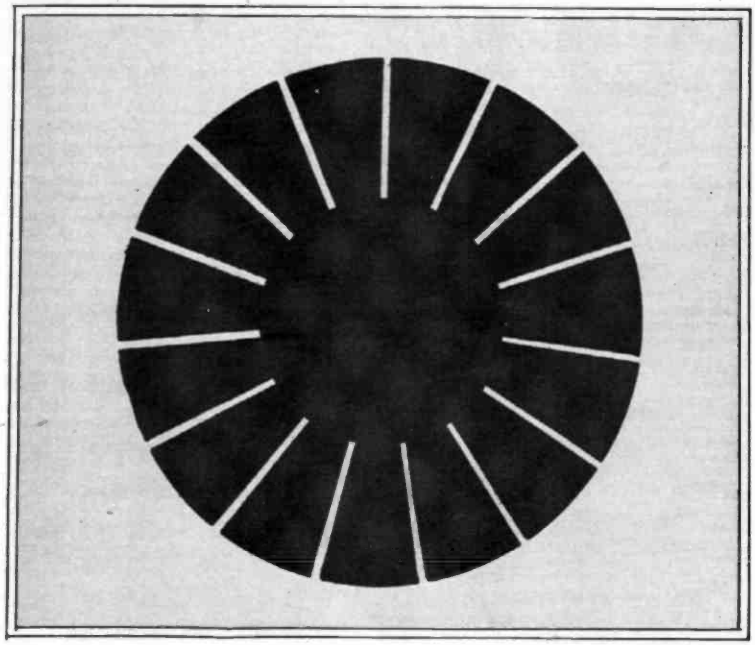
the turns on one side of a spoke, don't forget that there are just as many turns on the other side. For this coil, count ten on one side. You should now have a spiderweb coil wound with twenty turns of wire and having six inches of wire free at each end. This completes this coil, so we will put that with the 100-turn coil and wind the third coil.

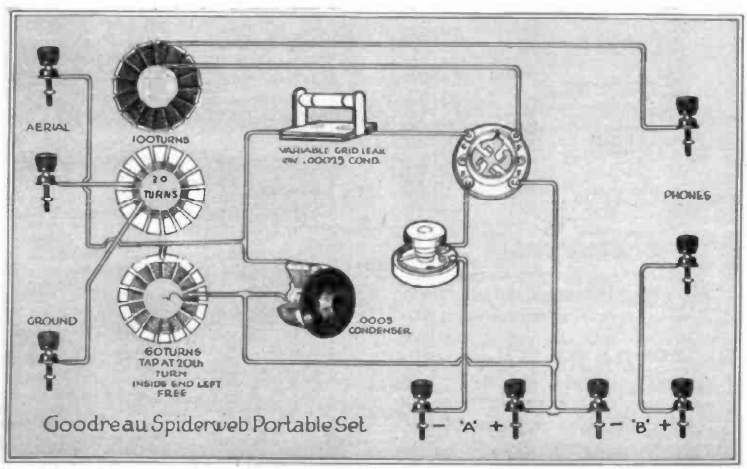
This coil consists of sixty turns of wire, but is tapped at the twentieth turn, that is, wind twenty turns of wire on this coil as you did on the other, then take a tap by making a loop in the wire, twisting it for about six inches and then wind forty more turns of wire on the coil as close to the first winding as possible. You should now have a coil of wire containing sixty turns of wire, with a tap at the twentieth turn. This completes the winding of all the coils needed.

We are now ready to drill the panel and mount the parts on the panel and base. First we will drill the holes for our binding posts.

On the left-hand side we will need three holes, two in the upper left-hand corner and one in the lower left-hand corner. On the right-hand side we have two holes for binding posts; these are in the lower right-hand corner.

Next comes the variable condenser, which may be plain or vernier. In the pictures we show a s Signal which was used in this set, but any good condenser will do. A Dubilier Variadon was also tried in this circuit and worked quite well, also saving quite a little space. We will mount the con-





denser on the left-hand side of the panel as near the binding posts as possible without touching them.

Next to the condenser we will mount the Pacent 30-ohm rheostat. We have completed the panel now and we will go on to the next thing, which is to mount the rest of the parts on the base.

First let us drill a hole through the center of each spiderweb coil form and then drill a hole in the base, in such a position that the spiderweb coils may be fastened in position on the base with a small screw and nut. The coils should be partly under the variable condenser and should be fastened to the base in the following order: first the 100-turn coil, next the twenty-turn coil and last the sixty-turn coil. Make sure the ends of each coil are free and then fasten the coils firmly to the base with the screw and nut.

Next we will mount the grid condenser and leak. Mount these in position shown in pictures, and fasten to the base with small screws and nuts. Next (Continued On Page 26)

Lightning a Danger? Not a Bit

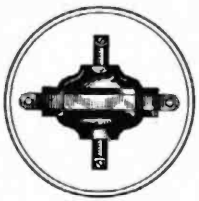
NOW that summer is once more approaching let us start right away to get rid of one of the superstitions most harmful to the spread of radio.

This superstition is that a radio aerial installed upon a roof exposes the house to extra danger because, according to the ignorant, it "attracts" lightning in the summertime.

Let's get this thing straight right here and now. This superstition is not only an evidence of ignorance, but it is really a statement which is just exactly the opposite of the facts.

It cannot be stated too emphatically that, on the contrary, a properly installed and grounded aerial is the best protection against lightning that science has yet evolved.

I am showing on this page a number of sketches which will give a fairly complete and comprehensive idea of how an aerial should be installed to meet these conditions. Let us take this aerial installation up first and then discuss the matter of lightning.



KEYSTONE ARRESTER

Running up and down each side of this page you will see two poles which represent the aerial mast. On the left hand side, at the top, you will see marked A a pulley which is fastened permanently to the top of one mast. The halyard or hoisting rope for the aerial runs through this pulley. Nothing is better for this hoisting rope than window sash cord and this can be bought at any store dealing with house furnishings or hardware.

BRACH ARRESTER

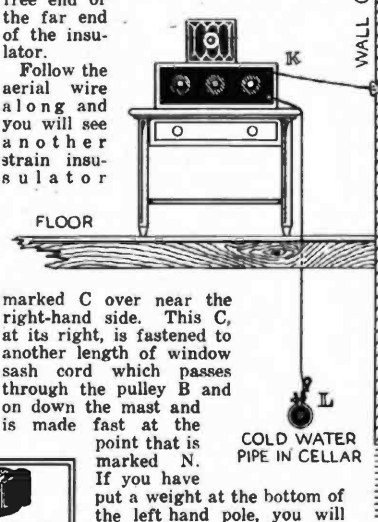
Down at the bottom of the pole on the left hand side you will see that this window sash cord is fastened to the pole at the place marked M. As a matter of fact, it will be very much better in all cases not to fasten this halyard at this point, but to hang to the halyard a heavy weight or a bucket of sand which will be sufficiently heavy to keep the aerial pulled taut all the time. The advantage of this is that when strong winds blow in either summer or winter and put a dangerous strain upon the aerial, so that, if everything were made fast, something would have to break, this weight will be lifted and the halyard will run through the pulley at A and as soon as the strain is off, the weight will pull the aerial taut again. In other words, it acts as a spring and any undue strain will simply pull the weight up instead of breaking something and as soon as the strain is over the weight will naturally drop again and the aerial will stay taut. Such a weight should be on only one side of an aerial installation.

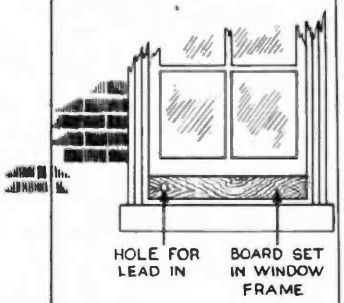
KEYSTONE GROUND FITTINGS

The upper end of this halyard is tied through one eye of the strain insulator marked B. The other eye of this strain insulator has the free end of the aerial passed through it and a knot is tied so that this is a permanent connection at this point. This B is the free end or the far end of the insulator.

Follow the aerial wire along and you will see another strain insulator marked C over near the right-hand side. This C, at its right, is fastened to another length of window sash cord which passes through the pulley B and on down the mast and is made fast at the point that is marked N. If you have put a weight at the bottom of the left hand pole, you will not need a weight at this point and the halyard can be made fast. It does not matter at which pole you put the weight just so long as you use it to relieve the aerial of the strain in windstorms.

Now let us go back to the insulator C. Before the aerial is hoisted, the length of it is laid out on the ground and the aerial wire is passed through the eyelet at C and the two sides are wrapped around with string or another strand of wire so that the wire from C on down to the lightning switch is simply a continuation of the wire from B. In other words, you have one continuous wire beginning at the insulator B on the left, passing through the eyelet of C and on down to fasten to the insulator at E and then on down until it ends by being held fast under a screw head of the switch-blade at G. Both at C and at E it is merely passed through the eyelets of the insulators and is bound fast with string or another piece of wire.

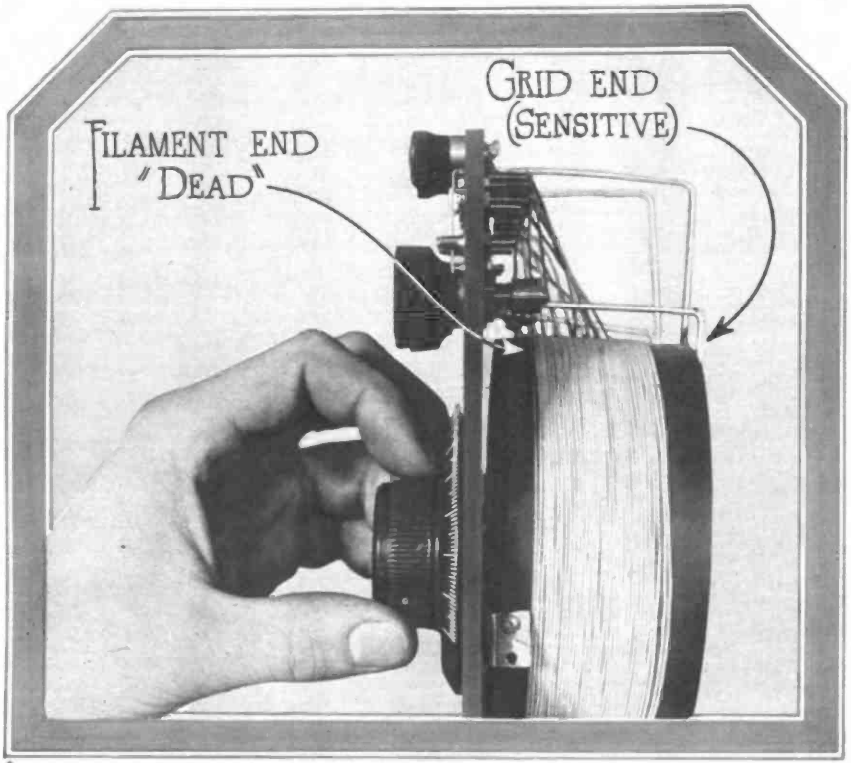




The insulator E, which is fastened to a hook in the wall at F, is merely to keep the wire tight from E up to C in order to keep the aerial and lead-in from swaying in an ordinary breeze. The wire can be loose from E down to G, as this will be only a short length, but it must be kept well away from all walls. In fact, your down-lead from the aerial must never be nearer than one foot to any wall or roof. This is an important thing to remember, as walls and roofs absorb a great deal of the energy which is caught by the aerial.

At G we have the ordinary type of lightning switch. The law does not absolutely require this, but does require a lightning arrester or protective gap, as it is sometimes called. Whether the law requires a lightning switch or not, take my advice and be sure to install one and when you are not using the set, always have the switch-blade

(Continued on Page 32)



The coils are correctly mounted when the end which connects to the grid or grid condenser are farthest from the panel. The effect of the hand is not exerted on the front end of the winding since it is at ground potential

FIGURE ONE

Don't Shield—Wire Up Correctly

HERE'S an article that will solve the difficulties of nine out of ten radio novices. Don't you hate that annoying hand capacity effect in your set? Don't you feel like saying things you ought not to when, as you take your hand away from the set after tuning in an elusive distant station, you lose the signal entirely and find that you have to keep your hand up against the dial in order to retain it?

You have, of course, been told that you should shield the panel of your set. Here, however, Mr. Foote shows that shielding is a cumbersome and unscientific method of doing away with this trouble. He shows you what you ought to do and what you should have done in the first place.

Read this article; it is one of the best that we have had.

H. M. N.

By BRAINARD FOOTE

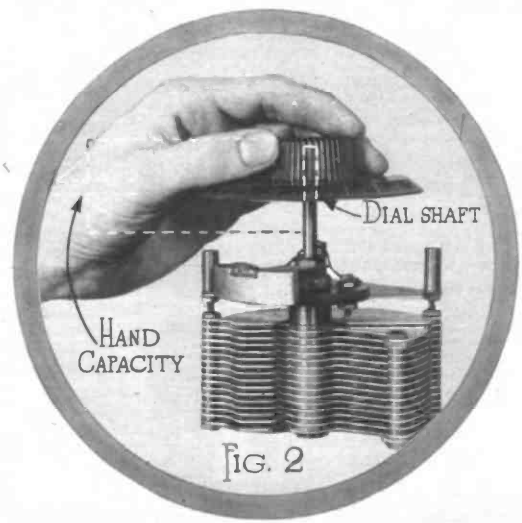
IN THE old days we used to do a good share of the tuning by holding one hand in the air somewhere near the front of the radio set and waving it back and forth to get the "squeal" near the point of silence and to hear the words and music from a far-off weak fellow. This "vernier" tuning method became objectionable, as it was not a sure plan unless one's hand was as steady as a rock. Therefore various schemes arose whereby "hand capacity" was to be done away with.

The most common recommendation was that of shielding the back of the panel. A large sheet of tin-foil or sheet copper was cut to the proper size and fastened in behind the instrument board. Then came the laborious process of fitting the sheet around the shafts so these wouldn't touch the shield, and of cutting holes for the mounting screws of condensers and other tuning devices. And when the shield was completed and the set again put into operation, it was found that the hands still exercised no small amount of tuning effect and that, while less serious than formerly, hand capacity remained in considerable degree as an annoyance. What was wrong? Merely some unintentional errors in the mounting of some of the tuning instruments to the panel and the improper wiring of the others.

The answer to the mounting question is to be found in the fact that all points in the receiving set are not equally sensitive to the proximity of some part of the human body. This may be easily verified by any one.

Merely touch the finger to different wires in your set, and you will discover that while this causes howls and squeals in some places, completely tunes out a station when your finger is upon other wires, there are a good many points where your finger causes hardly any change in the reception.

Obviously, then, it would seem advantageous to keep these "sensitive points" in the background, and to place only the "dead points" near the front panel, where the hands are likely to approach. A radio re-



Illustrating hand capacity with the variable condenser. The dotted fixed condenser indicates the capacity of the hand with respect to the shaft of the condenser

ceiver assembled with this distinction in mind may be handled at will, and no detuning worth mentioning will result when the hands are pressed against any dial or any part of the panel.

While on the subject of shielding versus mounting, let us consider whether or not shielding is detrimental in any way. In the audio amplifier, where shielding isn't of any use any way, the shield can cause no trouble, for there are no radio frequency currents flowing. But there are radio frequency currents flowing in the tuning instruments in which the detector or radio frequency amplifier tubes are concerned. Assume that there are two condensers and related tuning coils of a radio frequency amplifier placed about four inches apart, with their coils carefully put at the prescribed angle where inductive coupling is eliminated. Then we perhaps place a shield between the condensers and the panel. Aren't the two condensers in close "capacitive" relation to the shield, and through the shield to each other? This fact constitutes another serious objection to the shield. And even in a plain regenerative circuit, a shield may cause unwanted capacitive feed-back between grid and plate circuits.

Tuning instruments should be considered separately in studying them for the best method of connection. Let us take up the coil first. Figure 1 illustrates a tuning coil, tapped also, and shows how near the hand may come when a condenser or other dial is being manipulated. The coil has one end connected to the grid condenser and the other end to the positive side of the filament circuit. If the end which goes to the grid be placed next to the panel, it will obviously be easy to bring the hand close to the grid end, and the grid is the most sensitive point in the whole receiver.

The body has a certain capacity with respect to the earth, which is in turn electrically connected to the ground post of the set and to the filament wiring. Therefore, when the hand is brought near the grid end of the coil, the effect is the same as though a small condenser were connected in shunt to the coil. Naturally the wave length of the circuit goes up. Hence we must keep the hand AWAY from the grid end of the winding.

The coil of Figure 1 is connected in circuit in such a manner that the grid or sensitive end is at the back and at a distance from the hand.

Similarly, the hand comes near the inductance switch and hence very close to its metal shaft, which extends well up inside of the knob. Following the same line of argument, we can realize the necessity for connecting the inductance switch on the filament or "dead" side of the circuit, and having the grid end connected to one of the taps.

In a single circuit set, the inductance switch should always connect to the ground for this very reason.

Now then, we come to the variable condenser—one of the most prolific causes of hand capacity effects. In Figure 2 the ease with which hand capacity troubles may occur despite panel shielding is clearly illustrated. The dotted fixed condenser symbol represents the capacity existing between the shaft of the condenser and the hand. Note how far into the dial the shaft of the condenser projects and how close the hand may then come to the shaft. Of course, the rotor plates are directly connected to the shaft and for this reason the rotor plates of a variable condenser are more sensitive to hand capacity than the stator plates.

The variable condenser should always be connected with its rotor set of plates on the filament or "dead" side.

Now the fixed plates, since they go on the grid or sensitive side, may be affected by hand capacity. Hence the further away the fixed plates are, the less will be the hand capacity effect. The very best type of condenser, from this point of view, is one in which the end plate is of metal but not connected to the fixed plates at all. This end plate is grounded to the filament circuit and thus to the rotor plates.

To insulate the ordinary variable condenser from the capacity of the body, a circular sheet of aluminum, tin-foil or brass is cut to a diameter somewhat greater than that of the fixed set of plates, and having a hole in the center slightly larger than the shaft. This is tacked or glued to the panel, or held there by a screw and nut, and the sheet is grounded by a wire running to the filament circuit. Many manufacturers employ such a shield in their apparatus. Let us proceed now to the combination of coils and condensers in a receiving set. Figure 3 illustrates a sample outfit in which the tuning coils for grid and plate circuits are placed outside of the tuning condensers. The photograph shows with fair detail just where the connecting wires are placed, and combines the suggestions of Figures 1 and 2. Incidentally, this is the set built to illustrate my article on short-wave reception published last month in this magazine.

In mounting any tuning apparatus, the ideas contained in Figure 3 should be adhered to in order that the adjustment will not be upset by the (Continued On Page 29)

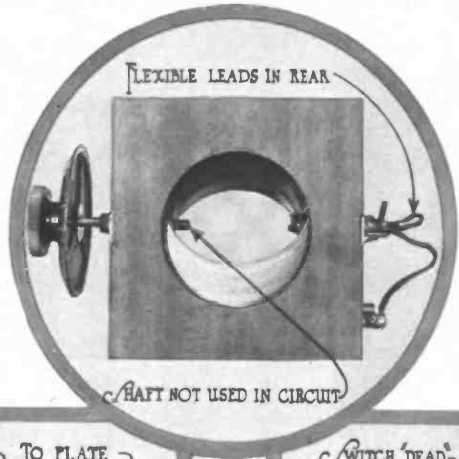


FIG. 5

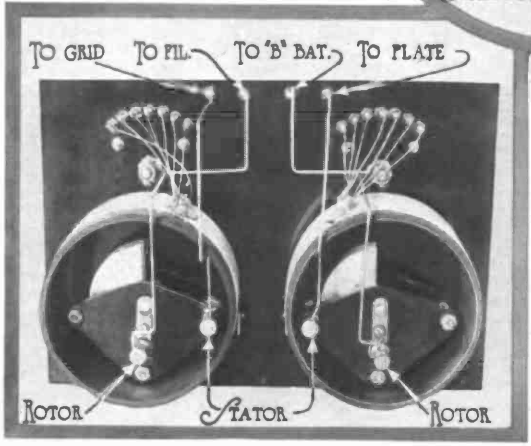
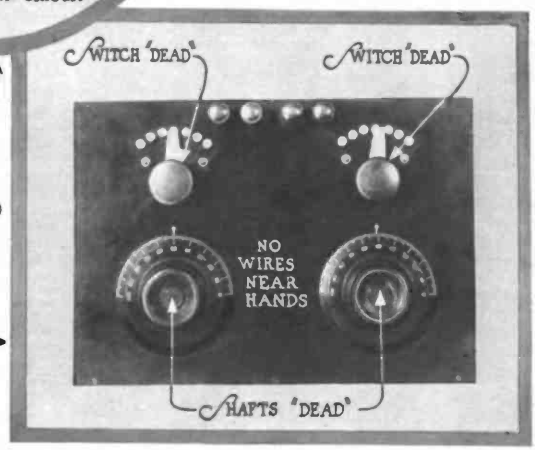


FIG. 3

FIG. 4



Rear view of the tuning circuits of a tuned plate receiver made for short wave lengths, where hand capacity is a serious objection. Note that all the "sensitive" points are at a distance from the panel

Front of the set shown in Figure 3. The only sensitive points on the panel are the two outside binding posts at the top, and the hands do not come near them. The switches are on the "dead" side, too

Circle—This type of variometer is not troubled by hand capacity. The front shaft is not a part of the circuit, and the rotor leads come out at the rear

WJAZ The Link With the Frozen North

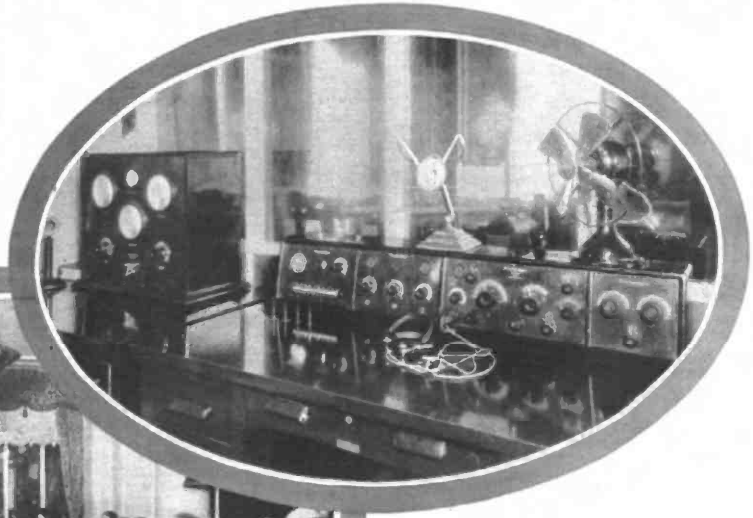
By N. A. FEGEN

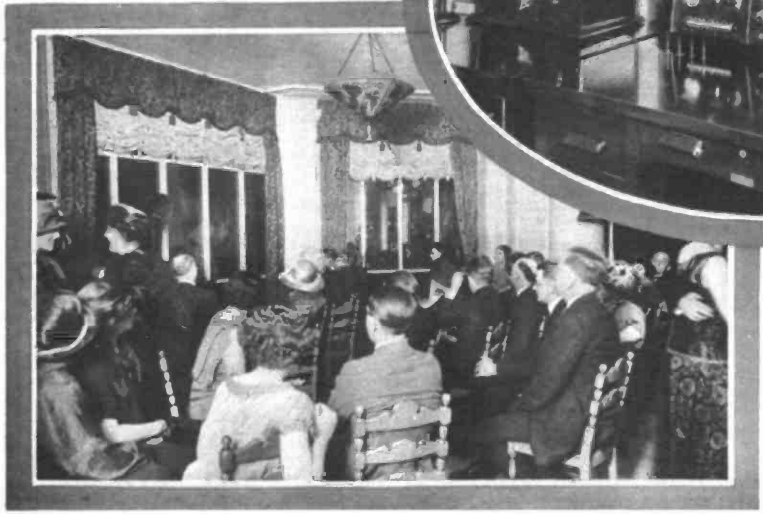
THE Chicago Evening Post said of Station WJAZ, "It is very much in the public eye. It fills the eye and the mind and the ears, too, for that matter, of Chicagoans, because it is such a powerful station that only a small percentage of receiving sets can tune it out and pull in other stations while it is on the air. It is in the public eye, ear and mind of the great outside world, for the very reason that makes it a subject of much adverse comment locally—because it can be heard everywhere and anywhere, when other stations refuse to 'come in.'"

Station WJAZ, the Zenith-Edgewater Beach Hotel, exercises its dominion of the air from its stronghold a few miles north of the heart of Chicago, where it rears its brick and mortar self majestically and high up in the air, and peers with friendly window eyes in all directions.

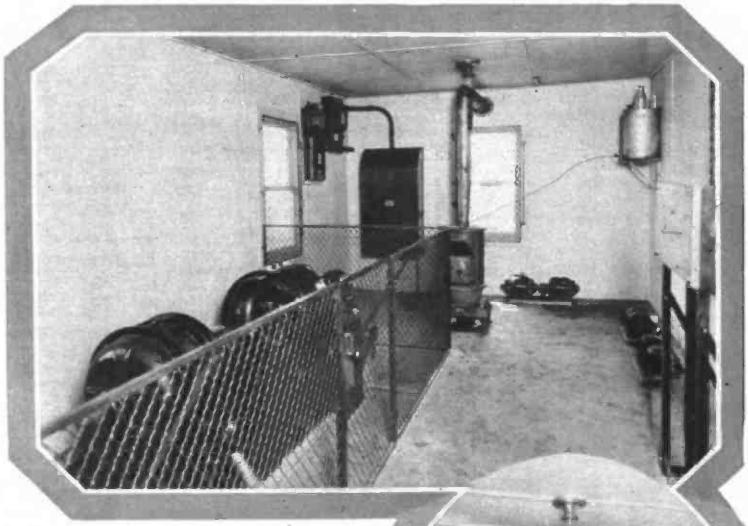
It is right at the lake with the watery expanse of many miles to the northeast, east and southeast. No obstacle to radio in these directions. And whatever the interference on the land side, it is slight, because, as has been said, the hotel holds its head high above its neighbors.

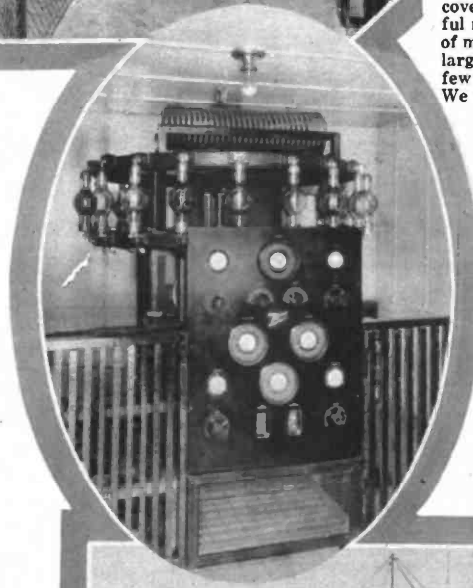
Alongside the lake, which some one has called "the ballroom of the winds," one might imagine it subject to varying moods of these servants of the weather. Whether soft winds fan or strong winds buffet, whether its environment is peaceful or stormy, Station WJAZ remains undisturbed—pleasant and kindly. From its Crystal Studio issues music and song and entertain-





At the top is a view of the beautiful Crystal Studio of Station WJAZ, Edgewater-Beach Hotel, Chicago, Ill. The oval shows a portion of the operating room with the apparatus used in the broadcasting of their programs. To the left is the Crystal Studio as seen from the Colonial Room of Station WJAZ





Above is a view of the generator room. To the right is the transmitter and at bottom of the page is the antenna of Station WJAZ

ment to beguile the leisure of millions of radio fans who depend upon its daily ministrations. Its influence extends thousands of miles in each direction. It is one of the greatest sources of entertainment in the world.

When, during the Chicago Radio Show, a listener's vote was taken by the three largest Chicago stations to determine in what degree the different kinds of radio entertainment were desired by the radio public, Station WJAZ polled 170,699 votes out of a total of 263,410. There were responses from every State in the Union; from ships at sea; from Central America, South America, the Yukon and Eskimo Land, and now one from Mr. Roberts, the American Vice Consul at Samoa, 7300 miles away—twelve degrees south of the Equator, in the Western Pacific.

Every Wednesday at midnight Station WJAZ sends word to Dr. Donald B. MacMillan of the North Pole—but that's a little ahead of this story. Let us first get a close-up of Station WJAZ. The MacMillian episode will come later.

Let's walk through the 200 feet of sand on the north of the Edgewater Beach Hotel to the low roofed building hugging the waterfront and housing the electrical apparatus of the station. And then let us go through the beautiful crystal room where the artists sing and play and speak to the unseen audience of 15,000,000 people.

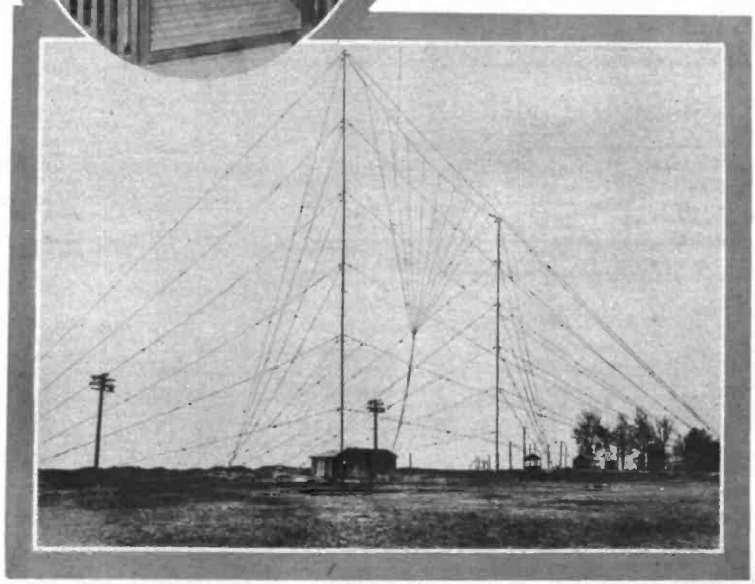
WJAZ is owned and operated by the Zenith Radio Corporation, makers of Zenith receiving and transmitting apparatus. As far as the location of the station is concerned, there is nothing left tobe desired. It is away from the gridiron of downtown buildings, whose metal and electricity tend to rob radio of its energy, and from which the other Chicago stations are struggling to escape.

No expense on labor was spared in the equipment or in the installation. A glance through the building where the mysterious looking apparatus is kept under close surveillance, and another glance through the studio, will establish the fact that the idea back of it all was not how little to spend on the station, but how to make it excel.

On the way to the detached building, 500 feet north of the hotel, where the energy of Station WJAZ is stored, and set in motion, one's eye is attracted by the oddly shaped antenna reaching high upward in all directions and looking for all the world like an immense web of which the spider is the building at the lower end. There are nine wires, each 130 feet long, suspended high in the air.

Inside the building, one expects to find machinery in size and complexity to equal the mammoth newspaper printing press. It is not a little surprising, therefore, to discover outside of the very large and powerful motor generator, a rather simple layout of mechanical contrivances. There are some large vacuum tubes and a few cables and a few pieces of peculiar looking machinery. We don't know what these mechanical devices are called and our guide does not volunteer any information. When we make bold to ask him, he explains in involved radio terminology altogether unintelligible but serving the purpose of putting a stop to further questioning for the time being.

But there are a lot of interesting pictures on the wall, bearing testimony to the strange history of the evolution of radio and of Station 9ZN, the alias of WJAZ, but really the first call letters by which the station was known. The buzz and whir of the motor is all the external evidence of the functioning of the station. One wonders how in the world the simple equipment can send radio waves a half dozen times around the globe in the short space of a second. (Continued On Page 30)



You Can Suppress *that* Interference

NOTHING is more important to the average broadcast listener of today than the development of some device which will really eliminate most of the interference which so constantly spoils our reception of programs. Out at Station 3XP we must have tried out at least fifty "wave traps" in a long continued attempt to find just the device that we were looking for.

For the last six months or more, almost every radio magazine and every radio section of a newspaper has been full of different diagrams for this purpose. We have tried out every one that we have seen and have still not been satisfied.

Last month I received a letter from Walter D. Fuller, secretary of the Curtis Publishing Company, which offered me a new idea and upon trial we immediately found it to be by all odds the best interference eliminator that we had used. Mr. Fuller's letter follows:

My dear Mr. Neely:

I had a radio experience lately which may be of interest to you. I have a home-built neutrodyne set using the Freed-Eisemann hookup, which is exceedingly satisfactory. I have, however, had trouble in separating New York from Philadelphia stations and in separating the 360-meter stations. Therefore I recently tried a wave trap as sketched on the reverse side of this sheet.

This assisted materially in relieving the situation, but it accomplished two other things which are of even more importance.

I had found it impossible to tune in stations under about 300 meters due to the length of my antenna, yet I did not like to reduce this length because it decreases the volume of signals. I tried two antennas, one short and one long, but found that when the set was neutralized for one it would squeal on the other and vice versa.

Then I tried a condenser in the antenna lead and also in the ground, but this also caused a squeal unless specially adjusted. It also decreased the volume of signals materially.

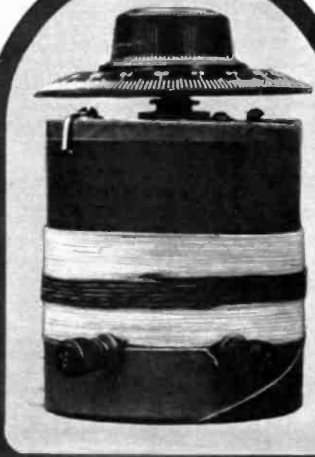
The use of this wave trap makes it possible for me to go down below 200 meters with no squeal. It also seems to assist in the balancing of the set and makes it much more satisfactory. It seems to take out some of the extraneous noises.

The trap itself is not new, of course, but I had not heard of its application along the lines mentioned before and thought you might be interested.

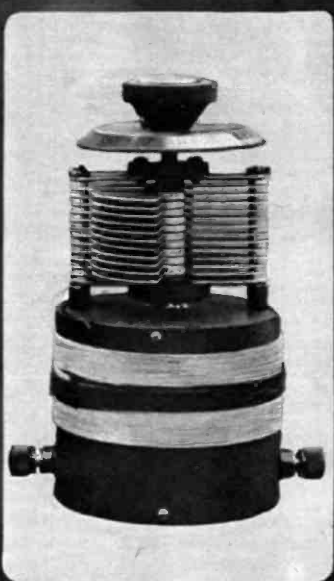
The fifty turns are wound on a bakelite tube three inches in diameter with No. 22 double cotton-covered wire. The six turns are single flexible lamp cord and are wound directly on top and in the middle of the fifty-turn coil.

Very truly yours,
WALTER D. FULLER.

This wave trap as given by Mr. Fuller might be called a "suppressor" or "silencer." It will almost entirely suppress or absorb signals on one certain wave length at one certain setting of the condenser and it can be accurately logged so that you will know exactly where to set the dial to suppress KDKA or KPO or WOAW or WJAZ or any of the other stations.



Above is the wave trap as we made it with the Rathbun condenser and container. The photograph shows clearly how the forty-five turns of cotton-covered wire were wound on first and the six turns of the large stranded wire were wound over top of it



Another form of the wave trap spoken of in this article. Here the variable condenser is mounted high above the coil so as to be kept away from the magnetic fields

It suppresses only one wave length at a time and has no effect whatever upon any of the other wave lengths when it is set at that particular adjustment.

I am not giving the usual schematic diagram of this set because the trap is so simple as to make a diagram unnecessary. Mr. Fuller used fifty turns of coil around a three-inch tube and used a 43-plate condenser.

It just happened that we had no tube exactly three inches in diameter in our laboratory and so we hunted around for the nearest size to it that we could find. I also wanted a tube of such a size that I could set a variable condenser in it, and, in looking around on our shelves, we ran into an interesting combination.

We found on our shelf a Rathbun 23-plate condenser in its original round pasteboard box. It struck me at once that this was the ideal combination, because the box itself made the form or tube around which the coils of wire could be wound and the condenser could be mounted through the bottom of the box. This Rathbun condenser requires only one hole for mounting and so the entire combination made an ideal wave trap.

This condenser box is three and one-half inches in diameter and so we put on only forty-five turns of the No. 22 double cotton-covered wire.

Just here let me explain one feature of the wave trap which we stumbled into and which was new to me. I have seen many hookups showing a variable condenser set entirely inside of a coil of wire and have read that it made no difference. On an ordinary receiving set perhaps it does not make a difference, but we found if the condenser in this wave trap was entirely surrounded by this coil it did not work. The condenser had to be set outside of the core. In other words, while the coil can be wound around the box, the condenser plates must not be directly surrounded by the wire.

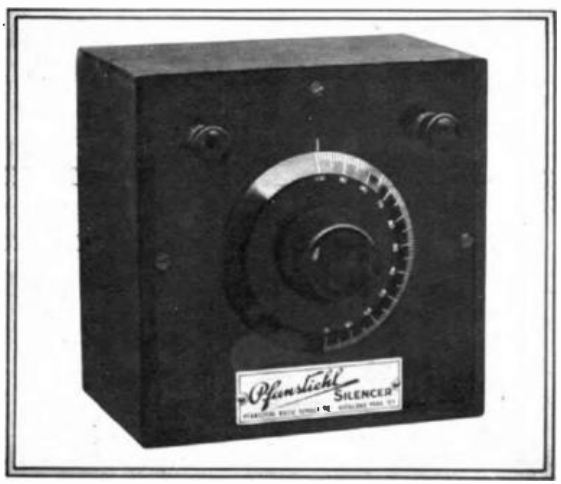
We made this wave trap up in the two forms shown in the accompanying photographs. One of them shows the condenser set on top of the coil and the other shows the whole thing inclosed in the Rathbun box, but even in this inclosed form, the plates of the condenser do not go down far enough to be surrounded by the wire. Both of these forms are thoroughly efficient and the experimenter can try either one that he wants.

The first thing to do is to wind on the forty-five turns of No. 22 double cotton-covered wire (or fifty turns

f you are using a three-inch tube) and to make the two ends fast in the most convenient way possible.

With the condenser mounted, the two ends of this coil are soldered to the two connections on the variable condenser. This combination of coil and condenser is not connected to anything thereafter. It is absolutely separate and apart from all of the rest of your radio set. This part is really the trap. It admits signals of a certain wave length, depending on the setting of the variable condenser, and when these signals are brought into it they simply run around and around like a squirrel in his revolving cage, but they do not get anywhere.

In the middle of this coil we wound on six turns of a silk-covered stranded flexible copper wire and the two ends



The Pfanstiehl "Silencer" is a commercial form of interference eliminator which works much as does the apparatus described in this article. Naturally, this commercial form is much better looking than home-made apparatus can be.

of this wire connected to the two binding posts shown in the picture. The aerial lead-in is connected to one of these binding posts and a wire runs from the other binding post to the aerial binding post on the receiving set.

Now let us see what the action is when this wave trap is in use.

You know that signals of all wave lengths are captured by the aerial and brought down through the set into the ground. Let us assume that the trap part of this outfit or the forty-five-turn coil and variable condenser are tuned to 326 meters. All of the different wave lengths then pass around the six turns of heavy wire but the signals which are on 326 meters are immediately absorbed by this wave trap and run around it without getting back again into the aerial. Consequently we have eliminated this 326-meter signal entirely from our set.

Let us suppose that we are listening in at Delanco, N. J., and we want to tune in WGY at Schenectady on 380 meters, while WDAR, right near us in Philadelphia, is broadcasting on 395. WDAR is an extremely powerful station and is quite close to us and so under ordinary conditions it is extremely difficult to tune them out to get clear reception from WGY.

With this wave trap, however, we simply turn the dial until it is at 32 on the pointer. This makes WDAR so weak as to be scarcely audible. In fact, even when we have our neutrodyne set tuned correctly for WDAR, we can almost suppress it by turning this one dial on the wave trap.

The way we use it, however, is to tune in WGY at its loudest without paying attention to the interference from WDAR and then, with WGY coming in as well as possible, we turn the dial of the wave trap until we have suppressed WDAR entirely and then make a slight readjustment of the tuning elements of the receiving set.

We find that any station will come in at maximum strength when the wave trap is just below or just above the point at which it would totally eliminate that station. The point of elimination is a very fine one and only two or three degrees on the wave trap dial will take you from maximum to minimum on any station.

We used a 23-plate condenser instead of a 43-plate, but we find that this combination works better on the lower wave lengths than it does on the higher, so I am inclined to think that Mr. Fuller's plan of using a 43-plate condenser is better. If you do not happen to have such a condenser, however, but do have a 23-plate, you will find that the combination will be extremely valuable and will do almost everything that you want it do.

Recently we have put two of these traps in series in the aerial lead-in and this makes the selection even sharper, though it does, of course, give an extra control.

Dance Orchestras Keep Up to Date by Radio

ONE of the newest adaptations of the use of radio in every day life is that to which Harold Gieser, of Buffalo, puts a Federal six-tube set. Mr. Gieser is director of the Vincent Lopez Dance Orchestra at the Hotel Statler, Buffalo.

It is necessary for the orchestra which Mr. Gieser directs to work in close relation with Vincent Lopez wherever he may be playing and also with the Vincent Lopez Orchestra at the Hotel Pennsylvania in New York. Mr. Gieser's living quarters are on the fifteenth floor of the Hotel Statler at Buffalo and he installed this set for the purpose of listening to the work of Mr. Lopez while out of Buffalo and also listening to the latest in orchestrations put on at the Hotel Pennsylvania to the end that they may be instantly adopted by the orchestra which he directs in Buffalo.

Mr. Geiser conceived the idea of using radio in this way when he first came to Buffalo and happened to hear Mr. Lopez, then in a theatrical engagement in New York, play a new arrangement. He was almost instantly able to adopt the arrangement in Buffalo, with the result that his orchestra was playing the latest New York orchestral arrangements by one of the country's favorites within twenty-four hours after the arrangement was played in public on the stage.

On March 11, Mr. Lopez, then playing at Keith's in Philadelphia, broadcast from station WIP a new arrangement. Mr. Geiser and his men heard it by radio and the next night played it in Buffalo.

"I frequently call the members of my orchestra to listen to other orchestras," said Mr. Geiser. "One night, for instance, we noted exceptionally good rhythm from the Henry Hoskins Orchestra, playing in the Garden Room, St. Francis Hotel, San Francisco. It was an especially fine piece of work. I immediately conferred with my banjo and drums men to duplicate it here.

"Almost daily I call certain individuals of the orchestra to listen in for certain parts, either new arrangements or unusually good performance of the orchestra at the Hotel Pennsylvania. Radio certainly has been a great aid to us in giving Buffalo up to the minute music in the best possible manner."

With only four tubes of the six-tube set in use at the present time, Mr. Gieser gets Chicago, and even west coast stations clearly. His antenna is strung from cornice to cornice between two wings of the Hotel Statler, which is three floors above his apartment. He is troubled little by interference or local disturbances.

He mentions the orchestra at the Edgewater Beach Hotel, the Clyde Doerr Orchestra, "The Early Birds from Kansas" and music from stations at Davenport, Ia.; Elgin, Ill.; Cleveland, Louisville, Cincinnati, Pittsburgh, as well as all of the eastern points, which he listens to frequently. One night within five minutes he studied orchestrations from Cleveland, Chicago, Cincinnati and Louisville with equal clarity.

Harold Gieser and members of the Vincent Lopez Dance Orchestra at the Hotel Statler, Buffalo, in Mr. Gieser's apartment on the fifteenth floor of the hotel, listening to a new arrangement of a dance number being played by the Vincent Lopez Orchestra at the Hotel Pennsylvania, New York. Mr. Gieser stands immediately back of the receiving instrument in the center

Goodreau's Spiderweb Portable Set

(Continued From Page 18)

mount the tube socket in position shown. The socket used in this set was a Workrite, but any good socket of this type, such as Na-Ald, may be used. I have used a UV199 tube in this set as shown, but any tube may be used if desired, but you must change batteries to suit.

Now we will mount the base to the panel. This is done by means of small brackets, one on each side of the

panel, being fastened to panel and base by small screws and nuts.

We are now ready to wire the set. Before we start this wiring I wish to ask you to pay no attention whatever to the wiring as you see it in the pictures. These pictures are given to guide you in mounting the parts in their proper places, and it is almost impossible to trace the wiring in the pictures. Follow the pictures in mounting the parts, and the wiring diagram when you wire the set. Then you will be sure of success.

First we will wire the tickler coil, which is the 100-turn coil. One end of this coil is connected to the post marked P on the tube socket, the other end is connected to one phone binding post. From the other phone binding post we will also connect a wire and this wire will go to the post on the B battery marked 22½ plus.

Next we will wire the twenty-turn coil. One end of this coil goes to the ground binding post, the other end goes to the antenna post nearest the ground post, or the lower of the two posts in the upper left-hand corner.

We are now ready to wire the last coil. Connect a wire from the upper antenna post to one end (the outside end) of this coil, and connect a wire from there to the stationary plates of the variable condenser; from there it goes to one side of the grid condenser and leak. The other side of the grid condenser and leak is connected to the post on the tube socket marked G.

Now the tap which was taken after twenty turns had been wound on this coil is connected to the rotor plates of the variable condenser, and from there connect a wire to the positive A battery and from the positive A connect a wire to the negative B battery. The A battery in this case for 199 or 299 tubes is the ordinary Eveready C battery, but we are using it as an A battery.

Now connect a wire from the negative A battery to the center post on the rheostat and another wire from the other post of the rheostat (the one on the left looking at set from rear) to the post on the tube socket marked F.

From the other post marked F a wire leads direct to the positive post of the A battery.

This completes the wiring. Check it up now and make sure everything is O. K.

Having made sure that all wires are in their proper places we are now ready to test the set and see how it is going to work. Insert the tube in the socket and connect the batteries and phones to the set. Next either connect antenna and ground or antenna alone to the set.

If you use antenna or ground alone connect them to the upper binding post on left-hand side of panel. When using both antenna and ground, the antenna should be connected to the middle binding post and the ground to the lower binding post.

Now turn on the rheostat about half way, and rotate condenser dial slowly until signals are heard. You will hear a whistle when you strike a wave, as you will on any regenerative set. Then turn condenser dial until the whistle is as loud as possible, then decrease the filament voltage by turning down the rheostat, which should clear the signals.

This is a very simple set to construct and operate, and no trouble should arise in building it. However, if it should arise, you will find that I shall be most willing to help you out.

I would be glad to hear from all of those who construct this set and would be very much interested in the results they get with it. I think it will please you and I hope you will find it to be what I claim it is—a real portable receiver.

proximity of one's hands. These suggestions are:

1. Connect rear end of tuning coil on grid side.
2. Connect fixed plates of condenser on grid side.
3. Connect inductance switch on filament side.
4. Keep all grid wires several inches behind the panel or away from parts of the panel near which the hands come.
5. Apply suggestion No. 4 to leads running to the plate circuit.
6. Keep rear end of tuning coil for the plate circuit connected to the plate.
7. In condensers tuning the plate circuit, connect fixed plates to the plate terminal of the socket.

The photo of Figure 3 is a rear view of the 100-meter receiver described in the last month's issue, and is of a tuned plate receiver. This accounts for the similar tuning arrangements for the grid and plate circuits. It is interesting to note the gradual increase in hand capacity sensitivity of a tapped inductance coil. Any one using a single circuit set with five or six taps may instantly tell which is the grid end of the circle of taps by touching his finger from one to another. At the filament end the effect is slight, and, by the way, the test should be made with the filament switch set to include all the turns on the coil. As the finger is progressively touched on taps getting nearer to the grid end, the tuning is upset more and more, until at the grid end it is possible to tune a station out by merely touching this tap.

However, since the hand need not come within an inch or two of the grid taps, there is no need of placing them in behind the panel.

And in the connection with the wiring of the entire set, it should be pointed out that a phone condenser should always be used where the phones are in series with a circuit in which there is radio frequency current present. Not only does this reduce the amount of radio frequency "juice" which gets into the phone cords, but it makes regeneration more easy to obtain.

Don't Shield—Wire up Correctly

(Continued From Page 21)

Even where the detector is non-regenerative, as in a Neutrodyne or other radio frequency receiver, a certain amount of radio frequency current gets into the plate circuit of the detector tube. Hence a phone condenser is essential in these also.

Where no phone condenser is employed, it is usually possible, nevertheless, to make the receiver oscillate and the radio frequency current flow across the small capacity formed by the parallel phone cords. The cords act as the two plates of a fixed condenser. The objection to this lies in the fact that radio frequency currents get nearer to the body and as a result hand capacity is much more pronounced when the phone condenser is omitted. In a set using two stages of audio amplification in addition to the detector, the phone condenser should be placed across the outside springs of the detector jack.

It is important to remember, however, that the "ultra-audion," or its popular variation, the Gibbons, will not function with a condenser across the phones in a single circuit.

Turning our attention to the exterior, let us see how well we have reduced hand capacity effects. See Figure 4 for this view, and let it represent *any* set in which coils and condensers are used for tuning.

In the first place, we have connected the condensers so that their rotor plates are "dead" to hand capacity.

We have next connected the coils so that their "dead" ends are nearest the panel.

Moreover, we have placed the inductance switches on the "dead" side of the circuit and removed the binding posts from the lower edge of the panel, where the nearness of one's wrists might affect the sensitive posts.

The particular model shown has outlet posts at the top because the detector and amplifier are placed on a shelf above the set itself.

However, the best position for aerial, ground and battery binding posts is on a strip of hard rubber or other good insulating medium placed near the back of the cabinet.

This not only keeps the sensitive points away from the body, but eliminates straggling wires from defacing the front of the receiver. And with suitable precautions to keep *all* leads running to the grid or to the plate of *every* tube in the set spaced at least three inches in back of the panel, it will be possible to lay both hands on the panel or on the dials without upsetting even a very faint DX station which is tuned in with accuracy.

Certain special tuning instruments should also be connected in the light of the preceding suggestions. In Figure 5, for instance, is shown the best type of variometer to select—the particular feature indicated being the manner of making contact to the inner coil. Where ball of the variometer is electrically joined with outside binding posts at the rear of the instrument by two flexible wires passed through a hollow shaft into the center, the hand capacity will be very slight. By this is *not* meant a shaft which runs all the way through and has merely a cut in the side to allow the leads to come out into the center of the variometer ball, but there should be two separate shafts as illustrated. Otherwise there will be a series-capacity effect from the hand to the shaft and from the shaft to the wires inside of it.

Should a variometer of the ancient type be in use and it be discovered that both shafts are employed for conveying the current in and out of the ball, the hand capacity may be minimized by connecting the outer wire from the rotor on the grid side and the shaft which protrudes through into the dial toward the filament side.

No hand capacity is experienced with the variometer of Figure No. 5 unless the shaft happens to make contact with one of the wires accidentally. Such instruments are being produced by the manufacturers of better grades of apparatus.

In wiring any type of receiver, the filament circuit should be grounded with the possible exception of a loop receiver. Should the loop set be grounded in this way, the tuning is slightly broadened and the directional characteristic less noticeable. However, unless in the heart of several broadcast stations, best results will be secured with the loop circuit's filament grounded as well. It makes no difference whether the positive or the negative is grounded, but it is most convenient to ground the side to which the first grid return is connected. In the case of a simple detector set, this will be the positive, while with the

loop receiver and other types of radio frequency equipment, it will be the negative.

Not only does this method of decreasing hand capacity result in far less troublesome tuning, but results are almost always better, inasmuch as the sensitive and "dead" spots of the set are not intermingled. Then again, it is more likely that a certain weak signal may be tuned in to a nicety where hand capacity effects do not have to be reckoned with.

WJAZ the Link With the Frozen North

(Continued From Page 23)

Before taking a last look around in that wee little building, we again go over the pictures on the wall. They really are good.

The studio is located in a specially built-in room, a compartment on the main floor of the hotel, back of where the Edgewater Beach Orchestra is positioned. Its walls are of glass, wherefore its name—"Crystal Studio."

Outside the studio one can see broadcasting activity within, but cannot hear except for the Zenith radio sets at the public's disposal. Thus the opportunity of seeing the "scenes behind the stage" is given to visitors.

And when there is a round of applause for a beautiful song, or for well spoken words, the artists within are not disturbed as they are in the usual studio. Inside the crystal compartment absolute quietness reigns, except when some one is before the microphone and music or voice pours forth to be sent upon ethereal waves to the outside world.

The walls and ceiling of the studio are fitted with beautiful heavy drapes of red velvet, which, with the indirect lighting, and the wealth of color combination hidden behind the billowed ceiling, gives the room an atmosphere of refinement and dignity.

The microphones are cleverly concealed from the view of the performing artists, thereby lessening the consciousness that they are singing or playing into an instrument of cold steel.

A wall of heavy triple plate glass separates the studio from the operating room from which the entire operation of the station and studio is controlled. This enables the operator at all times to be aware of the position of the artist performing, insuring the maximum in perfection for the listeners.

The transmitter, located 500 feet north of the studio, is under direct control of the operator by means of an inter-communciating system. A standard radio receiving set is used to listen in so that the various selections may be heard just as the distant listener hears them.

This receiver is very selective, and it is possible to listen in on other stations while WJAZ is in operation. A practical demonstration of this to the audience of WJAZ was recently made, when the signals from KYW were "tuned in" while grand opera was being broadcast by the latter station.

The signals were passed on into the amplifiers of the transmitter by means of a suitable transformer and then rebroadcast on a wave length of 448 meters from the WJAZ transmitter. Telegrams from various parts of the United States were immediately received confirming the strength and clarity of the re-transmitted signals.

To the left of the receiver, shown in the illustration in the same cabinet, is the control panel, where connections are made with the various microphones, and the transmitter amplifier. It is here, also that the receiver is connected to the transmitter for rebroadcasting. On the next desk immediately to the left of the control panel is the line amplifier, where the

output of the microphones or the receiver is amplified several thousand times before it enters the line to the powerful transmitting station to be radiated into space by the big antenna.

In the center of the amplifier is the special modulation meter which indicates the strength of the sound entering the microphone. Whenever the strength is below or exceeds a certain value, compensation is made by means of the two controls also located on this panel.

On the stroke of 12 every Wednesday night a program is broadcast which for uniqueness is unexcelled in the domain of radio. Within 11 degrees of the North Pole a little band of men, as the clock points to midnight, Wednesday, sit huddled together in the forepart of the schooner Bowdoin, "frozen in" for the winter. They are Dr. Donald B. MacMillan and his exploration party on a scientific expedition.

They set out from Wiscasset, Maine, June 23, 1923, in Captain MacMillan's 89-foot schooner, bound for the northermost limits of Eskimo Land. Ensconced in the forward end of the schooner was a sending set and a standard receiving set—not a specially prepared set, no extra tubes, no extra amplification—just the standard set.

It is a great thing for radio, this adventuring into the land of perpetual silence, undoubtedly the greatest from the standpoint of popular appeal that has yet taken place.

At a dinner given Dr. MacMillan, March 21, 1923, he told the true hardship of the Arctic—not the cold, not the lack of food, but the awful silence, so terrible indeed that men go mad because of it. He recalled one expedition in particular when this tragic fate befell a number of the crew and the only way the remainder of the party could get back to safety was to shoot them.

One of the party suggested, "Why in the world don't you take along radio equipment?"

This started Dr. MacMillan on a new line of thought. Two months later, the idea of radio communication had so much appeal to the explorer that he had arranged to take with him the best and most dependable radio for his purpose.

So here they are—Dr. MacMillan and his crew of seven within a few miles of the North Pole. The deck of the boat is covered with snow, to shut out the cold and keep within the little heat it is possible to generate. Stretched between the high masts of the Bowdoin is the antenna wire. The look of expectancy brightening the faces of these men and eagerness with which their eyes are bent on the receiving set in the captain's quarters can readily be imagined. For they are about to get word from home.

And, as they hear a familiar voice, "This is Station 9XN (the experimental call letters of WJAZ) calling Station WNP—Wireless North Pole"—breaking through the white stillness of the Arctic night, they tremble with delight. As often as the proceeding is repeated, Wednesday after Wednesday, the same feeling of uncanniess overpowers them. Wonderful to get word from home once a week!

What a change from the previous trips when each day was a year of loneliness and no word reached them except the trite gossip of the Eskimo. Think of being so completely cut off from communication as not to know about the World War until the return home, three years after the war started. But that was before the advent of radio!

As these men sit and listen, a highly dramatic performance is going on in Chicago, one that is closely related to that stage setting of snow and ice, the Bowdoin covered like a frosted cake, the dreary mast with its orna-

mentation of antenna wire, the men below with the radio set. For ten kilowatts are giving the words of E. F. MacDonald, Jr., of the Edgewater Beach Hotel broadcasting station, wings to carry them to the North Pole region.

Promptly at midnight Wednesday he announces the change of the call letters from WJAZ to 9XN and sends greetings to Dr. MacMillan and the crew. Then he reads to them letters and messages from friends and relatives—messages of weddings, births and deaths; messages of all sorts from home that might be of interest; Dr. MacMillan gets a report from his secretary in Boston; occasionally a friend of the doctor's will make an address. When the personal messages have gone over the air lanes, a resume of the week's news—the interesting and outstanding events of the world—is given. This is the weekly program. Station WJAZ and the radio set in the Bowdoin are the means of this remarkable feat of long distance communication.

WJAZ broadcasts every evening except Monday, which is "silent" night in Chicago. No day programs are rendered, nor is a day schedule of any sort followed, unless some special occasion warrants.

The evening programs, except for Sundays, begin at 10 o'clock and continue until as late as 2 A. M., especially on Saturdays. These consist of popular dance music, popular songs and instrumental pieces. On Sunday there is an earlier evening program of classic and semi-classic music. These are called the "Artists' Programs."

The programs are arranged to give the greatest possible variety of music. From the marine dining-room are broadcast the popular and jazz music played by the Oriole orchestra, one of the smoothest-playing dance orchestras in the country, headed by Dan Russo and Ted Fiorito. The classics, semi-classics and the ballad type of music are "put on the air" from the Crystal Studio, using only the best artists available. These programs are arranged and presented under the able direction of E. Warren K. Howe, musical director of WJAZ.

And, lastly, during the last season WJAZ has had every Sunday the leading grand opera stars from the Chicago Civic Opera Company entertaining at 8:00 P. M., Central Standard Time. In the last five weeks, for instance, we have had Claudia Muzio, one of the leading sopranos with the company; Angelo Minghetti, foremost lyric tenor; Florence Macbeth, one of the leading coloratura sopranos of the world; Virgilio Lazzari, one of the few "Vero bassos;" Myrna Sharlow, dramatic soprano; Mary Fabian, the "Baby Prima Donna," who has become famous with opera patrons through her rendition of the role of "Gretel" in "Hansel and Gretel;" Irene Pavloska, leading contralto with the company.

It is interesting to note also how the public appreciates such talent. Miss Macbeth received over 2600 letters and Madame Pavloska over 3000 responses.

* * *

Mr. H. M. Neely,
Radio in the Home, Phila., Pa.
Dear Mr. Neely:

All records were broken the othe. day when our station, the Zenith Edgewater Beach Station WJAZ, was heard fully 7300 miles away—almost half-way around the earth. At midnight, Central Standard Time, each Wednesday Station WJAZ changes to its experimental call 9XN for the purpuse of broadcasting messages and news to Dr. Donald B. MacMillan and his exploration party aboard the Bowdoin, now frozen in within 11 degrees of the North Pole. Wednesday night we call "MacMillan Night."

On Thursday morning at 1:45 A. M. the regular program was being put on for Dr. MacMillan and his crew and E. F. MacDonald, Jr., of the Zenith-Edgewater Beach Station and president of the National Association of Broadcasters, was delivering the many messages to them from their friends and relatives, together with the news of vital interest to the explorers, who, on previous expeditions, have been entirely shut off from the news of the outside world. At this time, 'way down in Samoa, 12 degrees south of the Equator, Operator Roberts, of the Naval Station VMG, was listening for news from the world abroad when he picked up Station WJAZ and sent the following message to the Director of Naval Communications at Washington, D. C., who, in turn, forwarded it to us:

"Please inform Zenith-Edgewater Beach Hotel Radio Station that Chicago messages and music to MacMillan, North Pole, were received by me at 7:45, Samoa Time, December 19th. ROBERTS."

It is of considerable interest to note that a message intended for Donald MacMillan, now within 11 degrees of the North Pole, should be heard by Mr. Roberts in Samoa, 12 degrees south of the Equator in the western part of the Pacific Ocean.

Cordially and sincerely yours,
S. I. MARKS,
Executive Office,
332 South Michigan Ave.

Lightning Dangerous? It Is Not. Not a Bit

(Continued from Page 10)

over to the side which connects to the earth. Then, when any lightning or heavy static comes, it will be grounded immediately and will not go to the set and endanger it by a possible burnout of the windings of your coils through too heavy a charge.

The lower contact of the lightning switch on the outside of the wall shown in the sketch goes down to a pipe driven into the earth at I. This is the outside or lightning ground, and while it is possible to use the same ground for both the set ground and the lightning ground, I do not advise it. It is much better to take a length of three or four pieces of one-inch pipe, buy the little pipe fittings that are shown in another sketch on the page, a point for the end to help you drive it into the earth and a cap on the top to enable you to drive it down and also giving you a fitting to which to connect the pipe.

The lightning arrester, or, as it is sometimes called, the protective device, forms a permanent bridge between the middle blade of the lightning switch and the clip which leads to the earth. This is done as an insurance against accident in case you forget to ground your aerial when you have finished using your set.

To see how this works, just let us follow a supposed bolt of lightning if it should happen to strike the aerial—though it is virtually impossible for this to happen.

The lightning would go down the down-lead from C to E and so to G, and then would immediately jump across the gap in the lightning arrester through the path shown by the dotted lines and would be grounded at I.

These lightning arresters are the bane of many a radio fan. This is because he has not been particularly careful of the make of arrester that he bought and a cheap arrester is very liable to break down inside, and this break down means a permanent short circuit which will prevent the radio signals from getting into your set, because this short circuit gives the signals a direct path from the aerial to the earth and this path is

easier for them to follow than if they went around the coils in your receiver.

I am showing in two other sketches two of the standard and dependable instruments for this purpose—one the Keystone and the other the Brach. Scientifically made instruments of this kind are the best possible insurance against damage to the set and also against the short circuit which will mean no more signals with a cheap arrester.

Let us now assume that we have our lightning switch in the up position so that the radio signals which are captured by the aerial will be led into the receiving set. They would come down the wire from C, go along the blade of the switch and up and in through the porcelain tube at J. It is this porcelain tube that proves a stumbling block to most men who want to install an outdoor aerial because Friend Wife seems to have an idea that a hole must be bored in the window sash in order to let this porcelain tube come in and she will not have any holes bored in her window sash.

This is not necessary. If you will look at the little sketch of a window shown in the upper right-hand corner of the page, you will find a very simple way to overcome this objection. This merely requires that a board be set into the window frame and the window closed down on it so that

BLACKBURN
GROUND CLAMP

there is full protection against the weather. The hole for the porcelain insulator is driven through this board and the insulator is set in that so that there is no damage whatever to the house.

Inside of the house, the ground connection should run to a cold water pipe in the cellar or in a bathroom on one of the other floors. This lead should be as short as possible. Scrape all of the dirt off of the cold water pipes and be sure that the connection is clean and bright. Then fasten about this pipe one of the standard earth connectors or ground clamps, as they are called, and you are all ready to face the summer without any fear.

Now, in order to explain just why there is no danger of lightning, I am going to take the liberty of once more quoting from a little magazine which I published more than a year ago called E-Z Radio. In the August issue I had an article on lightning and the following excerpts are the important ones from it:

"Several short-sighted manufacturers of lightning arrestors have recently been putting out glaring full-page advertisements in the radio magazines, announcing in screaming big letters "Save your home! Your aerial attracts lightning!"

"Of course, in a series of articles like this it is not incumbent upon me to comment on the tendency that such an advertisement has to scare people out of radio and so reduce, rather than increase, the manufacturers' own market. But it is within my province to dispute the truth of these widely spread statements, and I cannot make one fact too strongly emphatic, and that is this:

"Your Aerial Does Not Attract Lightning. With the Standard Outfit It Is the Best Lightning Protection That Your Home Can Have.

"Let us for a few minutes take up this matter of lightning, what it is and what it does, so far as science knows.

"We have seen in our studies of radio apparatus that a condenser is a series of metal plates divided into two groups placed near each other, but with no electrical connection between the two groups. We have learned that when the plates of one group are charged with positive electricity and the plates of the other are charged with negative, there occurs a state of strain or tension in the ether between them and that this tension will build up to such an extent that it will break down resistance and discharge itself in the form of electricity.

"In radio sets we arrange our circuits in such a way that the electricity caused by the breaking down of this strain is conducted through our wires and used in the production of signals. Just so long as we furnish a path for this electricity to travel on it will pass through the wires harmlessly and give us the music and speech that we want to get.

"But if we did not provide this leak, the strain would become so great that an actual spark would jump across the space between the two sets of plates. If you want to see this actually demonstrated, take one of your variable condensers, hook it up in the place of your spark plug on your automobile, set your timer for a contact and watch your variable condenser give a miniature imitation of an old-fashioned Fourth of July.

"During a thunder storm the clouds form one plate and the earth another in a huge condenser. A charge of one kind of electricity will build up in the clouds and a charge of an opposite kind will build up in the earth beneath them.

"This causes a state of strain in the ether between. Just what is the nature of this state of strain we do not know. It is believed that the positive side of the condenser disrupts the atoms nearby, steals from them a lot of their negative particles, which we call electrons, and that these atoms in turn steal from those around in an effort to regain their normal number.

"When we change the balance of particles in an atom we cause it to become what we call an ion, and the process is called ionization. When the ionization of the atmosphere has reached a certain degree it forms a path over which a sufficiently strong charge of electricity can pass, and at the very first disruption of this path the whole resistance breaks down and the charge empties itself all at once between the two plates of the condenser and we have what we call lightning.

"If, however, we put up into the air between the earth and the clouds a good conductor of electricity and carefully provide a path for this electricity to travel along the conductor straight into the earth, the ions will be attracted by the conductor and will regain their normal electrical state through the easier path to the earth, and so the state of strain will be relieved and no spark or bolt of lightning will shoot across.

"That is what we do when we put up a lightning rod. As you know, the more points there are on a lightning

(Continued on Page 39)

How to Charge Your Storage B's

THE problem of charging storage batteries in the most convenient way seems still to be a puzzle to the newcomer in radio in spite of all of the information that has been printed about it.

Some months ago I gave a diagram showing how an ordinary double-throw switch could be mounted on the side of the ordinary storage battery so that it could be thrown to one side for use with the set in receiving and thrown to the other side when the battery is to be put on charge.

This is a simple enough matter with the ordinary four or six volt battery and is also easy enough with one block of 22½ volts of storage B batteries. But when the reader finds it necessary to put more than one block of B batteries on his set, he is usually stumped as to how to charge, let us say, a set of three of these batteries, totaling around 67 volts, with a charger that will deliver only 27 volts. The average man is quite familiar with the idea that when we speak of volts in electricity we are talking about the pressure which is forcing the current along and that this pressure is quite similar to the pressure in a water system.

Therefore, if his blocks of batteries are capable of exerting a pressure of 67 volts and his charger is capable of exerting a pressure of only 27 volts, he can quite easily see that instead of the charger charging the batteries, the batteries, having the greater pressure, will force their current back through the charger or at least have a tendency to resist the charging current and not take any of it. This is virtually correct. It is therefore necessary for us to devise some method by which we can change our block of three sets of batteries so that 27 volts will be sufficient pressure to overcome their opposition.

Let us just analyze for a moment what we have in this combination of three blocks of batteries. In the first place, each block represents about 22 volts of pressure. When we connect them with the plus side of one to the minus side of the next we have them in what we call "series" and a series connection always adds the voltage of one cell to the other. Consequently, when we have something over 22 volts in each cell we have around 67 volts when we add all three of the cells together in series.

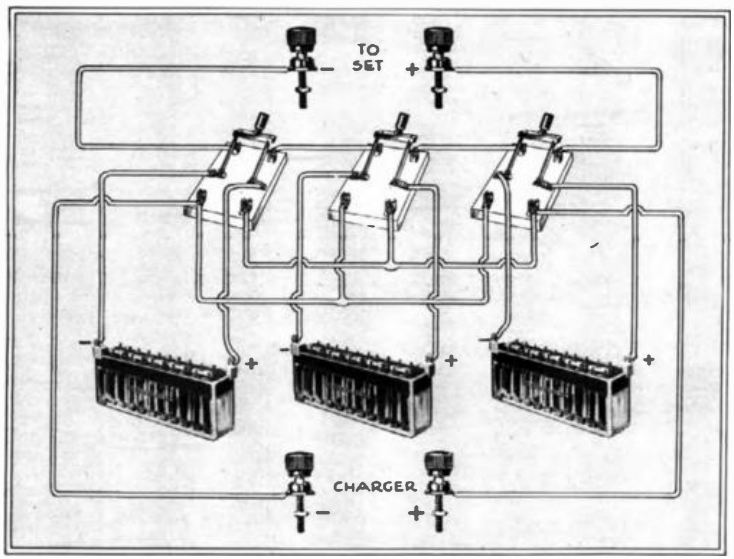
But there is another way of connecting these blocks of batteries and that is what we call "parallel." In parallel connection, we connect all of the minus sides together and connect all of the plus sides together and then we use all three of them as virtually one battery, but they have a common positive side and a common negative side. In parallel connections of batteries, the same rule of adding the voltage does not hold good. In connecting in parallel, we do not increase the voltage at all.

To explain this parallel connection, let us assume that we have a tank of water fifteen feet above the ground. We bring down one one-inch pipe from that tank and open the spigot and we will find that a certain quantity will flow from this pipe. Now let us put a second pipe into the tank to the ground and we can open that pipe also and that second pipe will deliver the same quantity of water that the first one did, but it will come down with exactly the same amount of force or pressure because the "head" of the water, or its height from the ground, is the same. What we have done by adding the second pipe is simply to double the *quantity* of water that is flowing, but we have not increased the *force* with which it flows. Now let us put a third pipe of the same size from the tank to the ground and we have tripled the quantity of water flowing, but we still have not increased the force or the pressure.

It is exactly that same way with batteries hooked up in parallel. The voltage is not increased, that is, the force behind has not been increased. What we have done by putting three batteries in parallel is exactly what we did by putting three pipes from the tank of water—we have tripled the amount that can be taken from the batteries, still leaving the pressure or voltage the same. Therefore we can easily see that the parallel connections will still give us only about 22 volts of pressure, but there will be three times the quantity to draw from that there would be with only one battery.

Just at present, however, we are concerned principally with voltage and if a parallel connection of these three batteries produces only a little over 22 volts of pressure, we can then easily overcome that with the 27 volts of pressure which we can get from the ordinary battery charger which has a B battery attachment to it.

The problem then becomes simply one of rigging up some switching arrangement by which we can throw the switches to one side to connect these batteries in series and so get 67 volts for use with our receiving set and, when we are done receiving, throw the switches to the other side and connect the batteries in parallel so that we can reduce their voltage to 22 volts and thus be able to charge them with our charger. The sketch which is reproduced with this article shows a very simple and easily installed arrangement for doing this. The apparatus consists of three ordinary switches which are known in the stores as "double-pole, double-throw" switches.



When we speak of double-pole, double-throw switches, the average man thinks that it is a very technical term, but it is not. You are all familiar with the ordinary switches usually made with the white porcelain bases, and having two copper blades connected with a handle across them. These blades can be thrown to one side and fit snugly into two copper clips which receive them there, or they can be thrown on the other side to fit into two similar clips.

The expression "double-pole" refers merely to the two separate blades and the double-throw refers to the fact that you can throw them to either one side or the other.

In this switching arrangement, you will notice that the leads from the batteries are brought directly to the middle points of these switches.

When the switches are thrown in one direction, the plus side of one battery is connected to the minus side of the next and that places the cells in what we call series and the whole combination will deliver the 67 volts necessary for the operation of our loud speaker.

When the switches are all thrown in the opposite direction, all (Continued on Page 48)

Answers to Questions on the SUPER-HETERODYNE

LAST month's article on the M. & H. Super-Heterodyne, the article written by Joseph Morgan, designer of the circuit, has fairly swamped us with letters about this circuit.

I have turned all of these letters over to Mr. Morgan and asked him to write an article for this issue summarizing most of the questions and dealing with them in a bunch in this way because I felt that many other readers who might have been interested would have asked the same questions.

This, then, is a summarized answer to most of the inquiries and will give everybody further information on this popular circuit. *H. M. N.*

By JOSEPH MORGAN

IN THE last issue of *Radio in the Home* I gave directions for building the super-heterodyne receiver, with a list of the parts required. It is very important that all material entering into the construction of this set be of the very highest quality obtainable; however, in case it is impossible to obtain any of the particular items, substitutions may be made without detracting from the excellence of operation, provided these substitutes are of equal quality to the ones listed. For instance, the variable condensers may be any of the standard makes in which the losses are known to be low.

Vernier adjusters, preferably of the geared or friction type, are quite indispensable, particularly in the case of the oscillator condenser. The Perfection vernier attachment, which operates with a cam, is particularly suitable for this set.

In the case of the rheostats and potentiometer, the necessity for the highest grade material is not as great, but it is always advisable to use good parts throughout the set. There are plenty of rheostats manufactured which are of sufficiently high quality to place in a super-heterodyne, but there is a still greater number of poor ones. In this matter it hardly pays to run chances, and the best is always the cheapest to use in the long run.

In place of the 6-ohm master rheostat, Amperites may be used on the individual tubes, thus eliminating one control. Style X is correct for 201A tubes.

The list of good potentiometers is not so lengthy. The following are recommended: General Radio, Pacent and Fada.

The audio frequency transformers are of extreme importance if quality of reproduction is desired. By no means should cheap ones be used. Federal, General Radio, Rubicon, Amertran and All-American are recommended, and while there probably are others just as good, the above are reliable and easily obtainable.

If fixed grid leaks are to be used, Daven or Radio Corporation leaks should be employed. If it is desired to use variable leaks, Variohm, Bradleyleak or Turn-It are suggested.

No other superformers nor precision selector should be substituted for the ones shown in the diagrams last month, as the circuit was designed especially for these transformers.

It has been found that it is advisable to connect the loop tuning condenser across the loop and pick-up coil, as shown in Figure 1. This is especially necessary in using a small loop with few turns, as the added inductance enables the circuit to be tuned to the higher wave lengths. If the condenser is connected across the loop only, the pick-up coil will decrease the signal voltage on the grid of the first detector, due to the "reactance drop," and what is considerably worse, it may even oscillate at its own natural frequency and cause audio-frequency beats by interference with harmonics of the oscillator. These will be manifested as howls and whistles in the loud speaker and are therefore very objectionable.

In order to obtain maximum amplification and minimum consumption of B batteries, it is necessary to use as much bias as possible on the grids of the 6000-meter amplifiers.

The diagram for the C battery connection is Figure 2. One common biasing battery is used for the audio frequency amplifiers.

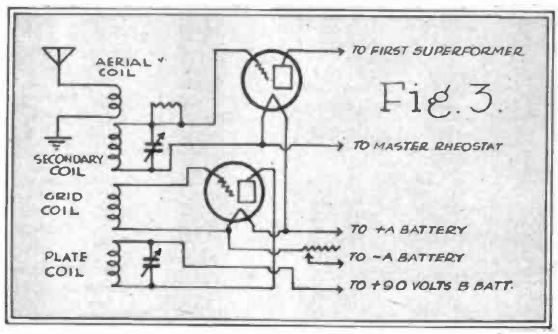


Fig. 3.

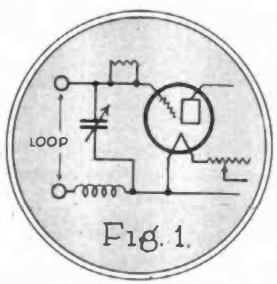


Fig. 1.

Best results are obtained by using 201A tubes, as the amplification is as high as or higher than that of any other tube on the market. However, it is not absolutely necessary to use these. De Forest tubes are very satisfactory, and even UV199 tubes may be used, although it is not possible to obtain nearly as much volume as with 201A's, on account of the smaller electron emission and consequent limitation of the plate current. Western Electric and Myers tubes can be used for the detectors, oscillator and audio frequency amplifiers, but are not satisfactory as intermediate amplifiers on account of their characteristics being different from those of the 201A.

In order to be able to use as much negative bias as possible on the grids of the intermediate frequency amplifiers, it is necessary to reduce as far as possible all tendency for feedback between the plate and grid circuits of each tube. For this reason, the connections, particularly in the grid circuits, should be as short as possible. This can be accomplished by placing the "superformers" between the tubes and making the connection between the "superformers" and the grids as short as possible. Elevating the tube sockets in order to shorten the connection by a half-inch or so is often worth the trouble. Shielding the precision selector is also helpful.

Numerous requests have been received for designs of portable superheterodyne receivers. While the number of tubes and amount of apparatus required render it somewhat bulky, it may be condensed to a surprising degree by making use of several devices and changes.

For the portable set, it need hardly be stated that UV199 tubes are a necessity. The most practical arrangement is a six-tube set, consisting of the oscillator, two detectors, two intermediate amplifiers and one audio frequency amplifier.

In place of the honeycomb coil mounting, which takes up consider-

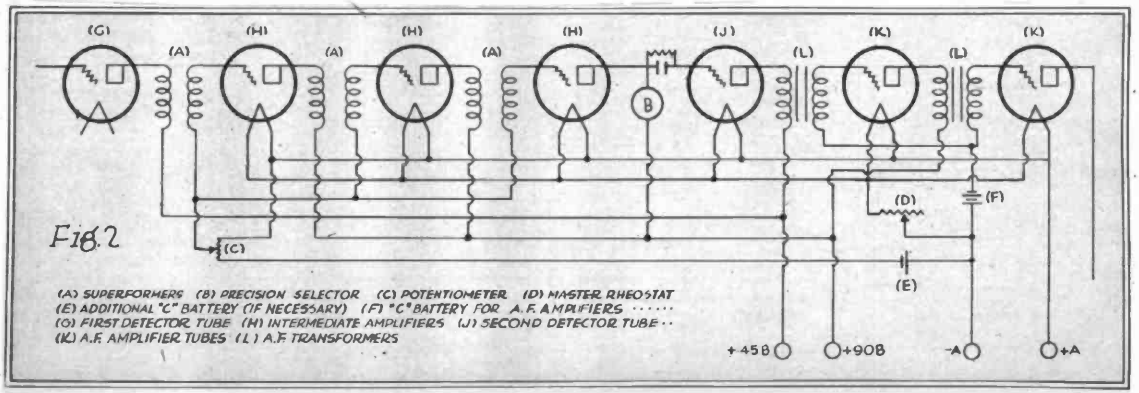


Fig. 2

(A) SUPERFORMERS (B) PRECISION SELECTOR (C) POTENTIOMETER (D) MASTER RHEOSTAT
(E) ADDITIONAL "C" BATTERY (IF NECESSARY) (F) "C" BATTERY FOR A.F. AMPLIFIERS .....
(G) FIRST DETECTOR TUBE (H) INTERMEDIATE AMPLIFIERS (J) SECOND DETECTOR TUBE ..
(K) A.F. AMPLIFIER TUBES (L) A.F. TRANSFORMERS

able space, fixed windings can be used. These should consist of the same number of turns as used on the honeycomb coils, namely, thirty-five, on each of the oscillator coils, with about one-half inch spacing between the ends of the coils. For the pick-up coil, ten turns is usually sufficient, if the distance between this coil and the grid coil is about one-half inch. These windings should be of No. 28 single silk-covered wire on a 2½-inch tube. The loop may consist of ten to fifteen turns of single-conductor fixture wire as large as can be placed inside the cabinet, or a folding loop may be used. The required number of turns will depend upon their size and spacing.

Automatic filament adjusters will prove useful in a portable set, and variable grid leaks should be avoided. The arrangement of the parts is largely a matter of individual taste, and there is plenty of room for display of ingenuity.

There are, however, limitations which must be recognized and kept in mind. On account of these limitations, the intermediate frequency transformers cannot be placed in a compact row behind or below the tubes, but must be located between the tubes. At first thought, it would seem that this arrangement will make the panel rather longer than is desirable in a portable set, but it is possible to make use of another arrangement in two rows, of which one can be placed either behind or below the other. There are three tubes in each row, with transformers between them, with one exception.

In the top or front row, beginning from the left, are: First detector, first superformer, first intermediate amplifier tube, second superformer and second intermediate amplifier tube.

In the bottom or rear row are, from left to right, oscillator tube, audio frequency amplifier tube, audio frequency transformer, second detector tube, and precision selector. If one row is placed above the other, the oscillator coil may be placed in a vertical position at the extreme left, preferably behind the variable condensers, which may be placed one above the other at the left end of the panel. To the right of these may be the two rows of tubes and transformers, with the battery compartment behind them.

Although the small blocks of B battery are not economical, it is advisable to use them in this set, as 90 volts of the large blocks would increase both the bulk and the weight of the set to a great degree. The A battery can consist of four to six Eveready "Three" batteries in parallel, or three dry cells in series, if sufficient room is available.

Many experimenters will desire to use an outside aerial in place of the loop, in order to obtain even greater distance and volume. This can be done, as will be shown later, but, contrary to expectation, it often does not improve the reception, and sometimes even detracts from the quality of reception.

The reason is simple, but often overlooked; the ratio of "signal-to-stray" intensity is greater with a loop, on account of its sharp tuning and static-eliminating qualities. The amplification obtainable with the super-heterodyne is always sufficient to reach the "threshold-point" on a loop. The "threshold-point" is the condition of reception when the signal-to-stray ratio is just great enough for the signal to be distinguishable. Since the signal-to-stray ratio is greater for the loop than for an outdoor aerial, the threshold-point is "farther out," and since it can be reached, longer distance is possible

than with the conventional type of antenna.

In other words, although actual reception is possible from greater distances with the outdoor antenna, the music or words are indistinguishable, as they are completely submerged in the atmospherics and stray noises.

The loop also has sharper tuning qualities and a directional characteristic which render the selectivity even greater.

However, if it is desired to use an outdoor antenna, it can be connected as shown in Figure 3. This coil is similar to the Harkness coupler. Being wound on the same tube as the oscillator coils, no extra pick-up coil is required. The aerial coil is made of No. 18 bell-wire, or of flat copper strip about one-sixteenth inch wide. The secondary consists of thirty-six turns of No. 24 single silk-covered wire. A layer of varnished cambric tape or oiled silk is placed over this, and the aerial coil, consisting of twelve turns, wound directly on top of the secondary coil. These are on a 2½-inch tube, and a one-inch space is left between them and the grid coil of the oscillator, which is of thirty-five turns of No. 28 single silk-covered wire on the same tube, after which a half-inch space is left, and thirty-five turns more of the same wire are wound for the plate coil.

If it is desired to use the honeycomb coil type of oscillator, the secondary of the aerial coupling coil is connected in place of the loop, and the aerial and ground are connected to the primary. Or, a standard variocoupler may be substituted for the aerial coupling coil, although this increases the number of controls.

Some experimenters prefer bus wiring and soldered connections. In portable sets, where there is a great deal of jarring, it is necessary to use connecting wires insulated with flexible varnished cambric sleeving, known familiarly as "spaghetti." Straight wires and square cornered bends always add materially to the appearance of any set, and soldered connections are preferred when a permanent job is desired.

Once the set has been assembled and wired, and the loop and batteries connected, the natural thing for the owner on the Atlantic Coast is to try to tune in San Francisco. Very often he is disappointed because nothing comes through at all, or because squeals are heard.

Then it is necessary to begin "shooting trouble." First, all the circuits should be carefully tested for "opens" and "shorts." Take a voltmeter of 100 volts range, and connect its negative terminal to the negative of the "C" battery, touch the positive terminal in turn to all points in the set, beginning with the center tap of the potentiometer.

Several positions of the potentiometer lever should be tried, from full negative to full positive. The corresponding voltmeter readings should vary from zero to 4.5 volts.

The positive terminal of the voltmeter should then be touched to various points which are connected to the negative side of the "A" battery. The reading should be 4.5 volts.

Then with the bulbs lit to normal brilliancy, the terminal should be placed on the negative side of the filaments of the various tubes. It should then read between 5 and 6 volts.

The next set of points should be the positive side of the "A" battery. Here the reading of the voltmeter should be between 10 and 11 volts.

Next, the connection should be made to the positive side of the "B" batteries. On the 45-volt detector tap the meter should read about 55 volts, and on the 90-volt tap about 100 volts. On the plates of the audio frequency amplifier tubes it should read about 90 or 95 volts, but this depends upon the current taken by the voltmeter, so that an indication as low as 75 volts does not necessarily indicate the presence of any wrong connection or poor transformer. On the plates of the detector tubes it should read about 40 or 50 volts, and on the plate of the oscillator 55 volts. On the grid of the oscillator tube it should read 4.5 volts; on the grids of the intermediate amplifier tubes up to 4 volts, depending upon the setting of the potentiometer, and on the grids of the detector tubes it should not indicate, but on the filament side of the grid condensers it should indicate about 4.5 volts.

The positive terminal of the voltmeter is then connected to the negative side of the A battery, and the negative terminal connected to the grids of the two audio frequency amplifier tubes in turn. Both readings should be 4.5 volts.

If any of these voltages are not as they should be, there is evidently something wrong with the wiring. The connections should be traced out and checked with the diagram.

If the wiring is in perfect order, the next thing to do is to test the operation of the set, step by step. First plug the phones in the first detector jack and tune in a local station. Record its wave length, and the dial setting of the loop condenser.

Then light the oscillator bulb and turn the oscillator condenser slowly until a whistle is heard. Adjust carefully until the pitch (frequency) of the note is as low as it is possible to get it. Record this dial reading also. Now repeat this performance for as many of the local stations as possible, trying to get both high and low wave lengths.

If no whistle can be heard, the oscillator is probably not functioning. To test this, disconnect the B battery. Then, with the filament of the oscillator burning at normal temperature, connect the B battery. A slight decrease in the brightness of the filament will result, if the tube is oscillating. This can be noticed most easily by looking at the lower part of the glass of the tube. If the tube does not oscillate, reverse the connections of either the plate or grid coil of the oscillator. If it does not then oscillate, change the bulb, and examine to see if the contact springs in the socket are all touching.

When the local stations have been tuned in, as outlined above, curves can be plotted for the dial settings. Make the vertical scale wave length (200 to 600 meters) and the horizontal scale dial settings. Make separate charts for the loop condenser and the oscillator condenser. The curves are made by marking the points corresponding to the dial settings and wave lengths of the local stations, and drawing a smooth curve through these points.

After the curve for the oscillator condenser is obtained, take several convenient points on the curve, and for each point calculate the frequency in kilocycles corresponding to the wave length. This may be obtained by dividing 30,000 by the wave length. At a wave length of 300 meters, the frequency is 1000 kilocycles.

Now take two frequencies, one 50 kilocycles higher than the one corresponding to the given wave length, the other 50 kilocycles lower. For 300 meters these will be 950 and 1050 kilocycles. Then obtain the wave lengths corresponding to these two frequencies. This is done by dividing 30,000 by each frequency in turn. In the example we are working out, there will be 286 and 316 meters.

On the chart find the dial settings corresponding to these wave lengths and mark the original wave length

at each of these dial settings. When this has been done for about four dial settings, two more curves can be drawn through the resulting points. One will lie below the original and the other above it. These are what are known as the upper and lower heterodyne settings.

Now plug the phones in the second detector and light all bulbs excepting the audio frequency amplifiers. Set the loop condenser at a setting corresponding to the wave length of any local station which is transmitting at the time. Make sure the oscillator is functioning.

Now set the dial of the oscillator condenser at the setting corresponding to the wave length of the station, from one or the other of these "heterodyne" curves. If one does not work, try the other. Adjust the potentiometer as explained last month, and turn the dial very slowly a division on each side of this point to make sure you have not missed the station's wave. If no response is obtained, all the apparatus from the first detector to the second detector must be tested.

The tube sockets are a good place to look for trouble, for one loose grid or plate contact will prevent the receiver from functioning. The jack may not be wired correctly, or the plug may not make contact. However, with the trouble "sectionalized," so to speak, it should not be hard to find.

Trouble in the audio frequency amplifiers is usually due to overloading, and is noticeable by distortion and high-pitched whistles. It may be avoided by placing grid condensers and leaks around the secondaries, or by using the filter described last month.

While the super-heterodyne is somewhat difficult to construct, particularly for the inexperienced experimenter, and even though trouble at first is often very discouraging, the final results obtained are well worth the time and patience of any radio fan who desires the ideal combination of extreme selectivity, unbelievable volume in distant reception and excellent tone quality, combined with a reliability and ease of operation which will not be bettered, it is safe to say, for many years.

Lightning Dangerous? It Is Not—Not a Bit

(Continued From Page 33)

rod the better it is, because we are presenting more surface to attract more ions, and so we prevent the state of strain from taking place over the particular spot protected in this way.

"If four or five little metal points such as you find on a lightning rod will protect a house, you can imagine how much better protection you will have through the very much greater conducting surface offered by the wires of a radio aerial. This is true, of course, only when you have your aerial connected directly to the earth during a thunder storm. This is done by putting your lightning switch in the "ground" position. Set in this way, the blade of the switch gives an easy path for the ions and so prevents a state of strain in the ether above."

The Langbein and Kaufman Circuit

(Continued From Page 16)

of the numerous crystal-using circuits has led some of the highest radio authorities to say that the use of crystals may in the future increase rather than decrease, as compared with tubes. There have always been many times more sets using crystals than tubes as detectors.

As to the care of crystals, our laboratories have exploded the common fallacy about dirt or grease. Apply a mixture of both to a good crystal; wipe it off so that a barely visible greasy film remains. You will find that the crystal works as well as ever, if the cat-whisker penetrates the grease.

But any substance which has hardened on the crystal, and likewise rust or corrosion, which interferes with the contact, will lower the crystal's power. Hence the value of the rustless gold contacts. Most fixed detectors will be destroyed by soldering a connection on to them, as the crystal will probably be displaced or desensitized by the high heat.

It is interesting to know that crystals may rectify positively at one spot and negatively at a spot which may be only a microscopic distance away.

The large proportion of poor or worthless crystals sold is partly due to the use of insensitive ore and often to the practice of some manufacturers in not testing the partly good lumps they use. Thorough testing involves sampling and testing the lumps, then testing the sized crystals, and finally testing the selected ones after mounting, and rejecting those mounted wrong side up.

Only one pyrite or galena deposit in one hundred produces radio crystals. They are the by-product of gold and lead mines in different parts of the world.

Probably the most popular of all delusions regarding crystals is the belief that their sensitivity can be recognized by their appearance. Our laboratories have discarded tons of pyrite and galena which bore every resemblance, even in microscopic de-

tail, to our accepted material of like origin.

The so-called synthetic crystals are all, without exception, artificial or re-crystallized galena. Nature crystallizes galena from a cold wet solution, whereas man recrystallizes it with dry heat. Hence, the synthetic process does not copy Nature's process.

An extensive series of tests was made last summer by America's oldest radio school to grade some twenty makes of crystals, comprising all that could be bought in Philadelphia at that time. They found but one make of natural crystals which ranked as best, with an average of 106 on the audibility meter. Three makes were good, with an average of 78. Six makes were fair with an average of 51. Five makes were poor, with an average of 28.

Finally, seven makes of synthetic crystals were classed as fair, which averaged 72 in audibility.

Thus, while most synthetic crystals are weakly sensitive all over, they are not loudly sensitive like good natural pyrite or galena.

How and why a crystal works may be told in everyday words somewhat as follows: The radio waves caught by your aerial are alternating currents of such high frequency that even if the telephone diaphragm vibrated, the human ear could not hear such shrill sounds. So it is necessary to produce a direct and pulsating electric current, which will cause vibrations audible as speech or music.

Therefore, the alternating current, which may be thought of as a combination of direct and reverse currents, must be separated or "rectified," as we say. It is here that the crystal acts as a sort of valve or sieve, allowing most of the direct current to flow through the crystal, and allowing very little of the reverse current to pass.

This pulsating direct current vibrates the telephone diaphragm and we then hear music and speech.

It is certain that much of the crystal's power depends upon its structure. Messrs. Roberts and Adams, of the Washington Geophysical Laboratory, published their studies on crystals in the August, 1922, number of "The American Mineralogist." They think that the crystal's as yet unexplained rectifying power may be due to its crystalline layers rather than to its chemical composition.

The crystal's structure is known to consist of minute layers of only one kind of atom; thus in galena these elementary layers consist only of lead or again only of sulphur. In either case, these ultra-microscopic layers, when on the surface, are electrically unbalanced; that is, they are one-directional in their electrical conductivity. They will carry currents in one direction only. It is therefore argued that crystals owe their power to such elementary layers as are on the crystal's surface.

The question of the best crystal and reflex hookups is too large a subject to take up here, but I shall be glad to send to any one who writes for it, a diagram of five such good hookups. Kindly address W. M. Foote, care of Station WFI, Strawbridge & Clothier, Philadelphia, Pa.

This talk was given some time ago, so any reader who may be interested had better send their requests to this magazine instead of to the broadcasting station, and I will see that Dr. Foote gets them. *H. M. N.*

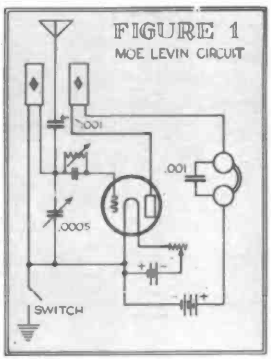
More About the "Levin Singletrol"

By MOE LEVIN

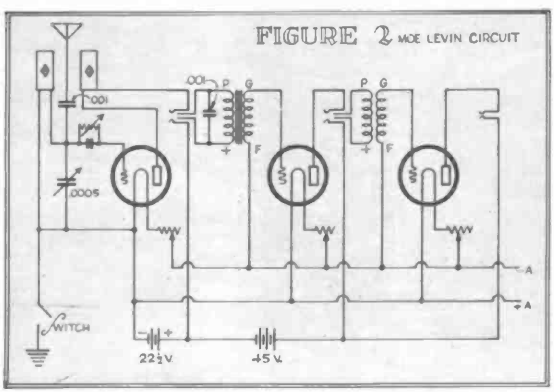
IN the February issue of this magazine I described the Levin Singletrol Circuit.

The letters I received were so numerous that it was impossible for me to answer them all, therefore I am using this issue as a medium.

Some of the letters were complaints, some compliments and some asking more information. I will go into detail as much as possible and trust that I will answer all the questions.



The hookup showed a four-tube diagram and many took it for granted that it would not operate on less than four tubes. Most wanted to use either one tube or three tubes. Therefore, I am showing how to use it either way.



Some were also confused by the two diagrams in the placement of the fixed condensers.

The circuit will work either way equally as well.

You will notice that I am making a change in the aerial and ground leads and also introducing a switch in the ground lead. I am reversing the ground and aerial binding posts. By throwing the ground switch on and off, the ground is connected or disconnected from the set. In doing this it is possible to change the wave length without touching the dial or changing the coils.

For instance, when the ground is on and the higher wave length is received, throw the ground off and it will bring in the lower wave length.

I find that a 35 and 75 turn coil is about the best combination. However, in some cases, a 35 and 50 is better.

As to using radio frequency with this circuit, I would say that it is not advisable. A great many requests have been for this addition, since such favorable results have been obtained with it.

I have received five letters from Philadelphia in which the writers claim to have received Los Angeles.

As I advised in my previous article, it is important that only superior parts be used in order to get superior results. Several sets have been brought in to me with the complaint that the circuit does not function as described. In every case I found the trouble to be either in cheap, defective parts or an error on the part of the builder. In one case I simply reversed the leads of the tickler and the set worked perfectly. This is important.

Try reversing the connections of the tickler coil for best results.

If the tube oscillates too freely and this cannot be eliminated by turning down the detector filament, separate the coils about a half inch and slightly retune.

Be sure and connect the movable plates of the variable condenser to the filament.

If this set is constructed properly, it will do everything I claim for it. Some of the sets that are brought in to me are really a disgrace. They all have the same story: "I just hooked it up temporarily to see how it works." That is the cause of a great many good circuits being condemned. You can't "just simply wire up" a set at random and expect the best results.

This set will operate on a ground alone on short distance with plenty of volume. In that case use a 50 turn in the primary and a 35 turn in the tickler.

As to tubes, the best to use are 200 for detector and 201-A or 301-A for amplifiers. Dry cell tubes will function well, but cannot be compared with storage battery tubes.

Radio Kindergarten

(Continued From Page 12)

the first battery used we call it by the first letter of the alphabet, or A. You can remember from this that no matter what your hookup is and no matter what kind of tubes you are using, the A battery is always the battery which is used to light your filament.

In his experiments, Edison used a separate battery connected to the plate, and as this was the second battery used, it was called by the second letter of the alphabet, or B. You can therefore always remember that the B battery is the battery which is connected to the plate of your vacuum tube even though the current may have to go through telephones, variometers, transformers and several instruments before it reaches the plate. That does not alter the fact that the B battery is connected in such a way that it affects the plate.

Now according to Ohm's law, no current should flow from the plate to the filament in Edison's experimental tube because there was an open space there. Edison connected the negative side of his B battery to the plate and found that Ohm's law held good; no currents passed from the B battery as indicated by his delicate measuring instrument.

Edison then reversed his connections and placed the positive side of the B battery to the plate.

And then a very marvelous thing happened. With the positive side of the B battery connected to the plate, the measuring instrument showed that a definite current of electricity was passing in some manner or other across the open space between the plate and the filament. This was totally against Ohm's law and it puzzled Edison. It meant either that Ohm's laws was wrong or else that something was happening in that open space that science knew nothing about.

Further experiments showed that this current passed across from the plate to the filament only when the filament was burning. When Edison turned the filament down, the current stopped. Therefore, it seemed to indicate that the burning of the filament was doing something or other in the space between to form a passage way for the electricity.

The only explanation that science could make at that time was that the heat of the filament was doing this, but that wasn't a valid theory because it had already been proved that the mere temperature of space did not alter the fact that electricity would not pass across it.

Well, to make a long story short, science gradually discovered that this "Edison effect," as it is still known, was caused by the fact that when the filament became incandescent, it sent out a constant bombardment of electrons into all of the space about it.

This explains why there was no passage of current when the negative side of the B battery was connected to the plate because, as we have already learned, negative electricity repels negative electricity and in that case the negative plate would repel the negative electrons and not permit them to come across.

But we know that positive electricity will attract negative, and so it follows simply that when the plate was positive, it attracted the negative electrons thrown out by the incandescent filament, and it was soon discovered that this constant stream of electrons passing across the space offered a fairly good path for the electricity and that was what caused the flow from the B batteries.

This Edison effect was used afterward by Fleming in what was known as the Fleming valve, and this enabled telephone engineers to use B batteries at various locations along a long distance line to boost up the strength of the signals.

It remained for Dr. Lee De Forest, however, to add the third and crowning glory to the vacuum tube.

Dr. De Forest, after very long and intensive study of the Fleming valve, placed between the metal plate and the filament, but still not touching either, a little network of metal which he called a grid. This grid was nearer to the filament or source of electrons than the plate was and consequently a very much weaker current on the grid would have more effect on the electrons than would the current on the plate because of this nearness and therefore added influence. Now with this in mind we can easily see what happens in the vacuum tube.

We lead the signals from our aerial into our receiving apparatus and transfer them by various means to the grid of the first tube.

When the signal is positive, the grid attracts the electrons being thrown out by the filament and brings them out to where the positive charge of the plate can catch them and bring them all the way across, thus offering a good path for the flow of electricity from the B battery through the plate.

When, however, the signal is negative and the negative charge gets on the grid, it repels the electrons which are trying to get out from the incandescent filament and does not permit them to go across the open space and form a bridge across space for the electricity from the plates. Consequently, when the signal is on the negative part of the wave, no electricity flows from the B battery.

It is this "rectified" and amplified impulse that we use to work the diaphragms in our phones and loud speakers and so give us our music and speech.

How Often Must We Pay?

(Continued From Page 13)

unfair, ridiculous, impracticable and irrational, but show absolutely no equity whatsoever. They have interpreted the Copyright Law to suit their purpose, and have read into it subject matter which did not exist at the time the Copyright Law was passed, as for instance is proven by the fact that when the present Copyright Law was enacted, radio broadcasting was not in existence.

Therefore, we say that our Copyright Laws are still in need of additional interpretation or amendment, and probably more in need of the latter than the former if the public is to be considered.

Of one thing we may be certain and that is that broadcasting stations will not be dictated to, nor bulldozed by any one. Nor will the majority of these stations permit the listening public to have its entertainment handicapped, hampered and hobbled by any organizations through attempted taxation or otherwise. Radio must have the same freedom as does the daily press. It must keep itself in a position to deliver to the millions of listeners, information and entertainment which is not controlled and not dominated by any one or any group.

The National Association of Broadcasters is seeing to it that these worthy objectives are being fulfilled and it will continue unflinchingly to see that the public, upon which the future stability of radio depends, obtains its rights, especially in the matter of not being taxed on the music for which it now pays not only once but often.

Three Tubes in a Corona Case

(Continued From Page 11)

experiment to find out which coils to use for the particular bed spring or electric light system which you are using in your hotel for an aerial. Usually I think you will find that the seventy-turn coil in the left mount (as you face the panel) and the fifty or sixty-turn coil in the right-hand mount for a tickler will act best.

I ordinarily start tuning by having the ends of the coils only about three-quarters of an inch apart and doing the tuning with the Variadon condenser. There is always a characteristic hiss of regeneration when this circuit is working properly, and if you do not get this hiss it will not be much use to try tuning because it is doubtful whether your set is functioning properly. In that case, try moving the coils farther apart or closer together and at the same time turning the variable condenser.

If even this does not work, change coils until you do get that characteristic hiss, and as soon as you get that you will very quickly locate a station by turning the dial of your condenser.

Move this dial until the signals are loudest, regardless of whistles or squeals, clear up the signals as much as you can by moving the coils with relation to each other and then take your hands away and do your fine tuning with a stick or pencil by means of the little pointer on the shaft of the midget condenser.

There is really nothing much more that need be said about this set because the tuning is entirely a matter of practice. If you can possibly place your tube sockets—we are showing the well-known Na-Ald socket—if you can place these sockets upon pieces or rubber sponge, it will be well worth while to do it, as these small tubes are extremely "microphonic," and will ring and howl if jarred even the slightest bit.

How to Charge Your Storage B's

(Continued From Page 34)

of the positive connections of the batteries are wired to each other and all of the negative connections are wired to each other and that gives us a parallel connection and we are able to charge the batteries when the switches are set in this way.

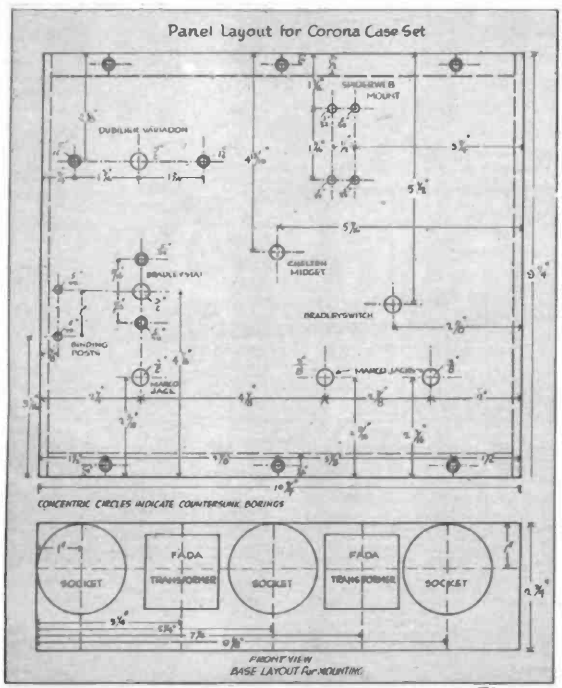
With the increasing use of more than two or three tubes in a set, this matter of B batteries becomes an extremely important one.

You must bear in mind that each separate tube draws a certain amount of current from the B batteries and, what is just as important, you must remember that the more voltage you place upon the plates of these tubes, the greater will be the relative drain upon these batteries. That means that if you are working your amplifiers at 60 volts, each tube will draw a certain amount of current, but as soon as you raise your B battery voltage to 90, each tube draws a correspondingly increased amount of current out of your B batteries.

It is for that reason that you must consider your B batteries very seriously just as soon as you begin to operate a set which contains more than three tubes.

This must be born in mind by every fan, whether he uses dry cell B batteries or storage B batteries. For the dry cell user, it is only fitting to give a warning that he must not expect too much out of his batteries if he is going into sets using from five to eight or ten tubes. This is a tremendous strain on B batteries and he must be prepared to renew them quite often. Of course, the obvious thing for him to do is to insert a C battery in the grid leads of all his audio-frequency amplifying tubes and this will cut down the drain upon the B batteries about 50 per cent, in addition to giving very much better quality of reproduction.

For the user of storage B batteries



this must be born in mind also, because it means that he will have to have a charger and some arrangement by which he can consistently put back into his storage batteries the current that he is drawing out.

The arrangement given here with these three double-pole double-throw switches is about the simplest and most efficient that I know of and it is so easy to understand that any novice can quite readily install it on his own set.

It can also be increased for any number of blocks of batteries by using one switch for each battery and extending the connections on the same system of "jumps" shown here.

H. M. N.

Editorially Speaking

(Continued From Page 4)

table result of this ultra-sensitivity. In other words, the super-het will pick up noises that will not affect the ordinary instrument and will magnify these noises in volume to such an extent that they frequently will totally ruin the quality of a concert being received.

This, to my mind, is the most serious fault not only of the super-heterodyne, but of any of the sets which are so extremely sensitive.

You must remember that there is always a certain amount of static in the atmosphere; you must realize that there are always certain tiny noises connected with batteries whether wet or dry, with connections which may be more or less faulty, and with all of the dozens of phases of a radio set in which absolute perfection is not attainable.

Every one of these noises is present, but if the set is not too sensitive, it will not pick them up and they do not bother us. The more sensitive the set becomes, the more liable it is to interference from these noises and this is a very serious aspect of all such hookups as this.

I have heard it quite widely said that the super-heterodyne will give twice the distance of any other set. This is absolutely not true. It will, if it is properly constructed and properly operated, give somewhat more distance. It will perhaps give this distance a little more consistently. But to say that it is twice as efficient as its nearest competitor is to betray the fact that you have not worked sufficiently with different super-heterodynes really to know what their possibilities and what their limitations are.

For the man whose chief pleasure in radio is reaching out over great expanses of land and sea, I should say the super-heterodyne is decidedly worth while. It will give him the ultimate in radio and that is what he is after.

For the man who wants entertainment in his home, I should say that the super-heterodyne is not worth the money nor the trouble. I have had eight or ten of these hookups on my test table at Station 3XP, I have worked with them carefully and sincerely and yet, when I want the concerts in my own home, I turn to my neutrodyne set with my power amplifier.

That is because I am not a DX hound. I have had the Pacific Coast from my little station in New Jersey and it has not even given me a thrill. I can take a one-tube set, used with a big loose coupler which I bought fifteen years ago and with this ancient tuning outfit I can bring in the dot and dash signals from Europe or South America any time I want to, so that distance is and has long been an old story with me. I fail to see why the transmission of voice should give any more thrill than the transmission of the dot and dash. Perhaps I am lacking in imagination, but that is probably because I have been in this game so long.

However, the DX fan is a decidedly valuable member of radio society. He and his demands are keeping radio experts hard at work developing new things constantly and he is freely and generously spending money to pay for these developments. Therefore I feel that he is entitled to a good deal more honor than most of the set manufacturers are giving him. The trouble is that he is always ahead of their factories and therefore he keeps them constantly in hot water wondering what he will demand next. But I am strong for him, although I do not belong to his fraternity.

He is the man for whom the super-heterodyne is undoubtedly the one and only thing to be considered for next season. But I feel that the super-het market is for him and for him alone.

Personally I have not the slightest desire to have a super-heterodyne in my home. That is, as I have said, because in my home I want pure music and faithful reproduction of speech with just as little extraneous noises as it is necessary to have. I do not get this kind of thing with a super-heterodyne.

There is another aspect of the super-het that I think has been totally overlooked in the wild mania to own one of these elaborate instruments. This is not only the aspect of first cost with its eight tubes, but the aspect of maintenance, especially in so far as B batteries are concerned.

The average of all of the super-heterodynes which I have used is a drain of about 33 or 34 milliamperes from the B batteries with eight tubes. This means that in three hours' use, 100 milliamperes have been drawn out of the batteries and in ten nights of three hours each, an ampere has been taken from them. Now the average B battery really becomes virtually useless after you have used about 1½ amperes from it, so that, on this calculation, it would mean that your B batteries will be dead in fifteen nights of use with a super-heterodyne, even if you use a C battery on the audio frequency amplifying tubes.

Buying ninety volts of B battery every two weeks is what I would call paying fairly dear for a possible increase in efficiency in distance reception, with absolutely no improvement in quality or general satisfaction.

There seems to be another superstition and that is that the super-heterodyne will eliminate sparks and the squeals of reradiation. That is not so. The super-heterodyne does not eliminate anything; on the contrary it picks up more things than any other set does and amplifies them until they become a nuisance. Spark signals and reradiation squeals are even more annoying with super-heterodynes than they are with other sets.

I do not want anybody to think from this that I am trying to dis-

(Continued on Page 46)

Grimes Designs a Portable Inverse-Duplex Set

(Continued From Page 9)

teries consist of four of the small size 22½-volt units connected in series for a total of 90 volts. This voltage is necessary for best results. Less B battery will result in decreased efficiency.

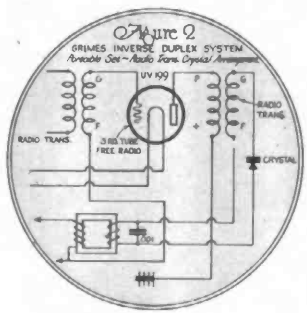
Considerable experimenting with adjustable and fixed crystals will be necessary before you will satisfy yourself as to the best combination. Fortunately, they do not cost as much as tubes, and a person may purchase several of them without "going broke." If an adjustable type is used it should be encased in a glass housing or other dustproof device. The best adjustable crystal I have yet found is the "Rusonite" crystal, while the best fixed crystal I have used is the "Pyratek." Of course, there are crystals and crystals. Even those listed above will vary among themselves—many being excellent. I have shown the "Pyratek" in the front view of the set. This was formerly called the "Duratek."

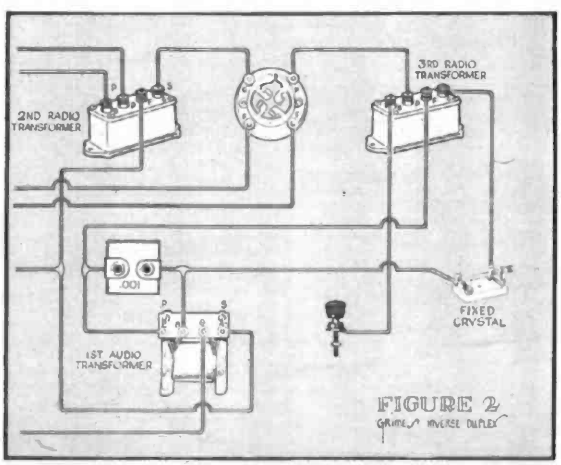
The several binding posts on the front of the set are for aerial and ground connection and for loop when desired. The loop is placed in the cover. This was found to be limited in range and many places were located in the country where the results were not satisfactory. Therefore, aerial operation is to be recommended for vacation use when employing the small dry cell tubes.

The entire weight of the set as shown is only about fifteen pounds—slightly heavier than a portable typewriter. However, the set is not designed for universal portable use, because of its single control, which broadens the tuning near a large station. The set is particularly built for campers' use. The set shown in the photographs is being used by Mr. G. B. Agnew, president of the Grimes Radio Engineering Company, while on a trip through Nevada and Arizona.

And now, last but not least, you are undoubtedly interested in just what troubles are likely to be encountered when hooking up the set. Outside of the few points above mentioned, there is always the possibility of defective equipment. This is the one drawback to building one's own. It is indeed hard to know, unless you have electrical instruments, when a transformer is open or a condenser shorted. This defective equipment will give you trouble in any circuit; so I am hoping you have discovered it before this.

Assuming that your apparatus is in first-class shape (for in the vast majority of cases it will be), audio howls are likely to occur from certain types of audio transformers. These howls will require certain changes in the inverse-duplex, such as reversal of connections or increased by-passing condensers. Generally, if the secondary leads of the first audio transformer are reversed, the trouble will disappear. If this is not sufficient, increase the value of the by-passing condenser across the secondary of the second audio to .005 mfd. If squawking occurs on certain settings of the tuning condenser, merely drop the grid tap of the first tube to take in fewer turns on the secondary of the fixed coupler.





Editorially Speaking

(Continued From Page 41)

courage the use of the super-heterodyne, because I am not. I only want to point out the plain and unvarnished facts in the case and to give the average non-technical reader some basis on which to decide for himself whether he wants to go to the expense of one of these circuits or not. It summarizes about like this:

If you are after the ultimate in distance, by all means use the super-het.

If you are after beautiful quality and genuine pleasure in your home, combined with simplicity of operation, the super-het does not hold anything for you, even to equal any one of a dozen standard sets which can be purchased right now on the market.

Grimes Writes Exclusively for Us

(Continued From Page 7)

not only in the cost of tubes, but in the vastly more important upkeep expense spoken of in my editorial for this month. This is the expense of B batteries.

Nobody expects Mr. Grimes to accomplish this immediately. It is a very delicate and complicated job to design an Inverse-Duplex system for the super-heterodyne, but Mr. Grimes has already done it for the neutrodyne (we will publish that in the near future), and I have no doubt he will succeed with the more complicated and more cumbersome super-het.

It struck me that the readers of this magazine might like to know something about the personality and history of the man whose name has become so familiar to them and who is going to be one of their intimate visitors every month from now on. And so I hunted up a friend who has known Mr. Grimes most of his life and here is the life story just as it came from the pen of that friend:

David Grimes was born at Minneapolis, Minn., in 1896. He is of English, Irish and Scotch descent, although both his parents and grandparents were born in America.

"Dave," as he is known, attended several of the Minneapolis public schools, graduating in 1910 from the Lake Harriet grade school. He early showed a keen desire for experience and took particular delight in accomplishing tasks for the mere sake of accomplishment. While still in the elementary grade schools he built up a retail newspaper business that later, in his high school days, developed into a newspaper route, earning for him the enormous sum of $30 per month.

A grade school orchestra was also one of his earlier accomplishments, as he has a musical turn of mind. Notwithstanding, his contribution to this organization was in the trap drum section. A boyhood romance started here and the girl who played the piano later became his wife.

In the fall of 1910, he entered the West High School in Minneapolis and started to prepare himself for journalism. He became a member of the class debating team and soon worked up to be its captain. This team won the championship that year and the members were presented with a silver cup.

From then on, "Dave" entered into various activities and the three remaining years in high school saw him as a member of the orchestra and band, president of the Chess Club, president of the High "Y" Club, treasurer of the Engineers' Club, member of the Senior Executive Board, business manager of the senior play and treasurer of the senior class.

A change in plans occurred, however, about the sophomore year as Grimes became interested in wireless, as it was then known. He promptly forsook his journalism idea and devoted all of his spare time in studying and experimenting with this new science. He had one of the first radio telephones in the West—his interest being in telephony rather than telegraphy. "Dave" then entered the University of Minnesota in the Electrical Engineering College.

When this country entered the war in 1917, "Dave" was a senior and, despite his earlier journalistic handicap to his engineering work, had been elected a member of Tau Beta Pi, the honorary scholastic engineering fraternity. He had also been elected to Alpha Kappa Sigma, an engineering Greek letter fraternity, that has since become affiliated with Theta Xi. He was engineering representative on the Board of Governors of the Minnesota Union, a major in the Reserve Officers' Training Corps, a member of the Grey Friars and president of the senior class.

Refusing an opportunity for a commission in the Army as it didn't place him in the Signal Corps—his chosen work, he accordingly enlisted as a private in the Signal Corps and after going through some training was transferred, upon his request, to the Air Service. There he was given a commission and appointed as Officer in Charge of Radio at Kelly Field, Texas.

After building up the department from practically nothing to an organization training about 200 cadets a week, Grimes was transferred overseas and placed on research work on radio navigation of bombing planes.

As a result of this work he developed his Inverse-Duplex System, that has recently attracted considerable attention. At the close of the war, he returned to this country, finished his degree at the University of Minnesota and entered the development and research department of the American Telephone and Telegraph Company at New York. He remained here for three valuable years and then entered business for himself.

He has recently taken to the pen, his first love, and has written widely on this work. He has now connected exclusively with *Radio in the Home*, thus combining his two main life interests—engineering and journalism.

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Simplicity

When a radio receiver is so simple that a child can operate it as well as a grown person, then radio has reached a stage of development that is little short of perfection.

The Neutrodyne principle as applied to the FADA "One Sixty" has produced a radio receiver that is simplicity itself. Once the notations have been made of the dial settings of any stations, *anyone* can reset the dials in the given positions and listen to that station at will.

Because of FADA engineering skill, the FADA "One Sixty" four-tube Neutrodyne receiver is as selective, brings in distance and produces as great volume as any five-tube set. And, best of all, the FADA "One Sixty" can be depended upon to bring in most of the programs—local and far distant—on the loud speaker.

The pleasing design of the cabinet and its beautiful finish make it an ornament to any home. Its efficiency makes it a delight to all who listen. It is a receiver that you will be proud to own. See the FADA "One Sixty" at your dealer's. Price, exclusive of tubes, batteries and phones, $120.

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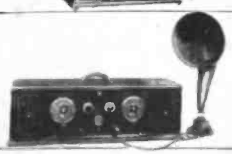
	MODEL †	PRICE	APPROXIMATE RANGE	TYPE OF ANTENNA	DEGREE OF SELECTIVITY
	**Radiola III** With two WD-11 Radiotrons* and head telephones.	$35	Up to 1500 miles with headphones. Local stations on Loudspeaker.	Outdoor or indoor antenna.	Improved selectivity. Minimum radiation.
	**Radiola Balanced Amplifier** To be used with Radiola III. With two WD-11 Radiotrons.*	$30	Gives Loudspeaker operation with Radiola III up to 1500 miles under favorable conditions.	Outdoor or indoor antenna.	
	**Radiola III-A** with four WD-11 Radiotrons,* head telephones and Radiola Loudspeaker.	$100	Loudspeaker operation up to 1500 miles under favorable conditions.	Outdoor or indoor antenna.	Improved selectivity. Minimum radiation.
	Same without Loudspeaker.	$65			
	**Radiola Regenoflex** with four WD-11 Radiotrons,* and Radiola Loudspeaker.	$206	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity. Non-radiating.
	Same without Radiotrons or Loudspeaker	$150			
	**Radiola X** with four WD-11 Radiotrons,* Loudspeaker built-in.	$245	Loudspeaker operation up to 2000 miles under favorable conditions.	Outdoor or indoor antenna.	Extraordinary selectivity Non-radiating.
	**Radiola Super-Heterodyne** with six UV-199 Radiotrons and Radiola Loudspeaker.	$286	Loudspeaker operation up to 2000 miles with internal loop. With external loop up to 3000 miles under favorable conditions.	No antenna. (Concealed small loop built into set.)	Super-selectivity. Non-radiating
	Same without Radiotrons or Loudspeaker.	$220			
	**Radiola Super-VIII** with six UV-199 Radiotrons,* Loudspeaker is built-in.	$425	Loudspeaker operation up to 3000 miles under favorable conditions.	No antenna. (Concealed large loop built into set.)	Super-selectivity. Non-radiating.

† *All Radiolas sold without batteries.* * *Only dry batteries used.*

It is impossible to give here full description of these remarkable new sets. Send this coupon for an illustrated booklet that tells the story complete ly, with detailed descriptions of every set. Then see your nearest dealer.

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Radiola

REG. U. S. PAT. OFF.

decided to erect a broadcasting station, when he was made manager and first announcer. Mr. DePew is a native of the State of Texas, having spent the early years of his life on a cattle ranch in San Saba county.

F. B. Wamsley, assistant announcer, was born at Cleves, Ohio, of English parentage. He received his high school education in Cincinnati, Ohio, and was employed there in the banking and brokerage business for about twelve years prior to coming to Zion several years ago. Mr. Wamsley is connected with the Zion Institutions and Industries as cashier general, announcing at the radio station being his avocation.

Henry H. Albrecht, former Navy radio operator, who has seen service on both coasts and in various sections of the world, is chief operator for Station WCBD, handling all broadcasting with the assistance of Theodore Mason, junior operator.

The radio building stands in the center of the temple site, a ten-acre tract of ground, which is surrounded by Shiloh Park, a reserve of two hundred acres, this building and Shiloh Tabernacle being the only buildings within this reserve. The radio station occupies the geographical center of the City of Zion, which is laid out with eight boulevards diverging from the center and running to the limits of the 6500 acres which comprise the city and environs. The steel towers are 150 feet high and stand at an elevation of eighty feet above Lake Michigan, which is a mile and a half to the east. The radio station is in plain sight of Sheridan road, a paved thoroughfare which runs from Houghton, Michigan, to St. Louis, Missouri, through the North Shore and the City of Chicago.

The Chicago and Northwestern Railway runs through the eastern part of the city, and the Chicago North Shore and Milwaukee Electric Railway serves the western part of the town.

The City of Zion was founded by John Alexander Dowie in 1901. Wilbur Glenn Voliva succeeded John Alexander Dowie in 1906, at a time when the organization had fallen into disrepute, when its credit was nil, and when nothing but millions of dollars of debt and seeming disaster stared the people of Zion in the face.

From this inauspicious beginning, with no assets but a loyal people, he grappled a problem to quail the stoutest heart. Mr. Voliva has built up the Zion Estate to its present great proportions. Last year these institutions and industries, twenty-six in number did a business of more than $4,000,000. A constant flow of visitors is received at the radio station, especially during the warm months, when thousands of tourists driving through the city on Sheridan road are greeted by signboards of invitation and welcome. Many of these tourists are equipped with radio receiving sets and while camping beside the road in various adjoining States they listen to a concert and hear an invitation something like the following:

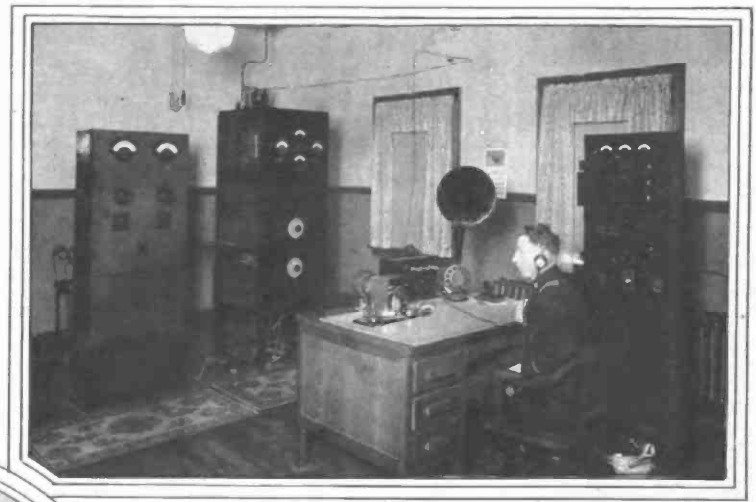
"This is Radio Station WCBD, Zion, Illinois. We specially invite the tourists in this section to visit this radio station when passing through Zion. As you drive through the city on Sheridan road, you will see the towers and radio station a half mile to the west. Officers of the church are in attendance at Shiloh Tabernacle at all hours and will show you through both the Tabernacle and the radio station, which are located near each other on the Temple Site."

Driving along Sheridan road, which is the main artery of travel between Chicago and the Great Northwest, countless thousands of tourists have seen the graceful towers of the radio station, with Shiloh Tabernacle in the background, standing on the highest point of the surrounding country. Every day throughout the whole year visitors are received by courteous guides and shown the workings of the radio station and Tabernacle.

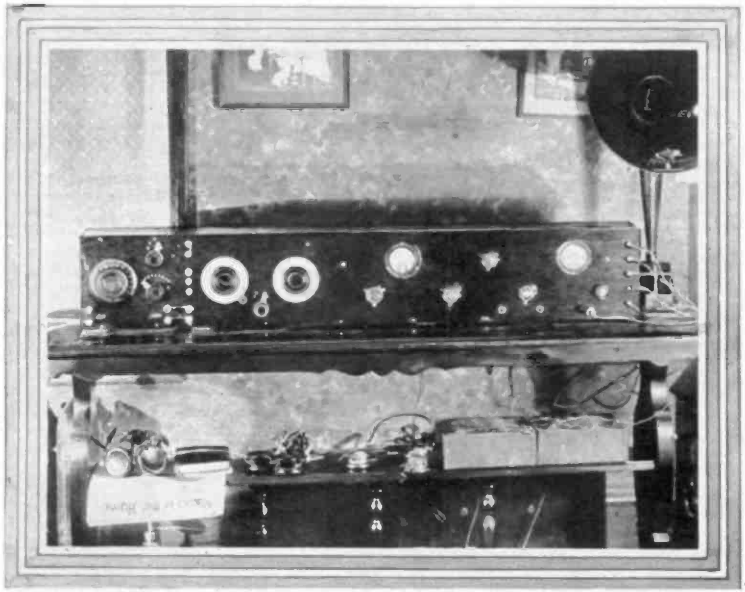
Broadcasting Station WCBD was erected by Mr. Voliva for the primary purpose of spreading the Gospel in speech and song. The service and programs broadcast by this station have resulted in a most satisfactory class of correspondence received from every stratum of our population, each mail bringing many letters from representative men in business and professional life, in addition to the constant stream of mail from city homes and suburban population. A morning mail will contain letters from captains of industry, a professor of English in an Eastern college, men of the field, soiled letters written with pencil from a humble cot in a Southern State, letters on crested stationery breathing of the boulevards, and one from the frozen regions from the outreaches of Canada, stating that dog sledges had borne it 250 miles to the nearest postoffice. Here is a typical letter from an Ohio city:

"I would be remiss in my duty if I did not write to say how much I appreciated your concert last night. Having been deaf —not hard of hearing, but deaf—for more than twenty years, I heard for the first time in all the period the selections, 'In the Sweet By and By,' 'The Little Brown Church in the Vale,' 'Tramp, Tramp, Tramp, the Boys Are Marching,' and others which I sang myself years ago. The concert carried me back to the time I sang in church choirs. The cornet solo by Mr. Newcomer, 'Lead Kindly Light,' was wonderful. The tears trickled down my cheeks as I listened in to the wonderful music, as I had never expected to hear these songs again. It was as if angels were singing especially for me—a deaf man. The request numbers which you gave were just what I would have requested. Others in my home listened in also, but I surmise that they were watching me as much as listening to the pro-

(Continued on Page 29)



Above is shown a picture of the operating room and Henry H. Albrecht, chief operator. To the left is a picture of F. W. Wamsley, assistant announcer of the station



The final triumph. The complete set with Magnavox and, of course, a copy of "Radio in the Home." That last feature is really the reason we are printing the photograph

A Raw Amateur's Experiences

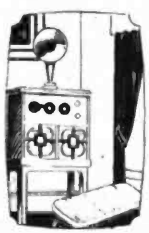
By FRANK C. PARKER, M. D.

WE READ of circuits and circuits and still more circuits—and circuits that are more still than circuits—till we become so hypnotized with their possibilities, real or imaginary, that we know not which way to turn, at the same time developing a longing for something which we have not.

It was while in one of these trances after absorbing considerable literature and trying out various hookups that I read of the super-heterodyne's pleasing personality. This super-heterodyne seemed to have the earmarks of just what I was looking for—selectivity and volume. My good friend, Alvin D. Beyer, of Norristown, suggested that we take the plunge. My reply was, "You know me, Al." So off went an order for two sets, the particular set under discussion being a most extensively advertised model.

Note.—This set is NOT advertised in "Radio in the Home."—H. M. N.

After the customary long wait required as a set standard by most saleshouses nowadays, the various parts began to arrive. Strange as it may seem, the first things received were the loop and B batteries—the last things needed—but as B batteries improve with age we, of course, had no kick coming, especially from the B batteries.



Next a few transformers and condensers presented themselves, followed at two-week intervals by panels, cabinets, sockets, rheostats, gridleaks, oscillator coils, radio frequency coupler coils, binding posts, ammeters, voltmeters, bus wire, spaghetti, et al, the whole family, after securing their reservations, arriving approximately two months subsequent to placing the order!

What a sight it was! Here they were apparently in excellent health and guarded by several large fatherly looking blue prints resembling the constructional details of the new 1935 Ford equipped with individual shock absorbers beneath either seat.

Before wandering farther we will here enumerate the various parts and their values, other than commercial. Here they are:

1 Variable condenser of .001 capacity, for the heterodyne.
1 Variable condenser of .00027 capacity, for wave length.
Potentiometer of 400 ohms resistance.
3 20-ohm rheostats for controlling the two detector and one heterodyne lamp.
1 7-ohm rheostat controlling the three radio and two audio tubes designated the master rheostat.
8 Tube sockets.
2 2-meg. grid leaks.
2 Fixed condensers, .00027.
2 Radio frequency transformer fixed condensers, .0025.
1 By-pass fixed condenser, .001.
2 By-pass fixed condensers, 1 mf.
1 Radio frequency coupler consisting of two coils composed approximately of 925 turns in layers of about 20 turns number 32 cotton covered wire.
2 Audio transformers, 4½ to 1.
3 Radio frequency transformers, type UV-1716.
1 Oscillator coupler composed of three coils of Number 20 cotton covered wire, coil L having 6 turns; L1 having 21 turns, and L2 having 41 turns. This coupler is of special design, the coils being one within the other.
2 Closed and 1 open jack.
2 wire-wound resistors.

Panel, cabinet, wire, screws, spaghetti, binding posts and, if you prefer, a voltmeter, ammeter and filament control switch.

The loop is of the solenoid type, each side being three feet and wound with 9 turns spaced about five-eighths of an inch.

A variable condenser, .0005, is used to tune the loop.

An antenna adapter is furnished for use on the outdoor aerial. This adapter consists of three coils and a variable condenser.

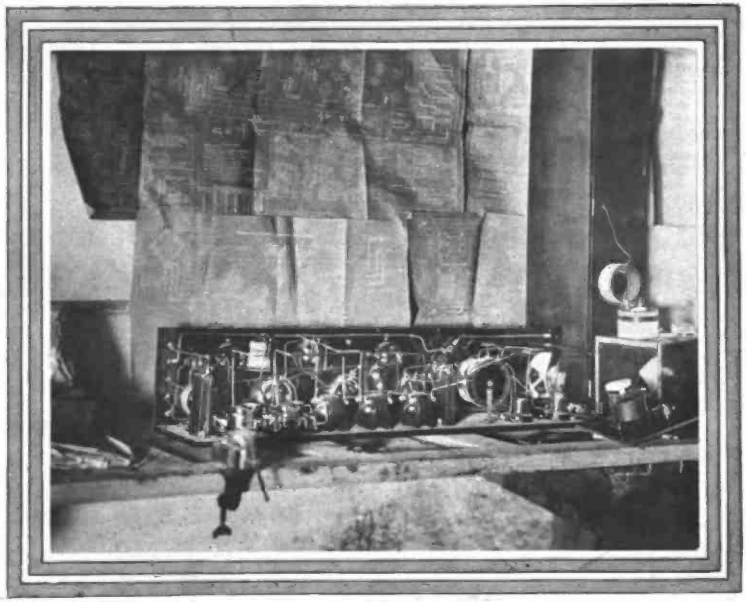
Eight lamps, preferably C301A or UV-201A, are necessary. Other lamps may be employed.

A B battery of 90 to 100 volts is required as well as a C battery of 4½ volts. (As far as signals are concerned no difference was noted either with or without the C battery. However, B battery current is saved by its use.)

Outside of the above few trinkets nothing else is required save a certain amount of patience and at least eight hours' sleep each night. If you get into trouble, go to bed and forget about it until the morrow, when things may right themselves unexpectedly.

After making a thorough survey of the situation it was decided that in order to gain the proper perspective and keep on an even keel we had better come up to leeward of the diagrams and examine them carefully if not most minutely, so at it we went. We traced every wire from beginning to end—that is, those which had ends—and after following many of them through the streets of the forbidden city, would slip off a grid leak and fall into the yawning jaws of a condenser waiting to receive us with outstretched arms. We knew from the old scarabs lying about that His Honor King Tut lay buried there and that the rooms were already occupied, so we would be compelled to retrace our steps in another direction.

I might add right here that it is always a good plan in looking over these or any other blue prints, to hold them to the light for closer inspection, as many, many dark secrets are concealed in the watermarkings in the paper, which may never come to light unless pressure is brought to bear. They are most reticent and at times can be coaxed out only by the gentlest persuasion. While we found the blueprints to be most



After you solve the intricacies of Mah Jong, you will be able to tackle the intricacies of these blue-prints and this array of apparatus

with the SUPER-HETERODYNE

commendable and thorough, the lower right-hand corners bearing the signatures of the various dignitaries associated in the plot, who each and every one had passed upon them and had given them their O. K. by attaching their signatures, still quite a few errors slippped by. For instance, the two coils "L" and "Ll" of the oscillator coupler were shown connected, when as a matter of fact they have not been on speaking terms for some time, as evidenced by later appearing diagrams.

Some condensers were marked .0027 in preference to .00027, which is now considered more in keeping with the Parisian mode. Data relative to the C battery and kind of lamps employed did not seem to approach the standard set down by Daniel Webster in his classical novel.

However, I must say, leaving all hilarity aside, that the blueprints, outside of the errors, were elegantly done and most imposing. They were very thorough and carried out in the most minute detail. We are all liable to error and I really think the designer did exceptionally well to get through his task without more defects presenting themselves.

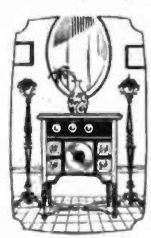
We had heard of four of these superheterodynes having been constructed without success and we wondered whether or not it might not have been just this little slip which has had something to do with the failure to perform.

Approaching the serious, let me say right here that the data furnished with this particular outfit is most complete, and after the errors are eliminated the affair should work out satisfactorily, if not otherwise.

Running along now to the various units, we find that the excellent instruction book accompanying the outfit with a $2.00 ticket, lays stress upon testing out each piece of apparatus before setting it up. This may seem superfluous as the individual units are all new and fresh from the factory. Having been through this thing before we concluded the above to be good advice and accordingly proceeded to carry out the plan.

Out of four variable condensers we found two "shorted"—plates rubbing. One we were able to straighten out, the other was returned and we received a duplicate without any quibbling on the part of the dispensers of the set. Let me say that we have had no trouble in having defective parts replaced. Our principle difficulty lay in getting a rise from any letter asking for information. Three letters brought one reply after a wait of three weeks. Of course, this is part of the "service." Our only object in citing these instances is to give the reader an idea of about what he must expect in case he desires his set in a "hurry." As our Louisville friend says, "Make your own time allowances."

After the condensers, we turned our attention to the radio frequency transformers, type 1716. Out of six we found one broken and two with open secondaries. These were sent back and after a most annoying wait of over six weeks we succeeded in getting them from another source. We have reason to believe, however, that the inability to supply these transformers was not due to any fault of the dispensers of this knock-down set. The hunt for these 1716 transformers was a prolonged and tiresome one and held up the completion of the second set for over six weeks. Radio shops all over Philadelphia and New York were appealed to without success. The transformers apparently were not being released by the manufacturer for some reason best known to themselves.



We are told that "All Gaul is divided into three parts." The word is misspelled. The "u" should be replaced by another "l." Regardless of the number of parts, the whole circus seems to be controlled by a select few. Uncle Sam appears to have discovered this fact recently.

Tripping along, we next turned our undivided attention to the four large by-pass condensers. One of these we found "shorted" between lug and metal housing. This was easily corrected. One 'phone jack needed a slight adjustment to allow of proper contact with the inserted 'phone plug and one lamp socket was defective. Aside from these defects, any one of which would have Daughertyized the completed set, we found everything in good trim.

From the above you can readily see that you will save yourself much annoyance by following the advice to test out each part before proceeding with the hooking-up process.

Having satisfied ourselves that all was in readiness, we proceeded to place the parts as indicated upon the diagram. Here was a long box into which we were to put all this debris and wire it up. How in the name of William Jennings Volstead were we going to get inside this box to work? The instruction book did not say, so after much deliberate thought our son came to the rescue and suggested we take off the bottom of the box. How practical! Who would have thought of such a thing but a young son. We would advise every one to have a young son sticking around even though he does play with the grid leaks and drop them inside the condensers and takes the ammeters, tacking them on his express wagon for speedometers.

Well, we removed several screws and took off the bottom of the box. Easy. Next we attached the panel to this board and, strange to say, we found it just the exact length of the board. For once something fitted perfectly. This encouraged us immensely, so we lighted another cigar, gave the parrot an extra stroke on the back, and during the excitement of a retaliatory bite knocked a perfectly good tube off the table and destroyed its bias completely. Keep all parrots away, as they do not enthuse. The various pieces of appa-

(Continued on Page 30)