

RADIO REVIEW

AND
TELEVISION
News

HUGO GERNSBACH Editor

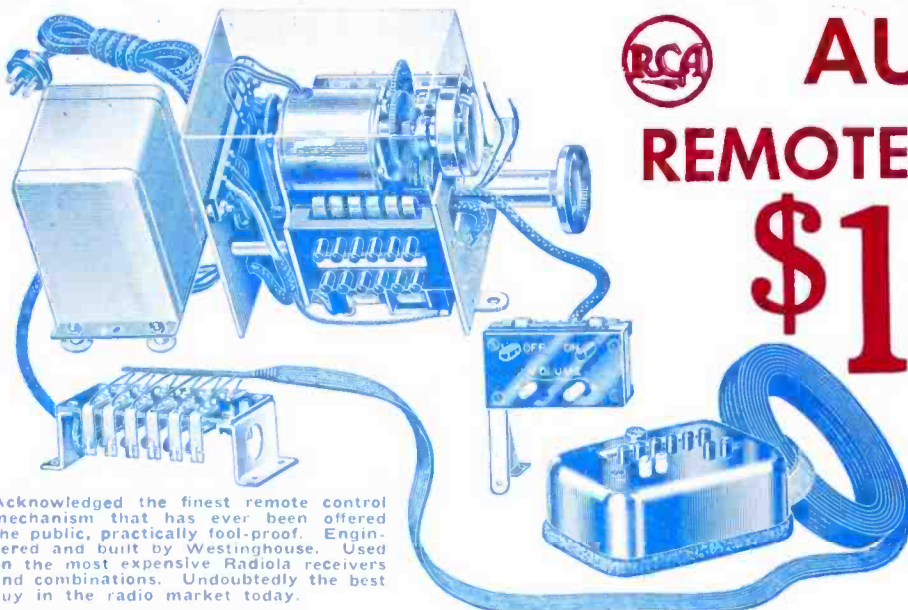


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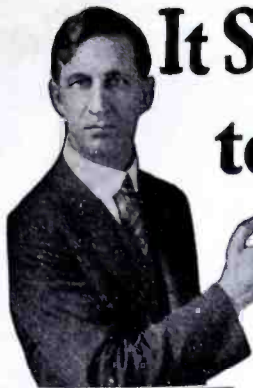
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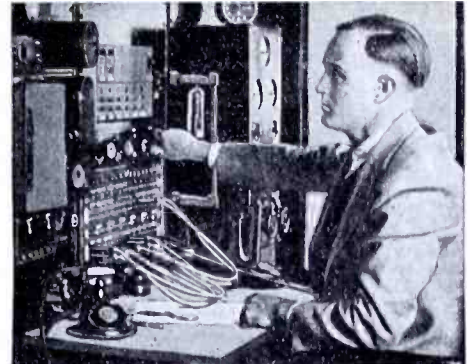
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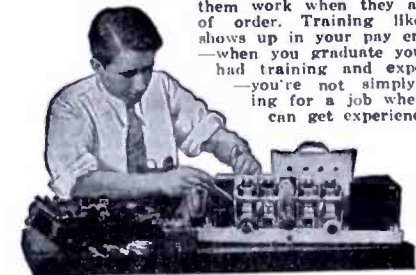
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H. WINFIELD SECOR, Managing Editor
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VOLUME II

NUMBER 6

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RADIO REVIEW & TELEVISION NEWS

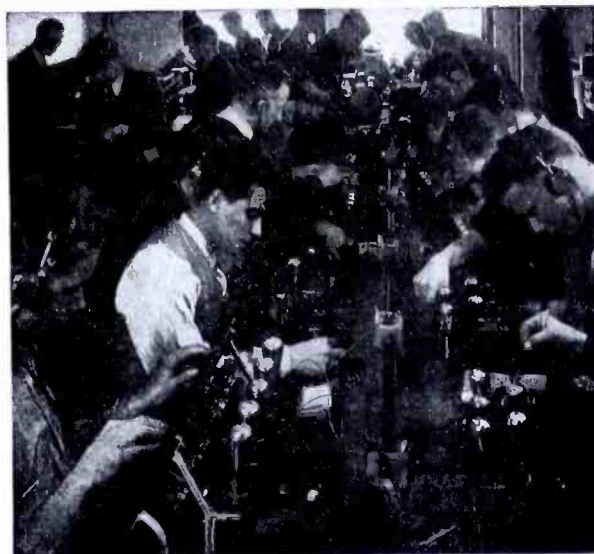
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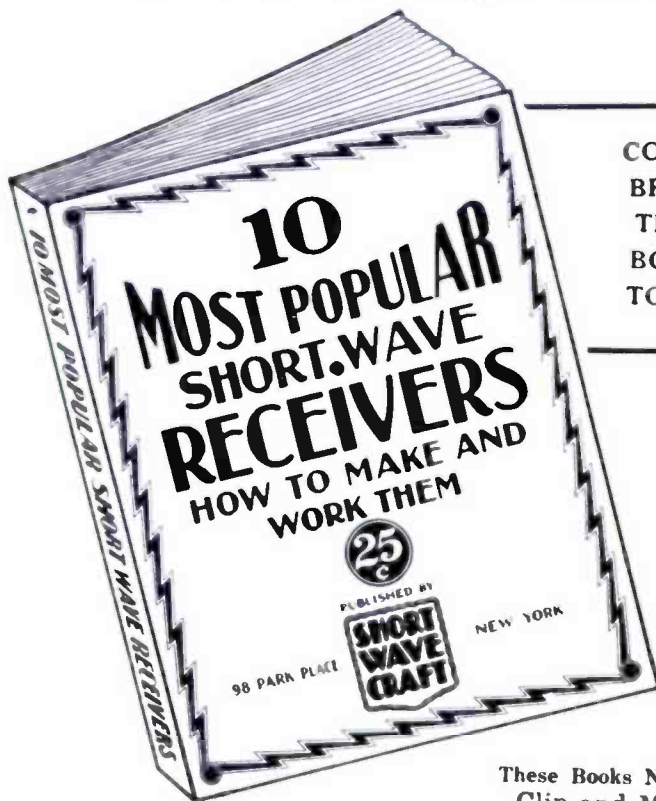
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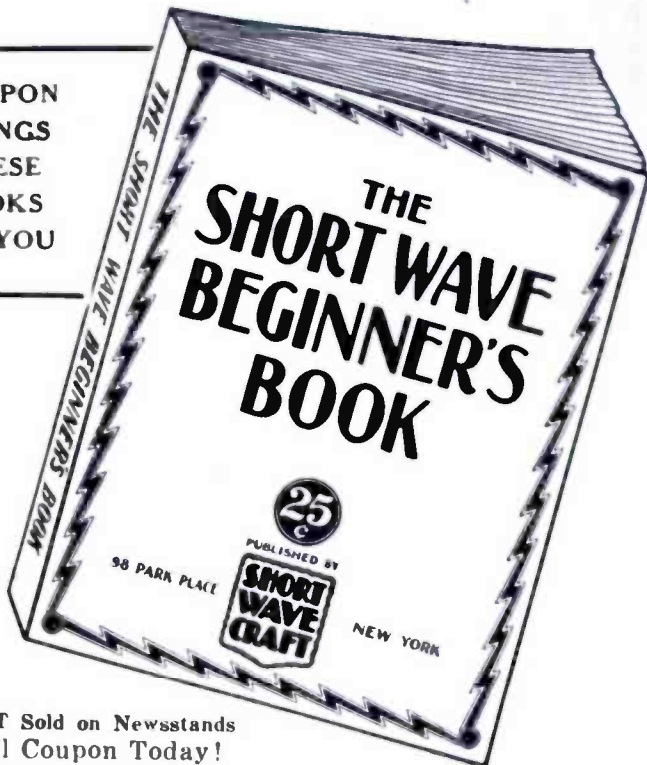
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The book is profusely illustrated with all sorts of illustrations, explanations and everything worthwhile knowing about short waves in this interesting and growing field. Yet without, the book is not "technical." It has no mathematics, no "high-faluting" language and no technical jargon which would only serve to frighten you away. The entire book is kept in popular language throughout. Wherever technical words are used, explanations are given, leaving nothing to the imagination. You are shown how to interpret a diagram and a few simple sets are also given to show you how to go about it in making them. Yet everything has been done to make it possible to give you a complete understanding of short waves from the ground up.

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It abounds with many illustrations, photographs, simple charts, hook-ups, etc., all in simple language. It also gives you a tremendous amount of very important information which you usually do not find in other books, such as time conversion tables, all about aeriels, noise elimination, how to get verification cards from foreign stations, all about radio tubes; data on coil winding and dozens of other subjects.

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VOLUME II NUMBER 6
JANUARY-FEBRUARY, 1933

HUGO GERNSBACK, Editor
H. WINFIELD SECOR, Managing Editor
ROBERT HERTZBERG, Associate Editor

A BOOM FOR EXPERIMENTERS

AN EDITORIAL By HUGO GERNSBACK

● RADIO REVIEW AND TELEVISION NEWS was probably the first American magazine to give constructional information on musical radio instruments. In our previous issue, the first of these was described. In the present issue, still another one is shown, and subsequent issues will have a lot more. As a matter of fact, a fair section of our next issue will be devoted to radio music. Of course, the Theremin musical instrument is not a new device. It has been known for a long time, and while it is still a very interesting electrical instrument, far better ones are now becoming available, and these will be described for builders and experimenters in subsequent issues.

I was particularly impressed last summer when I was in Berlin, to witness the demonstration of the *Trautonium*, which is an entirely different sort of radio musical instrument than the Theremin. The Theremin works by capacity effect: as you move your hand, nearer and further away, the tone changes. With the *Trautonium*, you change the music by sliding your fingers over a wire which makes contact with a long resistance placed underneath it. It is possible, with these new instruments, to imitate anything from a piccolo to a bass drum, and you can imitate a cello just as well as a saxophone or an oboe, or other brass instruments. These instruments produce marvelously clear and pure tones, impossible to obtain from present-day musical instruments.

Best of all, these new electronic musical instruments require but few radio parts, and can be assembled by any experimenter without much trouble. Another great advantage is that such an instrument, which can imitate all pieces of an orchestra, takes up little room, much less, in fact, than a midget radio set. Most of these instruments use only one or two tubes, and by means of a loudspeaker coupled to your radio set, they fill the entire room with beautiful music. Separate amplifiers, of course, can be added if desired.

During the next few years there will be a tremendous new industry developed in this electronic music. Radio manufacturers are already beginning to put radio music instruments of this type on the market, and there is no telling how far the movement will go.

My important message to experimenters is this: get into this radio music art as quickly as possible, and learn everything that is to be known! Pretty soon, the industry will require men who know the new art from the ground up, and those who have been experimenting privately will naturally be available first when the call comes, as it certainly will.

For the experimenter, the new electric music art is a brand new paradise, and it is difficult to restrain one's enthusiasm on the subject.

Radio experimenters during the next few years will discover that there is a new boom in this particular phase of radio, and thousands of them will be building all sorts of radio musical instruments of this type, either for pleasure or for gain. It seems that the public is taking even more avidly to the new art than it took to radio broadcasting.

At a recent private demonstration which I witnessed, there was shown a simple instrument of the *Trautonium* type. Those who attended all wished to have the same instrument (which, by the way, does not cost more than \$25.00) that the radio engineer who had built it for his own personal use suddenly found himself with 12 orders on his hands which he had not anticipated. He is now building the instruments for his friends.

Remember that music never was a fad, and is in itself a staple fixture in our lives. That is why I predict that radio music will have a great future, because it is something that will grow with time. It is not a fad, or something that the public will get tired of.

RADIO REVIEW AND TELEVISION NEWS IS PUBLISHED ON THE 5th OF EVERY OTHER MONTH — THE NEXT ISSUE WILL BE PUBLISHED MARCH 5th

Editorial and Advertising Offices, 96-98 Park Place, New York, N. Y.

A HOME MADE ELECTRIC "THEREMIN"

Electric musical Instruments are the latest craze. Here is one you can build out of ordinary radio parts and accessories, many of which you may already have on hand.

● ELECTRICAL instruments that produce weird music at the wave of a hand are enjoying a wave of popularity both in the United States and Europe. The German radio press in particular is full of articles on the subject, and many radio constructors are making good use of spare radio parts in assembling outfits for their personal use.

The originator of the idea is Professor Leon Theremin, a famous Russian scientist. Several years ago, when he introduced his apparatus in the United States, Theremin received great acclaim, and he even gave a demonstration at the Metropolitan Opera House, in New York, that was attended by numerous society people. The Radio Corporation of America manufactured a "Theremin" for commercial sale, but for some reason or other—possibly the high cost of the instrument or the difficulty of playing it properly—it never really "caught on."

Revival of Interest

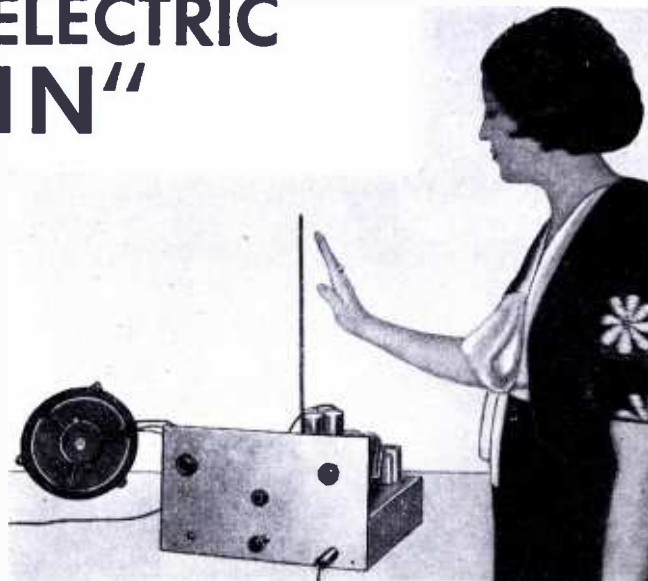
The present revival of interest may be traced to a better understanding of the principles involved and to the greatly reduced cost of radio parts. A duplicate of the first "Theremins," built four years ago, would have cost a radio experimenter as much as a small automobile, and when it came to a choice most experimenters naturally decided automobiling held out more promise than Theremin-ing.

Two Oscillators Used

Essentially, musical instruments of the Theremin type consist of two radio frequency oscillators accurately adjusted to the same frequency so that the "zero-beat" condition results. That is, no audible sound is heard from a loud speaker connected to a "mixer" tube, or to an audio amplifier fed by such a tube. This effect is familiar to every experimenter who has ever played with a regenerative radio receiver.

A metal rod or ring connected to the grid of either of the oscillator tubes is the controlling element. If the operator merely brings his body or hand near this rod, the capacity change that results is enough to shift the frequency of the particular oscillator circuit. The zero-beat condition is thus disturbed and a heterodyne note equal to the arithmetical difference in frequency between the two oscillators is set up. By waving his hand, and thus making the capacity variation irregular, musical tones of great purity may be obtained.

The variety of tones that can be obtained with an arrangement of this kind depends naturally on the ratio of the body-capacity change to the overall capacities in the oscillator circuits. The choice of the most advantageous oscillator settings is entirely a matter of



Appearance of the completed "Theremin," showing the position of the hand in relation to the tone rod. The loud speaker is at the left.

experiment, as described later in this article.

Easily Made

A simple "Theremin" using radio parts can easily be made at home. The model illustrated on these pages was made by Clifford E. Denton according to suggestions contained in *Das Theremin Musikgerat*, published by Deutch-Literarisches Institut J. Schneider, (Berlin). Standard American parts are used, so the American constructor will have no difficulty in following the specifications. The complete circuit diagram is given on the next page, along with details of the oscillator coils. The accompanying illustrations show the construction in clear form.

Construction

If the chassis is purchased ready made a great saving in time is possible, although many will want to make their own. Care should be taken to see that all holes are correctly drilled and that the proper parts are bought or used so that the finished unit will have a professional appearance.

Mount the power transformer so that the power or primary terminals are near the rear of the chassis. Mount all the sockets including the speaker plug socket, which goes on the rear of the

chassis. Use a rubber grommet to protect the power cord from chaffing where it enters the set.

Mount the three electrolytic condensers and the choke on top of the chassis. Use a long screw on the inside end of the detector socket so as to hold the choke in place. Most of the resistors are held in place by the wiring. The small tubular type coupling and by-pass condensers are similarly supported.

When mounting the General Radio jack used to hold the pitch variation rod be sure that it is well insulated from the chassis with washers. Check this point by means of an ohmmeter or any other simple continuity test.

Note that the tuning condensers are mounted on the chassis and are not connected or fastened to the front panel. The only thing mounted on the front panel is the small 7 plate vernier condenser.

The rest of the assembly follows conventional lines and any one with experience in radio set construction will find this a simple task.

Wiring

Before the setup is wired it is wise to wind the coils. Obtain two pieces of bakelite tubing 3 inches long and 2 3/4 inches in diameter. Starting a short distance from one of the ends of a form, wind on 20 turns of number 28 S.S.C. wire. Leave a small space and wind on 25 turns of the same kind of wire. The remaining coil is then placed on the form and has a winding length of one inch. This last winding has 68 turns. Both coils have the same number of turns but have different methods of connections at their terminals, as indicated in Fig. 1. Figure 2 shows the spacing between the windings and screws serving as terminals.

Anyone following Figs. 1 and 2 will have no trouble in constructing the coils. The coils are held in place with two small "L" type brackets and should be bolted down carefully. Poor mounting and poor connections will make it difficult to main-

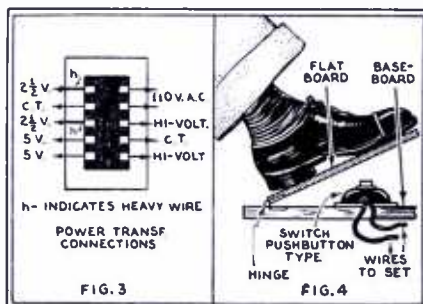
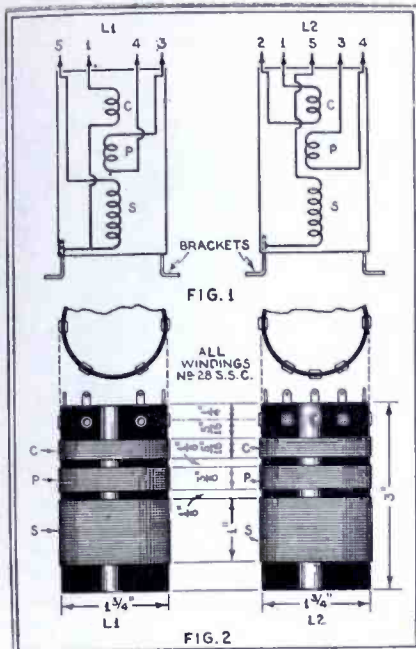


Fig. 3: details of the transformer connections. Fig. 4: how the foot control is constructed.



Details of the two oscillator coils, which can easily be made at home.

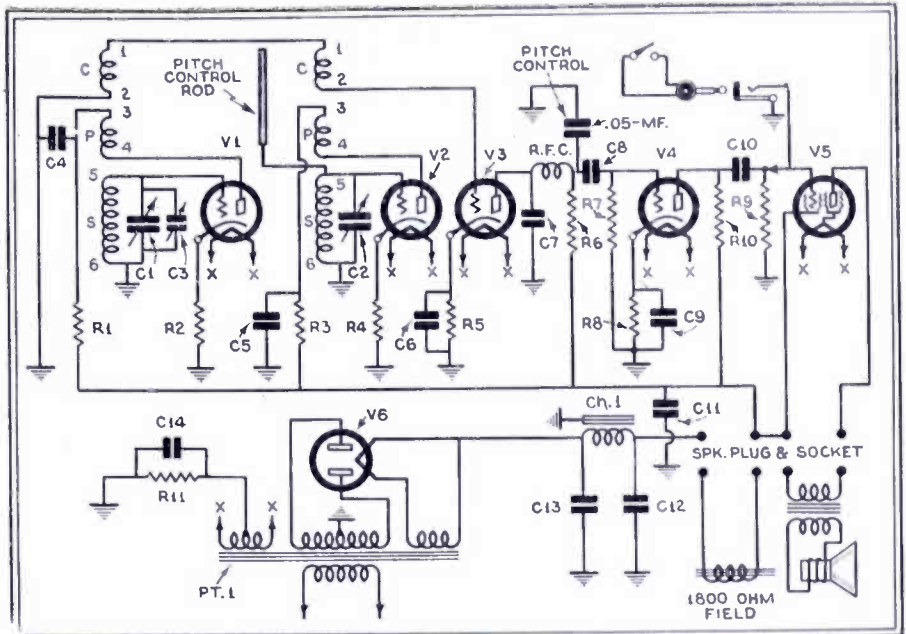
tain a constant pitch output when the Theremin is played.

The power transformer connections are indicated in Fig. 3 and will help speed up the wiring if the power transformer is purchased without an accompanying diagram. Any one who has built a radio receiver or a power amplifier will have no trouble in wiring this unit and it should be done in a few hours. Solder all connections well and be sure that everything is bolted down.

Operation

To place the Theremin in operating condition simply connect the speaker, insert the tubes and plug the power plug into the electric wall socket.

Tune condensers C1 and C2 until the sound emitted by the loud speaker is a low pitched growl. Then adjust condenser C3 until the growl stops. Move the



Complete schematic diagram of the home made "Theremin". Experimenters will quickly recognize the two oscillators and the audio amplifier.

hand near the rod and the pitch should increase until it becomes inaudible. Note that with every change in the position of the hand that there is a change in the pitch of the sound coming from the speaker.

A muting switch is needed to stop the sound, otherwise the output of the Theremin is continuous. This mute is necessary so that the musical tones can be held for any desired period of time. The foot controls this action; see Fig. 4.

Volume control is manual in operation and is mounted on the front panel. Playing one of these instruments is good exercise. You need two hands and one foot to do it right!

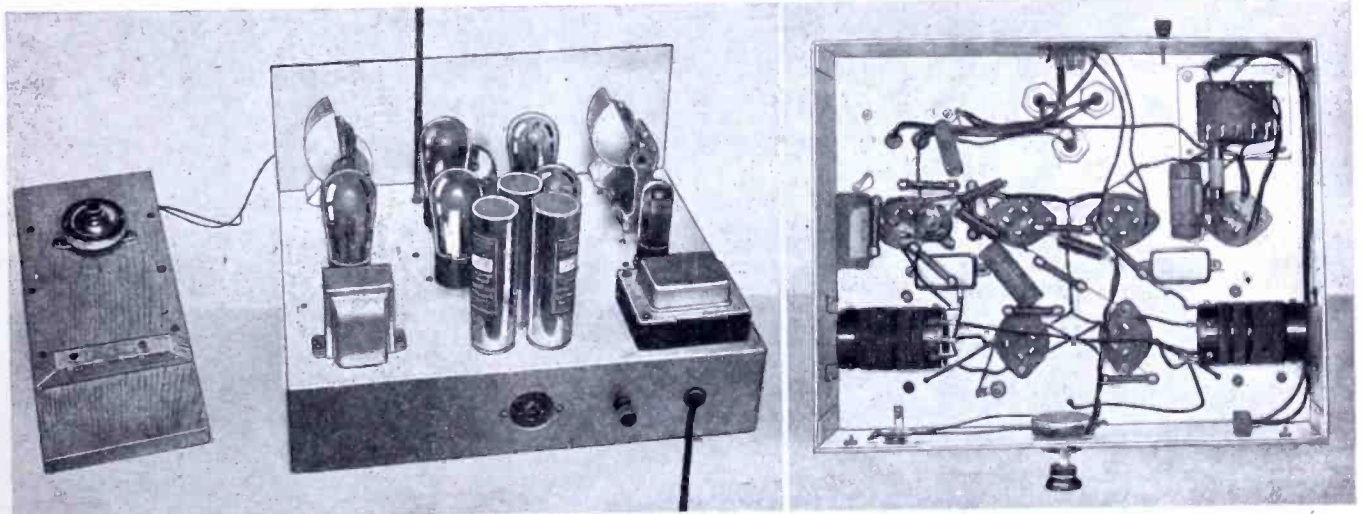
Try various settings of the tuning condensers to obtain the best range and quality of tone. The original model works best with the tuning condensers at the point where the plates are half

meshed. Each Theremin should be tried carefully and the best setting of the tuning condensers noted or the condensers should be locked in the best position.

Parts List

- Two—National Tuning Condensers, .0005 mf. (C1, C2)
- One—Pilot 7 plate Midget Condenser. (C3)
- Two—Flechheim By-pass Condensers, Type GF-10. (C4, C5)
- Two—Flechheim Dry Electrolytic Condensers, Type (C6, C14)
- Two—Flechheim Tubular Condenser, Type AZ-18, .015 mf. (C8, C10)
- One—Flechheim Tubular Condenser, Type AZ-8, .001 mf. (C7)
- One—Flechheim Dry Electrolytic Condenser, Type (C9)
- Three—Flechheim Dry Electrolytic Condensers, Type (C11, C12, C13)
- One—Blair R.F. Choke. (R.F.C.)
- Two—International Resistors, 15,000 ohms, 1 Watt. (R1, R3)
- Three—International Resistors, 2,200 ohms, 1 Watt. (R2, R4, R8)

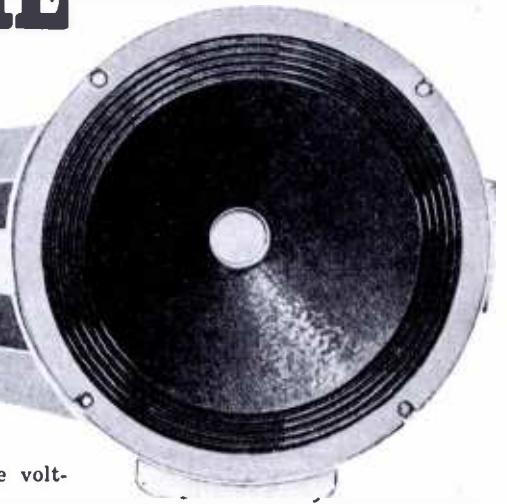
(Continued on page 301)



Left: Back view of the complete "Theremin" chassis, with the foot control switch at the extreme left. The socket on the back of the chassis is for the loud speaker plug. The single binding post is for the ground connection. The arrangement of parts is easy to follow. Note the power transformer at the right, the filter choke at the left, and the

cluster of three filter condensers in the center. The oscillator tuning condensers are fastened to the front panel. Right: Under view of the chassis. The parts are evenly distributed and the connections are short and simple. All wiring is done on the under side of the chassis. The small resistors and condensers are held in place by their own wires.

MATCHING THE LOAD



● NOT LONG ago I sold one of my loud-speakers. I didn't sell an output transformer with it, for the purchaser had a multi-ratio transformer of his own. A few days later, he expressed some disappointment with the results. The loud-speaker, he said, only gave a surprisingly small volume, considering that he was using a large power tube, and working it right up to the point where distortion began, writes P. K. Turner in *Wireless Magazine*, (London).

So I went to see about it. I found that he had set the transformer ratio so that the loud-speaker behaved like a resistance of twice the tube impedance—as he said, that is the standard value that everyone advises. None the less, by adjustment of the grid bias and the transformer ratio, I at once got a very great increase of volume before the tube began to distort.

Now why was this? Because that "standard" value is not a safe guide at all. Matching the load to the tube is not so simple. But at the same time it is not really at all difficult, and it is well worth learning; so here goes for an explanation of it.

Typical Conditions

First of all, I want to avoid the difficulties introduced by the transformer, so to start with we will consider the circuit of Fig. 1, which shows, in a slightly unusual form, a tube—in this case a PX4—fed with plate voltage through a large choke, and connected to a loud-speaker (shown as the resistance R) through a large condenser. As will be shown later, if the plate voltage is 180 volts and the bias 20 volts, the current from the battery will be 45 milliamperes.

I am going to imagine that the choke is a perfect one, that is, it has negligible D.C. resistance, but so high an inductance that it simply won't allow a sudden change of current. As the D.C. resistance is negligible, there will be no volts loss in it, so that there will be 180 volts on the tube, and the top plate of the condenser will also be at this voltage.

Also, there is no current in R, so both ends of it will be at the same voltage, and so the bottom plate of the condenser will be at 0 volts. There is therefore 180 volts across the condenser—and remember that it is the property of a large condenser that it can receive a short sudden "surge" of current with only a negligible change of voltage across it.

Thus Fig. 1 now shows all the voltages and currents in the circuit.

Increased Grid Bias

Now suppose that just for an instant the grid bias is increased to 30 volts, and that we want to find the current and volts in the plate circuit during that instant. It can be found from the tube curves that if there were no choke or load, the current would drop from 45 to 12 milliamperes. But in the circuit of Fig. 1 it can't do that. The choke, as explained, keeps the battery current at 45 milliamperes, neither more nor less.

What happens, then? The tube *does* take less, but the surplus goes through the condenser and load. We can't find what are the actual currents in any obvious way, even if we know the load resistance: but we can do the opposite; if we assume a current in the load we can easily find out what change of bias caused it.

Thus, suppose there were 10 milliamperes in the load, which is 2,000 ohms. Then there must be 20 volts across it by Ohm's Law, so the bottom plate of the condenser must be at +20 volts, and its top plate therefore at $180 + 20 = 200$ volts. Also, if there is 45 milliamperes going up through the choke and 10 down through the load, there must be 35 milliamperes through the tube. So the condition of the tube at this instant is: plate volts 200, current 35 milliamperes. (Fig. 2 shows the currents and voltages.)

Now look at the tube curve-sheet, Fig. 3. Our original state was plate 180 volts, bias 20 volts, current 45 milliamperes—point A. During the instant of increased bias, we have just found: plate 200 volts, current 35 milliamperes, or point B, corresponding to 26 volts bias. Now work out in the same way some other cases. I will give just one example.

An Example

Suppose the current at some instant is 15 milliamperes up through the load. The top end of the load will be 30 volts below 0, or — 30 volts, and the voltages and currents will be as Fig. 4, that is, plate 150 volts, current 60 milliamperes, point C on the curve-sheet.

If you work out several such cases, you will notice two things. First, all the points so found on the curve-sheet lie on a straight line—the line actually shown through A, B, and C. Second, the *change*

in the plate volts and current in the tube are, exactly, the instantaneous volts and current in the load. So that if we can find an easy way of drawing this line, then for a given change of grid volts we can at once find out the instantaneous load conditions.

Luckily, this is quite easily done. The point A is 180 volts, 45 milliamperes on the scales of the curve. Work out the volts required to drive this 45 milliamperes through the load. In this case it is

$$\frac{45}{1,000} \times 2,000 = 90 \text{ volts.}$$

Add to this the value of the volts for point A: $180 + 90 = 270$. Then the line required is got by joining A to 270 volts on the bottom scale (point D).

If now we want to solve our original problem, of what happens when the bias is increased from 20 to 30 volts for an instant, we have only to see where the 30-volt bias curve cuts the load line. It is at 212 volts, 29 milliamperes. Point A was 180 volts, 45 milliamperes, and the differences are 32 volts, 16 milliamperes, which are the instantaneous volts and current on the load. So the first problem is completely solved. If the load is a pure resistance, and we know what its resistance is, we can draw the "load line" at once, and find what instantaneous current and voltages are produced by any sudden change of grid bias.

Audio-frequency on the Grid

Now suppose that, in addition to the steady bias from the grid battery in Figs. 1 and 2, we have an audio-frequency voltage on the grid. I assume that my readers already realize that the maximum instantaneous grid voltage must not exceed the bias, to avoid grid current which would introduce distortion.

What we shall have will be that the momentary grid voltage will continually vary on either side of its original 20 volts. If the audio-frequency input is 20 volts amplitude (the maximum safe amount on account of grid current), then the grid volts will continually vary between 0 and 40 volts, and the conditions in the load will be given in turn by all the points on the load line between E and F.

This enables us to find quite easily the power in the load. Remember that the

power in milli-watts is the product of the volts and the milliamperes. Both are varying all the time; but there is an easy formula which gives what is called the "effective" power—a sort of average, which gives a true indication of the useful power actually available.

First we find the maximum "swing" of the volts and current between the extremes reached. These extremes are (point F) 238 volts, 16 milliamperes, and (point E) 104 volts, 83 milliamperes, and the swings are 134 volts, 67 milliamperes. Multiply these two together and divide by 8, and we get the effective power. In this case it is 1,120 milliwatts. The product of swings is always to be divided by 8.

Now suppose we try a different load. I have marked on the curve-sheet, Fig. 3, where various load-lines cut the curves for 0 and 40 volts bias. They are marked 1, 1½, 2, 2½, 3, and correspond to 1,000, 1,500, 2,000, 2,500, and 3,000 ohms. If we do as I have just described in each case, we find that the "swings" are, beginning with the 1,000-ohm case, 97, 120, 134, 145, and 153 volts, and 97, 67, 80, 67, 58, and 51 milliamperes, leading to powers as in this little table:—

Load Resistance in ohms	Output Power in milliwatts
1,000	1,170
1,500	1,200
2,000	1,120
2,500	1,050
3,000	980

So that if the input is kept up to the maximum permissible one of 40 volts swing, the output power is a maximum for a load of about 1,500 ohms. Is this twice the plate impedance? Not on your life!

Working Conditions

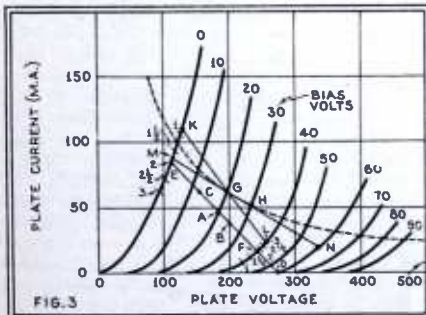
We find the plate impedance under working conditions like this: First take an equal increase and decrease of current from A, and find, on the tube curve through A, the corresponding voltages. Thus, take 55 and 35 milliamperes (that is, 10 milliamperes up and down), and we get 189 and 170 volts. Find the differences: they are 19 volts and 20 milliamperes. Divide the volts difference by the current difference, and we have the plate impedance: in this case it is:—

$$\frac{19}{20} \times 1,000 = 950 \text{ ohms.}$$

(We multiply by 1,000, because the 20 was milliamperes and not amperes.)

Maximum Power

Thus we see that in this particular case the maximum power is got from a



Typical tube characteristic curve (for a British type PX4)

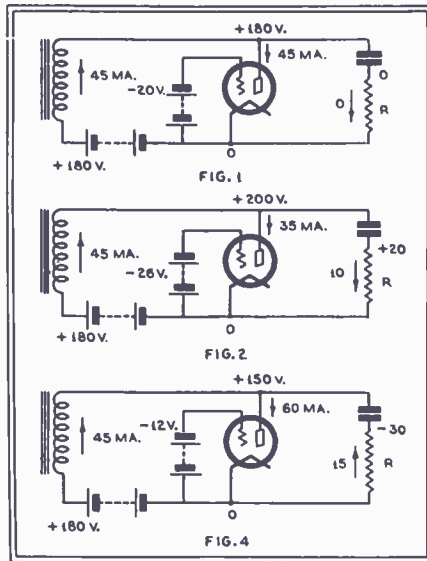


Fig. 1: conditions in typical power tube circuit with output choke, corresponding to point A of Fig. 3. Fig. 2: another set of conditions for the tube of Fig. 1, corresponding to point B of Fig. 3. Fig. 4: third set of conditions for tube of Fig. 1, corresponding to point C of Fig. 3.

load of about one and a half times the plate impedance.

But this is not all the story. This is the maximum power for 40 volts grid swing in each case; but we have paid no attention to the amount of distortion set up. Now a full investigation of the distortion is much too complicated an affair for us to undertake. But there is a very simple approximation which is quite sound for such cases as this, though it will not do for pentodes, or any other case where there is third harmonic distortion.

If we assume that all the distortion is caused by setting up a second harmonic, then we can find it thus: Work out, not only the total swing of current or voltage in the load, but the change from point A in each direction. Thus in the 2,000-

distorted output." This is nonsense, strictly speaking, for there will practically always be some distortion. But it is found that, under the best conditions, distortion up to 5 per cent. is not perceptible, while with a lower quality generally, rather more may be allowed. So let us take it that we will call 5 per cent. "undistorted."

Obviously, the lower values of load resistance, though they give more power for maximum input, cause distortion. So that the undistorted output they must be used with a smaller grid swing. This will reduce the output power, so that it is not at all sure that they will give more power for the same distortion limit.

An Approximation

To make a full and accurate calculation, we should have to work out, for each load-line, how much input would give 5 per cent. distortion, and what would be the output power. But usually we can dodge this very laborious job by an approximation. We can assume that the reduction in power is proportional to the reduction in distortion. Thus, for the 1,000-ohm case, we have 1,170 milliwatts with 12 per cent. distortion, or

$$1,170 \times \frac{5}{12} = 490 \text{ milliwatts for 5 per cent. distortion.}$$

If all the cases are reduced to 5 per cent. distortion, we get the following table:—

Load Resistance in ohms	Output Power in milliwatts for 5 per cent. Distortion.
1,000	490
1,500	700
2,000	800
2,500	1,050
3,000	980 (for 4 per cent.)

(Note that for 3,000 ohms, we can't increase the input to raise its 4 per cent. distortion to 5 per cent., for then we should run into grid current.)

Let us bring together all the above results, together with those for some

Load.	INPUT 40 VOLTS		DISTORTION 5%		DISTORTION 7%	
	Power	Distortion	Power	Input needed	Power	Input needed
1,000	1,170	12	490	25	690	31
1,500	1,200	8½	700	30	990	36
2,000	1,120	7	800	35	1,120	40
2,500	1,050	5	1,050	40	1,050	40
3,000	980	4	980	40	980	40

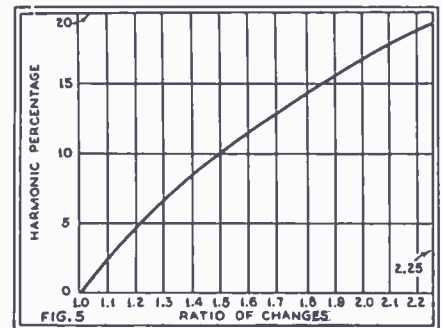
ohm case, the current change is from 45 to 83 milliamperes one way, and 45 to 16 milliamperes the other way, or values of 38 and 29. Find the ratio of these two. It is 38/29, or 1.31. Then look at the curve of Fig. 5. This gives, for a ratio of 1.31, a distortion of about 7 per cent.

If we similarly work out the cases for the other loads, we find:—

Load Resistance in ohms	Distortion for Maximum Input
1,000	12%
1,500	8½%
2,000	7%
2,500	5%
3,000	4%

We all know that it is common practice to talk of so many milliwatts of "un-

other distortion limit—say 7 per cent.—in one table:—



Curve showing percentage of harmonic distortion for various ratios of plate current change.

MODERN TUNING COIL PRACTICE

● TUNING coils are of all shapes and sizes. At the present time small coils appear to be fashionable. Some are made complete with switch and many have a metal cover.

Now, even a properly made coil of small size cannot be as efficient in many ways as an equally well-made coil of larger dimensions, says *Wireless Magazine* (London). The position is the more interesting when we take account of the need for shielding, the characteristics of aeri-als and tubes, and make allowances for the known defects of gang-tuning condensers.

As practical people, we know that the small coil with its relatively high losses is the easiest to handle in any circuit.

A set fitted with small coils is likely to be stable provided the circuit is a sound one.

Small coils are the easiest to gang, because they tune relatively broadly. Owing to their size, they can be placed conveniently near the tuning condenser.

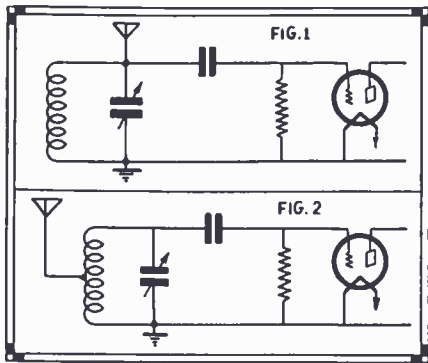


Fig. 1: a direct aerial connection of this kind is not recommended. Fig. 2: a tap on the aerial coil provides better coupling.

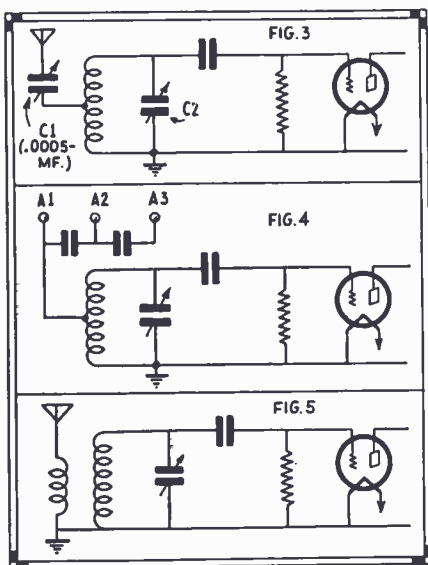


Fig. 3: an antenna series condenser gives good control of coupling. Fig. 4: adjustable condensers are satisfactory in many locations. Fig. 5: a separate primary coil is effective.

Short connecting wires can then be used, which reduce troubles from coupling.

And so we can go on, accepting the small coil because, speaking generally, it can be used with little trouble.

We look to the tuned circuits for selectivity and we know that the strength of the signals applied to the first tube and the amount of the amplification at high frequency depends to an extent upon the coils.

Coils Must Match Set

Tuning coils must be designed to suit the rest of the set. Thus, if the receiver is a simple two-tuber, having a detector and power tube, the question of instability hardly arises.

We desire the best selectivity and maximum input to the detector tube. Very special selectivity is not required as, presumably, the set will receive only the local stations and one or two others. With favorable circumstances, a few more stations may easily be within range, but the point is that a set of this nature can receive at good strength only a limited number of stations.

Indeed, it may well be definitely harmful to provide good selectivity involving a sacrifice in signal strength. We might conclude, therefore, that a really good coil is what is needed for a small set, as this coil will provide fairly good tuning and strength.

With a small coil the results would definitely be inferior. We could, therefore, use a large coil for the medium wavelengths, having, for example, 55 turns of No. 22 or 24 silk or enamelled wire.

There would be no sense in joining this good coil directly in the aerial circuit as in Fig. 1. For one thing, the tuning would be poor and, secondly, the strength of the signals applied to the detector would be less than the maximum obtainable. You should tap down the coil, as in Fig. 2.

A tap half way, to which the aerial is connected, might prove much better. The selectivity would certainly be better. But whether or not the strength would be greater depends upon the size and nature of the aerial.

If this were a small one, it might be found that the strength is about equal to that obtained when the aerial is joined nearer the top of the coil.

When a large aerial is used, however, the strength will almost certainly be greater and experience shows that a tap about one-third from the bottom or earth end is usually the best.

The selectivity will improve as the tap is made nearer the earthed end. But the signal strength will not be found to increase in this manner. Considering signal strength alone, as you tap down from the top or grid end of the coil, the signal will at first improve, and later will weaken as the tap is made nearer the ground.

The actual results depend upon the wavelength of the signals as well as up-

on the size and "goodness" of the coil and the details of the aerial.

As the wavelength of the circuit is increased, its losses fall. The result is that you might easily find that the best results are obtained at 250 meters with a tap one-quarter up from the earth end; at 350 meters, one-third up; and at 500 meters, half up.

So you see that if you fix one tapping point for the aerial connection, the results cannot be the best possible over the whole tuning range. A good idea is to provide three taps.

This may not be convenient, however, because switching must be considered. A single tapping must then be used if possible.

But how are we to get over the difficulties of loss in signal strength and selectivity? An adjustable condenser fitted in the aerial lead to the coil or switch will help matters considerably. With such a condenser, joined as in Fig. 3, and having a maximum capacity of .0005 microfarad, the effective coupling of the aerial to the coil may be varied over a wide range and the effect is somewhat like altering the tapping position.

Effect of Aerial Condenser

Let us start with the condenser C_1 of Fig. 3 set at its maximum capacity. If you tune to a station and then short-circuit this condenser, the chances are that the results will hardly be affected after a little retuning.

Now reduce the capacity. Immediately three things happen. First, the main tuning condenser C_2 must be increased a little. This shows that an effect of lowering the capacity of the aerial condenser C_1 is to reduce the amount of the capacity effectively across the tuned circuit composed of the coil and C_2 . Condenser C_2 must, therefore, be increased in capacity a little to maintain the circuit in tune.

The next thing you are sure to notice is a change in the selectivity. The selectivity will have improved, the tuning being sharper. This is because the load due to the aerial is now reduced.

The tuning may be very much better and you might now find it is possible to hear clearly the two local stations, whereas before one could be faintly heard, although the circuit was fully tuned to the other.

There will also be a change in the signal strength. It might have increased or decreased. If you are testing with the coil tapped half-way and the circuit is tuned to above about 400 meters, the chances are that the strength will have increased, especially if a good outdoor aerial is being used. With a small aerial the opposite result may well be obtained. There is no other effect to be noted. If there is reaction, and there usually is with a detector and power valve circuit, it will be found that less reaction is required to make the circuit oscillate. This

should be so, as the load has been reduced.

Now suppose that the capacity is still further reduced, the moving plates being turned almost nearly out of the fixed plates. There will be no doubt as to the effects produced. The tuning will be much sharper.

No doubt the signals will be greatly weakened, the regeneration will have to be reduced in order to avoid oscillation, and the coil-tuning condenser will have to be increased a little to bring the circuit once more fully into tune. You can, therefore, obtain a fairly wide range of tuning, including selectivity and strength, merely by altering the value of the aerial coupling condenser C_1 . This method is, therefore, a valuable one.

If you note the effects and tune properly, very good results can be obtained. The best use can be made of the aerial system and the coil, but care must be taken to note exactly what happens.

Briefly, if you reduce the capacity of C_1 (Fig. 3), the capacity of C_2 , the tuning condenser, must be increased a little, and the regeneration must be reduced a trifle in order to avoid oscillation.

The strength varies most when the capacity of the aerial coupling condenser is changed from a large to a small value. It is possible that the great strength of the local station may be so cut down by turning C_1 to its minimum position that it can hardly be heard.

Thus we have here a good volume control, but it must be remembered that a change in C_1 must be followed by a change in C_2 and also the reaction, when critical reaction is being used.

In any case, the best results at all wavelengths cannot be obtained from a coil having the aerial joined to a single tap and a number of taps on the adjustable coupling condenser ought to be used.

If the extra tuning control is objected to, then the arrangement of Fig. 4 is usually satisfactory. Three aerial terminals or sockets are used. One is taken direct to the tap on the coil and the others are connected through fixed condensers of .0002 microfarad each. In one position the two condensers are in series, forming, in effect, a .0001-microfarad condenser.

The tap would in this case be chosen to give the maximum strength at the highest wavelength. Then at a point about half way in the tuning range, the second aerial connection with the .0002-microfarad condenser would be used. For extra selectivity, the third connection would be made, both condensers being in circuit.

Instead of tapping the coil, a separate winding may be used (Fig. 5). In general, the aerial winding should have from one-third to a half as many turns as the grid coil (Fig. 6). A fairly fine wire may be used for the aerial coil, such as No. 28 or 30.

If this is wound as in Fig. 6, the results will be quite different from when there is a space between the coils as in Fig. 7.

You will find, if you wind the two coils upon separate forms, beginning the windings near the edges, that the signal strength, selectivity, and tuning may be altered by altering the distance between the coils.

As they are separated, the selectivity is improved; in fact, the effect is much the same as tapping the aerial towards the earthed end of the coil of Fig. 1.

But if a large aerial coil is used, and

testing at, say, 300 meters, the distance between the coils is increased to improve the selectivity, it will be found that the results at longer wavelengths, such as 500 meters, have been affected, too.

In fact, the coupling may be altogether too weak, that is, the distance between the coils may be much too great for satisfactory results. To obtain the best results, the coupling ought to be made variable, and if this were 1923, instead of 1932, we would fit an adjustable coupling and get good results.

The best fixed arrangement is to fit the aerial coil about $\frac{1}{8}$ in. from the grid coil and to have the grounded ends together as in Fig. 8. Then, either tap the aerial coil or use the fixed condensers as shown. If a volume control is needed and the best results are desired at the expense of a further control, fit an adjustable .0005-microfarad tuning condenser in the aerial lead and use it as described above.

It is important to have the two grounded ends of the coils together. Let us see what would happen if we placed the aerial coil at the grid end of the grid coil, as in Fig. 9.

There would be a capacity coupling between the aerial and the grid. The selectivity would be affected, particularly at the lower wavelengths, signal strength would suffer, and the tuning would be affected as the aerial condenser was altered. It is bad practice and should never be used.

Always have the aerial coil at the ground end of the grid coil. When the aerial coil is tapped, the regeneration coil should go at the grounded end, as shown in Fig. 10.

When the regeneration coil is in this position, the regeneration circuit will have the minimum effect upon the tuning of the circuit as a whole, and the proper regeneration effects will be obtained.

There is usually but little to choose between connecting the regeneration condenser between the plate of the detector and the coil, and between the ground and one end of the coil.

If a metal panel is used, the moving plates of the regeneration condenser can be grounded, but when the panel is of bakelite or wood, there is little to choose between the two methods of connecting.

Notice the direction of the windings for the right results. When the grid coil and the regeneration coil are wound in the same direction, the outside ends go to grid and plate respectively. The inner ends then go to earth, the regeneration condenser being included in the circuit in the plate or earth side without affecting the results.

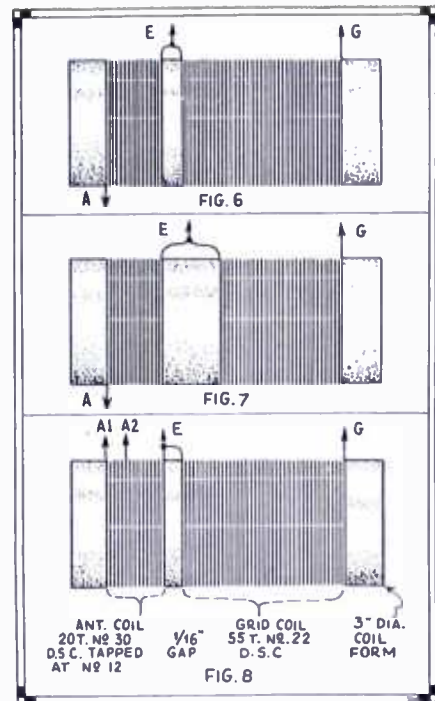
When we come to consider the long-wave coil, we find that the principles discussed for the medium-wave circuit apply in detail.

A separate aerial coil can be used or the grid coil can be tapped. A slotted form is often used, and the aerial section may have one-third or a half as many turns as the grid coil. But now a difficulty is nearly always met with.

If you tune over the lower end of the long-wave circuit, say from the minimum, which might be 900 meters, to 1,400 meters, the medium-wave local station may be heard. The medium-wave station is said to be "breaking through."

Sometimes the aerial circuit itself, consisting of the aerial and the portion of

(Continued on page 295)



Above: three different methods of winding and connecting the primary and secondary of a typical tuning coil.

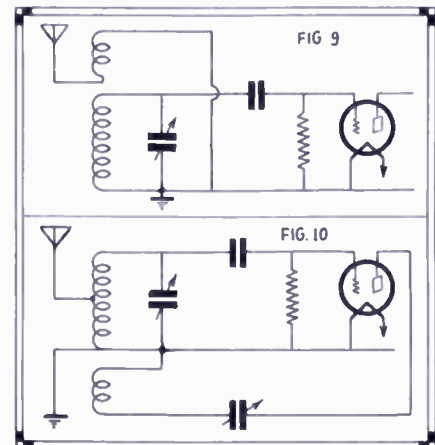
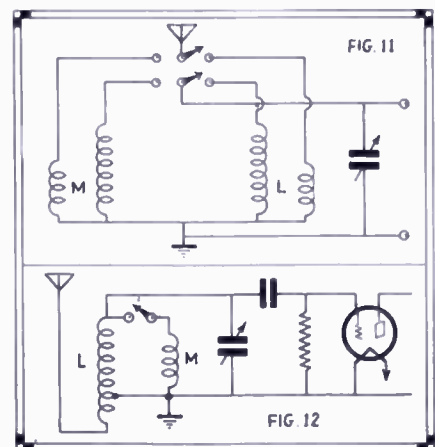


Fig. 9: placing the primary over the grid end of the secondary is bad practice. Fig. 10: proper method of placing the tickler in a regenerative circuit.



Above: two methods of switching from medium to long wave adjustments.

A BAND PASS THAT YOU CAN ADD TO

Many receivers that are only two or three years old suffer from inadequate selectivity. This simple unit will help considerably.



The band-pass unit is small and inconspicuous and may readily be placed next to the broadcast receiver.

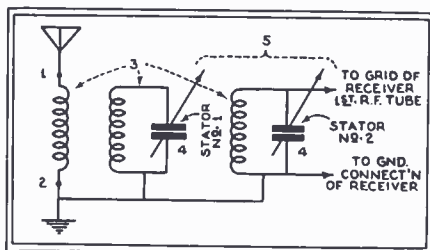
● THERE must be many receivers in general use today which, although possessing adequate sensitivity for long-range reception, have been reduced to the status of local station sets solely because they lack the requisite selectivity to cope with the conditions obtaining today on the broadcast wavebands. This state of affairs need not necessarily continue, for with but little alteration to the receiver its selectivity can be greatly enhanced, writes H. B. Dent in *Wireless World*, (London).

This can be achieved in one of two ways: either the R.F. resistance of the tuned circuits can be reduced or they can be increased in number. So far as the first mentioned alteration is concerned it is very doubtful if a very marked improvement can be effected in this direction just at present.

Little Alteration to the Set

Since it would seem that an increase in the number of the tuned circuits is the most satisfactory line of attack, the next consideration is how best to apply this without drastic alteration to the receiver. A single tuned circuit interposed between the aerial and the set offers a ready solution, but as there would then be three tuned circuits all adjusted to resonate at the same frequency—assuming one R.F. stage is employed—it is highly probable that the quality will show distinct signs of deterioration due to the attenuation of the side bands with three fairly sharply tuned circuits in cascade.

To preserve the quality it would then be necessary to apply compensation to the A.F. amplifier, but this entails considerable alteration to the set and



Simple schematic diagram of the band-pass unit. Note that there is only one common connection between the three windings; however, they are coupled magnetically.

would hardly seem justified in view of the fact that the additional unit can be designed to provide quite adequate selectivity without impairing the quality of reproduction.

So far as this matter is concerned the writer would venture the opinion that the addition of the band-pass filter to a set not so equipped will lead to an improvement in the tonal quality as well as affording a degree of selectivity not possible of attainment with the simple aerial tuning systems in vogue but a year or so ago.

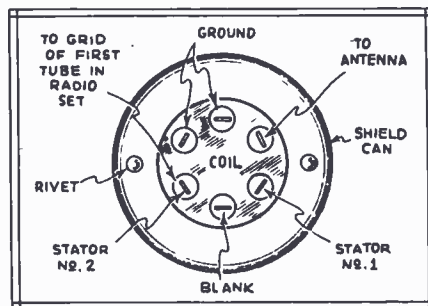
The general arrangement of the circuit employed for the unit is shown in the theoretical diagram.

The coils are wound on the same form and form an R.F. transformer with a semi-aperiodic aerial winding. The secondary coil of this transformer is tuned by one section of the condenser, which is a two-gang assembly, while its companion, is employed to tune the second coil in the filter. Both sections are fitted with small trimmers.

Construction and Wiring

The construction of this unit is simplicity itself. If the parts used are as specified the chassis can be obtained drilled and folded ready for use. If other parts are used the chassis can be had cut to shape but drilled for the sockets only. Of course, you may follow your own ideas as far as mechanical construction is concerned.

Mount the tuning condenser with small brackets, being sure to solder two connections to the stator plate terminals and passing these wires down through holes in the chassis made for this purpose. Mount the band pass coil in the hole cut for it at the rear of the chassis. Put the antenna-ground unit on the rear wall of the chassis, place the front panel into position and fasten the dial into place. The actual assembly will take a few min-



Bottom view of the band-pass coil, showing the six connection lugs as they come through the hole in the aluminum sub-panel.

utes and the wiring can be done in about five minutes more. The coil should be wired in as shown in the sketch indicating the connections on the bottom of the coil. These connections are made looking at the soldering terminals on the bottom of the coil.

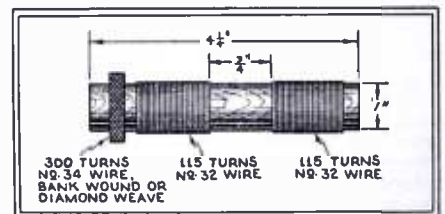
Operation

Disconnect the antenna from the radio set and connect it to the antenna terminal of the band pass unit. Connect the ground to the ground post of the band pass unit and run the flexible grounding wire from the unit to the ground terminal of the receiver. Connect the wire marked "to grid of receiver 1st R.F. tube" as per directions. A screen grid cap is shown in the illustration as the model was used with receiver employing a screen grid tube in the first R.F. stage. If a 26 or a 27 type tube is used in this stage some other means will have to be used to make the connection. The Alden Mfg. Co. makes several adapters that can be used for this purpose.

Tune in a signal on the receiver and adjust the compensating condensers on the band pass tuning unit for the best results. In many cases the distance getting ability of a set can be improved by the addition of this tuning unit, especially in cases where the first tube of the radio receiver is of the untuned type. Do not connect the output of the band pass tuner to the antenna-ground terminals of the set as this will result in a loss of volume which will nullify the benefits which can be obtained from such a unit.

Not a Wave Trap

The band-pass filter described in this article is not to be confused with an ordinary wave trap, whose function it is to eliminate the interference from a strong local station. The filter actually adds to the selectivity of the receiver by virtue of its tuned and loosely coupled circuits. While it adds another control to the tuning operation, the results it produces are well



Details of the band-pass coil. The winding form may be a bakelite tube, or a cardboard tube if its thoroughly treated with paraffin to prevent shrinkage.

FILTER ANY RECEIVER

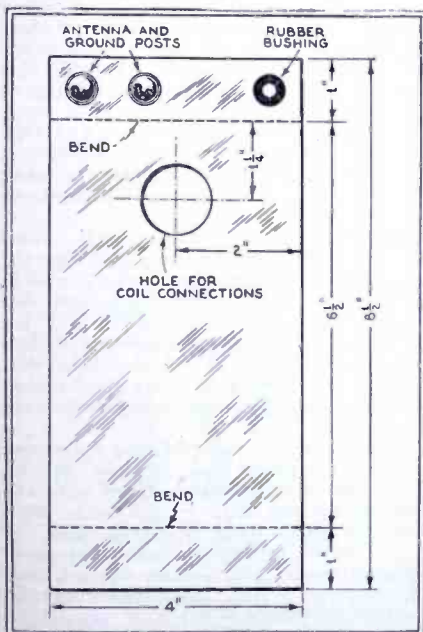
worth the slightly greater tuning effort that is involved.

If your receiver is troubled with excessive interference from only one nearby station, and operates satisfactorily at all other dial positions, a simple wave trap will do the trick. This may consist merely of a 1 inch cardboard tube, with a primary consisting of 30 turns and a secondary, $\frac{1}{4}$ inch away, of 115 turns, both of No. 32 DCC wire. Connect the primary directly in series with the aerial lead to the set, and shunt the secondary by a .00035 mf. variable condenser. Nothing else is connected to the secondary. The receiver is turned on and a station tuned in. Turn the wave trap condenser slowly and you will find a point at which the interfering station disappears, without affecting stations on other wavelengths.

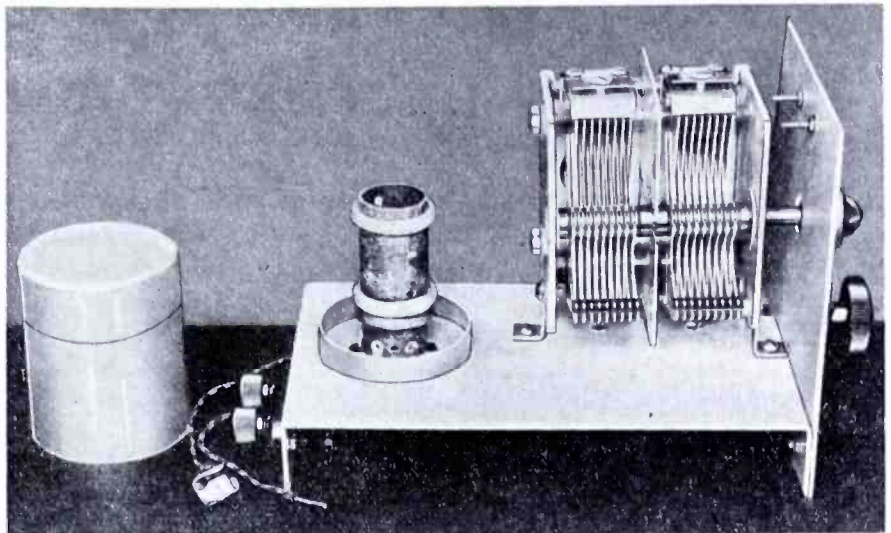
The use of a wave trap of this kind has no effect on the selectivity, sensitivity or tone quality of the receiver to which it is connected. Its purpose is merely to offer a high impedance path to signals of the frequency to which it is tuned, and low impedance to all other frequencies. Of course, if you want to hear the interfering station, you will have to detune the wave trap circuit slightly. Keep a note of the previous dial setting for reference purposes.

Parts List For Filter

- One Blan Aluminum chassis and front panel.
- One Eby antenna ground terminal strip. (1, 2)
- One Genwin Band pass coil. (3)
- One Premier Electric Co. two gang .0035 mf. tuning unit. (4)
- One National tuning dial type B mid-get 0-100-0. (5)



Details of the simple aluminum sub-panel.



The complete unit with the shield cover removed to show the coil standing upright. Note the flexible wires with the screen grid cap at the end of one of them.

WHAT CAN THE SHIELDED ANTENNA ACCOMPLISH?

● WHEN the period of crystal detectors was over and the tube receiver got more and more public acceptance, every sort of antenna was used, and one hardly worried about using the most favorable type, says *Das Funkmagazin* (Berlin). As long as household electrification was more or less in an infantile stage and the receivers and sound reproducers were not made too sensitive, this might be all very well. With the increase in sensitivity, which went hand in hand with the increasing use of inside and make-shift antennas, matters changed, all the more so since the electric industry insisted on placing more and more electrical appliances and medical apparatus into the hands of the public.

Now comes the (German) Union of Electrical Plants and declares that installing interference protective devices is unnecessary, if one only uses the proper antenna. By "proper antenna" is meant the shielded antenna, i.e., a high antenna, in the case of which simply the lead wire, from the part of the antenna projecting out of the "static fog", running to the receiver, is shielded.

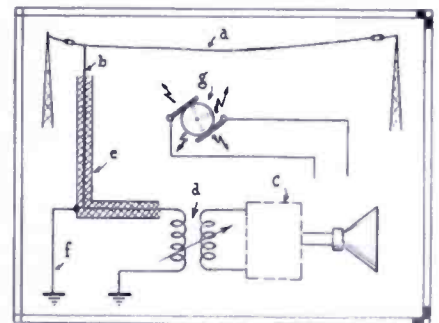
Accordingly, the lead wire running from the high antenna to the receiver must be shielded, to obtain a separation from the local field of high tension apparatus in the house. As we well know, however, this local field is conveyed not only by the electric wires but generally also more or less by all the pipe lines in the house.

For the shielding a metal pipe is recommended. This is arranged at a sufficient distance from the antenna lead-in wire, which runs through its axis. The metal pipe, which takes up and conducts away the local field, is grounded, as in the illustration. We have at *a* the insulated high antenna;

b is the lead-in wire to receiver *c*, which is to be coupled as loosely as possible at *d*; *e* is the shielding, which in the case at hand can be grounded at *f*.

There is no doubt that this arrangement, which looks very simple on paper, works, since for example the disturbing currents produced by a radio disturber *g* (motor commutator) are induced in the shield wire *b* and conducted away to the ground at *f*.

In practice such a shielding pipe cannot be put conveniently on a large city house. There is only the possibility of using as shielded conductor a properly made lead-in cable. Such cables are now on the market, and indeed in very efficient design. For instance, the lead-in conductor consists of stranded copper wire, which, to give the greatest possible space between wire and outside covering, is surrounded with paper, muslin, rubber, etc. Around the thus formed cable core is pressed a seamless tin-lead or braided wire covering.



The source of the interfering noise is represented here by "g", the shielded lead-in by "b-e".

THE SCREEN GRID TUBE AS DETECTOR

A special article by an authority in the tube world that will be read with interest by all who like to do simple experimental work

● DURING the past few years we have heard a very great deal about screen-grid tubes of all sorts, makes and characteristics, and it may be safely said that there can hardly be a modern receiver employing radio-frequency amplification which does not utilize the properties of the screen-grid tube, says F. E. Henderson in *Wireless Magazine* (London).

Amplifying Action

The way in which the screen-grid tube works as an amplifier has been described many times and most amateurs are now familiar with the peculiar type of characteristic shown by the screen-grid (or tetrode) tube when compared with an ordinary triode, but up to the present this class of tube appears to have been employed practically wholly as an amplifier of radio-frequency signals.

Now there appears a tendency to extend the use of this variety of tetrode to include the detector position in a set, and many receivers are now appearing on the market which utilize a screen-grid detector.

It will be of interest, therefore, to have a look at this type of tube and its characteristics for a few moments with particular reference to how it operates in the detector socket.

It should first be realized that every detector tube, apart from a simple diode rectifier, is in effect both a rectifier and amplifier in one bulb. Thus, in a plate-bend rectifier use is made of the curvature of the plate current characteristic to rectify the radio-frequency signal, and of the straight part of this characteristic (if any) to deal with the de-modulated signal voltage for passing on to the output circuit.

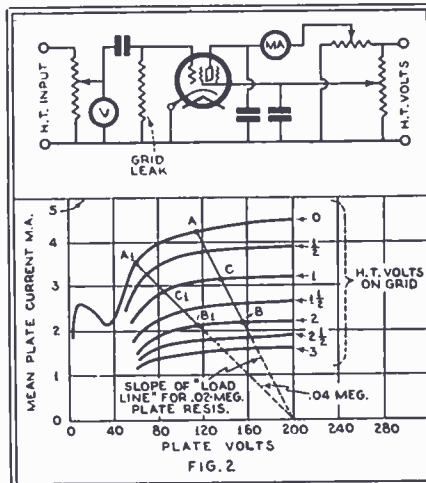
In the grid-leak detector, which is

more commonly employed, rectification is effected wholly in the grid circuit, the de-modulated signal being applied to the plate circuit which, in effect, becomes an audio-frequency amplifier.

It is not the purpose of this article to discuss the relative merits of plate-bend and leaky-grid rectification, but owing to the well-known disability of the plate-bend detector to rectify highly-modulated carrier waves of radio frequency without distortion, and the more universal use of the leaky-grid rectifier in consequence, we shall consider the screen-grid tube as applied to the leaky-grid method of detection.

Input Voltage

Perhaps it is not generally realized that with any tube working as a detector the load resistance and the input signal



Set of plate current, plate voltage curves for a screen grid tube working as a detector. Above: typical detector connections for this type tube.

voltage applied is as important, if not more important, than with a loud-speaker power tube if distortion is to be avoided; also the effect of different degrees of modulation on the carrier wave must be considered.

Fig. 1 shows a set of current plate voltage curves for an ordinary triode working as a detector, the curves being drawn for different values of radio-frequency signal voltage applied to the grid circuit.

Unequal Spacing

It will be seen that the distances between the sets of curves are not evenly spaced, the curves widening out when a certain signal voltage is applied and crowding together again as the signal voltage is increased.

Now let us consider the effect of introducing some form of loading into the plate circuit, which may take the form either of a pure resistance or of a trans-

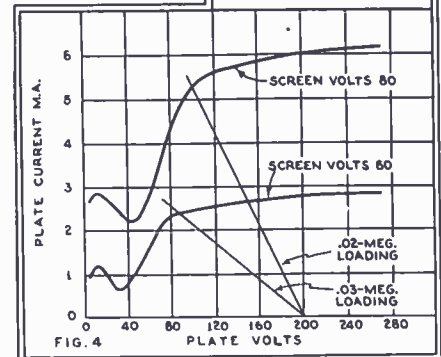
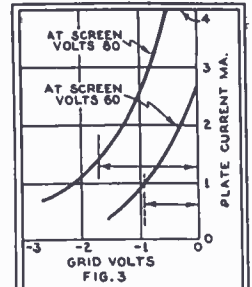


Fig. 3: how low screen voltage limits the grid signal input. Fig. 4: how high screen voltage limits plate load resistance and output voltage.

former or choke. As with a power tube, the introduction of a resistance into the plate circuit causes a certain voltage drop across the resistance when current flows through it, and the amount of the voltage drop will vary according to the plate current.

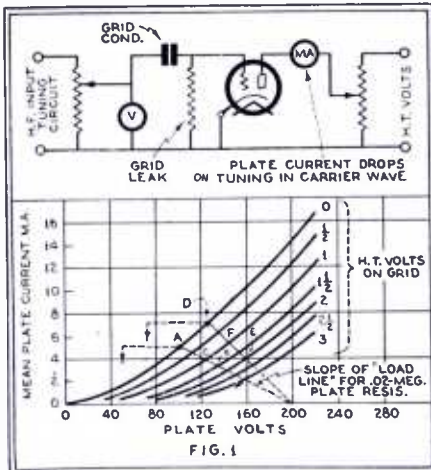
This can be shown diagrammatically by drawing what is known as the "load line" across our set of characteristic curves. Suppose the plate resistance is 20,000 ohms and the plate supply voltage 200 volts. By Ohm's Law the current flowing through a resistance of 20,000 ohms with a voltage drop of 200 equals 10 milliamperes ($C = E/R$), and thence by drawing a straight line connecting 200 volts and 10 milliamperes on the curve the slope of the load line can be obtained.

This cuts the tube curves, and where it cuts them indicates the change in plate current for any given signal voltage applied to the grid circuit. It will also give the actual applied plate voltage at any moment.

For this particular load line and tube it will be apparent that the least distortion will be obtained for a drop in mean plate current from A to C milliamperes as shown.

Suppose that the value of plate resistance were decreased by half, giving the straight line cutting the curves D and E, it will be seen that the plate current can now be allowed to fall from D to F for the same percentage absence of distortion, but it could be shown also that with a lower value of plate load resistance the output available from the tube is reduced.

There is a best value of load resistance which, for a given drop in plate current, on tuning-in the desired signal with the least distortion will at the same time give the best output from the tube. If care is taken to avoid overload by some form of pre-detector volume control, very high values of load resistance may be employed without danger of distortion, in spite of the fact that such resistance might exceed the optimum value for best
(Continued on page 296)



Set of plate current, plate voltage curves for a typical triode working as a detector. Above: typical connections for a grid leak detector circuit.

A COMPLETE CRYSTAL RECEIVER IN A TOBACCO CAN

Here is a clever but simple little novelty that you can make in an evening. No tubes or batteries are required



The tobacco can crystal receiver in operation. The man is shown adjusting the knob of the tuning condenser

● WITH 50-kilowatt broadcasting stations springing up all over the United States, a complicated multi-tube receiver is not necessary for the person who is satisfied to listen to one or two programs. Not only are tube receivers getting smaller and smaller, but even the good old fashioned crystal outfit is returning to popular favor. The fact that a crystal detector requires no batteries or other sources of local current is a big feature in its favor as far as a lot of people are concerned.

Work Done In Short Time

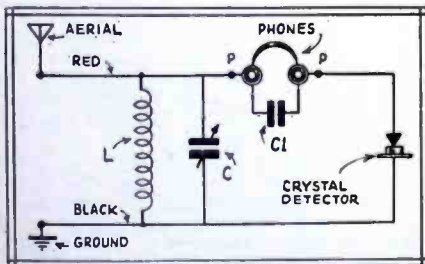
A simple, effective crystal receiver can be built into almost any small container, such as a tobacco can, candy box, etc. Clifford E. Denton, following a suggestion published in the Danish radio magazine *Popular Radio*, rescued one of his Edgeworth tobacco tins from the waste basket and in a couple of hours converted it into a neat little set that produced creditable signals from a dozen stations in and around metropolitan New York. Of course, a good outside aerial and a sensitive pair of earphones help matters considerably.

The tobacco can contains a fixed tuning coil, a small compression type variable condenser, a crystal detector of a new type, and an earphone bypass condenser. These are built up in L-shaped form, so that the whole assembly can be slipped into the can after all the wiring has been completed. Flexible wires about two feet long are used for the aerial and ground connections, while two tip jacks are provided for the phone cord.

The circuit, as shown on this page, is the simplest imaginable direct coupled affair. The tuning condenser is connected across the coil, with the crystal detector and earphones in series and across the tuning combination. The tuning is rather broad, but interference between stations is not as bad as you might expect with a single tuning circuit.

Compression Type Condenser Is Used

The tuning condenser is one of the old X-L "Variodens-



Schematic diagram of the tobacco can crystal receiver. L, tuning inductance, C, tuning condenser, C1, .001 mf. bypass condenser, P,P, phone tip jacks.

Close up of the finished unit removed from the can. J, phone tip jacks, D, crystal detector, L, tuning coil, C1, "Variodenser" tuning condenser, C2, .001 mf. phone bypass condenser. The detector is adjusted by means of the little knob protruding through the right end of the case.

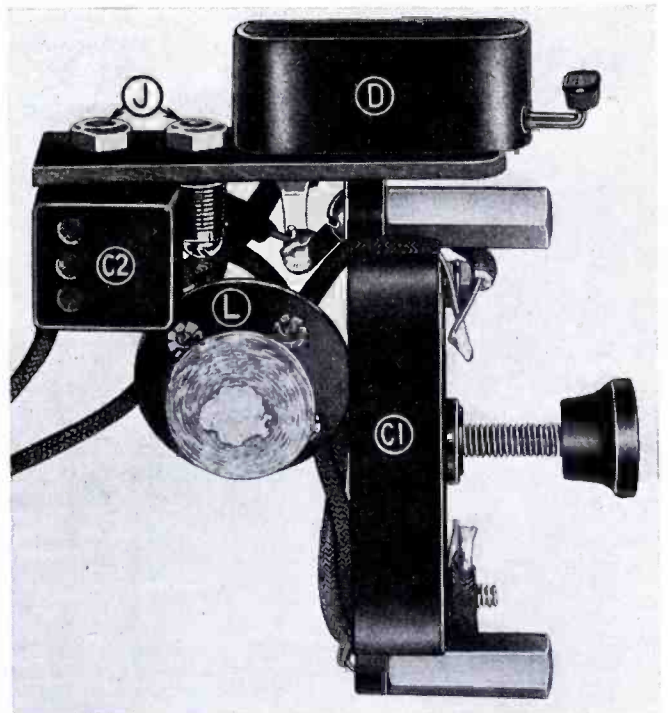
ers", which were very popular several years ago for neutralizing, trimming and balancing purposes. The model G-5, which has a capacity range of 100 to 500 mmf., is just right for the purpose. For those readers who are not familiar with this type of condenser, we might state that the capacity is varied merely by the movement of a springy metal plate against a flat fixed one, the position of the flexible plate being controlled by a screw pressing against it. Of course, the plates are prevented from shorting by a suitable insulating dielectric. As the screw must be turned through several complete revolutions to adjust the condenser from minimum to maximum capacity, the instrument cannot be used with a dial or other indicating device; this shortcoming is of no consequence with a simple crystal receiver because the setting is not critical anyway.

Covered Crystal Detector Has Long Life

The crystal detector used by Mr. Denton bears the descriptive name "Piggly Wiggly." It is much better than the old-fashioned open detector, the crystal itself and the cat-whisker being enclosed in a neat molded bakelite case only 1½ inches long, ½ inch wide and ½ inch high. The cat-whisker is adjusted from the outside by means of a little red button. With this type of construction the crystal is protected against natural oil from the fingers and retains its sensitivity almost indefinitely.

The tuning coil is a special Find-All lateral wound unit, consisting of 130 turns of 10-41 Litz wire on a wooden spool ¼ inch in diameter. The completed coil is ¾ inch in diameter and about ¼ inch thick. Of course, you can make your own

(Continued on page 301)



THE "VOLUME" SPEAKER

A clever novelty that can be made by any experimenter.

● ALTHOUGH this loudspeaker is primarily designed for use with the "Volume" Three set, it will work equally well with any other set. For those of you unfamiliar with the "Volume" Three series I should explain that it commenced with a "three tuber" built into a hook, or to be more precise, a wooden case camouflaged to resemble a book, says S. Gassman in *Popular Wireless*, (London.)

Surprising Punch

It had two A.F. transformer-coupled stages and these, in conjunction with the special aerial coil, gave surprising punch for so small a receiver. There followed the battery case, which consisted of two volumes fixed side by side with the inside open to accommodate the "A" and "C" batteries and storage battery or power equipment.

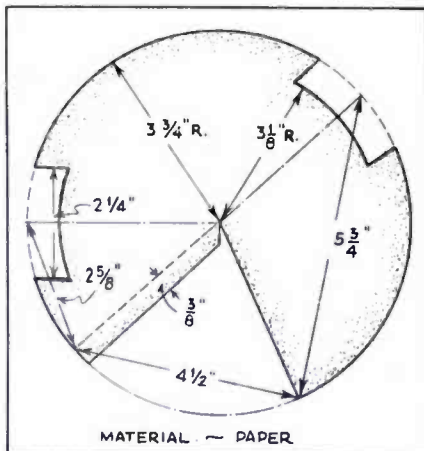
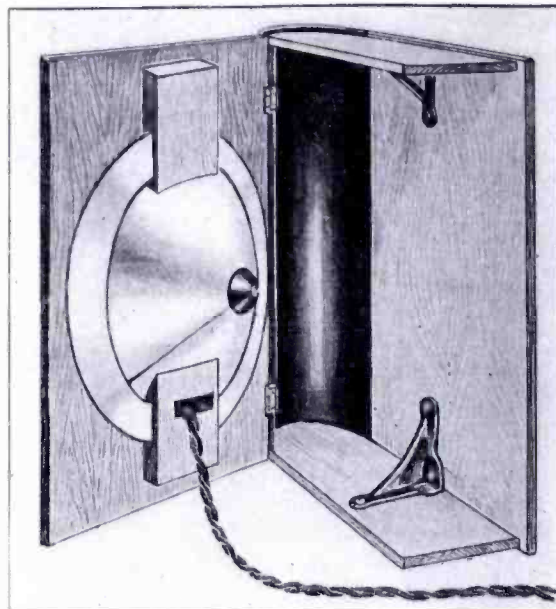
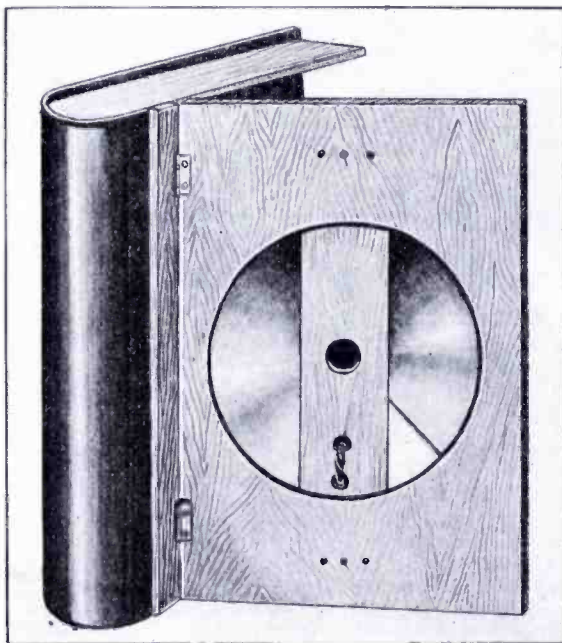
Mystifying Your Friends

The loudspeaker described in this article is the third and last of the series and forms the fourth "edition."

Besides entertaining you through the ordinary channels, this series may provide you with amusement at the cost of your family or friends who, not knowing of the contents of the volumes and hearing but not seeing the set, would be highly mystified.

You will see from the photographs that the loudspeaker is a cone type, with a reed-movement unit. This is mounted to one of the sides which is hinged to the main framework so that the loudspeaker can be swung in almost any direction.

But before proceeding with the construction it is advisable to check up two points. First, that the speaker will not be too large for your bookshelf; and secondly, that the side that holds the speaker is on the side best suited for your requirements.



Right above: the book speaker swung open. Above: Cone dimensions. Below: the cover is covered with cloth to conceal the speaker.

The two sides, top and bottom are of wood. The curved back is made of copper sheet which you will find easily workable.

You will also observe two small panel brackets screwed inside the framework for extra strength and rigidity.

The sizes of wood that will be required are as follows. One side, 11 in. x 8 in.; the other, 11 in. x 7 1/2 in. The top and bottom ends are both 9 in. x 3 in., while there are two more odd pieces, one 11 in. x 1/2 in., and the other 10 in. x 2 in. All the wood is 1/4 in. in thickness.

Cut With a Pair of Scissors

The curved back, which is made of thin copper sheet, is of gauge No. 22, and measures 11 in. x 4 3/4 in. The metal can be cut with a large pair of scissors, but your dealer will most probably cut it to size for you if you ask him to.

The side that measures 11 in. x 7 1/2 in. has a hole in it

6 1/8 in. in diameter. The centre of the hole should be 4 in. from one of the long edges (which subsequently becomes one of the front edges of the case), and 5 1/2 in. from an adjacent edge.

If you use the loudspeaker unit shown here, then the strip on which it is mounted should have a hole 3/4 in. diameter in it in its exact centre. Two smaller holes should be drilled below this, both 1/4 in. diameter and of distances 1 1/2 in. and 2 1/2 in. respectively from the 3/4-in. hole.

All Ready to Start

The larger hole is for the loudspeaker adjusting screw, while the smaller holes carry the loudspeaker flex in such a way as to prevent it touching the cone.

With the exception of the top and bottom ends, the various pieces of wood are now ready for assembling, but a little care is required in getting the shape correct on the top and bottom ends. 1 1/8 in. from one end draw a line parallel with it and mark off its centre. Then, with a radius of 1 1/8 in., draw an arc. This will give the shape of the end. Behind the line drawn, that is to say, on the side nearest the curved end, another line should be drawn parallel to it 1/4 in. away. This line indicates the position of the back edges of the two sides that are eventually to be fixed to it.

Repeat these operations on the piece of wood that is to become the other end, and having finished this the various sides and ends are ready for assembling.

Lay the bottom end of the case-to-be on the bench with the curved end furthest away. The 8-in. wide side should be fixed to it with its bottom edge also on the bench and with its back edge in the position you have marked on the curved end, you will remember this was the line nearest the curve.

The top end is then fixed 1/4 in. down from the top of the side and the metal brackets as shown in the photographs.

Next to be fitted is the 1/2-in. wide strips to which the baffle is to be hinged. Secure it in a similar manner to the opposite side, i.e. with its back edge on the indicating line and its bottom edge resting on the bench.

(Continued on page 298)

MODIFYING LOUD SPEAKER "TONE COLOR"

● **SOME** years ago, I remember, there was a good deal of talk about devices for controlling the tone of a phonograph, I mean an ordinary acoustic phonograph—this was before the days of electrical reproduction. One or two devices which were brought out at the time seemed to me quite effective. I thought there was a decided improvement obtained by their use, says Dr. J. H. T. Roberts in *Popular Wireless* (London).

Of course, it depended on the skill of the operator, as the control could be varied from one moment to another during the actual playing of the record. It was not unlike the method of control of an automatic piano.

Opinions differ a good deal about this question of tone control, particularly as applied to the ordinary phonograph. Some people say that you cannot "improve on nature," so to speak, and that when the record is turned out by the manufacturers it is as nearly perfect as possible, so that any modifications introduced by the user can only have the effect of making it less faithful to the original.

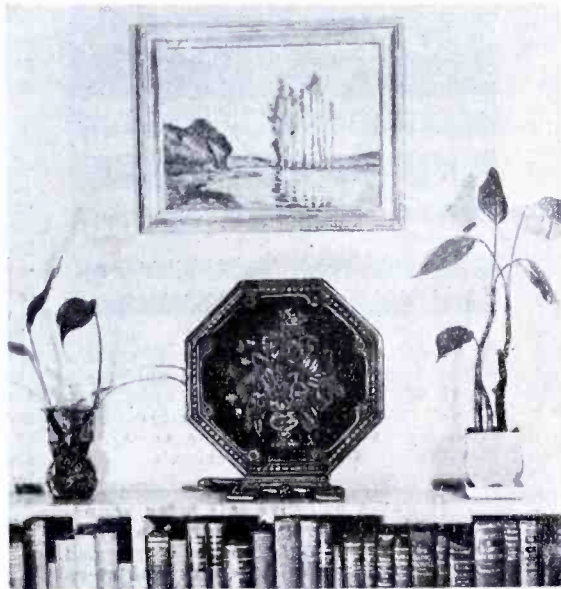
Back to Normal

In these days, however, when we are so largely concerned with radio apparatus and electrical reproduction of records, we use various appliances and components which were not considered at the time of which I am speaking, which was a few years back.

Tone control has, therefore, taken on a new meaning, and interpreted in its best sense it means to bring the reproduction back to normal after it has been accidentally been modified by the characteristics of the various components which have been used. The loudspeaker, for example, must impress its own particular characteristics upon the reproduction, and what with tubes, transformers and other components, the reproduction often departs very sadly from the original by the time it reaches the listener.

The purpose of tone control, as we understand it to-day, is to neutralize these effects, so far as may be possible, and to put back into the music or speech what has been taken from it, or to take away what has been accidentally added to it.

To-day tone control as applied to a radio receiver has become extremely popular, and even those who urged objections against what they regarded as unjustifiable interference are rapidly being converted. Tone control, or tone "coloring," as it is sometimes pictur-



esquely called, is, in fact, quite the rage in the United States, and many manufacturers of radio sets have had great success with sets of which "tone color" is the outstanding feature.

Selective Modification

It is important to distinguish between *tone control* and *volume control*. Probably the simplest way to appreciate this distinction is to bear in mind that true *volume control* simply means a raising or lowering of the volume as a whole without differentiating between high or low notes, while *tone control* means a *selective* modifying of the higher or lower parts of the register, so that the balance is definitely altered.

When the *volume control* is used it simply means that the loudness of the reproduction is increased or decreased, but there is no effect upon the general character of the sound. When the *tone control* is operated, however, the character of the sound is definitely modified.

On the one hand it may be raised in general pitch, becoming clearer, even possibly shrill, while on the other hand it may be lowered in pitch, made rounder

and fuller, even to the extent of becoming "woolly" or "boomy."

I should perhaps mention that practically all devices for tone control act by cutting down some part of the register. For instance, if the overall tone is too high pitched, then a high-note "suppressor" may be used, which simply has the effect of cutting down the higher-pitched tones and so rendering the lower register *relatively* (but not *actually*) louder. In the same way, if the overall tone is low and boomy, it can be raised and clarified by the use of a low-note suppressor, which cuts down the lower frequencies and thereby brings the higher frequencies into greater prominence.

There are various types of tone control, but the simplest arrangement is one which is adapted to be connected across the output of the set or across the terminals of the loudspeaker. If this arrangement is intended to suppress or bypass the higher frequencies it makes use of a *condenser*, while if it is intended for the lower frequencies it makes use of a *choke*.

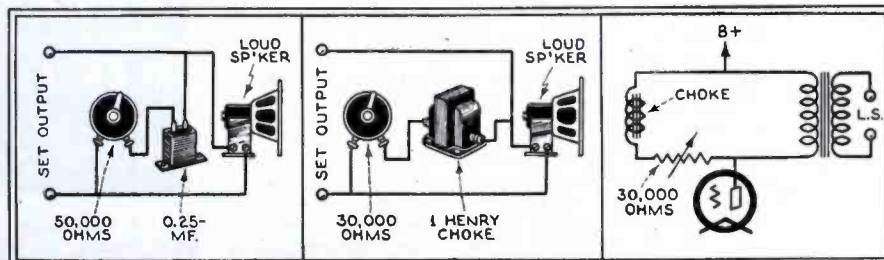
You know that the higher the frequency of alternating or intermittent current the more easily it is able to pass through a condenser. The condenser, therefore, is a much easier path for the higher acoustic frequencies than it is for the lower frequencies.

If we take a condenser of sufficient capacity and shunt it across the loudspeaker terminals, clearly it will bypass the higher frequencies, and the extent to which it bypasses the frequencies will become less and less as the frequencies become lower and lower. This, then, is the basic principle of the high-note suppressor.

For general purposes a fixed condenser of about $\frac{1}{4}$ mfd. will be suitable, and it only remains to introduce some method of regulating the amount of the effect produced by this condenser.

The regulation is easily introduced by connecting a variable resistance in series with the condenser (the pair in series being then connected across the loudspeaker terminals or output of the set.) A variable resistance of 50,000 ohms is often used, although actually somewhat lower values of resistance will frequently be found suitable.

You will see that this resistance in series with the condenser acts as an obstruction to the bypassing of the loudspeaker current. Let us imagine for the moment that the resistance is enormously high, then clearly no matter how large the capacity of the condenser (Cont. on p. 297)



The first two diagrams are self-explanatory, in the first case a condenser being employed instead of a choke as in the second instance. The principle of the latter method is shown by the third diagram.

SOUND FROM DRAWINGS!

A new scheme for producing harmonies from geometrical patterns through the medium of photo-cell apparatus.

● BRITISH talking picture engineers have already "manufactured" a human voice by drawing with India ink the sound track of a talkie film.

Now German scientists are experimenting with the production of harmonies from geometric patterns and a well-known Berlin film song writer has succeeded in turning regular geometrical patterns into musical harmonies. This composer, Oscar Fischinger, finds that after sitting down at the drawing table and patterning simple geometrical outlines, angles and curves, he can by photo-cell apparatus translate these into sound, says *Amateur Wireless* (London).

Definite Relationship

There are, indeed, as ascertained by Fischinger, strange correlations between geometric figures—strict mathematical forms and patterns—on the one hand, and musical works on the other. Sounds are patterns and patterns can be made to sound by talkie projectors. In fact, when transferred to a talkie film, patterns will assert their inherent tonal qualities, as sounds and tunes. The immediate acoustic relations between any given geometric systems, their instrumental *timbre*, can be ascertained experimentally.

Some examples will give an idea of the effects of various wavelengths:—

Fig. 1 is a wave picture of the note C in three different octaves. Fig. 2 shows three different notes from three octaves, Fig. 3 the three notes F Sharp, C Sharp, D Sharp, and Fig. 4 illustrates five different C's, inserted into one another.

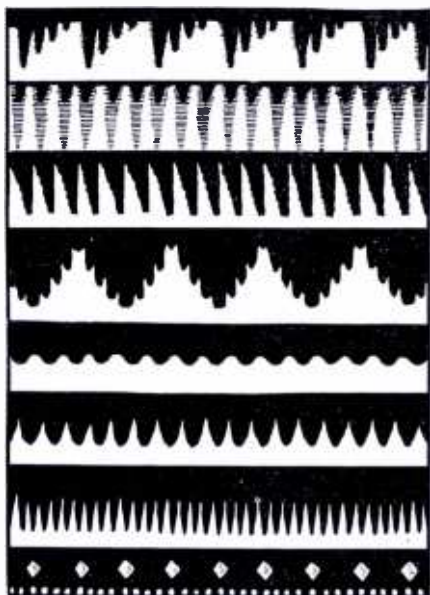


Fig. 1 (top).—Three C's of different octaves. Fig. 2 (centre). Three different notes of three octaves. Fig. 3 (bottom)—Three notes, F sharp, C sharp and A sharp, sounding simultaneously.



In order downwards: Fig. 4. Three C's in a tone pattern. Fig. 5. One note played at various intensities. A sound pattern showing variation of timbre. Fig. 8. The sound pattern of the voice of a German singer.

Flat waves will give soft notes, sounding as though from a distance, whereas those drawn at right angles correspond to sounds of normal strength and steep waves to sounds of excessive intensity. Fig. 5 strikingly illustrates these differences in behavior. Fig. 6 next shows how the quality of sounds can be further changed by varying the wave form as desired, how soft and floating as well as heavy and massive sounds, how loud and abrupt sounds, on the one hand, and soft evanescent sounds, on the other, can be produced.

Rings Sound Like Bells

The characteristic *timbre* of given instruments is rendered with surprising faithfulness by given geometric figures. Some concentric rings, e.g., as in Fig. 7, will result in the sounds of an electric bell, of which their very ornamental arrangement is reminding.

Another geometric figure, which in the talkie projector corresponds to the sounds of a flute, bears a striking resemblance to the conventional picture of a serpent, and a third ornament, characterized by bassoon-like sounds, even in its shape shows a certain connection with that instrument.

The various grey shadings of (drawn) musical ornaments are of considerable importance. The contrasts of a wave characteristic of prevalent effects, certain waves, i.e., certain sounds, can be made to predominate, while other waves, in various grey shading, are superposed upon them. This is how very complicated tonal systems are obtained, which even as ornaments are productive of very attractive effects.

International Aspects!

Any tonal systems desired can be combined: Possibilities in this respect are quite unlimited, even personal or national characteristics being represented by ornaments. German singers, for instance, have a preference for an abrupt, rather violent formation of voice, in accordance with the curve shown in Fig.

8, whereas Frenchmen and Italians prefer a soft, melodious formation, as corresponding to their nature and as expressed outwardly in the characteristic patterns!

Movie Film Used

All these pictures are enlargements of talkie film bands of standard width (3 millimeters). While several ornaments can be traced beside one another parably greater possibilities will result from a utilization of the full width of the film, and musical composers are likely to avail themselves of these possibilities. In fact, they will be able on such films not only to hit any pitch with the utmost accuracy but to represent, beside one another, the characteristic *timbres* of all the instruments of which an orchestra is made up. The composer's work is by this new draughtsmanship, recorded in far greater detail than by the usual system of note writing—all personal, individual characteristics, usually left to the conductor's interpretation, thus being faithfully registered.

Type Patterns

Experimenters who have photo-cell apparatus available can readily try some of these experiments without going through the trouble of laboriously drawing the patterns by hand. Many fancy patterns can be obtained from printers or typesetters in the form of clean proofs of borders or other ornaments. Hundreds of different patterns of interesting shape and variety are available.



Fig. 7 (in order downwards). Showing the *timbre* of different sounds: xylophone, electric bell, two-note bell, bassoon, flute, an instrument rich in upper harmonics, bassoon and various high pitched sounds.

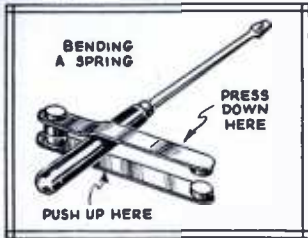


RADIO KINKS

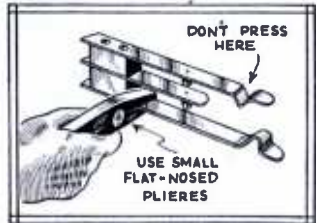
FROM ABROAD



Fixing Jack Springs

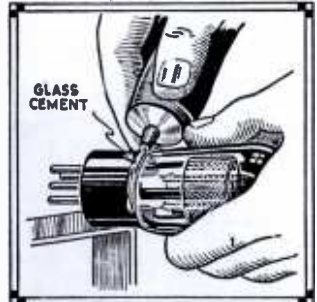


It is curious that 90% of the people who try to bring switch and jack springs closer together go quite the wrong way about it. After fussing around with a pair of pliers for half an hour the springs are usually in no better condition than before. They make their worse mistake in pushing the springs together.



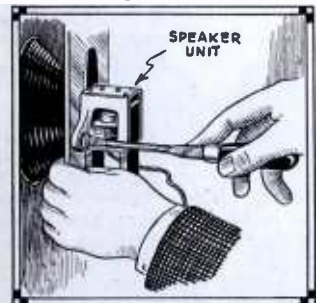
There are two ways to do the job properly. One is to push a screwdriver handle between the blades near the place where they are fastened, and to press down on the end. Where closer adjustment is required, use a pair of small flat nose pliers, take a good grip on the spring as shown above, and slowly force the spring into the desired shape. As a last resort take the switch or jack apart and do the bending in a vise. Modern Wireless (London).

Cementing Loose Bulbs



Don't throw a tube away merely because the glass envelope wobbles a little in the base. Secure a ten-cent tube of strong glass cement and smear it into the cracks. Let the cement dry thoroughly before using the tube again. Modern Wireless (London).

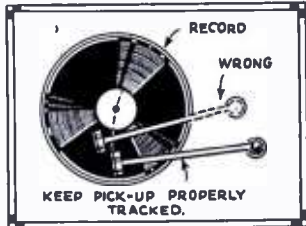
Adjusting Speaker Unit



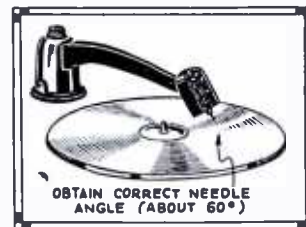
A lot of rattling noise and poor reproduction at high volume levels is sometimes due to loose screws in the speaker driving motor or the baffle mounting. In some speakers the vibration is so strong that the screws should be tightened periodically to prevent trouble. Modern Wireless (London).

Among these little kinks, gathered from numerous foreign radio magazines, you may find a time or money saving suggestion that will pay your cost of this issue several times over. Read them and save them! They may be very useful in the future.

Phonograph Kinks



With the new electrically cut records and improved phonograph pickups of low price, phonograph music is enjoying a well deserved come-back. Even the golden voice of the immortal Caruso has been re-recorded electrically, with the music of a modern orchestra "dubbed" in; the result is a record that is truly thrilling.



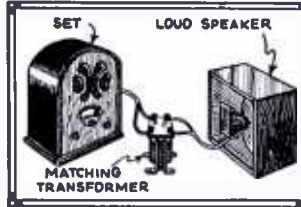
A number of precautions should be observed in the use and handling of the records themselves and their accessories. First, it is important to have the pickup arm properly located, so that the needle works in to the exact center of the record. The right and wrong positions are shown above. Second, the needle must not dig into the record, but must "wipe" around it, forming an angle of about 60 degrees to the surface. Third, keep the records clean and free of scratches. Remember that the modulations of the recorded voice and music are represented by microscopically small indentations in



the composition surface. If the shape of these indentations is destroyed or deformed, naturally the music will sound distorted. Wipe a record lightly with a soft duster before and after using it, and keep it in an individual envelope so that it is protected from other records.

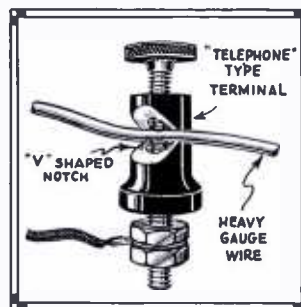
A final note: don't try to use a needle too long. Needles are very cheap; be generous with them. Blunt needles are likely to damage the many lines in the record, and are therefore poor economy. Modern Wireless (London).

Use Matching Transformer



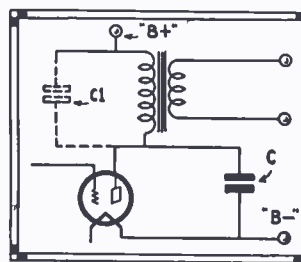
The quality of any radio receiver can be no better than that of its loud speaker. There are many good tuner-amplifiers and many good loud speakers, but in many cases a combination doesn't sound so "hot". Why? Mostly because the speaker is not properly matched to the output tube. Find out the impedance of your speaker, look up the plate impedance of the output tube in any tube chart, and get a matching transformer to suit. Amateur Wireless (London).

Quick Connector



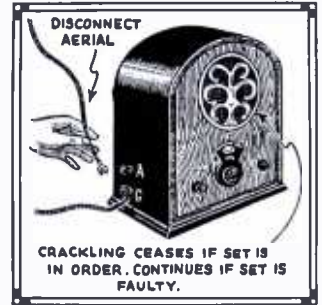
Sometimes you may wish to connect a wire to your aerial lead-in or ground, or some other wire, and you may not have a suitable clip on hand for the purpose. Fish out a large size metal binding post from your junk box, place it in a vise, and cut a V shaped notch in the side, as shown, the notch to penetrate about two-thirds of the way through. When the fastening screw is turned in, it cleans the wire at the same time that it grips it. Modern Wireless (London).

Connecting a By-Pass



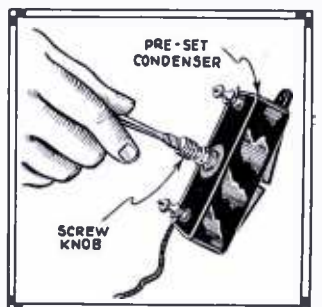
There are two ways of connecting a by-pass condenser in the plate circuit of a tube, from the plate back to B minus and from the plate to the B plus terminal on the audio transformer. The by-passing effect is perhaps slightly better with the first, but with the second the condenser is subjected only to the voltage drop across the primary, and not to the full plate voltage, as in the second case. Amateur Wireless (London).

Locating Noise



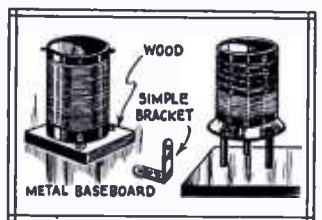
In shooting noise trouble, many service men neglect to disconnect the aerial and ground, and blame the set for noise that may not be its fault at all. Unhook the aerial and ground wires; if the noises stop you know the set is not at fault. Amateur Wireless (London).

Adjustable Condenser



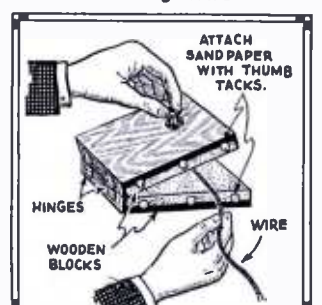
In adjusting adjustable condensers of the folding plate type, don't turn the screw in too tightly, otherwise the case will split or the folding plate will be punctured. Modern Wireless (London).

Mounting Coils



In mounting coils on wood baseboards, simple L-shaped brackets may be used. However, with metal chassis, it is a good idea to elevate the coils somewhat by means of uprights. Modern Wireless (London).

Cleaning Wire



Removing the insulation from enameled wire is a nuisance under ordinary circumstances. The job can be made a whole lot easier if a cleaning block, as illustrated, is used. Modern Wireless (London).

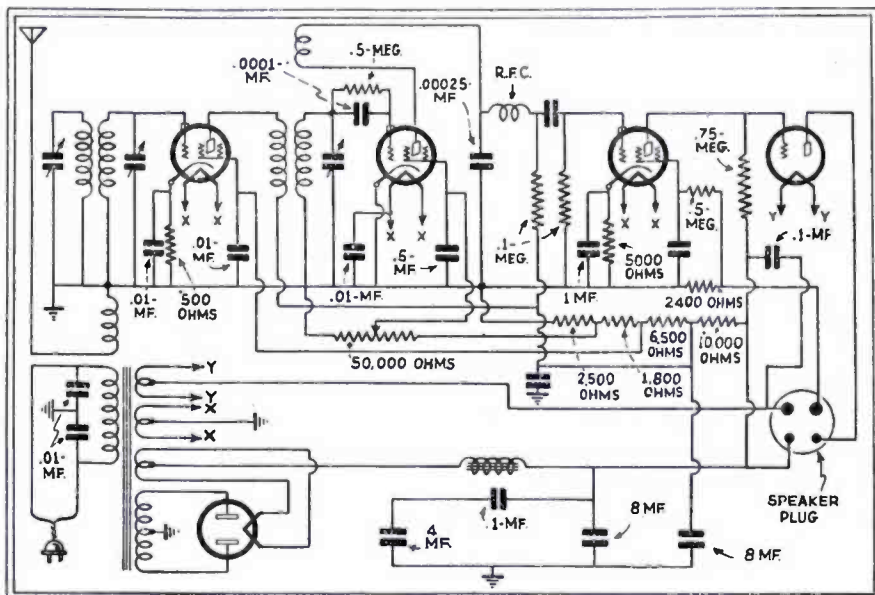
WORLD WIDE HOOK UPS

FIVE-TUBE A. C. SHORT-WAVE RECEIVER

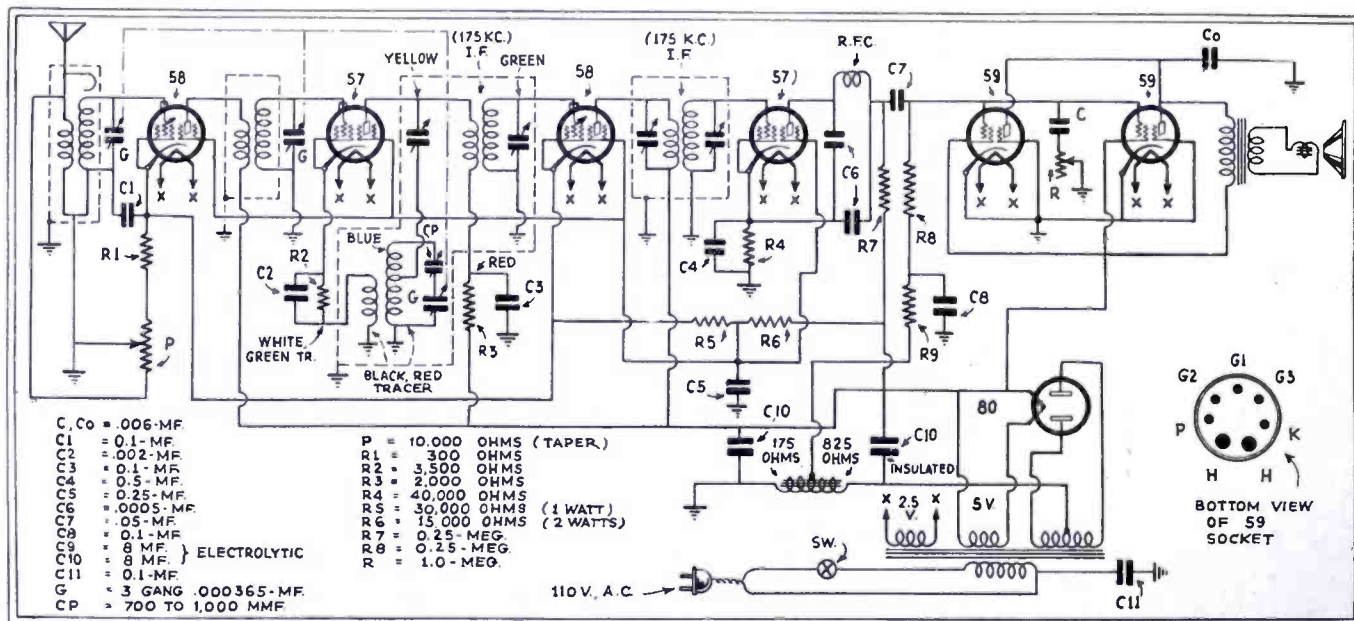
● THE circuit shown at the right, taken from *Radio Popular* (Buenos Aires), is a good one for the short-wave fan. It uses five tubes and comprises a stage of tuned R.F. amplification, regenerative detector, and two audio stages. The set is entirely A.C. operated. No dimensions are given for the tuning coils and condensers, as standard plug-in coils, with the condensers recommended for them, may be employed.

The first three tubes may be type 35 screen grids, or the new 58 pentodes if the extra grid is tied back to the cathode. The output tube may be a type 45. The power pack is of straightforward construction. There is a slight mistake in the diagram as shown; there should be a connection from the center tap of the rectifier filament winding to the top of the first 4. mf. filter condenser.

Notice that the first audio tube is a screen grid amplifier. This will give exceptionally high gain and is well worth trying in other circuits also. Regeneration in the detector is controlled by a screen potentiometer, a method recommended for its smoothness.



SEVEN-TUBE "SUPER" HAS HIGH GAIN



● THOSE who have a strong hankering for DX will find this seven-tube superheterodyne a very satisfactory outfit, according to *Radio World* (New York). It is an up-to-the-minute receiver, using the new type 57, 58 and 59 (seven prong) tubes. An easy night-time range of 3000 miles is claimed for it. This means reception of both coasts from practically any point in the United States. The sensitivity averages about 2 microvolts per meter.

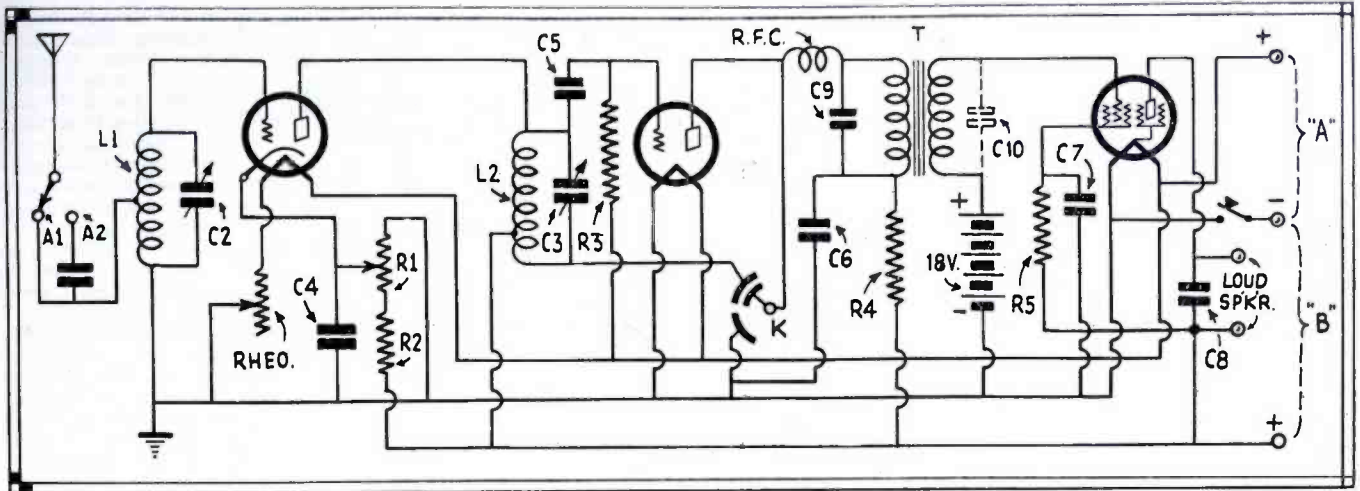
All told there are seven tuned circuits, three of them represented by the three gang condenser and being variable, four of them represented by primaries and secondaries of

the intermediate coils and being fixed. Seven tuned circuits give all the selectivity that is desirable, and care has been exercised not to cut side bands and thus reduce the high audio frequency response.

The new output tube, the 59, which is of the heater type, is somewhat along the same lines as the 47, but has much less hum because of the separation of heater and cathode. Two 59's are used in parallel in this receiver, with a suitable coupling transformer to protect the loud speaker.

The values of the various parts are given in the diagram. The parts used are all of American manufacture.

"CHAMPION 3" IS FAVORITE FRENCH CIRCUIT

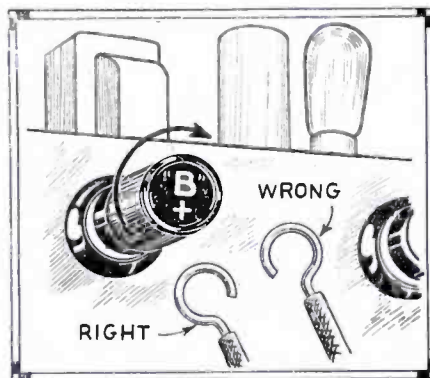


● THE "Champion III" is highly regarded by French radio constructors as a simple, efficient broadcast receiver. The circuit above, as copied from a booklet published by E. Chiron (Paris), reveals itself as a straightforward one-stage R.F., regenerative detector, one stage A.F. arrangement, battery operated. (Europe is far less "electrified" than the United States, and batteries are used for power supply for most small sets.) Notice the unusual method of regeneration control: a differential condenser connected directly between the plate and the filament return circuit of the detector tube. This receiver operates a loud speaker quite satisfactorily in France.

Parts values are as follows: C1, .00025 mf.; C2, C3, .0005 mf. tuning condensers; C4, C6, ½ mf.; C5, .001 mf.; C7, 1 mf.; C8, C9, C10, .001 or .002 mf., depending on the loud speaker and the audio transformer; L1, L2, tuning coils; K, differential condenser—one rotor, two stators; R1, 50,000 ohm potentiometer; R2, R5, 10,000 ohms; R3, 5 megohms; R4, 20,000 ohms; Rh. 20 ohms; TR, audio transformer.

HOW TO BEND WIRE TERMINALS

● A simple tip, but one which makes a great difference to the neatness and trouble-free nature of the wiring in a set; when baring flexible wire or battery connections, take care that only the rubber is cut and that the wire is not nicked; also when the wire ends have been bared, twist the strands tightly together and make a loop in a clockwise direction. If the loop is made in the other direction the strands will tend to unravel as the terminal head is tightened. If the binding post top is removable, it is sometimes advisable to form a closed ring of wire. Soldering the ring will stiffen it and make it stronger. This will not slip off easily. —*Amateur Wireless* (London).

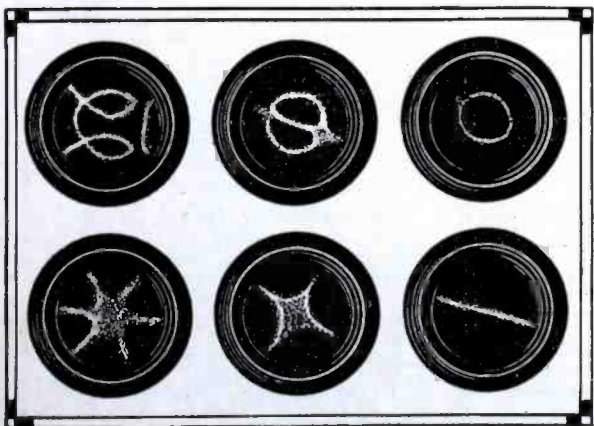


Loud Speaker Figures

Many interesting effects may be observed if the diaphragm of a loud speaker or pair of earphones is sprinkled with ordinary salt. The illustrations at the left (E. Chiron, Paris), show some of the patterns obtained.

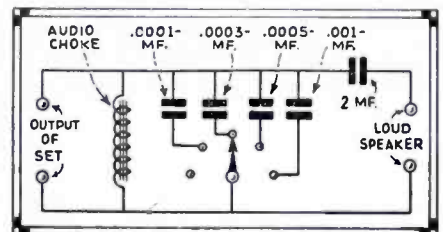
Midget Condenser

The sketches at the right show two simple but reliable adjustable condensers for antenna coupling, trimming, neutralizing and other purposes.



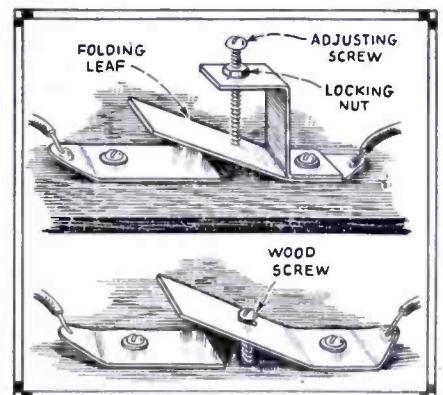
Protecting Loud Speakers

● LOUD speakers, particularly those of the magnetic type, are very delicate instruments, and must be protected from the heavy plate current of the last audio amplifier tube, in whose plate circuit it is usually connected. This advice, given in "Tous Les Montages de T.S.F." (E. Chiron, Paris), should be observed carefully by all radio experimenters.



If the set is not equipped with an output transformer, suitable protection can be had in the form of an output choke of about 30 henries and a mf. fixed condenser, connected simply as shown in the diagram. The four additional fixed condensers, thrown in and out of the switch, are for the purpose of "tone control." They give artificial emphasis to the low notes by cutting off some of the highs. Different values of capacity at this point will give markedly different results.

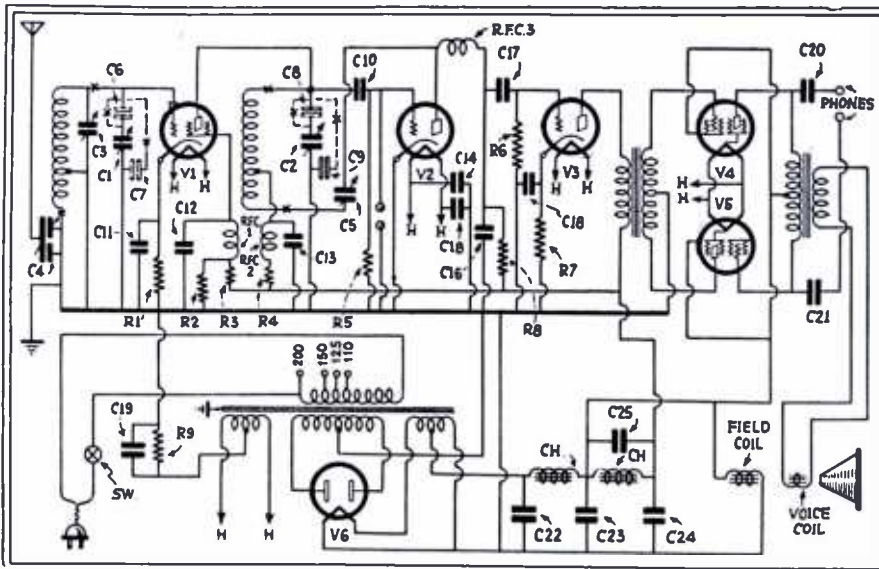
Also try different values of audio chokes, as some may work better than others.



THE "SUPER DX" - A GERMAN SET

● THE "Super-DX" receiver described in *Das Funkmagazin* (Berlin) is a real all-wave receiver, as it tunes from 15 to 2000 meters, and therefore takes in all the short-wave, medium-wave and long-wave stations. The original receiver uses a bank of fixed coils, thrown in and out of the circuit by means of a rotary switch, but regular plug in coils may be employed just as easily.

Six tubes are used. The first (V1) is a screen grid T.R.F. amplifier, feeding in to a regenerative detector (V2). This is followed by a resistance coupled stage (V3) and a final push-pull stage using pentodes (V4, V5). A full wave rectifier (V6) is found in the power pack. The taps on the primary of the power transformer are provided simply for various line voltages. The heavy line running through the center of the diagram represents the metal chassis and "ground".



The condensers in the tuning circuit shown in dotted lines are loading condensers for the long-wave range. For the American broadcast band they are unnecessary. Condenser C2 and C3 are the main tuning controls, while C5 is the regeneration throttle. Notice that the lower section of the detector grid

tubes selected.

While not many American experimenters will care to duplicate this circuit exactly, at least they will obtain some ideas from it. Note for instance that the bottom section of the detector grid coil is tapped to make it act as tickler.

inductor acts as a tickler. This means that the detector plate choke RFC3 must be a pretty good one if smooth regeneration is expected. It might be a good idea to connect one very small choke in series with a larger one, to give a uniform choking effect on both short and long waves.

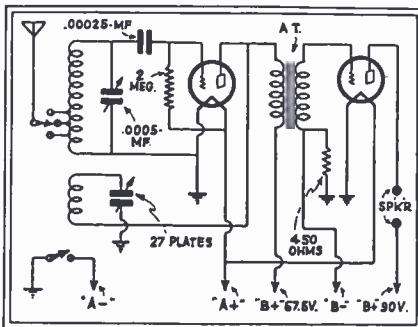
Notice that phones may be connected across the outside terminals of the output transformer primary. Condensers C20 and C21 are provided to protect the operator against shocks.

The values of the various fixed condensers and resistors will depend on the

SIMPLE 2-TUBE CIRCUIT FOR S. W.'s

● "IT'S as easy as ABC," says *Wireless Weekly* (Sydney) about the two tube short wave circuit shown at the right. It should be, for it is almost a dead copy of the original Reinartz circuit as it appeared in *QST* about a dozen years ago. It may be operated very conveniently on dry cells with type 30 tubes in both the detector and audio sockets.

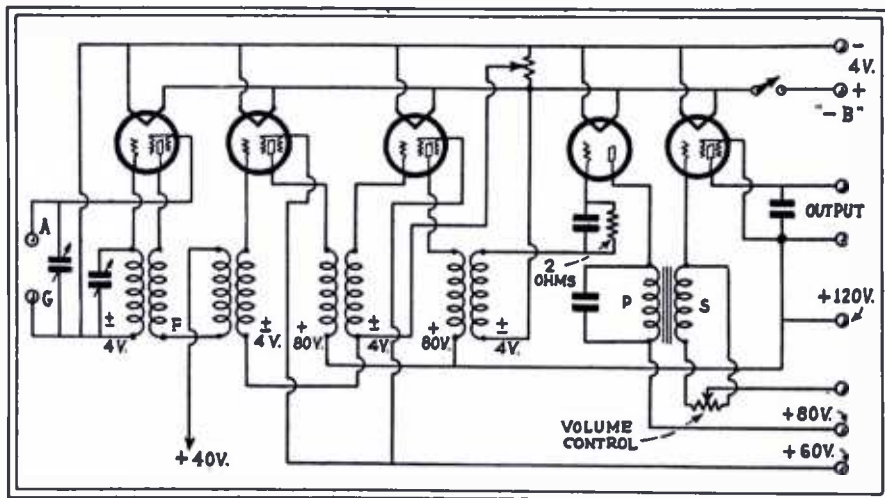
Variable antenna coupling is furnished by several taps at the bottom end of the grid coil. These may be dispensed with in favor of a midjet variable condenser. The tickler and its control condenser are shunted across the detector plate, with-



out an R.F. choke. This system may be all right with some small audio transformers whose primaries have a respectably high impedance to the signal frequencies, but it undoubtedly would help matters considerably to place a choke between the plate and the P post of the transformer.

Bias for the audio tube is provided by the plate current drop through the 450 ohm resistor connected in the filament return lead. This eliminates the "C" battery. A 1 mf. by-pass condenser across this resistor may be useful. The transformer ratio may be as high as 6:1.

REGENERATIVE R. F. AMPLIFIER



From *Le Haut Parleur* (Paris) comes the circuit published on the left. The arrangement looks rather tricky because the French have a habit of bringing the filament wires up to the top of the diagram (not a bad idea at that). Study reveals that the first R.F. amplifier is regenerative, and is followed by two more R.F. stages working into a grid-leak-and condenser detector. The audio stage uses an output tetrode, although a pentode will probably be better.

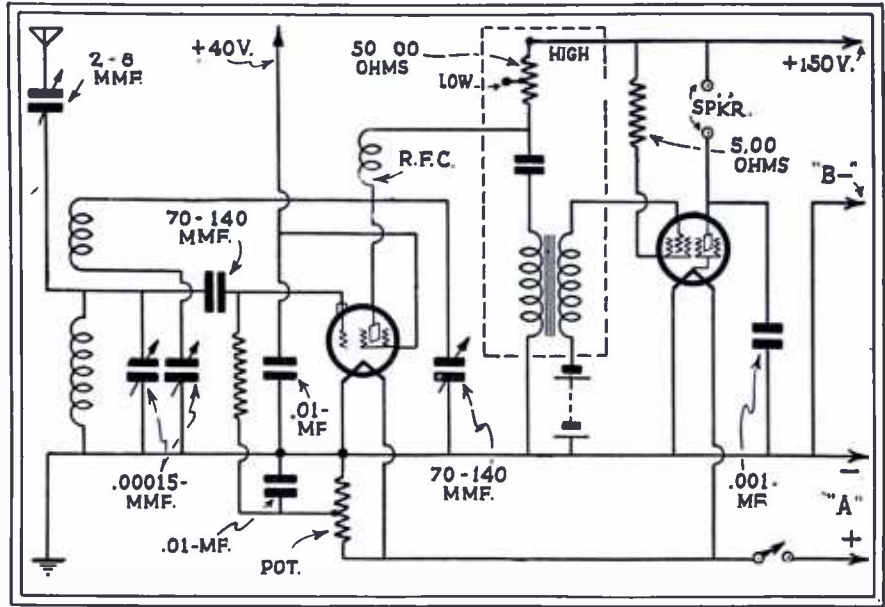
The particular feature worth trying is the regeneration in the R.F. stage. Properly controlled, this is likely to give enormous amplification. The R.F. regeneration may be varied by moving the plate coil in relation to the very first grid coil (on the extreme left). For battery operation the tubes may be 30's, 32's and 33's. For A.C. operation, use 35's, 27's and a 47 or a 59 in the output stage.

NOVEL DETECTOR PLATE FEED SYSTEM

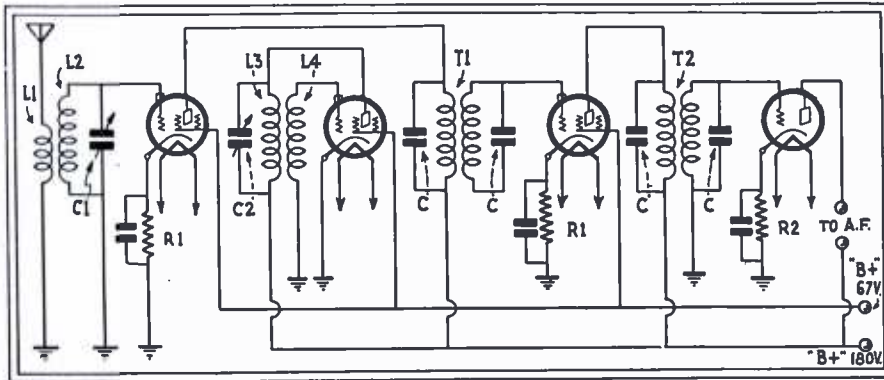
● THE opening the British Empire short wave stations is stimulating interest in the short waves throughout the British radio press. A typical circuit, taken from *Wireless World* (London) and shown at the right, conforms with the continental habit of using as few tubes as possible. Only two are used; one as a regenerative detector and the other as an audio amplifier. With the detector a tetrode and the output tube a pentode, considerable volume may be expected.

The shunt method of tickler connection, which is very popular in Europe in spite of the superiority of the series system, is used here with a variable condenser acting as the actual regeneration control. The screen of the detector tube is maintained at a fixed potential.

The detector plate hook-up is rather novel. The coupling is by a plate resistor and a fixed condenser, but the condenser, instead of running directly to the grid of the audio tube, goes to the primary of an audio transformer instead. This scheme has great possibilities in the way of increased amplification, and is well worth trying in receivers now using screen-grid detectors.



ELECTRON COUPLED OSCILLATOR



● THE "R. T. 72" circuit at the left, publishing originally in *Radio per Tutti* (Rome), is a superheterodyne with a modified form of electron coupling between the oscillator and the mixer tube. L1, L2 and C1, and the tube to which they connect, represent the mixer. L3, L4 and C2 and their tube constitute the oscillator. Note that the oscillator screen is connected to the mixer screen. T1 and T2 are regular intermediate frequency transformers.

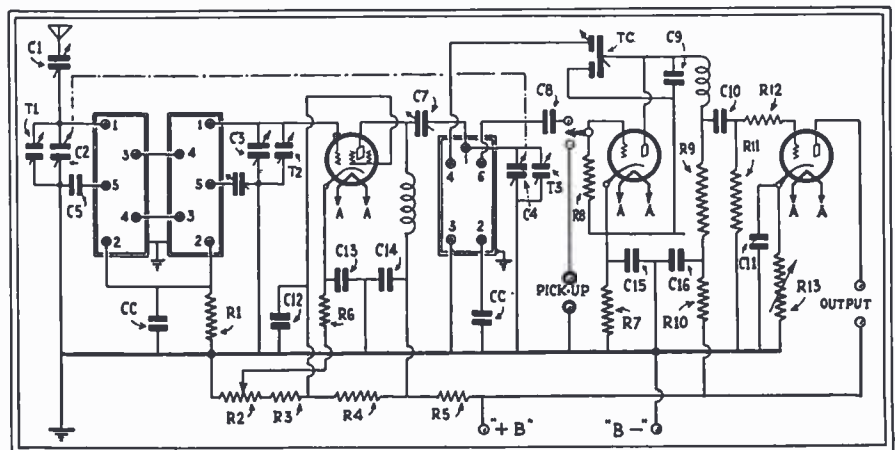
This arrangement produces a stable set, with little of the annoying interlocking effect experienced with other types of coupling.

BAND PASS REGENERATOR

● BAND pass filters are widely used in European receivers because they give selectivity without requiring tubes—tubes being expensive and requiring current. Here is a Dutch version of a one stage R.F. amplifier circuit with regenerative detector. The boxes represent shielded R.F. transformers. The main tuning condensers are C3 (T2 is a trimmer) and C4 (with trimmer T3). The coupling between the R.F. and detector tubes is adjustable by means of condenser C7.

The single pole, double contact switch in the grid of the detector is a radio-phonograph changeover switch. The up position is radio; the down, phonograph. A high impedance pick-up may be connected directly to the post marked "Pick Up". A low impedance pick-up will require a coupling transformer.

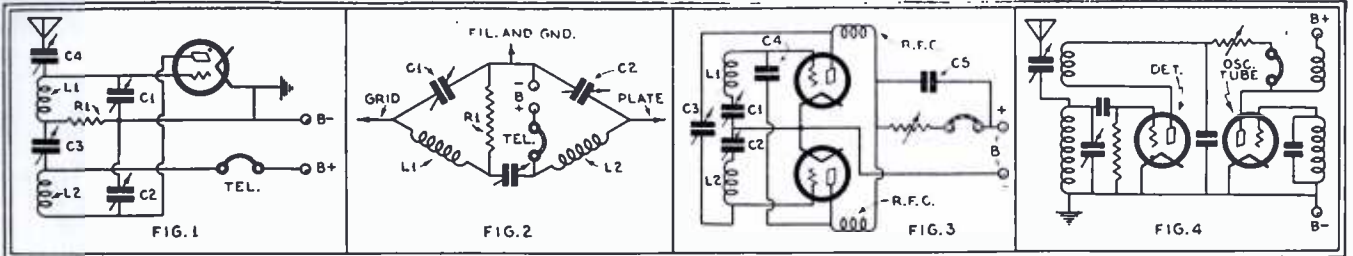
Resistor R2 is the volume control. The values of the other resistors will naturally depend on the tubes and other cir-



cuit parts chosen. While there is nothing particularly new about this circuit,

the changeover switch and the regeneration control are worth remembering.

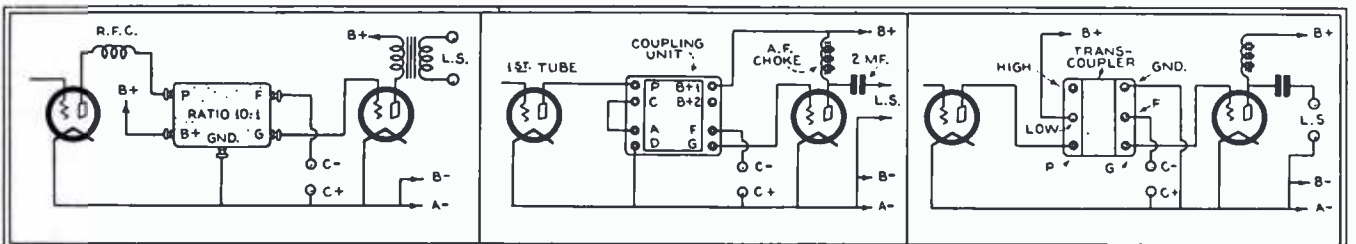
UNUSUAL ENGLISH SHORT WAVE CIRCUITS



● SOME unusual short wave receiver circuits are described in a recent issue of *Modern Wireless* (London). Figure 1 shows a rather tricky arrangement that is known as both the "Balanced Colpitts" and the "Hoffman." The grid leak R1 is in series with the grid coil, the grid condenser being dispensed with altogether. The connections of Fig. 1 are shown in more symmetrical form in Fig. 2. This is not as queer looking as the conven-

ditional drawing and is easier to study in this form. Super-regenerative circuits show up to marked advantage on the extremely high frequencies (very short waves). A good circuit of this type is indicated in Fig. 4. It will be seen that an ordinary detector scheme is used with a "super" tube connected to its plate circuit. Figure 3 shows a hookup using two detectors in push-pull.

MORE ON PARALLEL PLATE FEED

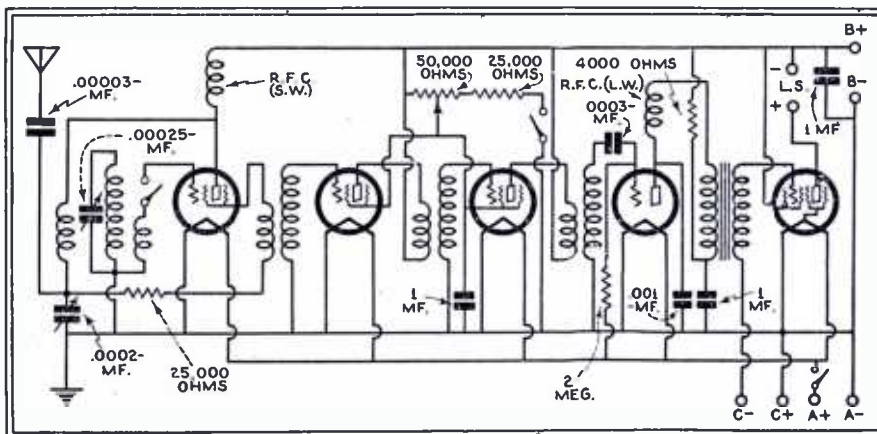


● HERE are three well-known British coupling units together with their schematic circuits. In each case the feed resistance and coupling condenser are included in the unit. On the left is the Telsen coupler which has a ratio of 10 to 1, and in the centre the R.I. "Parafeed" unit which readily lends itself

to the auto-transformer method of connection. The coupler on the right is the Bulgin "Transcoupler," and an interesting feature of this component is that two alternative "feed" resistance values are available.—*Popular Wireless* (London).

DETECTOR-OSCILLATOR COMBINED

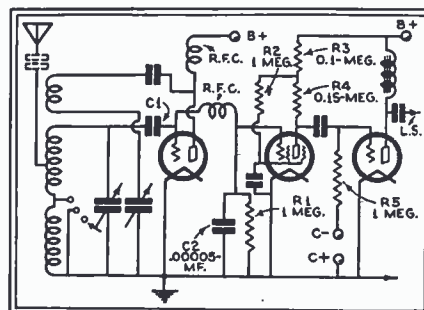
● HERE is super-heterodyne embodying a novel method of employing a screen-grid tube as detector - oscillator (as in the autodyne method of reception), the control grid and the plate being employed as a means of producing the local source of oscillation, and the screen being used solely for the purpose of transferring the beat-difference energy. It has been the effort of the writer to



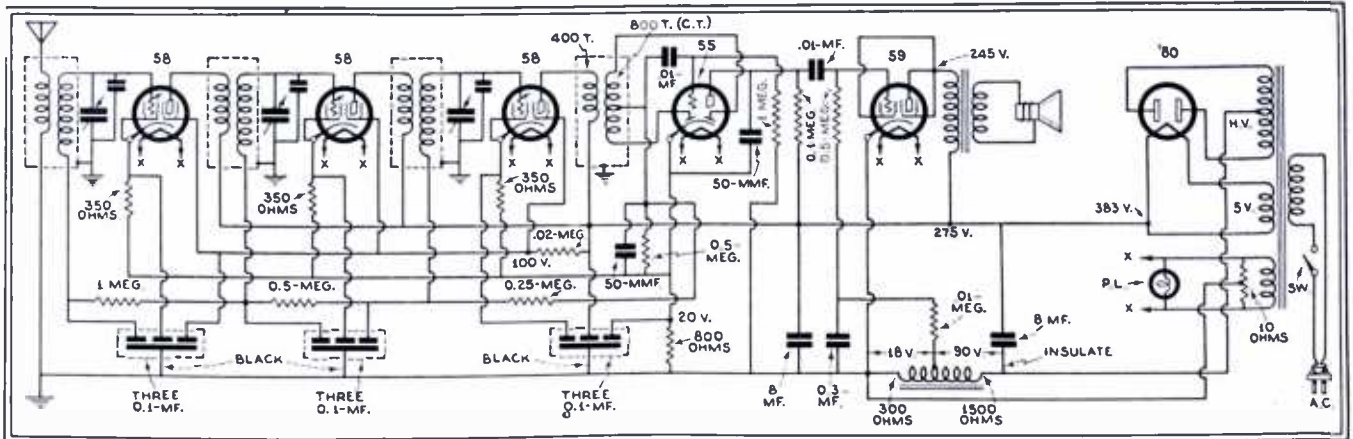
produce a short-wave receiver that gives good results and that does not require the manipulative skill of the short-wave expert to produce results, writes W. G. Hill in *Wireless Magazine* (London). It has always been a difficult task for the novice or even the person with a good knowledge of ultra high-frequency circuits to operate a receiver covering the waveband from, say, 20 to 60 meters.

REGENERATIVE DIODE DOES DOUBLE DUTY

● "A Three-Valver for High Quality Reproduction" is how *Modern Wireless* (London) described the set whose diagram is shown at the right. This is a short-wave receiver with a tapped tuning coil to provide two wavelength ranges without plug-in coils. For the shorter range, the switch is moved up to short out the lower section of the coil; for the higher range it is opened. The first tube works on the diode principle, but its plate is employed to enable regeneration to be used. This is a novel scheme and is well worth trying. Note that the normal grid of the tube



R.F. SET WITH AUTOMATIC VOLUME CONTROL



● FORTUNATELY radioists are not of one mind, so that some are keenest for distance reception while others are most concerned about quality. The present circuit comes under the quality classification, not being a great distance-getter because the selectivity is not high enough, says *Radio World* (New York). When automatic volume control is included in any set the sensitivity and selectivity are less than what they would be without it. Here we make up in part for the sensi-

tivity drop by a stage of semi-tuned R.F. amplification, which also builds up the low radio frequencies so that the response at the R.F. level is more nearly uniform. Usual T.R.F. systems have greater amplification at the higher frequencies, but the falling off at the low R.F. end sometimes causes concern, because desired stations come in too weakly.

The three tuned circuits provide enough selectivity, even with A.V.C., to make the receiver useful for local reception.

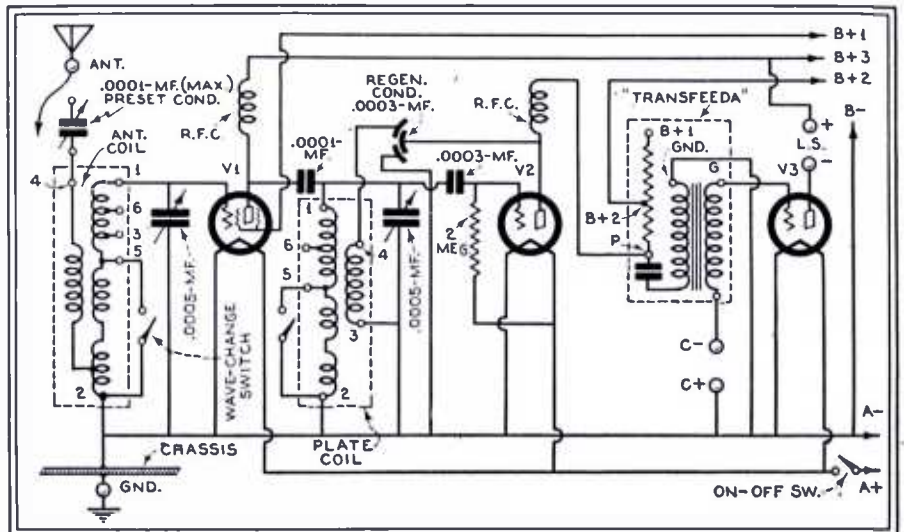
THE "PROGRAMME PRINCE"

● EASY operation is as important as efficiency of design in the construction of a radio receiver. Many a perfectly good set has been spoiled by being difficult to work, since the excellent properties possessed by the receiver have not been fully used, says *Modern Wireless* (London).

Naturally, the ease or otherwise of handling a set depends to a large extent upon the particular person operating it. An expert who has been more or less continuously working radio receivers will be able to get the last ounce out of intricate sets that defy the skill of the ordinary listener beyond measure.

Simplicity in design as well as in mere construction was kept in the forefront when the circuit and layout of the "Programme Prince" were discussed. The result is that it is one of the simplest set imaginable, both from the constructional and the operating points of view.

Two dials for tuning, conveniently



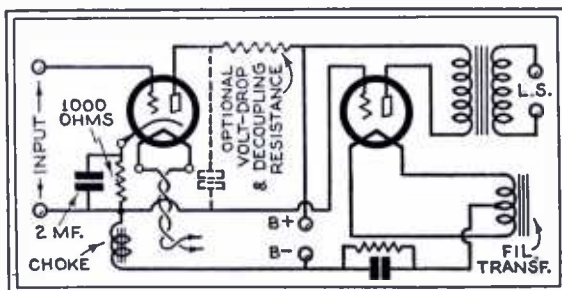
placed with reaction control between, constitute the real "controls," while the wave-change and "on-off" switches complete the panel components. Not complicated, is it?

And yet the set is capable of pulling in a remarkable number of programmes, and could well be called the "Programme

Prinzer" as an apt alternative name.

The appearance of the panel, too, is pleasing, while in these days of light pockets the economy of running will be appreciated by home-constructors. The set takes a matter of 10 to 12 milliamps., or less, dependent upon the type of tubes.

AN EXPERIMENT IN CATHODE COUPLING



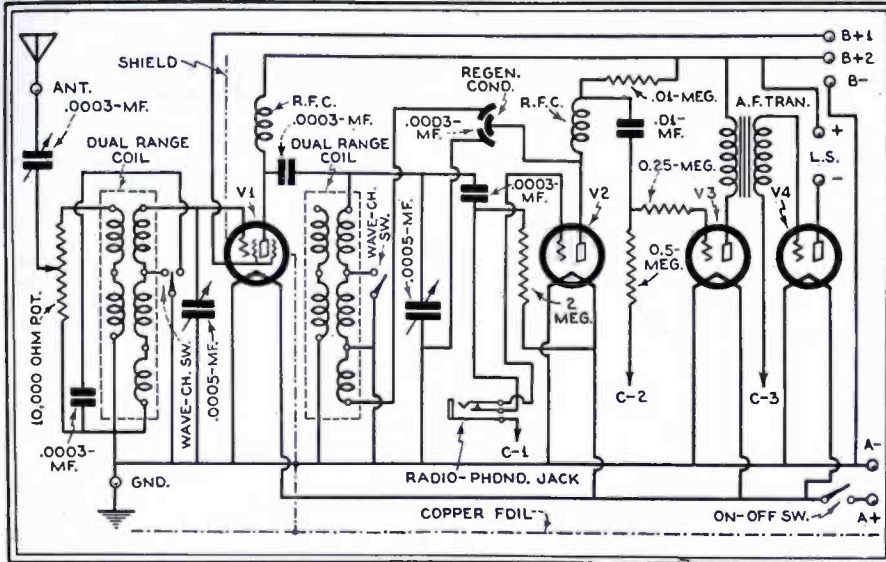
● A NEW form of coupling has been utilized recently for quality amplifiers. This system, which is known as cathode coupling, is a modified form of the direct system in which the plate of one tube is connected straight to the grid of the second tube. Systems of this sort have been advocated for some time as avoiding the need for coupling condensers which must inevitably cut off the lower frequencies, and direct-coupled amplifiers have been successfully employed on many occasions, writes J. H. Reyner in *Amateur Wireless* (London).

In this circuit, however, it is not the plate of the tube which is directly coupled to the next grid, but the cathode. The system is principally applicable to tubes having indirectly-heated cathodes, as otherwise it is necessary to use two sources of supply for the filament. The simple cathode-coupling circuit is shown in the diagram.

It will be observed that the external impedance in the plate circuit of the first tube is not connected between plate and B+ as usual, but between the cathode and B-.

In this particular instance the first tube is indirectly heated and the second tube is a directly-heated type supplied with current from a separate filament winding.

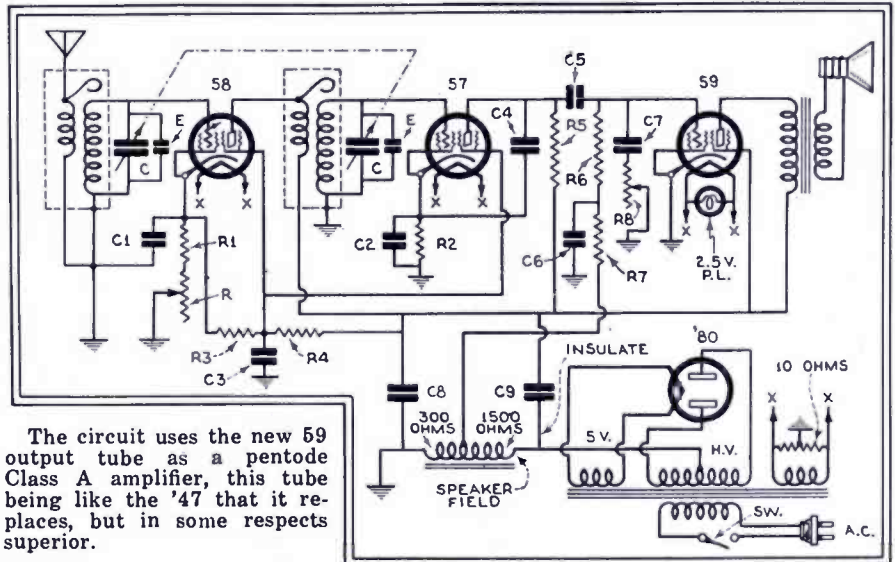
USES A SUCCESSFUL TUNING SCHEME



LOW-PRICED 4-TUBE SET

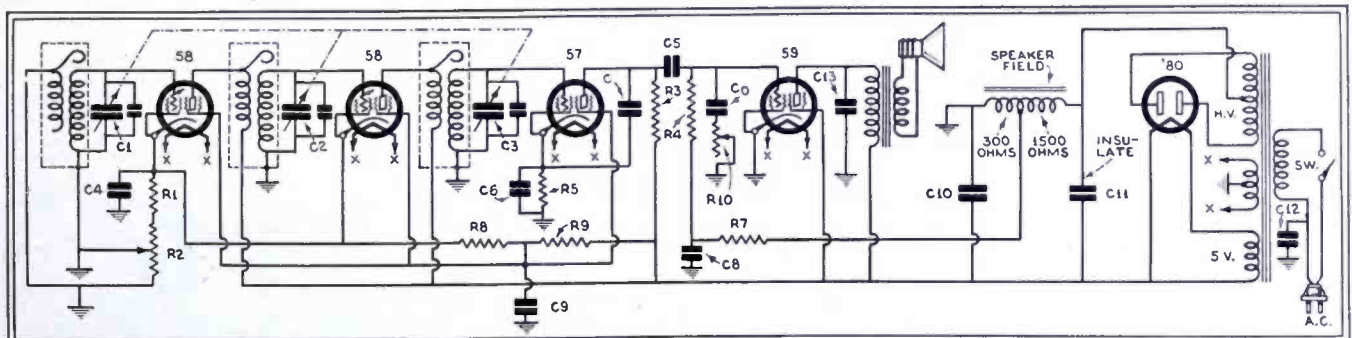
● IN THE low-priced field certain circuits have been found to be outstanding, after considerable experimental and developmental work, and although the diagrammatic differences as between any one of these and an ordinary receiver might seem small, the performance difference is large. Therefore six circuits are shown in recent issues of *Radio World* (New York), in their improved and so-called perfected form, although it is admitted that nothing in this life is perfect.

The most modest of these is the four-tube A.C. receiver, which has only three tubes effective in the receiver proper, but the rectifier tube is counted as one of the set tubes, as seems necessary to avoid confusion or awkwardness. Three tubes! It doesn't seem possible that speaker performance can be obtained on so few tubes, does it? And yet the circuit is really worth while. It has plenty of pep, good tone, and freedom from hum. It is one of the better grade four-tube circuits.



The circuit uses the new 59 output tube as a pentode Class A amplifier, this tube being like the '47 that it replaces, but in some respects superior.

5 TUBE, HIGH GAIN T. R. F. RECEIVER



● A THREE-GANG condenser is used in this set, with three coils and two stages of TRF, with 58 tubes as RF amplifiers and the 57 as detector. The output again is the new 59. This is another of the *Radio World* circuits.

With such a circuit it is to be expected that sensitivity and selectivity will be higher, particularly sensitivity,

as that is a sheer gain. The selectivity improvement is relative, in that it depends on the amount of amplification or input level. Since there is a volume control that affects both levels, the selectivity is very much higher when, as often is the case in practice, the total sound level is kept at less than maximum, e. g., no higher than the maximum output level of a four-tube model.

● FEATURES of the "Five Grid Four," described in *Modern Wireless* (London), are dual range coils, differentially controlled regeneration and input volume control. The circuit is designed for sheer reliability and efficiency and is consequently composed largely of schemes that have proved again and again worthy of the trust placed in them.

The circuit comprises a stage of screen grid R.F. amplification, regenerative detector and one resistance-capacity and one transformer audio stages. The dual range feature is necessary because of the European broadcasting situation, and of course is of no interest to American radio constructors.

The R.F. tube is capacity coupled to the detector through a .0003 mf. fixed condenser, with the shunt feed of the plate voltage to the R.F. tube. Shunt feed is likewise used in the regenerative detector. Battery type tubes are shown, but the circuit may readily be adapted to A.C. tubes.

The phonograph-radio jack merely opens the radio circuit when a phonograph pick-up is used.

REVIEW OF AMERICAN RADIO MAGAZINES

● IN reviewing the American radio magazines herewith we are giving brief resumés of the outstanding articles in each issue. Occasionally a diagram will be included if its reproduction is desirable, but in general we will not reprint whole articles. If any particular subject appeals to you, you can easily obtain a copy of the magazine directly from the publisher. This review service may save you a lot of useless reading and put you on the track of valuable information that you may not otherwise learn about.

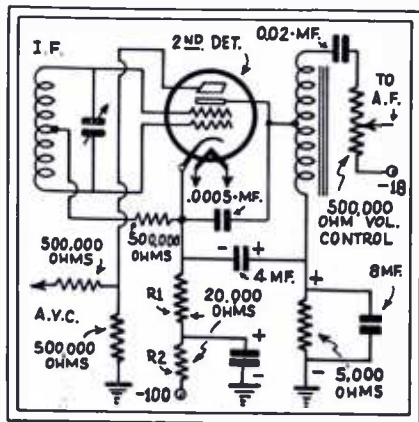
Radio News (New York) February, 1933

"Extending the Loud Speaker Range," by Joseph S. Grant. The author describes his experiments in increasing the frequency response in a reproducer system for any radio receiving set, thus improving the quality of reception that can be obtained. Three speakers in a special circuit to increase both the high and low frequency characteristic comprise the arrangement.

"The New 'Super Six' Midget," by C. Bradner Brown and Kenneth Alexander. A six tube midget superheterodyne using the new 50 series tubes. It is easy to build, and inexpensive, yet offers surprisingly good performance. Complete constructional data are given, including details of the intermediate frequency transformers, and tuning coils.

"Handy Microphone Substitutes," by Austin Lescarbourea. In this article are given a few hints that will help the experimenter when there is no "mike" available. The suggestions include the use of head phones, magnetic and dynamic speakers and phonograph pickups, connected in the correct way to a power amplifier or radio set audio amplifier.

"Finding Mutual Conductance," by George E. Fleming. In testing tubes, any one of a number of tests can be made that will tell if the tube is in good condition. One of the most satisfactory of the single tests is to measure the mutual conductance. A practical mutual conductance meter is described and its operation is completely outlined.



Modern Radio (Hartford, Conn.) January, 1933

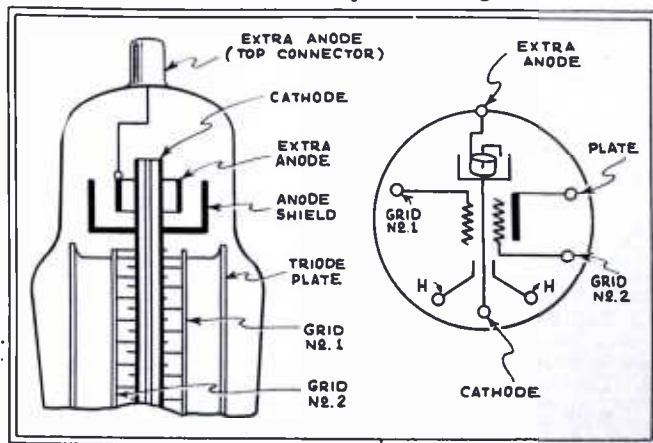
"The U.S. Forest Service Radio Equipment," by Frank W. Prince. Two transmitter-receiver units designed for use in fighting forest fires are described by the author. One is a semi-portable unit weighing about 50 pounds. This unit combines a low-power phone and C. W. transmitter and a receiver. The second unit is a portable C. W. transmitter-receiver, weighing 12 pounds. In both sets the 30 series tubes are employed. It is interesting to note that special "B" batteries were designed to keep the weight as low as possible.

"Automatic Temperature Compensation for Crystals," by John L. Reinartz. In economically designed transmitters, temperature compensation may be used to replace the complicated and expensive heated temperature control units. The rigid requirements of the Radio Commission regarding frequency control can be met by placing the quartz crystal in a holder made of a material that will change the air gap to compensate for changes in temperature, instead of keeping the temperature constant.

Electronics (New York) January, 1933

"Tubes with Cold Cathodes," by Dr. August Hund. A description of recent work on glow-discharge amplifiers, oscillators and modulators. Two types of tubes are mentioned; one depending on the induction of negative ions and the other depending on the negative resistance principle similar to the Poulson arc. In both cases, the source of electrons is the glow discharge that takes place upon the ionization of an inert gas.

Left: detector circuit using the special Wunderlich automatic volume control tube. Right: Constructional details of the Wunderlich A. V. C. tube.



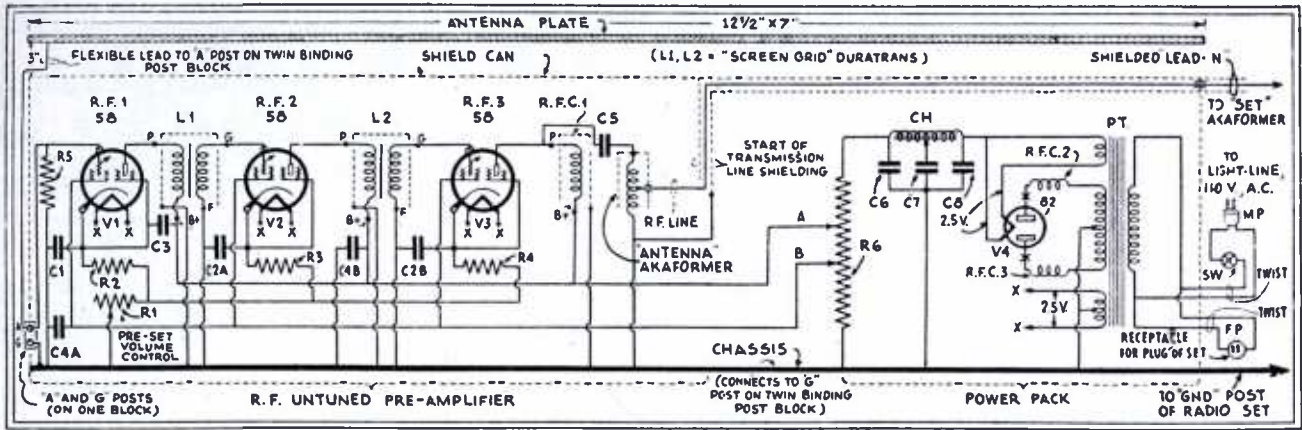
"Inter-Carrier Noise Suppression," by Norman E. Wunderlich. A new tube incorporating an extra plate, common to the cathode but shielded from the other elements. This extra plate serves to amplify the AVC (automatic volume control) potentials, before they are applied to the receiver. This permits a more flexible and efficient automatic volume control arrangement. It has the advantage that no extra tubes and circuit complications are necessary, such as required in previous arrangements performing the same functions.

"Circuits for Amplified Automatic Volume Control." The recent developments of amplified AVC units or "time delay" AVS units as they are sometimes called, marks a distinct advance in the automatic control of signal level. The original automatic volume control units were insufficient to keep the signal level constant under all conditions, for a number of reasons.

QST (Hartford, Connecticut) January, 1933

"A Portable Transmitter and Receiver that Works at Home or Abroad," by Murray J. Douglas. A complete amateur station that is adaptable for use either in the "shack" or in an automobile. When used at home, the output of the portable transmitter is amplified by a 100 watt push-pull amplifier. The unit includes a three tube receiver, a monitor, a wavemeter, and a field strength meter. The fan who is interested in breaking into the "amateur game" will find this article very interesting.

"Tunable Hum," by F. S. Dellenbaugh, Jr. Rectifiers of the mercury vapor type frequently cause parasitic oscillations in associated circuits, such as amplifiers. This type of hum is often mistaken for the A.C. ripple caused by insufficient filtering. Its cure, though, is quite different than for the latter trouble. While this article was primarily written for transmitters, the same principles apply to receiving circuits. The serious experimenter will find it very interesting.



Complete circuit diagram of the "Amplitenna" described in RADIO CRAFT.

Radio-Craft (New York) February, 1933

"How to Make the 'Amplitenna' Capacity Aerial," by R. D. Washburne and F. R. Harris. Here is a high-gain R.F. amplifier which has no moving parts, requires no circuit aligning, has no controls except an off-on switch, costs very little to build and is designed for easy assembly. Connect it in place of the usual aerial instrument wherever you want high amplification of broadcast frequencies.

"An Experimenter's Long-Wave Tuner Chassis," by Samuel Whisk. A description of a custom built receiver to cover the bands from 550 to 2000 meters. Experimenters looking for new "thrills" will find them on the long waves. Here, many powerful foreign stations broadcast daily. These stations come in with notable consistency. The Navy air-craft beacon stations are also included in this band; not to mention all the commercial and ship code transmitters.

"The International 'Kadette' Receiver." A description of a new radio receiver, ideal for use in travelling. The set is designed to operate from either 110 volts A.C. or D.C. without any circuit changes or adapters. It is merely plugged into the electric light socket. The set may also be used in an automobile with "B" batteries or an automotive "B" unit. The filaments are then operated from the car battery.

"Sleuthing For Static," by Glen H. Browning. Here is an unusual article by an authority, on locating interference, which is bound to knock some of our older theories into a cocked hat. Mr. Browning describes an instrument for locating sources of interference which uses a non-directional antenna and actually measures the amount of noise coming in through the power line or via the aerial.

"Building and Operating the Supreme '56' Point-to-point Resistance Tester," by Charles Pepin-Donat. Point-to-point resistance testers have become very popular recently. They represent a new, flexible method of finding receiver defects, and they have the advantage that they do not become obsolete with the development of every new tube. This unit is also arranged to measure voltages up to 900 A.C. or D.C. and current to 300 A.C. or D.C. It is a real tester for the modern Service Man.

"Controlling Fidelity with the 58 Tube," by Edgar Messing. The 58 tube is one of the most promising of the new tubes. Its use is especially adapted to sharply tuned sets such as superheterodynes, a poor quality resulting from side-band cut-off can be compensated for in the 58 tube. The way this is accomplished is described in simple language.

"Making Money with P.A. Amplifiers," by Hubert L. Short. In this article, the author tells how to sell P.A. systems to business offices and factories, as a means of making money. This is a practical application that deserves more attention than it is receiving from Service Men.

"Building and Operating a 3-Tube Battery Operated, 7 1/2 Watt P.A. Amplifier," by Louis Gancher. A P.A. system for sound trucks, etc. It comprises a three tube amplifier and a motor generator unit to supply all the required potentials. It operates entirely from 6 volt batteries. The power consumption is so low that a 6 volt, 100 ampere-hour battery is sufficiently large to operate the unit all day.

Short Wave Craft (New York) February, 1933

"Pentodes in Low-Power Transmitters," by Dr. W. Moller. Details are given for making transmitters employing the pentodes for demonstration purposes. The author also tells what changes are necessary to convert triode oscillators to use the five element tubes. While the circuits shown are primarily intended for laboratory demonstration work, they may easily be converted for operation on the amateur bands.

A series of experiments with the transmitters are outlined, to help the student to understand the action of oscillators and short-wave transmitters.

"The A.C. Super-Wasp Brought Up To Date," by A. A. Dolid. Thousands of short-wave fans are the proud owners of the famous A.C. Super-Wasp receivers. While these sets have given remarkable results in a great many cases, they can be improved in quality and sensitivity by the use of new tubes. In this article the changes necessary to include screen-grid detection and a pentode power amplifier are explained.

"Two-Tube A.C. Band-Spreader Works Loud Speaker," by George W. Shuart. There has been a wide-spread demand from short-wave fans for an economical receiver that would work a

loudspeaker and have easy tuning control. The extremely sharp tuning of most short-wave receivers has been a handicap to "fans" who do not have the patience to sit and move the dials, slow enough. Mr. Shuart has supplied his solution to the problem in this two tube loudspeaker set with band-spread coils.

"A 5-Meter S.W. Superheterodyne," by A. C. Matthews. While the advantages of superheterodyne reception for the extremely short wave bands between 43 and 80 megacycles have been appreciated for some time, the actual construction of such a receiver has been more or less impractical due to the instability of the usual superhet. oscillators. The author has overcome the difficulty by the use of a screen-grid oscillator with extremely stable frequency characteristics. The complete set, including the rectifier uses seven tubes including the rectifier—it is an ideal receiver for 5 meter reception.

"Cisin 4-Tube Pentode Receiver," by H. G. Cisin. "Efficiency" was the basis on which this new receiver was designed. It is a 4 tube A.C. operated receiver using the 6.3 volt pentode tubes in the two R.F. stages and the A.F. stage, and a 6.3 volt screen-grid tube in the detector circuit. The set works a loud speaker on even the weak, far distant stations, due to the high gain in the R.F. amplifier. Plug-in coils permit operation on any wave band.

"Improving the Short-Wave Antenna," by Everett L. Dillard. No factor in short wave operation is more important than the aerial and the method of making a connection between it and the set proper. Mr. Dillard well known for his work on short wave antennas, provides some really sound information which every short wave "fan" should study carefully. The energy wasted in the antenna lead-in and coupling arrangement can never be regained in the receiver.

Turn Off Power Pack

In experimenting with modern A.C. receivers, always turn the power pack off before removing tubes from their sockets, particularly the audio output tubes. If the pack is left on, the removable of the load will cause the output voltages to rise, perhaps to dangerous values. The filter condensers are quite likely to break down under the strain, although under ordinary circumstances they will last indefinitely.

NOTES ON GANG TUNING

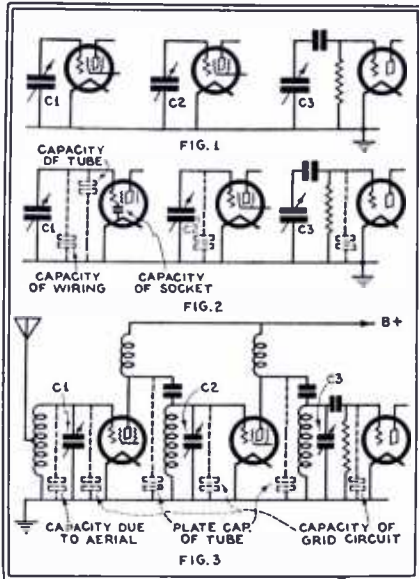


Fig. 1: the three sections of a gang condenser connected to two screen grid tubes and a detector. Fig. 2: Additional capacities due to wiring, screen grid tube and socket in a ganged circuit. Fig. 3: other capacity effects are introduced by the aerial, plate and grid circuits.

● RECEIVERS having adjustable tuning circuits may be arranged to have a separately controlled condenser for each circuit or the condensers may be mechanically coupled and operated through one knob.

A few years ago, separate tuning condensers were always used. Popular sets had two neutralized stages and therefore three tuned circuits. The coils were wound to the same specification and the tuning condensers were also made at least to look alike.

The result was that the readings of the dials of the condensers varied a little as the set was tuned over the wavelength band, says *Wireless Magazine* (London).

Thus the condenser used to tune the coil having the aerial connected to it often read several degrees below the others at the low-wavelength end of the scale and read about the same as the others at the top end.

Circuits Not Alike

The condenser used to tune the coil joined to the detector would usually differ in its reading by various amounts from the others according to the wavelength. Obviously the circuits were not alike.

Perhaps one coil had a little greater inductance than another. The capacity of one condenser at, say, 50 degrees, might have been below that of the rest and at 90 degrees a little greater, and so on. Then again, there would be differences in the circuits.

Let us, therefore, look a little more closely into this problem of ganging the tuning of, say, three circuits, using screen-grid tubes, of course, and the usual detector.

We have first to see that the circuit is one that can be ganged. True, it is possible to couple the sections of the gang condenser with insulating sleeves or bushes, but present-day condensers have the moving plates of each section fitted to a metal shaft.

Often a metal chassis is used to carry the parts of the set, and so it is convenient to arrange that all moving plates are grounded, joined to low-tension negative, to the cathodes of A.C. tubes or to some other point of fixed potential not much removed from earth.

Obviously the three sections should be alike, that is, the sections should have equal values of capacity as far as possible when tested with the dial in any position.

In practice, the sections are not identical. You might set the dial at 15 degrees and find C_1 to have a capacity 5 per cent. above C_2 and 2 per cent. below C_3 . At 30 degrees the capacities might be nearly enough alike, with perhaps a reasonable difference at the other testing points. The makers adjust the sections and arrange that the errors are less than a certain amount.

Positions of Plates

It does not follow, though, that the adjustments hold good for a period of a few years. In fact, there is always the chance that the plates may change their positions slightly.

Wear may take place in the bearings and so on. The result is that the gang condenser may not be accurate permanently.

However, let us assume just now that the sections are well matched. A glance at Fig. 1 will show that there

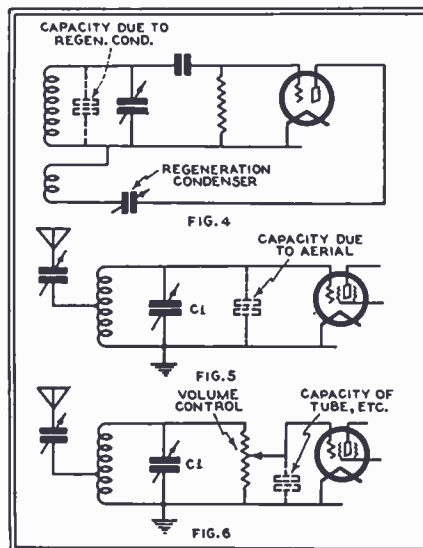


Fig. 4: regeneration circuit with the stray capacity it introduces. Fig. 5: effect of adjustable capacity in aerial circuit. Fig. 6: complications may be introduced by a volume control.

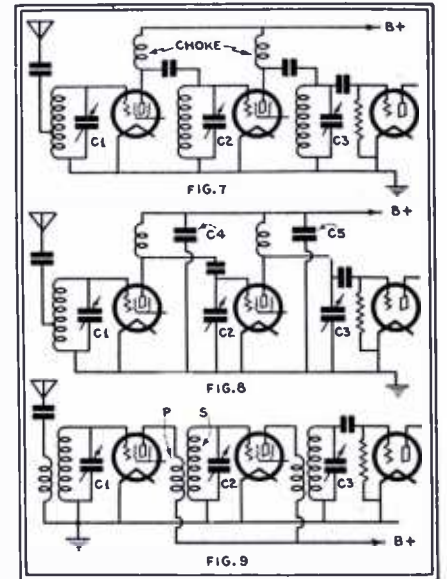


Fig. 7: circuit with plain tuned grid coils in a screen grid circuit. Fig. 8: popular plate circuit arrangement for screen-grid tube sequence. Fig. 9: a safe circuit with tuned R.F. transformers.

are other factors to be considered before we consider the coils. First are the tube sockets, then the tubes and the wiring. These elements have capacity and Fig. 2 shows the extra condensers. It is quite unlikely that all the extra condensers have equal capacities. True, the capacity of the connecting wires to each condenser might be equal, but joined to C_1 is the first screen-grid tube. Joined to C_2 is the second screen-grid tube and the first.

The next condenser, C_3 , has connected to it the anode of the second screen-grid tube and the grid circuit of the detector. If we draw the coils as in Fig. 3, we shall see the plate-circuit capacities.

It is clear that the total stray capacity in each circuit is not likely to amount to the same value in each case. In practice, they seldom do, as the capacity added to C_3 is usually very different from that added to C_2 .

To make matters worse, the aerial must be connected. An aerial has capacity and, according to how it is coupled, will increase the stray capacity across C_1 .

If the aerial is joined to a tap on the aerial-grid coil, the capacity added to the circuit will be less than when the aerial is joined to the top of the coil. In order to minimize the effect, the aerial may be joined to a tap so that about one-third of the coil is between the aerial and earth.

Series Condenser

A fixed condenser of .0001-microfarad capacity may be used in the aerial wire to the coil still further to reduce the capacity thrown across the condenser C_1 .

These stray capacities naturally affect the accuracy of the tuning. To get over this difficulty, the sections are provided with small auxiliary condensers, called trimmers. They are set to make the fixed and stray capacities equal.

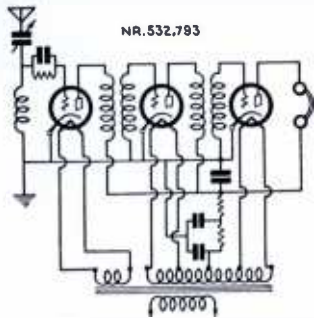
(Continued on page 299)

DIGEST OF RADIO PATENTS

Hook-Up

German Patent No. 532,793

Tube hook-up with use with A.C. fed electron tubes, in the case of which the cathode is heated by a heater electrode by electron bombardment. At the same time through charging of condensers connected between the cathode and heater electrode there is produced the plate potential necessary for operating the tube. The heater electrodes of two tubes are so connected to the same A.C. transformer for the purpose of providing the



operating D.C. for all the tubes, that one heater electrode is connected with one pole to one terminal of the secondary winding of the transformer and the other with one pole to the other terminal of the transformer, while with the other poles of the heater electrodes the corresponding heating potentials are taken off at the secondary winding itself, and that the plates of the condensers between the cathode and the heater electrode are connected to the middle of the secondary winding of the transformer.

Picture Transmission

American Patent No. 1,849,818

This invention relates to the transmission of pictures and particularly to the transmission of moving pictures or to television.

One of the difficulties encountered in present television systems is that of obtaining faithful amplification of the transmitted impulses over the wide range in frequency of such impulses heretofore found necessary.

As a result of this invention the minimum frequency which must be amplified, such as with a picture which is half light and half dark, is raised from the number of pictures per second to the number of scanned lines per second.

In accordance with the invention the object whose image is to be transmitted is scanned and produces impulses corresponding to the shade variations in each line in the usual and well known manner. Invariably the light areas and dark areas scanned in a single line will not total the same but the one or the other will predominate, the positive and negative values of the impulses due to the light and dark areas likewise predominating the one over the other. At the end of each line scanned an auxiliary impulse is produced of such a sign and of such value that when added to the impulses of that line a complete balance is effected. This in effect correctly locates the zero of the alternating picture frequency wave.

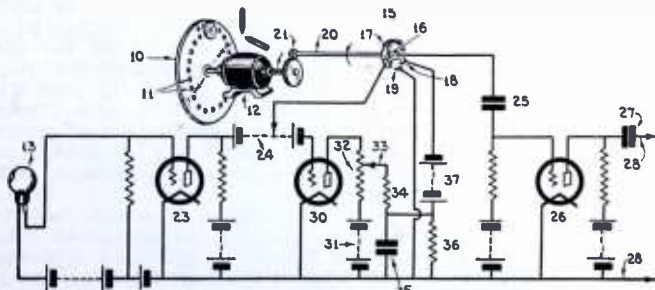


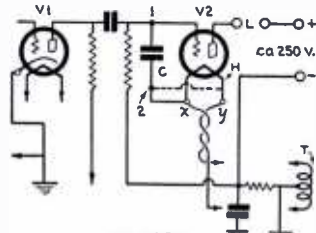
FIG. 1
No. 1,849,818

The most interesting radio patents granted recently to inventors in the United States and Europe are reviewed here for the benefit of amateur experimenters and research engineers who have neither the time nor the inclination to wade through stacks of irrelevant patents in a search for information. While it does not pretend to be a complete review of the patent situation, it undoubtedly will prove of considerable value to many of our readers.

Hum Elimination

Austrian Patent No. 126,301

The residual hum in resistance amplifiers, even with good filtering, is caused by A.C. which among other things even reaches the grid of the last tube. If it is possible to impress on it an A.C. potential of equal frequency and amplitude and 180 degrees out of phase, the



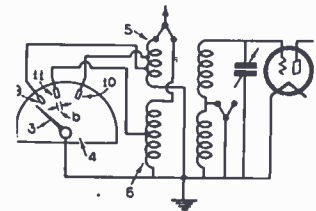
NR. 126,301

hum is eliminated. The grid of the tube is connected with the point I of the compensating condenser C and point II with one of the foot points x or y (to be determined experimentally) of the filament of the last tube. By exact adjustment of condenser c and by choice of the right connection x or y, the hum can be reduced or eliminated.

Wave Traps

Austrian Patent No. 126,324

In seeking foreign stations it is always unpleasant to have a local station at the tuning point reproduced in the loud speaker. One can help matters as follows. The variable condenser shaft is



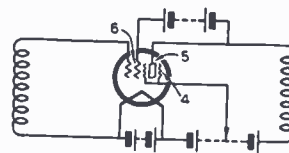
NR. 126,324

is provided with a lever 3, which in turn grounds contacts 9 to 11 (via the shaft of the rotor). These contacts can be so arranged on a disc that their positions correspond to local station setting on the tuning condenser.

Screen Grid Tube

British Patent No. 366,634

Protected conductor for screen grid tubes. To prevent the plate potential of screen grid tubes from falling below the amount of the screen grid in the case of great loads, an additional grid 6 is



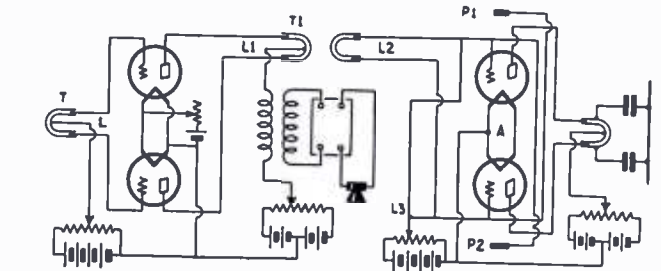
NR. 366,634

provided between the screen grid 4 and the plate 5 and is connected with the plate by a battery 6. The battery is large enough to prevent secondary emissions and not to disturb the primary electron emission, when the plate potential sinks to a low value.

Short-Wave Amplifiers

British Patent No. 372,660

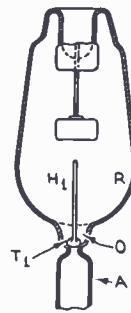
Relates to amplifiers of the type in which the grid carries a relatively high positive potential, while the plate operates either at a negative or a small positive bias, so as to increase the speed of the electron stream beyond the point at which it may prejudice the handling of ultra-short wavelengths. According to the invention the tube circuits are tuned



by Lecher wires L, L1, terminating in "trombone" sliders, T, T1. A quarter-wave loop line L3 may also be used to feed the operating potentials to the grids. As shown, a push-pull oscillator O is

Sealing Arrangement

German Patent No. 503,389



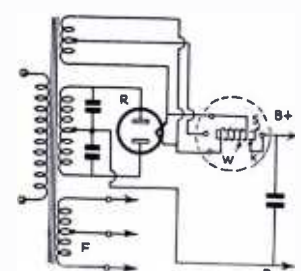
NR. 503,389

Process for evacuating electric incandescent lamps and other vacuum vessels, in the case of which the entrance of the pump tube is reduced with respect to the interior of the vacuum vessel, before the sealing and separation of the pump tube, characterized by the fact that after the completion of the pumping process the glass wall of the pump stem is reduced to a very tiny opening by heating the glass cylinder against the edge of any insertion piece applied near the fusion opening of the pump tube, and that thereupon the real fusion point is warmed and sealed.

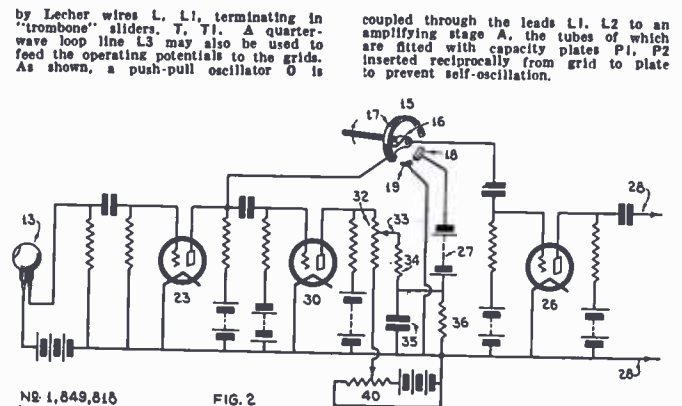
"On and Off" Switches

British Patent No. 371,018

To ensure that the plate supply to a broadcast receiver is switched on and off in correct sequence with the filament current, a winding W in parallel with the filament supply to the rectifying tube R is used to heat a bimetallic strip S,



causing the latter to bend over and make contact at K with the B+ terminal. This can only occur after the tube filaments have been energized for a definite interval of time from the secondary winding F. Once made, the contact K remains closed so long as the tube filaments are lit, but automatically breaks the plate circuit a short time after the filament supply has been switched off.



NR. 1,849,818

FIG. 2



TELEVISION SECTION



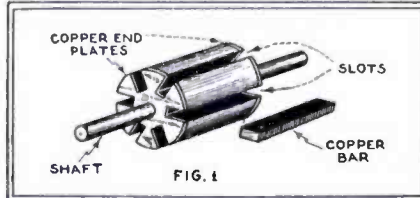
MAKING A 1200 R.P.M. SYNCHRONOUS MOTOR FROM AN 1150 R.P.M. INDUCTION MOTOR

By M. MAYNARD

● FOR the television fan who is so fortunate as to be located on the same power system as his broadcasting transmitter, the synchronous motor is undeniably the most satisfactory means for driving the scanning disc available at the present time.

Such a machine, powerful enough to drive a 17" or 23" lens disc, is rather expensive, however—usually beyond the means of the average experimenter. It is the purpose of this article, therefore, to describe a simple modification of a standard 1150 R.P.M. A.C. motor to render it synchronous at 1200 R.P.M.

Incidentally, it might be added that the scheme is not at all new; actually, it marks 'way back to the good old days



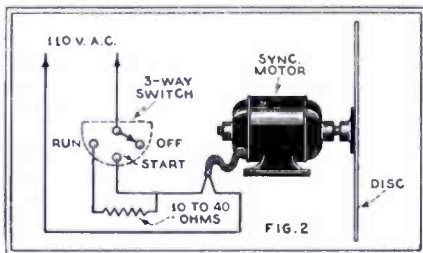
Position of the six milled slots in the rotor of the revamped motor.

smoothly at its rated speed, the rotor is removed, six slots one-quarter inch in width and of about three-quarter inch depth, being milled directly across at 60° intervals around the circumference of the rotor, as shown in Fig. 1. If the constructor does not happen to have access to a milling machine, this can best be entrusted to the local machinist, to whom this is at most a half hour's job.

The above procedure gives the six salient rotor poles necessary for synchronous operation. Six copper bars should now be cut and fitted into the rotor slots so as to fill each of the latter completely and just come flush with the ends of these bars to the copper end plates of the "squirrel cage" rotor, the latter may be replaced in the motor, assembly then being completed.

It may be explained that the above step is not absolutely necessary—the motor will run synchronously without the copper bars. However, these permit easier starting and somewhat better torque in this type of machine than is evident without them.

Suggested connections to the motor are shown in Fig. 2. The author recommends that a line resistor of from 10 to 40 ohms (one or two Kresge heater elements will do) but "cut in" in series with the motor after the latter has pulled into step with the A.C. line; the value of resistance used should be such as to



Connections for the reconstructed motor suggested by the author.

when the synchronous rotary spark gap was considered the ultimate in the ham transmitter. Many an induction motor found its way into the amateur station through this scheme.

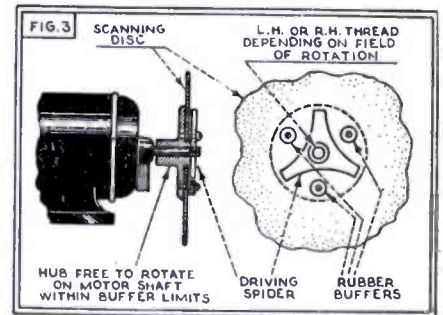
An 1150 R.P.M. single phase 60 cycle motor of 1/4 to 1/2 H.P. rating may be acquired for very few dollars from the local dealer in electrical machinery. This motor should be of the wound-stator type, having no brushes, slip rings, or commutator—the size selected depending on the disc to be driven.

Having made sure that the motor runs

just keep the motor from falling out of step after once "pulling in." The machine will now run almost noiselessly, providing, of course, that the usual precautions are taken to filter out transmitted vibrations by use of sponge rubber between motor and mounting shelf.

In conclusion, it may be said that the experimenter will be more than gratified at the performance of the above motor; it will easily equal that of the commercial types on the market.

As is the case with the latter, however, it will be found that the load permissible is determined largely by the kind of "floating power" arrangement



"Floating Power" arrangement for coupling the scanning disc to the motor.

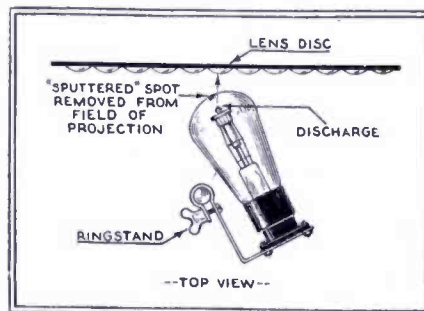
employed in coupling the motor to the scanning disc. A very successful scheme used by the writer to drive a 17" lens disc is shown at Fig. 3; simple as it is, it represents considerable experimentation with many type of spring coupling hubs and is recommended as the best.

In a future article, the author will describe a "professional" home-built scanner employing the above motor in conjunction with a lens disc, disc case, and a novel silencing base for the complete unit.

EXTENDING THE LIFE OF THE CRATER LAMP

● THE approach of the end of useful life of the television crater lamp is characterized by a diminution in efficiency due to decrease of gas pressure through sputtering of cathode material onto the glass envelope directly in front of the crater. The resultant darkening of the glass at this point in turn decreases the illumination efficiency of the lamp tremendously, and is in itself a justification for removal of the tube.

While we can do nothing about the former of these difficulties, the writer has hit upon an extremely simple and effective method of getting around the proposition of cathode sputtering.



Suggested mounting of the crater lamp.

This is shown in the illustration, and consists of simply turning the lamp angularly with respect to the disc, so as to remove the "black spot" from the field of projection. No discernible distortion results from this procedure, since the crater discharge gives a true "point source" effect, not confining itself within the crater, but extending far enough out for projection from a surprisingly wide angle.

Using this scheme, the author has succeeded in doubling the useful life of a standard "Speed" lamp which otherwise would have been discarded after two or three months of use because of sputtering.

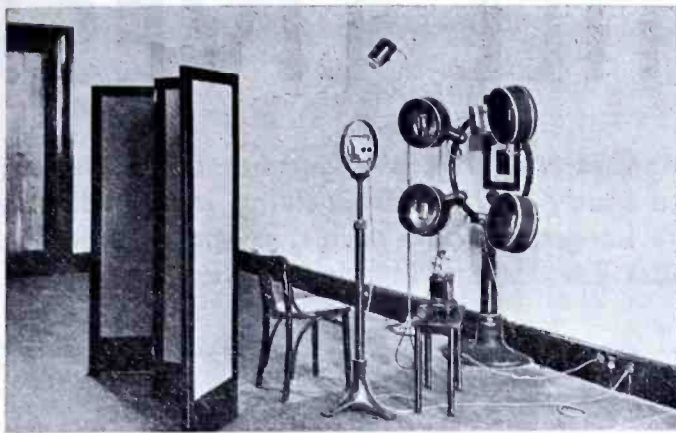


Fig. A: Set up in the studio.

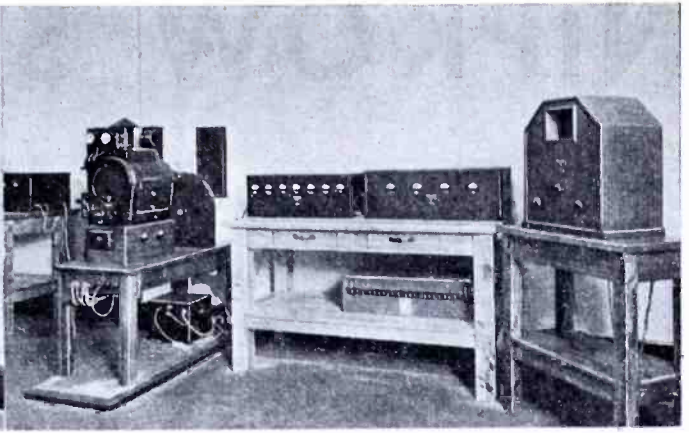


Fig. B: Apparatus in the control room.

ROME TELEVISION STATION IS EUROPE'S LATEST

● EVIDENCE of the continued interest in television on the continent of Europe is forthcoming in the latest information dealing with the equipment installed in Rome for the Ente Italiana Per Le Audizioni Radiofoniche (E. I. A. R.) by the Fernseh A. G., the company formed to develop the Baird system in Germany. The E. I. A. R. is a powerful body controlling all the radio transmitters in Italy and experiments in television have already started. The Italians are desirous of learning for themselves the best picture ratio, the number of scanning strips, the optimum frequency range and the most suitable wavelength for providing a real broadcast service, and the apparatus has therefore been made adaptable to suit this specific purpose.

A Baird spot light transmitter suitable for close up and semi-extended portrayals has been adopted and as the various electric supplies are not inter-linked in Rome a form of automatic synchronizing independent of the supply frequency was essential. A scanning speed of 20 pictures was chosen and to allow for two different picture ratios the apparatus is designed to give either a vertical formation of 4 by 3 and a horizontal formation of 3 by 4, the number of scanning strips in both cases being 60. In terms of picture points this gives 2,700 for the former and is primarily for head and shoulder transmissions, and 4,800 for the latter, to be used for larger scenes, the transition from one to the other being effected by changing the scanning discs and altering the framing mask.

The Transmitter

Illustration B gives a general idea of how the apparatus is mounted in the control room. On the left is the spot light transmitter, the scanning disc being encased. The automatically fed arc lamp has a parabolic mirror condenser optical system, focussing on the subject being carried out by a light intensity projection objective.

To aim at perfect synchronization it is necessary that the number of revolutions of the transmitting disc should

Interest of Italian experimenters aroused by new transmitter, which uses Baird system.

by H. J. BARTON CHAPPLE

be constant as possible. For this reason the motor, driven by direct current, carries a toothed wheel (60 teeth, 12 poles) which is built into the same case and maintains the number of revolutions constant to within .0001%. The alternating current required for driving this wheel (1,200 cycles per second) is produced by a tube generator of as constant a frequency as possible.

By taking special precautions it is possible for the frequency of this generator to be made practically independent of the heating voltage and plate voltage variations. As, apart from this, the main apparatus feeding this also contains a compensating device to maintain this voltage constant, the frequency during the course of several hours was kept constant in accordance with the value mentioned. In the four stage amplifier the alternating current produced by the valve generator is amplified up to a few watts and is conducted to the stator windings of the toothed wheel for the transmitting motor.

To bring about the greatest pick-up of the light reflected from the object scanned, the photo-electric cell holder seen in illustration A carries four parabolic mirrors of 12 inch diameter in whose focal length the four photo cells are fixed. The mirrors and the photo-electric cells are built into metal cases to provide good electrostatic screening, these cases being closed in the front by a wire netting and carry, furthermore, a built-in amplifying valve. Through this compact method of construction of photo-electric cell and first amplifying tube, the detrimental capacities are reduced and comparatively large photo-electric cell resist-

ances may be employed. The four tubes are connected in cascade on the plate side and join to the photo-electric cell amplifier by a low resistance cable.

By employing a combination of potassium and caesium in the cells a natural reproduction of the half tones was attained, the different degrees of sensitiveness of both types of cells being equalized by a suitable choice of the single photo-electric cell resistances.

The eight-stage resistance-capacity coupled photo-electric amplifier maintains a practically constant degree of amplification over the wide range of 20 to 50,000 cycles. The power amplifier has two outputs, one of which feeds the neon lamp of the control receiver, while the modulation apparatus of the wireless transmitter is connected to the other. By means of a regulating link independent of frequency, the degree of amplification can be continually varied over a large range.

Mirrors and Discs Used

At the receiving end both disc and mirror drum model receivers are provided. The line frequency simultaneously transmitted with the picture signal modulates a tube generator at the receiving end and the amplified oscillations are fed to a toothed wheel. The synchronizing apparatus is built into the disc television receiver underneath the motor support and is worked from the power lines. The driving motor for the disc contains in the same case the alternating current driving motor and the 60 toothed wheel. The control knobs, visible on the front of the disc receiver seen at the right of illustration A, serve to alter the number of revolutions of the motor, adjust the framing and phasing by rotating the motor frame, and alter, in stages or continuously, the frequency of the tube generator.

The two discs, as they are calculated for the same average radius, are interchangeable, so that only the movement of the mask is necessary in order

(Continued on page 301)

NIPKOW STILL LIVES!

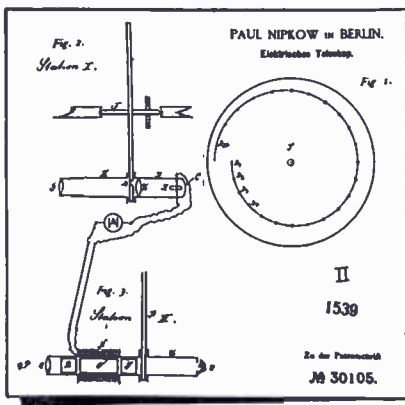


The grand old man of television as he appears today: Paul Nipkow as photographed by the author.

● ALREADY for years the famous Nipkow, the ingenious inventor of the classical televisor, has passed for one of the tragic figures in the ranks of the inventors who did not live to see their ideas realized. The only thing known of him was the German patent of January 6, 1884, Patent No. 30,105. So much the greater was my amazement, when one day, in looking through the fat Berlin directory, I suddenly saw before me the name of the great televisor inventor, "Paul Nipkow," with the occupation given as "head engineer, retired." Although the matter looked very improbable and it reads in black and white in all bibliographies that Nipkow was a Russian from St. Petersburg (now called Leningrad), I nevertheless set out. The house in old Pankow, in one of the most beautiful suburbs of Berlin, I soon found. There was the door plate with the name "Paul Nipkow," too. But although I am an old journalist and have done many difficult things, I really lacked the courage to ring the bell.

As a matter of fact, what would the

Extreme left: Nipkow's original conception of the television scanning disc, showing the fundamental scanning spiral. Center: Nipkow as he appeared at the age of 27. Right: facsimile of the first page of Nipkow's original television patent, granted in 1884.



The father of modern television is a German, not a Russian, and is hale and hardy at 72. He is living a quiet life in Berlin, where he granted this exclusive interview for "Radio Review and Television News".

By Wilhelm Schrage

people in there say, if I should ask them about the inventor of the televisor? Was there perhaps a totally different Nipkow living here, one who simply by chance had the same name as the great Russian? A Nipkow who had never even heard of television and would think I was making a fool of him? I knocked—and stood at the door, awaiting with conflicting emotions what would happen.

The door slowly opened a little. Behind the narrow slit stood an old grey haired woman. At the question: "Please excuse me, but does the inventor of television live here?" she took on an expression which the words "incredulous" and "confused" are too weak to describe. I should have liked best to run away at once. Then came as answer a stammered "Yes," a "Yes" so prolonged that I was inclined to assume that I had taken the long trip from Berlin to Pankow in vain. Finally the old lady, after a long and thoughtful pause, said, while gently closing the door, "Yes, I'll just go and ask."

Now I waited outside nervously, expecting at any moment a very "forceful" answer or even perhaps the impact against my head of a hard object capable of producing severe injuries.

But nothing of the kind happened. A smooth shaven man of about 35 opened the door and said,

"Please come in, my father will be right here."

I sat in a room which was adorned

according to the good old Berlin custom with a plush sofa and countless knickknacks. Antique—but very pleasant and comfortable. After a while there came in a man apparently about 60, who said while extending his hand to me, "Yes, I am the inventor."

He told as freshly and gaily as a twenty year old, how, on Christmas eve, in the year 1883, with his stomach not too well filled, he was working at his favorite problem, the televisor, considering everything this way and that, and how he suddenly came upon the long desired solution, at midnight or perhaps a little later.

"I jumped up," said he, "and danced around the room like one possessed, so that my landlady came into my room full of terror, fearing that something had happened to me. Actually something had happened to me, but something delightful, something which made the hitherto so gloomy Christmas a brilliant festival, the most beautiful Christmas festival I can remember. Suddenly my stomach no longer called for food, I was gay, rich, and happy."

Very interesting was his answer to the question of how he had occupied himself with the idea of constructing a televisor. Nipkow laughed and said, repeatedly twirling his fine large moustache, like a sergeant's which was not at all grey,

"Well, that is not as peculiar as you think. At that time the newly introduced telephone was in the center of

(Continued on page 300)

A NEW PRINCIPLE APPLIED TO TELEVISION SUPERHETERODYNES

by R. W. TANNER

● DURING the past three years a great many improvements have been made in the art of television. The greatest amount of research work has been applied to the scanning mechanism, the light source and the optical end, but what has been done to improve the receiving circuits? The present television receiver is nothing but a broadcast circuit having broadly tuned signal or intermediate frequency stages and a resistance audio amplifier. Such a circuit is far from satisfactory. Tuning with 100 kc. selectivity results in much interference, man made static as well as station interference. With television superhets, having only one tuned circuit preceding the first detector, interference is generally so great (unless located within a short distance of the transmitting station) as to make reception of clear pictures almost an impossibility.

The type of receiver needed for television reception is one which is capable of tuning sharply to eliminate station interference and having a compensating circuit after the signal frequency detector to increase the amplitude of the higher image frequencies which have been cut off in the tuned circuits.

Details of Circuit

The writer has under development a new circuit which employs a principle exactly suited to the needs of television. While this circuit is not ready to be made public as yet, one of the principles can be applied to the ordinary superheterodyne.

In the new circuit the signal is not mixed with current from an oscillator to provide the best frequency, as is the case with a superhet. However, with a few simple changes, we can use the superhet circuit and obtain the results required for television.

The function of a super circuit using the new principle is rather simple. A signal frequency amplifier is employed, not so much for added R.F. gain, but rather for increased selectivity due to the added tuned circuits. The currents in the signal frequency amplifier plate circuit are fed to the first detector grid through a two-section band pass filter.

A 58 R.F. pentode is employed as a first detector due mainly to the increase in gain, which can equal approximately one-third that of one I.F. stage. Another reason for its use is that such a tube must be operated with a comparatively low value of bias resistor, making it possible to use the tube also as a second harmonic oscillator. If a tube were employed which required a large bias resistor, oscillation would be practically out of the question.

Now, here is the way the new principle is applied. The beat frequencies in the detector plate are fed through a loosely coupled band pass filter, tuned

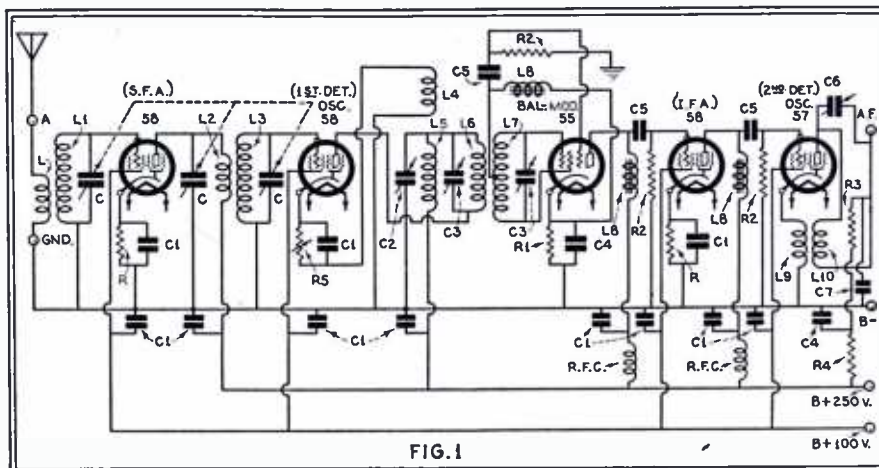


FIG. 1
Complete circuit diagram of the special super-heterodyne designed by Mr. Tanner. See the text for the electrical values of the various parts.

SERIOUS television experimenters who would like to bite into a really interesting problem in circuit design will find much "meat" in this exhaustive article. Mr. Tanner has been doing a great deal of laboratory research, and offers the first fruit of his labors to the readers of this magazine. Full circuit constants are given for the benefit of the constructor.

to the intermediate frequency, to the grids of a pair of tubes connected in push-pull. These tubes are employed in a manner similar to the balanced modulator of the single side band system of transmission. With the advent of the new RCA-55 tube having two detector grids, it is possible to eliminate the push-pull stage and employ only one 55.

The combination of double grid detector and three electrode amplifier makes it possible to use fewer I.F. stages. The output of the 55 balanced modulator, if it can be considered as such, consists of ONLY the two sets of side bands, the carrier being entirely eliminated. By employing the proper medium of coupling between the I.F. stages, we can amplify one set of side-bands with a rising characteristic towards the highest image frequencies, which, in the case of 60 line transmission, is 43,200 cycles. If the coupling impedances are correctly designed and constructed, the voltage gain in the I.F. stages will exactly compensate for the side band cutoff in the signal frequency tuned circuits.

While it would possibly be preferable to employ a filter to pass one set of side bands to the exclusion of the

other, by proper choice of intermediate frequency, which cannot be too high, and correct design of the I.F. coupling impedances, the useless set of side bands will cause no trouble whatsoever.

After the side bands are amplified by the I.F. amplifier, they are fed to the grid of a second detector. At this point a carrier must be applied before rectification can take place. The second detector is also operated as a second harmonic oscillator. In other words, the oscillator coils are tuned to a frequency just half of that of the required carrier.

The intermediate frequency selected for the experimental work with this new principle was 90 kc. Considering the highest image frequency of 43,200 cycles, the I.F. impedances would be wound so as to peak at approximately 133,200 cycles (133,000 is close enough). The impedance coils used in the experiments were lattice wound 1" in diameter.

The amplification ratio from lowest frequency, 90,020 cycles, to highest frequency, 133,000 cycles, can be controlled by placing small iron cores through the center of the I.F. impedances. From one to five laminations of very thin silicon steel will generally suffice. The use of the iron cores reduces the slope of the gain curve.

Although this is not intended as a constructional article a few details of the coils and other parts will be given to enable the experienced experimenter to try something really new.

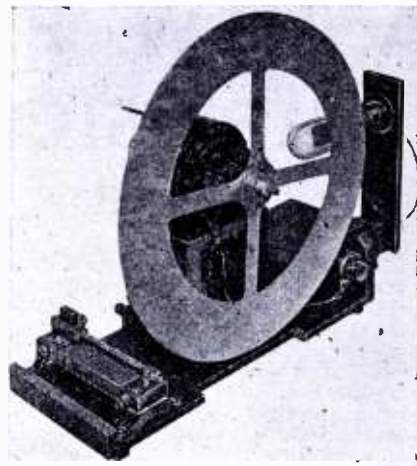
The tuning condenser C has a capacity per section of .00035 mf., each section being shunted by a .0001 mf. trimmer. The high tuning capacity makes for increased selectivity and a minimum of noise. The high value specified for the trimmers is for the purpose of better alignment and to cut down the capacity range so that the tuning will just about cover the range of 100 to 200 meters when the

(Continued on page 293)

HOW "SCREEN NEWS" IS TELEVISED

Messages on paper tape reproduced by television receiver like flashing bulletin signs. System has great possibilities for deaf people and for other special purposes. Called "Telegoscopy" by J. L. Baird, inventor.

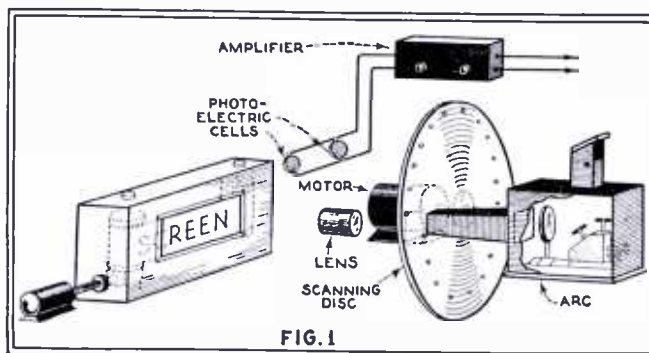
by H. J. BARTON CHAPPLE



Above: Special disc outfit for reproducing television "screen news." Left: Pictorial layout of the transmitting apparatus.

● "STAND by for television screen news" was a familiar interjection during the course of the experimental television transmissions put out by the Baird Company in England soon after it commenced the broadcasts using the first B.B.C. transmitter at Brookman's Park. Not only was there a novelty appeal in this portion of the program, but it provided those looking in with an excellent method of testing the efficiency of their receiving apparatus. In those early days, namely, the Autumn of 1929, the signals were transmitted through one channel only so that television was like the early films when subjects had to be captioned. These captions were obtained by running a moving band of letters in front of the transmitter so that those looking-in at the receiving end read out the name of the artist and the song by the letters passing across the screen, something like the present-day news bulletin signs.

The pictorial diagram of Fig. 1 explains the scheme that was adopted. The ordinary spotlight method of scanning and a standard ratio disc were employed, the photo-electric cells picking up the reflected light in the conven-



tional manner for conversion into equivalent terms of electrical current.

Figure 2 is a diagram of the white screen placed at the back of the artist while being televised, and in the center is an aperture behind which the "news" apparatus was placed.

Originally this was hand worked, but later a motor driven model was introduced. When the announcer interposed for a moment on the vision wavelength and was heard to say

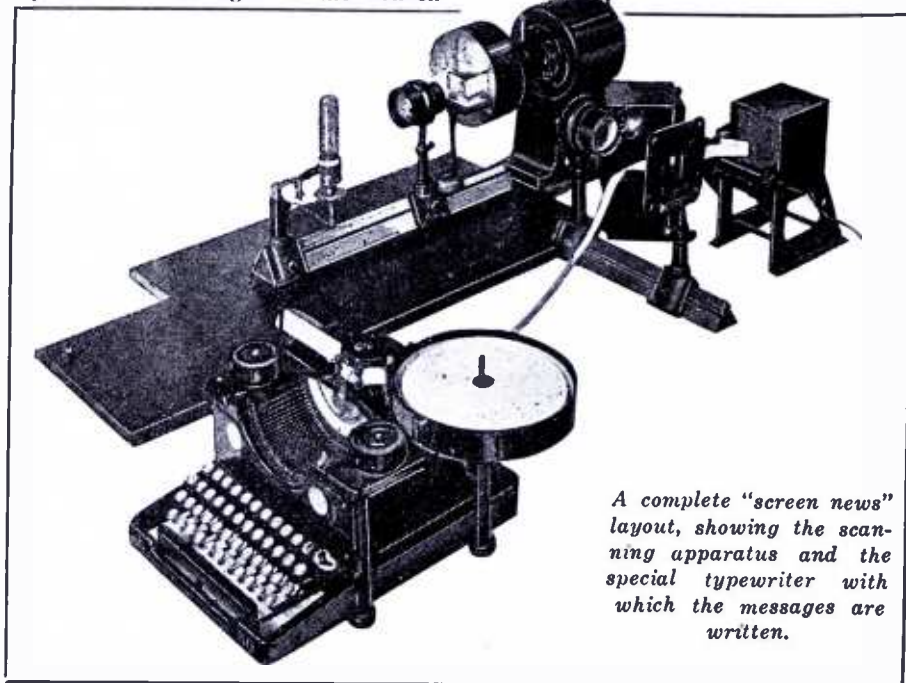
"Stand by please for Television Screen News," the sliding panel, which had previously obscured the aperture, was drawn to one side and the lettering moved across the field of vision from right to left. The size of the letters was 3 by 2 1/4 inches, these being the most suitable dimensions for producing the best results.

The interior of the apparatus contained an endless roll of varnished linen, which passed at intervals over rollers, and along which were regularly spaced small slots for the insertion of the letters. A lining of thick felt reduced the sound caused by the letters continually passing over the rollers.

With moving black letters on a white background, those looking-in could see very readily whether there was any distortion being brought about by the radio set employed. Shadows, if present, were quite clear, while ghost images were readily noticed on long distance reception. This method of conveying intelligence was really one of the earliest uses suggested for television, and in 1927, when Mr. J. L. Baird was working on this scheme of television development, he took out several patents covering the apparatus designed and coined a word to represent the process, namely "telegoscopy." This rather unwieldy word is a combination of three Greek words "tele," "logos" and "skopos" and means literally "seeing writing at a distance."

In the year 1929, however, special equipment was built up to scan and actual tape on which the letters were typewritten. It was made originally for Prince Parachutra to transmit Siamese characters, for being unorthodox,

(Continued on page 293)



A complete "screen news" layout, showing the scanning apparatus and the special typewriter with which the messages are written.

they did not lend themselves satisfactorily to other methods of transmission, as for example, in those circumstances where fading makes Morse transmission difficult. An accompanying illustration and Fig. 3 shows both the original apparatus laid out for inspection and the method of working (pictorial form). A special typewriter was used, adapted to printing Siamese characters on a tape similar to the machine shown. The large roll of white paper tape runs freely in a shallow cylindrical casing on the top right-hand corner of the machine and this tape is fed out on the left with the usual intermittent feed associated with a typewriter. The tape then passed through a frame-work at a constant speed, a loop of tape being maintained between the two machines to allow this to take place. A beam of light from a projection lamp was focused on to a prism inside an apertured drum scanner, then bent at right

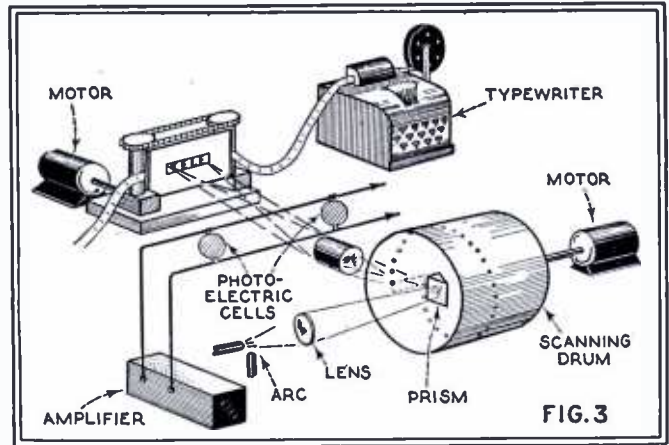
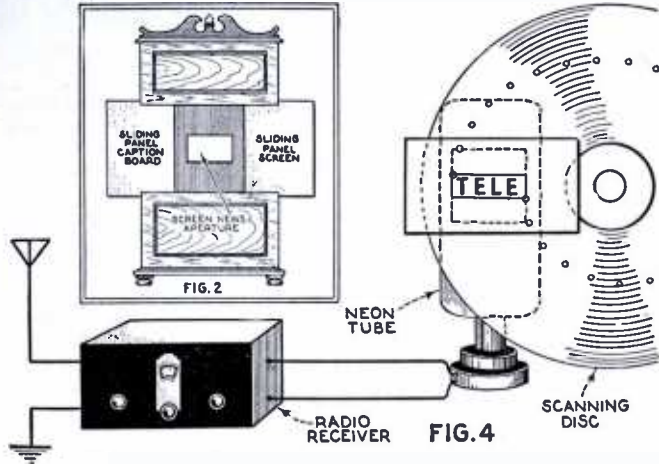


Fig. 2: The apparatus is behind the center aperture.

Fig. 3: layout of the complete typewriter set-up.

Fig. 4: arrangement of a "news by television" receiver.



angles by the prism and made to cover a rectangular area as shown by the dotted lines.

Rotation of the drum caused each hole to move vertically across this area and a pencil of light passed through being projected finally on to the tape. To make the fullest possible use of the available line or radio transmission channel, the scanning area

conformed exactly to the size of the portion of tape in the field at the time, the picture shape being long horizontally and narrow vertically. Photo-electric cells picked up the light reflected from the scanned printed strip and the resultant signal pulses were amplified and transmitted in the orthodox manner. With this form of apertured drum, line curvature is almost absent

and at the receiving end the resultant lettered image can be viewed by disc, mirror drum, lens drum or apertured drum apparatus.

Another illustration shows one of the actual experimental receivers employed while testing out this "news by television" by wireless. A sixty-hole disc was employed and the plate of the neon lamp is seen to be long horizontally and narrow vertically. Figure 4 pictorially represents the arrangement adopted.

If a permanent record of the script is required British Patent No. 324904 gives details of a scheme. Briefly it consists of a chemically prepared tape passed through a set of contacts which are connected in turn in scanning sequence to the output of an amplifier at the receiving end. This marked tape can be read out direct or be projected on to a screen if desired.

The whole scheme just described has a definite use and may supplant, or at least supplement, other means of communication in quite the near future.

A NEW PRINCIPLE APPLIED TO TELEVISION "SUPERS"

(Continued from page 291)

When tuning, the two dials, the three-gang condenser and the oscillator condenser C2 are rotated at the same time. The tuning on both dials is rather sharp, depending of course, upon the degree of coupling between L2 and L3 and between L6 and L7. The spacing between coils L6 and L7 should not be less than 1½" and possibly somewhat greater.

After the signal frequency circuits are adjusted correctly, a signal should be tuned in and the I.F. peaking condensers C3 adjusted to point of maximum signal strength. At the same time, an adjustment of the second detector oscillator condenser C6 will be needed so that the second harmonic will be exactly the same as the beat or intermediate frequency.

It would be well to say at this time that the center tap on L7 MUST be exact or some of the carrier will get through the balanced modulator. To be sure of this, when having the coils made, specify coil L7 wound on same form in two equal sections side by side placed as close as possible. The center tap will then be the common connection to each.

The new principle involved in the function of this television superhet, that is, the process of compensating in

the I.F. amplifier for the loss of the higher image frequencies in the signal frequency circuits, is unique in its application and in past experiments has proven very interesting, to say the least. This new principle is still in the process of development but considerable is expected of it when the work is completed.

Circuit Constants

- C—3 gang .00035 mf. tuning condenser.
- C1—1. mf. bypass condensers.
- C2—.00015 mf. oscillator tuning condenser.
- C3—.0005 mf. I.F. tuning condensers.
- C4—1 mf. bypass condensers.
- C5—.00025 mf. I.F. coupling condensers.
- C6—.0018 mf. 2nd oscillator tuning condenser (approximate capacity).
- C7—.001 mf. bypass condenser.
- R—300 ohm S.F. bias resistor.
- R1—2500 ohm bias resistor.
- R2—.5 megohm I.F. grid resistors.
- R3—100,000 ohm 2nd detector plate resistor.
- R4—25,000 ohm A.F. filter resistor.
- R5—Variable 1st detector grid bias resistor 0 to 2,500 ohms.

RFC—I.F. radio frequency chokes.

L—Antenna coupling coil.

I1—S.F. grid coil.

L2—S.F. plate coil.

L3—1st detector grid coil.

L4—Oscillator cathode coil.

L5—Oscillator plate coil.

L6—1st section of I.F. band pass filter. 8 M.H. inductance. Lattice wound.

L7—2nd section of band pass filter. 8 M.H. inductance. Lattice wound.

L8—I.F. coupling impedances. 30 M. H. Lattice wound.

L9—1.2 to 1.5 M.H. cathode coil. Lattice wound.

L10—Approximately 7 M.H. inductance. Lattice wound.

Coil details:

L	L1	L2	L3	L4	L5
5	22	22	22	16	39

L and L1 wound with 24 D.C.C. wire on a form 1½" diameter. The turns are not spaced. L is ¼" from L1. L2 and L3 are wound on a 1½" form 4" long, with about 1¼" separation between sections. Same size wire as on the other form. The oscillator coils L4 and L5 are also wound on a 1½" form with a 24 wire.

MOST POWERFUL TELEVISION TRANSMITTER IN WEST COMPLETED

● **COMPLETION** of the most powerful television transmitter in the West, and among the most powerful in the United States, is announced by the Don Lee Broadcasting System, through Harry R. Lubcke, director of television for the network.

Rated at 1000 watts, and with 4000 watts maximum output for signal peaks, the new transmitter, with call-letters W6XS, went on the air for the first time on regular schedule, Friday, December 23, 1932, from 6:00 to 7:00 p.m., broadcasting action reels and close-ups of motion picture stars. This schedule will be maintained daily, except Sundays and holidays, it is announced.

Embodying many ultra-modern and far-advanced features, many refinements of which have been worked out by Lubcke and his staff, W6XS is ten times more powerful than the sister television transmitter, W6XAO, which has pioneered several significant achievements in the ultra short-wave field, notably the transmission of a motion picture image to an airplane speeding high above Los Angeles last summer.

Opening on regular schedule on the first anniversary of W6XAO, the new high-powered television transmitter of W6XS will operate on a frequency of 2150 kilocycles, or 140 meters. Grid modulation, new air-cooled vacuum tubes and other highly advanced features of the 1000-watter, are expected to provide signal coverage of the entire state.

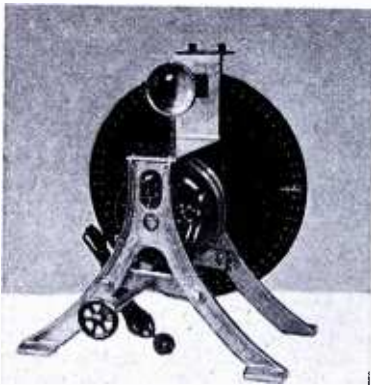
As in the case of the smaller W6XAO, the new transmitter is at present located in the Don Lee Building at Seventh and Bixel Streets, Los Angeles, where the Don Lee staff of engineers have just completed construction of the West's new television giant.

W6XS will transmit an image of 80 lines, at a rate of 15 images a second, the same as broadcast by W6XAO.

It is significant to note that both transmitters will be operated simultaneously, thus offering receiving stations an opportunity to check results on both the ultra high-frequency channel used by W6XAO, and the lower frequency channel of the new transmitter.

NEW HARTMAN SCANNER UNIT

● **THE** accompanying photo shows a new scanning unit which has recently been brought out by the Hartman Television Laboratories of 1304-18 N. Howard



Street, Philadelphia. It is known as Model 16L. The General Electric 1200 RPM Synchronous motor is over 6 in. in diameter and has plenty of reserve power for driving the 16 in. lens disc. The motor is rated at 1/6 H.P. Two contact rings with brush holders are fastened to the outside frame of motor, making it possible to continuously rotate the motor housing without twisting and winding up the 110 volt cord. The two cast iron hangers, besides being fitted to hold and swing the motor, have a platform mounted on their tops which supports both

the lamp housing and picture screen. Lamp housing is adjustable both horizontally and vertically. The 8 x 10 translucent screen which is supplied is held in an aluminum frame. A convenient knob is furnished for "picture framing" and is located just below the translucent screen. This model scanner is also furnished with a punched disc and magnifying lens for experimenters who wish to save the expense of a lens disc, and is known as the Model 16 P. Lens disc and screen may be purchased separately.

LIST OF TELEVISION STATIONS

● **THERE** are now about thirty-four licensed experimental television stations in the United States, of which some thirty are intermittently in operation, according to the *New York Sun*. About eight of these transmitters are linked with regular broadcast stations for sound accompaniment and are sending out their images simultaneously with audible programs from sound broadcast

studios. Recently W2XAB in New York City discontinued using W2XE for its sound channel and now has a voice channel alongside its picture channel. (See October 1932 number of TELEVISION NEWS.)

The list which follows gives the latest complete data for the scanning disc needed, as well as the location of the transmitters.

Call Letters.	Power in Watts.	Company.	Location.	Scanning Lines.
1,600 TO 1,700 KILOCYCLES				
W2XR (1)	500	Radio Pictures, Inc.	Long Island City	60
W1XAV (2)	1,000	Shortwave and Television Co.	Boston, Mass.	60
2,000 TO 2,100 KILOCYCLES				
W3XK	5,000	Jenkins Laboratories	Wheaton, Md.	60
W2XAP (3)	5,000	Jenkins Television Corp.	Washington	60
W2XCD	5,000	Deforest Radio Co.	Passaic, N. J.	60
W9XAO (4)	500	Western Television Corp.	Chicago	60
W6XAH	1,000	Pioneer Mercantile Co.	Bakersfield, Cal.	60
W9XK	100	Iowa State University	Iowa City, Iowa	60
W8XAM	1,000	Sparks-Withington Co.	Jackson, Mich.	?
2,100 TO 2,200 KILOCYCLES				
W3XAK	5,000	National Broadcasting Co.	Portable	?
W2XBS	5,000	National Broadcasting Co.	New York City	60
W3XAD	500	RCA-Victor Co.	Camden, N. J.	60
W8KAN	1,000	Sparks-Withington Co.	Jackson, Mich.	?
W2XCW	20,000	General Electric Co.	Schenectady	?
W8XAV	20,000	Westinghouse Elec. & Mfg. Co.	Pittsburgh	?
W6XS (5)	500	Don Lee Broadcasting Corp.	Gardena, Cal.	?
W9XAB (6)	2,500	National Broadcasting Co.	Chicago	60
W9XO	100	Kansas State Agri. College	Manhattan, Kan.	60
2,750 TO 2,850 KILOCYCLES				
-----	1,000	Sparks-Withington Co.	Jackson, Mich.	?
W9XG	1,500	Purdue University	W.Lafayette, Ind.	60
W2XAB (7)	500	Atlantic Broadcasting Co.	New York City	60
W3XE	1,500	Phila. Storage Battery Co.	Philadelphia, Pa.	120
W9XAA (8)	500	Chicago Federation of Labor	Chicago, Ill.	60
43,000-46,000, 48-500-50,300 AND 60,000-80,000 KILOCYCLES				
W10XG	500	De Forest Radio Co.	Portable	?
W9XD (9)	500	The Journal Co.	Milwaukee, Wis.	?
W3XAD	2,000	RCA-Victor Co., Inc.	Camden, N. J.	?
W2XBT	750	National Broadcasting Co.	Portable	?
W1XG	30	Shortwave & Television Co.	Portable	?
W2XR	1,000	Radio Pictures	Long Island City	?
W2XF	5,000	National Broadcasting Co.	New York City	120
W2XDS	2,000	Jenkins Television Co.	Portable	?
W6XAO	150	Don Lee Broadcasting System	Los Angeles, Cal.	?
W3XK	1,000	Jenkins Laboratories	Wheaton, Md.	?
W3XE	1,500	Phila. Storage Battery Co.	Philadelphia	?
-----	1,000	Sparks-Withington Co.	Jackson, Mich.	?

- (1) In connection with sound station W2XAR, New York.
- (2) In connection with sound station W1XAU, Boston.
- (3) In connection with sound station W3XJ in Washington, D. C.
- (4) In connection with sound station W1BO, Chicago.
- (5) In connection with sound station KHJ, Los Angeles.
- (6) In connection with sound station WMAQ, Chicago.
- (7) In connection with sound station W2XAB in New York.
- (8) In connection with sound station WCFL, Chicago.
- (9) In connection with sound station WTMJ, Cleveland.

Modern Tuning Coil Practice

(Continued from page 267)

the grid coil connected (or the separate aerial coil) tunes broadly over the medium wavelengths. This allows the strong local station to get up a signal in the aerial coil which reaches the grid by the strap capacities in the circuit.

The "goodness" of the coil affects the results. With a good coil, having tapplings, it might so happen that the local station is tuned in quite strongly. With a bad coil it is more the general lack of selectivity that allows the local station to get through. If you definitely tune the aerial to a wavelength such as 1,000 meters, break-through vanishes.

But the regeneration circuit will be found to behave strangely at about this point. This arrangement is really not satisfactory and it does not pay, therefore, to use a good coil and to tap it near the grid end.

This avoids break-through, but the selectivity over the long-wave band is poor, as the coupling is too great. As soon as it is reduced, the wavelength of the aerial circuit is lowered and the medium-wave stations is again admitted.

A separate aerial winding can be used and if there are sufficient turns, the break-through will disappear, but the aerial and grid coils must be well spaced.

It is possible to adjust a coil to suit a particular aerial and set of conditions, but for general purposes there is a simpler method of attack. The thing to do is to destroy the resonance at any medium wavelength.

A resistance may be fitted in the aerial circuit. The exact value will, once again, depend upon the type of coil, its goodness, and the nature of the aerial.

The resistance may be joined in the aerial lead to the coil and an adjustable one of a few hundred ohms is best tried. A small choke having 200 turns of No. 36 or 38 enamelled wire on a bobbin about 1-in. diameter will have the desired effect. But any such addition to the circuit is bound to affect the long-wave stations a little.

Thus the addition of a choke breaks the resonant circuit to medium wavelength, but tends to affect the selectivity and signal strength over the long wavelengths. If bad break-through is experienced, try first a pre-set condenser in the aerial lead to the coil. Then try a low value across the aerial tap to ground. This is often effective. See that the aerial wire does not lie near the grid lead to the tube or the tuning condenser, and be particularly careful when the medium-wavelength coil is fitted near the long-wavelength coil.

Much of the trouble is to be traced to the way in which the two coils are connected by the switch and it is advisable to fit the two coils at right angles.

If you switch over from one coil to the other as in Fig. 11, the results will be least affected by break-through provided the precaution is taken to adjust the aerial circuit. When a choke or damping resistance is used in the longwave circuit, it must be switched out of circuit when the medium-wave coil is being used or the results will be very poor.

Medium- and long-wave coils are switched in many ways. They may be placed in parallel with a simple switch, as in Fig. 12, for medium wavelengths, the switch being opened for long wave-lengths. Another method is to short-circuit the long-wave part when receiving over the medium-wave band, Fig. 13.

These last two methods are often used, but not when really good coils are fitted. The best practice is to change over completely as in Fig. 11, but then care must be taken to see that the coils are not coupled.

If, for example, the coils were close together and you were receiving over the medium wavelengths a point in the tuning

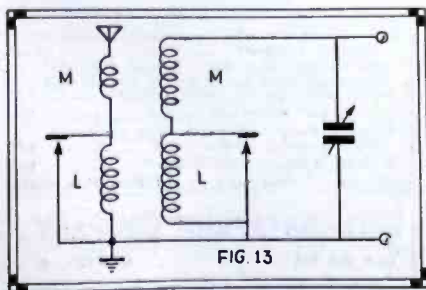


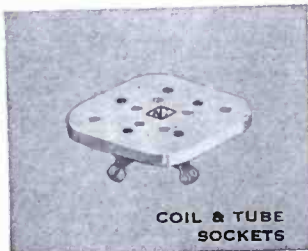
FIG 13

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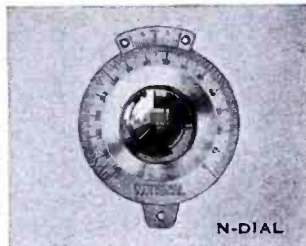
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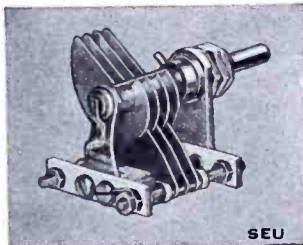
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NATIONAL SOCKETS

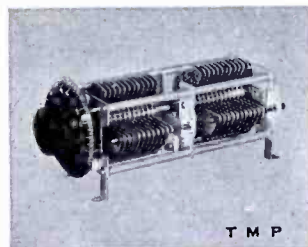
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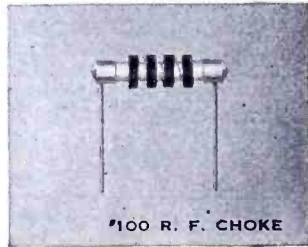
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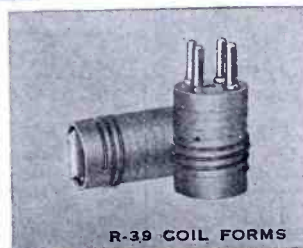
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might be found where the set seemed "dead."
 This would be due to the wavelength being equal to the natural wavelength of the unused long-wave coil. If this coil is short-circuited, the natural wavelength will alter and the tuning of the medium-wave coil might not be affected. By placing the coils at right angles, however, the possible ill effects are greatly reduced.
 When using good coils, therefore, mount them at right angles, as far apart as possible, and switch from one to the other.
 Break-through will be the minimum, and if it cannot be avoided by altering the position of the aerial tapping, a resistance or small choke should be joined in the aerial circuit.

The Screen Grid Tube As Detector

(Continued from page 270)

detector output. For complete absence of distortion, the value by which the plate current may be allowed to drop on tuning-in the signal is also fairly critical. It depends on the load resistance and is usually about 20% of the "no signal" plate current.
 Now let us look at similar characteristics for a screen-grid tube. As with triodes, there is an optimum value of "tuning-in" drop in plate current. Fig. 2 shows the drop permissible with different values of load resistance. Fig. 2 shows the plate current-plate voltage curves for the screen-grid tube taken out for a number of values of applied high-frequency voltage to the grid input circuit.
 On drawing the load line in the same way as for a triode it will be at once seen that there is a very much more restricted area available within which various values of load resistance can be applied without the risk of distortion.
 When dealing with triodes it is common practice to look up the published figure for internal resistance, or impedance, and double this for a suitable load resistance in the plate circuit. What happens when this rule is applied to screen-grid tubes?

Triode Impedances

With this class of tube the rated internal resistance, or impedance, is usually of a very high value compared with that of a triode. For instance, a triode normally used for detector purposes may have an impedance of approximately 10,000 ohms, whereas rated figures for impedance on screen-grid tubes vary from 200,000 to 500,000 ohms.

A plate resistance or loading of such a value would not only entirely upset the correct relationship between plate and screen voltage, but would introduce serious distortion.

Plate Resistance

On referring again to Fig. 2 we may assume that the load line AC refers to a plate resistance of, say, 20,000 ohms. From the shape of the curves any value of plate load resistance below 20,000 ohms will be quite suitable from the point of view of distortion, but lower values will naturally give less voltage output.

If we attempt to use higher values than 20,000 ohms for the particular tube in question, the load line, A1 C1 B1, cutting the family of curves at a more oblique angle, will obviously give rise to quite uneven distribution of current change for the radio-frequency voltage applied to the grid and bad distortion will result.

Hence for a given screen-grid voltage there is a definite critical optimum value of plate load resistance. The lower the screen voltage the larger can be made the plate resistance for a given applied plate voltage.

Decreased Strength

On the other hand, as the screen voltage is reduced, the radio-frequency signal strength which the grid can accept without the tube being overloaded is decreased.

When using a screen-grid tube as a detector, therefore, it is necessary to effect a compromise between screen voltage and load resistance such that the tube will accept a reasonably large radio-frequency signal without overload, but, at the same time, to choose a load resistance which will enable us to obtain full advantage from the higher voltage amplification afforded by the screen-grid tube.

Fig. 3 shows the plate current/grid voltage curves of the screen-grid tube for two different screen voltages, indicating limitation of input by reduction of screen voltage, and Fig. 4 the corresponding plate

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current/plate voltage curves for the same tube for two different screen voltages, indicating the limitation of load resistance by a high screen voltage.

Having taken the above precautions, however, there is no doubt that the screen-grid tube offers a distinct advantage over the triode as a detector, chiefly owing to its higher efficiency as a voltage amplifier, but also in a very large degree to its much lower plate-grid interelectrode capacity, which reduces the damping on the tuned-grid circuit and therefore materially improves the selectivity of the receiver.

One of the biggest disadvantages of a triode tube—particularly one with high amplification—is that the effect of interelectrode capacity between plate and grid "throws back" on to the grid circuit any change in loading which occurs in the plate circuit.

This makes accurate "ganging" over the whole of the wavelength scale extremely difficult.

Avoiding "Throw-back"

The use of a screen-grid tube as detector, with its attendant low plate-grid capacity, avoids this "throw-back" effect, and enables accurate ganging of pre-detector tuned circuits to be done so as to hold good over a wide band of wavelengths. This naturally makes for improved selectivity.

The selectivity being such an important factor in radio receivers of modern design, the possibility of utilizing the screen-grid as a detector tube is of the greatest interest and importance to designers.

MODIFYING LOUD SPEAKER TONE COLOR

(Continued from page 273)

may be, it will not be possible for very much bypassing to take place. On the other hand, if the resistance is extremely low, the condenser will have full play in bypassing the loudspeaker current.

So you see what we have in a selective bypasser in the form of the condenser and a non-selective obstructor in the form of the resistance. The condenser does the selecting, allowing a much freer path for the high frequencies than for the low ones, whilst the variable resistance gives us a check on the extent to which the condenser is allowed to rob the loudspeaker of its current.

Now when it comes to low frequencies we make use of a low-frequency choke instead of condenser. Here the position is just the reverse. The choke, as you know, will form an easy path for low frequencies, but a difficult path for high frequencies. The choke, in fact, acts in precisely the same way as the condenser, except that the choke favors the frequencies more and more as they become lower, whilst the condenser, as already mentioned, favors them as they become higher and higher.

All we have to do then for the low-note suppressor is to take the low-frequency choke (1 henry) and connect it across the loudspeaker terminals or the output of the set. For the purpose of regulating, as before, we introduce a variable resistance in series with the choke. With the choke the variable resistance may be, say, 30,000 ohms or sometimes less.

There is just one point which I should mention and that is that in a good many modern sets an output transformer is used between the last tube of the set and the loudspeaker. For instance, to take an extreme case, if a low-resistance moving-coil loudspeaker is used a high-ratio stendown transformer will be used between the set and the speaker.

For Boomy Loudspeakers

If this transformer is included in the set, the tone-control arrangement cannot conveniently be fitted externally to the set and must be connected across the primary of the transformer. On the other hand, the transformer is sometimes included with the loudspeaker itself, in which case the loudspeaker terminals are, in fact, the input terminals of the primary of this transformer: the tone control can then be connected externally to the set as already described above.

As regards the value of the low-frequency choke, generally about one henry or down to say, 0.5 henry will be found suitable.

You will find a tone control of this kind very useful in cases where the loudspeaker is apt to give a harsh or tinny tone. In such a case a high-note suppressor is indicated, consisting of condenser and resistance as mentioned above.

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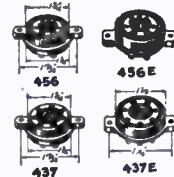
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THE VOLUME SPEAKER

(Continued from page 272)

Hinging the Baffle

Two hinges need to be screwed to this strip with their centers $1\frac{1}{2}$ in. from either end. The hinges are 1-in. brass and are fixed with $\frac{1}{4}$ -in. screws. The baffle should now be fixed to the hinges.

The framework is completed by fixing the metal back. The metal can be pierced or drilled to take four screws or nails $\frac{1}{4}$ in. from the bottom end. If screws are used, then the holes must be well countersunk. Also drill four holes $\frac{3}{8}$ in. down from the top end. When the foil has been fixed to the curved ends file away any unevenness caused by nail or screw-heads.

At last we come to the actual loudspeaker construction which is the main purport of this article. I think we had best begin with the cone, which can be cut from any good make of cone paper. The diagram on the previous page will give you all the details you will require for making it.

Leave It Overnight

When cut out, stick it together with seccotine or glue, and leave it to dry overnight with a light weight of some kind or another placed on its apex to preserve its shape.

Mounting the loudspeaker unit to its strip of wood is the work of a moment. The cone is fastened to the reed with its edges about $\frac{1}{4}$ in. from the baffle. To prevent the remote possibility of chatter it is advisable to solder the nut and reed together at the apex of the cone. Falling solder, a spot of seccotine will do nearly as well.

The cone is finished by gluing a series of strips of thin washleather about 1 in. wide all the way round the cone and baffle with the exception of the strip of wood to which the speaker unit is fixed.

Now for the "camouflaging." Before doing this, however, it is necessary to try out the loudspeaker and adjust it, for the speaker unit is to be covered with cloth.

A Free Choice

Therefore, when adjusting the unit turn the adjusting screw to the position before the point of maximum sensitivity so as to be on the safe side.

I must not forget to mention that the loudspeaker flex should be passed through the holes provided for this purpose before the framework is covered.

Well, coming back to the covering, use a cloth suitable for covering a baffle aperture, and yet not too thin for the framework to be seen underneath it.

The choice of the material and its color is, I think, best left to you. Its size must not be less than 22 in. x 12 in.

Beginning with the side opposite the baffle, cover this so that the material overlaps about $\frac{1}{8}$ in. and the top and bottom edges about $\frac{1}{2}$ in. These overlapping portions only are glued to the wood and if necessary held in place with drawing-pins while drying.

It is inadvisable to glue the whole surface of the cloth, for it might soak through and so spoil its appearance. Stretch the cloth round the back and glue it to the strip of wood to which the baffle is hinged.

From there it is again stretched across the baffle and secured on the underside of this, but be sure when covering this side that it is closed.

Completing the Camouflage

It is necessary for the top end of the framework to be quite smooth and flat. Therefore the overlapping portions along the top edges of the two sides should not be glued on to the surface of the top end.

There now remains the closely ruled sheet of paper representing the leaves of the book. Rule a sheet of notepaper 10 in. by 3 in. wide along its length with a lead pencil, the lines almost touching one another.

The paper must then be cut exactly the same shape as the topline and glued down. If air bubbles appear prick them with the point of a pin and rub lightly with a handkerchief.

This completes the data for building the loudspeaker, and you will indeed be fortunate if the building of it gives you as much pleasure and enjoyment as it gave me.



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NOTES ON GANG TUNING

(Continued from page 286)

One trimmer may have to be set to have a larger capacity than the rest for the purpose of making the circuit right, but if the circuit capacities added to the trimmer in each case are made alike, the condenser will show the same measured capacity (with the slight errors mentioned above due to the sections) for each circuit. The coils and switches have capacity and so have any other parts that may be used in the circuits connected to the condensers.

If the act of tuning does not alter the stray capacities, then balancing may be effected by adjusting the trimmers.

To show that tuning may affect the stray capacity, let us consider Fig. 4, which is a regeneration circuit from the detector. It is clear that the capacity added to the detector-grid circuit will vary with the setting of the regeneration condenser, as the regeneration coil is coupled to the grid coil.

Careful design will reduce the effect, but cannot remove it. The use of a volume control in another part of the circuit might also throw the tuning of the gang condenser out.

It would not be advisable to use an adjustable condenser in the aerial circuit as in Fig. 5, for example, as the capacity thrown across the tuning section C1 would vary with changes in the volume-control condenser.

There is another control which is also difficult (Fig. 6). A potentiometer is used here.

When the sliding contact is at the top, the full capacity of the tube is across C1, the first section of the tuning condenser. But when the contact is moved, there is across C1, a resistance in series with the capacity of the tube, and so the circuit is put out of balance.

In spite of these difficulties, however, the capacity side of the problem can be so arranged that the results are, from a commercial point of view, at least, quite good. Changing a tube is, of course, likely to up set the circuit and re-trimming is necessary. A change in the aerial ought not to affect the tuning. If it does, the aerial circuit is of poor design.

The coils used in the circuit will be adjusted to have equal values of inductance. Coils are shielded and switches are used. The shielding may upset the results if the metal covers of the coils do not fit properly and make good contact with earth.

Effect of Coil Can

A coil might have an inductance of 210 microhenries without shielding and the addition of the shield may reduce the inductance to 200 microhenries. Changing the position of the shield will alter the inductance and it is therefore important to see that coil covers are firmly fixed and then the coil is tested for accuracy.

When there is a long-wave section close to the medium-wave section in the same shielding box, the switching may easily be the cause of trouble. If the long-wave part is short-circuited, for example, the inductance of the medium-wave coil may be different from when the coil is not short-circuited, but connected to switch contacts making a high resistance contact.

Use of Plain Coils

Plain coils are often used, joined as in Fig. 7. Here the plate current of the two screen-grid tubes passes through radio-frequency chokes and the tuning circuits are coupled through fixed condensers.

The chokes have inductance and capacity and these amounts must be allowed for, if necessary. But usually the self-capacity of a choke is so low that it is negligible and the inductance is so high that the effective inductance of the tuning circuits is not materially lowered.

With poor chokes, however, the tuning may be upset and it is necessary to be careful how and where the chokes are fitted in position.

Metal near a choke may increase its capacity and the wiring to it can easily add to the capacity.

A different and fairly popular circuit is that of Fig. 8. The plate current for the screen-grid tubes passes through the coils themselves.

It is interesting to note how the tuning circuit is completed. Fixed condensers C4 and C5 are used between the tops of the coils and the bottoms of the tuning condensers. These are in the radio-fre-

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cy circuits. Usual values are microfarad non-inductive.

Need for Good Spacing

As the high-voltage is across the sections C2 and C3 of the tuning condensers, it must have well-spaced plates. As a safeguard a fixed condenser may be joined between the plate of the screen-grid tube and the section of the tuning condenser C2, another one being joined to C3.

These fixed condensers will tend to reduce the net capacity across the coils and must, therefore, be large; 1-microfarad condensers are usually fitted. With high-frequency transformers, the tuning will be easier, as the stray capacities are likely to be less.

Transformers are shown in Fig. 9. This circuit is a particularly safe one, no high voltage being applied to the tuning condensers. The coils are a little more difficult to construct than the plain coils, but the results are usually better.

The primary coils can be adjusted to suit the tubes and this circuit is one I recommend. There will be the least ganging difficulty.

NIPKOW STILL LIVES!

(Continued from page 290)

general interest, like the radio today, and I said to myself that the telephone is imperfect, if one cannot see the person with whom one is talking. And I calculated correctly then, about 50 years ago. Nowhere is there so much trickery and harm as in telephoning, just because the speakers cannot see each other.

"Please tell me, Herr Nipkow, you surely offered the apparatus to the Postal Department, or did you find some other possibility for using it?"

"Neither the one nor the other. I was so poor that I had to let my patent lapse after a year. I did not even have the money to continue my study, to say nothing of the money for making experiments. You see, originally I wanted to become a teacher, but when my father died, there was nothing else for me to do, after performing my military service, than to work for the still existing Signalbau Company, where I remained for 32 years, at the end as head engineer."

"Are you still occupied with television today, and have you been so in the mean time?"

"It is only in the last few years that I have fetched out again my old hobby-horse, which I understood very well how to ride, as you can see from my old patent. I have also applied for two very good new patents. One concerns a new synchronizing arrangement and the other a so-called 'picture mill'."

"Please, Herr Nipkow, what do you think of the present television models?"

"Well, as a simple man I cannot say that so simply. You know, what the others have produced with the disc television—according to my basic patent—will not set the world on fire. After all, it is mostly only my old design, perfected according to the present status of technology. In America, I have read somewhere lately, an American named Jenkins has invented a drum television. At any rate that is something new. There is at least a new idea in it, though Heaven only knows whether it will prove practical. If I am not mistaken, however, the Braun tube, the long glass tube with the deflected cathode ray, has the most prospect for practical realization."

"Herr Nipkow, please tell me when and where you were actually born. In biographies there are some very comical data. You look so young, yet it is 50 years since you applied for your patent on the perforated disc television named after you."

"I was born on the 23rd of August, 1860, at Lauenburg in Pomerania, hence about 300 kilometers from Berlin. Oh yes, we Pomeranians last well, we are a hardy stock. Your assumption that I am Russian is therefore wrong. I am a native German and I believe a good German, to boot."

"Herr Nipkow, before I leave, one more question: What did the scientists say about your television at that time?"

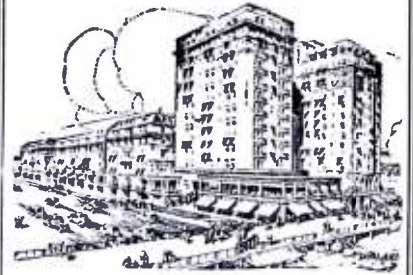
"I spoke at some meetings of engineers and met with enthusiastic approval. I was also permitted to publish an article about my invention in the 'Elektrotechnische Zeitschrift.' That was all."

"Well, Herr Nipkow, perhaps you will have better luck with your other inventions!"

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ATLANTIC CITY is more than a summer resort. It is a health resort, to be visited any season with great satisfaction and lasting benefit. Ocean air and sunshine are "on tap" twelve months in the year—there is renewed vitality and better health in every draught. The St. Charles is the foremost seashore resort hotel, ready for you at any season and at all times, with every comfort and convenience, superb meals, a program of guest-entertainment and rates enable all to take advantage of Atlantic City's healthful winter climate.

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PERPETUAL TEST ADAPTER

NEW FEATURE TAKES THE PLACE OF SIXTY ADAPTERS. CAN BE USED WITH YOUR PRESENT SET ANALYZER OR TUBE TESTER



and provide for testing all FIVE, SIX and SEVEN prong tubes developed in the future. Fits all standard and custom-built set analyzers and tube testers. Permits the testing of all new tubes, including the types 29, 33, 34, 39, 41, 42, 43, 44, 46, 47, 51, 55 (diode), 56, 57, 58, 64, 65, 67,

69, (both plates of 80, 82, 83), 85, 89, Wunderlich, 91 (triple twin), 93 and 95.
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POSTAL RADIO

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Unequalled Flexibility and ease of control
Multi-Mu Sensitivity
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Super-Smooth Oscillation Control
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Impedance Audio for Quality Phone Signals
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Alan 2 B Battery Set requiring type 32 Multi-mu tube and a d one 33 Pentode. Special \$ 7.45
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Kit of 2 Tubes 1.55
Alan 3 B Battery Set using a type 345 and 1 type 33 15.50
Kit Price 13.79
Kit of Three Tubes for Above 2.30
Alan 4-R Deluxe, using 2 type 345, one type 30 tube and one type 33 \$18.20
Kit Price 15.40
Kit of 4 Tubes 3.05
Alan III A. C. 4 Tube A. C. Receiver, using 2 Type 58 Tubes, 1 Type 56 and 1 Type 80. Absolutely humless. Ready to plug into 110 Volt A. C. line \$25.50
Kit Price (with diagram and directions) 19.95
Kit Guaranteed Tubes 3.05
Alan IV A. C. 5 Tube A. C. Receiver, utilizing 2 Type 58 Tubes, one Type 56 and one Type 47 Output Power Tube and one Type 80. Ready to plug in \$26.20
Set of Tubes for Alan IV A. C. 4.25

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ALAN RADIO CORP.
83T Cortlandt St., New York



Stoppani Belgian Compass

May Be Used As a Galvanometer

Because of its uniform magnetic properties, high sensitivity, and delicate frictionless bearings, the Stoppani compass may be utilized to advantage as a highly precise galvanometer for detecting electric currents in experimental or conventional radio circuits. The compass is easily and readily converted into said galvanometer by merely winding several turns of ordinary radio wire completely around the face and lower case of the compass; leaving small spaces between turns to observe the movements of the needle. The ends of the wire are brought out as test leads to be inserted in series in circuits under test. A deflection of the compass needle in either direction indicates the presence of an electric current. Incidentally the intensity of the current may be closely approximated since the force with which the needle vibrates is proportional to the intensity of the current flowing through the wire. Stoppani compass is an ideal S.T.I.V.E.Y.O.H.S. instrument with elevated sights. It is made of Solid Bronze, Parkerized, non rusting, graduated in 1/10. Ruby Jewelled, 4 inches square. Fitted in a hardwood case, with set screw in corner to hold needle rigid when not in use. The United States Government paid more than \$30.00 for this precision instrument.

Our Price \$4.50

Gold Shield Products Company
112 Chambers Street, T.N. New York, N. Y.

LYNCH ANTENNA NO-STAT SYSTEMS

\$5⁰⁰
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Complete

More Profit
Lower Price
Easier to Sell
Easier to Install
Better Results

Eliminates Man-made static and permits the use of several receivers on a single antenna.

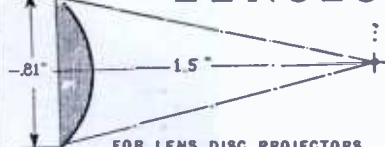
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If your jobber cannot supply write his name and address on your letterhead and attach this ad with check for \$3.00. Kit will be sent prepaid and sale credited to your jobber.

Interesting literature describing the many other popular Lynch products sent on request.

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1775 Broadway, New York, N. Y.

LENSES



Write for Free Lens Disc Data.

13/16" Lenses, each	12c
3/4" Lens ea, each	15c
1/2" Lenses, each	18c
Tube of Cement for Mounting Lenses	25c
18"-24" Black Duraluminum Disc	
(1/16") thick	\$3.50
6 1/2" Cast Aluminum Hub for Spring Drive	\$2.50
18"-24" Guaranteed Lens Disc	\$25.00

Send Money Order, Cash or Check to
TELEVISION OPTICAL EQUIPMENT COMPANY
478 Broadway, New York City

CRYSTAL RECEIVER IN A TOBACCO CAN

(Continued from page 271)

coil, using ordinary No. 26 or 28 silk or cotton covered copper wire instead of the more expensive Litz. "Litz" wire—more correctly "Litzendraht"—is flexible cable in which the individual strands consist of enamel wire. The "skin effect" at radio frequencies is less marked than with solid or ordinary stranded wire, and the R.F. resistance is therefore lower.)

Construction Is Simple

The crystal detector and the two phone tip jacks are mounted on a piece of bakelite or hard rubber 2 1/2 inches long and 7/8 inch wide. The X-L condenser is supported at right angles under the detector by means of a small L-shaped bracket. Two threaded brass studs one inch long are fastened to the feet of the X-L condenser. Short machine screws passed into these studs through the side of the tobacco can hold the whole assembly in place.

Two more holes, about 1/2 inch in diameter, must be made along the same edge of the can. One, near the top, accommodates the red adjusting button of the crystal detector. The other, fitted with a soft rubber grommet, passes the adjusting screw of the X-L condenser. Of course, the latter screw is put in place after the whole unit is fastened inside the can. If you use different parts you can readily alter the construction as you see fit.

This little crystal receiver is more or less of a novelty, and of course must be compared with receivers using tubes. However, it really works very nicely.

The following parts are required:

- 1—Tobacco can.
- 1—Piggly Wigly crystal detector.
- 1—X-L Variodenser, model G-5. Capacity range 100 to 500 mmf.
- 1—Special Find-All coil.
- 2—Phone tip jacks.
- 1—.001 mf. fixed condenser.

ROME TELEVISION STATION IS EUROPE'S LATEST

(Continued from page 289)

to convert the receiver to the one or the other picture formation. The enlarging optical system is composed of a plano-convex lens and an achromatic lens. The pictures can be enlarged up to 3 1/2 x 4 1/2 inches, and has quite a large angle of observation.

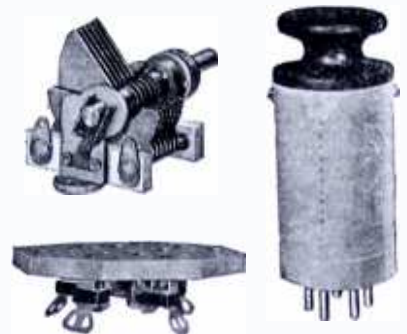
The mirror drum receiver works with a spot light neon and a mirror drum of 8 inch diameter and produces a picture on a matt plant of glass of 3 1/2 x 4 1/2 inches. The apparatus is fitted up in the Palazzo E.I.R.A. and a movable stage is provided for the persons being transmitted. Apart from the general subdued room illumination, auxiliary illumination is available for illuminating a manuscript sufficiently bright for reading without influencing the photoelectric cells to any extent.

A HOME MADE ELECTRIC "THEREMIN"

(Continued from page 263)

- One—International Resistor 30,000 ohms, 1 Watt. (R5)
 - One—Acratest resistor, 400 ohms, 2 Watts. (R11)
 - One—International Resistor, 150,000 ohms, 1 Watt. (R6)
 - One—International Resistor, 500,000 ohms, 1 Watt. (R7)
 - One—International Resistor, 100,000 ohms, 1 Watt. (R9)
 - One—Acratest Potentioneter, 200,000 ohms. (R10)
 - Two—Special Coils (L1, L2) see text for construction.
 - One—Acratest Power Transformer, Type 6027. (PT)
 - One—Acratest Choke, Type 2503. (CH1)
 - Two—Four prong wafer sockets. (V5 and speaker plug socket.)
 - Four—Five prong wafer sockets. (V1, V2, V3, V4)
 - One—Blau special drilled aluminum chassis, and front panel.
 - One—Power cord and plug.
 - One—Carter jack and plug.
 - Knobs, wire, etc.
- Tubes Required:
- One Eveready Raytheon 80 (V5)
 - One Eveready Raytheon (V4)
 - Three Eveready Raytheon 55 (V1, V2, V3)

If You were a WATCHMAKER



SUPPOSE you planned to build yourself a watch, instead of a radio. Would you use shoddy parts?

Not if you expect it to last and keep accurate time.

Quality parts in a radio are as essential as quality parts in a watch. You can't get out of them any more than is engineered into them.

That is why the Hammarlund reputation means so much to the radio builder who prefers performance to promises.

In its thirty years' history Hammarlund has never built a cheap part.

Prices today are attractive, because manufacturing costs are lower—but Hammarlund quality is never sacrificed to price.

The new Hammarlund Catalog "33" describes condensers, coil forms, sockets, transformers, chokes, couplings, equalizers and shields for all types of radio work—transmitting, or standard and low-wave reception.

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For Better Radio
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FEBRUARY SPECIALS!!

EVERY month we list on this page certain **STAR** ★ items, which are **NOT LISTED IN OUR CATALOG**. These are all specials of which the quantities on hand are not sufficient to catalog them. *Once sold out, no more can be had.* First come, first served. Save yourself disappointment by ordering NOW.

STOP SHOPPING. The lowest prices are right on this page. No one undersells us. We meet any price on ANY NEW Merchandise. Order direct from this page and save money. 100% satisfaction on every transaction. Take advantage of these special offers. **ORDER NOW, TODAY.**

Baird Universal Short-Wave and Television Receiver

A Reliable, Fool-Proof Instrument

This receiver has obtained world-wide recognition as the most advanced type of short-wave television receiver for home use, yet devised. Amazingly simple in construction, marvellously efficient in performance, the Baird Receiver has been brought to a pinnacle of perfection heretofore thought impossible except in sets of most costly design. **THIS RECEIVER IS ESPECIALLY VERSATILE AS IT IS NOT LIMITED FOR USE ONLY AS A SHORT-WAVE OR TELEVISION RECEIVER.** Its design is such that by simply changing the Ortocon plug-in coils, it becomes a highly efficient regenerative receiver covering a wave band from 15 to 550 meters. This receiver, therefore, is "universal" in the full sense of the word. In other words, **IT WILL RECEIVE PRACTICALLY EVERYTHING WHICH IS ON THE AIR BELOW 550 METERS—REGULAR BROADCAST PROGRAMS, TELEVISION, AMATEURS, POLICE CALLS, TELEGRAPH SIGNALS, ETC.** The **DAIRD SHORT-WAVE-TELEVISION RECEIVER** is a completely wired assembly in a handsome mahogany cabinet. Extremely simple to operate. When used in conjunction with the Baird No. 36 Television outfit, clear cut television programs may be obtained from stations all over the country.



MAY BE HAD IN KIT FORM

With this complete assembly of parts anyone can build a Baird Short-Wave-Television Receiver at home in a few hours. Surprisingly simple to assemble; 8 sockets, three coil shields, 3 tube shields, 2 condensers and 3 binding-post studs are already mounted on the chassis. Complete descriptive and constructional data as well as large blueprints are furnished with each kit. There is no charge for wiring.

HERE ARE SOME OF THE HIGH LIGHTS—lack for Ear Phone Operation, Phonograph Pickup Connection, All Aluminum Chassis, Coils and Screen-grid Tubes Individually Shielded, Shielded Variable Condensers, 2 Screen-grid R.F. Stages, Shielded Screen-grid Detector, Employs Famous Detecolls, High Quality Resistance-coupled Audio Amplification, Operates either Magnetic or Dynamic Speaker. The completed receiver measures 25 ins. x 18 1/2 ins. x 16 ins. Employs 6 Tubes, 3-22A's, 2-22T, 1-245 and 1-11B rectifier. Shipping weight, 65 lbs.

List Price \$80.00

\$46.85
\$50.85

No. 35 Baird Universal Short-Wave and Television Receiver
YOUR PRICE

Complete With Set of 7 Triad Tubes Receiver in Kit form—Same Price.

Baird Complete Television Receiver and Televisor

Ready For Immediate Operation
Ten People Can "Look-in" at the Same Time

Includes Everything Necessary to Receive Pictures Immediately



With a Baird Television Receiver you can double your radio enjoyment. Not only can you hear your favorite radio entertainers but you can see them as well. Your home literally becomes a stage of the world. Fascinating and instructive, the ultra-modern Baird Television Receiver takes first place among all forms of home entertainment. **OPERATING THIS TELEVISION RECEIVER IS JUST AS SIMPLE AS TUNING IN AN ORDINARY BROADCAST RADIO SET. ANYONE CAN OPERATE IT WITH THE GREATEST OF EASE.** (Comprises a Baird "Universal Short-Wave Television Receiver"

and a Baird "Self-synchronizing Scanning Unit," both described elsewhere on this page) complete in a handsome mahogany cabinet with shadow-box and self-contained 6 in. magnifying lens. Designed by the foremost engineers in the industry and built by skilled mechanics, the Baird Television Receiver is a matter of rugged construction and fine workmanship—**YET IT COSTS NO MORE THAN A GOOD RADIO.**

Measures 10 1/2 ins. x 25 ins. x 24 1/2 ins. Shipping weight, 80 lbs.

List Price \$140.00

No. 437 Baird Complete Television Outfit.
YOUR PRICE **\$62.50**

COMPLETE WITH SET OF 7 TRIAD TUBES **\$66.50**

Gen-Win Television Coil Kits

Range 100 to 212 Meters

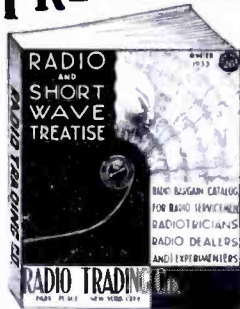
Short Wave coils covering the television range or broadcast coils which have been tapped for the television band will not work as efficiently as coils which are designed especially for television frequencies. Gen-Win Television Coils are wound with special die drawn wire having a very low resistance—quite an important factor for successful reception of television images of detail. **WE RECOMMEND THESE COILS TO SET BUILDERS, SERVICE MEN AND EXPERIMENTERS FOR CONSTRUCTING EFFICIENT TELEVISION RECEIVERS.** The coil forms are of genuine molded bakelite to insure low dielectric losses and sturdy mechanical strength. A complete set of blueprints as well as descriptive and constructional data for building a receiver around these coils is included with each kit. These coils may be had in matched sets of either three or four. Shipping weight, 1 1/2 lbs.

No. 407 Set of 3 matched Television Coils
YOUR PRICE **\$1.50**

No. 408 Set of 4 matched Television Coils
YOUR PRICE **\$2.00**

WE ARE A WHOLESALE HOUSE AND CANNOT ACCEPT ORDERS FOR LESS THAN \$3.00.
If C. O. D. shipment is desired, please remit 20% remittance, which must accompany all orders.
If full cash accompanies order, deduct 2% discount. Send money order—certified check—U. S. stamps.

FREE RADIO AND SHORT WAVE TREATISE



The new Winter, 1933 edition of our Radio and Short-Wave Treatise, No. 26 has just come off the press—100 solid pages of useful information, radio items, diagrams and illustrations. Positively the greatest book in print — **NOT JUST ANOTHER CATALOG.** Contains a large editorial section with valuable information not found anywhere else. Special consideration has been given to the radio beginner in this issue. Among the new technical information listed are the following:

HERE IS A PARTIAL LIST OF CONTENTS
Fundamental Principles of Radio—Ohm's Law—Discussion of New Tubes—Constructing a "Triple-Twin" Amplifier—All About Supratheterodynes—Eliminating Man-Made Static—Constructing a Two-Tube Short-Wave "Globe-Trotter" Receiver—\$3.00 Prize Suggestions—Radio Kinks, etc., etc.
WRITE TODAY. Enclose 4 cents for postage. Treatise sent by return mail.

Latest Television Scanning Lens Disc



60 Lenses—12 1/4" Disc
Here is a lens scanning disc which is engaging the attention of all television enthusiasts and experimenters—a disc which affords an image of approximately 2 1/2 square inches in conjunction with one of the new Neon Crater tubes. Each lens is accurately ground to 7/16 of an inch and is optically focused by a special device to .0002. The disc itself is of non-corroding duraluminum and is 12 1/4" in diameter. An excellent unit around which to construct an ultra-efficient, up-to-the-minute television-scanning projector, enabling unit is guaranteed against all mechanical defects. Shipping weight, 10 lbs.
No. P3999 60 Lens Scanning Disc.
YOUR PRICE **\$24.40**

The entire family to "look-in" at the same time. Each unit is guaranteed against all mechanical defects. Shipping weight, 10 lbs.
No. P3999 60 Lens Scanning Disc.
YOUR PRICE **\$24.40**

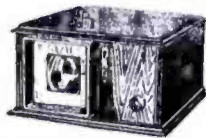
Television Lenses for Scanning Discs

The latest in television scanning systems are lens discs. These discs make possible projection of television images on a screen very much the same as moving pictures are projected. The lenses illustrated here are hand ground and are identical in physical and optical characteristics. They are of the plano-convex type and measure 13/16 in. diameter x 5/32 in. thick.
No. 3935 Television Lenses for Scanning Discs
YOUR PRICE **\$0.12**



Baird Complete Televisor Outfit

In Attractive Cabinet with Built-in 6" Magnifying Lens



The most practical and efficient television image producing outfit for home use. **ENABLE FROM EIGHT TO TEN PEOPLE TO ENJOY A TELEVISION PROGRAM AT ONE TIME.** Equipped with horizontal scanning belt and automatic synchronizing motor which definitely eliminates the old time fusing and straggling to keep the image in frame. **THERE ARE ONLY THREE CONTROLS;** the magnet arm lever, the rheostat knob and the A.C. "on-off" switch. **EXTREMELY SIMPLE IN OPERATION.** This televisor, when used in conjunction with the Baird Short Wave and Television Receiver, listed elsewhere on this page, will bring in clear cut pictures and programs from television stations all over the country.

MAY BE HAD IN KIT FORM

Here is a chance to build your own televisor set with this Baird Televisor Kit. Everything necessary to complete your scanning system is included. **YOU CAN EASILY ASSEMBLE IT IN AN HOUR.** Baird Kits make it possible for the individual who wants television in his home to gratify his desires without spending a prohibitive sum of money. You will find it a pleasure to build—and a delight to operate this Baird Televisor. Station signal makes possible synchronization from any power network. Only Baird sets accomplish this. The complete unit in its cabinet measures 25 ins. x 20 ins. x 15 ins. There is no charge for wiring. Ship. wt., 65 lbs.

List Price \$75.00

No. 36 Baird Complete Televisor with Neon Tube
YOUR PRICE **\$15.65**

Neutron Caesium Photo-Electric Cells

Applicable to Sound Movies—Television and Commercial Photo-Electric Applications

The new Neutron Photo-Cell is a recent development in its field, employing a special caesium compound as the light-sensitive element. An absolutely stable, non-microphonic unit, which will operate continuously over a long period of time without voltage adjustments of any kind.
Possesses high sensitivity, responding instantaneously to all light impulses. A decided advantage over the old potassium type cell.
Available in two different sizes. Shipping weight, 1 lb. The bases are of standard IX type.
List Price \$10.00

No. 640 Neutron Caesium photo-cell, 2-1 16" diam.
YOUR PRICE **\$3.75**

No. 641 Neutron Caesium photo-cell, 2-5 16" diam.
YOUR PRICE **\$4.50**

No. 642 Neutron Caesium photo-cell, 2-5 16" diam.
YOUR PRICE **\$4.50**

"See All" Television Scanner Kit

One of the most highly developed television scanner kits recently placed on the radio market. A product of unexcelled workmanship and engineering. Special care has been given to the scanning disc which after all is the real heart of any television receiver. The neon lamp will pulsate with the television signal currents, that we know beforehand, but if a poorly made scanning disc is involved in front of the neon tube, poor results will naturally be obtained.

PRODUCES EXCELLENT BRILLIANT IMAGES
One of the reasons for these extra fine images is that the holes in the disc are SQUARE, not round, thus providing a far greater illumination. Another feature of this disc, which has its holes punched in a special aluminum alloy, is that a **DOUBLE SPIRAL** of holes is provided, which greatly simplifies the framing of the image.

COMPRISES "PHONIC" AND EDDY CURRENT MOTORS
The "See-All" scanning disc is both dynamically and statically balanced; the scanning holes measure .0055 inch on a side. The "See-All" scanner kit comprises a particularly fine disc, 12 inches in diameter, and which also comprises the six-toothed laminated iron "phonic motor" wheel and copper disc for the eddy current and phonic wheel motors.

The above illustration shows the "See-All" scanner assembled from the kit. Kit complete with all iron cores and windings for both driving and phonic wheel motors, scanning disc shaft with self-aligning bearings, by-pass onenser, neon tube socket, support and shield, instruction book and assembly blueprints, together with scanning disc and phonic wheel. Instruction book and blue prints, showing just how to assemble the scanner and giving data on a short wave television receiver as well furnished with the kit.

List Price \$19.75
No. 2400 "See All" Television Scanner Kit
YOUR PRICE **\$12.95**

Radio Trading Co.

102A Park Place

New York, N. Y.

ORDER FROM THIS PAGE. You will find special prices from time to time in this magazine. Get our big **FREE** catalog for the greatest Radio Bargains. Should you wish goods shipped by parcel post, be sure to include sufficient extra remittance for same. Any excess will be refunded.

RADIO CONSTRUCTIONAL CIRCUITS FOR SET BUILDERS, EXPERIMENTERS, RADIO STUDENTS, SERVICE MEN, RADIO ENGINEERS, ETC.

The circuits listed below constitute the only available authentic source of experimental radio constructional information. They cover every type of receiver, including pentode circuits, automobile radios, super-hets, portables, Universal A.C.-D.C. sets, Loftin-White circuits, Two-volt battery sets, short-wave receivers, all-wave sets, boosters, converters, power portables, Wunderlich circuits, and many others. Additional special circuits covering broadcasting equipment, etc., are available on request.

Every set described in these pamphlets has been constructed and has been tested carefully, so that successful results are pre-assured if directions are followed. The pamphlets describe both the theoretical and practical features of the receiver, show the schematic wiring diagram, together with the various necessary views. A complete list of parts is also furnished. The pamphlets also contain clear and concise assembly instructions and step-by-step wiring directions.

No.	Title	Price
91 & 92—1931 DeLux 2-Volt Battery Set—for Air Cell or Storage Battery		\$1
101 & 102—The Find-All Television Receiver—A De-Luxe Circuit		\$1
103 & 104—The Playmate—A Pentode Power Portable (A.C.) Three Tube		\$1
109 & 110—The Find-All Four A.C.-D.C. Universal Portable (a.c.-d.c. feature)		\$1
111 & 112—The Find-All Six Auto-Radio Set—Ultra-Modern Automobile Receiver		\$1
113 & 114—The Television-Broadcast Receiver — For Television and Broadcast		\$1
115 & 116—1932 Triple-Pentode Battery Set—Finest, Most Modern Battery Set		\$1
117 & 118—Earphone "Pal" Portable A.C.-D.C. Set—Light, Compact		\$1
119 & 120—The Quadruple Pentode A.C.-D.C. Midset S.T.—Two Variable Mu Pentodes and two Power Output Pentodes Produce Superior Results		\$1
121 & 122—The Universal A.C.-D.C. "Buddy" Earphone Short-Wave Set		\$1
123 & 124—The Pentode A.C. Six with Wunderlich Tube—Most Recent Development		\$1
125 & 126—The Dual Pentode Auto-Radio Superhet. with Wunderlich Tube		\$1
127 & 128—The Find-All Four Short-Wave Set with 56, 57, 58 and PZ Tubes; The Find-All Four Broadcast Set with 56, 57, 58 and PZ Tubes		\$1
129 & 130—The Three-Tube Reflex with 56, 58 and PZ Tubes—Reflex Revolt with Modern Tubes		\$1
131 & 132—The Two-Volt Superheterodyne with Latest 2-Volt Pentodes		\$1
133 & 134—The A.C. Triple Pentode with 44 and 42 (6.3 volt) Tubes		\$1
135 & 136—The Short-Wave Triple Pentode with 44 and 42 Tubes		\$1
137 & 138—The Find-All DeLux Super-Het. Short-Wave Converter		\$1
139 & 140—The Find-All Modern Midset—A Three-Tube All-Pentode A.C. Set (58, 57 and 59 Tubes)		\$1
141 & 142—Newest Type A.C.-D.C. (Universal) Portable—Compact, Light, Inexpensive		\$1

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PACENT INTRODUCES THE RADIOFORMER

for **NOISE or MAN-MADE STATIC ELIMINATION**

Since the inception of radio, one of the greatest problems standing in the way of perfect reception has been the difficulty of eliminating noise or man-made static.

The Pacent Radioformer solves this problem in a thoroughly satisfactory manner and in addition installation is simple. No more crackling, no more interference or noise from motors, vacuum cleaners, refrigerators, elevators, high tension lines, etc.

Radio Dealers and Service Men will find the Pacent Radioformer the most profitable and fastest moving accessory of the day. Sell it with every set sale—use it to make new contacts with old customers—make complete aerial installations at a good profit. Try it out in your own store—arrange for trial demonstrations to your customers—one demonstration is one sale. Send order for sample aerial unit only or complete kit thru your jobber or directly to us.

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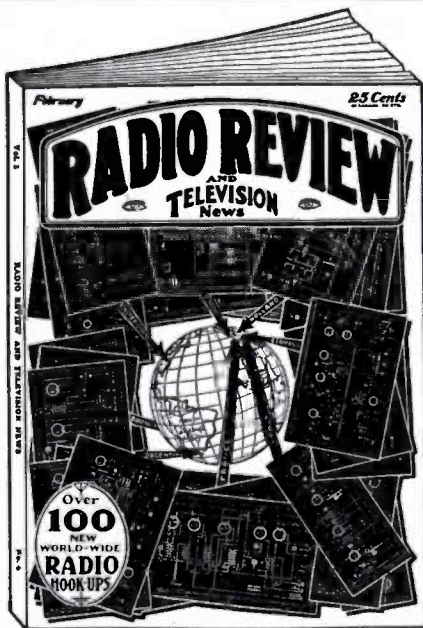
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