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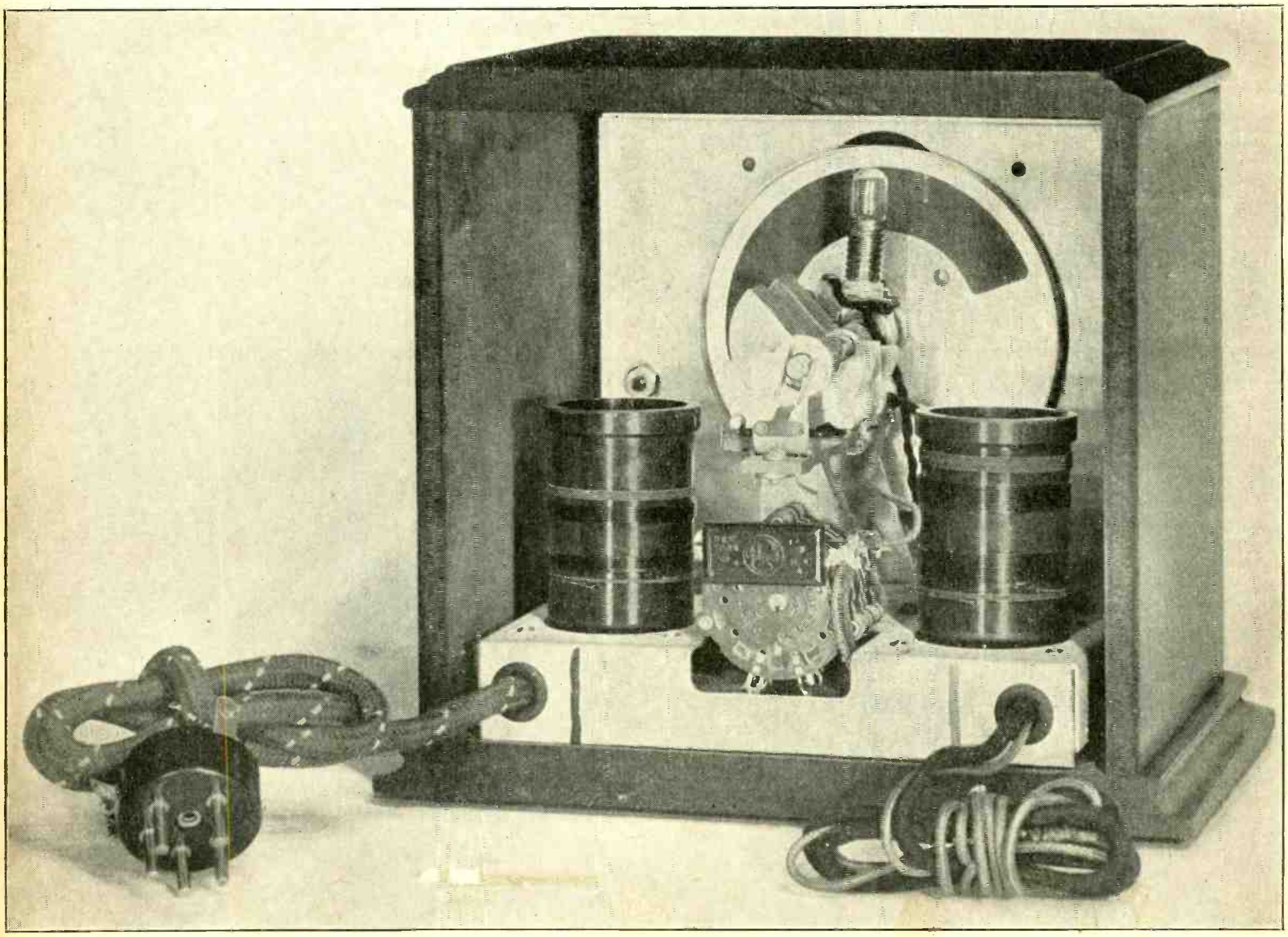

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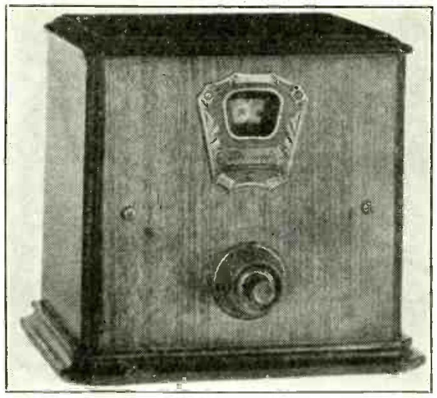

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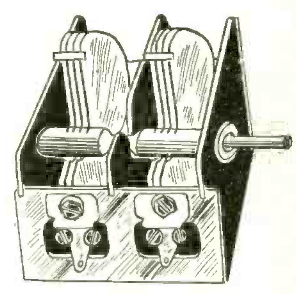

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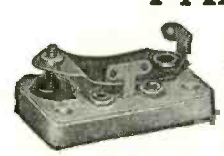

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Detailed Procedure for ACCURATE PADDING

By Herman Bernard

THE only constructional problem concerning the superheterodyne of today, as built for broadcast frequencies, is padding, or making the oscillator and radio frequency tuning track. This means that any dial position for the oscillator section of the gang has to represent a frequency higher than the signal frequency, and the amount of increase must always be equal to the intermediate frequency. Thus, for the 1,500 kc setting of the tuner, or signal level, if the intermediate frequency is 175 kc, the oscillator frequency must be 1,675 kc, or, at the other extreme, for 540 kc signal frequency the oscillator frequency must be 715 kc. To line up the superheterodyne properly it is necessary to obtain coincidence to within 5 kc, where the tracking is poorest, otherwise there will be squeals, but the task is not extremely difficult, and it is the intention to give a method that yields the desired results.

Sequence of Procedure

The work should be done in the following order:

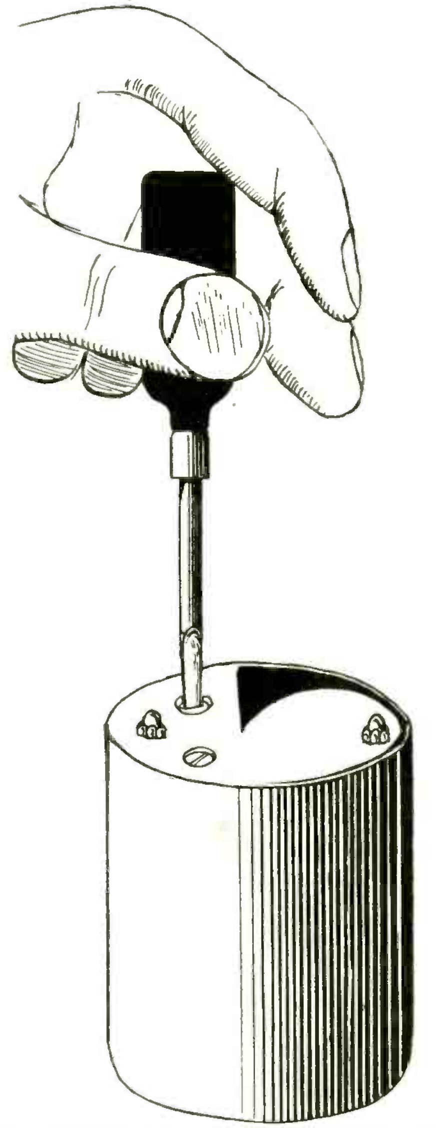
(1)—The intermediate frequency should be lined up exactly.

(2)—The radio frequency dial positions for the tie-down points should be established.

(3)—The oscillator should be adjusted for these tie-down points, which are 175 kc higher (for that intermediate frequency) than the signal points, although representing the same dial positions.

(4)—The padding should be checked at a mean frequency.

By following this sequence, and doing the work thoroughly, the superheterodyne may be excellently padded, provided, however, the constants are such as to permit this result. The radio frequency coils with their tuning condensers are assumed to cover the broadcast band, a fact that may be checked up at the r-f level, and since the oscillator section, in a padded circuit, is originally of the same capacity and of rate of capacity variation as the other sections, the only remaining difficulties are the oscillator inductance and the padding condenser. The inductance must be closely correct, while the padding condenser must have a sufficiently high minimum and sufficiently low maximum that the required capacity may be found somewhere between the extremes by experiment. What is the actual capacity used in the padding condenser the experimenter probably will not find out, but he need not know, since the proper adjustment will give the proper results.



It is not the present intention to give coil data for various condensers, nor padding values, but it may be stated that in the Super Diamonds, where the r-f coils are tuned by 0.00041 mfd., the inductance of the tuned secondaries is 250 microhenries, whereas the oscillator inductance is 218 microhenries, and the padding condenser for use with such inductance, for an intermediate frequency of 175 kc. is 850-1,350 mmfd.

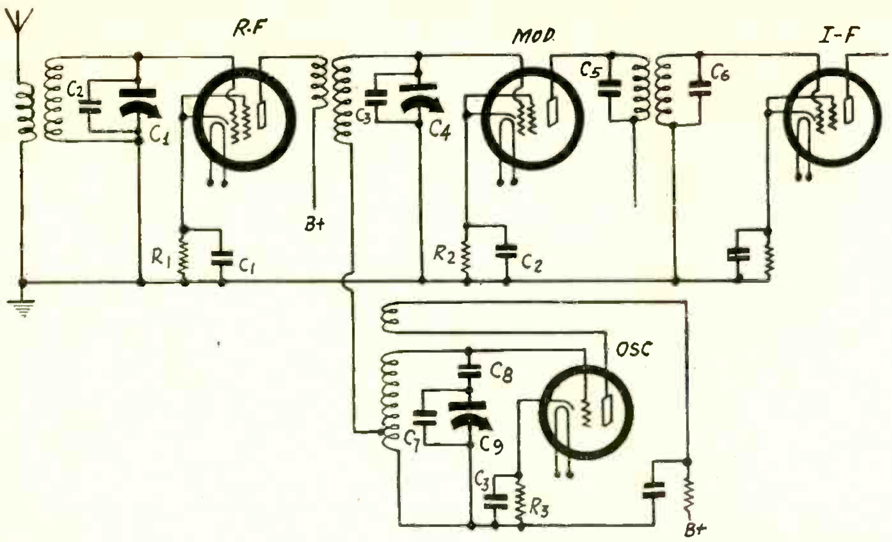
The verification of the broadcast band coverage by the tuner may be made by using the r-f stage as such, the autodyne (or in other circuits simply the modulator or first detector) as an audio frequency detector, and the audio amplification as it exists. Normally the range will be from about 1,530 to 530 kc, exceeding the broadcast band by a total of 40 kc.

Taking up the procedure in its recommended order, we find first, now that the set is completed, we have to line up the intermediate amplifier. To do this work as it should be done requires a test oscillator, and in the absence of a test oscillator it may be expected that only some fair approximation may be reached by the most versatile, but that nobody can get very far along the road to real accuracy without such an oscillator. Since one may build a test oscillator at a total cost well under $5, including tube, it is recommended that one have his own oscillator or that he try to borrow one, but not that he try to duck the problem and attempt peaking the intermediates by the hit-or-miss method, for a hit is rare and a miss is to be expected. Better to turn over the lining up process to some one instrumentally equipped to do it, rather than to risk making a botch of the job by nervously turning an insulated screwdriver and wearing out the bushings and threads of intermediate tuning condensers.

Coupling of Test Oscillator

If there are three or more intermediate coils in the receiver (normally two or more intermediate stages), with test oscillation voltage put into the first detector plate, with that tube in or out of the socket, it may be hard to find the resonance point. Too many circuits may be out of tune to enable a ready determination of the desired peak. So in that

(Continued on next page)



A typical "front end" of a superheterodyne, with one intermediate stage shown. C1, C4 and C9 are a gang condenser for tuning. C2, C3 and C7 are compensators. C8 is the padding condenser in "lifted" position. C5 and C6 are condensers across an intermediate coil.

(*Continued from preceding page*)
instance, and it is just as well to adopt the plan generally, the oscillation voltage may be fed to the grid circuit of the tube ahead of the demodulator (second detector).

Just how this coupling is to be accomplished may be explained in the instruction sheet accompanying the particular test oscillator used, and in that instance follow such direction. In the absence of any definite direction, connect a wire between output post of the test oscillator and the grid of the tube ahead of the second detector. If the oscillation from the test oscillator is sufficiently strong, then the output wire from the test oscillator need only be wrapped a few turns around the grid lead of the tube ahead of the second detector, no conductive coupling. If the oscillation intensity is insufficient this will evidence itself by failure of response.

It is assumed the oscillator is modulated, for this gives the more reliable index. If there is no response when i-f trimmers are turned, connect the bared end of the output wire from the oscillator directly to the grid cap or other control grid connection of this tube (depending on the type of tube it is, for location of this grid), and turn the i-f trimmers again. Now you will get response, let us say, for if you do not, either a volume control is not permitting the signal to get through, or there is something wrong somewhere between the i-f tube ahead of detector and the speaker output, and this trouble will have to be remedied before any further attempt is made at lining up.

What Intermediate Frequency?

Of course the question may arise as to what shall be the intermediate frequency. If one is building a set he knows what it should be, sets the test oscillator to the required frequency, and proceeds. If one encounters a commercial receiver, he should get the model and serial number, and refer to a service man's manual to ascertain the intermediate frequency required, set the test oscillator accordingly, and line up.

Now, since the test oscillator is delivering a signal, this may first encounter a mistuned circuit, because we are adjusting the coil ahead of the second detector, with input made to the next preceding coil. The possibility of off-resonance is of no importance, as the difference will not be great enough to stop the signal from coming through.

Now, follow this procedure carefully: Ascertain which is the primary and which is the secondary condenser. A voltmeter of 0-300-volt range or higher should be used, and when connected between grounded shield of the transformer and the adjusting screw on the intermediate condenser will give the plate voltage reading. Normally the grid circuit will give no voltage reading between its condenser and shield. Another way to discover the plate circuit is by quickly touching a screwdriver between the shield and the condenser, for the plate circuit yields a spark. This method directly shorts at least part and sometimes all of the B supply, and is dangerous. However, it is realized that despite the danger the method is frequently used.

Grid Tuning Predominates

Having identified the two circuits that way, or in some other manner, as by continuity testing between grid cap and intermediate condenser, the first thing to do, now that the adjustment is to be made, is to tune the grid circuit. This is the circuit that has the predominating tuning effect. After the grid circuit is tuned for maximum signal strength in the speaker, or greatest deflection in the output meter, if such meter is used, the adjustment of the grid circuit is utterly complete, and should not be molested thereafter. Next, the plate circuit is tuned. This circuit may not show much of an effect, at least until the capacity used becomes quite excessive, when signal output drops. Turn back the condensers until the signal value is high again, and if there is not much change as the capacity is decreased, add a little more capacity, by turning the screw in a right-handed direction, and stop. While it is true that the plate circuit tuning has some effect on the frequency of resonance in the grid circuit, the plate circuit has been treated in a manner rendering this effect negligible, and the result comes within the exactitude requirements.

With this transformer tuned one may move the oscillator output connection ahead one tube, to a preceding grid, and tune the second preceding coil ahead of the second detector, in exactly the same manner as the last coil was tuned. If there is still another coil, and that feeds out of the modulator (or, in some circuits, the autodyne or combination oscillator-modulator), connect the test oscillator output to the plate of the modulator or autodyne tube, with that tube in socket, if practical.

Usually to leave the tube in the socket requires access to the under side of the chassis, for the output wire, at its bared end, is clipped with a spring clip to the plate prong, carefully, and in such manner as to avoid danger of a short to ground or other low potential.

The benefit of all the circuit conditions is enjoyed when the tube is left in socket. If an adapter is used, access in the same manner is possible from the chassis top, by putting the adapter in the socket, the tube in the adapter and the output lead to the adapter's connector provided for that purpose. If you have no such adapter—and one isn't really necessary—and you can't gain access to underneath the chassis, remove the first detector tube and push the bared end of the output wire into the plate spring of the socket in such manner as to make good contact, which may require a close V bend of the wire, but without danger of short to chassis or other potential. Sometimes it is advisable to bend the wire back on itself twice, tighten the loops with pliers, and thus get a bigger diameter, somewhat resembling the thickness of a tube prong, for better contact.

When the plate circuit of the modulator is tuned, the final adjustment of the transformer, there may be little difference, until capacity is nearly maximum. In some circuits, like the Super Diamonds, this condenser has its rotor connected to another condenser, and identity of the lead by the voltmeter test to chassis or shield will not be disclosed. However, the grid circuit may be identified by its continuity between grid cap and tuning condenser, and the plate circuit by elimination. The adjustment then made, first of grid circuit, then of plate circuit. If the potential is particularly "hot," or sensitive to body capacity effects, when the plate circuit is tuned in autodyne supers, like the Super Diamonds, the adjustment should be made with the autodyne tube out of socket. Oscillation does not depend on the selection of adjustable capacity used here, as the minimum is more than enough to provide feedback.

Correction of Slight Error

Now the intermediate channel is lined up completely. If your test oscillator provides various frequencies by the usual method, you may turn the test oscillator, with feed left connected to plate of the first detector, with that tube in or out, and notice whether the maximum response prevails at the required frequency. It will, unless you have made a mistake.

If the maximum response obtains at some slightly different frequency, reset the oscillator at the specified intermediate frequency, retune the grid circuit ahead of the second detector, the companion plate circuit, etc., working back to the first detector output. There is no need to change the position of the feed from test oscillator when the re-alignment is made.

Now the intermediate channel has been lined up and, if need be, corrected to exact resonance, and if there will be any trouble in peaking and padding hereafter, we need not expect that it will be due to any fault in the intermediate amplifier.

Thus we have finished with the first step in the total operation and have met the requirement that "the intermediate frequency should be lined up exactly."

The next operation is to establish the r-f tuning points at least for the tie-down frequencies. What these frequencies shall be will depend on what the designer or engineer recommended. For nearly all present-day broadcast purposes, using intermediate frequencies of the order prevailing, these points will be 1,450 and 600 kc. Again, a test oscillator will come in handy, even if not being exactly necessary. Somehow we shall have to obtain these two frequencies. If broadcasting stations operating on these frequencies are within reach of the model t-r-f set constituted from part of the receiver we shall use them. It is important to stick very closely to 600 kc, and it is not advisable to use any frequencies farther away than 10 kc, i. e., 610 or 590 kc, and preferable of course to use exactly 600 kc. In this region particularly 10 kc means much, in the way of capacity, and as the adjustment will be of the series or padding condenser, we must take every precaution to get this right. At the high frequency end it is equally important to stick close to 1,450 kc, and, finally, it may be said that under no circumstances need one expect as excellent padding as is contemplated unless both tie-down frequencies are exactly as recommended.

A mean frequency for check-up must be registered, too, and for the tie-down frequencies just stated this mean should be 1,000 kc.

The R-F "Remake"

The full procedure for constituting part of the set as a t-r-f circuit will not be detailed, as being beyond the scope of this article.

However, if need be, sufficient circuit changes should be introduced to afford t-r-f response. In some circuits connecting the grid clip of the modulator tube to the otherwise opened grid of the second detector will do the trick. In the Super Diamonds it will not, because then there is zero bias on the 55 triode, not much detection will result, and besides the volume control is such as then to kill off any signal. For the Super Diamonds rebuild the autodyne to the extent of removing the plate lead, putting a resistor of around 30,000 ohms directly between cathode and ground, and connecting a 250,000-ohm resistor from plate to maximum B plus, with bypass condenser of any value across the biasing resistor, the larger the better, and any value, 0.00025 mfd. or less, from plate to ground. Connect any fixed condenser from plate of the erstwhile autodyne to control grid of the power tube.

The r-f section should be lined up on this basis, by adjusting the trimmers. There would be, normally, two trimmers: one across antenna coil secondary, other across modulator (or autodyne) input. The trimmers should be lined up at some high frequency, and it is just as well to select 1,450 kc, as we are most interested in that. For the low frequency end nothing is done except to register the 600 kc point. The 1,000 kc mean point should be registered too, for reference later.

Now the r-f is lined up, although only tentatively. The work should be done with the oscillator coil in place, and coupled, for then at least some of the effect of the coupling is present, particularly capacity. However, when the circuit is restored to a superheterodyne, as should be done now, with the oscillator tube functioning there will be a difference, due to mutual inductance, and a slight upset will have taken place, perhaps without one being quite aware of it. However, the trouble will show up later and the remedy can be applied then.

The next step is to effectuate the tie-down points, but in this regard it is important to know something about the theory, otherwise one may be widely at loss to understand some seemingly radical differences and surprises.

The oscillator has two independent variables, one the series or padding condenser, the other the compensator or small parallel equalizing condenser. Granting that the oscillator inductance is correct, the adjustment of the padding condenser will permit of gaining very strong response at the 600 kc setting, whereas the adjustment of the compensator across the oscillator will permit great differences in frequencies, possibly from nearly 2,000 kc to 1,450 kc (depending on the capacity of the compensator and on the inductance of the coil). The inductance governs the setting to a considerable extent at the high and low frequencies, and if it is incorrect will result in good reception at the tie-down points, and at frequencies near them, but with poor sensitivity and very many squeals at other points. Multifarious squeals and poor tone quality should be taken as a plain indication of bad tracking.

Now, as parallel capacity is added to the oscillator it is effective all along the tuning scale, less effective of course as the frequencies become lower, because the largeness of the condenser capacity tends to mask the compensator, nevertheless the effect continues. The frequency variation will be small, 10 to 30 kc or so, around 600 kc, due to any compensator readjustment, but will be large for equivalent change in compensator capacity at the high frequency end, as stated.

Therefore the compensator is used for tying down the oscillator high frequency end, the padding condenser for tying down the low frequency end, but now since the padding condenser produces virtually no capacity change at the high end (due to it being a large capacity in series with an extremely small one), we are persuaded to select as the first step in the tying-down process the adjustment of the padding condenser. The first work can be done in the other direction, but for the reason stated it is preferable to deal first with the variable that will be least affected by the next variable to be adjusted.

So we set our test oscillator at 600 kc (or 60 kc on some, and use the tenth harmonic), feeding this voltage to the antenna post, with aerial disconnected from receiver. If our test oscillator has sufficient intensity we do not need any conductive coupling, but may simply turn on the oscillator, adjust it to 600 kc, have it in the same room with the set, or near the set, and gain sufficient input that way.

Turn the set dial to where 600 kc came in on a t-r-f basis. Adjust the oscillator compensator until it is screwed down half way. Turn the screw from maximum to minimum, and count the revolutions. Turn back half the number of revolutions. Now adjust the padding condenser until the volume is greatest or needle deflection maximum. The low frequency end is now tentatively lined up.

There may be some difficulty here if the padding condenser is lifted instead of being grounded, but that difficulty merely consists of the effect of body capacity. Use an insulated type of screwdriver (neutralizing tool), and the trouble will be little, if any, although some slight body capacity may be present even then. After the adjustment is made for maximum response, and the hand is removed, if the response falls even noticeably, the capacity in the series circuit (padder) is now too small by the amount of the removed body capacity. Therefore slightly add capacity, retest for response, and if not up to first maximum, turn a bit more, and more, until the maximum condition prevails.

Grounded Padding Condenser

The grounded type of padding condenser is preferable because of immunity from body capacity effects, but has some disadvantages, as it may tend to reduce the oscillation of the oscillator, and besides always will render a lower amplitude of output oscillation than will the lifted type of padding condenser, because the input to the tube is between the coil extremes, and when the condenser is between coil and ground the input is divided, as the voltage drop in the padding condenser is not a part of the input. If a grounded padding condenser is small enough (say, if it were smaller than the capacity of the tuning condenser itself) oscillation might stop.

Having tentatively padded at 600 kc, at the r-f position on the dial, which is applicable to both r-f and oscillator, we now know that at this point the r-f oscillator is 175 kc higher, because the intermediate frequency is 175 kc.

Adjusting the test oscillator at 1,450 kc, we turn the gang condenser **slowly** around this region, and discover where the 1,450 kc frequency really comes in. The result may surprise us. It may come in, say, where 1,550 kc ought to be. Or it may come in where, say, 1,300 kc **ought** to be. However, we know that the oscillator compensator has yet to be adjusted, and therefore we select the 1,450 kc t-r-f position on the dial, and add or subtract compensator capacity in the oscillator circuit by this rule: if the dial reading at which 1,450 kc now comes in has to be shifted to a lower frequency position to reach the 1,450 kc r-f marking, we must decrease the compensator capacity across the oscillator; if the dial reading at which the frequency comes in has to be shifted to a higher frequency position to reach 1,450 kc we must increase the compensator capacity across the oscillator.

Critical Adjustment

The changes in frequency are rapid, and the adjustment is exceedingly critical. Actually it is necessary finally to turn the screw such a small amount that were it not for the frequency change noted it would not be evident that there had been any movement. And the very slightest noticeable movement will make a change of perhaps 50 kc or more. So watch your step most carefully in making this particular adjustment.

When the adjustment has been made on the dot it is necessary to retest the antenna and autodyne input compensators, for the introduction of the working oscillator has changed the constants in at least one of these circuits. No longer are these two compensators, called r-f compensators, of superior importance, by themselves, for we have attained the desired oscillator position on the dial for 1,450 kc signal, and now the oscillator has become the ruling or determining frequency. In closely-coupled circuits, including autodynes, the modulator input compensator acts as if in parallel with the oscillator compensator, and these two circuits then have to be adjusted together. We have to make the two other circuits correspond to it, which we do by readjustment at 1,450 kc, without molesting the oscillator. It will surprise many, no doubt, to experience a great increase of sensitivity when these two compensators, first set for this position with some accuracy, are reset to fit the new requirements.

As stated, the alteration of the oscillator parallel capacity this way has affected the low frequency padding, and a slight readjustment therefore may have to be made at the low frequency end. However, under no circumstances touch the compensators, for they have been set to stay, and do not molest anything at all in the circuit, anywhere, except the padding condenser.

The third requirement has been fulfilled, the most exacting requirement of all, and now we pass to the fourth **and** final one, having to do with checkup. We know that the actual r-f setting for the 1,000 kc frequency may be somewhat different now, though the difference is hidden, for we have changed the capacity in the circuit that originally determined the mean frequency position, yet we may check up at least to the extent of knowing that 1,000 kc, using the test oscillator, comes in fairly close to the mark previously stated. If it does not, and there are squeals in this region, the oscillator inductance is incorrect, because the two tie-down points and frequencies adjacent will be well protected even with a wrong inductance, but squeals, poor tone, lack of sensitivity and even dubious selectivity may accompany the tuning at **approxi-**

(Continued on next page)

(*Continued from preceding page*)
mately thet middle part of the dial. The direction of the error may be estimated.

If the compensator across the oscillator had to be turned down all the way before 1,450 kc came in at the right point, and the padding condenser required all or nearly all of its capacity, and there are squeals in mid-dial tuning, then the oscillator inductance is too low. If the compensator had to be all the way out, and the least, or nearly the least, of the padding condenser capacity, had to be used for the 600 kc adjustment, then the oscillator inductance is too high, if there is squealing in mid-dial tuning. Fix in mind the fact that these indications are true only if the squeals are present, to boot.

The obvious remedy would be to use more turns or fewer turns on the oscillator's tuned winding, or, an easier way out for some, to increase the intermediate frequency if the indications are of too low inductance, and decrease the intermediate frequency if the inductance is too high. Then, of course, the whole padding operation would have to be repeated.

Incidental Frequency Factors

Besides the foregoing there are some other factors that change the frequency, and while the units are seldom changed, it is well to be informed of how they possibly upset the frequency matching.

The biasing resistor in the oscillator circuit is the most important one in this respect (R3 in diagram). If this is increased substantially, the frequency increases. Therefore the inductance of the oscillator's tuned winding depends to a slight extent on the value of biasing resistor used, a fact the circuit designer either had to bear in mind, or at least the inductance was based on the standard voltaging of this tube.

Because the oscillator is so important in determining the frequency of response, if a set is lined up on the basis of a given value biasing resistor or voltage, then of course no change should be made as part of any subsequent experiments, unless it be understood that a redesign of the oscillator coil may be necessary.

Changing the plate voltage also slightly changes the frequency, as this is to the same effect as changing the grid bias. The impedance of the plate circuit is altered in either instance.

Changing from one type oscillator tube to another (e.g., 57 to 58), usually requires compensator readjustment at least.

The Effect on R-F Level

Of course the effect present in the oscillator is also present in the r-f tubes, including the modulator. For the same reason the resistance values and voltages should not be changed after the lining up has been accomplished on the basis of given values. While the frequency difference is small from one viewpoint, as compared to the total span of frequencies covered in the tuning operation, nevertheless the actual change in frequency might be 20 kc at the high frequency end, which is serious. This applies to d-c voltage changes of a sufficient magnitude, in plate, screen or cathode circuits, and also in general to coupling alteration, if the coupling is changed considerably. But the coupling alteration does not affect the plate impedance, and compensation may be introduced, whereas altered plate impedance can not be readily atoned for singly by compensator, padding condenser or inductive method.

If the oscillator coil has tightly coupled windings, any substantial change in the number of turns or the separation between coils will affect the frequency a little. Usually the frequency is lowered as the coils are brought closer together, if one winding is on top of another, because the increased capacity effect is large, compared to the possible reduced inductive value due to mutual coupling.

Four-Tower Aerial Overcomes Planes' Sky Wave Handicap

Washington

Another important step in providing practicable and accurate aid to air navigation has been taken by the Department of Commerce with the recent development of a new type of transmitting antenna which insures more accurate reception of the signals sent out by the radio range beacons to guide airmen along the Federal Airways System.

The new antenna was developed by the Research Division of the Aeronautics Branch organized at the Bureau of Standards and in cooperation with the Airways Division of the Branch, as a means of eliminating troublesome night effects which took the form of variations of the courses from their true positions. The experiments have been completed and new antennae are now being installed on the airways.

Aural Signals Sent

The problem confronting the Department's radio engineers was complicated by the action of the Kennelly-Heaviside ionized layer hanging many miles above the earth. This layer was particularly objectionable in that it produced changes in the position of the courses sent from the radio range beacons on the airways.

When flying at night in a fog, rain or snow, which conditions decrease the visibility to the point where the airways rotating beacon lights cannot be seen effectively, or in the daytime when visibility is low, pilots rely very extensively on the radio direction signals. These radio beacons are located 200 miles apart along the Federal airways.

Signals Strayed

Signals sent out by these stations at the present time are aural in character and are received by the pilot through headphones. If the plane moves off to one side of the course marked by the radio beacon, the pilot will receive a series of Morse code signals of the letter "N." If off to the other side, the code signals for the letter "A" will be picked up. When the aircraft is on course, a continuous signal consisting of a series of dashes will be heard.

The difficulty in the past has been that when the signals were sent out from the ground stations to a plane flying on its course some of them would shoot up to the Kennelly-Heaviside layer where they would be immediately reflected back to the earth.

But after having been reflected from this ionized layer, in many cases, especially at night and in mountainous country they would cause an apparent shift in the course. Consequently a pilot would sometimes become confused after finding his range course shifting from its proper position. This phenomen was most objectionable when the plane was flying at a distance of 50 or more miles from a station and was not particularly troublesome over shorter distances.

The task the Aeronautics Branch presented to its Research and Airways Division was that of eliminating the component of the radiation producing this bad effect.

Four Tower Radiators Used

This was accomplished by Bureau of Standards scientists after many experiments by using a different type of antenna at the radio beacon stations. By changing the antenna from the loop system formerly used to a system using four tower radiators placed at the corners of a large square, the objectionable component of the sky-wave was practically eliminated.

Tests flights from Bellefonte, Pa., over the Alleghany mountains proved the new antenna system to be successful, and 45 of the beacons on the Federal Airways System are to be equipped with the new type antennae. About half of the new antennas are being installed at stations constructed within the past year but not equipped with antennas pending the development of the new type. The others are being provided at stations previously in operation where the night variations occurred most frequently.—(Issued by the Department of Commerce.)

Partisan Political Talks Protested by Germans

Washington

More political news from foreign countries and more actual non-partisan local political reviews are desired by German radio fans, according to a report from Vice Consul C. W. Gray, Berlin.

The Berlin branch of the Association of German Radio Dealers recently asked 350 member firms to find out what the public wanted. The replies indicated that the public was opposed to the radio being converted into a political instrument.

More light entertaining music would also be welcomed, the questionnaires revealed. While classic music was appreciated, the replies showed that fewer programs were desired. A desire for better artists in all fields was expressed.

While the German fans felt that too much political talk was being broadcast, it expressed the desire that interesting sessions of the German Parliament be broadcast, possibly from records. Outstanding court trials also were included, and it was pointed out that legal discussions on the radio would be better received if language understandable by the average listener was used.

* * *

Radiotelephone service between trains and ferries was recently inaugurated in Germany by the National Railroad Company, enabling passengers on these transportation services to carry on conversations while en route, according to advices from Assistant Trade Commissioner A. Douglas Cook, Berlin.

Express trains operating between Berlin and Hamburg and ferries plying from Warnemuende to Gjedser are now equipped with short-wave radiotelephone apparatus which permits direct telephone connections betwen the two services, it is reported.

Reason for Blocking

Blocking of an oscillator is due to gradual stopping and starting of oscillation on account of cumulative grid voltage changes. The rate of blocking depends to a large degree on the time constant of the grid leak and stopping condenser, but it also depends on the other adjustments of the oscillator, particularly those on which the amplitude of the grid voltage depends. One way of stopping the blocking is to reduce the grid leak resistance, or the grid stopping condenser capacity, or both.

THE RADIO KNIFE

And Other Recent Developments

By Dr. C. E. Skinner

Assistant Director of Engineering
Westinghouse Electrical & Manufacturing Co.

WE are all familiar with radio and radio broadcasting. We are not so familiar, however, with the innumerable by-products of radio which are finding their way into industry in an amazing way. Many of these devices make possible operations hitherto impossible by other means, and others permit the carrying on of many operations with a speed and efficiency and accuracy unknown by the previous available methods or by human means.

An extremely interesting device was exhibited in Cleveland, known as the radio knife. This device is merely a straight wire or loop of wire connected to a high frequency outfit and so arranged that this wire literally burns its way through living flesh, searing the blood vessels as it goes with the burn extending hardly at all beyond the point of contact of the so-called knife as it is used for surgical operations. We are told that this device changes certain difficult operations from the major class to the minor class, and its further extension into surgical work of many kinds will undoubtedly be a boon to both surgeon and patient.

The Photo Cell's Uses

We have the photoelectric cell which is performing amazing operations in a wide variety of fields. These operations include such things as the control of lighting of interiors, the photocell determining accurately when lights should be turned on and when they should be turned off and performing this operation without the intervention of human control. The control of theater dimming and color programs becomes very easy through the agency of this tube. Elevators are very accurately leveled at the different floors and a beam of light across the door makes it impossible to close the elevator doors or start the elevator when a passenger is entering or leaving.

Program control of floodlighting and sign flashing is made very easy and with equipment in which there is practically no deterioration making and breaking the circuits, and the programs may be changed very simply by very inexpensive maens.

The control of chemical processes where color is a factor for the indicating of the amount of smoke coming from a power house stack is carried on automatically by these remarkable tubes. There are scores of other applications either already accomplished or under consideration for the use of these outstanding by-products of radio.

Lightning Measured

From the beginning of the general use of electricity lightning has always been one of the difficult things to reckon with due to its destructive characteristics, particularly when it strikes transmission lines, destroying insulators, transmission poles, and the apparatus connected to these lines, such as generators, transformers, etc.

During the last few years equipment for the production of artificial lightning to a certain extent comparable with the lightning thunder storms, has been built in different places and extensive studies with the this controlled artificial lightning have gone far to give a real understanding of the character of lightning and to indicate the ways and means of circumventing its destructive effects.

Furthermore, apparatus has been devised for actually measuring the natural lightning which from time to time creates havoc in electric systems, particularly those existing in areas where much lightning abounds. Within the last two or three years these studies have shown with a certain degree of accuracy the voltage, current and power in a lightning stroke. With this knowledge the experimenter of today would certainly take far more precautions than did Benjamin Franklin in his classic experiment which proved that lightning and artificial electricity known in that day were the same.

Magnetic Ores

All electrical devices in the dynamo and motor class require as one of the fundamental materials in the construction some form of magnetic material. This is provided almost exclusively by iron. Two other known materials which contain magnetic properties are nickel and cobalt, but these in themselves are very weak magnetically as compared with iron.

From the beginning of the electrical industry to the present time there has been continuous research in the hunt for better and better magnetic materials for the various applications in electrical equipment, electrical instruments, etc.

Two general classes of such magnetic materials are required. The first, a material which can be magnetized to a very high degree and which will immediately lose its magnetic quality when the magnetizing force is removed, and the other, a material which, when magnetized, will retain the highest degree possible of magnetic value.

The former is used in practically all dynamos, motors, transformers, etc., the latter wherever permanent magnets are required, such as magnetos, many instruments and many other applications.

Two outstanding steps have taken place through the years in the development of magnetic materials. These major steps are combined with innumerable detailed improvements with a continually increasing knowledge of the fundamentals of magnetic materials which give us today in both the classes mentioned materials tremendously superior to those known in the former years of the electrical industry.

The first of these was the invention of silicon steel by Sir Robert Hatfield nearly thirty years ago with continuous detailed improvement in this class of material up to the present day and with an intensive program of research under way today which gives promise of further radical improvements.

Savings Effected

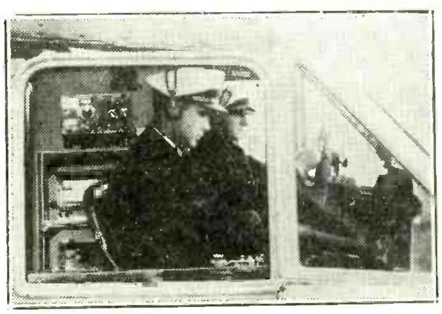
The second may perhaps be divided into two steps, the first, when tungsten and similar materials were used as a part to form an alloy for permanent magnets, and the second, with the development of cobalt iron alloys perhaps four or five times as efficient as the best previous tungsten class of alloys of a decade or so ago.

2,000-Ohm Resistor for 58 as Modulator

The 58 tube, which in general is similar to the 235, was designed so that it would not detect well, or more particularly, it was designed so that it would not cross-modulate. Yet this tube, it has been found, is an excellent first detector in a superheterodyne. The reason is that no amplifier tube has a perfectly straight output characteristic and if it is operated over a wide enough part there will be distortion.

In the mixer the oscillator can easily be made to supply a voltage high enough to overload the tube, considered as an amplifier, and thus make it a good detector. But normally the biasing resistor for the 58 modulator should not exceed 2,000 ohms or oscillation might fail, unless the plate voltage exceeded 150 volts.

Radio in Plane



Pilots of Eastern Air's passenger liners keep in communication with the ground while en route at 125 miles an hour. A microphone is used for voice transmission to the ground or to other planes, and on the window sill can be seen the telegraph key which is used for long distance or bad weather contacts

Mutual Inductance in Oscillator Coils

In most oscillators the mutual inductance between the plate and the grid windings must be negative in order that oscillation be possible. But when the two windings are considered as a single coil with the two interior terminals going to the cathode and the plate supply, the coil appears to be a single one and hence such that the mutual inductance is positive.

The apparent contradiction is explained by the relative directions of the plate and the grid currents. In the Hartley oscillator, for example, the mutual between the two sections of the single winding is positive with respect to the resonant current but negative with respect to the plate and grid currents. The sign of the mutual is a matter of viewpoint.

TUBE CHARACTERISTICS

171A

Type of tube	Filamentary triode
Socket	Four contact
Purpose	Power amplifier
Overall height	4 11/16 inches
Overall diameter	1 13/16 inches
Filament voltage	5 volts, d.c.
Filament current	0.25 ampere
Ballast for 6-volt supply	4 ohms
Amplification factor	3

Amplifier, 90-volt plate

Plate voltage	90 volts
Grid bias	16.5 volts (19 for a.c.)
Plate current	12 milliamperes
Plate resistance	2,250 ohms
Mutual conductance	1,330 micromhos
Maximum undistorted output	125 milliwatts
Optimum load resistance	3,200 ohms

Amplifier, 135-volt plate

Plate voltage	135 volts
Grid bias	27 volts (29.5 for a.c.)
Plate current	17.5 milliamperes
Plate resistance	1,960 ohms
Mutual conductance	1,520 micromhos
Maximum undistorted output	370 milliwatts
Optimum load resistance	3,500 ohms

Amplifier, 180-volt plate

Plate voltage	180 volts
Grid bias	40.5 volts (43 for a.c.)
Plate current	20 milliamperes
Plate resistance	1,850 ohms
Mutual conductance	1,620 micromhos
Maximum undistorted output	700 milliwatts
Optimum load resistance	5,350 ohms

(*Socket No.* 1, *January 21st issue, page* 11)

200A

Type of tube	Filamentary triode
Socket	Four contact
Purpose	Detector
Overall height	4 11/16 inches
Overall diameter	1 13/16 inches
Filament voltage	5 volts, d.c.
Filament current	0.25 ampere
Ballast for 6 volt supply	4 ohms
Amplification factor	20
Grid-plate capacity	8.5 mmfd.
Grid-filament capacity	3.2 mmfd.
Plate-filament capacity	2.2 mmfd.
Grid leak resistance	2 to 3 megohms
Plate voltage	45 volts
Grid bias	A minus
Plate current	1.5 milliamperes
Plate resistance	30,000 ohms
Mutual conductance	670 micromhos

(*Socket No.* 1, *January 21st issue, page* 11)

240

Type of tube	Filamentary triode
Socket	Four contact
Purpose	Detector and amplifier
Overall height	4 11/16 inches
Overall diameter	1 13/16 inches
Grid-plate capacity	8.8 mmfd.
Grid-filament capacity	3.4 mmfd.
Plate-filament capacity	1.5 mmfd.
Filament voltage	5 volts
Filament current	0.25 ampere
Ballast for 6-volt supply	4 ohms
Amplification factor	30

Detector

Plate voltage	180 volts
Load resistance	0.25 megohm
Grid bias	A plus
Plate current	0.5 milliampere
Plate resistance	90,000 ohms
Mutual conductance	330 micromhos

Amplifier

Plate voltage	180 volts
Plate load resistance	0.25 megohm
Grid bias	3 volts
Plate current	0.2 milliampere
Plate resistance	150,000 ohms
Mutual conductance	200 micromhos
Voltage amplification	18.75

(*Socket No.* 1, *November* 21*st issue, page* 11)

201A

Type of tube	Filamentary triode
Socket	Four-contact
Purpose	Detector and amplifier
Grid-plate capacity	8.1 mmfd.
Grid-filament capacity	3.1 mmfd.
Plate-filament capacity	2.2 mmfd.
Overall height	4 11/16 inches
Overall diameter	1 13/16 inches
Filament voltage	5 volts
Filament current	5.25 ampere
Ballast for 6-volt supply	4 ohms
Amplification factor	8

Detector, Grid Leak Type

Plate voltage	45 volts
Grid bias	A plus
Plate current	1.8 milliamperes
Plate resistance	12,000 ohms
Mutual conductance	670 micromhos

Amplifier, 90-volt plate

Plate voltage	90 volts
Grid bias	4.5 volts
Plate current	2.5 milliamperes
Plate resistance	11,000 ohms
Mutual conductance	725 micromhos
Max. undistorted output	15 milliwatts
Optimum load resistance	11,000 ohms

Amplifier, 135-volt plate

Plate voltage	135 volts
Grid bias	9 volts
Plate current	3 milliamperes
Plate resistance	10,000 ohms
Mutual conductance	800 micromhos
Max. undistorted output	55 milliwatts
Optimum load resistance	20,000 ohms

Socket No. 1 January 21 issue

112A

Type of tube	Filament triode
Socket	Four-contact
Purpose	Amplifier
Grid-plate capacity	8.1 mmfd.
Grid-filament capacity	4.2 mmfd.
Plate-filament	2.1 mmfd.
Overall height	4 11/16 inches
Overall diameter	1 13/16 inches
Filament voltage	5 volts
Filament current	0.25 ampere
Ballast for 6-volt supply	4 ohms
Amplification factor	8.5

Amplifier, 90-volt plate

Plate voltage	90 volts
Grid bias	4.5 volts
Plate current	5.2 milliamperes
Plate resistance	5,600 ohms
Mutual conductance	1,500 micromhos
Max. undistorted output	30 milliwatts
Optimum load resistance	5,600 ohms

Amplifier, 135-volt plate

Plate voltage	135 volts
Grid bias	9 volts
Plate current	6.2 milliamperes
Plate resistance	5,300 ohms
Mutual conductance	1,600 micromhos
Max. undistorted output	115 milliwatts
Optimum load resistance	8,700 ohms

Amplifier, 180-volt plate

Plate voltage	180 volts
Grid bias	13.5 volts
Plate current	7.6 milliamperes
Plate resistance	5,000 ohms
Mutual conductance	1,700 micromhos
Max. undistorted output	260 milliwatts
Optimum load resistance	10,800 ohms

Socket No. 1 January 21 issue

230

Type of tube	Filamentary triode
Socket	Four contact
Purpose	Detector and amplifier
Grid-plate capacity	6.0 mmfd.
Grid-filament capacity	3.7 mmfd.
Plate-filament capacity	1.25 mmfd.
Overall height	4 1-4 inches
Overall diameter	1 9-16 inches
Filament voltage	2 volts, d-c
Filament current	60 milliamperes
Ballast for 3-volt supply	16.7 ohms
Ballast for 6-volt supply	66.7 ohms
Amplification factor	9.3
Plate resistance	10,300 ohms
Mutual conductance	90 micromhos
Optimum load resistance	20,000 ohms

Bias Detector

Plate voltage, maximum	180 volts
Grid bias	18 volts

Amplifier

Plate voltage	135 volts
Grid bias	9 volts
Plate current	3 milliamperes
Max. undistorted output	70 milliwatts

Amplifier

Plate voltage	180 volts
Grid bias	13.5 volts
Plate current	3.1 milliamperes
Max. undistorted output	130 milliwatts

(*Socket No.* 1, *January* 21*st issue*)

231

Type of tube	Filamentary triode
Socket	Four-contact
Purpose	Power amplifier
Overall height	4 1-4 inches
Overall diameter	1 9-16 inches
Filament voltage	2 volts, d-c
Filament current	130 milliamperes
Ballast for 3-volt supply	7.7 ohms
Ballast for 6-volt supply	30.8 ohms
Amplification factor	3.8

Amplifier

Plate voltage	135 volts
Grid bias	22.5 volts
Plate current	8 milliamperes
Plate resistance	4,100 ohms
Mutual conductance	925 micromhos
Max. undistorted output	185 milliwatts
Optimum load resistance	7,000 ohms

Amplifier

Plate voltage	180 volts
Grid bias	30 volts
Plate current	8 milliamperes
Plate resistance	3,600 ohms
Mutual conductance	1,050 micromhos
Max. undistorted output	375 milliwatts

(*Socket No.* 1, *January* 21*st issue*)

232

Type of tube	Filamentary tetrode
Socket	Four-contact
Purpose	Detector and amplifier
Overall height	5 1-4 inches
Overall diameter	1 13-16 inches
Grid-plate capacity	0.06 mmfd. (max.)
Grid-filament capacity	6.0 mmfd.
Plate-filament capacity	11.7 mmfd.
Filament voltage	2 volts, d-c
Filament current	60 milliamperes
Ballast for 3-volt supply	16.7 ohms
Ballast for 6-volt supply	66.7 ohms
Screen voltage*	67.5 volts

Bias Detector

(0.25 megohm load.)

Plate voltage	180 volts
Grid bias	6 volts
Plate current	0.3 milliamperes or less
Screen current	About 1-3 plate current

Amplifier

Plate voltage	135 volts
Grid bias	3 volts
Plate current	1.7 milliamperes
Screen current	About 1-3 plate current
Amplification factor	610
Plate resistance	950,000 ohms
Mutual conductance	640 micromhos

Amplifier

Plate voltage	180 volts
Grid bias	3 volts
Plate current	1.7 milliampere
Screen current	About 1-3 plate current
Amplification factor	780
Plate resistance	1,200,000 ohms
Mutual conductance	650 micromhos

(*Socket No.* 4, *January* 21*st issue*)

*When a high load resistance is used in an amplifier circuit the screen voltage should be much less from 7.5 to 22.5 volts.

The cap of the tube is the control grid terminal and the G-prong on the base is the screen grid terminal.

234

Type of tube	Filamentary pentode
Socket	Four-contact
Purpose	Super-control r-f amplifier and detector
Overall height	5 1-4 inches
Overall diameter	1 13-16 inches
Filament voltage	2 volts, d-c
Filament current	60 milliamperes
Ballast for 3-volt supply	16.7 ohms
Ballast for 6-volt supply	66.7 ohms
Grid-plate capacity	0.02 mmfd. (max.)
Grid-filament capacity	6.4 mmfd.
Plate-filament capacity	12.8 mmfd.
Screen voltage*	67.5 volts

Bias Detector

(*For detector in superheterodyne*)

Plate voltage	90 to 180 volts
Grid bias	8 volts for 180 volts on plate
Plate current	Adjust to 0.3 milliamperes or less by means of bias

Amplifier

Plate voltage	135 volts
Grid bias	3 volts
Plate current	2.8 milliamperes
Screen current	About 1-3 of plate current
Amplification factor	360
Plate resistance	600,000 ohms
Mutual conductance	600 micromhos

Amplifier

Plate voltage	180 volts
Grid bias	3 volts
Plate current	2 milliamperes
Screen current	1 milliampere
Mutual conductance	620 micromhos
Amplification factor	620
Plate resistance	One megohm

*If the tube is used in a resistance coupled circuit for amplification with a high resistance in the plate circuit the screen voltage should be much lower.

The cap is the control grid.

(*Socket No.* 4*A*, *January* 21*st issue*)

Auto Rectifier and 2-Volt Dual Grid Tubes Impending

AS if in fulfillment of the report that fifteen new tubes are to be "sprung" within a month or six weeks of one another, the seventh and eighth can be mentioned now as being about to be announced and somewhat later released.

These two new tubes are the 84, a rectifier especially suitable for automobile use, and the 49, a new 2-volt dual-grid power amplifier tube for either Class A or Class B output. The data concerning these tubes as here given are not official, but will be found to conform closely to the official information when that is released, and meanwhile serve as advance notice of these two valves.

Characteristics of the 84

The 84 will be a full-wave rectifier of the high vacuum type, with heater cathode construction. The characteristics include:

Heater voltage, 6.3 volts.
Heater current, 0.5 ampere.
A-c voltage per plate (maximum) 225 volts.
D-c output current (maximum) 15 milliamperes.

The tube will have a small five-pin base and will resemble the 56 in general appearance.

The heater type cathode will be such as to permit a voltage difference of 300 volts d-c between heater and cathode, so that the heater for the 84 may be operated from the same storage battery that serves the rest of the automotive series tubes in the receiver. High rectification efficiency is provided, due to the close electrode spacing.

Filters Discussed

It will be set forth that the 84 is well suited to providing rectified power to radio equipment of the automotive type, and that the performance of the tube is similar to that of any other high vacuum rectifier. The usual recommendations and precautions will be stated as to the operation of the tube, including the advice that the filter be such that the maximum plate current and voltage specifications be not exceeded.

In general, this has to do with the use of not too high a capacity next to the rectifier, as this tends to lift the peak voltage and put quite a strain on the condenser. So the condenser next to rectifier, and incidentally a condenser in the reservoir position of the rectifier, should be of sufficiently high voltage breakdown rating to meet the requirements.

The instantaneous a-c input voltage for a sinusoidal wave is about 1.4 times the average value of the voltage as measured by an a-c voltmeter, and if the wave front is not sinusoidal, as it may not be in automobile installations, due to vibrator types of a-c feed, the instantaneous peak a-c voltage may be even more than 1.4 times the r.m.s. value.

Choke Input Suggested

Also, if the wave front is non-sinusoidal, and condenser type input is used, that is, a condenser next to the rectifier, the peak plate current at no load may be four times the current existing when there is load. So precautions must be taken in several directions, including condenser location, condenser breakdown rating, and voltage and current limitations of the tube plates.

Although the d-c voltage will be less if the choke input type of filter is used, the current will be less at no load, a better margin of safety enjoyed, and moreover improved regulation will result.

Synopsis of Data on the Six Valves

A synopsis of the purposes and capabilities of the six new tubes follows:

The 84 is a full-wave rectifier, using the heater cathode type of construction, and designed for automotive and similar use. It will serve to rectify the a-c component of vibrators used for making auto sets B-batteryless. The allowable current is small (15 ma) at 225 volts per plate.

The 49 is a 2-volt power tube, for Class A or Class B output, and has two grids. As a Class A amplifier it has a nominal power output of 0.17 watt and as Class B (two tubes) 3.5 watts.

The 25Z5 is a rectifier-doubler of particular interest to designers of "transformerless" receivers. It may be used as a half-wave rectifier in the "universal (a-c and d-c)" types, or as a voltage-doubling rectifier in the "straight a-c" types. The adaptability of the 25Z5 to "transformerless" receivers is facilitated by the heater design which permits of economical series operation with other tubes.

The 5Z3 is a heavy-duty, full-wave rectifier of the high-vacuum type intended for supplying rectified power to radio equipment having very large direct-current requirements.

The 2A3 is a power amplifier triode with a multifilamentary cathode. This new type represents new tube-design capabilities for delivering exceptionally large power output (Class A) at plate voltages generally used in console receivers. More specifically, a pair of 2A3's in Class A push-pull combination under maximum recommended operating conditions can supply 15 watts of undistorted power. The power handling ability of the 2A3 is the result of its design features which provide not only very large emission but also extremely high mutual conductance. These characteristics are efficiently obtained by means of an unconventional cathode consisting of a large number of coated filaments arranged in series-parallel.

The 2A5 is a power amplifier pentode of the uni-potential cathode type. Because of the heater-cathode construction and consequent low hum-level, the 2A5 is recommended to designers of a-c receivers which utilize a power-output stage of the pentode type. A single 2A5 is capable of supplying about three watts.

* * *

[The 25Z5, the 5Z3, the 2A3 and the 2A5 were described and illustrated in great detail last week, including socket connections. EDITOR.]

Specifications of the 49

The 49 will have specifications closely adhering to the following:

Filament voltage, 2.0 volts.
Filament current, 0.12 ampere.

CLASS A AMPLIFIER.

(Grid adjacent to plate connected to plate of socket.)

Plate voltage (maximum) 135 volts.
Plate current, 5.7 milliamperes.
Grid voltage, minus 20 volts.
Plate resistance, 4,000 ohms.
Load resistance 6,000 ohms*.
Amplification factor, 4.5.
Mutual conductance, 1,125 micromhos.
Nominal power output, 170 milliwatts.

*Approximately twice this value is recommended for load on the tube when the tube is used as a driver for Class B.

CLASS B POWER AMPLIFIER.

(Two grids connected together at socket.)

Plate voltage (maximum) 180 volts.
Dynamic peak plate current, 50 milliamperes.

Typical operation of two tubes:

Filament voltage, 2 volts; filament current, 0.12 ampere; plate voltage, 180 volts (maximum); plate current, per tube, 2 milliamperes; grid bias, 0; load resistance, plate to plate, 12,000 ohms; nominal power output, 3.5 watts.

The 2A5 a Surprise

Of the four tubes detailed in last week's issue as to their characteristics, uses and connections, three had been anticipated in these columns, but the fourth, a new pentode, was a surprise. This was the 2A5.

This tube has a heater type cathode, like the 59, its immediate predecessor in pentode uses, although the 59 may be used as either pentode or triode, which the 2A5 may not, for it is like the '47, except that it is of the heater type, and also except that its amplification factor is the highest of any and of all of the receiver type tubes. Whereas the amplification factor of the 59 used as pentode is 100, and that of the '47 is 150, the new tube has an amplification factor of 220. The mutual conductance is 2,200 micromhos, approximately the same as that of the 59 when used as pentode and as the '47.

The Recommendation

The negative bias voltage is 16.5 volts, the ohms load for output may be either 7,000 or 9,000 ohms, with 7,000 slightly preferred, so that '47 speakers, including those with the 300-ohm tap in 1,800- ohm negative-leg-rectifier-choke field coil, may be used on the new tube. The power output is 3 watts. The '47 tube and socket in existing receivers are the only changes needed. The socket is of the six-pin type, due to the cathode independence of the heater. The connections are: heater, heater plate, screen, cathode, and grid.

Little was said about this tube comparatively, but the official announcement set forth: "The 2A5, because of its heater-cathode construction, consequent low hum level, and large power output, is recommended to designers for output use in a-c receivers employing a pentode power stage."

HILL IN NEW SERIES

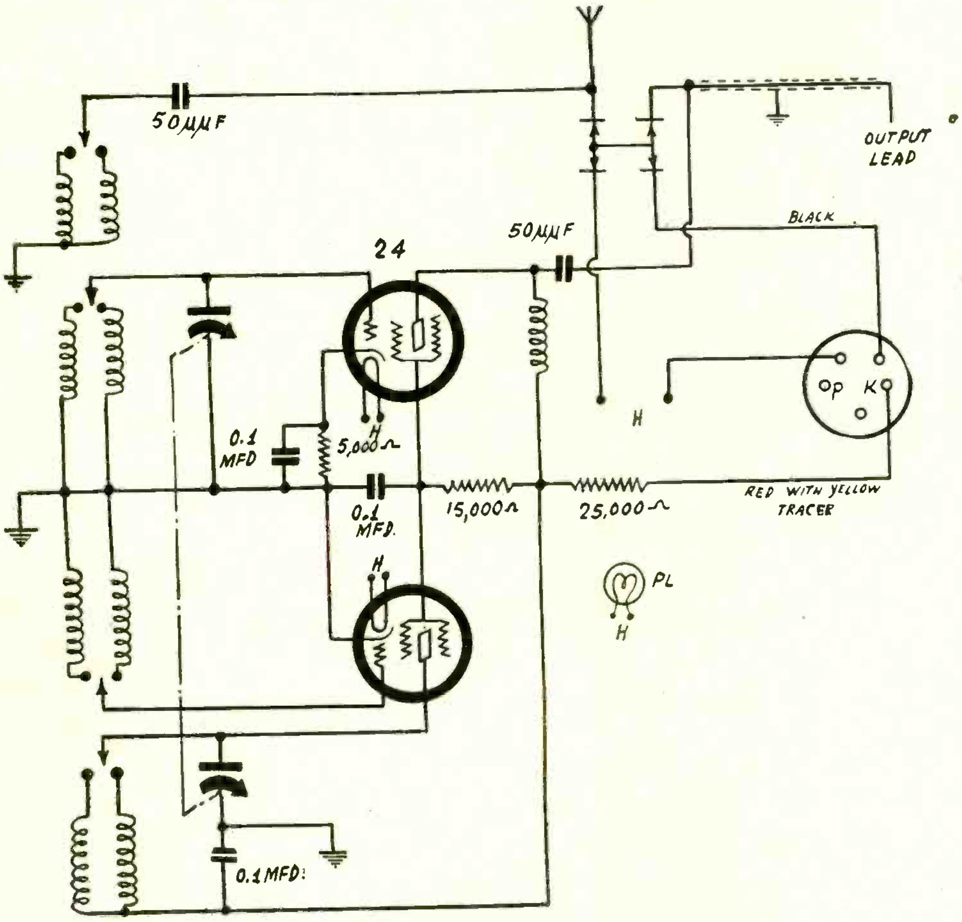
Edwin C. Hill presents a different outstanding personality each week in a series of programs heard over an extensiv network of the Columbia Broadcasting System on Fridays between 9:30 and 10:00 p.m., EST. The programs, to be known as "The Inside Story," are broadcast over 39 stations under the sponsorship of the Socony-Vacuum Corporation.

BRUNSWICK CONVERTER

Short Waves on Set's I-F, 600 to 800 kc

By Harry Lefkowitz

Walter H. Nussbaum, Inc.



Circuit diagram of the Brunswick Model 100 short-wave converter.

HERE is the circuit of the Brunswick short-wave converter, a two-tube superheterodyne frequency-changer by means of which short waves may be received on regular broadcast sets.

The circuit consists of a 224 detector with tuned input and a 224 oscillator. The oscillator and r-f coils corresponding to any frequency band are on one form, the r-f being near the bottom of the plug-in form. On each form are four windings, the primary for the r-f coil, the secondary, the tickler for the oscillator, and the oscillator grid coil. Thus there are eight terminals on the form. However, there are only six prongs so that three of the coil terminals are connected to the same prong. These, of course, are the ground terminals on the r-f primary, the r-f secondary, and the oscillator grid coil.

The circuit contains two coil sockets so that two coils may be in the set all the time. A four pole, double throw switch is provided for selecting either. Hence two wave bands are available by merely turning a switch, while the third is available by substituting the extra coil for one in the converter.

Identification of Coils

The coils are identified by means of a color code. On the upper rim of each form is a small recess containing pigment. On the smallest coil, that is, the one covering the 20 to 36 meter band, the color is black. On the next coil, covering the band from 37 to 60 meters, the color is red. On the largest coil, which covers the 120 to 200 meter band, the color is green. The black and the red coils are for truly short-wave reception while the green is for reception of police signals.

It is recommended that the black coil be left in the socket at the left, looking from the rear of the converter, and that coil changing be limited to the coil socket at the right.

The switch knob is arranged so that when it is turned in the direction of a coil it picks up that coil. Thus the black coil is actually on the right side of the set, looking from the front, and it is picked up by turning the switch to the right. Of course, the other coil socket is picked up by turning the switch to the left.

Built into the coil-changing switch is also a filament switch and antenna change-over switch. This is operated by pushing in or pulling out the central knob. When the central knob is pushed in as far as it will go, the converter is disconnected and the broadcast set is ready for use. The antenna is then connected directly to the antenna binding post on the set and the heater circuit in the converter is open. This will be manifest by the fact that the pilot lamp will not light.

When the central knob is pulled out, the antenna is connected to the primary of the short-wave converter and the filament circuit is closed. The central knob may be turned for selecting coils in either position.

The larger knob surrounding the switch is the tuning control. It turns, at a slow rate, a pair of small Hammarlund condensers. Thus the two tuned circuits are tuned simultaneously. The coil turns have been proportioned so as to give an approximate tracking.

Coupling Between Coils

In most superheterodynes there is a pick-up coil for transferring the oscillation to the mixer tube, or the oscillator and mixer are the same tube. In the present circuit the mixing is done by mutual inductance on the coil form. This method has also been used on broadcast superheterodynes. It simply solves one of the problems that always arises in the design of short-wave mixers where there are many coils, and that is the means of proportioning the pick-up to the frequency. In this scheme the right coupling can be obtained simply by adjusting the distance between the r-f and oscillator coils.

The mixer 224 works on the negative bias principle. The bias resistance in the cathode lead has a value of 5,000 ohms, and this is shunted by a condenser of 0.1 mfd.

No bias and no grid leak resistance are used on the oscillator. The tuning is done in the plate circuit. The stator of the condenser is connected to the plate and to the top of the coil and the rotor is connected to ground. Since the coil is also connected to the source of high voltage, it is necessary to complete the tuned circuit through a 0.1 mfd. by-pass condenser, which is connected between the source of high voltage and ground. Of course, this condenser is so large that it does not affect the tuning of the circuit. Another 0.1 mfd. condenser by-passes the screens of the two tubes.

Low Voltages Used

Comparatively low voltages are used on the elements of the tubes. Thus the available high voltage is dropped through a 25,000-ohm resistor before it is applied to the two plates. It is further dropped by a 15,000-ohm resistor before it is applied to the screens.

The output of the mixer tube is fed to the antenna post of the broadcast set through a 50 mmfd. condenser and a lead with a grounded shield. A radio-frequency choke is used in the plate of the mixer as a coupling device.

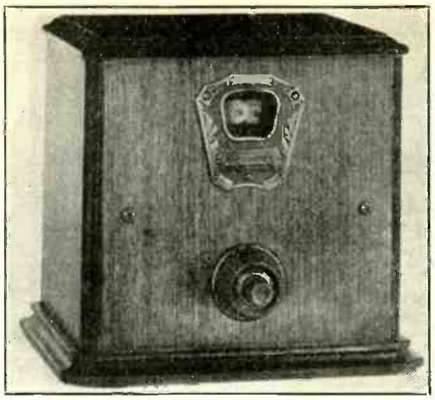
Power for operating the converter is supposed to be taken from the receiver with which it is used. Therefore an adapter is provided. This is of the five-prong type so that it may be plugged into any 5-contact socket in the set. The adapter is merely a device for making accessible the heater and plate voltages. The heater leads of the converter connect to the heater prongs on the adapter, and the plate return leads of the converter connect to the K terminal on the adapter. Therefore, if the socket is wired for a 247 the proper connections will be obtained, because such a socket is wired with the high voltages on K.

There are many receivers with which this converter may be used, and not all of them will be alike in respect to the plug arrangement. If 224 tubes are used in the converter the first requirement is that the heater or filament voltage across the two H prongs be 2.5 volts. Most tubes now use 2.5-volt heaters, including power tubes.

Many sockets which may be all right in respect to the heater voltage may not be all right in respect to the high positive voltage. It is always possible, however, to rewire the adapter to fit any case. Thus if it is necessary to insert it into an r-f socket the high voltage lead can be connected to the P prong on the adapter, for that would pick up the high voltage, or it could be connected to the G post, where it might pick up 100 volts.

A good antenna about 30 feet long should be used with this converter for best results, and a good ground is also necessary. Of course, the sensitivity of the converter will depend in a large measure on the sensitivity of the receiver with which it is used. The higher that sensitivity the higher the sensitivity of the converter. It may be worked with t-r-f as well as with superheterodyne receivers.

In operating the converter the broadcast receiver should be set at some frequency between 600 and 800 kc, on which there is no local station. Then the converter tuning dial should be turned very slowly. It may be that short-wave stations within 1,000 miles will come in without any great care in tuning, but stations many thousand miles away will be passed over unless the tuning is done very slowly and carefully.



Front view of the converter.

Getting many stations with the converter and a good broadcast receiver is mainly a matter of accurate tuning and knowing when to tune. The time difference between the receiver and transmitter locations must be kept in mind. It is useless to tune unless the station tuned for is on the air at the moment.

In case there should be interference with a station as it is tuned in, this may be eliminated by changing the intermediate frequency employed, that is, by changing the setting of the tuner of the broadcast receiver. By this change image interference may be avoided. As the change of the intermediate frequency is made the wave coverage is also changed. Hence if the converter tuner is to be logged, the calibration should be done for a particular setting of the broadcast tuner. In case it is difficult to tune in a given short-wave station, the broadcast tuner can be used as a very fine vernier tuner. Suppose, for example, that it is not possible to stop the high frequency tuner directly on the peak of a weak wave. By making a slight change in the intermediate frequency the tuning can be made exact. This fact is particularly advantageous in case there is any lost motion in the converter tuner.

Short-Wave Broadcast Stations

(We are indebted to the International Short-Wave Club, with headquarters at Klondyke, Ohio, U. S. A., for permission to publish this list, which includes stations authentically reported active.)

All times are given in Eastern Standard Time, add five hours for G.M.T. Wavelength only is given. For frequency equivalent see conversion table on page 20.

(Note—The following group of stations broadcasts musical programs. Commercial stations we listed separately.)

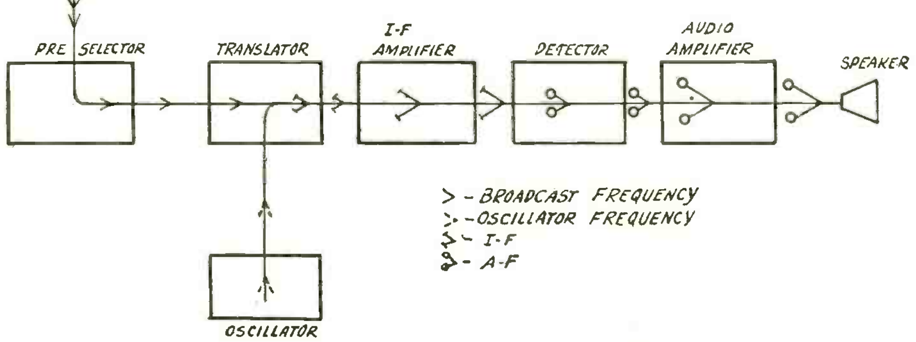
Wave Length Call	*Location*
14.47—LSY	Buenos Aires, Argentina. Near 4 P.M. Sundays.
15.93—PLE	Bandoeng. Java. Tuesdays 8:40-10:40 A.M.
16.87—W3XAL	Boundbrook, N. J. Week days. 7 A.M. to 3 P.M.
19.57—W2XAD	Schenectady, N. Y. 3 to 6 P. M. daily. Sat. & Sun. 1 to 6 P.M.
19.68—	Pontoise, France. 7 A.M. to 10 A.M. daily.
19.73—DJB	Zeesen, Germany. 8 A.M. to 12 noon daily.
19.84—HVJ	Vatican City. Broadcasts daily 5 A.M. to 5:15 A.M.
19.90—T14-NRH	Heredia, Costa Rica. Saturday 11 A.M. to noon, 4-5 P.M. and 10-11 P.M. Sun. and Mon., 11 A.M. to noon and 4-5 P.M.
20.60-HBJ	Geneva, Switzerland. Testing.
20.95—G2NM	Sonning-on-Thames, England. Sundays.
23.38—	Rabat, Morocco. Broadcasts Sunday, 7:30 to 9 A.M.
25.20—	Pontoise, France. 10.30 A.M. to 1:30 P.M. daily.
25.25—W8XK	Pittsburgh, Pa. 3 P.M. to 9 P.M. Daily.
25.34—W9XAA	Chicago, Ill. Relays WCFL, irregularly.
25.40—12RO	Rome, Italy. Broadcasts 11 A. M. to 12:30 and 3 to 5:30 P.M.
25.42—W1XAL	Boston, Mass. testing, irregularly.
25.53—G5SW	Chelmsford, England. Monday to Friday, 6:45 A.M. to 7:30 A.M. and 12:30 to 6:10 P.M. Sat. 7-8 A.M. and 12:30 to 6:10 P.M.
25.60—	Pontoise, France. 3 P.M. till 6 P.M. Daily.
25.60—VE9JR	Winnipeg, Canada. Daily exc. Sat. and Sun., 11:45 A.M. to 1:30 P.M.
26.83—CT3AQ	Funchal, Madeira. Tues.-Thurs., 5 to 6:30 P.M.; Sun. 10:30 A.M. to noon.
28.98—LSX	Buenos Aires, Argentina. Daily, 8 to 9 P.M.
29.26—D1Q	Zeesen Germany. Used irregular.
30.40—EAQ	Madrid, Spain. 6:30 to 8 P.M. daily. Sat. 1 to 3 P.M.
31.00—T14NRH	Heredia, Costa Rica. Daily exc. Sunday 9 to 10 P.M.
31.25—CT1AA	Lisbon, Portugal. Heard Tues., Thurs., Fri., 4 to 7 P.M.
31.28—VK2ME	Sydney, Australia. Saturday midnight to Sunday 2 A.M., 4:30 to 8:30 A.M. and 1:30 to 3:30 P.M.
31.30—HBL	Praquins, Switzerland. Testing near 4 P.M.
31.36—W1XAZ	Springfield, Mass. 3:30 P.M. to 11:30 P.M. Daily.
31.38—DJA	Zeesen, Germany. 2 P.M. to 6:30 P.M. daily.
31.40—VK3ME	Melbourne, Australia. Wed. 5 till 6:30 A.M., Sat. 5-7 A.M.
31.48—W2XAF	Schenectady, N. Y. Relays WGY daily 5 P.M. to 11 P.M.
31.51—OXY	Skamleback, Denmark. Broadcasts 2 to 6:30 P.M.
31.58—PRBA	Rio de Janeiro, Brazil. Heard between 6 P.M. and 8:30 P.M.
32.26—	Rabat, Morocco, broadcasts, Sundays, 3 to 5 P.M.
33.50—TGX	Guatemala City, Guatemala. Saturdays 10 P.M. till midnight.
34.68—VE9BY	London, Canada. Mondays 3 to 4 P.M. and irregular times.
38.60—HBP	Geneva, Switzerland. Testing.
39.40—HJ3ABF	Bogota, Colombia. 7 P.M. to 11 P.M.
40.50—HJ3ABD	Bogota, Columbia. Tues., Thur., Sat., 8 to 11 P.M.
41.00—CM5RY	Matanzas, Cuba. Saturdays 10:45 to 11:30 P.M.
41.60—EAR58	Teneriffe, Sat. and Sun., 4:30 P.M. to 6:00 P.M.
42.00—HJ4AAB	Manizales, Colombia. Thur. and Sat. 7-9 P.M. and 11-12 P.M.
42.20—HKN	Medellin, Colombia. 8 P.M. till 10 P.M. 8:30-10:30 P.M. Earlier Sun.
45.31—PRADO	Riobamba, Ecuador. Thursdays, 9 P.M. till 11 P.M.
46.60—REN	Moscow, U. S. S. R. Relays Moscow, 1 P.M. to 6 P.M.
46.67—VE9BY	London, Canada. Wednesday 8:30-9:30 P.M. Friday 7:00-7:55 A.M. and Saturdays 8-11 P.M.
46.96—W3XL	Boundbrook, N. J. No regular schedule.
47.00—HKS	Cali, Colombia. Irregular, near 10 P.M.
47.00—HCIDR	Quito, Ecuador. 8 P.M. till 10 P.M.
47.50—TITR	San Jose, Costa Rica. 10 to 12 A.M., 4 to 9:30 P.M.
48.00—HKA	Barranquilla, Col. 8 P.M. to 10 P.M. Daily.
48.85—VE9CL	Winnipeg, Canada. Daily except Sun., 6 P.M. till 8:30 P.M.
48.86—W8XK	Pittsburgh, Pa. 4 P.M. to 11 P.M., daily. Late Saturdays.
48.95—YV11BMO	Maracaibo, Venezuela. Broadcasts, 8 to 11 P.M.
49.18—W9XF	Chicago, Ill. 3:30 P.M. to 1 A.M. daily.
49.18—W3XAL	Boundbrook, N. J. Saturday 4 P.M. to midnight.
49.20—JB	Johannesburg, South Africa.
49.22—VE9GW	Bowmanville, Can. Week days, 3-9 P.M., Sun. 11 A.M.-7 P.M.
49.29—VE9BJ	St. John, N. B. Near 5 P.M. and 11 P.M.
49.34—W9XAA	Chicago, Ill. Relays WCFL, Sun. 11 A.M.-9 P.M.; Wed., Sat., 8:30 A.M. to 9 P.M.; Tues, and Thurs., 8:30 A.M. to 8 P.M.
49.42—VE9CS	Vancouver, B. C. Sun. 3:30 P. M. to Midnight. Fri. at 0 to 1:30 A.M.
49.50—W8XAL	Cincinnati, Ohio. 5 A.M.-9:30 A.M., 12:30-2:30 P.M. and 6 P.M. to 12:30 midnight.
49.50—VQ7LO	Nairobi, Kenya, Africa. Daily 11 A.M.-3:30 P.M. Tues. 3 A.M.-4 A.M. Thursday 8 A.M. to 9 A.M.
49.50—CMCI	Havana, Cuba. 9 P.M.-11 P.M.
49.51—ZL2ZX	Wellington, N. Z. Mon., Wed., Thur., Sat., 2:15 to 6:15 A.M.
49.59—VE9HX	Halifax, N. S. Mon., Tues., 6-10 P.M. Other days 6-7 P.M.
49.96—VE9DR	Drummondville, Can. Relays CFCF, 7 P.M. to 12 Midnight.
50.00—RW59	Moscow, U.S.S.R. 9 A.M.-11 A.M., 2 P.M.-5 P.M. Daily.
50.00—HKD	Barranquilla, Col. Daily 8-10 P.M.
50.26—HVJ	Vatican City. Broadcasts daily, 2-2:15 P.M., Sun. 5-5:30 A.M.
50.60—HKO	Medellin, Colombia. Mon., Wed., Fri. 8 to 10 P.M., Tues., Thurs., Sat. and Sun., 6 to 8 P.M.
51.00—HKB	Tunja, Colombia. Irregular near 10 P.M.
51.72—VK3LR	Victoria, Australia. Heard 2 A.M. to 6:30 A.M.
52.70—FIUI	Tananarive, Madagascar. Sat., Sun. 1-3 P.M. Other days 9:15-11:15 A.M,
58.00—PMY	Bandoeng, Java. 12:40 to 2:40 A.M, and 6:40 to 9:40 A.M.
62.50—W2XV	Long Island City, N. Y, Wed. and Fri. 8 till 10 P.M.
62.56—VE9BY	London, Canada. Saturday midnight on.
70.1—RV15	Khabarovsk, U.S.S.R., 3 A.M.-9 A.M.
109.60—VE9CI	London, Ontario. Daily 9 to 11 P.M. Sun. 11 A.M.-7 P.M.

Why Super Is So Selective

It is generally understood that a t-r-f receiver is not as selective as a superheterodyne, even if there is a large number of tuners in the t-r-f set. The reason for the lack of selectivity is not that the individual tuned circuits are not selective enough, for they may be more selective than the individual circuits in the intermediate amplifier, but that the several circuits are not tuned to the same frequency. When the condensers are ganged it is practically impossible to get all the tuned circuits of a t-r-f set lined up properly. In the superheterodyne proper alignment is no trick at all for it is only necessary to tune accurately once and all the i-f tuned circuits are lined up afterwards on all signals. Exact tuning is the main reason for the difference between the selectivities of the t-r-f and the superheterodyne sets.

THE COLO

Theory of 12-Tube Cir



The six functional divisions of a superheterodyne.

IN its essentials, a superheterodyne receiver is made up of six groups of circuits, exclusive of the power supply:

1. Pre-Selector
2. Oscillator
3. Translator or 1st Detector
4. I.F. Amplifier
5. Detector
6. Power Output Amplifier

The Pre-Selector Stage—The tuned circuits of the pre-selector or antenna stage are entirely similar to those of the more familiar t-r-f receiver. This stage provides a certain amount of frequency discrimination (selectivity) but its main function is to prevent image frequency response, a detailed explanation of which will come later. The signal chosen by the pre-selector is either fed directly to the grid of the translator tube or else is amplified by another tube and then fed to the translator grid.

The Oscillator—The oscillator generates an r-f voltage which is fed to the translator tube. The tuning condenser which determines the oscillator frequency is ganged with the condensers that tune the pre-selector and translator stages. Through proper shaping of the condenser plates, the oscillator frequency can be made to differ by a constant amount from the frequency to which the pre-selector and translator circuits are tuned. Present design usually has the oscillator frequency 175 kc higher than the pre-selector and translator frequencies.

The Translator—When two voltages of different frequencies are combined in a rectifier, voltages at two other frequencies are generated. One of these frequencies equals the sum of the frequencies of the original two voltages and the other equals their difference. Accordingly, since both the incoming broadcast signal and the oscillator signal are impressed on the translator grid, a resultant voltage is created, of a frequency equal to the frequency difference between the oscillator and the broadcast signal. Since the broadcast signal is audio modulated, the resultant signal contains the same audio modulation. As an example, in a typical superheterodyne the oscillator is tuned to 1,175 kc when the pre-selector and translator circuits are tuned to 1,000 kc and the translator tube converts or translates the 1,000 kc broadcast signal to one of 175 kc, with the original modulation maintained. There is also created a 2,175 kc signal, the sum of the oscillator and incoming signal frequencies, but this sum frequency is not used. The plate circuit of the translator tube contains the primary of a transformer tuned to 175 kc. The tuned secondary constitutes the input to the i-f amplifier.

The I-F Amplifier—The i-f amplifier boosts the strength of the translated signal and applies it to the detector tube. Because the amplification takes place at a comparatively low frequency and that a fixed one, it is possible to design an i-f amplifier to give more than six times the amplification that could be had from the same tubes used in a broadcast frequency amplifier. Too, a much more desirable shape is obtainable for the resonance curve of an i-f amplifier, according better selectivity and better reproduction fidelity since side-band cutting is minimized. The whole advantage of the superheterodyne circuit is derived from the benefits of amplification at "intermediate" frequency.

The Detector—The detector removes the carrier from the i-f signal, leaving only the modulation frequency, the a-f component, which is fed to the power amplifier.

The Power Output Amplifier—The power output amplifier is an audio amplifier that increases the audio power delivered by the detector to an amount sufficient for operation of the loud speaker. At present there are two types of audio output amplifiers, namely Class "A" and Class "B." The Class "A" is quite familiar, having been used for years. A discussion of the Class "B" will appear later.

The Selectivity of Superheterodynes

It is commonly recognized that the selectivity of the average superheterodyne greatly surpasses that of the average t-r-f receiver, even though the number of tubes, the number of tuned stages and the shape of the resonance curves of the individual circuits are the same for both.

Consider the response of a typical t-r-f receiver to an interfering signal. If the receiver is tuned to 1,500 kc and the interference is of 1,510 kc frequency, the interference is "off tune" 10 kc in 1,500, or .66%. Should the strength of the interfering signal be on a par with the signal to which the receiver is tuned, considerable interference would be experienced unless the selectivity of the receiver was extreme. Such selectivity would bring about serious side-band cutting.

Now assume the same conditions but applied to a superheterodyne. With the receiver tuned to 1,500 kc, the oscillator is at 1,675 kc (on the supposition that 175 kc is the intermediate frequency used). The interfering 1.510 kc signal beats with the 1,675 kc oscillator signal, creating a resultant frequency of 165 kc. But a 165 kc signal applied to a 175 kc i-f amplifier is 10 kc in 175 or 5.75% "off tune," compared to .66% for the t-r-f receiver—a selectivity difference between the two of more than 850%.

In the pre-selector stage of a superheterodyne, the interfering signal is discriminated against to the same extent as it is by a like number and kind of stages in a t-r-f receiver. However, in the i-f stages the discrimination is very much greater.

Because most of the selectivity of a superheterodyne lies in its i-f stages, and since the i-f amplification takes place at one fixed frequency, the high selectivity of a superheterodyne is maintained quite uniformly throughout its entire tuning range. A further advantage gained from having the amplification take place at one frequency is that the sensitivity of the receiver remains substantially constant. The sensitivity and selectivity of a t-r-f receiver vary quite markedly as the frequency setting is changed, unless elaborate design precautions are taken to offset this variation.

As has been shown previously, in any superheterodyne the broadcast signal is mixed with an r-f voltage generated by the receiver's oscillator to produce a resultant signal of fixed frequency—the i-f signal.

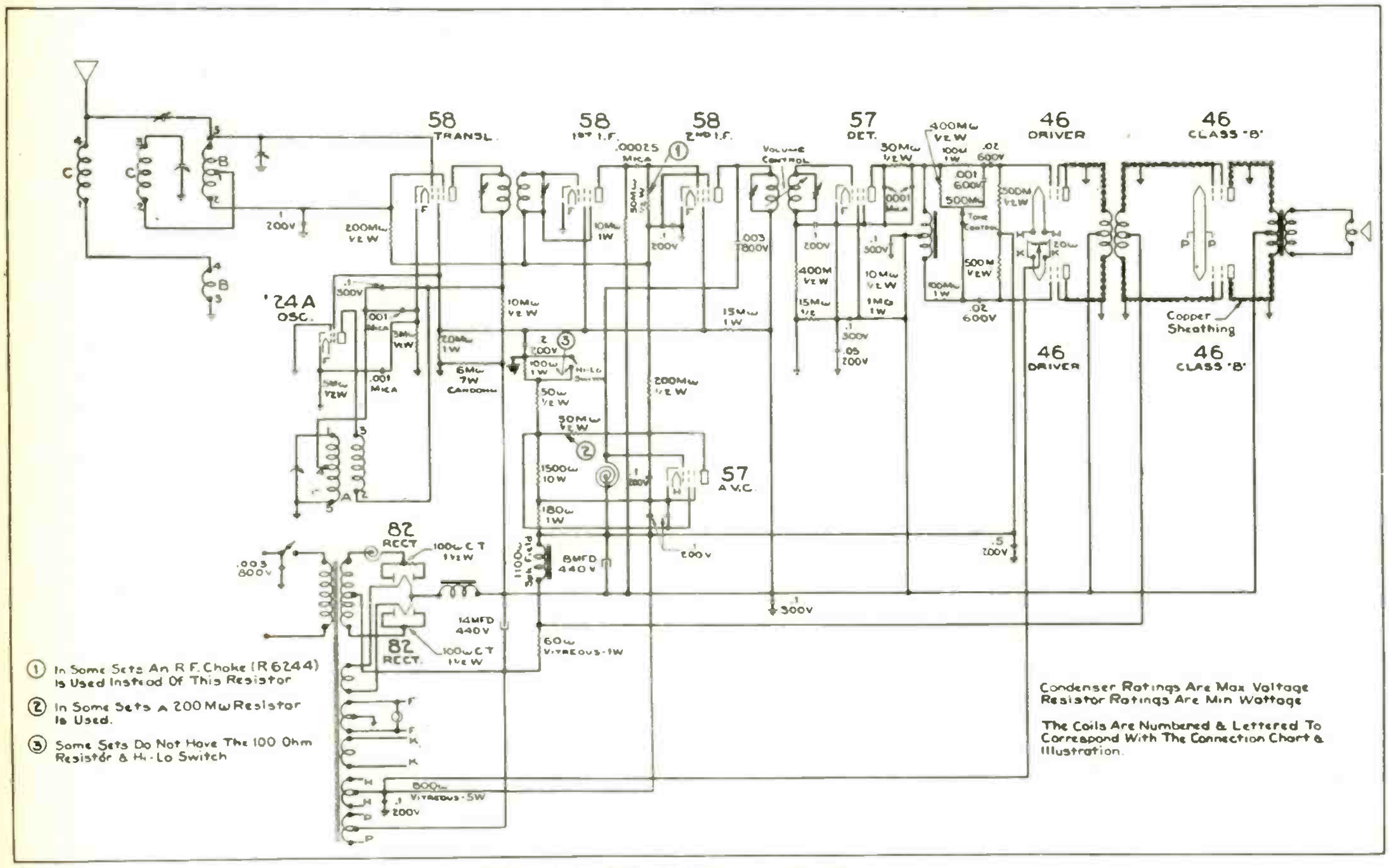
For example, in a typical receiver, turning the dial to 1,000 kc tunes the preselector and translator stages to 1,000 kc and the oscillator to 1,175 kc. The resultant frequency, 175 kc, is amplified by the i-f stages. But if, while the receiver is tuned to 1,000 kc, there is a 1,350 kc station on the air, powerful enough to get its signal past the pre-selector stage, this 1,350 kc signal will beat with the 1,175 kc frequency of the oscillator and also produce a 175 kc signal to be amplified by the i-f stages. It should be noted that an equally strong signal of some frequency between 1,000 kc and 1,350 kc would not cause interference because the resultant i-f frequency then would become lower than 175 kc, and so would be rejected by the i-f stages. This response at one point on the dial to two stations whose frequencies are twice the i-f frequency apart, is known as "image frequency response."

Another example of "image frequency response" is the following: A signal, say of 1,000 kc, if strong enough to pass the pre-selector stage will be heard at 650 kc as well as at 1,000 kc. When the receiver is tuned to 650 kc the oscillator is 175 kc higher, or 825 kc. The 1,000 kc signal beating with the 825 kc oscillator, creates a 175 kc signal which is accepted by the i-f stages. In this case "image frequency response" caused the same station to be heard at two points on the dial twice the i-f apart.

One method of overcoming this objectionable response is to include a sufficient number of tuned circuits in the pre-selector stage to prevent a signal of any frequency other than that to which the receiver is tuned, from reaching the translator. However, the use of sufficient stages introduces losses which require one or more additional tubes to compensate for them. Further, as was shown under The Selectivity of Superheterodynes, selectivity of this type brings about sideband cutting, with consequent suppression of high notes. In Colonial Superheterodynes, an exclusive image suppressor circuit in addition to the pre-

NIAL C-995

cuit, with Service Data



The Colonial C-995 circuit diagram

selector eliminates this double response without introducing sideband cutting.

A widespread misconception apparently exists among service men concerning the function of the trimmer condensers commonly found on ganged tuning condensers. The impression seems general that the trimmer condensers compensate for lack of alignment, for lack of uniformity amongst the units of the ganged condenser. Neither can they nor are they intended to compensate for such lack. A condenser with units out of alignment could be made to track only by properly bending the plates. Any attempt to secure alignment by adustment of the trimmer condensers would be successful merely for one particular setting.

However, in addition to the capacity of the variable tuning condenser, each circuit has the capacity of the apparatus associated with the tuning condenser. The coils have distributed capacity. The tubes, their sockets and the wiring of the receiver all have appreciable capacity. This stray capacity is commonly summed up as "circuit capacity." Nor it is likely to be the same for all stages. Differences in the location of parts and in the wiring create differences in the value of circuit capacity.

The total capacity in any stage is made up of this circuit capacity in parallel to the tuning capacity. But if the circuit capacity is not the same for each stage, then the stages will be out of alignment even though their tuning capacities are exactly the same and track perfectly. It is to equalize this circuit capacity in all stages that trimmer condensers are used. They add capacity to the stages which have low circuit capacity, bringing their capacity up to that of the stage with highest capacity. Then, with the circuit capacities of all stages equal, and the units of the variable condenser tracking properly, the stages will be in true alignment throughout their frequency range.

The frequency calibration of superheterodynes usually depends upon the oscillator. Accordingly, its trimmer should be adusted with the dial set to the frequency of the test-oscillator's signal, and the other trimmers then adjusted for proper alignment with the oscillator stage.

Adjustments should be made at the high frequency end of the tuning range since at the lower end the capacity of the trimmers is masked by the much larger capacity of the tuning condensers.

CAUTION: Service men are emphatically cautioned against tampering with the various aligning adjustments used in the receivers unless coil replacement makes it necessary. These condensers are carefully set at the factory with elaborate, precision apparatus. The amount they might drift out of adjustment is much less than the amount they would be out after an attempt to adjust them without proper equipment.

The I-F Stages:—A modulated, 175 kc oscillator of reasonably accurate frequency calibration is essential. An output meter, while not absolutely necessary, is of considerable help in doing an exact job. If the receiver has automatic volume control, it must be rendered ineffective. Reference to the service information for the particular model will show how this can be done.

Connect the output lead of the test oscillator to the grid of the i-f tube (in series with a .1 condenser if none is built into the oscillator) and connect the ground lead of the test oscillator to the receiver chassis. Tune the primary of the output transformer (the plate circuit of the i-f tube) off of resonance by unscrewing the adjusting condenser three or four turns. If in doubt as to which is the primary, connect a voltmeter from the adjusting screw to the chassis. The primary adjusting screw is at high d-c potential with respect to the chassis. Too, for this reason, an insulated screwdriver must be used. Tune the secondary (in the detector tube grid circuit) for maximum loud speaker or output meter response. Then tune the primary for maximum response. It may be necessry to reduce the volume control or the oscillator output to prevent tube overloading. Those i-f transformers having a copper ring on the wooden coil-mounting are tuned by moving this copper ring toward or away from the coils. After the secondary has been tuned, move the test oscillator output lead to the grid of the translator tube and follow the same procedure for tuning the input transformer. Always tune the secondary first and do not go back and readjust it after tuning the primary. Those receivers having two i-f stages are aligned in exactly the same manner since the second stage is resistance-capacity coupled to the first and only two transformers are used.

The Pre-Selector, Translator and Oscillator Stages—Set the test oscillator to about 1,450 kc and couple it to the antenna lead of the receiver. In order not to upset the dial calibration, the dial should be turned to the frequency of the test oscillator. Adjust the pre-selector and translator trimmers for maximum output response. If maximum response can not be obtained within the range of the trimmers, adjust the oscillator trim-

(Continued on next page)

(*Continued from preceding page*)

mer until maximum response does come within the range of the pre-selector and translator trimmers. (The oscillator section is the one furthest from the dial end of the condenser.) The dial must not be changed from the frequency of the test oscillator during the adjustment.

The Image Suppressor Condenser—The image suppressor condenser is reached with a long screw driver through the hole in the top of the antenna coil shield. Couple the test oscillator, tuned to about 1,400 kc, to the antenna lead. The oscillator must be adjusted to deliver a strong signal. Tune the receiver 350 kc lower than the test oscillator signal and advance the volume control until the oscillator is heard. Then adjust the image suppressor condenser to the point where the oscillator becomes inaudible.

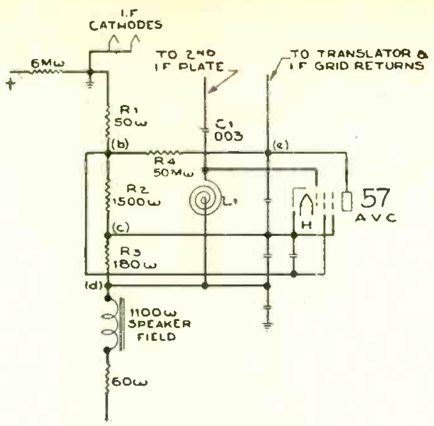
Class "B" Amplification

It is commonly agreed that for comfortable room volume an average of from one to two watts output from a receiver is sufficient. However, even though the average be but one watt, peaks may occur in the music, requiring as much as twenty watts of energy. A crash of drums in an orchestra, a fortissimo passage in a piano selection, a point driven home by an enthusiastic speaker, requires many times the average power. Unless the receiver has the reserve of power needed to supply these peaks, they are not realistically reproduced but come forth as noise. What was a drum beat in the broadcast studio becomes something else when reproduced, a mere noise. The result is blurry, unrealistic reproduction. It is because of its tremendous reserve of power, eliminating distortion due to power insufficiency, that Class "B" amplification has been hailed as the greatest single stride toward perfect radio reproduction in recent years.

In spite of the apparent similarity of the Class "B" output amplifier to the familiar push-pull amplifier, there are notable points of difference. At zero grid voltage the plate current of the type 46 tubes used in a Class "B" circuit falls practically to zero. The tubes work only on the positive half cycles of the signal voltage and accordingly draw large grid current. Instead of being given a negative "C" bias, they are given a small positive bias. Since the tube input impedance is low, the Class "B" input transformer has a step down ratio, primary to secondary. Unlike a push-pull amplifier in which the average plate current has a constant value, the plate current of the Class "B" amplifier varies as the signal. With no signal it is only a couple of milliamperes, but at maximum output it may have a peak value of 200 milliamperes. At the same time the grid current may swing from zero to 50 or 60 milliamperes peak. Of course, these values will appear lower if read on an ordinary d-c meter since such an instrument shows average instead of peak values. Because the grids draw current and therefore consume power, the Class "B" amplifier must be driven by an amplifier capable of supplying this power.

Inasmuch as the current requirements of the amplifier vary from a few milliamperes to nearly 275 milliamperes at peak output, the power supply must have excellent regulation so that its voltage remains substantially constant with the widely varying load. Among other things, this requirement of good regulation usually necessitates the employment of mercury vapor rectifier tubes. It is a characteristic of such tubes that their voltage drop remains virtually unvarying from a value of about 15 volts, regardless of the current passing through the tube. Because of this low and constant drop, a short circuit across the rectifier output will quickly ruin the tube and possibly damage the power transformer.

The C-995 receivers are twelve tube de luxe superheterodynes embodying advancement in design. Their frequency range extends from 530 kc to 1,765 kc. High gains r-f pentodes and two i-f stages insure extreme sensitivity and keen selectivity. Automatic volume control nullifies fading and prevents blasting. A push-pull Class "A" driver stage, a Class "B" output stage, two mercury vapor rectifiers, and a powerful 12" Class "B" dynamic speaker made for reproduction that is truly fascinating in its realism.



The automatic volume control detail, Colonial C-995

A '24A oscillator produces a voltage which is combined with the broadcast signal, creating a 175 kc signal in the plate circuit of the 58 translator tube. This 175 kc signal is transformer coupled to the first 58 i-f tube and resistance-capacity coupled to the second 58 i-f. It is then transformer coupled to the 57 detector. The coupling between primary and secondary of this transformer is variable and is employed as the volume control. Since it is inductive, it is completely noiseless in operation.

The first i-f, transformer is mounted on the top of the chassis with its adjusting screws accessible through the hloes in the top of the shield. The adjusting screws for the second i-f transformer tuning condenser are accessible through the holes in the chassis to the right of the first i-f transformer, facing the front of the chassis. A dummy tube, i. e., either a burned out one or one with a heater prong insulated from its socket contact, must be placed in the a-v-c socket to render the a-v-c action inoperative when peaking the i-f stages. Be sure the flexible grid lead is connected to the grid cap of the 57 dummy tube and that the tube shield is in place.

The detector is coupled through an auto-transformer (mounted on the speaker) to two 46s connected as a Class "A" push-pull driver stage. This auto-transformer has a high permeability nickel-alloy core. If for any reason excessive d-c (25 ma or more) flows through the transformer, the permeability of its core and hence the inductance of it may be greatly lowered. As a consequence, tone quality will be impaired and the transformer should be replaced.

The best quality of reproduction will be obtained when the type 46 tubes are well matched in their dynamic characteristics. Interchange their positions until the best combination is found.

The filaments of the 82 rectifiers are connected in series. Should one tube burn out the other will not light, preventing the overloading of the remaining tube which would result were they connected in parallel.

The A-V-C Circuit—The a-v-c circuit is shown schematically and its action will be easily understood if the following explanation is read carefully:

As revealed by the diagram, R1, R2, and R3 form part of a resistance network across the "B" supply. With reference to point (a), points (b), (c) and (d) are progressively more negative. Accordingly, the drop across R2 furnishes the plate voltage for the a-v-c tube and the drop across R3 furnishes its negative grid bias. The values are such that no plate current flows. Since there is no plate current, no voltage drop exists across R4, and points (b) and (e) are at the same potential. The drop across R1 furnishes the grid bias for the translator and i-f tubes.

Now assume a signal at the plate of the second i-f tube. It is impressed across L1 through C1. The positive half cycles of the signal voltage, impressed on the a-v-c tube's grid, cause plate current to flow, creating a voltage drop across R4. Point (e) now is more negative than point (b) by the amount of R4's drop. In other words the i-f and the translator grids have been made more negative with respect to their cathodes and consequently their amplification has been decreased. The stronger the signal, the greater the translator and i-f, negative grid bias and the less the amplification of these tubes. The gain, then, varies inversely as the signal strength, and the signal voltage at the plate of the second i-f tube is maintained at a substantially constant value.

The variable tuning condenser is floated on cushion rubber to prevent microphonics. Should there be trouble from microphonics which cannot be eliminated by changing the detector tube, the nuts on the four-condenser mounting studs may be loosened. Neither the condenser shaft, dial nor knob must be allowed to touch the chassis or cabinet lest the effect of the rubber mounting be lost.

There is a variable center-tap hum eliminating resistor mounted on the rear plate of the chassis near the speaker socket. Its screw driver adjustments is accessible through the hole in the chassis. Care must be used in making the adjustment since it is a fine one. In addition it sometimes is necessary to interchange the positions of the type 46 tubes until the combination resulting in minimum hum is found.

There is a condenser connected from one side of the power cord to ground for the prevention of line noise. The power cord plug should be tried in both possible positions in its receptacle and left in the one affording quieter reception.

The pilot light clip is pulled off of its chassis mounting for replacement of the bulb.

Tube Voltage and Current Chart

Model C-995

TUBE VOLTAGE AND CURRENT CHART MODEL C-995

TUBE	Plate Voltage	Screen Voltage	Grid Voltage	Plate m.a.	Screen m.a.
58—Translator	160	70	— 3*	1.4	.3
'24A—Oscillator	160	70	— 6	.8	.3
58—1st IF	145	75	— 4	4	.9
58—2nd IF	185	75	— 4	4	1
57—Detector	160	65	*	.3	.1
57—A. V. C.	50	70	— 9	0	0
46—Driver	240	240	—10* (—30 actual)	17	3.5
46—Class "B"	365	+4.5	+4.5	18-70 (a)	1.7-13 (a) (b)
82—Rectifier	Max. d.c.=365 v.			Plate Current =32 m.a. per plate per tube. (c).	

Watts = 150.

Speaker field voltage = 90 v.

(*) Reading low because of high series resistance.

(a) The latter value on a strong signal.

(b) Value is for both grids tied together.

(c) The plate current may divide unevenly between the two plates, but the total for each tube should be about 65 ma.

Control grid readings taken on 150 volt scale of 1,000 ohms per volt meter; others on 750 volt scale. Readings taken with antenna and ground shorted together and no signal received (except as noted above). These are average values.

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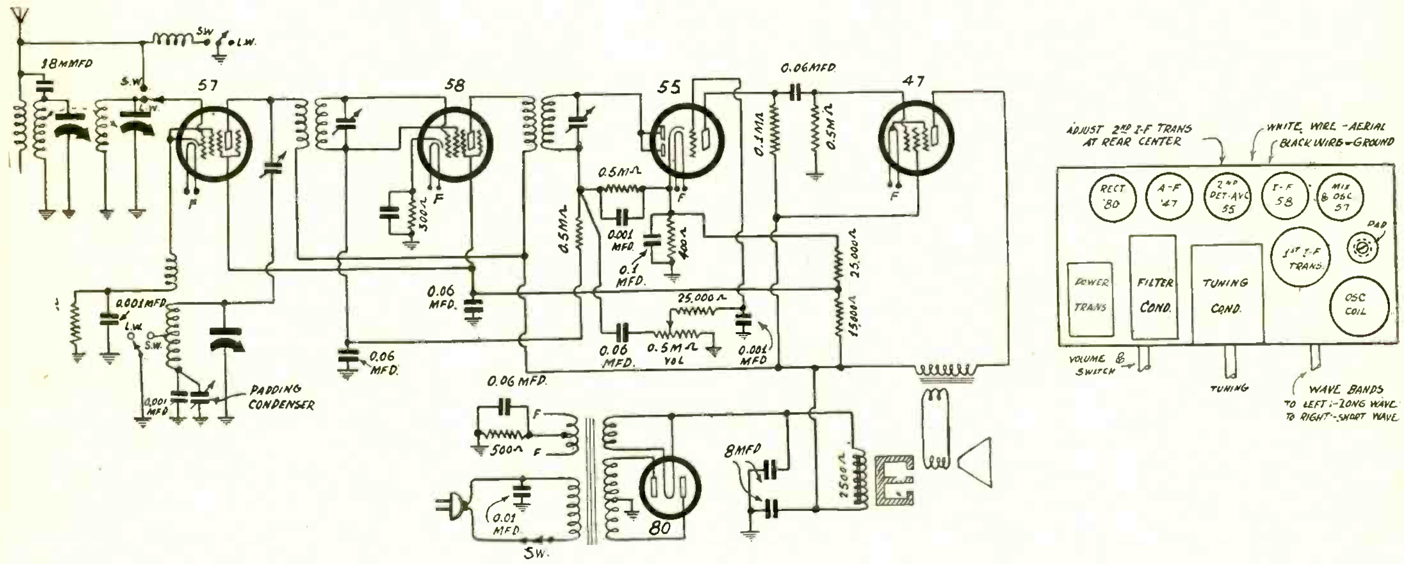
KENNEDY MODEL 563

Five-Tube Super 75 to 550 Meters



The circuit diagram of the Kennedy 563-A Receiver, a superheterodyne that covers the broadcast and police bands. At right the location of parts is shown.

THE tubes employed in the Colin B. Kennedy Model 563-A five-tube superheterodyne are as follows, and are operated at rated voltages and biases:

Oscillator and mixer	57
Intermediate frequency	58
Second Detector	55
Output	247
Rectifier	280

This receiver employs a combination oscillator and first detector, or mixer. The second detector is the new dual diode-triode, the diode portion acting as detector and providing automatic volume control acting on the grid of the type 58 i-f tube. The triode portion of the second detector is operated as an individually biased a-f amplifier.

Alignment Directions

The first two variable tuned circuits are not electrically coupled. They are mutually coupled by being placed close together and left unshielded. In all other respects the circuits are entirely conventional.

In aligning, it is first desirable to see that the i-f transformers are properly set. The first i-f transformer is on top of the base and has two adjustments. The second is inside the base but its single adjustment may be reached through a hole in the rear-center of the base. The intermediate frequency is 175 kc.

R-F Line-up

The tuning condenser may be adjusted for alignment or "tracking" of the tuned circuits by means of an oscillator and output meter. The oscillator should cover the band from 550 to 1,500 kc. The energy from the oscillator is coupled weakly into the antenna circuit, a simple means being to place the oscillator near the antenna wire. The receiver and oscillator are first tuned to approximately 1,500 kc., and by watching the output indicator, the three condenser trimmers are adjusted for maximum output. These three trimmers must then be left untouched for all further aligning.

Low Frequency Adjustment

The next step is to tune both receiver and oscillator to some point near 550 kc. Here the alignment is made by adjusting the oscillator "pad" condenser for maximum response. It may be reached through hole in base near the first i-f transformer. If necessary to adjust the two r-f condenser sections, it may be done by bending the condenser end plates. If necessary to align at points other than the ends of the "band" it may be done by bending portions of the slotted end plates of the condenser rotor sections. Alignment of the two ends of the scale is usually quite sufficient.

Short-Wave Band

It is desirable to move the dial back and forth across the signal while making the above alignments. This is particularly necessary when altering any capacities connected with the oscillator circuit. Use an insulated or bakelite screw driver. No aligning, other than of the i-f transformers, is necessary for the short-wave band (75 to 200 meters) as no attempt has been made to tune more than the oscillator.

Be certain that a good 57 tube is used in the first socket.

The Colonial Set

(*Continued from preceding page*)

Ordinarily, deviations up to 20% are permissable and do not necessarily indicate a fault. Where series grid resistors prevent grid voltage readings, proper plate current at the rated plate voltage will serve as an indication of proper grid bias and normal functioning of the tube. Care must be used when readings are taken with an analyzer since the capacity of the cable may cause the circuit to oscillate and give erratic readings. Usually, touching a finger to the grid or plate will stop oscillation. These readings were taken with the speaker field hot. Readings taken when the field is cold will be higher because of the lowered field resistance.

The very latest Model C-995 receivers built since the Service Manual was printed, have a sensitivity control switch mounted on the right side of the cabinet. Ordinarily, it should be left in the position marked "Lo." This position minimizes the between station noise, due to electrical disturbances, which in some localities is annoying. The position marked "Hi," should be used only when tuning for extremely weak, distant stations requiring the full sensitivity of the receiver.

As revealed by the schematic, this switch, in its closed position, shorts out a 100 ohm resistor. The residual bias on the i-f tubes is thereby reduced from a value of —8 volts to approximately —3 volts, increasing sensitivity.

A connection to ground from one side of the "Hi-Lo" switch is shown in circuit diagram, although omitted by mistake from the diagram in first edition of the Colonial Service Manual. This connection is shown in the circuit diagram. The importance of a good ground often is not fully appreciated because satisfactory results frequently are obtained without one. However, a good ground will always improve reception by reducing noise and hum.

Sometimes operation without a ground affords greater volume, but not without increasing line noise and, particularly in Models C-595 and C-695, hum. When greater volume is had without a ground it is because the electric light wires are acting as an antenna—but an antenna that is constantly being subjected to all kinds of electrical disturbances.

Servicemen should be sure that a good ground is used—preferably a wire tightly clamped to a water pipe that has been scraped bright.

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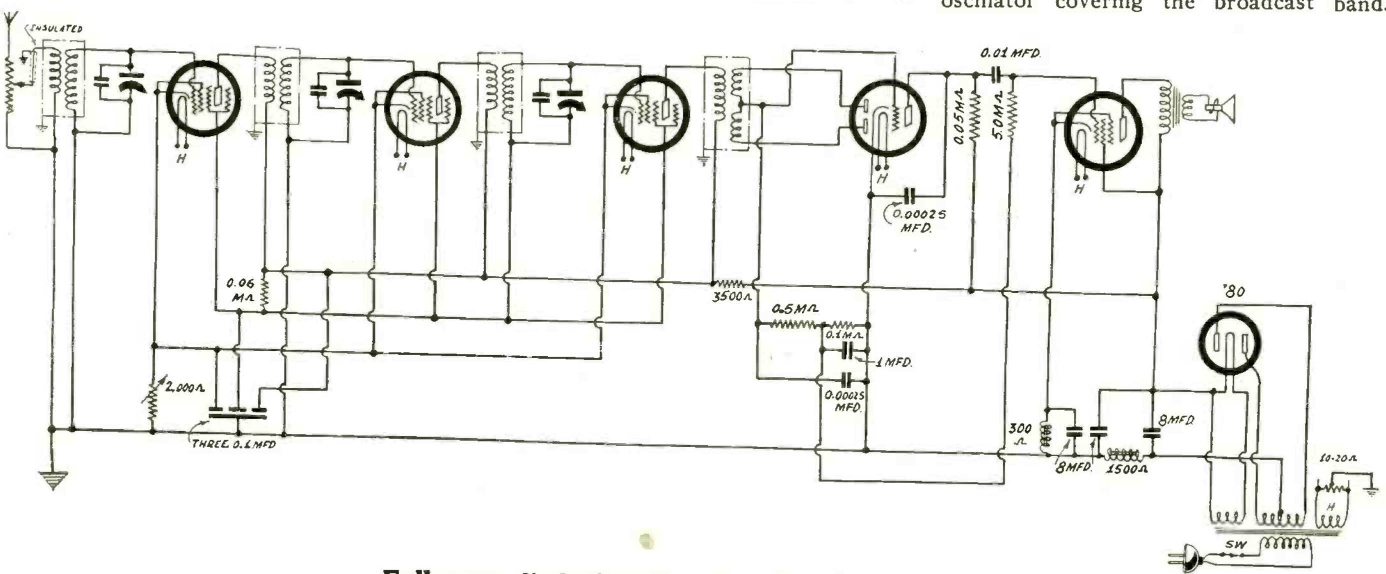


Full-wave diode detection in a six-tube t-r-f set.

Push-Pull and Diode Detection

IF YOU have a diagram of a six-tube receiver in which full-wave diode detection and a '47 output are used, will you please publish it? Of course, I want a tuned r-f circuit. I would prefer one with an automatic volume control, but if it does not have one I think I can modify the circuit. —R. A. McI., Buffalo, N. Y.

You will find the diagram of such a circuit in these columns. The '47 is used as the output amplifier and the 280 in the rectifier. All the other tubes are of the new type, the 55 being used as detector and audio frequency amplifier.

* * *

Saturation Current

WHAT is meant by the saturation current in a vacuum tube? Is a tube ever operated so that the saturation point is reached?—P. C., New York, N. Y.

For a given temperature of the filament or of the cathode there is a certain number of electrons emitted. If the plate voltage is high enough to attract all these electrons to the plate, the saturation current has been reached. This means that if the plate voltage were increased there would be practically no change in the plate current. Tubes are not operated so that they are saturated except momentarily when something goes wrong. For example, a positive bias might produce the saturation current, for the bias has mu times the effect of the plate voltage. It is possible that in oscillators having no grid leak resistance and stopping condenser the saturation current will be reached once during every oscillation cycle.

* * *

Motorboating and Blocking

MOTORBOATING and blocking sometimes sound very much alike. Is there really a difference between the two or are they only two names for one phenomenon?—T. Y. A., Indianapolis, Ind.

They are two different phenomena. Motorboating is an oscillation in the audio amplifier just as there is sometimes an oscillation in a radio frequency amplifier. Blocking is due to an intermittent cut-off of the plate current in the blocking tube due to the application of a strong signal. If the blocking occurs in a radio frequency oscillator the oscillations come in spurts, the amplitude rising and falling. Sometimes the amplitude falls to zero and stays there for quite a while. Blocking can always be remedied by using a lower grid leak in the blocking tube. This is not always a certain cure for motorboating.

* * *

Tone Control

WHAT should the resistance and the condenser in a tone control be to give the best range of tone? Where should the tone control be connected, in the grid or in the plate circuits of the power tube? —D. G. M., New York, N. Y.

For best tone range the resistance should be infinite and so should the capacity. That assumes that "best tone range" means complete control. Good values if placed in the grid circuit of an amplifier are 0.02 mfd. for the condenser and 100,000 ohms for the resistance. Where it should be placed depends on the values of the capacity and the resistance used.

* * *

Exploding Electrolytic

WHAT would cause an electrolytic condenser to explode? I have heard that that occurs occasionally.—G. H. A., Bronx, N. Y.

Leaving the power on for a long time with the polarity wrong would undoubtedly cause the trouble. When the voltage is applied in reverse there is a very heavy current through the electrolytic condenser and this current necessarily dissipates a great deal of heat in the condenser. The liquid inside heats up like water in a boiler.

* * *

Gas in Tubes

WHY is it that many of the latest tubes now draw a great deal of grid current and that it is necessary to use a very low grid leak to prevent distortion and blocking? —A. H. V., Kansas City, Mo.

It may be that the latest tubes contain more gas than earlier tubes. Considerable current will flow to the grid if there is gas inside the tube. The suspicion is also borne out by the fact that the latest tubes are noisier than some of the older, and it is well known that a gassy tube generates more hiss than a tube from which every trace of gas has been removed.

* * *

Removing Harmonics

I HAVE constructed a radio frequency oscillator covering the broadcast band. The harmonics are too strong and I should like to know what to do to eliminate them. Please suggest something.—S. G., Portland, Ore.

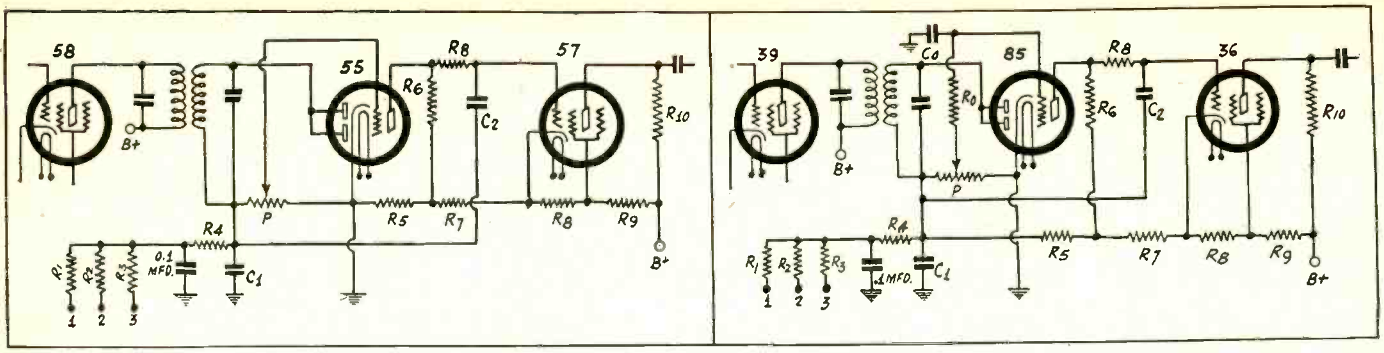
The best way to eliminate the even harmonics is to build a push-pull oscillator. Using a high resistance in the feedback circuit will cut down all harmonics. What harmonics you get also depends on where you couple to the oscillator. There is a small percentage of harmonic content in the current in the resonant circuit but much harmonic current in the plate circuit. Hence couple inductively to the oscillating coil. If you must remove practically all the harmonics you should couple a highly resonant circuit to the oscillator and tune this to the fundamental. If the oscillator operated at a fixed frequency, or if on a variable frequency, if it covered a frequency ratio of less than 2 to one, a low-pass filter could be used in the output of the oscillator. This should have a cut-off between the highest frequency to be generated and the second harmonic of the lowest frequency to be generated. Then it would be effective on all the harmonics without cutting off any of the desired fundamentals.

* * *

Computing Mutual Inductance

IF A radio frequency oscillator coil is wound on one piece of tubing in a continuous winding with a tap at the center, how can the mutual inductance of it be determined? That is, how can the mutual inductance between the plate and the grid windings be obtained?—T. H. J., Lexington, Ky.

Compute the inductance of the entire coil and also compute the inductance of either end. The mutual inductance is then the difference between one-half of the computed inductance of the entire coil diminished by the inductance of either the grid or the plate section. To illustrate: Let us assume a coil one inch in diameter having 124 turns of No. 28 enameled wire. Let it be tapped at the center turn. Then the inductance of the whole winding is 181.6 microhenries, half of which is 90.8 microhenries. The inductance of either



Noise suppressor circuits. At left, without filter; at right, with filter.

half of the coil is 74.9 microhenries. Hence the mutual is 15.9 microhenries.

* * *

Capacity Measurement with Voltmeter

IF A UNIVERSAL type voltmeter is connected to a voltage V through a condenser of capacity C, what is the relation between the capacity and the voltage reading on the meter?—R. B. Y., Boston, Mass.

The capacity is equal to $(v/rw)/(V^2—v^2)^{1/2}$, in which V is the applied voltage, v the voltage indicated on the meter when the condenser is in series, r is the resistance of the meter, and w is the radian frequency of the applied voltage.

* * *

Rectifier Plates Glow

WHEN I turn on the power on my a-c receiver the plate of the rectifier tube gets red hot and after a very short time the glow ceases. When I test the tube afterward it is always completely dead. This has happened several times. Incidentally, the tube I used for rectifier is a 227.—W. H. C., St. Louis, Mo.

There is a short in the set somewhere. Since it is a severe one it is possible that it is the first by-pass condenser in the filter. Buzz the circuit out to see where the short is.

* * *

Oscillation Assured

REGARDING the Super Diamond 7, if there is no oscillation in the oscillator (grounded padding condenser and grounded bias resistor) what is the cause? Please give code for the combination oscillator-first intermediate coil with eight leads.—K. L. E., Ames, Ia.

If the 58 tube is used as oscillator sometimes it will not oscillate in autodyne service, so use a 57. As to the padding condenser, if the grounded method is used, and no oscillation is present, lower the value of the biasing resistor as much as necessary to introduce oscillation. However, stoppage of oscillation usually will not be due the padding condenser location but rather to putting the biasing resistor directly to ground. That is the time particularly that the biasing resistance value has to be lowered to obtain oscillation.

The absence of oscillation may accompany the use of the 57 tube as autodyne in the Super Diamonds from causes stated, or from the bias being too high, due to abnormal plate current flow. The tube itself may be emitting too strongly, and the bias may exceed 7 volts, when oscillation stops. Here, too, a lower resistance value would be needed.

The code for the coil with eight outleads, for grounded padding condenser but "lifted" biasing resistor, follows: green with white tracer to one side of 3,500-ohm biasing resistor, other side of which resistor goes to cathode; black, to ground; yellow, to plate; red to 1,200-ohm resistor, other side of which resistor leads to B plus; green to grid cap of the first intermediate tube; black with red tracer, to 2 meg. resistor used for a.v.c. connection; blue, to stator of tuning condenser; white to one side of padding condenser (other side of padding condenser to ground). The padding condenser ground lug is the thick one.

To use an eight-lead coil as for the purposes defined in the seven-lead method, connect together the black and the white leads, and solder them to ground connection.

* * *

Connection of Oscillator Coil

HOW can an oscillator coil be connected so that there will be no doubt that the phase is right for oscillation? If the proper connection could be determined by inspection it would not be necessary to reverse leads in case the circuit failed to oscillate.—G. W. R., Boston, Mass.

There are two ways in which the oscillator coil may be connected correctly if it has two windings. There is only one way if it has a single winding with a tap on it. Suppose it is of the single-winding type. One end of the coil is connected toward the plate and the other end toward the grid. The tap is connected toward the cathode. Connected "toward" is used rather than "to" because there may be condensers, chokes, or resistors intervening between the coil terminal and the tube. This is the only way in which a single-winding coil can be connected. There is practically no possibility of making a mistake. The preferable way of connecting a two-winding coil is similar to the above. Instead of a tap there are now two wire ends, resulting from cutting the wire instead of merely tapping it. As before, one end of the coil is connected toward the grid and the other toward the plate. The middle end on the grid side is connected toward the cathode and the middle end on the plate side is connected toward the B plus. The second way of connecting the two-winding oscillator coil is to reverse both the grid and the plate windings. The two winding connections assume that the plate and the grid windings are made in the same direction.

* * *

Battery-Operated Oscillator

PLEASE SHOW a view of the location of parts for the battery-operated test oscillator, 50-150 kc, described in last week's issue, February 4th.—A. N. s., Cincinnati, O.

The illustration, rear view, is printed herewith.

Noise Suppression Troubles

WHY is it that a noise suppression circuit may not work at all, or may work in the wrong direction?—C. L. E., Long Beach, Calif.

It should be pointed out that the noise that is to be suppressed may actually prevent the suppression. If the noise comes through the amplifier when there is no signal present it comes through on some carrier, probably a parasitic oscillation. There will be a voltage across P even when there is no signal, and this voltage may prevent the n.s.c. from working properly.

In order to get the desired voltages across the various resistors we must properly proportion the resistances and the currents. Let us assume that the current through R9 is 10 milliamperes. It is practically the same through R8. Hence, if the drop in R8 and R9 is to be 250 volts, the sum of these would be 25,000 ohms. If the voltages in R8 and R9 are to be 100 and 150, respectively, the values should be 10,000 and 15,000 ohms. Now we may want a drop of 3 volts in R7. The current is still about 10 milliamperes and therefore R7 should be 300 ohms. If the drop in R5 is to be 25 volts this resistance should be 2,500 ohms.

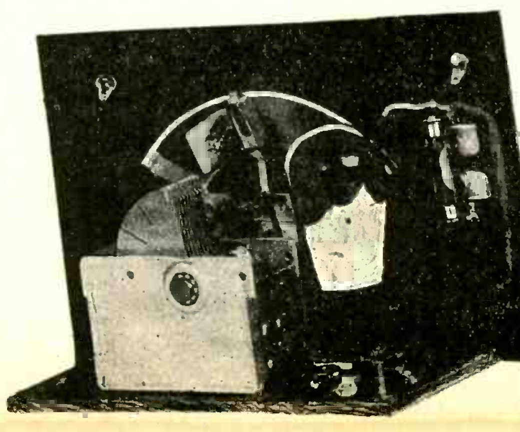
If we allow a greater bleeder current all the resistors are proportionately less. See digaram herewith.

Tubes on a "C" Supply Should Be Similar

When a C battery eliminator is to be used in a receiver care must be taken that such a tube is used for oscillator that the oscillation start at least as quickly in the tube as the space current starts in the tubes biased. Practically this means that if there is a filamentary tube in the set that is controlled by the C bias supply the oscillator tube should also be filamentary.

If a heater oscillator is used the controlled tubes should also be of the heater type, and this is particularly true of the power tubes. The reason for these precautions is that there is no bias until the oscillation has started and when there is no bias there is, or may be excessive current in the power tubes.

Rear view of battery-operated test oscillator. The grid leak and condenser are on panel at right. The leak is 7 meg., for modulation by grid blocking. For modulation removal a resistor of 0.1 meg. is switched in parallel with the 7 meg.



NEW ANTENNA USES VERTICAL COPPER RODS

By doubling the signal intensity of KYW, East Pittsburgh, Pa., with no increase in station power, engineers of the Westinghouse Electric and Manufacturing Company have performed what is said to be the first major radio achievement of 1933 and have added a new term to radio—the concentrator antenna.

According to Walter C. Evans, manager of the Westinghouse radio department, some of the attributes of the new antenna systems thus far noted are:

Increases signal intensity, approximately double, in areas where is desired.

Moves fading area to a considerable distance from the station, and so increases the effectiveness of the station in its useful area.

Is most efficient on higher frequencies, and improves the lower wave bands for broadcasting operations. (This last may be its most important function.)

Vertical Antennas Used

The new system at KYW, developed after months of research and experimentation, consists of two unusually high vertical antennas, with a new ground system. Vertical copper rods have taken the place of the more familiar antenna where wires are strung between towers.

The main antenna—Westinghouse engineers term it the exciter—consists of a copper rod, 204 feet high. It is supported on a wooden pole, 200 feet high. This huge pole, about five times as high as the usual telephone pole, is made of three western cedars, spliced together. The concentrator antenna also includes a pole, about 150 feet high, with a vertical copper antenna. The concentrator pole is about 250 feet distant from the exciter and is adjusted to resonate at 1,020 kilocycles, KYW's frequency.

Buried in the ground, underneath both poles, is a copper sheet, 14 feet square, with eight strips, running out in a radius of 75 feet. This is a type of ground installation extremely efficient in eliminating ground resistance.

Intensification by Flattening

The concentrator tends to bend down the radio waves coming from the exciter, flattening them so that they are intensified over the useful area of the station. In operation, it acts somewha as a prismaic lens does, encircling a light source, bending down and flattening the light rays, so that they are confined to useful angles near the earth.

By improving the ground wave of station and decreasing its sky wave, fading is said to have been overcome in the service area of the station.

In explaining fading, engineers state that an antenna system acts like two transmitters, one signal coming from the ground, the other from the sky. In these two signals are about equal in strength, they set up interference, which is known as fading. The same thing may be noted on a radio set, when two stations, on the same frequency, are picked up.

Fading Area Pushed Out

When, however, a ground wave considerably stronger than the sky wave is transmitted, the fading area is pushed out beyond the service area of the station.

By increasing the efficiency of the shorter wave-lengths, the concentrator antenna system has made a major contribution to radio. At present the frequency band between 750 to 550 is considered the best. From 990 to 1,020 is said to be fair, while most stations oppose being placed on the band ranging from 1,400 to 1,500 kc. With the new system, a station operating at 10 kilowatts, at the higher frequency, has transmitted a signal as powerful as another station, operating at 50 kilowatts. There is thus seen the possibility that a wide area of useful wave bands may be opened up, always a desirable thing in the overcrowded broadcast world.

Westinghouse engineers state that the antenna is a comparatively simple matter of installation, wit hthe added difficulties, however, of experimental and adjustment.

Voltmeter May Belie Battery Potentials

The e.m.f. of a battery is not the same as the voltage measured with a voltmeter connected across the terminals of the battery. The e.m.f. is always higher than the measured terminal voltage. The e.m.f. would be obtained with a voltmeter drawing no current, that is, with a static voltmeter, or a with a vacuum tube voltmeter in which the grid was heavily biased negatively. The e.m.f. is the driving force in the circuit. The voltage measured is only the difference between the e.m.f. and the voltage drop in the internal resistance.

If the cell is new and the voltmeter used draws very little current the measured voltage is so nearly equal to the e.m.f. that the difference is entirely neglible.

The flow of an alternating or a fluctuating current in the primary of a transformer induces an e.m.f. in the secondary thereof. Of course, that e.m.f. is also alternating, both when the primary current is alternating and when it is merely fluctuating.

If the secondary is connected in the grid circuit of a vacuum tube, the full e.m.f. is applied to the grid if and only if there is no grid current flowing.

As soon as grid current flows the voltage applied to the grid is less than the e.m.f. because of voltage drop in the resistance of the secondary.

Typewriter Demonstrated

A new radio typewriter was demonstrated over the stations of the Columbia network.

Linked wholly by radio, this new radio typewriter installed in a distant building or even another city can be operated at whirlwind speed, controlled by simply depressing silent keys at the sending point miles away.

During the demonstration, one of these radio typewriters was set up in the Columbia studios, and operated at high speed from a sending keyboard in a private office in one of the skyscrapers of the Wall Street district. "Better Radio Reception for Listeners" was discussed by Orestes H. Caldwell, former Federal Radio Commissioner, in a series "How to Get the Most Out of Your Radio Set," arranged by the Radio Division of the Electrical Association of New York, Inc. The demonstration was a part of this feature.

New Handbook is Out

A thoroughly revised tenth edition of the Radio Amateur's Handbook has been isued by the American Radio Relay League. Completely rewritten, with new illustrations and new material, the tenth edition represents an almost entirely new book.

The Handbook, which is used as a primary reference source by amateur and professional alike, has been modernized and according to the publishers contains numerous recent developments which have not previously been presented to the public in any form.

Approximately 180,000 words are contained in the 218 pages of the new edition, together with 207 illustrations. The entire field of amateur radio is covered, beginning with the history of the art in the first chapter and continuing through electrical and radio fundamentals complete short-wave station design and construction, and a thorough discussion of radio operating procedure.

TESTIMONIAL

RADIO WORLD is the only radio magazine of use and enjoyment to me.

MILLARD L. BEYER,
321 Eastern Parkway,
Brooklyn, N. Y.

COLLEGES ASK GOVERNMENTS' BROADCAST AID

Washington

Aid by Federal and State governments in financing college radio broadcasting is favored by the administrators of land grant colleges and state universities, according to the result of a survey conducted by Dr. Cline M. Koon, senior specialist in education by radio at the Federal Office of Education. Only twenty-four institutions are now operating their own broadcast stations, while twenty-nine others are making use of commercial radio facilities. Lack of funds prevented other institutions from owning broadcast stations or from making use of commercial stations.

The college heads were decidedly opposed to the sale of broadcasting time for commercial advertising, but many would permit restricted advertising rather than be forced to forfeit their radio broadcasting licenses, if no other source of revenue was available.

Subjects were placed in the following order of importance by the consensus of 631 educators:

Technical and economic information for specific groups; broadcasts designed to enlarge the services of the institution to the State; general information broadcasts; an open forum for the discussion of public questions of major importance; courses of systematic instruction for the general adult audience; information from State government departments; school broadcasts; entertainment.

232 Women Amateurs in World, 190 in U. S.

Hartford, Conn.—There are 232 licensed feminine radio amateurs in the world, it was reported at American Radio Relay League headquarters here today. Of these 190 are in the United States.

This percentage of the more than 50,000 amateur stations on earth, while small, is a growing indication of the interest among women in what has become one of the world's foremost hobbies.

YL's and XYL's they're called—young ladies and ex-young ladies—in the parlance of amateur radio, largely a language of abbreviations. Many of the XYL's (or YF's for wives) are the result of radio romances through the agencies of their amateur stations.

The geographical distribution of the feminine amateurs closely approximate that of their numerous brethren. While many of them are novices in the art, a few have achieved enviable reputations for operating ability and for their personalities over the air. A few have even been granted administrative appointments in the A.R.R.L. field organization.

Although normally regarded as distinctly a masculine activity because of the technical proficiency and depth of knowledge required, as well as the scientific importance to other branches of the radio art, amateur radio has welcomed these modern Dianas of the magic telegraph key and microphone with the same opportunity for pleasure and achievement that it gives its other devotees.

WMAL with NBC Makes Total 89

WMAL, one of the pioneer broadcasting stations, of Washington, D. C., has been added to the National Broadcasting Company networks.

WMAL, with a power of 500 watts in the daytime and 250 at night, operating on 630 kc, is joined to the NBC-WJZ network. The station, established in January, 1826, has been operating as an independent. It is owned by the M. A. Leese Radio Corporation, but will be managed and operated by the NBC.

WMAL is the NBC's second Washington outlet, and the 89th station on the coast-to-coast NBC networks.

BOARD OUSTS STATION WERE

Washington

WERE, Erie, Pa., owned and operated by the Erie Dispatch-Herald Broadcasting Corp., has been ordered off the air by the Federal Radio Commission.

The Commission found that the equipment of the station was "obsolete and incapable of efficient operation" and that the applicant does not possess sufficient financial resources to insure either the installation of modern equipment or the future operation of the station in a proper and acceptable manner.

The Commission pointed out that the deletion would not deprive the area of any substantial service not otherwise received. The station has been in operation since 1928 and was operating on 1,420 kc with a power of 100 watts, unlimited time. Commissioner Thad H. Brown dissented without comment.

1,000-Watt Television Transmitter Opened

Los Angeles

Completion of a powerful television transmitter is announced by the Don Lee Broadcasting System.

Rated at 1,000 watts, and with 4,000 watts maximum output for signal peaks, the new transmitter, W6XS, recently went on the air for the first time on regular schedule, Friday, December 23, 1932, from 6:00 to 7:00 p.m., broadcasting action reels and close-ups of motion pictures stars, according to Lubcke. This schedule will be maintained daily, except Sundays and holidays, it is announced.

W6XS is ten times more powerful than the sister television transmitter, W6XAO, which has pioneered several achievements in the ultra short-wave field, notably the transmission of a motion picture image to an airplane speeding high above Los Angeles last summer.

Opening on regular schedule on the first anniversary of W6XAO, the new high-powered television transmitter of W6XS, operates on a frequency of 2,150 kilocycles, 140 meters. Grid modulation, new air-cooled vacuum tubes and other advanced features are expected to provide signal coverage of the entire State.

As in the case of the smaller W6XAO, the new transmitter is at present located in the Don Lee Building at Seventh and Bixel Streets, Los Angeles.

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

SET FAITHFUL, 28-8,000 C.P.S.

Edwin K. Cohan, technical director of the Columbia Broadcasting System, has installed a specially-constructed receiving, amplifying and reproducing unit in his office in the Columbia building on Madison Avenue, New York, to serve as a high fidelity check on the network's transmission of programs. Whereas the average radio receiver can reproduce frequencies of 100 to 3,500 cycles, Cohan's new unit has a range of from 25 to 8,000 cycles.

The outfit is capable of reproducing all of the overtones and harmonics of orchestral music which are beyond the scope of radio sets generally, and of reproducing the human voice with fidelity. The set therefore gives an almost perfect key to the performance of Columbia's transmitters, for it reproduces practically all of the frequencies which are sent out on the air.

To insure such fidelity it was necessary to equip the unit with two loudspeakers and an elaborate array of filters which flatten the otherwise uneven characteristics of the speakers. One of the speakers is effective over a range of 25 to 3,000 cycles, and the other from 3,000 to 8,000, both together covering a range almost equal to that of the human ear, whereas the average receiver reproduces only half of this range.

The set is equipped with a switch known as the "microphone compensator," which permits the listener to allow for the difference in the types of microphones used in transmitting different programs.

W1XAL Application Strikes Official Snag

Washington

Examiner Elmer W. Pratt of the Federal Radio Commission has recommended the denial of applications for short-wave facilities by Shortwave Broadcasting Corp., Shortwave & Television Laboratory, Inc., and Shortwave Television Corp., all of Boston, Mass. Shortwave Broadcasting Corp. sought a license for an experimental relay broadcasting station (WIXAL). The application of the Shortwave Television Laboratory, Inc., was for a renewal of license for experimental televsion station WIXAV, and the applications of Shortwave & Television Corp. were for a license for an experimental television station (WIXG) and a renewal of license for experimental television station WIXAU used for transmitting sound in connection with television.

Denial of the application of the Shortwave Broadcasting Corp. was recommended because it appeared that it was applying for an experimental relay broadcasting station which had been constructed by and would be operated by the Shortwave & Television Corp. without the proper supervision of the licensee.

The application of Shortwave & Television Laboratory, Inc., was opposed on the ground that this corporation had been completely absorbed by Shortwave & Television Corp. which owns and operates WIXAV. Mr. Pratt recommended that the application of Shortwave & Television Corp. be denied because it is "completely dominated and controlled y the General Electronics Corp." and that it has used its privileges "as a basis for stock promotion activities out of all proportion to the actual accomplishments or prospects of accomplishment."

ULTRA WAVES SOUGHT BY RCA FOR MESSAGES

Washington.

The development of the use of ultra frequencies has progressed so far that RCA Communications, Inc., is seeking to have this spectrum considered by the Federal Radio Commission for point-to-point commercial message service. The present 3,000 to 6,000 kc band is much inferior for that purpose, states the RCA subsidiary.

The preliminary facts were set forth in a letter to the Commission from Swager Shirley, attorney for RCA Communications. He wrote:

"During the past six months, experimental work in the generation, propagation and use of the very high frequencies (those above 30,000 kc.) has been brought to a preliminary conclusion by engineers of the Radio Corporation of America.

Sees New Situation Looming

"It is too early yet to reach final conclusions as to the best ultimate method of commercial application of these developments. Nevertheless present indications are that, within a reasonable time, we will know whether, as now seems to be indicated, the use of frequencies above 30,000 kc. will not make feasible point-to-point domestic radio communication of a nature quite impossible in the present bands of 3,000 to 6,000 kc.

"The application of these new developments would at once make obsolete any equipment and any radio system designed to use the frequencies upon which our applications are at present based.

"The commercial use of frequencies above 30,000,000 kc. began with the development and installation by the Radio Corporation of America of the interisland radio telephone system in Hawaii, which has been successfully operated for more than a year by the Mutual Telephone Company.

Ultra Results Improving

"The operation, during the past several years, by engineers of the Radio Corporation of America of several experimental transmitting stations in the very-high frequency band, constantly improved and constantly pushed to longer ranges and greater reliability, has been fruitful of many developments in the very-high frequency field.

"Marconi's announcement in August, 1932, of bending these very-high frequency waves for use beyond the visual horizon confirmed our experimental results.

"The experimental operation of a high quality telephone radio channel for three years between stations of RCA Communications, Inc., at Rocky Point and Riverhead, N. Y., on frequencies of the order of 500,000 kc., reported regularly to your engineering division, has afforded opportunity for progressive development of apparatus and of the technique of operation on such frequencies.

Has Repeater Working

"The most recent developments involve the successful operation of a very-high frequency "repeater" station which combined with other experimental data indicates the possibility of using these frequencies efficiently and economically over great distances for domestic radio transmission of commercial telegraphy, telephony, teletype, or facsimile and for combinations of these services.

"If a domestic radiotelegraph system were to be immediately installed, the frequencies originally applied for by the Radio Corporation of America would be appropriate. The radio art, however, is a swiftly moving art. Both the laboratory experiments and field demonstrations referred to indicate that an entirely different set of frequencies will be found more desirable.

Future Messages by Facsimile

"Laboratory experiments and field demonstrations further indicate that the present dot-dash language of telegraphy will not be found best suited for that purpose, but will be superseded by a swifter, more accurate and less expensive system whereby messages offered at the point of origin will be reproduced in facsimile at the point of destination.

"It seems probable that equipment now considered most useful for domestic telegraphy will be on the road to obsolescence when devices and methods which the engineers now foresee have been further developed, and that then entirely different frequencies will be found most useful for the purpose."

The Commission regards the situation and its possibilities as important and is giving the facts deep consideration.

WJZ Adds 20 kw; Now Using 50 kw

WJZ, pioneer radio station in the New York area and "key" station in one of the National Broadcasting Company's two basic Eastern networks, has been increased in operating power experimentally from 30,000 to 50,000 watts, by authority of the Federal Radio Commission.

The station thus uses power equal to that of its associate station, WEAF, "key" outlet of the other NBC basic Eastern network.

The new power rating, which wil be made permanent if the experimental operation proves satisfactory, is erpected to extend the station's service area and improve reception within the former area. NBC engineers express the opinion that the radius of service will be increased by 25 per cent. as a result of the change.

At Bound Brook, N. J., where the WJZ transmitter is located, engineers had little trouble in "stepping-up" the power. The station has been equipped with a 50,000 watt transmitter ever since it was moved to Bound Brook in 1925 and the few adjustments necessary to commence operation at full power were made easily in the seven hours interval betwen the normal broadcasting days.

Standard Resistor Code

For First or Second Significant Figure		*Number of Ciphers After the Significant Figures*
Black	0	None
Brown	1	0
Red	2	00
Orange	3	000
Yellow	4	0000
Green	5	00000
Blue	6	000000
Violet	7	——
Gray	8	——
White	9	——

The color for the first or second significant figure follows this code: body color denotes first significant figure; end color denotes second significant figure; dot denotes number of ciphers after the first two significant figures.

NOTED PATENT CASE REVIEWED

Washington

The United States Supreme Court heard argument on the review of lower court decisions protecting Percival D. Lowell and Francis W. Dunmore in patents on a-c sets granted to them on the basis of inventions made while they were employes of the Bureau of Standards.

Solicitor-General Thomas D. Thacher appeared for the Government, which seeks reversal of the decision of the lower court.

James H. Hughes, Jr., appeared for Dubilier Condenser Corporation, to whom Lowell and Dunmore assigned the patents. He urged that the case should be confined to the general rule that the obligation of an employe to assign to an employer an invention made in the course of his employment does not arise from the existence of the relation of employe and employer alone, but there must be in addition a contract to assign. The lower court found, he said, that there was no testimony that the men were employed to invent.

"It would require an entirely new concept of the employer-employe relation to hold that one employed as a research expert is employed to invent," Mr. Hughes declared.

Justice Brandeis observed that the bill perhaps is one praying specific performance in rem to secure what the Government claims is its property, based on a constructive trust between the parties.

The Justice also observed that the general rule in regard to inventions perfected by an employe when there is no specific contract for assignment to the employer might not apply to the situation here presented, because the Government not only claims the patents for itself but for the people as beneficiaries. Justice Stone also commented that the activities of the Bureau of Standards are conducted wholly for the benefit of the public.

Bill Permits Messages Free to Ships' Crews

Washington

Support for the bill (H. R. 11247) to permit employes of steamship companies at sea to use the radio facilities on the ships free for personal messages was expressed before the House Committee on Interstate and Foreign Commerce by Frank W. Wozencraft, representing the Radiomarine Corporation, a subsidiary of the Radio Corporation of America, and Arja Morgan, head of the Bureau of Informal Cases of the Interstate Commerce Commission.

Mr. Wozencraft explained that the measure is designed to provide radio facilities without cost to ship employes so that they may send social or emergency personal messages that do not entail any additional cost to transmit.

Ralph L. Walker, representing the Federal Radio Commission, told the Committee that the Commission had reported itself as not being in favor of the legislation, but that it had decided to reconsider the matter and to submit a new report.

List Prices of 25Z5 42 and 43, New Tubes

The list prices of the three recently-announced tubes have been distributed to the trade as follows: 25Z5 at $2.75; 42, at $2.00; 43, at $2.80.

STATION SPARKS

By Alice Remsen

The Pipes of Pan

For "Dance Nocturne."

(WJZ and WLW and Coast-to-Coat Network)

Sundays at Midnight, EST.

Listen to Pan! He is piping again!
Piping a dance for the sprites in the rain!
Piping a melody, haunting and clear,
A melody just for a few folk to hear.

Pan is a brown man with ears small and pointed;
Long-limbed and tall, finely made, slender jointed.
Pan is a sly one who laughs at convention;
Never a mortal can guess his intention.

Pan is elusive and cannot be captured;
His pipes leave the folk of the forest enraptured,
Throwing them into the wildest confusion,
Caught in a network of dreamy illusion.

Down through the forest his hooves are rebounding;
Down through the ages his pipes are resounding.
Faintly—an echo of silver tones blending
Into a message of song, never ending.

Listen to Pan! He is piping again!
Piping a dance for the sprites in the rain!
Piping a melody haunting and clear;
A melody just for a few folk to hear.

—A. R.

* * *

And if you listen to the "Dance Nocturne" you too will visualize Pan and his magic pipes, dancing sprites and elves under swaying forest trees. William C. Stoess waves a magic baton and his musicians weave delightful pictures in harmony. Eddie Alberts and Maurie Neuman do justice to vocal choruses and your girl friend does a couple of solos. Please listen in, I'm sure you'll like it. Here are the stations: WHAM, Rochester, N. Y.; WGAR, Cleveland; WJR, Providence; WIS, Columbia, S. C.; WSMB, New Orleans; WKY, Oklahoma City; KPRC, Houston; KGHL, Billings; KGO, San Francisco; WENR, Chicago; KWCR, Cedar Rapids; Koil, Omaha; WWNC, Asheville; WFLA, Clearwater, Fla.; WIBA, Madison, Wis.; WREN, Kansas City; KSTP, St. Paul; KHQ, Spokane; WSM, Nashville; WSB, Atlanta; WMC, Memphis; KTBS, Shreveport; WBZ, Boston; WBZA, Springfield, Mass.; KWK, St. Louis; WIOD, Miami Beach, Fla.; WDAY, Fargo, N. D.; KFYR, Bismarck, N. D.; KOA, Denver; KGW, Portland, Oregon; KOMO, Seattle, Wash.; and of course, WLW, Cincinnati and WJZ, New York.

* * *

The Radio Rialto

Another old-established air program has changed its setting. Cliquot Club Eskimos, radio's oldest continuous network broadcasting group, has come out of its night club atmosphere, and has embarked on a tour of aerial visits to the homes of their listeners for a series of friendly performances, with a new cast headed by Albert Kennedy "Rosey" Rowswell. Mr. Rowswell is a lecturer and after-dinner speaker who has appeared all over the United States, and a radio speaker and humorist known to millions of listeners. He will preside over the new series as the Cliquot Toastmaster. In this capacity "Rosey" will introduce "Gay Ellis" (Annette Hanshaw), blues singer; Jimmy Brierly, Eskimo vocalist, and an augmented orchestra under the direction of Harry Reser. . . . . And, by the way, I almost forgot: their broadcasting time and network have been changed; they now are heard via NBC-WJZ network each Monday night at 8:00 p.m. . . . .

Did you know that: T. Daniel Frawley, veteran NBC dramatic player, married Lilla Campbell, a niece of Mrs. Pat Campbell, famous English star? Elizabeth Lennox, contralto, is the daughter of a Methodist minister, the Rev. Lambert Lennox, of Grand Rapids, Michigan? Lew White, organist, is the son of Herman White, prominent Philadelphia music teacher and that James Wallington was born in my old town, Rochester, N. Y.? . . . .

There is a rumor in air circles that Rachmaninoff, celebrated Russian composer, will broadcast some time this year; he has steadily held out against radio, together with Paderewski and Fritz Kreisler. When he does broadcast, however, he must have the atmosphere of a regular concert hall around him and an audience. . . . Understand that Keith McLeod, Ed Thorgerson and Ernie Chappell are no longer with NBC. Hart Giddings has been gone for some time. . . . While Jeff Sparks is back at 711. . . . Very glad, Jeff. . . .

Emily Post, whose example in manners, customs and social routine is followed by millions of women, rises at five o'clock every morning. A person of dynamic energy, the well-known authority on taste and etiquette who speaks over an NBC-WJZ network on the Du Pont Cellophane program each Monday and Thursday morning at 10:45 a.m., generally is at work on a newspaper article or radio broadcast by 5:30 in the morning. On the other hand she frequently goes to bed at 8:30 in the evening. . . . Eddie Cantor's kidding of Rubinoff and his family on the Sunday night Chase & Sanborn program over NBC network is all in fun, and no one enjoys it more than Rubinoff's brother, who comes in for his share of drubbing from Cantor's wit. At the conclusion of a recent broadcast in which the comedian made merry over his description of the Rubinoff family at home in Russia. the brother was fairly convulsed with laughter. "Oh, boy," he said, "my folks will get a big kick out of this. They are home listening now; never miss it if they can help it. They just returned from a trip to Russia, my brother's Christmas present to them.". . . Mr. and Mrs. Seth Parker recently celebrated their 50th wedding anniversary at their home in Maine—but it's not the Seth and Ma that most of us know over the air. When Phillips H. Lord created the NBC Seth Parker, he thought he had a name all his own. Now he finds that there is a Seth Parker in Durham, Maine, not so many miles from Jonesport, the scene of his radio dramas. . . .

Edna St. Vincent Millay was accompanied to the NBC studio by two distinguished artists for her Sunday poetry reading recently. They were Effrem Zimbalist, internationally known violinist, and his wife, Alma Gluck, opera prima donna, who insisted upon viewing the broadcast from the studio control booth. . . . Morton Downey's schedule is changed. He has been heard every Monday and Friday at 10:00 p.m., but now offers his sustaining programs every Thursday at 10:45 p.m. and every Saturday at 10:00 p.m. In addition he will be featured on the Columbia Guest Revue presentation each Monday evening at 10 o'clock. Besides his radio activities, both on the National and Columbia networks, he is filling a number of vaudeville engagements in the vicinity of New York City. . . .

Midnight, Friday, January 20th was a gala occasion in New York radio circles. At that time, singers, announcers, musicians, actors, song publishers and broadcasting officials turned out en masse for the pre-view of Kate Smith's first full-length motion picture, "Hello Everybody.". . . Ernest Hutcheson's Sunday evening piano recitals with the Columbia Symphony Orchestra pack the studio with a large number of aspiring young musicians, most of whom are admiring students of the Julliard Graduate School of Music, of which Mr. Hutcheson is the Dean. . . . Fred Uttal, CBS announcer, adds to his official duties the avocations of scene painting and writing. Just now he's making a comparative study of biographical styles, concentrating on Emil Ludwig's "Napoleon" and "Bismarck" versus Thaddeus' "Voltaire" and "Frederick the Great.". . . Like Ed Wynn, Tom Howard and George Shelton wear funny costumes in all their broadcasts. Makes them fell at home; they just can't work without a make-up. . . .

The month of January, 1933, marked the opening of the thirteenth successive year as a radio star for Vaughn de Leath. . . . The great mystery of Gracie Allen's missing brother has now spread to Tin Pan Alley; two new songs, "Has Anybody Seen My Brother?", and "Gracie's Missing Brother," both dedicated to the popular little comedienne, are now being published. . . . "Easy Aces," the WABC-Columbia network's three-a-week comedy on American home life, has shifted to a new schedule; formerly broadcast on a Monday, Wednesday and Friday schedule, the Lavoris series has now become a Tuesday, Thursday and Saturday attraction; the new time, 8:00 to 8:15 p.m.

Out here in Cincinnati things are pretty much the same. A new program, "Notes in Business," is creating quite a stir in the business world. An advisory committee, which will assist the staff of WLW in collecting and editing material for use in "Notes in Business" broadcasts, was recently formed in New York, at a meeting presided over by J. Ralph Corbett, nationally known marketing expert and merchandising consultant for WLW. This advisory committee consists of the heads of over twenty-three industries. The motivating thought behind these business broadcasts is that of giving to the average man and woman of the street as well as to business, industrial and financial leaders, vitalized dramatic pictures of the latest development and trend of national and international business affairs. "Notes in Business" is not an ordinary news broadcast, but an intensely interesting and educational dramatization of business facts, so simply told that their effects upon our social and economic life are made instantly apparent to the most casual listener. The series of dramatic episodes move with a thrilling swiftness, which carries the listener to every corner of the world. They are woven into a unified whole by means of specially prepared music of an ultra modernistic character, scored by Lloyd Shaffer, the youthful conductor of the "Notes in Business" orchestra. . . . Listen in to this program; you'll like it. WLW, 7:30 to 8:00 p.m. Saturdays. . . .

"Tales of Terror," Don Becker's hair-raising program, is now being presented as a full hour feature, from 11:00 to 12:00 p.m. on Sunday evenings, with an intermission program between the two acts, said intermission consisting of Joe Emerson and your girl friend in a vocal and instrumental interlude, with a splendid orchestra under the direction of William C. Stoess. "Tales of Terror" is presented under the direction of Rikel Kent

(*Continued on next page*)

Station Sparks

By Alice Remsen

(Continued from preceding page)

and stars such microphonic actors as Marjorie Hannon, Gladys Thornton, Florence Golden, Maurice Franklin, Paul Stewart and Frank Henderson.

* * *

Biographical Brevities

About Little Jack Little

Little Jack Little was born in London, England. Studied piano at the London Conservatory of Music when only four years old. When he reached the age of nine his family brought him over to America and they settled in Waterloo, Iowa.

Jack attended public schools there. It was at the University of Iowa that he received the nickname of Little Jack Little and he has used it ever since. His right name is John Leonard. At the university Jack formed a dance band, which was so successful that he soon had three or four bands.

His ambition didn't stop there; he headed West, and landed in Denver, destitute. Got a job playing piano in an orchestra. Saved enough money to pay his fare to New York. Got a job playing piano for Yvette Rugel in vaudeville. Then tried a single of his own; didn't click. Henry Waterson, a music publisher, then put him out with a singer. plugging songs over the radio. The singer didn't show up several times; Jack did the singing, caught on—and there you are. He writes songs, too—good ones. Plays vaudeville now and they like him. Now singing over WABC and Columbia networks.

* * *

ANSWERS TO CORRESPONDENTS

LOIS NENCOOK, Albany, Calif.—Thanks for your kind words about the column and my broadcasts. I am sending you my schedule. I expect to have some pictures made in the near future and will then send you one.

DAVID BEILIN, Chicago—Sorry, but at this writing I have no definite information on Rubinoff. Shall try to get it for you soon.

Service Men to Exhibit at the World's Fair

The Institute of Radio Service Men, an international organization, will participate in the exhibits to be shown by the World's Fair Radio Amateur Council at the 1933 World's Fair, Chicago.

The Institute decided to participate to demonstrate to the public the fact that the entire radio industry is anxious to secure for them the best possible co-operation on their service problems.

A THOUGHT FOR THE WEEK

"JUST a Little Booze for the Old Soaks" doesn't sound uproarously funny to us —but then you can't stop those radio folk who insist on making fun of life's serious problems, if you can consider popular ballads of pa and ma as serious. Why, even Irving Berlin once travestied one of Mendelssohn's most beautiful compositions.

PARTS BUSINESS LEADS

Dealers in New York City report that those specializing in parts, or at least carrying considerable parts, are keeping ahead of expenses, but set dealers are hard hit. This reverses the boom period situation.

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.*

Robert Smith (Auto and Short Wave Radio), 1332 Lincoln Ave., Toledo, Ohio.
Harold McCullen, 1923 Madison St., Saginaw, Mich.
John Hagele, 21 Elm Place, Rye, N. Y.
T. Weston Browne, 2633 Bayou Road Street, New Orleans, La.
Radio Exchange, 203 Pine Street, Sweetwater, Texas.
G. T. Hubbard, P. O. Box. No. 43, Kingston, Okla.
Homer Forrest, Mgr., Forrest Specialty Shop, Box 231, Hillsboro, N. C.
James B. Oppenheimer, 5553 Waterman Ave., St. Louis, Mo.
H. Klein, 531 East 167th St., Bronx, New York City.
Loren Cox, Portland St., Bryan, Ohio.
Solon Person, Proctor, Ark.
Wm. C. Esslinger, 725 So. Division St., Ann Arbor, Mich.
Ernest A. Rose, Box 9, Nanuet, N. Y.
Arthur D. Herbert, 535 Brown Ave., Fresno, Calif.
D. H. Suitt, Austin. Theatre, Nacogdoches, Texas.
E. L. Horne, Batesburg, S. C.
B. J. Wilson, 125 W. Mt. Airy Ave., Philadelphia, Pa.
Offenbach Elec. Co., 1452 Market St., San Francisco, Calif.
Frank Long, 22 Mullen Ave., San Francisco, Calif.
William Bosler, 3118 Broadway, Astoria, L. I., N. Y.
H. P. Weiss, 703 South Westhedge, Kalamazoo, Mich.
Kuno Repair Co., 513 10th St., S., Great Falls, Mont.
Howard Miller, Box 313, Asheboro, N. C.
C. W. Price, 1921 N. Lawrence, Wichita, Kans.
Elmer C. McChesney, P. O. Box 810, South Bend, Ind.
Clinton E. Child, P. O. Box 7, Goodyear, Conn.
Michael Hornyak, 105 Wallis Ave., Farrell, Penna.
E. S. Middleton, Rt. 1, Box 152, Ceres, Calif.

CORPORATE ACTIVITIES

NEW INCORPORATIONS

First National Radio Productions, incorporated in California, capitalized at $100,000.
Frank Wolf Drummers' Supplies, New York City, musical instruments—Att., S. E. Harwitz, 1,450 Broadway, New York City.

BANKRUPTCY PROCEEDINGS

Petition Filed By

Coronian Wire Works, Inc., 295 Avenue A, New York City—Liabilities, $2,378; assets, $1,154.

Petition Filed Against

Orpheum Circuit, Inc., operating chain of motion picture theatres, 1270 Sixth Ave., New York City—No schedules filed. This corporation is a subsidiary of the R.K.O., which is affiliated with the Radio Corporation of America.

Receiver Appointed

Orpheum Circuit, Inc., 1270 Sixth Ave., New York City.

CORPORATION REPORTS

Stewart Warner Corporation—Preliminary report for 1932: Net loss after taxes, depreciation and other charges, $2,445,197, against $1,830,171 loss the year before. Quarter ended Dec. 31: Net loss after above deductions, $761,103, against $660,161 loss in preceding quarter and $817,856 loss in final quarter of 1931.

RCA Sues Four Firms as Patent Infringers

Patent infringement suits have been filed by the Radio Corporation of America and other companies against Edmund Burns, doing business as the Melrose Distributing Company in Los Angeles, Cal.; Martin Sexton, doing business as Radio Doc, in Los Angeles; the Vim Electric Company, Inc., and the John Wanamaker Department Store, both in New York City.

These suits relate to the sale or manufacture of radio receiving sets by the companies mentioned as defendants.

TRADIOGRAMS

By J. Murray Barron

The Brodney Brothers, A. I. and Marcus, of the Brodco Radio Corp., large buyers of surplus merchandise and factory output, reports considerable activity throughout their trade. In fact, their recent trip on the road indicates that most live merchants are always in the markets for real buys in radio merchandise. This would likewise indicate that the public in turn is ready to purchase worthwhile buys.

* * *

Two new input stages have been placed on the market by Universal Microphone Co., Inglewood, Cal. This brings the number of these instrument types up to five. There is some literature for those interested in amplifiers and microphones.

* * *

Walter H. Nussbaum, Inc., 61 Cortlandt Street, N. Y. C., is featuring in an unusual window display the Brunswick Short-Wave Converter. This, an exclusive item, a factory buy-out and offered at a price hardly more than that of a first-class set of short-wave coils, everything is complete, including the tubes.

* * *

Thor's Bargain Basement, 167 Greenwich Street, New York City, is now offering a six-tube direct current set complete in cabinet. This is not the kit set but a different model. Full information will be sent upon request.

* * *

During a recent week no less than three new miniature universal a-c and d-c radio receivers have made their appearance on the market, one of which is a superheterodyne. That these little fellows are selling there can be no question. Many are buying them as an extra set, others as a personal one, and the traveling public are very big buyers. So far only one organization has offered a kit to build your own, which may be so constructed as to operate from batteries if necessary. To those interested in the construction of this type some interesting data will be sent by addressing the Trade Editor.

Argentina Market Survey Completed by U. S. Bureau

Washington

The first of a series of foreign radio market surveys, requested by American exporters has been completed, according to Marshall T. Jones, Chief of the Commerce Department's Electrical Equipment Division.

The first survey covers several important phases of radio merchandising in Argentina. The Department decided upon these surveys only after communicating with the leaders of the radio manufacturing industry in this country.

Their response and advance sales of the survey indicate the service is needed by the industry, especially in view of the rapidly changing situation in most foreign radio markets.

The survey on Argentina covers the status of broadcasting, the market for receiving sets, types of sets proving most popular, and the most successful selling methods, as well as facilities for doing business.

RACKETEERS IN RADIO!

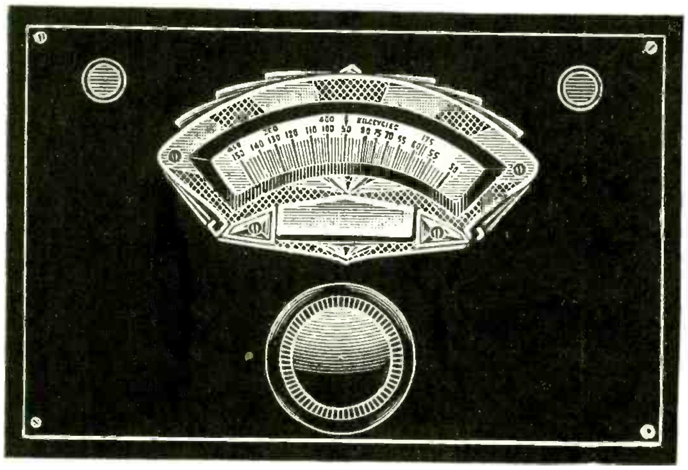
Peter Dixon, radio columnist, tells an interested public that two members of an air band have been attacked and that one is now in a dangerous condition in a New York hospital. He announces also that two prominent radio entertainers have as close friends some racketeers whose activities are no secret to the authorities.

Names, Mr. Dixon, names!

Modulated Oscillators

Accurate to 2 Per Cent

Offered FREE!



A MODULATED test oscillator is a strict necessity in service work and experimenting, and here is an oscillator in either a-c or battery-operated form that fulfills all the requirements. It permits lining up any intermediate frequency of 50 kc or higher (no limit), as well as peaking for broadcast frequencies.

This test oscillator has the fundamental frequencies imprinted right on the dial scale, 50 to 150 kc, so any tests for these frequencies should be made on the fundamental. All the commercial intermediate frequencies not found on the fundamental are registered on the upper tier of the scale, e.g., 172.5, 175, 177.5, 260, 400 and 450 kc. Any other frequency not included on the fundamental scale or the special upper tier registrations may be obtained by using a fundamental which is the result of dividing the desired frequency by the lowest whole number. Thus all intermediate frequencies are covered, either fundamentally or harmonically, and since the fundamental is 50 to 150 kc, the broadcast band is read directly by using the tenth harmonic and mentally affixing a cipher (500 to 1,500 kc). Also, by setting the test oscillator at 50 kc any receiver or other tuned circuit covering frequencies from 100 kc up may be calibrated in terms of 50 kc steps by tuning the tested circuit while leaving the test oscillator fixed at 50 kc.

Backed by Brilliant Engineering

THE a-c model uses the line frequency (60 cycles) for modulation, while the battery model uses the grid blocking principle, producing a high-pitched note. In the a-c model a 56 tube should be used, although in an emergency a '27 could be inserted. The 56 is a better oscillator and invariably permits zero beat adjustment. The tube for the battery model is the 230.

Since the modution is of a steady average value in the a-c circuit, and of a steady absolute value in the battery model, the lining up may be done either by ear or in conjunction with an output meter.

There are two binding posts on the test oscillator panel, one (at left) for output, and the other for optional grounding. It is not necessary to use the ground post, nor for broadcast frequencies is it necessary to use any wire for coupling to the receiver, as the radiation from the test oscillator will be strong enough to effectuate coupling up to 40 feet from the receiver. For intermediate frequencis a wire from output post (left) should be connected to plate of the modulator (first detector) tube, to line up the i-f channel. Both posts are insulated from the voltage supply and therefore no fear of short-circuiting need be felt.

THESE oscillators are compact and sturdy and represent the most inviting premium ever offered to subscribers for RADIO WORLD. They were designed by Herman Bernard especially for subscribers for this publication, and utilize the Hartley oscillator as simplified by Edward M. Shiepe (Massachusetts Institute of Technology).

An extra large knob is used so that the adjustment may be closely made with convenience, while the vernier dial, of the full-vision travelling light type, combines to make possible the very closest adjustment.

In the design of the oscillator, while it was desired to avoid the nuisance of having to consult charts to determine the frequency, it was recognized that special precautions must be taken as to accuracy if the scale and the tuned circuit were to coincide. This feat has been fully and eminently accomplished by grid circuit stabilization, and while an accuracy of 2 per cent is absolutely guaranteed, one should realize that this is the maximum deviation permitted, hence at many positions the accuracy will be much greater. Indeed, there will be exact coincidence at about half the total number of subdivisions on the scale. The average accuracy is 1 per cent or better.

The battery model has a modulated-unmodulated switch. The a-c model is constantly modulated.

How to Get an Oscillator FREE!

The test oscillator, either type, is obtainable only in kit form as a premium with a one-year subscription for RADIO WORLD (52 issues, one each week) at the subscription price, $6.00. The subscriber may build up the oscillator from information furnished with the kit. However, those desiring the kits wired and calibrated should send $6.00 for the kit, and $1.50 extra for wiring and calibration at a precision laboratory. The $1.50 is turned over by us to the outside laboratory.

Complete parts diagram, calibration instructions, for the a-c model free with one year's subscription at $6.00. Order Cat. PRE-ACOK and remit with order.

Wired model a-c oscillator. Send $6.00 for one year's subscription and $1.50 extra for wiring and calibration. Order Cat. PRE-ACOW, remit $7.50 with order.

Complete parts, diagram and calibration instructions for battery model. Send $6.00 for one year's subscription. Order Cat. PRE-BATOK, remit $6.00 with order.

Wired battery model. Send $6.00 for one year's subscription for parts and $1.50 extra for wiring and calibration. Remit $7.50 and order Cat. PRE-BATOW.

[Tube not included in offers. Shipments will be made express collect.]

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

DIAMOND PARTS

Tuned Radio Frequency Sets

FIVE-TUBE MODEL

A-C operated circuit, 50-60 cycles, 105-120 volts, using two 58 t-r-f stages, 57 power detector and 47 output, with '80 rectifier. Three gang shielded condenser and shielded coils in a sensitive, selective and pure-tone circuit. Dynamic speaker field coil used as B supply choke. Complete kit of parts, including 8" Rola speaker and all else (except tubes and cabinet). Cat. D5CK @............$15.89
Wired model, Cat. D5CW (less cabinet) @.... 17.19

Kit of five Eveready-Raytheon tubes for this circuit. Cat. D5T 4.97

FOUNDATION UNIT, consisting of drilled metal subpanel, 13¾ x 8⅝ x 2¼"; three-gang Scovill 0.00035 mfd., brass plates, trimmers, full shield; shields for the 58 and 57 tubes; six sockets (one for speaker plug); two 8 mfd. electrolytic condensers; set of three coils. Cat. D5FU....... 6.19

Super Diamond parts in stock.

FOUR-TUBE MODEL

The four-tube model is similar, except that there is one stage of t-r-f, and a two-gang condenser is used. Tubes required, one 58, one 57, one 47 and one '80. Complete kit, including 8" Rola dynamic speaker (less tubes, less cabinet). Cat. D4CK ....[illegible]

Kit of four Eveready-Raytheon tubes for this circuit. Cat 4D.TK 3.89

FOUNDATION UNIT, consisting of drilled metal plated subpanel 13¾ x 2½ x 7"; two-gang 0.00035 mfd. SFL condenser; full shield; two shields for 58-57; center-tapped 200-turn honeycomb coil; five sockets (one for speaker plug); two 8 mfd. electrolytics; set of two shielded coils; 20-100 mmfd. Hammarlund equalizer for antenna series condenser. Cat. D4FU $5.48

INDIVIDUAL PARTS

Travelling light vernier dial, full-vision, 6-to-1 vernier, projected indication prevents parallax; takes ¼" or ⅜" shaft; dial, bracket, lamp, escutcheon.

0-100 for 5-tube Diamond, Cat. CRD-0, @ $0.91.

100-0 for 4-tube Diamond, Cat. CRD-100, @ $0.91.

[If dial is desired for other circuits state whether condenser closes to the left or to the right.]

8 mfd. Polymet electrolytic, insulating washers, extra lug. Cat. POLY-8 @....................$0.49
Three 0.1 mfd. in one shield case, 250 volt d-c rating. Cat. S-31 @............................ .29
Rola 8" dynamic for 47, with 1800 ohm field coil tapped @ 300 ohms. Cat. FP @........ 3.83
2 coils for 4-tube. Cat. DP @.................... .90
3 coils for 5-tube. Cat. DT @.................... 1.35

DIRECT RADIO CO.
143 WEST 45th STREET
NEW YORK, N. Y.

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

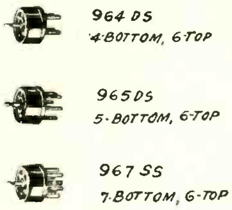
Wired model, licensed by RCA, with complete equipment, less aerial, but including RCA tubes. Cat. 898-W $37.40

DIRECT RADIO CO.
143 West 45th St. N. Y. City

ANALYZER

Plugs and Adapters

RECEIVER END



906-WLC—Finest Analyzer Plug, smaller diameter than that of smallest tube, so fits into tightest places in receivers. Seven-lead 5-ft. cable, six-pin base with stud socket at bottom center. Two grid caps interconnected (use handier one), and they also connect with stud socket, which is a latch lock, and with seventh cable lead, and with control grid of 7-pin tubes. Adapters (at right) all have six hole tops to receive Analyzer plug base, and have projecting stud that connects to Analyzer plug's stud socket. Latch in Analyzer Plug base grips adapter studs so adapter is always pulled out with Analyzer Plug (adapter can't stick in set socket). Pressing latch lever at bottom of Analyzer plug releases adapter....................................$3.23

964 DS—Six-hole top with stud, four-pin bottom.. .73
965 DS—Six-hole top with stud, five-pin bottom.... .73
967 SS—Six-hole top with stud, seven-pin bottom.. .73

The four devices described above enable access to all UX, UY, six-pin and seven-pin tube sockets in receivers. Additional adapters for all unusual tubes are obtainable. Write your requirements.

ANALYZER END

On the analyzer there must be socket accommodation for the tube removed from receiver. One universal socket and one adapter permit putting all UX, UY, six-pin and seven-pin tubes in Analyzer.

456 is a 9-hole "universal" socket into which will fit, with automatically errorless connection, any UX, UY or six-pin tube..$ .62

976-SL. To enable putting 7-pin tubes into the universal socket, an adapter with seven-hole top and six-pin bottom is used. A 6-inch lead with phone tip is eyeleted to the side. A pin jack on Analyzer, connected to seventh lead of 906-WLC cable, picks up control grid of 7-pin tube through the eyeletted lead..........................$ .73

Additional adapters for all unusual tubes are obtainable. Write your requirements.

437-E. Those preferring two different sockets (universal and a separate 7-hole socket) rather than one socket and an adapter, may obtain a 7-hole socket to match the universal in size and mounting holes.................... $ .62

MULTIPLE SWITCH

2NS9—K-P9. For switching to nine different positions, enabling current, voltage and other readings. Any one position opens a circuit and closes another. Thus the opener, by interruption, gives access to plate, cathode, etc., leads, for current readings, while the closer puts the current meter in the otherwise open circuit. Switch has detent for "snappy" action..................................$2.65

JUNIOR OUTFIT
For Receiver End

7-pin plain analyzer plug, 7-lead cable attached (977) $1.25
Three adapters for UX, UY and 6-pin sockets in receiver (976, 975, 974)............................ 2.19

DIRECT RADIO CO.

145 West 45th Street, New York City

Quick-Action Classified Advertisements

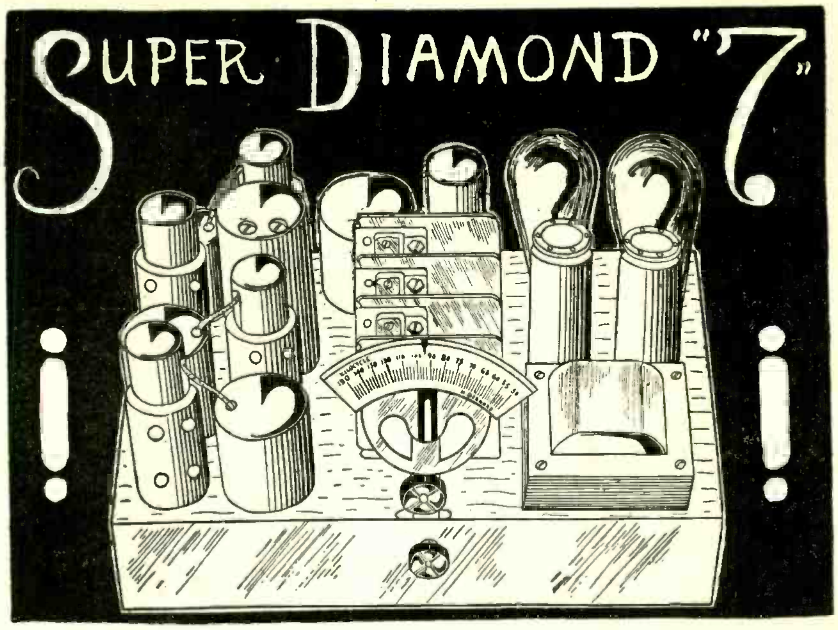
7c a Word—$1.00 Minimum
Cash With Order

SULPHATION, CORROSION, AND FREEZING OF STORAGE BATTERIES ABSOLUTELY ELIMINATED. VOL-TEX gives your battery new power and lengthens its life. Price $1.50 per box. VOL-TEX Canadian Distributors representative, J. Grist, 570 Maclaren St., Ottawa, Canada.

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.

BARGAINS IN FINEST PARTS! — Highest grade, new parts, few of each on hand. National dial, flat type, modernistic escutcheon, type G, clockwise, $2.19; Pilot drum dial No. 1285 @ $1.89; a-c toggle switch, 19c; triple pole, four-throw Best switch, insulated shaft, $1.62; double pole, four throw, $1.08. Direct Radio Co., 145 West 45th St., N. Y. City.

FILAMENT TRANSFORMERS FOR TUBE TESTER. Tapped at 1.5 - 2 - 2.5 - 3-1/10 - 5 - 6-3/10 and 7.5 Volts. Price $2.00. Sparty Radio Service, 93 Broadway, Newark, N. J.



The Set That Brought In 96 Channels Out of 96!

A SEVEN-TUBE receiver, designed by Herman Bernard, with highly accurate padding, and using a frequency-calibrated dial, the Super Diamond 7 is just the thing for DX enthusiasts. The circuit has full automatic volume control, full-wave diode detection, diode-biased 55 triode, and, except for the second detector, triple-grid tubes throughout. Stations 10 kc apart sharply separated though antenna power input of one is 100 times that of other. A circuit with beautiful tone. Complete kit of parts for this receiver, including everything, even speaker, except cabinet, front panel and tubes. (Cat. CKSD7) **$19.62**

FOUNDATION UNIT

The Foundation Unit for the Super Diamond 7 consists of a shielded antenna coil, a shielded interstage r-f coil, a combination oscillator and 175 kc assembly in one high shield, a shielded regular 175 kc transformer, and a shielded 175 kc transformer with center-tapped secondary; also a 0.00041 mfd. tuning condenser, three-gang, with compensators; an 850 to 1,350 mmfd. padding condenser, a frequency-calibrated dial and a drilled chassis. Cat. FU-SD7 @....................... **$6.55**

[The coils for r-f and oscillator are wound exactly according to specifications of Herman Bernard and are of a higher order of accuracy than in commercial practice, and moreover provide for matching the tuning to the scale of the frequency-calibrated dial that bears Mr. Bernard's name.]

ADDITIONAL PARTS

The nine 0.1 mfd. and two 0.25 mfd. bypass condensers for the Super Diamond 7 are specially made up in one shield, with mounting brackets, and is the same as used in the designer's model. Cat. CU-SD7 @ **$1.20**

Three-gang 0.00041 mfd. tuning condenser, compensators. Cat. TC-SD7 @ **$1.80**

Drilled chassis for the Super Diamond 7. Cat. CH-SD7 @.............. **$ .80**

The tubes used in this receiver are four 58's, one 55, one 59 and one '80. Total, 7 tubes. Tube kit is Cat. TK-SD7 @.. **$5.35**

850 to 1,350 mmfd. padding condenser, 50c; knobs for ¼ inch shafts, 7c each, four for 25c; Bernard's frequency-calibrated dial, 90c; electrolytic condensers, 8 mfd., 49c each; power transformer, $1.95.

SUPER DIAMOND 6

This is a 6-tube a-c receiver, like the "7," only there is one intermediate stage instead of two. Good sensitivity and selectivity, with finest tone yet developed in a super. Uses the same accurate padding system as the "7," same frequency dial. Gets plenty of distance, too.

Complete parts, including speaker (less tubes, less front panel, less cabinet). Cat. SD-CMP @ **$16.22**

Set of shielded coils, consisting of antenna coil, modulator input coil and combination oscillator and first 175 kc intermediate coil (latter two in one shield), and separate intermediate coil with center-tapped secondary. Cat. SDCK................ **$3.95**

Combination oscillator and 175 kc only, in one shield. Cat. OSN @.... **$1.80**

Three-gang 0.00041 mfd. condenser with trimmers built in; ⅜ inch shaft, 1⅛ inches long. Cat. DJ-41-T.......... **$1.98**

250,000 - ohm potentiometer with switch. Cat. R25S @............... **$ .72**

Pigtail resistors, 9c each; Rola speaker, $3.83; tube shields, 11c each; UX, UY sockets, 10c; six-pin, 11c; 7-pin, 15c.

The tubes required for the "6" are two 58, one 57, one 55, one 59 and one '80. Cat. TK-5D6 @ **$4.53**

AUTHENTIC CIRCUITS

The Super Diamond series—the six-tube and seven-tube models—are most excellent circuits, carefully engineered and tested. "Everything fits." You will be amazed at what results these circuits yield. They are real "hot" and we unqualifiedly recommend them.

DIRECT RADIO COMPANY

143 WEST 45TH STREET NEW YORK CITY