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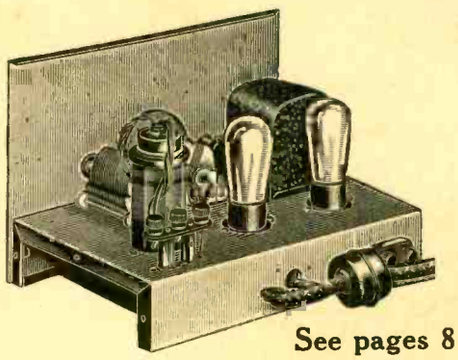

See pages 8 and 9.

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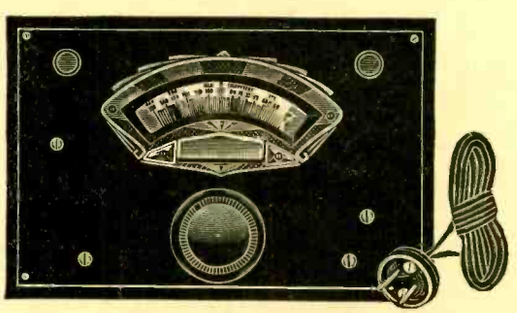
The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

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THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability.

The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

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A NEW PRINCIPLE
Applied to the Superheterodyne

CARRIER REDUCED TO AUDIO AT ONCE; FIXED I-F OSCILLATOR USED; NO PADDING, NO TRACKING, NO IMAGES

By Herman Bernard

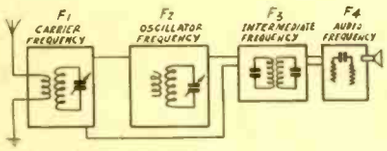


FIG. 1

The functional diagram of the formal superheterodyne. The carrier frequency is mixed with the oscillator frequency, producing an intermediate frequency that is amplified in the i-f channel, detected, then amplified and audio frequencies and fed to the speaker. Both the carrier frequency and the oscillator frequency are determined by manual tuning.

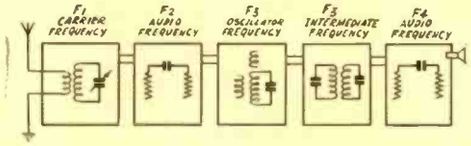


FIG. 2

The new method of using the superheterodyne principle consists of immediately reducing the carrier to its audio-frequency value, generating a fixed oscillator frequency, with which the previous audio component is mixed, and having the output amplified at the intermediate level, detected, amplified at audio frequencies and fed to the speaker. The fixed oscillator and the intermediate amplifier frequencies are the same. There is a series of four frequency levels in both examples.

A NEW method of using the superheterodyne principle is herewith detailed. It avoids some of the serious problems of the formal superheterodyne circuit. For instance, there can be no image interference, there is no requirement for padding or using a tracking section, what the intermediate frequency shall be is immaterial, all-wave coverage can be attained at about the same selectivity throughout, and all manual tuning can be confined to a single tuned circuit.

The difference between the formal superheterodyne and the new circuit may be observed from Figs. 1 and 2. In Fig. 1 the formal superheterodyne is shown in a combination of block diagram and circuit representation, the symbolic circuits being included mainly to emphasize the presence or absence of manual tuning.

We find in the usual superheterodyne that there is a circuit tuned to the carrier frequency. More than one stage may be included, but the idea is embodied as well in the single stage. F1 is the carrier frequency. A local oscillator generates a frequency higher than that of the carrier, and this higher frequency is F2. Since a span of frequencies is to be covered, both F1 and F2 are attained by manual tuning, usually a variable condenser in shunt with an inductance. F1 and F2 are combined, yielding a variety of frequencies in the output, but due to the tuning of the primary of the intermediate coil coupling out of the mixer only one of these frequencies is taken out, and that is F3. It is equal in present practice to F2-F1. After the intermediate amplifier come second detector and audio amplifier, and as the second detector is common to both the i-f and a-f levels its presence is assumed and not illustrated, no more than the mixer was illustrated.

Thus we deal with four different frequencies: (1), carrier; (2), oscillator; (3), intermediate, and (4), audio.

It is not necessary in presenting something new to say that the old is worthless, nor even that the new is better. Certainly the formal superheterodyne has advantages. Certainly it has disadvantages. Some of the most serious of these disadvantages the new circuit does not possess. Moreover, the new circuit has some problems of its own, but so far as experience has shown to date, these are not serious; that is, not difficult of solution.

The superheterodyne to-day consists of a gang-tuned circuit for the carrier and oscillator levels, therefore padding has to be accomplished either by a series condenser in the oscillator circuit or by a specially-cut tracking section included in the gang. The series capacity method can be elevated to good accuracy, but the series capacity may change a bit, due to temperature, moisture and tension, and upset a balance once struck with high accuracy. The intermediate frequency amplified is subject also to change of frequency; in fact, individual changes in respective stages, so sensitivity may decline. Realignment will correct these conditions. Nevertheless the padding is a serious necessity and the intermediate amplifier must be peaked accurately.

(*Continued on next page*)

FIG. 3
A regenerative detector is used in the first circuit, and thus the audio values, obtained, as diagrammed at left.

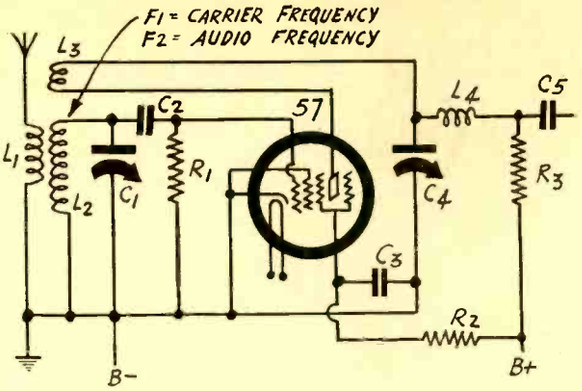
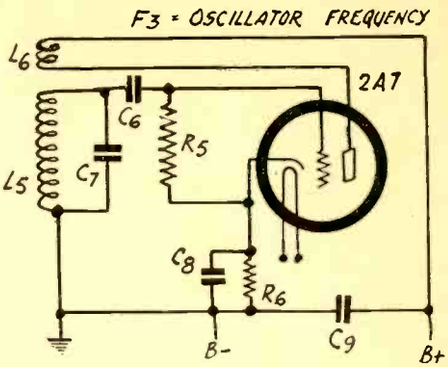


FIG. 4.
The fixed frequency oscillator, at right.



(*Continued from preceding page*)
These facts are truest of the latest circuits, where automatic volume control and squelch tubes depend considerably on the accuracy of such alignments.

Moreover, the intermediate frequency has a bearing on the selectivity. In general, the lower the intermediate frequency, the higher the selectivity, because the difference in frequency between the carrier and the intermediate amplifier is greatest. However, images have a relationship to practical selectivity, and therefore higher and higher intermediate frequencies are being used, up to almost the low frequency end of the broadcast band. The reason is to get rid of images. If the i-f were low, several tuned stages at the carrier level would have to be included for even a fair reduction of the danger of image reception.

One Reason Code Is Heard

An image is a frequency higher than the desired carrier frequency by twice the intermediate frequency.

The reason image trouble exists is that while we try to confine response due to the oscillator frequency being higher, we do not eradicate the possibility of reception when the oscillator frequency is the lower.

Assume an intermediate amplifier at 500 kc, a carrier of 1,000 kc, and an oscillator set at 1,500 kc. The desired carrier is 1,000 kc, and that is lowered to 500 kc for amplification at 500 kc by utilization of the output frequency difference (1,500 — 1,000 kc = 500 kc), or F2 — F1 = F3. We have considered a carrier that was lower than the oscillator frequency by the intermediate frequency. But there is also a frequency that is higher than the oscillator by the intermediate frequency. Thus, 1,500 + 500 kc = 2,000 kc. Unless there is sufficient preselection the 2,000 kc carrier may get through with intensity to cause interference, so that both stations are received at the same setting, which accounts for much of the code heard on broadcast receivers, though the code is in the short-wave band.

Some years ago the image gave considerable concern, in view of the mechanical possibility of receiving the same station at two different oscillator dial positions (the oscillator tuning then being separate, before ganging was the vogue). Hence the image danger was obvious. There was an image possibility at both positions. The two-spot tuning created a demand for one-spot tuning, but with the arrival of the one-spot method (necessary in ganging), there was no elimination of image trouble. Some remedies were proposed, but none of them seemed valid. Most of them affected only one frequency, or possibly two frequencies, whereas 96 frequencies were at stake, and the number of images possible was a function of the intermediate frequency, for the higher the intermediate frequency, the fewer the possible images. Nevertheless, image trouble arises in present-day receivers, and no station need necessarily be at the image position—just some radiation, enough to create an "impression" on the mixer. It is estimated the image need be of a strength of only 1 per cent. of the amplitude in the mixer circuit to render the interference audible.

The elimination of squeals from a superheterodyne has been accomplished by including sufficient selectivity ahead of the modulator to reduce the possibility of interference below the 1 per cent. value. This usually means a four-gang condenser, one section devoted to the oscillator, loose coupling throughout.

The New System

Now, reverting to Fig. 2, we find that by the new method, as by the old, there are four frequencies, counting the audio frequency twice, because it is used in two different but related functions. The sequence is as follows:

A single tuned circuit is used for bringing in the carrier frequency. To make possible this advantage it is necessary that the circuit be regenerated. A single tube is used, and the 57 has been found satisfactory experimentally. It is a radio-frequency amplifier and a detector. The same tube handles both frequencies, receiving the r.f., and emitting the a.f. If the output is developed across a resistive load the block-circuit diagram becomes almost literal. The a.f. is put into an oscillator, the newly modulated oscillation is fed to an i-f amplifier, the output of the i-f amplifier is detected, there is more audio frequency amplification, and the final ouput is to the speaker.

The four frequencies therefore are F1, carrier; F2, audio from carriers; F3, oscillator; F3 again, i.f. intermediate; F4, audio from i.f. Frequency levels alone considered, and not the related functions, there are only three levels: (1), carrier; (2), audio, and (3), intermediate.

It must be noted that *the oscillator frequency is fixed,* in the new circuit, instead of being variable as it is in the older one. Therefore the oscillator and intermediate frequencies are the same.

Circuits United

Let us see what the new circuit looks like constructively. In Fig. 3 we have the carrier tuner. It is the familiar one-tube regenerative set, using the parallel feed method of regeneration, capacity back-coupled. L1 is the primary, L2 is the tuned secondary, and L3 is the tickler or feedback winding, all windings fixed. L4 is a high inductance choke coil, of low distributed capacity, which renders C4 effective for feedback, since C4 is in reality a variable bypass condenser. The more capacity of C4 in use, the more effective the amplification and detection, up and to saturation of the tube. Therefore increase in capacity increases regeneration. C1 is the tuning condenser, C2 is the grid condenser and C5 is the stopping condenser between the detector and the audio amplifier. The grid leak type of detection is used, as it is the more stable in conjunction with regeneration. C3 is a condenser bypassing the a.c. on the screen, C4 is the feedback condenser. R2 is the limiting resistor, to keep the effective screen voltage lower than the effective plate voltage, while R3 is the plate load resistor.

In Fig. 4 we have the intermediate frequency oscillator. This oscillates, it must be remembered, at a fixed frequency. Grid leak and condenser are used for stability, and it is well that the capacity C7 in Fig. 4 be relatively large, compared to the inductance, because the frequency stability with such a circuit is better when the capacity-to-inductance ratio is large. The ratio is usually referred to as the inductance-to-capacity (abbreviated LC) and therefore that should be low. If the capacity is in micromicrofarads and the inductance is in microhenries, the capacity may be deemed to be large if it is numerically the same as the inductance.

In Fig. 5 is shown the combination of the two diagrams, Figs. 3 and 4, with coupling methods. The symbols, where repeated, represent the same constants as in the Figs. 3 and 4.

Biasing

The tube following the 57 is the 2A7. The audio frequencies are put into the control grid circuit, which is grid No. 4 in this tube, represented by the overhead cap. The circuit is completed from control grid to ground through the leak R4, and this grid is negatively biased around 3 volts, due to the potential difference across the biasing resistor R6.

How this bias arises has occasioned some perplexity, since there are two tubes in one envelope and both are differently biased. Take the pentode tube we are discussing, that being the modulator. The cathode is the datum or reference point. Ground is negative in respect to cathode by the potential difference across R6. Therefore if the grid is returned to ground it is at a potential negative in respect to cathode by the amount of the voltage drop in the cathode resistor. The heater and cathode are common to both tubes in the one envelope. The plate of the tube is associated with the pentode, and is located with the primary of the intermediate transformer. The screen, shown as such, is really two elements, known as grids Nos. 3 and 5, joined inside the tube. That completes the pentode. The triode is the oscillator, consisting of Grid No. 1 (control grid); Grid No. 2 (effectively the plate of the oscillator) and the common cathode. The heater is not a part of the tube geometry, as it simply provides thermal radiation.

The oscillator is of the grid leak type. Therefore the bias depends on the amplitude of the oscillation, which controls the check on grid current, which in turn controls the bias. Note that the leak is connected from grid to cathode. The grid condenser is lower down. Therefore the grids of the two tubes are not returned to the same point, the biasing resistor R6

affects the pentode, but not the triode (except for a slight reduction in plate voltage), and the triode depends for its bias on amplitude, leak and grid condenser.

The higher the amplitude of oscillation the more negative the bias. Therefore the tube is a detector (like a diode) and is also an amplifier. It may be called therefore a diode-biased triode.

Electrons Provide Bias

The increased amplitude increases the negative bias, and the relationship is substantially linear in a variable-tuned oscillator. The same circuit is used for a fixed-frequency oscillator to safeguard against any change in oscillation amplitude altering the frequency, for if the bias changes with the change in amplitude, and in the right direction, the frequency stability is bound to be good.

The bias is more negative the higher the amplitude of oscillation, although grid current indicates a positive grid, because the greater the amplitude, the greater the number of electrons that are caught at the grid, to stay there until discharged by the condenser through the leak. Since electrons are negative, the more numerous they are, the more negative the grid, compared to its steady state of operation. In point of fact, the grid need not be positive before grid current flows. It has been found that tubes of the heater type begin to draw grid current at 0.8 volts negative bias, at no signal input.

From the foregoing it should be clear that the carrier is tuned in, detected, and audio frequency as well as oscillation frequency fed to the mixer, the output of which is the modulated intermediate frequency, fed to the i.f. amplifier, which requires a second detector and audio amplifier, with power tubes for output, to complete the circuit.

We may now pay some attention to the selectivity question, as with a single manually tuned circuit it is not to be expected, offhand, that the selectivity will be any too high. For purposes of the present discussion, practical selectivity will be meant.

With the single regenerative detector tube, using good parts, and carefully selected constants, for short-wave work the selectivity meets all requirements for earphone use. If a stage of audio is added this remains true. Two stages of audio are not too much, to maintain the practical selectivity as high as desired. So

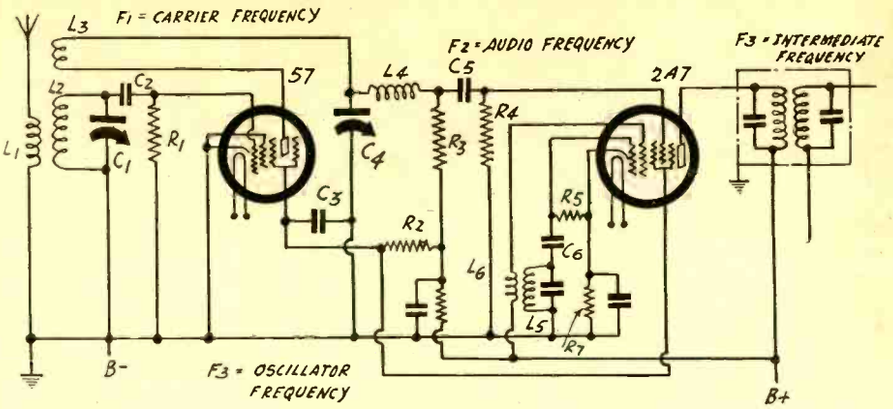


FIG. 5

The regenerative detector feeding the audio frequency to the 2A7 pentode modulator while the 2A7 oscillator also is coupled to the pentode, by the electron method.

practical selectivity relates to the amplitude of the input and the amount of the amplification, and may be roughly stated as represented by the fraction of dial degree over which the signal may be heard, although this has no scientific bearing on real selectivity.

Interference Rejector

When we have eliminated the carrier by detection, and have as a result audio frequencies, any interference present will be as an audio frequency. So we must derive from our single tuned circuit enough selectivity to get rid of interference that otherwise would infringe on the modulation band, or, instead, we may say that we can tolerate interference that consists of added modulation of the carrier, but outside the original modulation envelope of the desired carrier. This we may call fringe interference.

As we proceed therefore to the mixer circuit, we mix the interference, if any, with that of the original modulation of the carrier, or impressed audio frequencies, but since we are to use the oscillator as a new transmitter and feed the new output through a selective system, if the selectivity of that amplifier is great enough, it will get rid of the interference, or extra envelope. To this extent the intermediate amplifier, functioning in reality something like an audio filter, passes the original audio frequencies, freed now from the high-audio-frequency fringe interference that may have come through the singly-tuned circuit. Otherwise the intermediate amplifier, although accounting for much amplification, would add virtually no selectivity, for whatever was put into it was the detected result of the first circuit's input, interference and all, and it becomes simply a question of band width. Of course selectivity itself is a question of band width, but the present aspect is somewhat different from that usually present in consideration of the selectivity question.

Short waves have been considered. With the broadcast band the situation is different. A single tuned circuit would not do. The intermediate amplifier would not help the selectivity under conditions of transmitters operating 10 kc apart unless the i.f. amplifier cut sidebands. Even so, the help of regeneration is not as effective. There are too many stations powerful enough to reduce the effectiveness of regeneration, or, to put it differently, regeneration is more effective on weak signals than on strong ones. Thus a strong carrier, with regeneration sought to be used, but not every effective, might be interfered with more by a weak adjacent-channel station, due to the very use of renegation. Mathmatically, this is due

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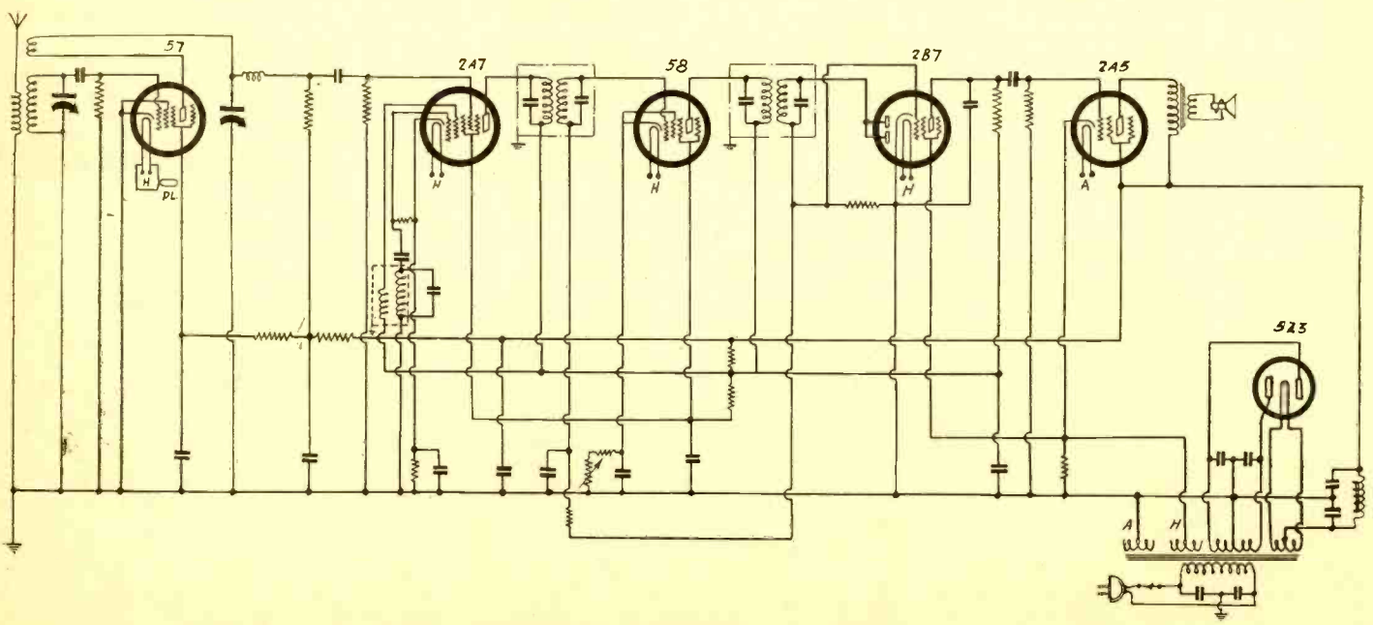


FIG. 6

A short-wave set, using four plug-in coils to cover from 1,600 kc to about 20,000 kc, embodying the new principle of immediate reduction to audio frequencies. This is a six-tube a-c set.

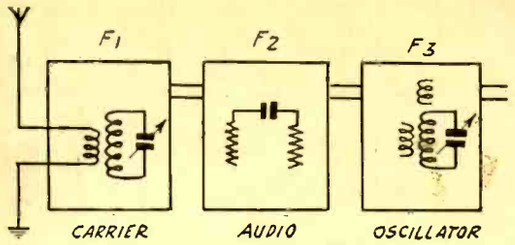


FIG. 7
System applied to a converter.

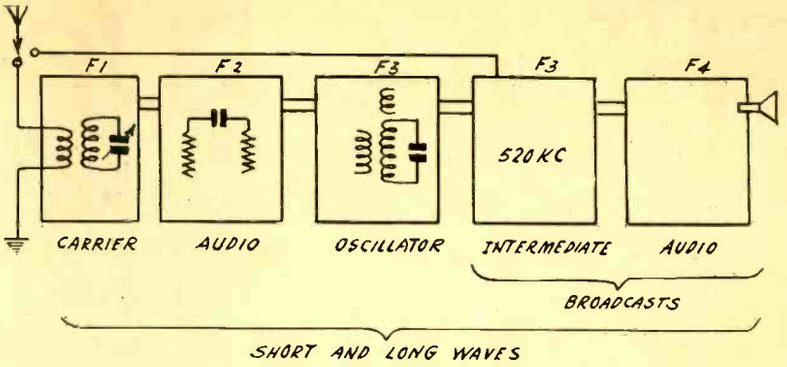


FIG. 8
System modified to include all-wave coverage.

(*Continued from preceding page*)
to renegeration varying as to the two-thirds power of the grid space.

Another point to consider is the inadvisability of having a broadcast band "blooper."

Intermediate's Effect

When we get into lower frequencies, if we desire to enter this region, which at present interests Europe mostly, we may return to regeneration, as on short waves, and as we do not encounter the strong signals, we find our results consistent with short-wave performance, when allowance is made for the carrying effects of different frequencies and for conditions of light and darkness.

It has been said that what the intermediate frequency shall be is immaterial, but it must be added now that it should be lower than the lowest frequency that is to be received. It is simpler not to go to frequencies lower than the lowest one in the broadcast band, because then some of the problems hinted at earlier in this discussion begin to arise. The oscillator would have to be of a closely-shielded type, either non-harmonic producing, or at least equipped with a low-pass filter, to keep harmonics from getting into the front-end tuner, otherwise, there would be squeal after squeal in the tuning process, one squeal removed from the other by the frequency of the oscillator. For 0.00014 mfd. tuning, at the front end, and an intermediate frequency of 100 kc, there would be 25 squeals on the lowest frequency short-wave band, and for each succeeding band 2.3 times as many squeals as on the previous band, until in the highest frequency band there would be hundreds of squeals.

The new principle may be applied to a variety of uses. The circuit already reduced to practice relates to the reception of short waves only, using an intermediate frequency just below the low limit of the broadcast band. The general idea is embodied in Fig. 6, except that an extra i-f stage has been added, only one stage being in the model that was built. Whether the extra stage is worth while depends on whether you can stop the i-f amplifier from oscillating, without introducing so much loss as to be about where you would be with only one stage, at a gain of around 200.

With this circuit plug-in coils were used, although the coils commercially obtainable did not give satisfactory performance and special ones were wound.

Use as a Converter

Fig. 7 depicts the idea of the new principle applied to a short-wave converter, where F1 is the carrier frequency, F2 the resultant audio frequency after detection in the single tube, F3 the oscillator frequencies, this being for the span of the broadcast band, while the output is to the primary of the set's otherwise antenna coupler. The antenna of course has been moved over to the converter input.

While a fixed oscillator frequency has been stressed, and now a variable oscillator frequency is suggested, a fixed one will be used in the short-wave converter, but if choice were barred, that would limit the use of the receiver's tuner to one particular channel, in conjunction with the converter. Since one of the severest converter problems is that some sets are sensitive at the low r-f end, others at the high r-f end, and different users have different local conditions, too often precluding the use of a converter requiring a particular frequency of the set, the variable adjunct is introduced. After the right spot is found, which is done in a few moments, the variably-tuned oscillator may then become a fixed-tuned one, and again we are at our original advantage.

Since the broadcast band offers a problem, where the receiver is to bring in short waves and broadcast band as well, we might have a variably-tuned intermediate amplifier, and attend to its reaching 520 kc, which can be done readily, by using 0.00041 mfd. or somewhat higher capacity tuning condensers, of low enough minimum capacity to assure receiving 1,500 kc.

Reading Fig. 8, the antenna would be switched to the left, the whole circuit active, and short waves would be tuned in, along the lines already discussed, Since the "broadcasts" part of the system would be set at 520 kc. For frequencies lower than the broadcast band, F1 would be serviceable as on short waves, and the only difference would be the substitution of a supermediate frequency (520 kc higher than any frequency now being received) for an intermediate frequency, a point of no great consequence. For broadcast reception, the antenna switch would go to input of "broadcasts." Suitable switching could take care of inoperation of the tubes not required when broadcasts are to be tuned in.

WSM's Giant Upright Antenna
A Lightning Rod for Countryside

Nashville, Tenn.

A lightning rod, 878 feet in height, pierces the lower and more ominous clouds on a stormy day, marking a definite milestone in the progress of radio. WSM's new single antenna has proven an advance upon the older type of double towers with wires stretched between.

With the exception of Eiffel Tower, in Paris, recently used for radio purposes, it is the world's tallest broadcasting structure, located in the center of a beautiful thirty-acre tract about fourteen miles due south of Nashville. WSM's brilliantly-lighted beacon is a landmark for air men and motorists for miles around.

The transmitter home is of southern colonial design with plenty of room for the very elaborate equipment necessary to keep just a little bit ahead of the times. Since the tower was officially put on the air the time lost was negligible during regular hours of operation, which are from 6:30 a.m. to 12 p.m., with the exception of Sunday when the schedule is shorter. There have been instances during a storm when the wires from the station to the studios were impaired as a result of what lawyers term "acts of God" but otherwise WSM's batting average has been mighty close to a thousand.

J. H. DeWitt, Jr., chief engineer of the station, reports that during a lightning storm the tower discharges the charged clouds and a blue haze appears around the ball on top of the flagpole. When the charge in the clouds becomes too great, a bolt of lightning runs for some little distance down the tower and goes into the ground, although it is not visible more than about a quarter of the way. As a result, this enormous lightning rod clears the atmosphere for miles around. The tower is a protection instead of a danger to the immediate community. The lightning goes into the ground through the gap betwen two balls at the base of the tower which are known as sphere gaps. Tourists have gotten a great kick out of watching this.

Located in a garden spot in middle Tennessee in Williamson County, not very far from the battleground of Franklin, famous in Civil War history, WSM provides a small farm where the operators really and truly make hay while the sun shines. While off duty the boys cut the hay which grows on the five acres under which run the ground wires of the tower. Buried eight inches below the surface, there are six miles of wire.

Headed by Mr. DeWitt, WSM's engineering department includes George Reynolds, Arthur Omberg, Bill Montgomery, Jack Montgomery (not related), Aaron Shelton, Carl Jenkins, Percy White and Garrett Davis. Most of these boys have been members of the staff for several years. Bill Montgomery and Arthur Omberg live in the country near the station and take a keen interest in the grounds.

THE A-C TUBE'S PART

SOME HISTORY RECALLED AS THE FILAMENT AND HEATER PATENTS ARE CONFIRMED

Washington.

BY granting two basic patents on alternating current tubes the U. S. Patent Office has definitely recorded the fact that engineers of the Westinghouse Electric and Manufacturing Company were responsible for the most significant development in radio receiving, and one which now dominates a $50,000,000 a year industry in tube manufacturing.

These patents are No. 1,909,051 to Freeman and Wade, relating to the indirectly-heated cathode a-c tube, and No. 1,911,024 to Kimmel and Sutherlin, relating to the directly-heated cathode a-c tube. Manufacturing rights to these patents are held by the Radio Corporation of America, although Westinghouse has retained its rights to incorporate the principles in tubes for all other purposes.

Change to A-C Sets Begins

It was the development of these two types of a-c tubes by the Westinghouse research laboratories which made possible the change from battery-operated to alternating-current receivers, in the fall of 1927.

"Those who remember radio activities six years back," states Dr. L. W. Chubb, Westinghouse Research Director, "will recall that nearly all radio sets were completely battery-operated. Some, at the time, were in part operated by batteries, with alternating current supplying power to the loudspeaker. These latter sets were termed "electrified." Few, however, recall that the number of sets being purchased by the public had been steadily declining for a two-year period.

"Then, in the fall of 1927, the Radiola 17 was developed. It included three new tubes. These tubes were the 226, a directly-heated cathode a-c tube; the 227, an indirectly-heated cathode a-c tube; and the 280, a new rectifier tube. These tubes, all developed by Westinghouse engineers—in fact the entire radio receiver was Westinghouse designed—made possible the first commercial alternating-current operated radio receiver.

Big Increase in Sales

"Sales of receivers immediately jumped and within two years had doubled their former peak. In 1929, it is estimated 4,438,000 a-c receivers were sold. Radio sales have declined since that time due to the depression but the impetus given radio receiver sales by the development of a-c tubes has maintained sales at a high level."

According to Dr. Chubb, Westinghouse engineers began the development of an a-c tube in 1921. The first tube perfected was the indirectly-heated cathode. In this tube, a separate heating element is used to cause the emission of electrons. In those early days, the cost of this tube was high; however, it was a high-quality a-c tube, measured even by modern standards.

Not until 1926 did Westinghouse research perfect the first satisfactory directly-heated cathode a-c tube. In this tube, the heating element also is the electron emitter. Inasmuch as the first directly-heated cathode a-c tubes, the 226, were not quite so free from a-c hum as the 227, the 226 was used as amplifier and the 227 as the detector.

The 280 Is Born

At the same time, Westinghouse had perfected the first satisfactory oxide-coated rectifier tube, the 280.

Later, further research and an improvement in manufacturing processes made the 227 comparable in cost to the 226, and so the 226 has now passed its peak in importance, although thousands are still made for replacements. More than 25,000,000 of the 226's were manufactured, however, in the years from 1927 to 1931.

An interesting event of radio history is the fact that this one pioneer alternating-current receiver included the two basic tube inventions which have done so much to make radio available to the millions of the United States. Of the four engineers involved in these patents, only Lee Sutherlin remains with Westinghouse. Freeman and Kimmel have died and Wade has left Westinghouse.

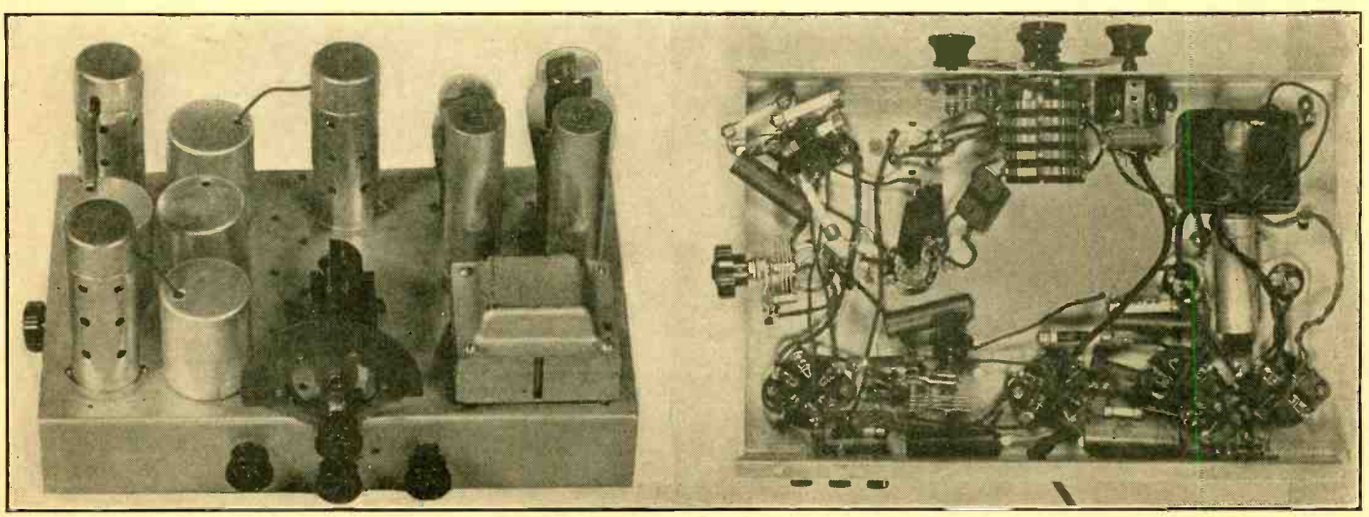
Photo-Electric Cell Protects a $20 Bill

Chicago.

The famous Westinghouse "electric eye," or photo-electric tube, has been perfected to such a degree that Westinghouse has placed a $20 bill in an exhibit at the World's Fair free to anyone who can get it.

However, as a hand reaches through the miniature paying teller's cage it intercepts a beam of light which causes the photo-tube control to raise a barrier instantly protecting the treasure it is guarding.

Experimental Set-up for Bernard's Superheterodyne



A set-up as shown above may be used for covering a particular span, as 200 to 70 meters, or other one in the short-wave band, on the basis of Bernard's new application of the superheterodyne principle. The tube and its coil are at left front, a shielded r-f coil comes next, while the two r-f transformers, single r-f tube, rectifier and power tubes are shown. By special coil design, switch may be used for wider band coverage.

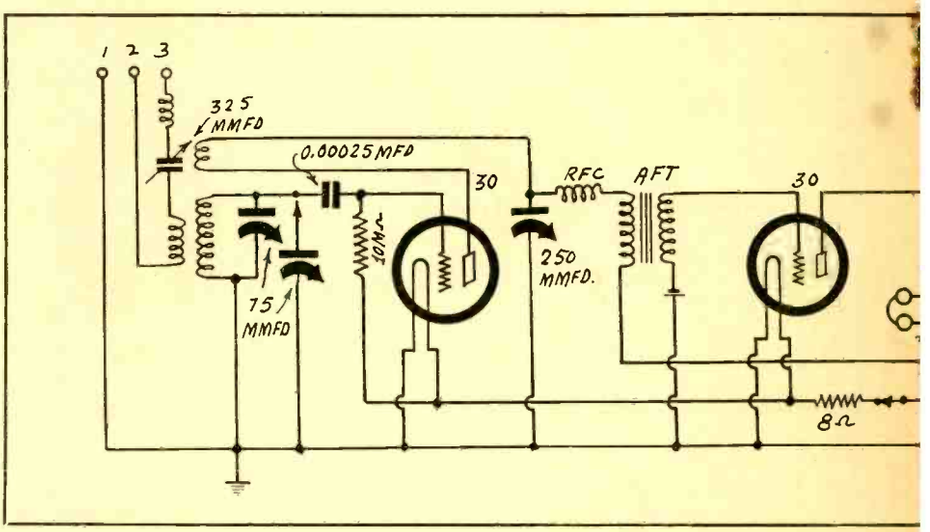
THE 2-TUBE WALLA
WITH DOUBL

RATIO OF SIGNAL TO NOISE INCREASED, LOUDER AND

By Herma

Try-Mo Radi

The new two-tube short-wave battery receiver designed by Don C. Wallace, Pacific Coast amateur and winner of the Hoover prize cup. The circuit is differentiated from the usual variety by the use of a doublet antenna, with transposed leadin and tuned aerial. The idea of the doublet is diagrammed at right.



DON C. WALLACE, who won the Hoover cup some years ago for the excellence of his design and construction work, has evolved a simple two-tube short-wave set, following authenticated and orthodox circuiting, except for the introduction of an antenna coupling novelty.

Instead of the usual primary, he has a split primary, with a large tuning condenser between the adjoining terminals, while the the other terminals, or extremes, are to be connected to a dipole or doublet antenna.

Such an antenna would consist of a horizontal stretch of wire in two equal parts, one part insulated from the other, as well as both extremes insulated from the masts. The downlead is taken through two wires, from the opposite sides of the mid-section insulator, and may consist of transposed leadin, using the insulating blocks now popular, or may be twisted pair lamp cord.

For Reception Purposes

The usual recommendation for such an antenna for transmitting purposes is that it should be composed of horizontal half-portions equalling each one-quarter of the desired wavelength, while the downlead would be at least one-quarter wavelength long. However, for reception this is not quite practical, and, therefore, much longer, though still equal, sections are used, and the downlead should be of at least the length as the two other individual pieces. The large condenser between the two halves of the primary coil takes care of wavelength adjustment, or tuning the aerial.

By pursuing this aerial method one is assured of a better ratio of signal to noise, and of course this is a decided advantage. It is a simple matter indeed to reach the noise level with a one-tube regenerative short-wave receiver of standard pattern, so what one wants to do is to bring in more signal and less noise, and thus be able to get louder and clearer signals, as well as greater distance.

Like Expensive Sets

Some of the better types of elaborate short-wave sets provide antenna terminals suitable to the use of the doublet, although to use the common aerial method, one of the binding posts would be grounded to chassis, which the operator may do. Therefore the small Wallace set embodies an idea that has been considered worthwhile for expensive equipment, and yet the Wallace set falls distinctly in the inexpensive class.

Bandspread Obtained

Wallace is an amateur, operating W6AM, at Long Beach, Calif., and is in close touch with the latest short-wave improvements. That he has centered his attention on the aerial system and the tuning shows that he has given approval to orthodox patterns that are electrically subsequent to the aerial and the tuned circuit, but has decided that in the aerial method there is room for improvement. He has contributed the improvement in a manner easily attained by anybody.

The condenser and coil combinations are such that bandspread tuning is achieved, although experimenters may wind coils of the type suitable for different bands, to effectuate as much or as little spread as desired. The standard coils for the circuit are of the plug-in variety, manufactured by William A. Bruno in his usual skillful and attractive style, the secondaries consisting of flat silvered ribbon wire. This increases the area of the conductor and makes for a very low resistance to the high radio frequencies concerned.

The Tuning Condensers

There are two special Hammarlund condensers on a gang for the grid circuit tuning, the total capacity 75 mmfd., and with the four standard coils the wave bands are as follows: Coil No. 1 = 20 to 32 meters; Coil No. 2 = 40 to 60 meters; Coil No. 3 = 75 to 150 meters; Coil No. 4 = 150 to 200 meters. It can be seen that the frequency ratio changes, but it should be clear also that for other spreads, different windings may be used.

If the larger of the parallel condensers is used for normal tuning, then the small is used in parallel with it for bandspread. The spread naturally is to lower frequencies.

The second tuning condenser need not be used, and then the coils will be tuned somewhat on the basis outlined. However, there is a front panel switch for cutting in the parallel condenser for spreading, and the choice is such as to favor spread at 160, 80, 40 and 20-meter amateur bands.

Messrs. Louis and Morris Lager, of Tro-Mo Radio Corporation, were so impressed with the performance of Wallace's little set that they decided to have the corporation merchandise the kit, and had the

LIST O

Coils

One set of four plug-in coils, for eight-terminal connection.*
One audio frequency transformer.
One Hammarlund radio frequency choke coil.

Condensers

One Hammarlund junior condenser, 0.000325 mfd.
One Hammarlund junior bandspread condenser, 75 mmfd., in two sections, ganged.
One 0.00025 mfd. fixed condenser.
One Hammarlund junior 0.00025 mfd. feedback condenser.

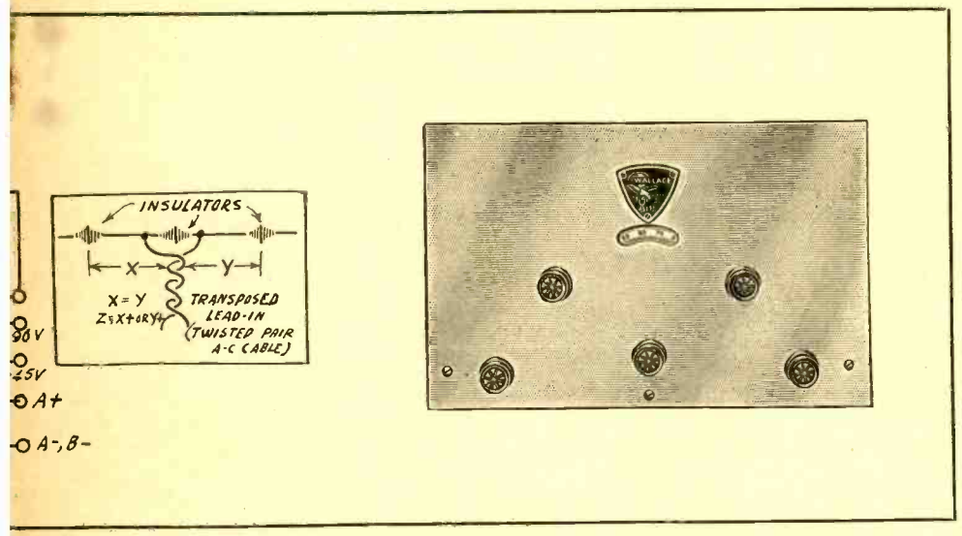
Resistors

One 10 meg. grid leak.
One 8-ohm filament resistor.

CE SHORT-WAVE SET
ET ANTENNA

CLEARER SIGNALS HEARD, AND MORE DX BROUGHT IN

n Cosman
Corporation



If the usually-encountered antenna-ground system is to be used, binding posts 1 and 2 are interconnected and aerial attached to No. 3. By the doublet method the primary is not grounded, though the chassis is. The two methods are best compared when equal pickup results, and noise then contrasted.

F PARTS

Other Requirements

One battery switch.
One condenser switch.
Three Hammarlund Isolantite sockets (UX)
One front panel.
One base.
One vernier dial.
One antenna binding post assembly.
One output binding post assembly.
One battery cable.
Five knobs.
Two 30 tubes.

**Note: The official kit for this circuit comprises one coil only. The three other coils, if desired, may be obtained. The official coils have silvered ribbon wire for reduction of radio-frequency resistance and follow Mr. Wallace's specifications.*

coils specially wound to Mr. Wallace's specification.

Plug for Coil

"The construction of the coil has been made as simple as possible, consistent with absence of losses," said Mr. Louis Lager. "There are eight terminals, of which four are made through a socket at top of the coil and four through the base pins of the plug-in coil proper. A plug fitting into the top socket is provided with the twisted pair for transposed feeder."

Tuning Directions

The receiver is tuned a little differently from the run of short-wave sets, because of the special aerial treatment. From experience one will determine approximately the correct setting of the 0.000325 mfd. condenser tuning the split primary, or antenna really. From that point on the tuning follows the usual fashion, in that the dial of the main tuning condenser is rotated while the set is oscillating, until a squeal is picked up. Then the regeneration is retarded to the point just below spillover or oscillation, and the station is heard. However, an extra precaution is slightly to retune the aerial condenser (0.000325 mfd.) and then, if need be, make a readjustment of the regeneration control, because the lowered antenna resistance has the reflected effect of increasing the regeneration perhaps to the oscillation point.

After this process has been repeated for various points on the dial a calibration may be recorded, and the same station then should be brought in time and again at the same dial positions. Of course, as bandspread is introduced by switching, another calibration may be run.

Use of C Battery

The 75 mmfd. condensers are themselves of the bandspread type, in that they do not exhaust the full frequency range when united. The two sections are on a single shaft. There is a total of 11 plates, of which two may be used or 11 may be used, that is, the 2 used alone, or the 9 paralleled with the 2.

The circuit shows a C battery biasing the audio tube, as this conserves B current and improves quality. If the B voltage is 90 volts and the C bias is 4.5 volts, then the plate current is only about 2.5 milliamperes. Without the C battery it might be more than twice as great.

The plate current of the detector is small, but varies considerably, due to the grid leak type of detection.

The filaments operate at 2 volts. They are shown wired in parallel. It is assumed that 3 volts are applied from two dry cells, preferably No. 6. The excess would be dropped in the filament resistor of 8 ohms.

Another way out would be to wire the filaments in series, using a 4.5-volt C battery for the A source, and utilizing the drop in the filament of the detector for biasing the output tube at 2 volts. However, the parallel method seems preferred by constructors, and they may therefore follow the diagam as shown.

[Other Illustration on Front Cover]

Financing Television Presents Same Problem as Sound Did in 1921

THE problem of financing television has not been solved any more than was the same puzzle when it confronted the pioneer broadcasters in 1921. There are, of course, because of the broadcasters' revenue, suggestions for using television in advertising; but there is no assurance that the Federal Radio Commission will sanction such commercialism of radio-sight. There are also proposals of pay-as-you-see television, just as there were pay-as-you-listen ideas in the early Twenties.

There will be so many uses for television that advertising, if permitted, may be restricted to one or two channels, and it may not be permitted to spread over the entire entertainment band.

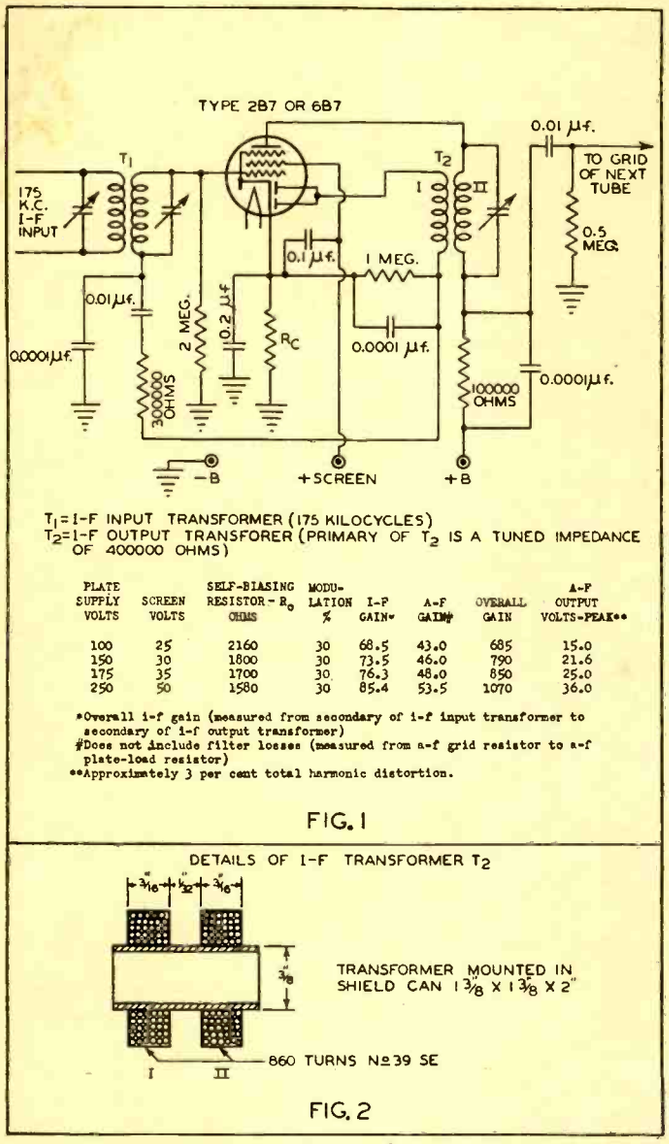
It is fortunate, with so many possibilities for television as a utility, that nature has provided numerous channels in the short-wave spectrum. Manifold uses of the "eye" in aviation are foreseen.

And the suggestion has been offered that a New York newspaper might televise its pages and have them plucked from space on the other side of the Rockies, where matrices would be made and a Pacific Coast edition put on the street not long after the paper was on the streets in the East.

Some day the same might be done for Europe, but first television must be made to leap long distances and electrical sight must be sharp enough to "read" any size of type.—Orrin Dunlop in "The New York Times."

PRACTICAL REFLEXING

Tested Circuits for Use of 2B7 or 6B7



T_1=I-F INPUT TRANSFORMER (175 KILOCYCLES)
T_2=I-F OUTPUT TRANSFORER (PRIMARY OF T_2 IS A TUNED IMPEDANCE OF 400000 OHMS)

PLATE SUPPLY VOLTS	SCREEN VOLTS	SELF-BIASING RESISTOR - R_0 OHMS	MODULATION %	I-F GAIN*	A-F GAIN#	OVERALL GAIN	A-F OUTPUT VOLTS-PEAK**
100	25	2160	30	68.5	43.0	685	15.0
150	30	1800	30	73.5	46.0	790	21.6
175	35	1700	30	76.3	48.0	850	25.0
250	50	1580	30	85.4	53.5	1070	36.0

*Overall i-f gain (measured from secondary of i-f input transformer to secondary of i-f output transformer)
#Does not include filter losses (measured from a-f grid resistor to a-f plate-load resistor)
**Approximately 3 per cent total harmonic distortion.

FIG. 1

FIG. 2

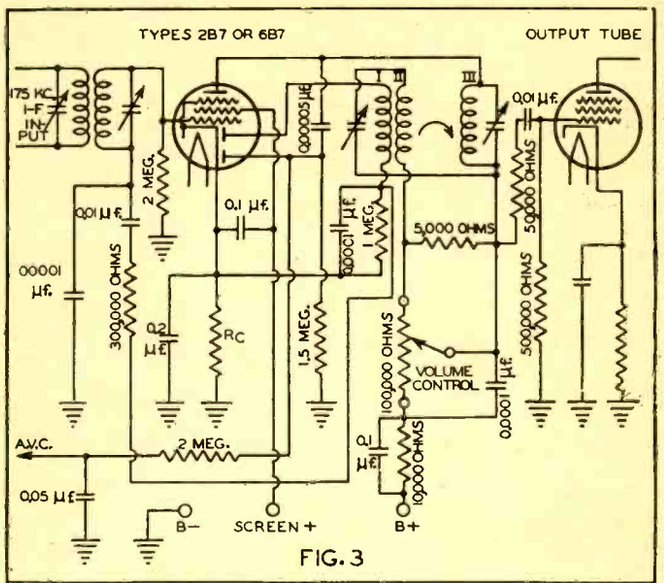


FIG. 3

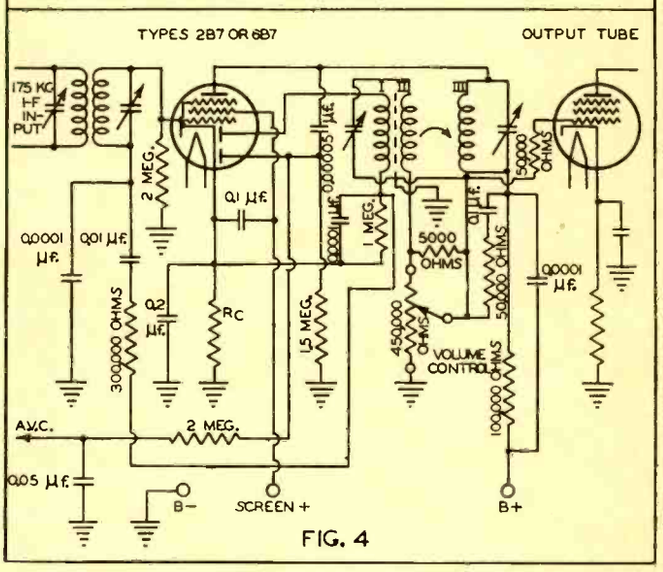


FIG. 4

Fig. 1 shows a reflex without automatic volume control. Fig. 2 gives the i-f coil data. In Fig. 3 the manual volume control operates on both i-f and a-f. Fig. 4 has a quiet manual control. Both Figs. 3 and 4 have a. v. c. The maximum resistance in series with the grid of the 2B7, or 6B7, usually should not exceed 1 megohm. However, under the circuit conditions of Figs. 1, 3 and 4, the low plate voltage and low screen voltage, combined with self-bias, permit satisfactory operation with a 2 meg. resistor.

Under the heading, "Reflexing To-day," theoretical considerations affecting the 2B7 or 6B7 in reflex circuits were published in the issue of July 8th. A circuit was shown, two tube curves printed, and the fact stressed that reduced drain, not economical first cost, was the controlling consideration. Reflex operation of the past was compared to the newer circuit. This week the subject is carried forward with practical construction data, as supplied by RCA Radiotron Company, Inc., and E. T. Cunningham, Inc.

REFLEX circuits recently have received renewed interest. Possessing such advantages as economy of A current drain, higher overall gain for a given number of tubes, higher gain for the same amount of chassis space, and a reduction in the number of tubes required to give satisfactory overall sensitivity, the reflex circuit merits particular consideration in the design of small transformerless receivers and automobile radio sets.

The type 2B7, or 6B7, possesses certain features which make it especially adaptable to reflex circuit application. Combining a duplex-diode and a pentode in a single bulb, the 2B7, or 6B7, can be made to perform simultaneously the functions of i-f amplification, detection, a-f amplification, and automatic volume control. The pentode unit of the tube in such an application is reflexed for a-f and i-f amplification.

Operating Conditions

Fig. 1 shows a suitable circuit for the 2B7, or 6B7, as a reflex amplifier. No automatic volume control is included in this circuit. With the circuit arrangement of Fig. 1 it will not be found satisfactory to obtain volume control by variation of voltages on the reflex tube. A volume control operating on the antenna input, or on tubes preceding the reflex tube, is generally satisfactory.

An examination of the circuit in Fig. 1 and of its constants shows that no unusual or inordinately expensive circuit elements are required. While the number of circuit elements is larger than that for a single amplifier stage, the total cost of these elements is about the same as that for two stages of amplification. However, one less socket and one less tube are required for the reflex circuit than for a two-stage amplifier. The chassis space requirements are less and the A and B current drain are lower. On the other hand the total gain of the reflex stage is somewhat lower than that for a two-stage amplifier.

Operating conditions for the 2B7, or 6B7, as a reflex amplifier are tabulated below the circuit diagram in Fig. 1. The importance of adequate plate-supply voltage is clearly indicated by the increased gain and voltage-output at higher plate-supply voltages. The voltage output from the a-f amplifier is comfortably sufficient

to swing the grid of an output pentode operated from the same plate-supply voltage as the reflex tube. The distortion with the a-f output voltages shown in the tabulation is approximately 3 per cent.

The operating conditions in Fig. 1 were calculated and then checked experimentally. In a compactly arranged chassis the gain may be slightly less than those tabulated in Fig. 1 due to coupling between the circuit elements. However, careful arrangement of the chassis elements will result in operating characteristics essentially the same as those tabulated.

The details of the i-f output transformer (T_2) are shown in Fig. 2. This transformer has been designed for economy of chassis space. Larger and better coils will give increased gain from the tube. The transformer as shown is suitable for use in small transformerless receivers or automobile-radio sets.

Combination Control

Fig. 3 shows another circuit arrangement for the 2B7, or 6B7, in which the manual volume control operates on both the i-f input to the diode and the a-f output of the tube, yet it requires only a single-unit potentiometer. This volume control arrangement cannot be used on circuits without automatic volume control, since an uncontrolled i-f input would result in blocking of the reflex tube.

The volume control arrangement shown in Fig. 3 requires an additional coil in the i-f transformer. The circuits of coil No. II and coil No. III are tuned to resonance at 175 kc. Coil No. II is located for optimum coupling with coil No. III. Coil No. I is approximately 50% coupled to coil No. II, so that i-f currents in coil No. II produce i-f voltages in coil No. I which feeds the diode.

With the volume control in the full-on position (slider at the top of the potentiometer), the circuit of coil No. II contains no series resistance. As the volume control is moved to give lower volume levels, the shunting effect of the slider around the 5,000-ohm resistor in the circuit of coil No. II is lessened by the introduction of the resistance of the potentiometer. The resistance introduced in the circuit of coil No. II lowers the current in the circuit, and consequently, the i-f voltage induced in coil No. I. Thus, the i-f input to the diode is lowered.

At the same time as the volume control is moved down, the a-f plate-load resistance is reduced, causing smaller a-f voltages to be developed across the a-f load which is the resistance of the potentiometer below the slider. Thus, the volume control operates on both the i-f input to the diode and the a-f output of the reflex tube. The i-f output from the tube remains constant, giving good a. v. c. action.

The series resistance introduced in the circuit of coil No. II is limited to 5,000 ohms in order not to reduce to zero the i-f voltage fed to the diode. If the i-f voltage fed to the diode is reduced to zero, the only a-f component in the plate circuit of the reflex tube would be that due to rectification of the i-f signal by the i-f amplifier. Under these conditions, distortion would result at low volume levels.

Quiet Volume Control

The circuit arrangement of Fig. 3 has a disadvantage in that the plate current of the tube passes through the sliding contact of the volume-control potentiometer. This arrangement sometimes gives rise to noisy operation of the volume control. In order to overcome this difficulty, the circuit arrangement of Fig. 4 is useful. In this circuit the potentiometer operates in the grid circuit of the tube following the reflex tube, and controls the a-f input. Since the potentiometer carries no current in this arrangement. less trouble from noisy operation of the volume control is encountered.

The a-f load on the reflex tube in the circuit of Fig 4 is never reduced to zero even at the lowest setting of the volume control. Consequently, with high capacity between coil No. I and coil No. II, sufficient a-f voltage may be induced in coil No. I to cause a-f rectification in the diode. Considerable distortion is the result of this action. The circuit of Fig. 4 is more given to this difficulty than the circuit of Fig. 3.

To overcome this difficulty, the capacity between coil No. I and coil No. II must be made very low, or an electrostatic shield must be placed between the two coils as shown in Fig. 4. The circuit of Fig. 3 gave satisfactory operation when tried experimentally even though no shield was employed.

The specifications for the additional coil in the i-f transformer used in the volume-control circuits of Fig. 3 and Fig. 4 are identical with those of coils No. I and No. II in Fig. 2. In adjusting the circuit, coil No. III is moved along the core until optimum coupling with coil No. II is obtained.

Although the gains obtainable with the volume-control circuits shown in Fig. 3 and Fig. 4 are somewhat lower than those obtainable with the circuit in Fig. 1, these circuits have the advantages of automatic volume control and a single-unit, manual volume control.

IONIZED ATMOSPHERE LAYERS MEASURED BY AUTOMATIC DEVICE, GIVING TIME AND FREQUENCY

Chicago.

The Institute of Radio Engineers, at its convention, heard new information on the series of ionized layers formerly named for Kennelly and Heaviside, but now known as the ionoscope. A means of accurate measurement of the layer heights and effects was described by T. R. Gilliland, of the Bureau of Standards, U. S. Department of Commerce, while S. S. Kirby, D. M. Stuart and L. V. Berkner, also of the Bureau, spoke on the same general subject.

The Bureau's "measuring rod" gives a height-frequency curve and comprises transmitter and receiver, automatically varied from 2,500 kc to 4,400 kc cycles at a uniform rate of 200 kc cycles every minute. The virtual height is recorded photographically by an oscillographic recorder as used for fixed frequency work.

Three Layers Measured

"In the daytime," Mr. Gilliland said, "three different strata were usually indicated. As a rule the E layer, with a virtual height of about 120 kilometers, is found to return energy for frequencies below 3,000,000 cycles. Between 3,000,000 and 3,600,000 cycles reflections are likely to come from the F-1 region, with a virtual height of about 200 to 240 kilometers, while above 3,600,000 cycles, the F-2 region, at 280 kilometers and higher, returns energy. These values vary considerably from day to day.

"Of particular interest is the character of the change observed when passing from one stratum to another as the frequency is increased. Although, at times, when passing from E to F-1, reflections may drop out completely for a short interval, frequently the curve is continuous and the time retardation will reach a high value just before the appearance of the F-1 reflection.

Effect of Darkness

"When passing from F-1 to F-2, the virtual height frequently reaches 800 or 900 kilometers, about 550 miles.

"As evening approaches, reflections no longer come from the E layer and the long retardation between F-1 and F-2 becomes less pronounced. By sunset the curve is almost straight and there is little change of height with frequency. Later at night the highest frequencies cease to be returned and long retardations again occur. The phenomenon of double refraction is in evidence at this time.

"The curves contain many important details which would be impossible to record by present methods of manual operation."

Magnetic Waves

Dr. Karl A. Jansky, of the Bell Telephone Laboratories, discussed electromagnetic waves:

"Electro-magnetic waves of an unknown origin were detected during a series of experiments on atmospherics at high frequencies. Directional records have been taken of these waves for a period of over a year. The data obtained from these records show that the horizontal component of the direction of arrival changes 300 degrees in about twenty-four hours in a manner that is accounted for in the daily rotation of the earth.

"Furthermore, the time at which these waves are at a maximum, and the direction from which they come at that time, changes gradually throughout the year in a way that is accounted for by the rotation of the earth about the sun.

Direction Is Fixed Above

"These facts lead to the conclusion that the direction of arrival of these waves is fixed in space; that is, that the waves come from some source outside of the solar system. By noting the right ascension and the declination when their intensity is greatest, the source is indicated to be either the centre of the Milky Way galaxy or from the direction of the movement of the solar system with respect to the naked-eye stars. The Milky Way is the more likely source of the two."

Blind Boy on Air; Learnt Songs Listening

Albert Carroll, twelve, blind, of 520 Marcy Avenue, Brooklyn, N. Y., is an entertainer entirely trained in the "musical conservatory of the air." He was discovered by Walter Drey and now is featured frequently on the morning Wigwam Club programs at WINS, New York City.

All the music Albert knows is what he has learned from listening to broadcasts on the receiving set at home.

Until his voice changes, Albert will continue to be a pupil of the loudspeaker. Albert has shown a marked predilection for "hotcha" music. Henceforth he will be encouraged to tune in ballad programs, so he may bring variety to his repertoire.

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6, without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Transformer Impregnation

WILL YOU PLEASE EXPLAIN the impregnating of power transformers and other such transformers, and state the advantages?—P. O. L.

When the transformer is built it is put into a vacuum tank and after a certain degree of evacuation molten wax or similar compound is poured into the vat and thus fills the transformer pores or openings, as well as covering the surface. The advantages are that the transformer becomes relatively free from the deleterious effects of moisture and should have a longer life and give better performance. After the impregnation the transformer is cased.

* * *

Housewife's Watch Affected

MY WIFE COMPLAINS that her wrist watch gets out of order a great deal and she seems to think that the radio is at fault, as this trouble did not happen quite so often before we got our radio. (You know how sturdy those small wrist watches are!) Can she be right?—H. G.

A man's wife is always right. No doubt she is an industrious housewife, immaculate surroundings being her forte. So she dusts and cleans in and around the radio set and gets her hand (with wrist watch attached) near the magnet of the speaker. Thus the movement of her watch becomes magnetized, and it is the devil's own job to get rid of this magnetization. The watch runs, if at all, erratically, and is not as good or dependable a time keeper as is an egg glass. Of course the lady should not wear her wrist watch when cleaning house, but you tell her that.

* * *

Troubles at the Seashore

I LIVE at the seashore during the summer. Reception conditions there are not what they are at my town home. Of course, there is no air obstruction, but the bungalow provides no facilities for a good ground, and as there is really no earth, only sand. I find that most of the neighbors do not use any ground, and for aerials have an assortment of choices, including a wire under the roof (asbestos, not tin), the gas range fixture, the water pipe, etc. Also, there is considerable hum trouble. Performance is good sometimes, other times poor, that is, weak. What do you suggest?—R. W.

It is difficult to get a good ground under these conditions. Practically the better aerial likely will be the gas fixture, despite the usual warning against using the gas pipes for aerial or ground. However, these pipes run for a great distance under the sand and therefore the conductivity should be good. There would be no need for a ground if the gas pipe is used as aerial. This is taken from practical experience under just such conditions as you describe. However, if you care to get a pipe about 12 or 15 feet long, and drive it into the sand, it will hit moist sand or perhaps water, and you should solder a connection to the protruding end and bring this to the set as ground, using an indoor or outdoor stretch of horizontal wire for aerial, as long as practical. The hum trouble may arise from using the water pipe as aerial or ground under circumstances such as you describe, but with gas pipe as aerial, with no ground external, you should get rid of this. See if there is not a small spark when you attach water pipe ground wire to the chassis. If there is, then an a-c potential difference exists, and this introduces the hum as modulation in the set. Try two condensers, one from one side of the a-c line to chassis, other from other side of the a-c line to chassis. About 0.1 mfd. would suffice. Inconsistent performance might be due to poor line regulation. In such communities the a-c line voltage may vary from 95 to 130 volts, a considerable difference. You might try a line-voltage regulator or ballast resistor to atone for this.

* * *

An Interfering Tone

IN THE CONSTRUCTION of a set having the 2B7 as detector, a. v. c. tube and audio amplifier, coupled to the 2A5, I find that there is a high-pitched note if there is a bypass condenser across the 2A5 biasing resistor. If I leave out the condenser the set seems to work all right. —I. F.

The omission of the condenser under such circumstances is not only good practice but necessary. However, if you desire to include the condenser, which would be of large capacity, then you could get rid of the interfering note by putting a 0.002 mfd. condenser from plate of the 2B7 to ground.

* * *

The Television Scanning Tube

IN THE TELEVISION scanning system devised by Zworykin, using the cathode ray oscillograph tube, with a somewhat similar outfit at the receiving end, please explain by what method the pick-up is made sufficient at the transmitting end, and also whether projection at the receiving end is practical.—H. E.

The method, outlined recently to the scientific convention in Chicago, has to do with an oscillograph tube at the transmitting end that directly picks up the image, focusing it by means of a movie lens on an area consisting of a multitude of photo-electric cells. How this photocell membrane is built up, or of what it consists, has been kept secret, and also other details were withheld. Just the general idea was set forth. It was stressed that the illumination was strong, an important point, due to the image being on the cell structure all the time, as in the movies, where there is one complete picture about every 1/24th of a second. At the receiving end, instead of the photocell structure, there is the oscillograph tube with the more usual fluorescent screen. The illumination is said to be sufficient, either in present attainment or within assured practical reach, to permit good-sized projection. It is assumed that a picture 2 feet square would be commercially acceptable, but if there is so much light available as is stated, then even a larger picture could be projected without too much sacrifice of illumination.

* * *

Vibrators and Generators

AS BETWEEN the B eliminator of the vibrating type, and the motor generator, for dispensation with B batteries in an auto set, which is preferable? Do both work well?—J. W. H.

Both do work well, but so far as we have been able to learn, the motor generator stands up better. There has been considerable work in service shops lately, due to the vibrator type not standing up, though, of course, there are several vibrator types that have long life, too. The vibrator type costs about half as much as the other, and in a strictly price market naturally some sacrifice in life of the product must be expected.

* * *

Tube as Voltmeter

IN RUNNING A CURVE of a vacuum tube detector, for use of the tube as a voltmeter, will you please let me know whether the tube may be calibrated for a. c. as well as for d. c.?—J. S. A.

Yes. By using batteries for bias, and adjusting the bias from zero to the cutoff point, the curve for the tube may be run for d. c. That is all it is good for on that calibration. However, the a. c. line may be used, a potentiometer of high enough resistance or great enough power capacity across it, arm to one side of rms voltmeter, other side of meter to one extreme of the potentiometer. Then the calibration will be in a-c rms. The line frequency may be taken as a pure sine wave, as it is approximately that. It is used as input to the grid circuit.

* * *

Reflex Howl

CONCERNING THE RECENT articles on new reflex forms, nothing has been said about audio howl. I remember the intense feedback in the old reflexes that made the howl a terrible nuisance.—H. E.

The howl is not present in the modern reflexes, because the circuits are better engineered, and the causes of the howling are fully understood, which was scarcely true five years ago or so, when reflexes had a vogue.

Station Sparks

By Alice Remsen

The Little House

FOR "THE GENERAL BUILDS A HOUSE"

WBAL—Thursdays, 7:00 p. m. EST.

I think I'd like a little house,
Built underneath a hill;
The roof all brown, and sloping down
A nice wide window sill.
A garden path of crooked stone;
A shady porch, a vine,
An open door, a polished floor,
Of well-grained, seasoned pine;
And in the hall a stately clock
To slowly tick the hours;
A fireplace, a cloth of lace,
A vase of home-grown flowers;
A smiling face to greet me there,
When my day's work is through;
A few books there—a soft armchair—
I'd love it!—Wouldn't you?

—A. R.

* * *

And if you listen in to the building of the General's House, I'm sure you'll feel the same way about it. You'll want to go right out and build a little house of your own. Get WBAL, Baltimore, on your radio and listen into this extremely interesting period.

* * *

The Radio Rialto

Auditions Are Coming

So many radio folk are away on vacations now that the Radio Rialto is pretty quiet. Sustaining programs are plodding their weary way through the summer. Commercial auditions are few and far between, but rumor states that this condition will be remedied within the next few weeks, and plenty of activity may be expected very shortly.

Behind the Scenes

Ethel Shutta is singing with hubby's band once more from that swanky Longue Vue Lodge at Hastings-on-the-Hudson, N. Y. You may hear Ethel, George Olson and his music via NBC wire. . . . I'm wondering if the rumor that Henry Ford will sponsor Lum and Abner is true. . . . Was very much amused to learn that Ben Bernie sleeps in a long nightgown and that Rudy Vallee snores; radio artists can have no personal secrets its seems; Jessica Dragonette reads for hours after she gets to bed and Jean Fay can't sleep unless a light is burning in her room. . . . John B. Kennedy, Associate Editor of Collier's, thinks air shows lack balance; Mr. Kennedy is right; producing a show for radio is like writing a play—there must be co-ordination in plot, character and dialogue; so many programs consist of a lot of heterogeneous matter thrown together to fill in a certain space of time, without rhyme or reason, orchestras using the same arrangements of tunes which are dinned into the ears of a long-suffering public, comedians using the same stale jokes; I remember one evening listening to three different air comics; they each used the same gag in exactly the same way; whoever wrote their material must have used the same book. . . . It is rumored that Frank Knight, erstwhile Columbia announcer, will be heard in a dramatic show on Broadway this coming season.

John McCormack in Series

John McCormack, the famous tenor, starts on a radio series October 11th; Wednesdays at 9:00 p. m. EDST, via WJZ. He will split an hour with Warden Lawes, who will conduct a feature titled after his book, "20,000 Years in Sing Sing." Two products are to be advertised, McCormack's singing will help to sell mouth wash, Warden Lawes reminiscing will do the same thing for liniment. . . . The Voice of Experience is taking a summer holiday. He'll be back on the air in September, however, in another series of daily broadcasts for the same sponsor. . . . Helen Nugent is being made much of in her home town of Cincinnati. Helen made her air debut over WLW of that city, and she is back there once more singing light opera roles. . . . Those dramatic episodes glorifying Poland Spring Spa in Maine, are going over very well; intelligent direction always shows good results; seasoned actors also help. Listen to them over WABC each Tuesday at 9:00 p. m. EDST. Don Carney plays the role of Doctor Wedgewood; his accent and delightful chuckle are alone worth the turning of a dial.

Tom Waring Draws 'Em

More than three thousand tickets were issued for the Tom Waring broadcast which took place from Carnegie Hall recently. Intricate technical arrangements insured a perfect pick-up from the big auditorium, and the large audience thoroughly enjoyed itself. . . . Guy Lombardo recently purchased a sixty-foot yacht which will serve as his summer residence off Long Beach, Long Island. This boat will be the flag-ship of the Lombardo navy, which includes two speed boats, a sloop and a rowboat. . . . . Here's a story told my by Jack Arthur. His colored cook obtained a divorce and Jack asked her if she was to get alimony from her husband. "Oh, no, suh!" retorted Mandy, "but he done give me fuhst-class reference." . . . Which reminds me that Jack always has hard luck during the summer; so far this season he's had two accidents, marooned in his speed boat and rescued from a watery grave by Guy Lombardo; and an auto accident which sent several people to the hospital and shook Jack up until he almost became a tenor instead of a baritone. . . . Wearied by the strain of his road tour, Rubinoff has cancelled six weeks' advance bookings and returned to New York for his first vacation in five years. His Sunday night broadcasts continue as usual. Since the middle of April Rubinoff has been playing one-night stands all through the Eastern States, traveling as far South as Macon, Ga. He returned to New York each Sunday for a radio rehearsal that started at seven in the morning and lasted through the day, and left immediately after the Chase & Sanborn broadcast Sunday night. No wonder he was tired!

NBC Man on the Sound

Paul Wing, the NBC story man, is spending all of his spare time away from the microphone cruising up and down Long Island Sound, working on new stories for his broadcasts. Wing is the skipper of his own small craft and his children, on whom he first tries out his adventure tales, are his crew. . . . William Clark, operatic tenor, is doing a series of weekly broadcasts over WINS, with Bernhard Levitow's Symphonic Ensemble every Wednesday at 4:30 p. m. . . . The WINS Players leading man, Bill Hardy, is vacationing in the Berkshires. . . . The Creole Song Birds are a new harmony duo heard on WINS, Wednesday, 10:30 a. m. . . . Another new act is Dwight Butcher, the hill-billy singer, Saturdays, 12:45 p. m. . . . From Baltimore comes the news that Station WBAL is presenting another house-building program called "The General Builds a House," each Thursday night, 7:00 p. m. EST. This series is commercial, sponsored by C. K. Wells, Jr., Inc., well-known builder of homes. Broughton Tall, WBAL's supervisor of literary research, is responsible for the script, which is in the nature of a mystery drama.

Here's a New Prodigy

A new prodigy has been discovered in the person of Paul Loesche, fourteen-year-old son of John Loesche, of Columbia's production department. Young Paul studies the cello with S. Spielman, cellist of Columbia's Symphony Orchestra, and also studies the trumpet with Del Staigers. Recently the youngster made a number of special arrangements for brass and choir, one of them a new version of an old drinking song dating back to 1460. This so impressed Andre Kostelanetz, Columbia conductor, that he featured it on a recent program. Now the young composer is hard at work on two new string quartets. . . . Bart King, tenor, under the management of the United Radio Artists, was one of the Paul Whiteman Audition winners. Heard him recently on a Week-End Revue over WEAF and found him possessed of a very pleasing voice. . . . Ray Perkins put on an hour of fine entertainment one evening last week. I enjoyed every minute of it. Especially did I like the "Raising Junior" episodes done by Peter Dixon and his charming wife; actually brought a lump into my throat and a tear in the old eye. . . . Running out of space and material, so must trot along to town and the editorial desk.

Studio Notes

Tom Corwine, NBC's animal imitator, at one time held a clerk job in his brother's store; that is until a woman customer asked for a chicken. When Tom heard his brother say that he was out of fowl, he stole into the back room and began cackling. The customer left in a huff and Tom followed shortly afterwards.

* * *

As Summer has just arrived officially there have been considerable sales of automobile radio receivers. The market hasn't even been scratched and there is not only time for a large sales outlet, but ample time to even take on new lines. In fact, a well-known manufacturer is about to start production on an auto set that will be sold through the trade and knows from investigations that there is sufficient time to sell many thousands before summer passes.

A THOUGHT FOR THE WEEK

WILLIE AND EUGENE HOWARD are veterans in the amusement field. Their singing and comedy have entertained audiences all over the United States. They are stars in their own right and have built up a tremendous following of loyal and admiring friends among American theatre-goers. Their appearance as Rudy Vallee's guests on the Fleischmann Hour last week proved once more that they are entertainers of established worth and of sure and attractive method. This successful appearance should insure their more frequent participation in radio programs. The Howard Boys belong on the air and ether audiences undoubtedly will welcome them as often as wise sponsors give them opportunities to prove that they thoroughly know their business.

RADIO WORLD

Title Reg. U. S. Pat. Off.

The First and Only National Radio Weekly

Twelfth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. B. Anderson, technical editor; J. Murray Barron, advertising manager.

TUBES AND STATIC

RADIO is still suffering from inadequate terminology. Styles and modes change quickly, choice of words may not. For instance, to-day the "converter" is much discussed, and it means a device for producing alternating current from direct current, for automobile sets, to dispense with B batteries. Only last year a "converter" meant a device that enabled the reception of short waves, when it was used with a broadcast receiver.

And so with "static." If we speak of it as "man-made" we refer to the interfering emanations from washing machines, vibrators, vacuum cleaners and other instruments using electrical motors. If we speak of "natural static" we mean nature's manifestations that produce similar crackles and crashes in the set. If we just say "static" it is hard to say what we mean, for it might include anything that produces about the same type of interfering sound.

Therefore a reader of a New York newspaper was prompted to write the following letter:

Old and New Radio Tubes

To the Editor of The New York Times

On the radio last night the announcer on the Louis McHenry Howe program introduced a commercial "spieler" who boldly told the transcontinental audience that old tubes should be replaced with new ones because worn-out tubes intensify static.

Now, it has been my opinion as a listener of long standing that old tubes are less sensitive; therefore they are less likely to intensify static and also the music.

Static is atmospheric electricity and therefore it seems natural that new tubes detect and amplify it to a greater extent than old tubes, the sensitivity and amplification of which are dulled by time.

Should not the broadcasters be more careful in what they claim on the air? Possibly the announcer meant to say that old tubes are likely to be noisy, but that is not what he said in answering a question, "How can static be eliminated?" RADIO.

New York, July 10, 1933.

The program referred to is sponsored by RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., who are presumed to know something about tubes, and even about static.

Irregularity of emission is present even in new tubes, and is more pronounced in old ones. Since this irregularity may result in a form of modulation sounding quite like man-made or natural static, it is quite all right to refer to static being intensified by old or new tubes. In times of economic stress perhaps the consumer is tempted to believe that old tubes result in less static, and tube manufacturers encouraged to announce that new tubes produce that desired end.

Old tubes have a lower emission, less sensitivity, and therefore, other things equal, the ratio of noise to signal may not change at all, old compared to new. But old tubes with erratic emission themselves contribute more noise, or static, and therefore the tube manufacturers must be right, as one would expect them to be. If the question, "How can static be eliminated" has to be answered directly, it should be said that it can not, at the present state of the science. If one broadens the question in the answer, by discussing the noise effects that sound similar to static, then, if new tubes are noisier, and the noise is described as static, the announcer's reply is consistent with the limitations of terminology.

The letter-writer's diagnosis was self-contradictory: more sensitive new tubes amplify static more than they do the signal, yet old tubes are less likely to intensify static *and the music.*

STUDIO GUESTS

THE National Broadcasting Company reports that nearly 10,000 guests were present at broadcasts of programs from 711 Fifth Avenue, New York City, while 14,000 witnessed broadcasts from the Times Square Studio, all during June. The Columbia Broadcasting System also has a high guest attendance, and individual stations throughout the country go in for the same hospitality. So the guest attendance business is thriving, perhaps due in part to the reasonableness of the admission, though mostly to a desire to look, see, as well as hear the performance, which puts one in the class of an "insider."

Another advantage is the effect on the performers, many of whom were recruited from the stage, and do their work with more gusto when confronted by an audience. And the listeners benefit doubly, since the applause by the guests becomes a realistic part of the program.

Fortunately, there are no hisses. If paid admissions were the rule perhaps a viewing audience would feel at liberty to hiss once in a while.

At the two places, on Fifth Avenue and in Times Square, a total of more than 6,300 artists appeared during the month. Among the artists were many celebrities, but among the guests there was an abundance of celebrities, likewise. It seems that celebrity loves company.

CONFERENCE IS ON

THE conference of North American and Central American countries now being held in Mexico City is seeking to establish a radio code for the guidance of the countries thus geographically circumscribed, so as to end present intolerable conditions. It is nice to have the conference in Mexico, since one of the most serious aspects of the problem concerns Mexican transmitters that interfere with stations in the United States and Canada.

Since the two northerly countries have a working agreement there is no trouble between them, and the hope is to formulate a plan that will be acceptable to all countries. Europe, with a much more confusing situation, was able to reach a plan, so, as the chairman of our delegation, Commissioner Sykes, says, the present purpose should not fail.

The topic of extension of the broadcast band to lower frequencies (higher wavelengths) probably will come up, but it is not expected to be adopted, due to opposition already voiced by set manufacturers and listener bodies. A more equitable distribution of channels, and a code that enacts a decent respect for the rights of listeners, ought to emerge from the conference. At least an international radio conference ought to get somewhere, though an economic and monetary conference may not.

TELEVISION, PATIENCE

EVERY time there is some advance in television technique there is a bustle of activity among those working in the television field. The recent announcement of a tube scanning system by Vladimir Zworykin has spurred others to renewed activity. But commercially practical television is not with us yet, and we must remain patent, though confident.

Amateur Phone Bands Extended by Commission

Washington.

With a general announcement of new amateur regulations to go into effect October 1st, the Federal Radio Commissoin authorized one immediate change in the existing regulations, at the request of the American Radio Relay League, national amateur body. This change, which is now in effect, provides for extending the territory in the radio spectrum authorized for the use of amateur radiotelephone stations.

This incease is made in two of the frequency bands reserved for amateur use, and provides for the operation of 'phone in the region from 1,800 to 2,000 kc, near the broadcast band, as well as from 28,000 to 28,500 kc, and from 400,000 to 401,000 kc in the ultra high frequency band. This territory has previously been available only for code transmission.

The new amateur regulations for October effectiveness provide for combination operator and station licenses, substituting for the separate documents now required, and also an entirely new setup for examinations. Examinations of applicants residing within 125 miles of Washington, the 20 district offices or 11 cities where quarterly examinations will be held are to be in person by supervisors. All others will be examined by mail and the papers graded at Washington.

Roosevelt Addresses Foresters at Camps

President Roosevelt spoke directly to nearly 300,000 members of the Civilian Conservation Corps when he broadcast a greeting to the foresters over a National Broadcasting Company network.

The President and several cabinet members were introduced to the audience by Robert Fechner, director of the Civilian Conservation Corps.

Radio sets were specially installed in the various camps throughout the country in which the foresters, recruited from the unemployed and carrying on the conservation work under military discipline, were quartered. A message had been sent to each camp advising the men of the broadcast.

The inauguration of reforestation project was one of the President's first steps to reduce unemployment and to start the nation on the road to recovery. It is known that he has followed the beginnings of the conservation work with interest, and he took the opportunity afforded by radio to send a personal greeting to the workers from the White House.

Music was played by the U. S. Army Band.

Hitler Regime Fixing Prices and Profits

The radio manufacturing industry of Germany is being organized under the Minister of Propaganda who is exercising considerable control over the manufacturing as well as over the broadcasting phase of the industry.

A report to the Electrical Equipment Division of the Commerce Department from Assistant Trade Commissioner A. Douglas Cook, Berlin, says that the manufacturers have entered into an agreement which specifies that sales may be made through a limited number of representatives for each factory, or by wholesalers. Another agreement is intended to insure a uniform basis of competition, although manufacturers are allowed to change prices at will.

The new organization, called the Wirufa, has stated that it does not expect to limit the number of radio dealers, a restriction which has been placed on retail outlets in other industries.

Among restrictions placed upon wholesalers is one prohibiting deliveries direct to users. Another provision, now being drawn up, will limit rebates and conditions of delivery. This projected proviso is said to be aimed at limiting dealers' profits.

The Minister of Propaganda has thrown the weight of his office behind the exploitation of a small receiving set, of which 100,000 are to be manufactured soon. This order will be divided up among the members of Wirufa.

Auto Sets Gaining Favor in England

Radio receiving sets for installation in automobiles are catching the public fancy in Great Britain and there are indications that they will become an important item in the radio trade.

A report received in the Electrical Equipment Division of the Commerce Department from Trade Commissioner Floyd E. Sullivan, London, says that one of the most currently popular models measures about 12 inches by 7 inches by 5 inches, is mounted in a single cellulose-sprayed steel cabinet and may be installed within easy reach of the driver. The superheterodyne circuit comprises four tubes.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

John W. Newman, 3901 Sheridan Road, Chicago, Ill.
H. R. Schwegler, 1430 Woods Place, Belvedere Gardens, Los Angeles, Calif.
R. L. Smith, 4301 Sheriff Rd., N. E., Washington, D. C.
Chas. Thacker, 2971 N. 29th St., Milwaukee, Wisc.
A. H. Laare, Laare Radio Service, 712 Howard St., Santa Rosa, Calif.
Lauroy E. Johnson, 2214 South St., 3rd Floor, Philadelphia, Pa.
Albert R. Bilger, 304 Ashwood Ave., Dayton, Ohio.
E. F. Kriegsman, 212 Pawtuxet Ave., Edgewood, R. I.
Edward Cunningham, 1607 So. 3rd St., Milwaukee, Wisc.
T. I. Burwell, U. I. Co., English Station, New Haven, Conn.

TRADIOGRAMS

By J. Murray Barron

The new Thor Communicator, a three-purpose unit, has caught on. It may be used as portable public address amplifier, as an inter-office communicator and as demonstrator for retail stores. This device should open up many avenues of trade for the serviceman and others. A good specialty salesman should find very little difficulty in obtaining good sales.

* * *

An important point to keep on mind with regard to the universal ac-dc receivers is that cheapness in price alone is not enough inducement to offer if regrets are to be avoided. Those seeking just a price proposition will find in most cases that is about all they can expect to get. It is very foolish to think only in dollars and cents when buying a radio receiver. Naturally we all like a bargain, but one should bear in mind that there is a limit to how low the price can be for high-grade merchandise, unless one buys discontinued models or surplus stock. The ac-dc battery combination receivers have many fine features that recommend them to various types of persons, in fact practically everybody can use one for some specific purpose. As it is possible to buy a really worthwhile set of the character for only a few dollars more than the so-called bargain, one that is slightly larger and is well constructed, with possibly a five-inch dynamic speaker and RCA or Cunningham tubes, and also with a volume and tone control, there is really no sense in buying the cheaper set. The better type covers the entire broadcast band and some of the police wavelengths. It is sensitive and selective and gives good tonal reproduction.

* * *

The short-wave fan will find some very interesting news to his liking this summer and fall. Great things are in store for him. With several contests in the immediate future for verified reception there should be the urge to make that "old set" step out, or if it is not of the first water, to build a real receiver and get after a record. There is much that can be done for the fan who is really interested in giving the desired information, so to those who are interested in short-wave reception some interesting information is available free. Just address the Trade Editor.

* * *

Alan Mannion, whom the readers of RADIO WORLD know for his radio ability, recently returned from a trip to New England and one fact alone that came to his attention was the great numbers of persons who improved their radio reception to a large extent simply by a proper aerial, or with attention paid to the present aerial, through changing the direction, insulating or other minor but worthwhile changes. In fine weather it is an excellent time to make these necessary alterations, and surely if one is interested in getting the most from his receiver he might as well have a good aerial.

* * *

Those interested in auto B eliminators, which could be used for a B supply on sets in connection with a 6-volt source, will find in the new announcement by Postal Radio Corp., 135 Liberty Street, New York City, a welcome message. "This unit has only been placed on the market after much experience in dealing with auto B eliminators and incorporating the best features of standard ones, together with especially developed ones from our own engineering department," says a statement by the organization.

* * *

Short-wave fans will find a new thrill in the Wallace Short-Wave Receiver, put out by the Try-Mo Radio Corporation, 85 Cortlandt Street, New York City. This is designed by the Hoover Cup Winner and is now sold in kit form to the exact specifications of Don C. Wallace.

* * *

The Fanning Radio Labs, 377 Eighty-seventh Street, Brooklyn, N. Y., announce a 4-tube ac-dc universal radio receiver that may also be used on batteries. There is also a new model 5-tube superheterodyne that likewise may be used on a.c. or d.c. or batteries. A small 3-tube ac-dc short-wave receiver, wired and complete with phones, is the latest number. There is a limited edition of a new leaflet on these numbers.

* * *

North Radio Co., 172 Washington Street, New York City, is now offering special sales on the Farrand Inductor Dynamic 12-inch speaker. This type is of excellent construction and gives fine tone. The company also is featuring the Audiola 2-tube short-wave converter in a window display in both the Washington Street store and at the Star Radio Co., 78 Cortlandt Street Store.

SUPERTONE'S AUTO SET

After having tested various circuits for auto use, Supertone Products Corp., of 35 Hooper Street, Brooklyn, N. Y., has selected a five-tube model, to be featured with its converter that dispenses with B batteries.

Largest Public Address System is at the Fair 118 Speakers Included

The largest system of radio loudspeakers ever hooked up together covers the 424 acres of A Century of Progress. One hundred and eighteen loudspeakers are distributed through the World's Fair. Six hundred miles of buried wires carry the 1,350-watt electric power. At every point in the Exposition grounds the music and the Fair announcements are heard and microphones can be hooked directly to the loudspeaker system to pick up musical entertainments.

Five different programs may be given simultaneously in different parts of the Exposition. Loudspeakers of the system that may be interfering with a musical or other event may be temporarily patched out. The three control rooms employ seven announcers and twenty-five operators, the largest staff of any single radio station in the world.

Primary purpose of the public address system of A Century of Progress is entertainment and news service in the Exposition grounds. The system can be connected directly with any outside station or network but in most cases the national services have brought in their own pick-ups to cover news.

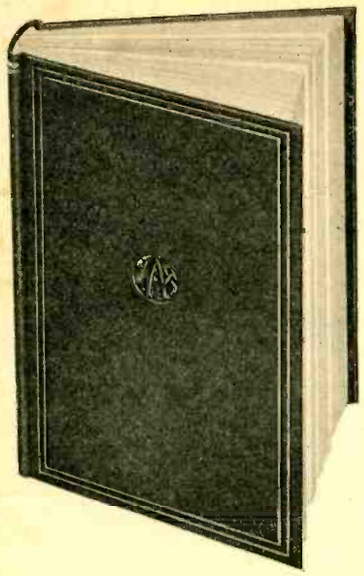
Westinghouse Increases Everyone's Pay 5%

A raise in salaries and wages has been effected by Westinghouse Electric & Manufacturing Company and subsidiaries. The company's statement follows:

"Conforming to the effort of the Government to raise the purchasing power of those dependent on industry for their income, we announce the following: an increase of five per cent. in the rate of pay of each individual employe."

The Westinghouse pay increase will add to the purchasing power of thousands of workers and will be effective in all sections of the country.

Technical Books JUST OUT!



MORECROFT'S "ELECTRON TUBES and THEIR APPLICATIONS"

(A NEW BOOK)

HERE is a new book by John H. Morecroft, consulting engineer, professor of Electrical Engineering, Columbia University, N. Y. City, a book many had been hoping he would write. It is a practical authoritative book on tubes and their manifold applications. Those acquainted with his previous books will not be disappointed for he has written the sort of book which every technician, engineer, experimenter, and student will find of incalculable value and inspiration. The whole story of tubes is here—written in clear, direct and forceful English.

The first part of the book discusses a general treatment of the subject of extracting electrons from metals and methods of utilizing them. The succeeding chapters deal with the characteristics and applications of all types of commercial tubes. Written in a simple and direct manner, this book will be of great service to the engineer who is at present working in the profession and whose achievements must depend upon his ability to improve processes and products—and from the many applications covered in the book he is almost sure to find tasks in his own field for which they will efficiently serve. 578 pages, 6 x 9 inches. Order Cat. MET @ $4. Remit with order and we pay postage. Order C.O.D. and you pay postage.

MORECROFT'S "PRINCIPLES OF RADIO COMMUNICATION"

(A NEW EDITION)

Prof. Morecroft's "Principles" is one of the standard books on radio for those who have mathematical training and are somewhat advanced in radio. First published in 1921, it is now, in its 1933 edition, fully up-to-date. New material has been added on amplification, shielding, electrolytic condensers, crystal oscillators with calibration of their harmonics and other topics. 1084 pages, 6 x 9 inches. Order Cat. MPR @ $7.50. Remit with order and we pay postage. Order C.O.D. and you pay postage.

MORECROFT'S "ELEMENTS OF RADIO COMMUNICATION"

(RECENT EDITION)

This is an adequate and comprehensive book on radio, stressing particularly the field of broadcast receiver design. The subject is developed in a natural and conventional manner and the mathematical treatment does not range beyond the field of advanced algebra. It is an excellent book for beginners.

CONTENTS

Simple Laws of Electric Circuits; Laws Particularly Useful in Radio Communication; General Idea of Radio Communications; The Vacuum Tube and Its Use; Radio Telegraphy; Radio Telephony; Receiving Sets; Problems.

269 Pages 6 x 9 Cat. MEL. $3.00

"THE INDUCTANCE AUTHORITY"

By EDWARD M. SHIEPE, B.S., M.E.E.

[A NEW BOOK]

THE ONLY BOOK OF ITS KIND IN THE WORLD, "The Inductance Authority" entirely dispenses with any and all computation for the construction of solenoid coils for tuning with variable or fixed condensers of any capacity, covering from ultra frequencies to the borderline of audio frequencies. All one has to do is to read the charts. Accuracy to 1 per cent. may be attained. It is the first time that any system dispensing with computation has achieved such very high accuracy and at the same time covered such a wide band of frequencies.

A condensed chart in the book itself gives the relationship between frequency, capacity and inductance, while a much larger chart, issued as a supplement with the book, at no extra charge, gives the same information, although covering a wider range, and the "curves" are straight lines. The condensed chart is in the book so that when one has the book with him away from home or laboratory he still has sufficient information for everyday work, while the supplement, 18 x 20 inches, is preferable for the most exacting demands of accuracy and wide frequency coverage.

From the tri-relationship chart (either one), the required inductance value is read, since frequency and capacity are known by the consultant. The size and insulation of wire, as well as the diameter of the tubing on which the coil is to be wound, are selected by the user, and by referring to turns charts for such wires the number of turns on a particular diameter for the desired inductance is ascertained.

There are thirty-eight charts, of which thirty-six cover the numbers of turns and inductive results for the various wire sizes used in commercial practice (Nos. 14 to 32), as well as the different types of covering (single silk, cotton-double silk, double cotton and enamel) and diameters of ¾, ⅞, 1, 1⅛, 1¼, 1⅜, 1½, 1¾, 2, 2¼, 2½, 2¾ and 3 inches.

Each turns chart for a given wire has a separate curve for each of the thirteen form diameters.

The two other charts are the tri-relationship one and a frequency-ratio chart, which gives the frequency ratio of tuning with any inductance when using any condenser the maximum and minimum capacities of which are known.

The book contains all the necessary information to give the final word on coil construction to service men engaged in replacement work, home experimenters, short-wave enthusiasts, amateurs, engineers, teachers, students, etc.

There are ten pages of textual discussion by Mr. Shiepe, graduate of the Massachusetts Institute of Technology and of the Polytechnic Institute of Brooklyn, in which the considerations for accuracy in attaining inductive values are set forth. These include original methods.

The curves are for close-wound inductances, but the text includes information on correction factors for use of spaced winding, as well as for inclusion of the coils in shields.

The publisher considers this the most useful and practical book so far published in the radio field, in that it dispenses with the great amount of computation otherwise necessary for obtaining inductance values, and disposes of the problem with speed that sacrifices no accuracy.

The book has a flexible fiber black cover, the page size is 9 x 12 inches and the legibility of all curves (black lines on white field) is excellent.

Order Cat. IA @ $2.00 (book and supplement). Remit with order and these will be sent postpaid to any destination. Order C.O.D. and you pay the postage.

Vol. III of RIDER'S MANUAL (A New Book)

Just out. John F. Rider's Vol. III Manual weighs nearly 11 lbs. and has 1,100 pages. all diagrams of commercial receivers. etc. (no text). Sets announced up to May 1st, 1933, are included—and complete information on every one, including resistance values. The volume is original and necessary and does not repeat data that are in Vols. I and II.

A Chronological Catalog and Index of all nationally-advertised radio receivers manufactured and sold in the United States between January, 1921 and January, 1933 are contained in Volume III. This list will be of tremendous aid in the identification of receivers for which the model number is not known.

Complete data include schematic wiring diagrams; chassis wiring diagrams; parts layouts; photographic views of chassis; socket layouts; voltage data; resistor values; condenser values; location of alignment and trimmer condensers; alignment and trimmer adjustment frequencies; intermediate-frequency amplifier peaks; alignment and intermediate-frequency adjustment instructions; color coding; transformer connections; point-to-point data; continuity test data; parts list with prices; special notes.

Complete tabulation of tube data showing electrical characteristics and constants for all of the tubes employed in radio receivers and amplifiers since 1921. Also a table of interchangeable types.

A complete table of I-F. peak frequencies as used in radio receivers. This list augments the information of this type shown upon the diagram pages. Intermediate-frequency amplifier peak information is very important because quite a few of the manufacturers employ more than one figure in their year's production. A wrong guess on your part means trouble.

Order Cat. RM-3 @ $7.50. Remit with order and we pay postage. Order C.O.D. and you pay postage.

Volume I—Order Cat. RM-1 @.....$5.00

Volume II—Order Cat. RM-2 @.....$5.00

Volume III of Rider's Manual has a page sequence in accordance with Vols. I and II, and is not cumulative, or repetitive of the earlier volumes. However, it contains an index for all three volumes.

HENNESSY RADIO PUBLICATIONS CORP.

145 WEST 45th STREET, NEW YORK CITY

JULY 29th 1933 15c Per Copy

RADIO WORLD

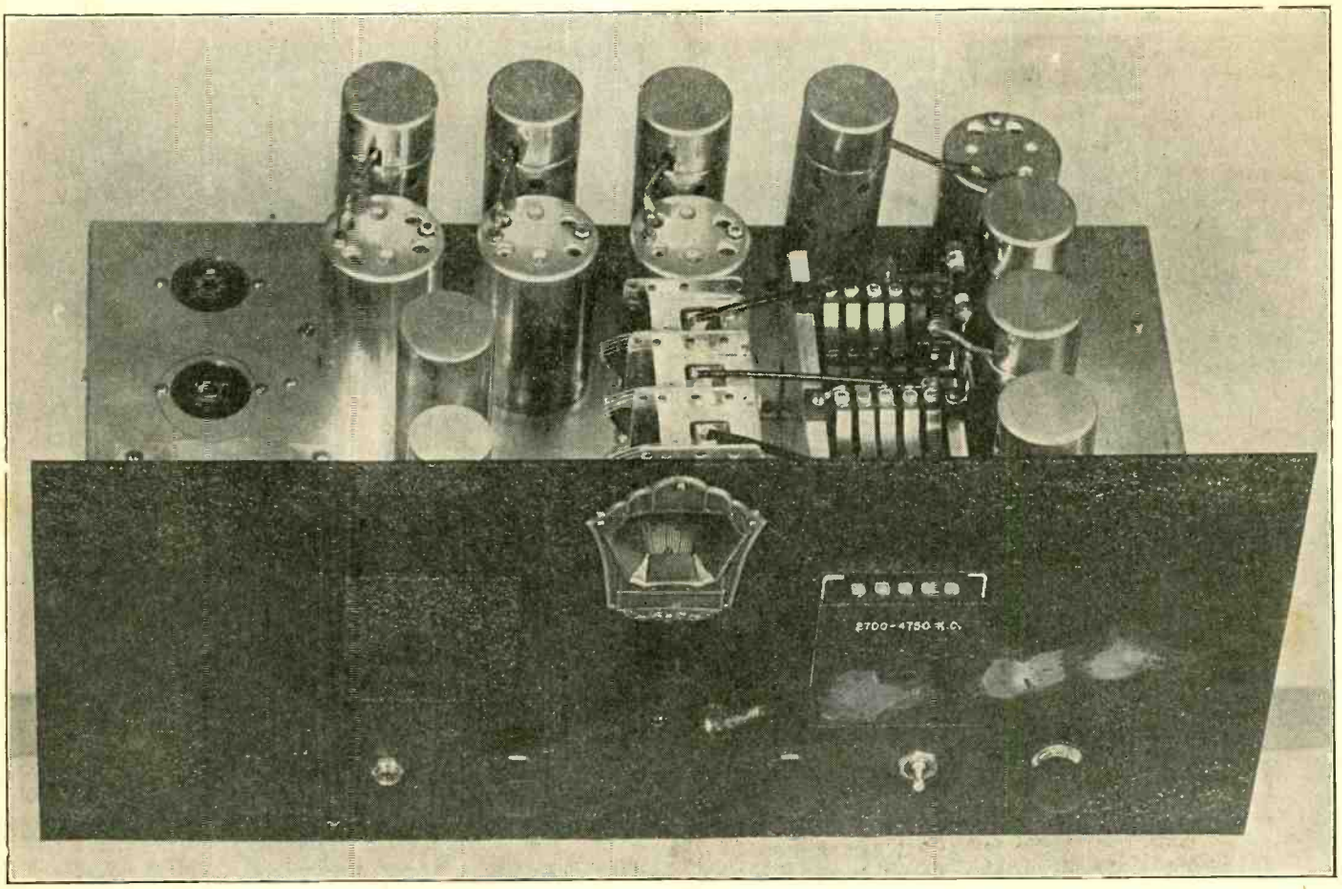
REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

Twelfth Year *592d Consecutive Issue*

NEW TUBE HAS TRIODE AND PENTODE COMPLETELY ISOLATED BUT IN ONE ENVELOPE

A SLICK SHORT-WAVE SET



View of a highly sensitive short-wave superheterodyne, using plug-in coils, with the three coils for each range in one copper shield, operated as a drawer. Band-spreading for amateurs is included. There are nine tubes. See page 3.

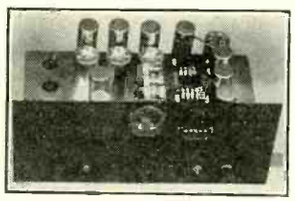
RELIABLE CONSTANTS for REGENERATIVE SHORT-WAVE SET

SINGLE MANUALLY TUNED CIRCUIT FOR SHORT WAVES

VERY SENSITIVE 6-TUBE SUPER FOR BROADCASTS

VARIOUS USES FOR THE NEW 53 TUBE

THE "MULTIFORMER"



A SHORT WAVE laboratory precision unit, now available for the first time through POSTAL, for the experimenter and "Ham" and used in the INTERNATIONAL SHORT WAVE RECEIVER, described in this issue.

In the MULTIFORMER we have three inductors, R.F. Detector and oscillator circuits which are simultaneously changed in a single operation from the front panel, and by a half-inch movement of the MULTIFORMER band spread is instantaneously provided over a 65 degrees spread on all four amateur bands.

You may now build at a nominal price, the finest short wave A.C. superheterodyne receiver, up to now obtainable only for commercial Short Wave communication.

The complete MULTIFORMER consisting of three coils individually shielded in a copper container, adjusted with proper kilocycle engraving on front panel, available in any one of the four bands with diagram of complete receiver. Price each.. **$4.95**

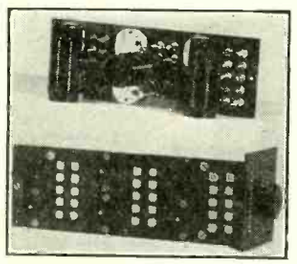
The especially designed socket to accept all range MULTIFORMERS, equipped with positive action phosphor bronze contacts. Price **$2.25**

Three gang 140 M.M.F.D. tuning condenser designed to match MULTIFORMER. Price..... **$2.25**

Complete International Short Wave Receiver

A 9-tube Professional Short Wave A.C. Superheterodyne receiver designed to cover from 15 to 200 meters with bandspread feature included and consisting of a high frequency R.F. amplifier stage, a high sensitivity first detector, electron coupled high frequency oscillator, two stages I.F. amplification tuned to 465 kilocycles, 2nd detector and audio beat oscillator for C.W. reception on a 2A5 output tube and 280 rectifier. GUARANTEED TO OUTPERFORM ANY SUPERHETERODYNE SHORT WAVE RECEIVER, now offered to the public, operating under similar conditions. We invite competitive tests.

The International Short Wave Receiver as described in this issue, in kit form, consisting of all necessary parts including power supply, front panel and MULTIFORMER for any band with simplified constructional diagram and instructions..... $41.50
The above kit, laboratory wired, tested and adjusted..... 49.50
Complete set of 9 matched Arcturus tubes..... 6.75
One Rola Dynamic Speaker, to match Receiver..... 5.50
Complete set on demonstration. Carries Postal Guarantee. Individual parts of the International set available separately. Write for prices. Tested and approved by RADIO WORLD.



POSTAL RADIO CORP.
135 Liberty Street New York City

NO MORE CALCULATING OF INDUCTAI :E!

Get your answers accurately from curves in the only book of its kind in the world, "The Inductance Authority," by Edward M. Shiepe, B.S., M.E.E. Two charts, one in the book, the other (18x20 inches) as a supplement, relate inductance, capacity and frequency, the large one from ultra to audio frequencies. Thirty-five charts, with 13 curves on each, cover the numbers of turns and inductive results for solenoids, for 35 wire sizes and insulation types. Wire sizes are Nos. 14, 16, 18, 20, 22, 24, 26, 28, 30, 31 and 32. Insulations: single silk, double silk—single cotton, double cotton and enamel. Form diameters: ¾, ⅞, 1, 1⅛, 1⅜, 1½, 1¾, 2, 2¼, 2½, 2¾ and 3 inches. Pages 9x12, printed on one side only. Price, $2.00 postpaid, including supplement.

RADIO WORLD
145 WEST 45TH ST., NEW YORK CITY

ANDERSON'S AUTO SET

Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

This new auto set is the most sensitive car receiver we have ever come across. Mexican and Canadian stations were tuned in from New York City on a 6-inch aerial. The circuit, an 8-tube superheterodwne, with automatic volume control.

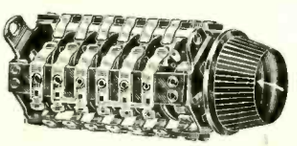
The complete parts, including set chassis and set shield, battery box remote control, battery cable, all condensers, resistors and coils, speaker with shielded cable; and a kit of RCA tubes (two 239, two 236, two 237, one 89, and one 85) are supplied less aerial. Cat. 898-K @.....$34.60

Wired model, licensed by RCA, with complete equipment, less aerial, but including RCA tubes. Cat. 898-W $37.40

Hennessy Radio Pubs. Corp.
143 West 45th St. N. Y. City

PUSH-PULL SUPER DIAMOND: Construction and trouble-shooting article and double-page picture diagram. In Radio World of March 18, 1933. 15c a copy. Radio World, 145 W. 45th St., New York City.

DUAL-RANGE SWITCHES



Wiping contact switches that improve with use and have an exceedingly low contact resistance enhance performance in the police-television-amateur bands without disturbing the line-up of the broadcast band.

The switches are sturdy, compact, smooth and dependable. The frame is insulated from the switch connections, so the switch may be used to slide condenser stator from one extreme of coil to a tap on the coil, or to short out part of the coil without changing condenser stator connection. The mounting hole is to be 5/16 inch diameter, with 8/32 hole ½ inch away, to engage a small flange that prevents slippage. Two extra holes on a fixed bracket permit additional anchorage to front and possibly rear flaps of chassis.

Type A is for governing three tuned circuits (triple pole, double throw) and besides there is a single pole single throw extra section for shorting and padding condenser or antenna series condenser. Entire switch encompassed by 2-inch diameter. Length, 5 inches; shaft, ¼ inch, 1" long. Used in 9-Tube Diamond. Cat. EBS-A at $1.49.

Type B is for governing four tuned circuits and substituting one padding condenser for another (five pole, double throw). The switch is 9 inches long. Used in the 12-Tube Diamond. Cat. EBS-B at $2.49.

We selected these switches because we deem them the best ones made, in the stated price range, and because they make excellent and definite contact and afford long service. The illustration reveals the general type of construction.

Hennessy Radio Pubs. Corp.
143 West 45th Street New York, N. Y.

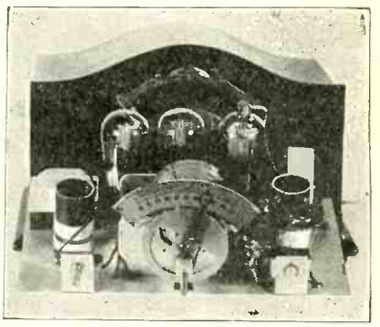
CHARACTERISTICS CHART

All the receiver tubes, and some others, under the following groups: Detectors and Amplifiers, Power Amplifiers, Rectifiers, Phototubes. Regulators. Two full pages, also page of descriptive text. In Radio World of April 1, 1933. 15c a copy, or send $1.00 for trial subscription of 8 weeks, including April 1. Radio World, 145 W. 45th St., New York City.

LOOK AT YOUR WRAPPER

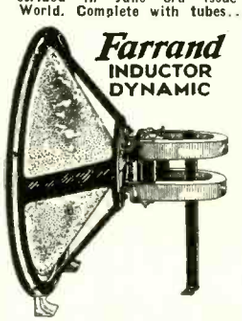
You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.

4 STAR SPECIAL



DETROLA Self-Powered Short Wave Converter

Foreign reception guaranteed. Working on all types of sets. As described in June 3rd issue Radio World. Complete with tubes..... **$8.95**



Farrand INDUCTOR DYNAMIC

SPEAKER Chassis

12-inch Double Magnet, Works on Battery and Electric Sets

Will equal the tone of any high price Dynamic Speaker. In original Sealed Cartons. Formerly listed at $35.00... **$2.95**

AUDIOLA 2-TUBE SHORT WAVE CONVERTER

Chassis. 15-200 Meters. Can be attached to any AC operated set. Brings in Foreign Stations, Police Calls, Amateur Talks, Ship-to-Ship Conversations, and many other thrills. Employs '27 and '24 tubes (less tubes) **$3.95**

BRONSWICK 5-Tube AC.DC. Midget Set with Dynamic Speaker. Using the latest tubes, 1-'77, 2-'78, 1-'43, 1-25Z5,

EXCELLENT TONE
VERY SELECTIVE

EXTRA SPECIAL

$9.95

The House of Quality Service

North Radio Co. 172 Washington St.
Star Radio Co. 78 Cortlandt St.
NEW YORK CITY

WAFER SOCKETS

6/32 mounting holes, 1-11/16 inches apart; central socket hole recommended, 1⅜ inches, although 1¼ inches may be used.

UX, with insulator.....10c
UY, with insulator.....10c
Six-pin, with insulator.....11c
Seven-pin, with insulator.....12c

HENNESSY RADIO PUBS. CORP.
145 WEST 45th STREET, N. Y. CITY

BOOKS AT A PRICE

"The Superheterodyne," by J. E. Anderson and Herman Bernard. A treatise on the theory and practice of the outstanding circuit of the day. Special problems of superheterodynes treated authoritatively. Per copy. (Cat. AB-SH), postpaid..50c

"Foothold on Radio," by Anderson and Bernard. A simple and elementary exposition of how broadcasting is conducted with some receiver circuits and an explanation of their functioning (Cat. AB-FH) postpaid.....25c

HENNESSY RADIO PUBS. CORP.
143 West 45th St. New York City

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Editor

HERMAN BERNARD
Managing Editor

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J. MURRAY BARRON
Advertising Manager

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TWELFTH YEAR

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Price, 15c per Copy; $6.00 per Year by mail. $1.00 extra per year in Foreign countries. Subscribers' change of address becomes effective two weeks after receipt of notice.

Drawer Type Plug-in Coils in THE INTERNATIONAL S-W SET

By Samuel Miller

Postal Radio Corporation

THE drawer type of plug-in coils, three coils plugged in simultaneously, with a small movement of the drawer inward for band-spreading for the amateur bands, provides an effective and handy means of accomplishing an otherwise awkward task. When one has to lift lids and plug coils in from the top, or reach behind a console to attempt to get to a socket near the front panel for plugging in only one coil (much less three coils), the task is fearful. Yet the convenience of a method that lends itself to console installations would be meaningless were not the performance on an exceptionally high level.

The front cover illustration shows the appearance of the front panel with the drawer slid out just enough for amateur band spread. If the drawer is pushed all the way home amateur band spread results.

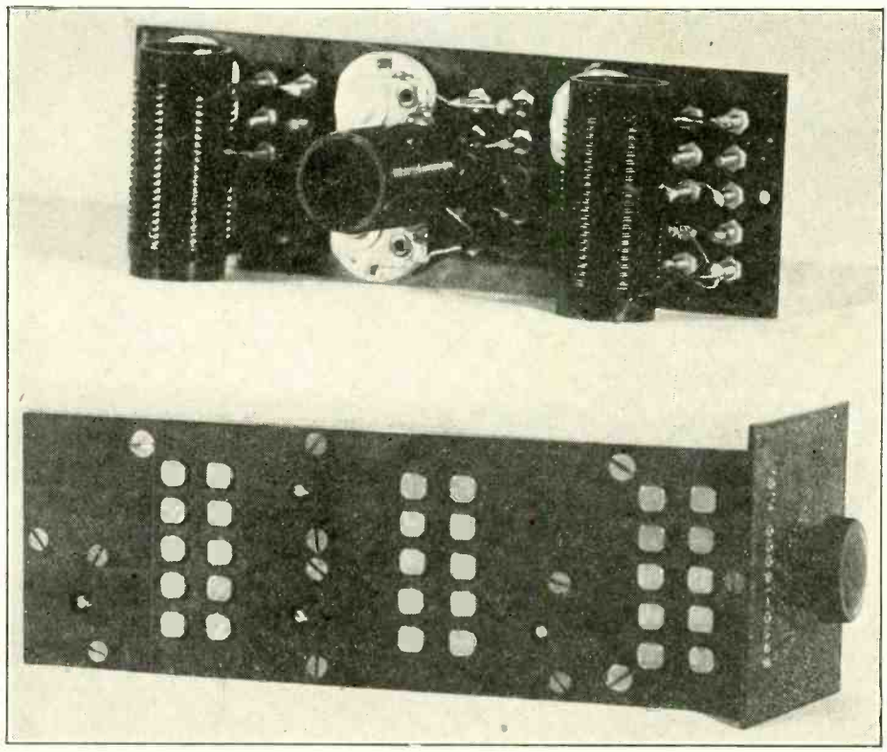
How the Coils Work

A better idea of how the drawer type coils work may be gleaned from the views of top and bottom. At top are two coils in the same axial position, the third or center coil at right angles to them. Beside the central coil are seen two of the three condensers that are set at the factory for bandspread results. The spreading is accomplished by paralleling the capacity of the tuning condenser by an experimentally-determined amount, to reduce the capacity ratio, maximum to minimum, hence reduce the frequency coverage, or spread the band. The amateur bands are spread out over approximately 65 degrees of the dial.

The bottom view of the coil drawer shows three pairs of rows, each row consisting of five tabs, or ten tabs for a pair of rows. Each grouped ten represents the terminals of a coil-condenser system for a stage, as there are three stages to consider: radio-frequency amplifier, modulator and oscillator. Actually, fewer tabs take care of the coils proper, the extra ones representing the effect of switching in the parallel condensers for bandspread.

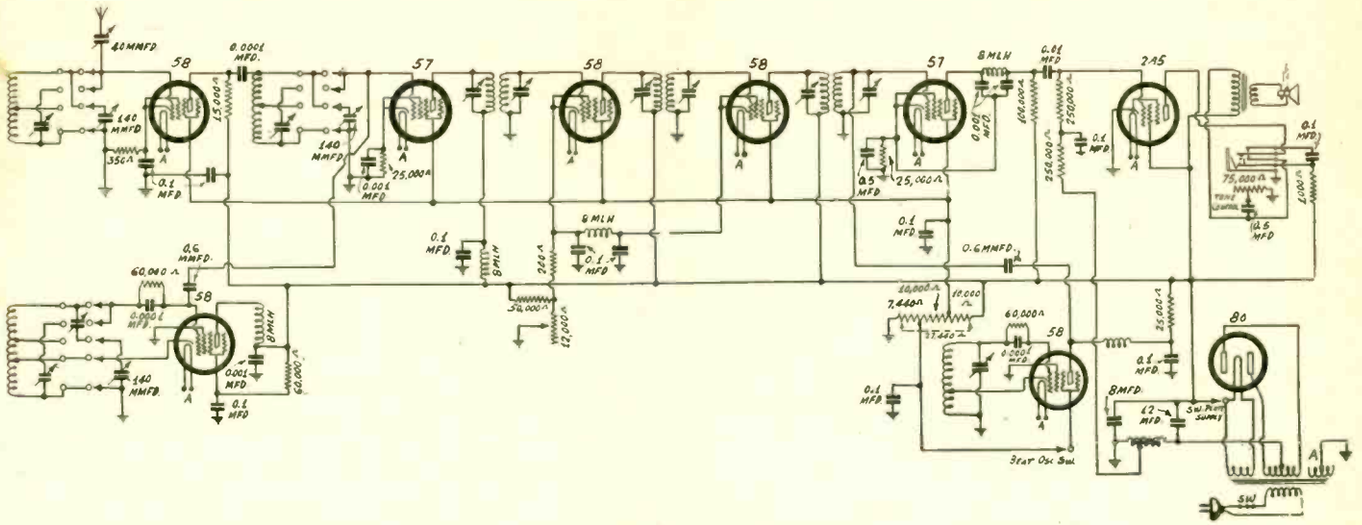
The knob at front of the drawer is for pushing and pulling, and not for turning. It can be observed that three coils represent one general band of tuning, and

(*Continued on next page*)



Top and bottom views of the drawer-type copper-shielded plug-in coils. By a half-inch movement outward contacts are made with a bandspread application. Each group of three coils takes care of three tuned circuits: radio-frequency amplifier, modulator and oscillator. There are four groups, or drawers, to cover the short-wave bands.

Images Rejected by this Short-Wave Set



Completely stabilized, this nine-tube short-wave receiver affords high gain, and at the same time simplifies the use of plug-in coils by adoption of the drawer-type of construction. The coupling between local oscillator and modulator is very loose, as is that between the beat oscillator and the second detector. Care must be exercised to have the beat oscillator couple exclusively to the second detector, and not to a preceding intermediate stage, otherwise this oscillation will be amplified, overload the second detector, and greatly reduce signal strength.

(*Continued from preceding page*)

since from 1,540 kc to 15,000 kc may be covered, there are four such coil combinations available.

Kinks Removed from Circuit

The commercial name for this drawer-coil system is the Multiformer, and it is being used now in an International nine-tube short-wave receiver designed by the author. Although special pains were taken with the coil system, and not only a workmanlike result attained but one that is sturdy and attractive, with copper shielding carefully included, the circuit itself was produced only after the kinks had been fully removed. Short-wave users in particular know what that means.

It was not deemed sufficient merely to have a receiver that was something nearly as good as sets that cost a great deal more, nor was any attempt made to meet the bargain requirements of competitors offering practically unworkable short-wave apparatus, but the goal was set at the needs and exactions of the professional user. In communication work an excellent set must be used, one that is completely dependable, and so this receiver got its first taste of popularity in the hands of the most discriminating and exacting users of short-wave apparatus.

Amateurs Like the Set

Among these, of course, were the amateurs, for they were attracted by the bandspread features, plus the high sensitivity, and full attainment of their desires. One of the factors that led them to like the set was the absence of image frequency interference, accomplished by using a stage of tuned r-f amplification ahead of the modulator. The intermediate frequency is 465 kc, and yet no matter what the intermediate frequency may be, there would be interference due to images and other causes, without this t-r-f stage, well worth including.

The ease of changing coils was another important point, as the work could be done swiftly from the front panel, and it was found that calibrations once accurately recorded could be relied on, because the whole circuit was so arranged that there was relative freedom from frequency shifting and drifting.

Beat Note Oscillator

Still another consideration was the inclusion of a beat note oscillator. This is necessary for clear reception of continuous waves.

The receiver therefore has two oscillators, of which the first is the local oscillator, used in conjunction with the frequency-changing, at the "front ends", and the other is the beat oscillator, loosely coupled to the second detector, and affording a note of a few thousand cycles.

The switch that controls the off and on positions of the beat goes to the plate supply through a voltage divider. Therefore the beat oscillator tube is going all the while, so far as heater is concerned, but the B voltage is off and when the switch is off. The moment the beat oscillator service is desired, a throw of the switch produces the note. One does not have to wait for the tube to heat up. Especially do not amateurs desire to wait, and most especially professional operators simply cannot afford to wait. The tube life is not used up when the B voltage is off, as simply a resistor (the heater) is drawing current.

Tuning Adjunct

Of course the beat oscillator may be used also as a tuning adjunct, since a beat is heard every time the front end comes across a carrier. Thus carrier location is simplified and even the relative intensity of the carrier may be approximately judged. The switch may be thown to off position so soon as the carrier is located, and the final tuning adjustments and volume level attained by the usual means.

Looking at the circuit diagram, we find that there is a variable condenser in series with the aerial. This serves several purposes. First, it limits the antenna capacity as effective on the coil to less than the capacity of the series condenser. This makes tracking simpler, but not perfect, since any aerial introduces tracking problems, due to dissimilarity between the input circuit and some succeeding one. However, by making this condenser adjustable, and manually accessible, it becomes a front-panel control for absolutely correct tracking of the modulator, at least, while the oscillator itself is made to come right up to snuff by a tiny padding system.

The first tube, or r-f amplifier, is a 58, the oscillator is a grid current type, also using a 58, while the modulator, or first detector, is a 57. It is true that a 58 may be used in this position, also, but the sensitivity will not be quite so high as if the 57 were used.

Bias for Volume Control

Bias on the two 58 intermediate amplifier tubes is altered for volume control, and to prevent the intermediate amplifier from oscillating, which it otherwise would do almost uncontrollably, the plate current of the 57 is filtered through an r-f choke and a condenser, and the signal is removed from the cathode circuits of the two i-f tubes, in one case through a pi-filter, consisting of an r-f choke and two condensers, and in the other case the second of these condensers, bypassing the biasing resistor. The first i-f tube therefore does not couple strayly either backward or forward. The filtration of the second i-f tube is in the cathode leg, and this proved very effective, probably because that leg is in the plate circuit, of course, but also is common to the grid circuit.

The second detector tube also is a 57, and this feeds directly into a 2A5, the most sensitive power tube so far. With the 58 beat oscillator and the 80 rectifier, full account is made of the nine tubes included in this dependable short-wave receiver.

High Goal Set

I stress the dependability because there is a flurry in the short-wave set and kit market right now, and so much junk is being put forward that customers must be assumed to have abundant confidence

(*Continued on next page*)

LIST OF PARTS

One—Postal Multiformer (band desired to cover)
One—Special Postal socket, for Multiformer
One—3 gang 140 mmfd Postal condenser
One—40 mmfd. Ant. comp. condenser
Three—465 K.C. I.F. transformers
One—Audio beat oscillator coil 456 K.C.
One—Power transformer, to handle 9 tubes
One—12 mfd. condenser 450 volt working v.
One—8 mfd. condenser 450 v. working v.
One—12,000 ohm. volume control and switch
One—75,000 ohm tone control.
One—Single circuit jack, with single pole double throw switch.
One—Toggle switch for "B" supply
One—Rotor switch for audio beat oscillator.
One—dial and front plate
Five—58 sockets
Two—57 sockets
One—2A5 socket
One—280 socket
One—Speaker 5 prong socket
Five—8 millihenry R.F. chokes
One—Ant. Gnd. binding post.
Eight—.1 mfd. tubular condensers
One—.05 mfd. tubular condenser
One—.01 mfd. tubular condenser
Four—.001 mica fixed condensers
Three—.0001 mica fixed condensers
One—.0000006 mmfd. condenser
One—25 watt wire wound resistor 27,440 ohm, tapped 10,000 ohm. 10,000 ohm. and 7,440 ohm.
One—10 watt wire wound resistor 1,000 ohm
Two—60,000 ohm. 1/3 watt pigtail resistors
One—15,000 ohm. 1 watt pigtail resistor
One—60,000 ohm. 1 watt pigtail resistor
Three—25,000 ohm. 1 watt pigtail resistors
Two—250,000 ohm. 1 watt pigtail resistors
One—350 ohm. 1 watt pigtail resistor
One—200 ohm. 1 watt pigtail resistor
One 1,000,000 ohm. 1 watt pigtail resistor.
One—Cord and plug.
One—Chassis 11" x 19" x 3"
One—Steel front Panel 9¼" x 20½"
Six—Knobs

FORUM

Editor, RADIO WORLD:

I HAVE ALWAYS thought you have not stressed quality amplifiers sufficiently and believe this will be a very interesting field for you to edit. Most any kind of a tuner will pick up a large number of stations nowadays, but the main point is, how do they sound after you get them? Perfection has been by no means obtained yet through the speaker grille and probably never will be, but there certainly is great room for improvement.

For some years I have used a pair of 250's in push-pull and an auditorium speaker. The theorist would say that this is wholly sufficient for a hall seating 5,000 persons and I presume that each one of those 5,000 could understand speech from this kind of out put, nevertheless it is none too much whatever for the good reproduction of band music and some of the lower instruments, such as a bass drum and bass fiddle right in the living room.

No amplifier should be run to capacity if distortion is to be avoided and I find that there is no excess power in the 250's for good reproduction of orchestra and band music for good living room volume.

I would like to see some articles in your magazine on amplifiers and speakers and the acoustics relative to them with the end in view of obtaining more nearly perfect reproduction.

High-mu power tubes do not rate highly with me, as my experience has been that the higher the mu of the power tube, the greater the percentage of distortion which it delivers. The 47 was the first high-mu power tube and I gave it quite exhaustive tests when it first came out, under the best conditions, and have never yet been able to obtain the tone from it that I could from the 45. This fact has since been admitted by a number of our manufacturers.

The only good purpose of any high-mu power tube is to eliminate the expense of building another stage of audio or in case of an automobile receiver it does permit of a greater output with less current drain and where the power supply is limited its use might be justified. However for the parlor console where real tone is desired, and where adequate power supply and space are readily available, let's have the best there is regardless of how many tubes it takes or what kind they may be or how many filters and other devices may be necessary to obtain the desired end.

M. A. CHALKER
1316 Mahoning Bank Building,
Youngstown, O.

Blan Welcomed Back After an Operation

Michael Blan (Blan the Radio Man) of New York City has returned to his store after several weeks in a hospital, where he underwent an operation. Many of his large following were quite anxious about Blan, as he has built up a host of radio friends during the past ten years or so, and his return was greatly welcomed.

MILLER'S NINE-TUBE SET

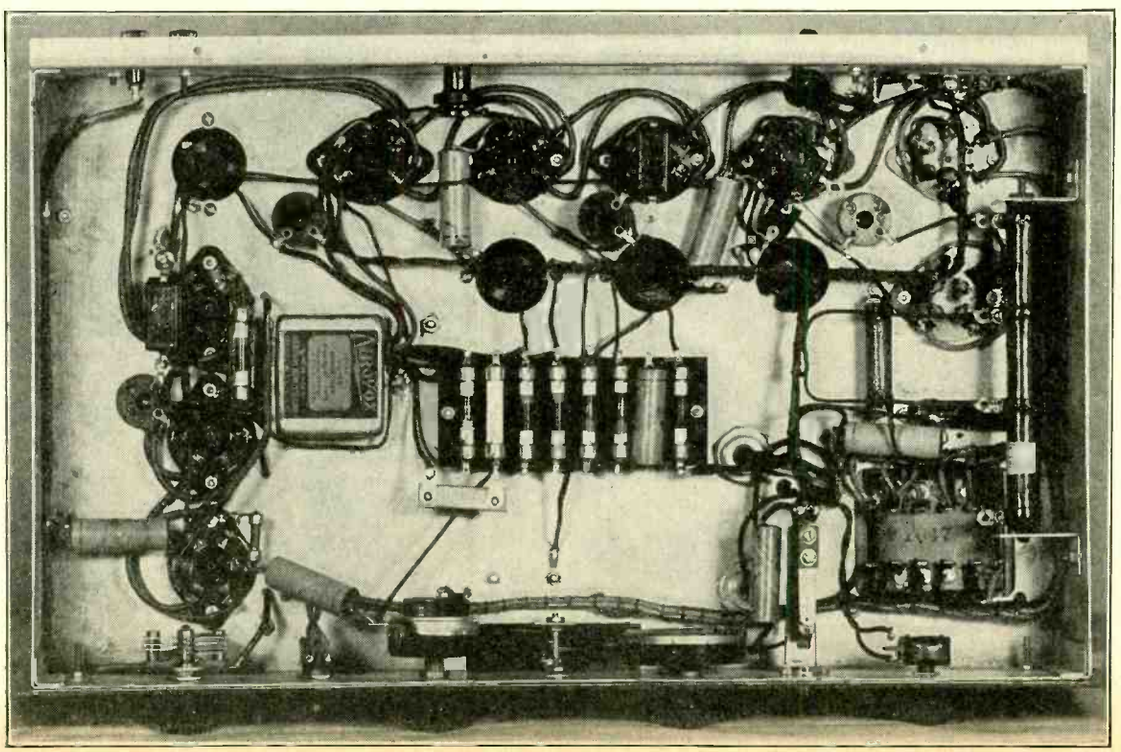
(*Continued from preceding page*)

that unlikely circuits will work wonders simply because they do not cost anything.

However, it is assumed that short-wave set users want dependable reception of foreign stations, that some of them are amateurs and want their bands when and how they want them, and that still others are professional users who must have the highest type of performance.

When the entire situation is canvassed it is found that the set that fulfills the requirements of the professional also meets the demands of the amateur and the fan who seeks European, Asiatic and other such reception and will even get up at 4 in the morning to try for it, or stay up until 4, whichever way you prefer your punishment.

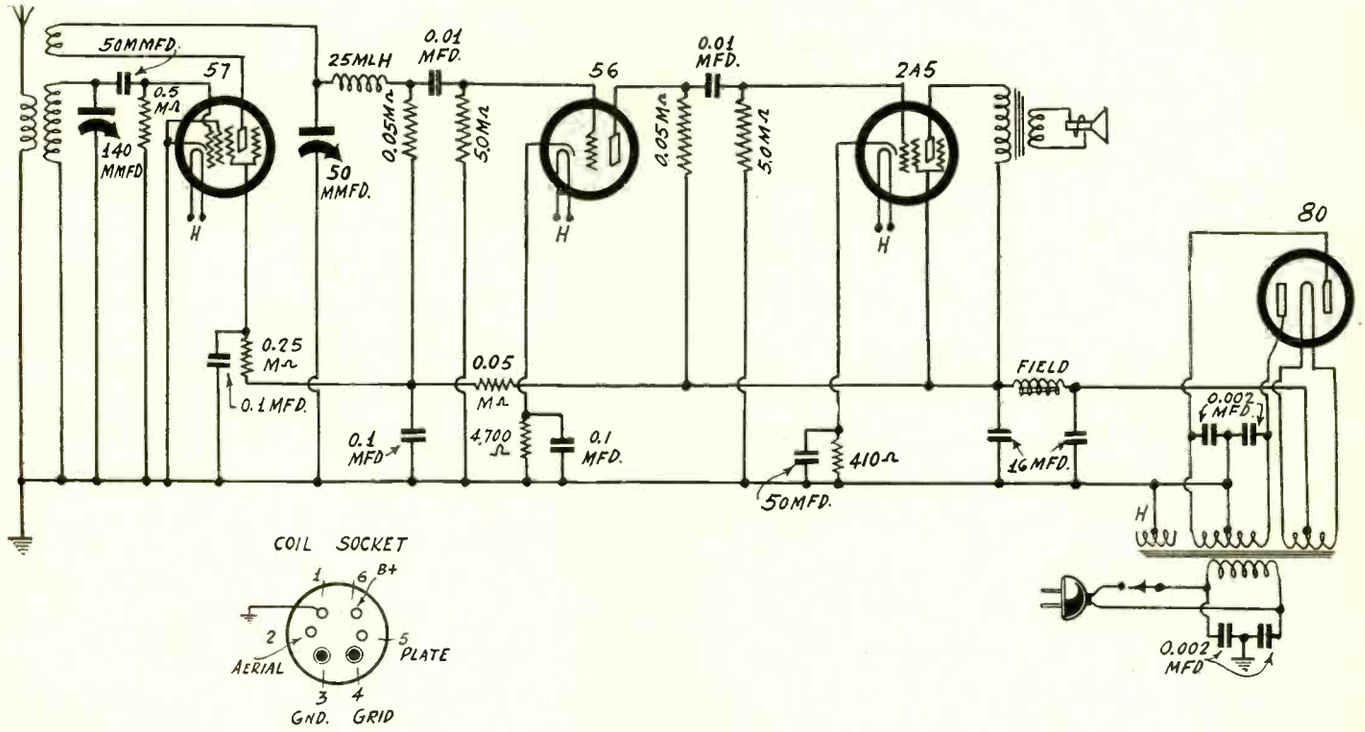
And it can be said truthfully that the present receiver, though it doesn't cost much at that, ranks with the best, and in some respects is superior to sets costing more than four times as much. Now, think of that!



Bottom view of the chassis, showing the neat construction and excellent distribution of parts. Although quite a number of parts is necessarily used, the layout avoids cramping and otherwise objectionable arrangement that would result in back-coupling.

THE TRADITIONAL SHORT-WAVE ONE-TUBE TUNER WITH VERIFIED CONSTANTS and Two Stages of Audio, for Speaker Operation

By Herman Bernard



A four-tube short-wave set, using a single plug-in coil for each band, and covering four bands, from about 1,500 kc to about 30,000 kc. The constants have been determined experimentally to enable ready construction of this approved and long-distance standing circuit. The bottom view of the coil socket or form is shown, with circuit connections designated.

AS a part of the experimental work in developing the short-wave reception system that reduces the carrier at once to an audio frequency, then modulates an oscillation at a lower frequency and amplifies that oscillation and detects it, a standard short-wave set was built as diagrammed. The data are given so that any who desire to build a very simple but still a good short-wave set, using four tubes, to operate a speaker, may do so.

Everything is orthodox, and the only choice of constants for use of the particular tubes in the receiver comprises any additional information to those familiar with short-wave set construction.

It should not be surprising to any that exactly the same hookup, with somewhat different, and, one might say, erroneous constants, produced miserable results. By the cut and try method the stated values were arrived at, and the results were satisfactory, especially as there was reception even on the coil with the smallest inductance. This is the coil that "plays dead" in so many short-wave sets, whether using plug-in coils or switching. The present circuit relates to the plug-in variety.

Audio Howl Eliminated

That nasty audio howl present in short-wave sets unless a corrective is introduced was eliminated entirely by proper proportioning of maximum oscillation. Besides, it was pretty definitely settled that the howl is due to saturation of the tube. Therefore the number of tickler turns was reduced. In the case of the commercial type coils used the number of turns was cut in half. This type has three windings. The obvious one is the secondary. The winding that is put on between the spaced turns of the secondary is the tickler. The winding removed 3/16-inch from the two others, and not interwound, is the primary. It was the interwound, light-colored wire whose number of turns was halved. The same hole in the coil form was used to bring the wire altered terminal of this winding through the inside of the coil form to the base pin for soldering.

To make the removal handy it is advisable to get a sharp pocket knife, and cut the wire where it enters the upper hole. That leaves a large amount of wire for threading, and makes the work a simple task of five minutes, because of the handy leeway with the extra length of wire. Then half the number of tickler turns is unwound for each of three plug-in coils, one coil completed at a time.

Smallest Coil Unmolested

The entire work consists merely of unsoldering the existing wire connection at the base pin, after the cutting has been done as explained, unwinding half, and passing the whole excess length through the old hole in the coil form, inside the form to the pin, scraping off the insulation from the wire, resoldering, and snipping off the excess wire that now protudes from the pin.

The smallest inductance coil is not molested.

Even when the connection is made on the three coils the feedback capacity does not have to be large. The commercial rating of the Hammarlund star condenser used is 50 mmfd. This condenser had seven plates. It is a small one and is mounted on the chassis. Since the chassis is assumed to be metal, and grounded, only the stator side of the condenser need be additionally connected, and goes to return of the feedback coil. Any who desire to eliminate the danger of shorting the B voltage if the opposite plates of the feedback condenser touch may put a large mica fixed condenser between the stator lug of the feedback condenser and the return of the feedback coil or tickler. (0.006 mfd. up.)

The R-F Choke Coil

It was found that on all coils there was "action," and that the proportion of inductance and capacity was thus right. To insure best operation the coil marked 25 mlh., which is a radio-frequency choke, had better be a honeycomb, as then the distributed capacity is low. However, any honeycomb of small physical size, comprising 800 turns or more, may be used. The one put into the set had 1,300 turns, tapped at 500 turns, but the tap was not used, only the extremes, and it made no difference which extreme went to return of the tickler and which to the plate resistor.

The choice of the plate resistor is important, and so in fact is that of the screen resistor. It is necessary to have the plate resistor low enough to insure oscillation, unless the effective B voltage is to be extraordinarily high for such a detector. Then, again, the high B voltage introduces that squawk. As built finally, the set did not spill over with any howl whatsoever, and the passing of the point just below oscilla-

LIST OF PARTS

Coils

One set of four six-pin plug-in coils as described.
One power transformer.
One 25-millihenry radio-frequency choke (honeycomb).

Condensers

One 0.00014 mfd. Hammarlund midline junior condenser (brass plates).
One 0.0005 mfd, grid condenser.
One 50 mmfd. Hammarlund star condenser (aluminum plates).
Three 0.1 mfd. bypass condensers.
Two 0.01 mfd. stopping condensers (mica).
Four 0.002 mfd. fixed condensers (mica).
Four 8 mfd. electrolytic condensers, inverted mounting type.
One 50 mfd. electrolytic condenser, 30 volt rating.

Resistors

Four 0.05-meg. (50,000-ohm) pigtail resistors.
Two 5.0-meg. (5,000,000-ohm) pigtail resistor.
One 0.25-meg. (250,000-ohm) pigtail resistor.
One 4,700-ohm pigtail resistor.
One 410-ohm, 2-watt, wire-wound pigtail resistor.

Other Requirements

One chassis.
One vernier dial.
One a-c shaft-type switch.
Three six-hole sockets, one five-hole socket (UY) and one four-hole socket (UX). The extra six-hole socket is for coil receptacle.
Two tube shields with bases (for 57 and 56).
Antenna-ground binding post assembly.
One dynamic speaker, with d-c field coil, any ohmage, 1,800 to 3,000 ohm.
One a-c cable and plug.
One 57, one 56, one 2A5 and one 80 tubes.

tion was marked by a gentle plop that was very agreeable to experience. It only goes to show that fringe howl can be cured with proper constants, and these constants relate to the necessity of proper operation in the circuit at hand, and require ignoring more formal recommendations for other or different use of the 57 tube.

Regeneration Is Vital

For instance 0.25 meg, is the usual recommendation for the plate load resistor, yet this value is not satisfactory in the present circuit. Where negative fixed bias detection is used, and no regeneration, the 0.25 meg. value produces better results, but here everything, or almost everything, depends on proper regeneration, so 0.05 meg. (50,000 ohms), which supplied this need, was selected.

Another precaution to take is that the effective screen voltage be lower than the effective plate voltage. Since the screen limiting resistor is returned to the same point as is the plate load resistor, and since the currents are proportioned about 3 to 1 while the resistors are proportioned 1 to 5, the screen voltage always will be lower than the plate voltage. This also makes for better quality of detection, besides avoiding the possibility of a chance dynatron oscillator.

Tunable Hum Absent

Suppose the plate current is 1 ma and the voltage fed is 100 volts. Then 50 volts will be dropped through the plate load resistor, an effective plate voltage of 50 volts remaining. Suppose the screen current is 0.33 ma. Then the voltage drop in the 0.25 meg. (250,000-ohm) limiting resistor is 82.5 volts, and the effective screen voltage is 17.5 volts. So the effective plate voltage is about three times as great as the effective screen voltage.

While the circuit will work well without the additional 0.05 meg. resistor that limits the voltage common to the plate load and the screen voltage-reducer to 100 volts, smoother action obtains when it is included. Besides, hum is less, in fact, so low as to be unobjectionable, and there is no tunable hum, either. This is due partly to the filter action of the resistor and the 0.1 mfd. condenser that bypasses the low-voltage side of the 0.05-meg. resistor to ground. The same cause is aided by the 0.002 mfd. condensers in the power transformer primary and power transformer high-voltage secondary circuits.

The 57 detector tube feeds a 56 and this drives a 2A5, so there is enough amplification for loudspeaker signals for most stations received. However, this is only a four-tube set, and while it is sensitive and selective, it does not produce sufficient volume to "fill a room" on foreign reception, though by moving up to only a few feet from the speaker the signals may be heard. At least, that was the writer's experience in a location not particularly good for short-wave reception. Others no doubt will fare better. Besides, there is nothing like telling the truth, even about a short-wave set.

The negative bias on the 56 is maintained high enough to prevent the flow of grid current, but this is not always possible in the succeeding stage, so while the grid leak in the last audio stage is shown also as 5.0 meg., a meter should be put in the plate circuit of this tube as a test, to be sure the plate current does not much exceed 40 milliamperes on strong signals. If it does not, the 5.0 meg, may be left in this stage, as it would be left anyway in the preceding stage. To reduce grid current, or its effect, reduce the leak value, although volume then declines a bit also.

Motorboating

The only disturbing trouble that may be experienced is an audio howl, ever-present, and this would be due to excess of a-f regeneration. Since there will be some such regeneration, the bypass condenser across the biasing resistor of the 56 is shown as only 0.1 mfd., but if the howl is present, either this condenser may be omitted entirely, or a condenser of 0.002 mfd, put from 56 plate to ground.

The 50 mfd, acts the same way, that is, toward increase of audio regeneration, but volume is much higher when this condenser is present, so the other remedies are advised, rather than omission of, or reduction of capacity of, the 50 mfd. condenser. This condenser is of the electrolytic type, by the way, and smaller in physical size than the 8 mfd.

The filtration of the B supply is accomplished with the field of any dynamic speaker. The d-c resistance of the field is of scant importance, so speakers of 1,800 to 3,000 ohms total may be used, and any tap on the field coil ignored. The 16 mfd. condensers really are two 8 mfd., thus accounting for a total of four 8 mfd. These may come two 8 mfd. in one container, or four separate containers.

"Boiling" of Electrolytics

If there is any "boiling" when the set is turned on it is due to the starting B voltage exceeding the voltage at which the electrolytics had been formed, at least the condensers next to the rectifier. To get around this, either a bleeder resistor is introduced, from the fully-filtered B plus lead (say, between 2A5 screen and ground), of around 15,000 ohms, 25 watts, or a series resistor put between the rectifier filament and the field coil, of around 10,000 to 15,000 ohms, 5 watts. Since the 2A5 tube does not draw much plate current at the start, there being little cathode emission at first, this boiling condition might exist when that tube is used, although not present when the filament type tube is used, e.g., 47.

Of course another remedy is to use condensers, next to the rectifier particularly, that have adequate breakdown voltage, say, 500 volts.

The tubes may not well be substituted, except that a 47 may be used instead of the 2A5 with a bit more resultant hum, and the rectifier may be a 5Z3 or an 83. If the rectifier filament winding of the power transformer is not center-tapped, use either leg for take-off of the B supply. If the 2.5-volt winding is not center-tapped, use a center-tapped resistor across it, 10 to 30 ohms, center to B minus (ground).

If the transformer has two 2.5-volt windings, use the one that stands the greater current for the 57 and 56 tubes, and the other for the 2A5, although there is small difference. The sum heater current of the 57 and 56 is 2 amperes and the single current of the 2A5 is 1.75 amperes.

There is a slight advantage in the separate 2.5-volt windings, as the 16.5-volt bias on the power tube is not then introduced as a voltage difference between cathode and heater of the 57 and the 56. The difference is not enough to warrant purchase of a new transformer if you already have one with single 2.5-volt winding.

Frequency Ranges

The receiver is not lacking in selectivity, even when a long aerial is used. For short-wave reception, excluding special antenna treatment, it is advisable in the interest of clear, loud signals to have a high, long aerial and a good ground. Even so, it is easy to pass over even semi-distant American stations. In the 49-meter band, for instance, short-wave program transmitters of or associated with, the Columbia Broadcasting System and the National Broadcasting Company, were easily skipped over, so careful tuning is required, and a dial with high vernier ratio is advisable, not less than 5 to 1 and preferably around 30 to 1, which is especially obtainable.

The tuning ratio with the Hammarlund 0.00014 mfd. condenser across the secondaries is about 2.3-to-1. So the frequency ranges would be approximately as follows:

Coil No. 1 1,500 to 3,450 kc.
Coil No. 2 3,450 to 7,935 kc.
Coil No. 3 7,935 to 23,800 kc.
Coil No 4 23,800 to 42,975 kc.

Make a Calibration

These are computed values, and not actual, but do give a good indication. The coils overlap a bit, and this has not been allowed for in the computation, so the highest frequency will become around 30,000 kc, or 10 meters. With the guidance given, and in conjunction with actual reception of stations of known frequency, the dial can be calibrated it will be found that, due to the fixed but loose antenna coupling, and the loose tickler coupling, the calibration will hold well for repeated reception. That is, the feedback condenser detunes the secondary only the least bit.

The coil data are as follows for 1 1/4-inch diameter:

Coil No. 1: Secondary, 50¾ turns of No. 30 single silk covered wire, space-wound; spacing equal to the diameter of the wire and insulation. Tickler, 11 turns of any fine insulated wire, wound in the space permitted in the secondary. Primary, separated 3/16 inch from secondary, 13 1/4 turns of No. 30 silk enamel wire.

Coil No. 2: Secondary, 22 1/4 turns of No. 22 single silk covered, space-wound; spacing equal to twice the diameter of the wire and insulation. Tickler, 6 3/4 turns of any fine insulated wire, wound in the space permitted in the secondary. Primary, separated 3/16-inch from the secondary, wound below it, near base pins, 8 1/8 turns of No. 30 silk enamel.

Coil No. 3: Secondary, 10 7/8 turns of No. 22 single silk wire, space-wound; spacing equal to three times the diameter of the wire and insulation. Tickler, 3 7/8 turns of any insulated wire, wound in space permitted in secondary. Primary separated 3/16-inch from secondary, 6 1-8 turns of No. 30 single silk wire.

Coil No 4: Secondary, 4 7/8 turns of No. 22 single silk wire, space-wound; spacing equal to 3/16-inch between turns. Tickler, 2 1/2 turns of any suitable insulated wire,

(Continued on next page)

CONSTANTS FOR NEW 6

SMOOTH REGENERATION CONTROL ATTAINED

By Herma

A ONE-TUBE regenerative short-wave tuner was built as detailed on the preceding two pages, and the constants in that part of the circuit were as shown, but when an intermediate amplifier was added, some of the constants had to be changed, to achieve smoothness and convenience in tuning, particularly regeneration control.

The circuit, as diagramed herewith, embodies the new idea of reducing the carrier at once to an audio frequency, setting up a local oscillator and modulating that oscillation with the audio, and feeding the oscillation through an intermediate amplifier tuned to the same frequency as the oscillator. Thus no repeat points are possible, no padding required, no tracking and no elaborate tuner system. The theory of such a circuit was published in last week's issue (July 22d).

Relationship of Constants

To get the tuner into smooth working condition it is necessary to have the proper relationship among inductances, voltages, capacities, resistances and aerial-ground. The first result was that regeneration was too ploppy. This was cured in part by reduction of the B voltage, until there were only 70 volts applied through the 50,000-ohm plate load resistor. The screen limiting resistor was 250,000 ohms, and in series with the high B voltage to the common 70-volt point was another 250,000-ohm resistor.

By making the connection to the maximum B feed in this way the voltage in the detector or first tuned circuit is maintained constant enough, no matter what normal differences in drain result in the rest of the circuit due to departure from specified constants, or to use of some differently-voltaged power transformer.

Smoothness of Control

Aside from the B voltage as a control for adjustment to proper regenerative action, the grid leak may be changed, lower values making for reduced regeneration, higher values for stronger regeneration. It must not be assumed that the stronger regeneration and consequent increased sensitivity are desired, for the main considerations are ease of operation and smoothness of control. These produce better results in the long run, because otherwise so many stations are missed for failure to put the feedback at the proper value, an attainment a ploppy circuit scarcely renders practical on weak signals.

The feedback capacity is 50 mmfd. at maximum, consisting of a Hammarlund Star condenser of seven plates. This is a small unit and is controlled from the front panel.

The other consideration is the tickler, but this topic was taken up in the article on the preceding two pages. The coils used are described in that article.

The coil problem consists largely in getting one coil to work properly, and then altering the number of tickler turns, or coupling between tickler and secondary, so that for each of the other plug-in coils the results are just as smooth. The coil data referred to bring about such a situation.

Four-Tube Set Tried First

It can be seen that the circuit is quite simple, as it consists of a regenerative detector, a local oscillator, an intermediate amplifier, a second detector, an audio amplifier and a rectifier.

Assuming that the rectifier, output tube and first detector circuit are constructed, intermediate and local oscillator not, the top of the grid leak at the 2A7 input may be carried over instead to the grid of the 2B7, for operation as a four-tube set. It is helpful then to have a little bias on the 2B7, so temporarily the 2B7 cathode may be connected to biasing resistor of the 2A7, especially as the 2A7 tube would be out of socket.

After the circuit is working well that way, and a note made mentally of the performance, the intermediate amplifier and oscillator may be hooked up. The oscillator coil may be a regular intermediate, which, if it has a doubly-tuned system, should have the condenser disconnected from the plate coil. While the circuit will oscillate without this removal, with only the grid circuit tuned it is easier to establish definite resonance.

Modulation Switch

A switch is shown, whereby the grid return may be moved from ground to H, where H represents either side of the heater of the 2A7. This switch may be on top of the chassis, as there is no need having it at the front panel. When thrown to H the switch causes the 60-cycle hum to be introduced into the oscillation, and thus a modulation is provided for audibility. The two intermediate transformers may be peaked on the basis of this built-in test oscillator. When the peaking is finished the switch is thrown to the grounded side and left thus.

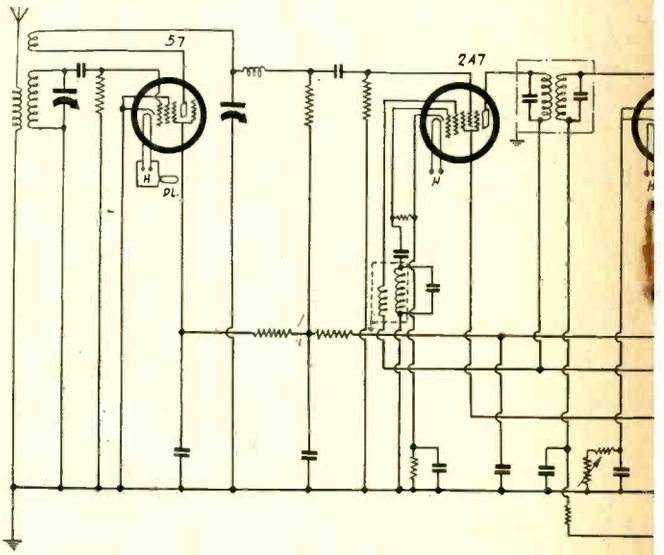
Now the circuit may be tried out as a whole, and if ploppiness is present, whereas it was absent before from the regeneration control, the leak value may be reduced a little, which may be done by putting 5 meg. or so in parallel with it, or the screen limiting resistor may be increased a little, or a larger aerial used. If there is no regeneration, the aerial is too long.

The coils have been wound for a certain value of feedback, so once the regeneration is correctly set for one coil it will be so for the other coils. However, the values specified worked out well, and the remedies are reiterated only on the assumption that some additional feedback will show up.

Instability Problems Elsewhere

The problems concerning the set have to do principally with instability in the intermediate and audio amplifiers.

It was found advisable to shield the 25-millihenry r-f choke coil that enables the 50 mmfd. condenser to act as a regeneration control, and also shield the similar



Constants are given for a short-wave set embodying oscillator results when the switch in the 2A7 osci

Small-Tickler Plug-in for

(*Continued from preceding page*)

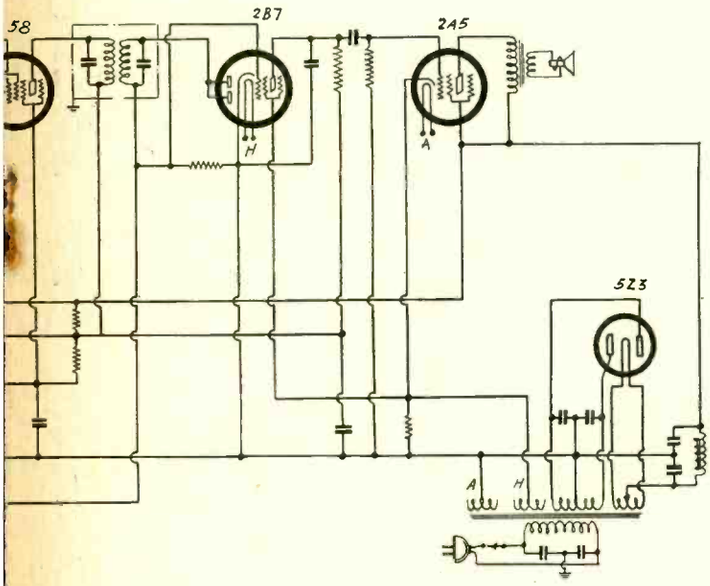
wound in space permitted by secondary. Primary, 4 1/8 turns of No. 22 single silk wire.

Note: Coil No. 4 in commercial coils need not have tickler reduced. The ticklers throughout are wound in the space permitted by the secondaries, and the form is to be drilled for passing the wire inside the form right at the wire terminals, if you drill your own forms and wind your own coils. In no instance, therefore, does the tickler occupy as much winding space as the secondary. The separation between primary and secondary is 3/16-inch throughout. The commercial coils have the following termination, considering the bottom view of the coil pins, heaters toward you, the numerical designations equalling those of the standard pin code (RMA): top of secondary

-TUBE SHORT-WAVE SET

IN A SIMPLE DESIGN—TROUBLE-SHOOTING DATA

n Bernard



g a new use of the superheterodyne principle. A test llator grid return is connected to either side of heater.

choke coil that is included in the lead to the control grid (cap) of the 2A7, which is intended to keep the tuner's radio frequencies out of the audio circuit of the mixer. It can be seen that audio frequencies alone are put into the control grid, or that such is the intention, and experience has taught that a little radio frequency will get by unless the extra choke is included in the 2A7 lead.

The first intermediate transformer should be well removed from the oscillation transformer, say, 6 inches, as all means should be sought to prevent stray coupling

Electron coupling between the oscillation transformer and the first intermediate transformer, through the space stream of the 2A7, is indeed strong enough, and any augmentation would be dangerous.

The rectifier tube is shown as a 5Z3 only because the starting drain, due to the large filter capacity next to the left rectifier, may be high, but a 280 tube may be used, if you have it already, though its life may be shortened a little.

No statement has been made as to what the intermediate frequency is, because it may be almost anything, without affecting the operation, therefore handy frequencies are suggested, such as 175 kc 450 kc, 465 kc., etc., for which transformers are readily obtainable. In general, the intermediate frequency should be lower than the lowest broadcast frequency, but not too low (not 100 kc, for instance), because of possible trouble from harmonics of the local oscillator. For that reason, too, the local oscillator should be removed from the detector about as far as the first intermediate coil is from the oscillator.

However, if you can run into instability trouble, a resistor in the plate lead of the 2A7, about 2,000 ohms, and another in the plate lead of the 58, about 10,000 ohms, both bypassed by 0.1 mfd. or higher capacity, will help cure this.

The 2A7 Output is R.F.

The output of the 2A7 is exclusively radio frequency, but it is modulated by the audio put in from the 57. The coil in the 2A7 plate circuit is a short circuit to audio frequencies, but of course since modulation has been accomplished, the 2A7 output is a radio frequency carrier with an audio frequency envelope, that is, the carrier subjected to variation at an audio frequency, but it is still a radio frequency that is so varied. This point is stressed in answer to questions as to whether the audio wasn't short-circuited and performance rendered impossible.

The audio instability has to do with oscillation at a low frequency (motorboating) and oscillation at a high frequency (shrieking). Both these are audio frequencies. It was found necessary to use a low value of grid leak in the power tube circuit, so 250,000 ohms are specified, though less may be used if the trouble endures. This gets rid of motorboating. There was no shrieking if the usual bypass condenser was omitted from the biasing resistor of the 2A5, even though the cathode voltage of the 2A5 is used as the screen voltage of the 2B7. However, a fairly large bypass condenser would have to be included either across the

(*Continued on next page*)

Coils

Use with 0.00014 Mfd.

winding, near gripping flange, to grid condenser, right-hand heater pin (4); *other end of secondary, to ground, left-hand heater pin* (3); *beginning of primary, to aerial, nearer top of form, to what would be plate pin if the form were a tube, this being the pin next to left-hand heater* (2); *end of primary to ground, connecting to pin adjoining the one previously discussed* (1); *beginning of tickler, terminal nearer top of form, to B plus, connecting to what would be suppressor pin if form were a tube* (6); *remaining terminal to plate of the 57, being pin adjoining cathode. The direction has been clockwise, viewing the bottom of the form with the pins in sight, beginning with right-hand heater, which would be negative filament of a battery tube. All windings are in the same direction.*

LIST OF PARTS

Coils

One set of four plug-in coils as described
Two shielded 25-millihenry r-f choke coils
One oscillation transformer, to oscillate at intermediate frequency
Two intermediate frequency transformers
One dynamic speaker, for 2A5 output; field coil, 1,800 ohms or so; output transformer built in. (A speaker intended for the 47 tube may be used.)
One power transformer

Condensers

One 0.00014 mfd. tuning condenser
One 50 mmfd. feedback condenser
One 50 mmfd. fixed mica condenser for grid circuit of the 57
Four 0.01 mfd. mica fixed condensers
Three 0.002 mfd. mica fixed condensers
One 0.00025 mfd. fixed mica condenser for oscillator grid of the 2A7
Four 0.1 mfd. bypass condensers
One 0.5 mfd. bypass condenser
One 8 mfd. electrolytic condenser, 500 volts
Two 16 mfd. electrolytic condensers, 500 volts (may consist of four separate eights, or of two containers, two 8 mfd. in each)

Resistors

One 1.5-meg. pigtail resistor
Three 0.25-meg. pigtail resistors
One 0.12 meg. pigtail resistor (may use 0.1 and 0.02 meg. in series)
One 5 meg. pigtail resistor
One 0.5 meg. pigtail resistor
One 15,000-ohm, 2-watt wire-wound resistor
One 0.1 meg. pigtail resistor
One 410-ohm wire-wound resistor
One 2-meg. pigtail resistor
One 0.02 meg. pigtail resistor (grid leak of oscillator)
Two 1,200-ohm pigtail resistors
One 250,000-ohm potentiometer, insulated type, with a-c switch attached

Other Requirements

One chassis
One front panel
One vernier dial, with pilot lamp and escutcheon
One a-c cable and cord
Four grid clips
One antenna-ground binding post assembly
One phonograph twin post assembly
One switch for phonograph
Tubes: One 57, one 2A7, one 58, one 2B7, one 2A5 and one 5Z3

VARIOUS USES OF 53'S

CLASS B OUTPUT, COMBINATION DETECTION AND AMPLIFICATION, AND PHASE-INVERTER FOR RESISTANCE-COUPLED PUSH-PULL

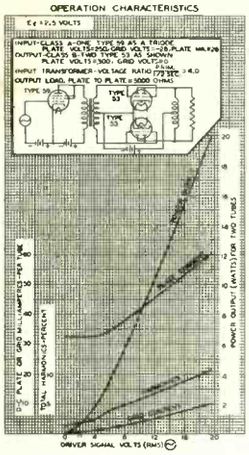


FIG. 1

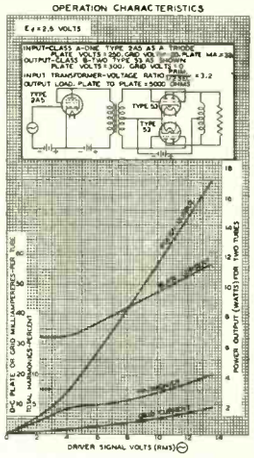


FIG. 2

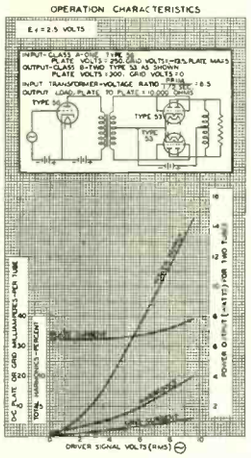


FIG. 3

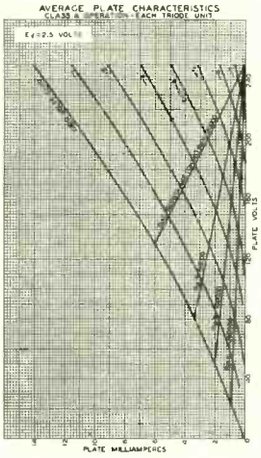


FIG. 4

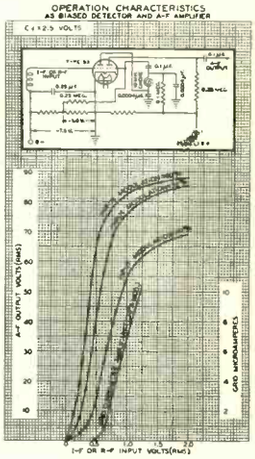


FIG. 5

COMBINING two high-mu triodes in a single bulb, the 53 is designed primarily for operation as a Class B Twin Amplifier. Ordinarily, only a single 53 is used in the output stage of a receiver. However, two 53's can be operated in a Class B output stage with the two triode units of each 53 in parallel. Approximately twice the output from a single 53 is obtainable with such an arrangement when a driver of sufficient power-handling ability is used.

Among other and less conventional applications of the 53 are: Biased-detector and one-stage a-f amplifier, two-stage a-f amplifier, and an amplifier and phase-inverter stage to supply resistance-coupled, push-pull output tubes.

Class B Output Stage

The rated output for the 53 with 300 plate volts is 10 watts. Since the two triodes of the 53 may be operated in parallel, and since two 53's so connected may be used in a Class B output stage, approximately 20 watts output can be obtained from two 53's.

The use of two 53's, with the triodes of each 53 in parallel, in a Class B output stage offers certain advantages over the use of other Class B types, since two 53's are capable of 20 watts output with 300 volts on the plates. No two tubes of other popular Class B types are capable of this output at the same plate voltage. The relatively small change in plate current of the 53 from no signal to full output permits the use of the speaker field as a series choke in the power supply, and also, the utilization of a power-supply system having somewhat poorer regulation than otherwise would be required for a Class B stage. Furthermore, the 53 offers economy in chassis space as compared with other Class B types.

The cost of the two 53's compares favorably with the cost of any two other Class B tube types on a power output basis.

Fig. 1 shows the operation characteristics of two 53's, with the triodes of each in parallel, in a Class B output stage driven by a type 59 operated as a triode. Good quality and high-power output are obtainable under these conditions. Full output from the 53's is obtained with an input signal to the driver of approximately 19.5 volts.

Fig. 2 shows the operation characteristics of two 53's driven by a type 2A5 connected as a triode. The power output with the 2A5 driver is slightly less than that obtainable with the 59 driver, but a smaller input signal to the driver is required.

A Biased-Detector, A-F Amplifier

Fig. 3 shows the operation characteristics of two 53's with a type 56 driver. The maximum power output with the 56 driver is less than that obtainable with the first two combinations, but the power sensitivity of the system with the 56 driver is considerably better.

In Fig. 4, the plate characteristics of a single triode unit of the 53 are shown. From this family of curves it will be seen that the characteristics of a single triode of the 53 are such that the tube is suitable for operation as either a biased-detector or an a-f amplifier.

Fig. 5 shows a suitable circuit arrangement for the 53 in which one triode unit is employed as a biased-detector and the other as a resistance-coupled a-f amplifier. The values of circuit constant are noted on the circuit diagram. The bias voltages for the two units are obtained from a bleeder resistor across the B sup-

(*Continued on next page*)

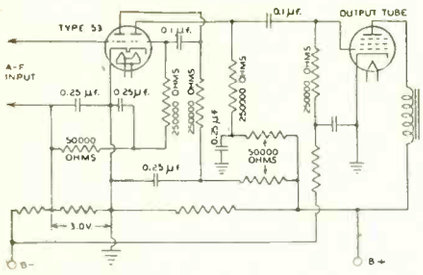


FIG. 6

Two-stage audio amplifier circuit. The plate supply is 250 volts, grid bias minus 3 volts, plate current per unit, 0.5 ma; voltage gain, 26.8; overall voltage amplification, 720; maximum a-f input, 0.08 volt (rms); output, 57.5 volts.

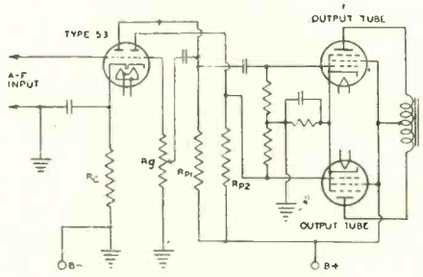


FIG. 7

Phase-inverter and driver circuit for push-pull resistance-coupled output tubes. This is one of the most interesting, although still experimental, uses of the tube, as push-pull resistance coupling has not yet been "tamed."

NEW S-W SET

(*Continued from preceding page*)

diode load resistor (500,000 ohms) or from plate of the 2B7 to ground, as diagramed. This condenser was 0.002 mfd., but it is not to be supposed that frequency discrimination resulted from its inclusion for, as stated, the vice consisted of over-accentuation of high audio frequencies, particularly one such frequency, and the removal of the vice must be considered, as it is, a virtue.

Bypass of Power Transformer

The two bypass condensers from either side of the primary of the power transformer to ground are not necessary in all instances, but they do keep radio frequencies out of the power transformer, and prevent modulation of the rectifier tube, especially if the power transformer hasn't its primary statically shielded from other windings.

The B supply system is such that no objectionable hum should be experienced. Certainly the filter capacities, 16 mfd. each, at the extremes of the field coil, are large enough. Then there is another electrolytic condenser, 8 mfd., across the 110-volt B line. The condensers in the primary circuit of the power transformer remove hum that arises from causes already stated, so that the usual objection to an inexpensive short-wave set, that it hums, should not arise. There was less than 5 per cent total hum in the output of the circuit as built (following the diagram), and this low value was due in part to the cathode emitter of the power tube, that is, isolation of the cathode from the heater.

ply, since a different bias is required for each triode unit, and better filtering is possible with this arrangement. The cathodes of all the tubes in the circuit are at ground potential. The bias voltage for the detector unit is minus 7.5 volts; the bias voltage for the amplifier unit is minus 3.0 volts. The detector bias voltage is not extremely critical, although maximum sensitivity occurs at the value specified. The detector plate current under these conditions is approximately 0.1 milliampere; the amplifier plate current is approximately 1.2 milliamperes.

The high sensitivity of this detector and amplifier system offers the possibility of a reduction in the overall r-f, or i-f, gain in the circuits of a receiver ahead of the detector. For example, it is assumed that the output tube is a type 2A5. The 2A5 requires approximately a 16-volt signal for full output. The modulated 30%, r-f, or i-f, signal required at the grid of the detector unit for full output from the 2A5 is then of the order of 0.3 volts. Even with signals of very low percentage modulation, sufficient output from the amplifier unit will be obtained to give satisfactory operation of almost any output tube.

Two-Stage A-F Amplifier

Another circuit arrangement for the 53 is shown in Fig. 6. Each triode unit is used as a high-gain, resistance-coupled, a-f amplifier. Suitable values for the circuit constants are noted on the diagram. The maximum input to the first amplifier unit is limited to approximately 0.08 volts, since larger inputs cause the second amplifier stage to draw grid current. This input gives an a-f voltage output of 57.5 volts from the second amplifier unit. The overall gain of the two stages of amplification under these conditions is 720.

The distortion of the 53 when used in this circuit was checked by viewing the output voltage wave-form on the screen of a cathode-ray oscillograph. No distortion was observed at inputs up to the point where the grid of the second stage began to draw current.

In resistance-coupled amplifiers, the frequency response at high frequencies is improved by the use of low plate-load resistances, but the gain is reduced. In order to secure good frequency response and the high gains obtainable with large values of plate-load resistance, the impedance of the input source should be low. The two-stage amplifier shown in Fig. 6 when the first stage is fed from a low impedance source gives, at 10,000 cycles, approximately 70% of the maximum voltage amplification.

Another application for the 53 tube is that shown in Fig. 7. Here the 53 is used as a combination amplifier stage and phase inverter, so that output tubes in a resistance-coupled push-pull circuit can be used. The a-f voltage developed across the plate-load of the second triode (R_{P2} in Fig. 7) is 180 degrees out of phase with the voltage developed across R_{P1}. Consequently, the grids of the two output tubes can be resistance-coupled to R_{P1} and R_{P2} respectively. The voltage taken from R_{P2} must equal the voltage developed across R_{P1}. The voltage developed across R_{P2} is adjusted by varying the position of the tap on R_g.

Other Applications

In addition to the application discussed, the 53 offers the possibility of a two-tube oscillator in a single bulb, say RCA Radiotron Co. Inc., and E. T. Cunningham, Inc. Good stability is attainable with such an arrangement. Another possibility is the use of one triode unit as an oscillator and the other as an amplifier.

The 53 can readily be used as a push-pull driver for an output stage. The application of the 53 as a two stage d-c amplifier also presents interesting possibilities.

Two Non-Coupled Tubes in One Envelope Are 6F7

RCA Radiotron Company, Inc. and E. T. Cunningham, Inc., have announced to equipment manufacturers a triode-pentode tube designated as 6F7.

Combining in one bulb a triode and an r-f pentode of the remote cut-off type, the 6F7 may be used in circuits in several ways, since the two units are independent of each other except for the common cathode sleeve. For instance, in superheterodyne receivers, the triode unit may serve as oscillator while the pentode unit functions as mixer tube (first detector).

6F7

GENERAL

Heater Voltage	6.3	Volts
Heater Current	0.3	Ampere
Direct Interelectrode Capacitances:		
Triode Unit—Grid to Plate	2.0	uuf.
Grid to Cathode	2.5	uuf.
Plate to Cathode	3.0	uuf.
Pentode Unit—Grid to Plate (with shield can)	0.008 max.	uuf.
Input	3.2	uuf.
Output	12.5	uuf.
Overall Length	4-9/32" to 4-17/32"	
Maximum Diameter	1-9/16"	
Bulb	ST-12	
Cap	Small Metal	
Base (For connections, see Note 1)	Small 7-Pin	

CHARACTERISTICS

	TRIODE UNIT	PENTODE UNIT	
Plate Voltage	100 max.	250 max.	Volts
Screen Voltage	.....	100 max.	Volts
Grid Voltage	—3	—3 min.	Volts
Amplification Factor	8	900	
Plate Resistance	17800	850000	Ohms
Mutual Conductance	450	1100	Micromhos
Mutual Conductance at —35 volts bias	.....	10	Micromhos
Plate Current	3.5	6.5	Milliamperes
Screen Current	.....	1.5	Milliamperes

CONVERTER SERVICE

	TRIODE UNIT	PENTODE UNIT	
Plate Voltage	100 max.	250 max.	Volts
Screen Voltage	.....	100 max.	Volts
Grid Voltage	‡	—3 min.**	Volts
Oscillator Plate Current (average)	4 max.	.....	Milliamperes
Typical Operation:			
Plate Voltage	100°	250	Volts
Screen Voltage	.....	100	Volts
Grid Bias Voltage	†	—10*	Volts
Oscillator Peak Voltage Input	.....	7	Volts
D-C Grid Current	0.15	0	Milliamperes
D-C Plate Current	2.4	2.8	Milliamperes
Screen Current	.....	0.6	Milliamperes
Plate Resistance	.....	2.0	Megohms
Conversion Transconductance	.....	300	Micromhos

‡Usually obtained by means of a grid-leak resistor.
**Grid bias should be at least 3 volts greater than the peak oscillator voltage applied to the pentode grid.
°May be obtained from 250-volt source through 60,000-ohm dropping resistor.
*Obtained by means of 1,700-ohm self-biasing (cathode) resistor.
†Obtained by 100,000-ohm grid-leak resistor returned directly to cathode.

Note 1:
Pin 1—Pentode Screen
Pin 2—Pentode Plate
Pin 3—Heater
Pin 4—Heater
Pin 5—Cathode
Pin 6—Triode Grid
Pin 7—Triode Plate
Cap—Pentode Grid
Pin numbers are according to RMA Standards Sheet 801-A (M8-116).

New Type Tubes Improve Sets

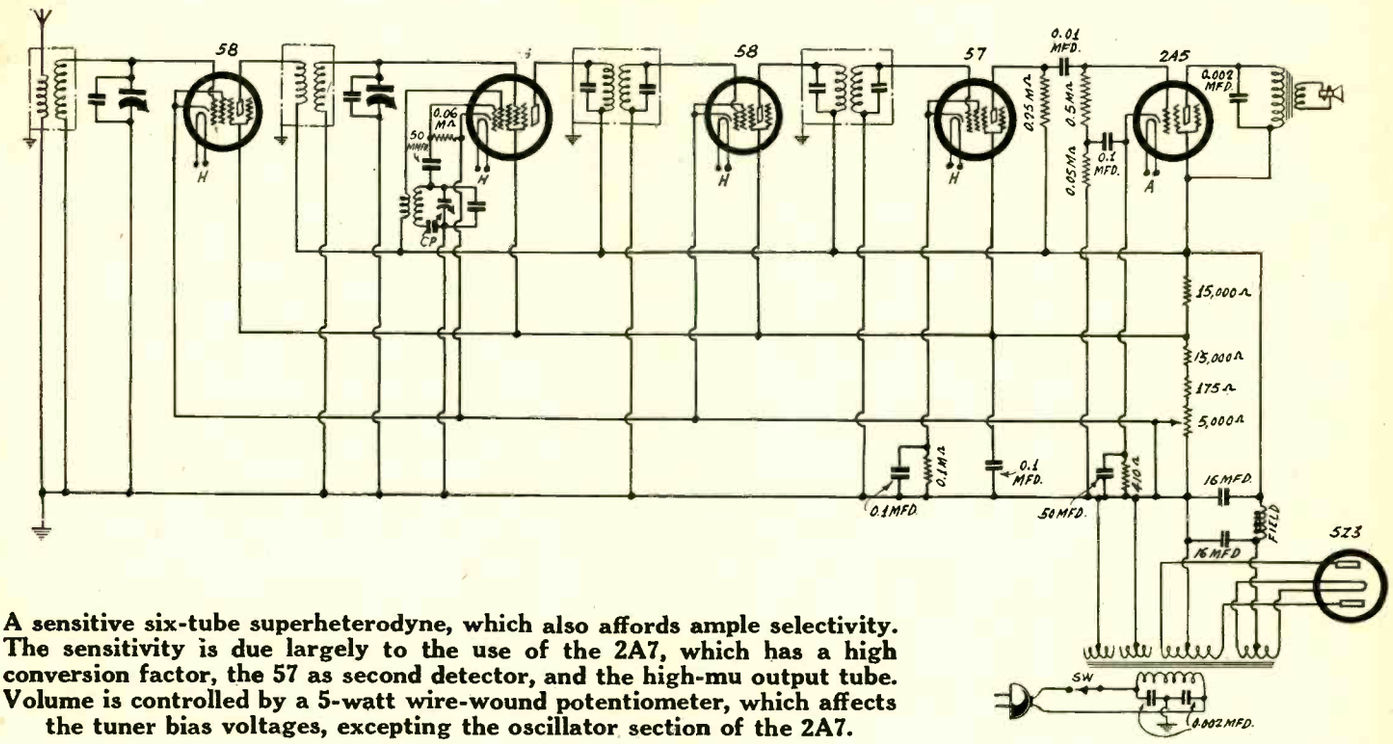
The opportunity to-day to improve one's radio receiver is very great, especially with the advent of new tubes. Some servicemen report exceptionally fine business from this angle. So the experimenter should study carefully his circuit or his neighbor's and see where the old type tubes can be replaced with newer models. With the proper combinations the change in many cases will be so startling and the cost so small by comparison that only then can the real value of the progress made in tube manufacture be more fully appreciated. There are many set owners who while not in the market for a new receiver would not hesitate to spend a few dollars for a worth-while improvement. One way to start this ball arolling is to try to make the change for someone who has a large circle of friends. In this way the first revamping job will act as an advertisement for you and lead to additional sales through its performance.

GRIMES AT 178 GREENWICH ST.

The transmitting department conducted by Frank Grimes for Try-Mo Radio Corp. is at 178 Greenwich Street, New York City, and not 179, as reported in July 15th issue.

HIGH SENSITIVITY
In a Six-Tube A-C Superheterodyne

By William J. Woodstock



A sensitive six-tube superheterodyne, which also affords ample selectivity. The sensitivity is due largely to the use of the 2A7, which has a high conversion factor, the 57 as second detector, and the high-mu output tube. Volume is controlled by a 5-watt wire-wound potentiometer, which affects the tuner bias voltages, excepting the oscillator section of the 2A7.

MANY times even an experienced radioist is surprised at the sensitivity and selectivity of a small receiver. It is certainly true that when the balance is nicely struck between gain and stability the results are extraordinary. The circuit diagram represents a receiver of high sensitivity and excellent selectivity, although only six tubes are used.

The circuit is a superheterodyne with one stage of tuned radio-frequency amplification, a combination oscillator and modulator (or mixer) in the same envelope, one intermediate stage, a very sensitive second detector and a high-mu output tube. The rectifier is the sixth tube.

For tuning a three-gang condenser is used, and may be 0.00035 mfd. The oscillator section is padded, but the padding condenser is grounded, so that body capacity effects are absent, and also the amplitude of the oscillation limited. Depending considerably on the tickler coupling, this amplitude should be held to 1 volt less than the steady bias condition of the modulator section. As this bias, on grid No. 4 (cap) of the mixer tube is around 3 or 4 volts, the oscillation amplitude should be 2 volts in one instance and 3 volts in the other. This is best measured simply with a vacuum tube voltmeter, with receiver's volume control at "full-on" position.

The primary of the antenna coupler should be small, otherwise a series antenna condenser used, say, 0.0001 mfd. or 0.00005 mfd. However, assuming a small primary is preferable, because easy enough, it would consist of 12 turns of No. 22 single silk wire, or any size wire approximately in that region, wound over a secondary that consists of 127 turns of No. 32 enamel wire, the form diameter 1 inch. The interstage coupler is the same, except that the primary is larger, consisting of 30 turns of any fine insulated wire, wound over a 127-turn secondary. The oscillator coil also has two windings.

For an intermediate frequency of 465 kc the oscillator secondary would consist of 98 turns of No. 32 enamel wire, while the tickler, wound over it, would consist of 27 turns of any fine insulated wire, say, No. 30 single silk. For an intermediate frequency of 175 kc the oscillator secondary would consist of 118 turns of No. 32 enamel wire, with same tickler. The padding condenser, Cp, for 465 kc, should be adjustable from 350 to 450 mmfd., for which purpose the commercial "type 500" may be used, while for 175 kc a larger capacity, adjustable from 800 to 1,350 mmfd., should be used.

The radio-frequency and intermediate frequency amplifying tubes are 58's, the mixer is a 2A7, the second detector is a 57, the output tube a 2A5 and the rectifier a 5Z3 or a 280.

The speaker field value is not critical, and may be around 1,800 ohms.

SHORT-WAVE REGENERATIVE SETS
USEFUL ALSO AS TEST OSCILLATORS

By Conrad Force

There are a great many short-wave sets in use that employ regeneration, and as these may be calibrated as oscillators, three typical circuits are shown. In Fig. 1 the tickler is switched to avoid the regeneration control and thus provides steady oscillation. In Fig. 2 the effect of the feedback condenser is nullified by a high capacity switched across it. In Fig. 3 screen control of regeneration is used, and the maximum voltage setting of the potentiometer arm is used. For adjustable tickler coils, set the adjustment at maximum feedback. Then, too, one has an oscillator.

The circuit should be calibrated for oscillation, and it will be found that there is a difference in some instances between the regeneration calibration and the oscillation calibration.

Of course the single tube is used. In Figs. 1 and 2 there is a third winding, assumed to be the antenna winding, and this may be used for taking the output. In Fig. 3 there are only two windings, and the output may be taken through a small condenser at the high side (right upper).

If there is a t-r-f stage ahead, the third winding, if present, would be in the plate circuit. Then either this may be switched, or the tested frequency fed to the antenna-ground posts, care being exercised to have the first stage precisely at resonance, as the calibration of the oscillator originally should be made that way.

Radio University

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RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Short-Wave Sets Compared

IN A RECENT ISSUE you printed a letter in which the writer said that he had better luck with regenerative short-wave sets than with supers, but I desire to point out that all of the better-grade short-wave sets are supers, and that their performance is superior. In fact, everybody knows this. Is it your own opinion that regenerative sets are better?—K. F.

The letter was printed in line with our policy of permitting readers a full expression of opinion. Often such opinion runs contrary to our own and the letter you mention is an example. It is a fact that supers are both more selective and more sensitive, and also an incidental advantage is tuning ease, due to the absence of the awkwardness of adjusting regeneration, which often becomes a trying task. This is not to deny the worth of regenerative short-wave sets.

* * *

Output Power and Sensitivity

RECENTLY, following advice I saw printed in your publication, I substituted a pair of 2A3 tubes for 2A5 push-pull, and I am surprised that the signals are not nearly as loud as before. I should say they are only one-third as loud. I do not notice any particular difference in the quality, in fact, there is not enough heard under the present set-up to permit a sensible comparison. I shall put back the high-mu output tubes directly.—H. W. D.

We did not print any advice to replace 2A5 push-pull output tubes with the newer 2A3 tubes, but did point out that the quality is better when the 2A3 tubes are properly used, and the undistorted maximum power output increased considerably. By proper voltaging and constanting, the output may be 15 watts without as much distortion as is obtained from 2A5 push-pull at least less than half that power output. To be able to use 2A3 tubes instead of 2A5 tubes it is necessary to have sufficient driving voltage ahead of the output stage, which your receiver evidently hasn't, for the working mu of the newer tubes is only a small fraction of that of the pentodes. You might try a 56 driver stage. Then, of course, the output impedance is quite different, being about half as great for the 2A3's as for the 2A5's. Either you should get a proper speaker or install a proper matching transformer in your present speaker. When these precautions are taken you should be in a position to side with those who realize the superior quality attained from the low-mu output tubes, and moreover you should not confuse sensitivity with power-handling capability. Sensitivity relates to the amount of voltage input required for adequate quantity of sound output. Power-handling capability relates to the amount of voltage that can be put in without distorting the output.

* * *

Push-Pull Resistance Audio

WHAT IS THE TROUBLE with what seems to be the likely audio circuit, push-pull resistance coupling? You have printed articles about this, but nothing ever seems to be properly reduced to practice on this subject anywhere in the field. There are no commercial receivers using it, and none of your kit circuits shows its inclusion.—U. T. W.

As yet push-pull resistance coupling is in the experimental stage, so designers of kits and sets do not want to include a circuit that is not more or less foolproof. Tests of such circuits made in our laboratories showed varying results, but even the best results did not produce enough sensitivity. The method, so far, seems to concern simply coupling from one stage to the output without much distortion, but that could be done with less adjustment trouble by the single-sided coupling from detector to output. New possibilities are offered by the 53 tube, and no doubt experiments will be carried on, but the adjustment must be expected to be beyond the capabilities of the general run of constructors, who have not the dynamic instruments for effectuating proper balance. An unbalanced attempted push-pull audio circuit is a sorry thing indeed.

* * *

2A7 Coupling

HAVE YOU MEASURED the quantity of coupling in the 2A7 tube, and can it be said to be large or small?—H. J. D.

We have not measured it, but it may be said to be fairly loose coupling at the frequencies for which it is intended (broadcast band). This can be verified by the results of equivalent capacity coupling between grids of two separate tubes in separate envelopes. However, as the frequencies increase the effect is that of much too tight coupling. For instance, a beat oscillator was constructed, for the 5 mgc region, and it was found that one circuit (triode) in the 2A7 invariably "pulled" the other (pentode). Because of the necessity for having a choice and control of the degree of coupling, new tubes are to be announced, which consist of a triode and a pentode in one envelope, entirely separate electrically, no common coupling in other words, hence requiring an external coupling medium. The first of these tubes is the 6F7, but it is assumed that the 2F7 for 2.5 volt a-c operation will follow, and also a battery type tube that permits the same advantages.

* * *

Coil Capacities

IN A SOLENOID what is the reason for spacing the turns? How does that affect the factor? Is it better to use a honeycomb coil of greater or fewer turns? How is Litz wire for broadcasts?—F. D. S.

The turns are spaced in a solenoid to reduce the distributed capacity. This alters the shape factor in the wrong direction, as the theoretically correct coil would have a diameter 2.4 times the axial length of the winding. In commercial practice this is not even approximated, as the coil diameter is always less than the axial length of the winding. However, the difference in results is small, that is, little added resistance or little reduced selectivity, within a wide margin. When spacing is used, of course, the axial length of the winding is increased, normally doubled, and that must be taken into account. Therefore for broadcast use, spaced winding is not common, since the wire would have to be fine indeed and the spacing likewise, and besides the distributed capacity resulting from regular solenoids of the tight-wound type is low enough. We do not know what you mean when you ask if a honeycomb coil of greater or fewer turns is "better," but in terms of r-f resistance, the greater the number of turns, the greater that resistance, and as for distributed capacity, the greater the number of turns the less the distributed capacity. Each turn is capacitatively effectively in series with the next, etc. Litz wire is all right for broadcasts, though better for still lower frequencies. The effect is to produce higher gain at the low broadcast frequencies, with reduced gain and reduced selectivity at the high frequency end. Thus Litz acts as a sort of leveller in the broadcast band, to attone for the rising characteristic of tuned radio frequency amplification. Still the selectivity reduction at the higher broadcast frequencies may be serious.

* * *

Accessor Circuit

AS I HAVE a meter I would like a diagram of some sort of device that serves as an analyzer or tester, to measure currents and voltages, also resistances, depending on the setting of switches and the connection of external meter, external multipliers, external shunts and external battery for resistance results.—H. G.

Such a device is called an accessor, and we expect to print in next week's issue an article detailing the construction. The Radio Manufacturers Association code for socket terminals will be used, and since seven base pins and an overhead grid are accommodated, numbers 1 to 8, the device will apply to all tubes that will fit into the sockets, which includes all standard tubes up to the moment of writing these lines. The socket terminals, being identified by numbers, are independent of the nature of the element affected, although naturally in some instances the same elements are represented by the same numbers on all equivalent tubes. This method keeps the tester from becoming out of date.

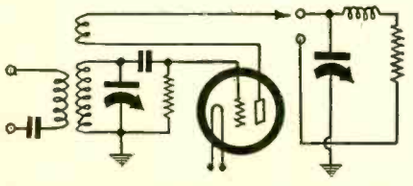

FIG. 1

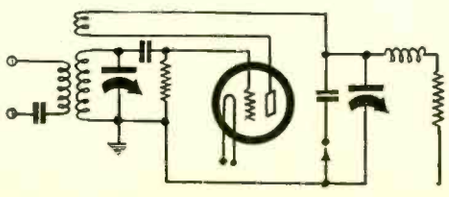

FIG. 2

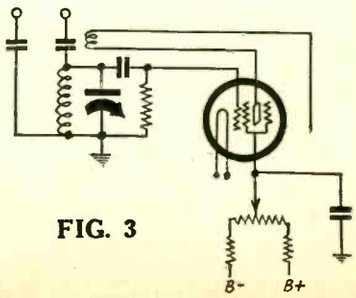

FIG. 3

These diagrams refer to article on opposite page.

Station Sparks

By Alice Remsen

A Man!

FOR "CHEERIO"

WEAF—Mondays, Tuesdays, Wednesdays, Thursdays and Fridays, 9:30 a. m. EDST

The guy who can go through the world with a smile,
When life has sort o' kicked him in the back;
The guy who can plod along mile after mile,
And always keep his feet upon the track;
The guy who can fight off temptation and sin
When he's starving hungry—his feet are all in—
That guy's a MAN!

The guy who can keep his head up in the crowd,
When everybody wants to pull it down;
The guy with a spirit which cannot be cowed
By poverty or fickle fortune's frown;
The guy who can grin when Fate hands him a pain,
Who squares up his shoulders and tries it again—
That guy's a MAN!

—A. R.

* * *

And if your head is bowed a bit lower than usual, just tune in on "Cheerio" and his inspirational talks. I'll guarantee that you'll feel like a new man, stick up your head and give the darned old world a fighting grin. Give "Cheerio" a listen; you'll like him, the singing, the music and the canaries.

* * *

The Radio Rialto

JUST PLAIN BUSINESS

Contract renewals are in order now and both NBC and CBS have a share in them. Richfield Oil has renewed for another thirteen weeks, with the same program set-up; the Jergen Company has another thirty-nine weeks signed up, bringing Walter Winchell back, September 3rd. So much for NBC. Over at Columbia the renewals include a thirteen-week extension for Jad Salts by the Wyeth Chemican Company, for their three-time-weekly program; and the Kolynos Company, which renews its "Just Plain Bill" serial, five-times-weekly. CBS also has a new account, a newcomer to the air—the American Home Products Company, which will start a half-hour program over WABC on September 24th. Maltex will also start a new series on WEAF, August 19th; half-hour once a week; my old friend, George Shackley, will conduct the orchestra. . . .

All Over the Place

Morris Hamilton, genial lad of the NBC program department, has his hands full these days, listening to auditions of promising talent and putting them on his pet program—The Morning Parade, Week-End Revue and the Revolving Stage. He manages to get some interesting items at times, and his bills are always well-balanced. . . . Goodness gracious! Word has just come in that Old Gold has renewed for twenty-six weeks; Fred Waring, Mandy Lou and David Ross will still be heard with them; jolly good program, too. . . . Aren't you glad that the Columbia Dramatic Company has returned to the air? This company of players will be a regular feature each Thursday night from 8:30 to 9:00 p. m. . . . Doris Hardy has been very active on the air recently; she is in full charge of all the radio programs, both dramatic and musical, for the Actors' Dinner Club, and is using five stations—WOR, WHN, WMCA, WHOM and WEVD. She selects all material, directs all programs and appears on each one either as actress or mistress of ceremonies. Quite a busy lady. . . . WLS, the Prairie Farmer station in Chicago, sends word that its deep-voiced folk-song singer will devote her vacation period to the making of phonograph records for the Brunswick Recording Company. Local representatives of the recording firm have been flirting with the titian-tressed mountain girl for several weeks in an effort to obtain a favorable contract and terms have finally been reached. The recordings will be made in New York and "My Renfroe Valley Home" and other songs which made Linda famous to WLS air and stage audiences will be included in the disc repertoire. . . .

Ellington's Stay Prolonged

Although the original booking for Duke Ellington and his orchestra in Europe was only four weeks, he has created so much enthusiasm in England and on the Continent that Irving Mills, his manager, was swamped with offers for additional engagements. So he accepted bookings for an extra month, which included the week of July 10th at the Palladium Theatre in London, four days of concerts in Holland, and two weeks at the Rex Theatre, Paris, which will carry along Ellington and his boys until August 5th, when they leave France to sail for home on the S. S. Majestic. . . . The Mills Brothers are back in New York; last week they played an engagement at the Metropolitan Theatre in Brooklyn and will, it is presumed, do the whole Loew tour. . . . Paul Whiteman's Victor recording of "Whispering" has sold just short of 2,000,000; this was his first record and he was scared to death to make it. . . . Have you heard Herman Hupfeld's new number—"I've Got to Get Up and Go to Work"? It's a corker. . . . WHOM is fast becoming a worth-while station; they're on the air from 8:00 a. m. until midnight; have sold quite a bit of time, under the sale leadership of Atwood Klinger. Some of their accounts are of national importance—Tydol, for instance; on such big propositions, spot announcements are used with a New Jersey billboard tie-up, which is a very unique arrangement; among the local accounts to take advantage of the WHOM wires are: Penn Clothing Exchange, Krakauer Brothers, piano manufacturers; Doctor Haines, D.D.S.; Bercesi Radio Shop, and the Bells of Warsaw, a sponsored Polish program; are broadcasting on 1450 kilocycles, 206.8 meters. . . . Have just received a half-dozen English press notices on Duke Ellington's debut in London; each one praises the dusky rhythm-slinger to the skies, one reviewer going so far as to call the performance a "scientific application of measured and dangerous stimula"; you know they treat their reviewing very seriously over in dear old London; another gentleman of the English press stated that the Duke possessed "an irresistible appeal for this neurotically puzzled and paradoxically repressed world in which we live"; another man expressed himself emotionally; confessed to weeping when the orchestra played Mood Indigo, and described the Ellington debut as "an orgy of masochism, a ruthless exercise in sensuality"; now what do you think of that! . . . I really believe that the Duke must have been a "wow"! . . .

Ukrainian Choir on CBS

The Koshetz Ukrainian Choir began a series of recitals over WABC and the Columbia network on Saturday, July 15th, from 8:15 to 8:30 p. m., EDST. They will be heard at this hour each week under the direction of Alexander Koshetz, former Ukrainian Minister of Education and Kappelmeister of the Kiev Opera House. Koshetz; the Choir has toured seventeen countries in recitals during the past few years, and has appeared before numerous royal gatherings in Europe, and played to extensive audiences throughout the United States. The repertoire includes Ukrainian primitive music of the early Middle Ages, religious chants of the 10th, 11th and 12th centuries, peasant and gypsy melodies, and contemporary Ukrainian operatic works. The Choir's American debut was made at Carnegie Hall in 1923, and they have appeared there regularly to increasingly enthusiastic audiences. . . . Lovers of Puccini will be glad to know that they may have an opportunity to hear the long restricted Puccini operas broadcast by radio station WMCA, New York. Donald Flamm, president of the Knickerbocker Broadcasting Company, has obtained blanket permission to broadcast these works at regularly stated intervals. . . . Johanna Grosse, radio and stage organist, has rejoined the staff of WLW, in Cincinnati, after an absence from that station of nearly four years. . . . And now the kettle is singing and I really must make a cup of tea. You'll pardon me, won't you?

New Small Short-Wave Tubes in Trial Stage

B. J. Thompson, of RCA Radiotron Co., Inc., points out that new tubes of small size for high frequencies are in an experimental stage and not being produced commercially. Mr. Thompson and G. M. Rose, Jr., recently read a paper on the tubes before the convention of the Institute of Radio Engineers in Chicago. Tube types were demonstrated.

Mr. Thompson since then has supplied the following additional information:

"The type of tubes which were demonstrated represented only triodes and screen grid tubes, no pentodes having been made. The longest wavelength at which we have carried out experimental work with these tubes is one meter. At six meters tuned radio frequency amplification is possible with conventional type tubes.

"These small tubes are in a very early experimental stage, and at the present time no attempt is being made to manufacture them on a commercial basis.

"There is no reason to believe that more than one stage of tuned radio frequency amplification would not be practical at a wavelength of 100 centimeters. In the apparatus demonstrated, the screen grid tubes were used only for radio frequency amplification, the triodes serving as detectors and oscillators."

$1.75 LIST ON NEW 1A6

The 2-volt pentagrid converter tube, 1A6, will list at $1.75.

DeForest Co. Buys All Jenkins Television Assets

The receivers for the DeForest Radio Company bought at auction for $200,000 all the property and other assets of the Jenkins Television Corporation of Wilmington, Del.

These assets include all patents of the Jenkins Corporation and shares of stock in the Jenkins Laboratories, Inc.; the Canadian Television Company, Ltd., and the Jenkins Television Company of New Jersey.

The sale was made by the receivers of the Jenkins concern to the DeForest Company, which was the only bidder. It is subject to confirmation by the United States District Court in New Jersey.

World Ham Convention To Be Held Next Month

The World-Wide Radio Amateur Convention will be held in Chicago, August 3rd, 4th and 5th, in co-operation with the Century of Progress Exposition.

There is a "ham" exhibit in the Travel and Transport Building at the Fair, occupying 2,000 square feet.

BUDLONG'S PATENT

Editor Radio World:

MY ATTENTION has been called to your issue of July 22nd, 1933 (No. 591), wherein is featured as the lead article a description of a receiving system based on the principle of detecting an incoming signal and using the audio output of the detector circuit to modulate a fixed local "intermediate frequency" oscillator, the resulting modulated oscillations being amplified and eventually detected again.

This system of reception has been patented by me and is described in U. S. Patent No. 1,909,805, filed March 16th, 1928, and issued May 16th, 1933. Of the seven allowed claims, the fourth more or less completely sums up the system: "4. The method of receiving radio signals which comprises converting the received radio frequency currents into audio frequency currents varying by and in accordance with the transmitted signal, generating sustained high frequency currents, employing said audio frequency currents to modulate the sustained high frequency currents, amplifying the sustained high frequency currents, and finally detecting the modulated sustained high frequency currents."

A. L. BUDLONG,
38 La Salle Rd., West Hartford, Conn.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Thomas Swatman (Radio Repair Man), 186 Hunterdon Street, Newark, N. J.
B. M. Windom, Ste 7A, Belmont Apt., Winnipeg, Man., Canada.
Frank F. Kucera, No. 3459 E. Boulevard, Cleveland, Ohio.
Everett Vincent, Pullman, Wash.
Lester Porter, Mt. Washington, Ky.
Scot Richardson, 1614 Coy Ave., Saskatoon, Sask., Canada.
Wm. L. Reed, 701 South Park St., Shawnee, Okla.
Jos. J. Black. 1773 Marks Ave., Akron. Ohio.
T. W. Draper, 299 Victoria Road, Walkerville, Ont., Canada.
William Jordan, Schodack Landing, N. Y.
O. W. Wendelburgh, c/o The Union Trust Co., Cleveland, Ohio.
Charles T. Collett, 817 Jefferson St., Fulton, Mo.
Ernest Jaschke, 171 Ludlow St., Long Branch, N. J.
Gilbert R. LaPoint, 8 State St., Westboro, Mass.
M. J. Vaillancourt, 63 Myrtle Ave., Albany, N. Y.
J. Dean Styers, c/o The Gazette, Gastonia, N. C.

TRADIOGRAMS

By J. Murray Barron

That there is a real interest in television by the public can not be denied. It is no fault of theirs that television has not advanced to a point where it is practical for general use. In fact, with a little more co-operation between the laboratory and the broadcasting studio thousands of fans would be ready to buy kits and etc. Even now, with less publicity than a year ago, the interest is great and the public in general flocks to demonstrations. It is a pity that some real active scheme is not worked out to give the experimenter more to work on and in perhaps this way something new, possibly different than now worked out, would be developed that might be the means of advancing television.

* * *

The Postal Multiformer unit for short-wave receivers gives to the experimenter and the ham something unique for radio construction. Here in one unit is a coil assembly of three inductors which fits into a specially designed socket that accepts the whole assembly and which permits of a complete change in a single operation of the entire three inductors—r.f., detector and oscillator, for any of the four amateur bands. With a unit of this kind the experimenter should find the construction of a short-wave receiver greatly simplified and greatly more efficient. For those interested in short-wave kits and sets there is free literature. Address the Postal Radio Corp., 135 Liberty Street, N. Y. City, direct.

* * *

The Powertone Wallace short-wave kit now merchandised by Try-Mo Radio Co., 85 Cortlandt Street, N. Y. City, is showing added activity and judging from the inquiries on this circuit from all quarters of the country the evidence is there will be a very great pick-up in kits early this fall. Naturally on account of the tests taking place from the first of August on, many are anxious to equip themselves with a good short-wave receiver. There is free literature on this particular circuit, which may be had by addressing the Try-Mo organization direct.

* * *

With all the so-called bargains offered it must be rather confusing to the shopper. In dealing with such sellers one has to be extremely careful and take nothing for granted. Only consider guarantees plainly stated on sales slips and be sure it's on the slip before the money is passed over. If this type of seller goes after mail order business it might not be amiss to get the definite understanding before sending money. Better still, one can play safe by doing business with reliable establishments. Naturally one can not mistrust everybody; still, as radio kits and sets are sold in various combinations it is well to understand perfectly just what is offered for the price.

Constants for Resistance A.F.

CONSIDERABLE emphasis used to be placed on the time constant of a resistor-capacity coupler in an audio circuit, and the value chosen so that low frequencies would not be attennated. I remember 4 mfd. condensers being not unusual, and rather high value grid leaks. Now I seldom see a condenser recommended at more that 0.05 mfd., and the grid leak values are sometimes low. What is the reason?—T. R. D.

The time constant in the condenser-resistor circuit may be disregarded in modern circuits, as there is such a quantity of feedback through the common impedance of the B supply, plus an ever-present risk of grid emission in the power tube, as to offset the frequency considerations as viewed from the resistor and condenser. That is, regeneration is present, and its effect is that of an enormous stopping condenser and leak. Thus the circuit may motorboat and if it does of course lowering the grid leak values is quite all right, because of reduction of the over-accentuation, that is, the procedure is in the direction of elimination of distortion, the very aim. Grid current in the power tube requires that the leak be low so that the tube should not lose much bias. With self-bias the resistor may be higher than with fixed bias (e.g., battery bias or bias through bleeder or negative-leg tapped choke is fixed.)

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TO RADIO EXECUTIVES: Employment is desired by a personable young woman of thirty, possessing broad secretarial and executive experience, tact, initiative, integrity and exceptional ability. Eleanor R. Bolton, 25 South Munn Ave., East Orange, N. J.

"THE FORD V-EIGHT—'B'-FOUR—'BB'-TRUCK," by C. B. Manly. A New and Practical Book for Everyone Interested in the Construction, Adjustment, Upkeep and Repair of The New Fords. Over 250 pages, 125 illustrations. Complete cross index. Pocket size, flexible leatherette cover. Price $2.00. Radio World, 145 W. 45th St., New York, N. Y.

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"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

NEW RADIO AMATEUR'S HANDBOOK, 180,000 words, 207 illustrations, 218 pages (10th edition, issued 1933). Price, $1.00 per copy. Radio World, 145 West 45th Street, New York, N. Y.

BLUEPRINT

627. Five-tube tuned radio frequency, A-C operated; covers 200 to 550 meters (broadcast band), with optional additional coverage from 80 to 204 meters, for police calls, television, airplane, amateurs, etc. Variable mu and pentode tubes. Order BP-627 @.....25c

RADIO WORLD, 145 W. 45th St., New York, N. Y.

CIRCUITS AND SERVICE DETAILS OF COMMERCIAL RECEIVERS in issues of Radio World as follows: The Philco Model 15 Superheterodyne, Oct. 29, 1932; Philco's 4-tube Superheterodyne, Dec. 10, 1932; The Philco 37, Dec. 31, 1932; Philco Service Bulletin—No. 146, Models 89 and 19, Jan. 21, 1933; The Model 28, Newest Sparton Set, Nov. 5, 1932; Sparton 14, 14A, and 18, Jan. 7, 1933; The Majestic 324, Nov. 12, 1932; Stromberg-Carlson's Latest Circuits, Nos. 37, 38, 39, 40, and 41 Receivers, Nov. 19, 1932; The Pilot Dragon, Nov. 19, 1932; National Co. Short-Wave Receivers, Dec. 3, 1932; The New Fada Chassis, Dec. 24, 1932; Howard Model M, Jan. 7, 1933; The Comet "Pro," Jan. 14, 1933; Gulbransen Series 322, Jan. 14, 1933; United American Bosch Service Corp. Instructions, Jan. 21, 1933; Crosley Models 132-1 and 141, Jan. 28, 1933; The Colonial C-995, Feb. 11, 1933; Kennedy Model 563, Feb. 11, 1933, U. S. Radio No. 700, Feb. 18, 1933; Bosch 250 and 251, also Clarion Model 300, and Zenith 430 and 440, Feb. 25, 1933. 15c a copy, any 8 issues, $1.00. Radio World, 145 W. 45th St., New York City.

115 DIAGRAMS FREE

115 Circuit Diagrams of Commercial Receivers and Power Supplies supplementing the diagrams in John F. Rider's "Trouble Shooter's Manual." These schematic diagrams of factory-made receivers, giving the manufacturer's name and model number on each diagram, include the MOST IMPORTANT SCREEN GRID RECEIVERS.

The 115 diagrams, each in black and white, on sheets 8½ x 11 inches, punched with three standard holes for loose-leaf binding, constitute a supplement that must be obtained by all possessors of "Trouble Shooter's Manual," to make the manual complete.

Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 30, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

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Vol. III of RIDER'S MANUAL (A New Book)

Just out, John F. Rider's Vol. III Manual weighs nearly 11 lbs. and has 1,100 pages, all diagrams of commercial receivers, etc. (no text). Sets announced up to May 1st, 1933, are included—and complete information on every one, including resistance values. The volume is original and necessary and does not repeat data that are in Vols. I and II.

A Chronological Catalog and Index of all nationally-advertised radio receivers manufactured and sold in the United States between January, 1921 and January, 1933 are contained in Volume III. This list will be of tremendous aid in the identification of receivers for which the model number is not known.

Complete data include schematic wiring diagrams; chassis wiring diagrams; parts layouts; photographic views of chassis; socket layouts; voltage data; resistor values; condenser values; location of alignment and trimmer condensers; alignment and trimmer adjustment frequencies; intermediate-frequency amplifier peaks; alignment and intermediate-frequency adjustment instructions; color coding; transformer connections; point-to-point data; continuity test data; parts list with prices; special notes.

Complete tabulation of tube data showing electrical characteristics and constants for all of the tubes employed in radio receivers and amplifiers since 1921. Also a table of interchangeable types.

A complete table of I-F. peak frequencies as used in radio receivers. This list augments the information of this type shown upon the diagram pages. Intermediate-frequency amplifier peak information is very important because quite a few of the manufacturers employ more than one figure in their year's production. A wrong guess on your part means trouble.

Order Cat. RM-3 @ $7.50. Remit with order and we pay postage. Order C.O.D. and you pay postage.

Volume I—Order Cat. RM-1 @.....$5.00
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Volume III of Rider's Manual has a page sequence in accordance with Vols. I and II, and is not cumulative, or repetitive of the earlier volumes. However, it contains an index for all three volumes.

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NEW MODEL SHIELDED TEST OSCILLATOR!

Either 50-150 kc Fundamental Model, a-c or battery; or 500 to 1,500 kc Fundamental Model, (broadcast band) a-c or battery, available.

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, t-r-f and oscillator circuits, is now ready. It is shielded in a metal box 9¾" wide x 6¾" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

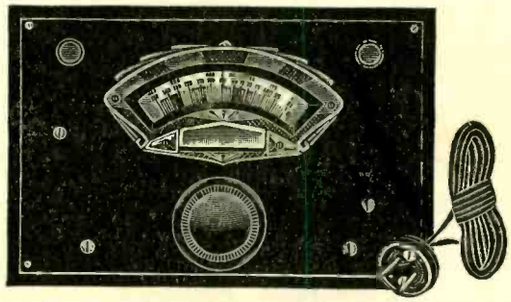
The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. In the cabinet there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.

Either model FREE with two-year subscription for Radio World (104 issues) $12.00



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability.

The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

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