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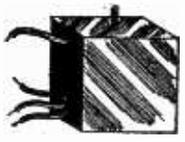

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Tracking Down Tunable Hum

Detector an Offender—Some Remedies

By Garrison C. Fenwick

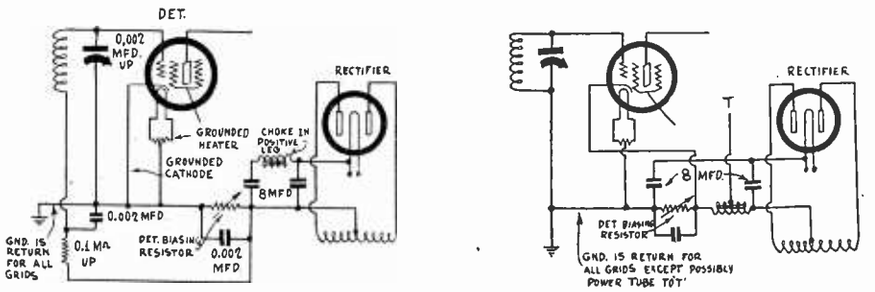
BESIDES the usual causes of hum in a receiver, such as inadequate filtration because of too low inductance B choke or too small capacity filter condensers, and misplacement of parts, there are unusual causes, or rather causes that do not come up for discussion ordinarily.

One of these is the biasing resistor of the detector tube. It is common practice to use a separate resistor from cathode to ground, and to put a bypass condenser across it. The main use of the bypass condenser is to avoid degeneration at radio frequencies, for the detector tube handles both radio and audio currents. The reason why the condenser is not of much importance to audio frequencies is that its capacity is always too low for that result. Many circuits use 0.002 to 1 mfd. to bypass this resistance. Even 8 mfd leaves the impedance to audio frequencies high indeed. Then, too, the detector tube in an a-c set most likely will be a screen grid tube, and another resistor comes into play, the one that drops the maximum B voltage to the screen voltage, and this, too, would require an enormous capacity condenser.

Why Hum Is Present

Since the hum is in the low-frequency region, either 60 cycles or 120 cycles, and mostly 120 cycles in full-wave rectification of the B supply, the bypass condenser across the detector biasing resistor is not large enough, can not practically be large enough, to remove the ripple voltage existing across this resistor. Even if the detector is a '27 tube the biasing resistor should be 100,000 ohms or thereabouts, though the plate load resistor is only 50,000 ohms, that is, the bias voltage is about twice the voltage drop in the load. It is true that around 20,000 ohms is most commonly used for biasing this tube as a detector, and the hum may be less that way, because the impedance is lower with the lower resistance, but also the detecting efficiency is lower. If the current through the plate circuit is limited to 0.2 ma, as recommended, then the 100,000 ohm resistor will develop the substantially correct voltage of 20 volts, assuming the plate voltage to be 250 vots.

With the case of the screen grid tube, e.g., the '24 heretofore commonly used, but about to be superseded by the 57, again the biasing resistor should be high. With this tube it is true the biasing voltage for detection, assuming 0.25 meg. in the plate circuit, 275 volts applied, the negative bias should be around 5 volts. Experiments showed most sensitivity at 5.3 volts. Assuming the plate current adjusted to 0.1 ma, for a 5-volt bias, the resistor in the cathode leg would have to be 50,000 ohms. This, too, is a large resistance value, and a small amount of hum voltage present in the detector tube, coming from the plate supply, is introduced into the grid circuit of the tube, for the cathode leg is common to the grid and plate circuits, and indeed there may be some regenerative effects to boost the hum.



The B choke is in the positive leg in the diagram at left and in the negative leg at right.

Some Makeshifts

Therefore some other methods may be tried. Of course, one of them is to let the set be as it is and put only a very small condenser across this resistance, say, 0.002 mfd., for its effect on r-f, and permit degenerative feedback at low frequencies, which reduces the amplification in the entire low-note region, and thus the hum frequency or its second harmonic may not be amplified in that circuit at all, or may be de-amplified. That is a makeshift method.

Because high capacity brings out truer results on the otherwise neglected low notes it is also true that an early effect is a seeming increase in hum. Actually there is no more hum originally present, but whatever hum is present in the detector is amplified. Thus, if there is a preliminary stage of audio, the same neglect of bypassing of impedances will sacrifice the amplification of low notes and tend to make less hum audible, although, of course, departing from the faithful standards of reproduction we all desire.

And in the power tube stage—except in the case of push-pull—again absence of a bypass condenser across the biasing resistor, or use of a small capacity, will bring the same result. Increase the capacity and the amplification increases in the hum region. Therefore, one must distinguish between the two factors: (1), the filtration, which may not be good enough to keep all hum out of a sensitive detector, and (2), intentional audio degeneration.

It is always most agreeable to come across the scientific solution, rather than resort to makeshifts. Where the hum is due largely to inadequate filtration, or that plus a highly sensitive detector, one may try without success to improve the filtration, as by adding more filter capacity and inductance, because to achieve the desired result would require tens of microfarads more, and bulky B chokes in addition. One may reduce the sensitivity of the detector and hum will be lower, but who wants to sacrifice sensitivity?

The Better Way

A better method is to reduce the impedance of the biasing resistor of the de-

(Continued on next page)

(*Continued from preceding page*)

tector. One way to do this is to put a much smaller resistor from cathode to ground, than the one now used, and introduce some bleeder current from a higher voltage tap of the B supply voltage divider. Suppose that the 90-volt tap is used. Then a resistor of 20,000 ohms may be connected between the 90-volt tap and detector cathode, and a 1,300-ohm resistor from cathode to ground. This is quite a reduction in impedance—50,000 ohms compared to 1,300 ohms. The current through the resistor would be about 14 ma. As the plate current in the tube is only 0.1 ma, the 4 ma drain holds substantially for both branches of the network.

Yet 1,300 ohms is something to consider, particularly as the bypass condenser, even at 8 mfd., does not remove the 120-cycle a-c voltage drop across the resistor. It would be fine to reduce the resistance some thousand ohms or so more, and this may be done.

If the power tube is a pentode biased negatively 20 volts approximately, then if another resistor is put in the common B lead through which all the set's B current flows, the resistance of the biasing element will be reduced compared to the current in the detector alone and the current in the set as a whole. Take a small set, say, a 5-tube midget. At 60 ma only about 88 ohms would be needed. We have declined from 50,000 ohms to 88 ohms. And 88 ohms is such a small resistance that it is hardly worth while putting any condenser across it, except to trap out radio frequencies, and for that purpose any small value may be used—0.00025 mfd. up.

Avoiding Tunable Hum

Another effect of such treatment is to get rid of the companion of steady-hum condition, and that is tunable hum. The usual explanation given for the presence of tunable hum is that the r-f tubes do a little detecting, and the ripple voltage in the B supply is modulated on the carrier by the stray detection action of these tubes. In many instances no doubt that is the correct explanation. But why should the same tubes cause intermodulation in one set and not in another which has no better filtration? And why should the same tubes cause tunable hum in one set and not cause it in another set?

One should look particularly to the detector, for there is no doubt whatever about the detector's modulating capabilities—modulation and detection are practically the same thing—and therefore tunable hum often can be eradicated by reducing the impedance of the biasing adjunct, although one should not reduce the biasing voltage. That means more current must be used for developing the voltage drop.

Tunable hum is that hum which shows up strongly when you tune in a station but which is absent, or hardly noticed and unobjectionable, when no station is tuned in. It will be observed that the stronger the station the louder the hum. This is easily explained by the fact that the resultant hum is the sum of the two frequencies—the carrier and the hum frequencies—in a detector. In an amplifier it would be the product of the two.

Cathode May Be Grounded

Now, many a set subject to tunable hum may be relieved entirely of that nuisance by the impedance-reducing method just described. Also, the steady hum value of the set will be lowered. Moreover, by this method in a-c sets it is practical to ground the cathode conductively, so that cathode and center of the heater winding are at the same d-c potential, important in a detector tube. Whether the B choke is in the negative or the positive leg makes no difference. The total B current may be put through the resistor just the same.

An incidental advantage of this method is that it permits direct reading of the detector biasing voltage. Ordinarily, if you use the type of meter that is the favorite with experimenter and service men—1,000 ohms per volt—the voltage reading obtained will be wrong. However, an approximation may be obtained by allowing for the error.

Use the meter at a high voltage scale, one that still permits legibility at 5 volts. Let us say it is 100 volts maximum. Then 5 volts will be read at when 5 per cent. of the maximum current is flowing through the meter. The reason for using a high voltage scale is to keep the current through the meter low, because this current produces the error.

Reading Is Too Low

The maximum meter current is 1 ma and the current at the 5-volt reading is 5 per cent. of 1, or 0.05 ma, equals 50 microamperes. The current through the biasing resistor, when it is exclusively from cathode to ground, is about 0.1 ma for the '24, equals 100 microamperes. Therefore the meter current is half the other, if both were separated. But the two resistors, the biasing adjunct and the meter's series multiplier, are in parallel. The two-to-one relationship is further confirmed by the fact that the multiplier resistance is 100,000 ohms and the biasing resistor 50,000 ohms.

Thus the meter will read low, just how much low we can not surely tell, since the actual current through the tube will change with the lowered bias resulting from the meter paralleling the biasing resistor, but we can adopt the ratio as a guide, and estimate that in this case that the meter reading is one-third less than the actual voltage that will obtain. So add one-third of the reading to estimate the true voltage.

A low resistance carrying high current permits direct reading very accurately, and the low scale of the voltmeter should be used.

It is handy to use an adjustable resistor for such biasing, and any of the 100, 200 or 400 ohm wire-wound rheostats will stand the drain. Adjust for proper voltage or by ear test until signals are clearest.

Change in Bias Voltage

While it is true that the current through the B supply changes with the signal, the louder the signal, the more current, hence the higher the bias, and the change is in the right direction. Moreover, even in the separate cathode resistor in the detector the current changes, and with grid bias detection the change is in the same direction as previously stated.

Wherever audio frequencies are concerned the biasing impedances should be kept as low as possible, always consistent with the correct voltages, however. It should be remembered that for a screen grid detector the screen voltage should be low—say, 25 to 40 volts—unless the biasing voltage is raised proportionately. Thus, by lifting the screen voltage to 90 volts, the biasing voltage may be raised to 10 volts. This is an unusual condition, and the standard practice had better be followed for the '24. However, with the newer representative tube, the 57, this lowered screen voltage, compared to amplification voltages, is not important at all, due to the suppressor grid, which reduces the rebound of electrons from the plate (secondary emission).

100 Ohms Instead

The standard rating for the 57 is 250 volts applied through a coupling resistor of 0.25 meg., 100 volts on screen, 6 volts negative bias, plate current adjusted to 0.1 ma at no signal, whereupon the screen current will be about 0.033 ma (33 microamperes), as the screen current is about one-third the plate current. The value of the biasing resistor is computable from Ohm's law: the resistance equals the voltage in volts divided by the current in amperes, or 6 divided by 0.0001, equals 60,000 ohms, for individual cathode resistor.

But if the total B current is used, and if that current is 60 ma, the resistance would be only 100 ohms. There is the same voltage drop in both instances—6 volts—but in one case an impedance highly suitable for the hum frequencies is present, while in the other and more favorable case the impedance is very low. The lower the impedance the closer the approach to a short-circuit of the a-c hum voltage in the biasing resistor.

Preliminary audio tubes are subject to the same conditions. It is just as advisable to use the total B current to obtain the drop. However, if two tubes require the same bias, as a '27 detector and a '47 power tube, both cathodes would have to be tied to the same point. This would not do, as the feedback would be severe indeed. It would normally be positive. However, that identity rarely exists. We have a detector tube that requires 5 or 6 volts, and a power tube that requires from 16.5 to 50 volts ('47 to '45 range), and therefore the two return circuits are separated, and the power tube resistor should be bypassed by 8 mfd. or higher capacity, for the resistance will be from around 400 ohms to around 850 ohms, approximately.

Perhaps it has been economy that has made set practice run toward the low-wattage, high-resistance voltage dividers, so that grid leak type resistors are used for screen and other biasing voltages, but numerous such resistors are necessary, and price reductions apply to heavy bleeder type high wattage voltage dividers, and the cost is therefore, after all, only a small amount more. The all-around results are better.

If bias detection is used the biasing resistance should be of low value, but if grid leak detection is used the cathode can be grounded directly. If the leak is small, say, 20,000 ohms, and the condenser small, say, 0.0001 mfd., with high plate voltage, then grid leak power detection results. If grid current is used for developing a drop across a resistor to bias r-f tubes automatic volume control results. A circuit of this type has been worked out and will be presented soon.

New Kent Singing Test Gets Under Way

Grace W. Towne, of New York City, chairman of radio, National Federation of Music Clubs, will be chairman for Eastern New York of the 1932 National Radio Audition. Announcement of the acceptance of this post by Miss Towne was made by A. Atwater Kent, of Philadelphia, president of The Atwater Kent Foundation, which sponsors these radio singing contests.

On the basis of enrollments already made, Miss Towne is optimistic over the prospect of placing a New York state singer in the forefront of Audition winners this year. The state already has had two finalists; Kenneth Hines, of Buffalo, a national winner in the audition of 1928, and Raoul Nadeau, of New York City, who won first place in the audition of 1930. Eastern New York winners, who participated in the Northeastern District Audition last year, were Miss Winifred Cecil, of White Plains, and Raymond Heatherton, of Floral Park.

Cash prizes of $5,000 each will be awarded by the Foundation to the young man and the young woman rating highest in the national finals. A third $5,000 will be divided, according to rating, among the other finalists. Enrollment for the audition must be through a local committee. Any non-professional singer between the ages of 18 and 25, inclusive, is eligible.

Practical Home Recording

Set May Be Used on Special Amplifier

By Nathaniel Feiner

Technical Manager, Federated Purchaser, Inc., N. Y.

FIG. 1

The appearance of the home recorder by means of which phonograph records may be made at home on plain blank aluminum discs.

HOME RECORDING has now become practical with the development of a new home recording device that is at the same time reliable, easily operated, durable, and inexpensive. The device records on plain aluminum blanks, cutting its own groove, at the rate of 96 grooves per inch. It is available either for 78 or 33 1-3 revolutions per minute and for records up to 12 inches in diameter.

For recording, a diamond cutter is used, because of the hardness and durability of diamond. The same cutter may be used for years without any appreciable wear on the point. This is an important feature because if the cutting tool is not sharp, satisfactory recording is not possible.

A high power amplifier is not necessary to operate the recording unit, as satisfactory "room volume," which most radio sets are able to deliver, will suffice. This has been made possible by making the recording mechanism highly sensitive.

Construction of Recorder

An idea of the appearance and the construction of the recording head can be gained from Fig. 1. At the left we have the coupling mechanism to the spindle of the phonograph motor. This is simply placed over the shaft after the record blank has been put on the turn table. As the motor is started the record blank and the spindle of the recording head begin to turn. The spindle in the head engages a long worm, which can be seen extending from one end of the device to the other, and makes this screw turn, without moving lengthwise.

At the right end of the head is a rugged support, which is securely attached to the top of the phonograph, just outside the outer edge of the record. This support, by the way, is the only thing that needs mounting and it is done by drilling a single hole in the table and attaching it by means of a screw and a nut. No special skill is needed to do this. The left end of the head, as was stated, is supported by the shaft of the motor.

A sturdy frame extends between the two ends, and there is considerable rigidity notwithstanding the fact that one end is mounted on a revolving shaft. In addition to the frame and the long screw, there is a carrier rod extending between the two ends, or we might say a monorail, on which the cutting unit travels. This is supported the entire length of the cutting unit so there can be no wobbling of the unit, and no undesired play or lost motion. The cutting unit can turn on this rail as well as move lengthwise. When the unit is not needed for cutting it is only necessary to lift it up and turn it back. The frame at the back prevents it from swinging too far back.

Motion of Cutting Unit

On the under side of the cutting unit is a half screw of the same pitch as that of the worm. As the unit is moved forward and allowed to rest against the worm, the half screw engages with the worm and the cutting unit moves radially with respect to the record blank. The pitch of the worm and the reduction ratio between the spindle and the worm determine the distance the cutting unit moves for each revolution of the spindle, or of the record. The direction of motion is from the center of the record to the periphery. This is contrary to the direction used on ordinary phonographs but is in line with that used on talking movie records.

Fig. 2 shows how to install the recorder. The record is in place and the left end of the head is resting on the spindle of the phonograph. The right end is attached to the top of the phonograph just outside the record.

Connections to Amplifier

Two leads are show in Fig. 2, which are to be used for making connections to the output of the amplifier. The recording unit takes the place of the loudspeaker. The record will be whatever comes out of the amplifier, whether it originates in the home or in a broadcast studio. In other words, the recorder can be used for recording special broadcast programs simply by substituting the recorder for the loudspeaker, or it may be used to record any sounds that originate in the home. In case the recorder is to be used for making records of home products a microphone is needed. There are microphones of all types available, some that cost less than a dollar and others that cost a couple of hundred dollars. There are carbon button microphones, single and double, condenser microphones, also single and double, and electro-dynamic microphones. Any good microphone can be used in front of an amplifier of two or more stages, depending on the sensitivity of the microphone, to get enough volume to operate the recorder.

After the aluminum discs have been engraved they may be played back immediately. For play-back an ordinary phonograph pick-up unit is employed in the usual manner. A steel needle is used on the pick-up unit. A special process has been developed which makes it possible to play an aluminum record with a steel needle without any surface scratch noise.

Position of Recorder In Respect to Record

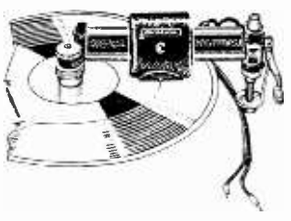


FIG. 2

This shows how the home recorder is attached to the turn table of the phonograph and how the record is placed.

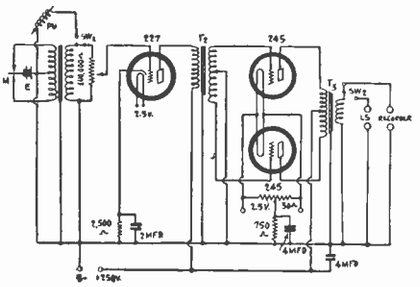


FIG. 3

This two stage amplifier may be used either with a microphone or pick-up and with a recorder or loudspeaker.

Playing Procedure

For playing back a record, or for playing any record on the phonograph it is not necessary to remove the recorder. All that is required is to throw the cutting unit up so that it will not engage the worm. Then the pick-up unit can be placed on the record and played as usual. The pick-up unit with its "tone arm" can be placed so that there is no interference between it and the recorder.

For amplifier for the pick-up the same one as is used for recording can be used. It is only necessary to substitute the pick-up unit for the microphone and the loudspeaker for the recorder. A switch can be arranged so that this change-over can be done with a single motion. We show a circuit of this type in Fig. 3. M represents a double button carbon microphone, actuated by a battery E of suitability. T1 is a microphone transformer suitable for the push-pull microphone, and PU is the pick-up unit. Sw1 is a single pole, double throw switch, by which either the microphone or the pick-up unit can be connected to the grid circuit of the first tube. The same 100,000 ohm potentiometer is used for controlling the volume from both.

In the output we have a similar switch arrangement. By means of Sw2 the output of the amplifier can be sent either to the loudspeaker LS or to the recorder. If Sw1 and Sw2 be made in one unit, that is, if we use a double pole, double pole switch, the switching at both ends of the circuit can be done with one motion. It is only necessary to arrange the leads so that the proper combination is obtained.

Various Combinations

However, if two separate switches are used, more combinations are possible, and it may be that some of them will be needed. Suppose we wish to copy a record. This can be done by using the pick-up unit and the recorder simultaneously. Of course, another phonograph is needed. But it is even possible to record part of a large record on a small one, or a small one on a part of a larger, but using the same mechanism for both. The

(Continued on next page)

SINGLE AERIAL FOR MULTIP HOW

By Felix C

A RADIO distributing system for hotels and large apartment houses by means of which a large number of radio receivers can be used on the same antenna has been perfected. The system permits as many as 3,000 receivers to be connected to the same antenna without interference of any set with any other.

There are obvious advantages of such a system in congested districts where hundreds, and even thousands, of families live in the same building. In such cases if each family were to install an antenna on the roof, there would be a great deal of interference. It would obviously be impossible for all to install the proper antennas for all the sets. If one good antenna were installed, the next one that would be put up, even though it be first class, would spoil the first, and neither would be as good as one alone. What would happen if there were a thousand antennas?

Not only do the many antennas spoil reception for all, but they badly mar the appearance of the top of the building. The fact that the wire entanglements are on top of a building a long distance above the street does not make any difference because there are people living high up who regularly look down on some of the roofs.

Another fact against using individual antennas is that the long lead-in wires will lose most of the signal, due to high capacity between the wire and the grounded structure of the building. It is a well-known fact that in apartment houses with built-in antennas the sets often pick up more signals without connection to one of these antennas than with it. This happens even when antennas are run down a dumbwaiter shaft.

Still another fact is that the noise picked up by these antennas is comparatively great. This is due to the fact that the signal that reaches the set is very weak so that it has to be operated at high sensitivity, and the noises picked up by the lead-in are strong.

With the distributing system, only one antenna is erected on one roof. This antenna is erected on sturdy poles about 100 feet apart and at least thirty feet high, and the lead-in is taken off the middle of the horizontal wire. Obviously, such antennas can not be erected for all of 100 or more receivers in the same building, but only one can be erected without difficulty.

This antenna would pick up a strong signal, relatively free from extraneous noises, particularly man-made static. If then the system is such that between the roof of the house and the various sets, no noise can enter the line, the signals as received at the input of any set will be relatively free of noises originating in the house. Also, if the line can be made so that there is little loss between the roof end of the lead-in and the various sets, the signals received will also be strong. Hence there is a two-fold advantage.

Antenna Terminal

The essential features of the distributing system are its low-loss and non-interacting characteristics. On the roof is a weatherproof terminal equipment which serves as the first part of the distributing system. From this specially built low-capacity cables run to the various receivers. These contain two leads with definite inductance and capacity per unit of length. The lines are scientifically constructed and the design follows the principles used in long distance telephone lines. The same principles of design are used for transmitting the energy from the transmitting equipment to the radiating antenna in radio stations, and their efficiency at radio frequencies has been proved by the success of these stations. The lines in the distributing system are so designed that their impedance matches the impedance of the antenna and that of the input to the set, thus insuring maximum energy transfer.

The equipment used to couple the transmission line to the receivers so effectively isolates each receiver that operation of one receiver has no effect on any other receiver.

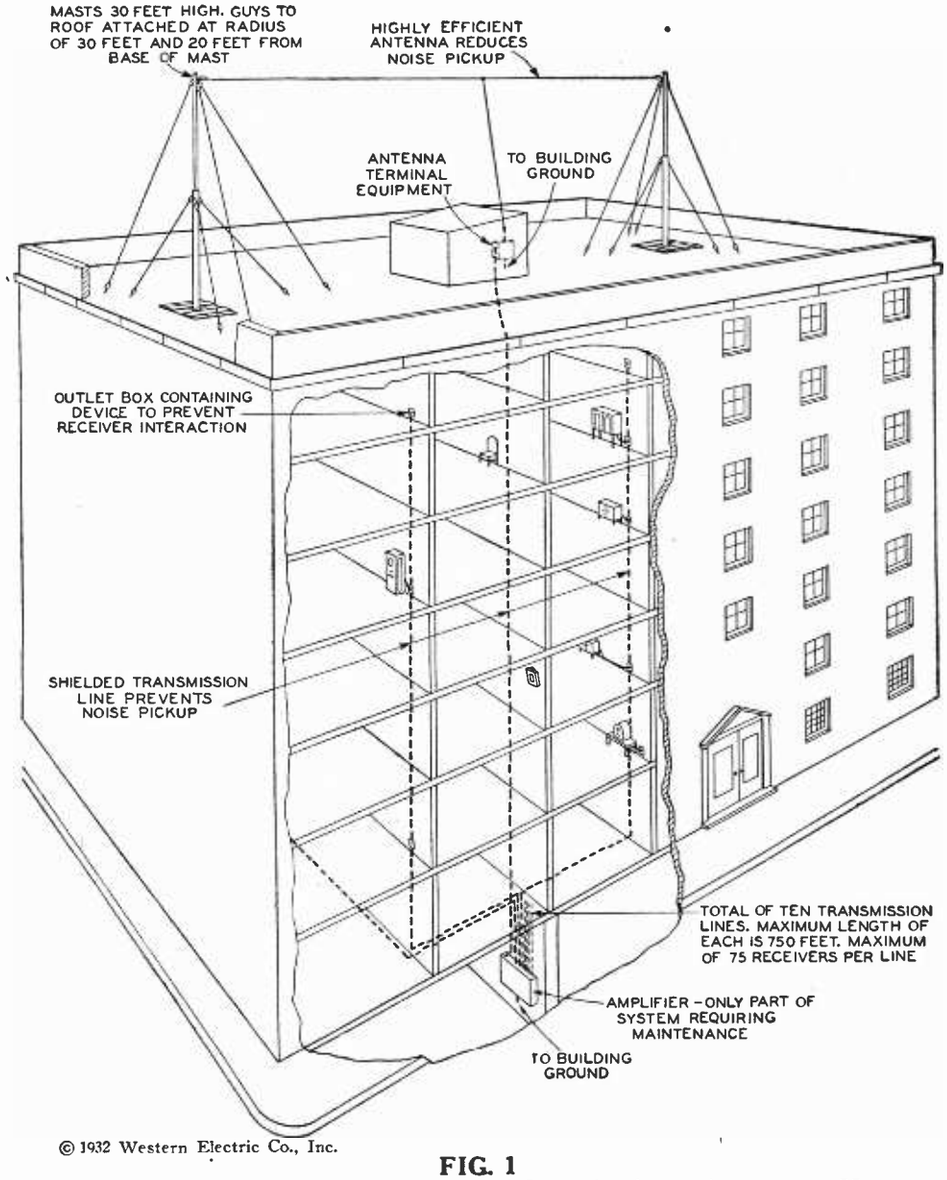


FIG. 1
Typical Installation of a single-aerial service in an Apartment House.

The Transmission Lines

The cables or transmission lines used in the distributing system consist of coaxial

How to Copy

(*Continued from preceding page*)

blank would be placed on top the record, or vice versa. It may also be desired to combine the microphone and the loudspeaker. This can be done if Sw1 and Sw2 are not ganged. In case we wish to copy a radio program on a record, the output of the set could be put in at the PU terminals. However, copying a radio program can be done more directly, and

LE SETS; THE INSTALLATION IS MADE

arruthers

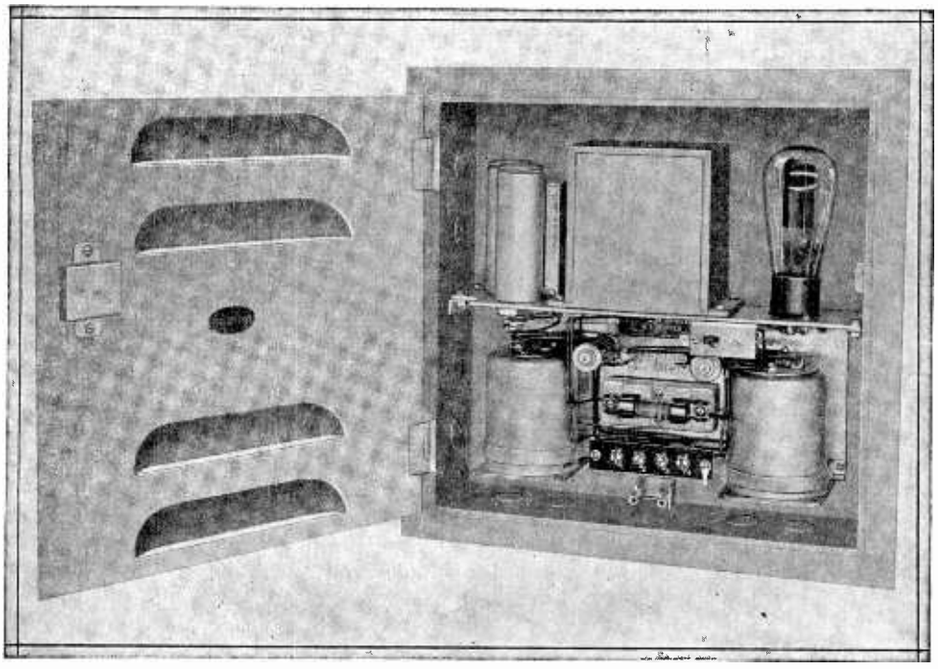


FIG. 2
Rectifier mounted in a steel cabinet as used in connection with a single-aerial service for multiple dwelling.

conductors separated by an insulator. The inner conductor is connected to the antenna, or to the "hot" side, and the outer conductor to ground. A two-conductor cable of this type has definite inductance and capacity per unit of length and has a definite characteristic impedance. In order to get the greatest efficiency in transmission a line like this should be terminated in impedances equal to the characteristic impedance of the line, and that is the reason a transformer is used at each end. With the proper terminal impedances there is little attenuation in the line, and if the resistance in series and the conductance in shunt are small, there will be little energy loss.

An antenna, too, has a certain impedance and the line input transformer should be such that it matches the impedances of the antenna and the characteristic impedance of the line. At the output of the line the transformer should match the characteristic impedance to the impedance of the device connected to the line.

The characteristic impedance is low so that the line is worked at comparatively low voltage and high current. This reduces the attenuation, and a greater proportion of the energy collected by the antenna is delivered to the load.

Line Is Shielded

The fact that the outer conductor of the pair is the ground, the "hot" side of the line is well shielded. Hence practically no interference is picked up from noise sources in the building. The only noise that gets to the receivers is that picked up by the free antenna on the roof, and this is far from electrical disturbances in the building and in adjacent buildings, so that it cannot be great. Of course, atmospherics are picked up but they constitute a very small proportion of the total noise, except on occasions when thunder storms are in the vicinity.

Some may wonder why it is necessary to use two conductors in the transmission line when one of them is grounded all the way. Why not use a single conductor and ground the other side wherever it is convenient and thus save the expensive cable? If such an arrangement were used the line would not be uniform and would have no characteristic impedance. While it would be possible to effect good matching in any case it would not be possible to standardize as the terminal transformers would have to be designed for each particular job. An engineer would have to bring his elaborate measuring equipment on the ground and take a measurement at each end of the line. This would be an enormous task in places where there are many installations and would be entirely unpractical and too expensive. Moreover, no changes could be made in any part of the system, such as moving the "hot" conductor or even changing the ground connections. If changes were made, measurements would have to be taken again and new transformers probably would have to be designed.

Standardizing Construction

When a cable of definite characteristics is used the impedances are the same regardless of the location of the cable or at what points the outer conductor is grounded. Hence for a given cable the design work can be done in the laboratory and the terminal transformers can be standardized. When this is done about the only variable is the impedance of the antenna, and there is only one which can always be made the same, within tolerable limits. The coupler between the line and the receiver is hardly a variable because there has been considerable standardization in the antenna circuit of radio receivers. Sets are measured on a standard dummy antenna consisting of an inductance of 20 microhenries, 200 mmfd., and 25 ohms, all in series. Naturally, receiver manufacturers design their sets so that they will give the best possible showing on this antenna, which means that they match impedances. Thus the line-to-receiver transformer need only match the characteristic impedance of the cable selected and that of the standard antenna.

The radio distributing system described here can be extended indefinitely by suitable changes in the apparatus combination. It does not seem likely, though, that more than 3,000 will be put on the same antenna. Only in the larger hotels would there be occasion to do so, and then only if every room were radio equipped.

Radio Programs

the use of the amplifier would be needed only in cases where there is not enough output from the radio receiver to swing the recorder.

The arrangement at the output of the amplifier assumes that the loudspeaker has about the same impedance as the recorder. If this is not the case another transformer will be needed, and the switching becomes more complex.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

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S. Marcovich, Calle Abancay 953, Lima, Peru.
Ivan Rollefson, c/o Sam Thompson, Outlook, Mont.
Michael Chernigoff, 540 Park St., Jacksonville, Fla.
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C. W. Woodworth, P.O. Box 364, Lockney, Texas.
D. L. Smith, c/o F. L. Watkins, 4301 Sheriff Rd., N.E., Washington, D. C.

The Drama

Universe the Stage

By J. E.

THE electron theory has played an important part in the development of electrical science and the industry based on it, and it is now playing an even more important part in that branch of physics that treats of the structure of matter.

At one time it was held that electrons existed in matter and that electric current was a drift of electrons in matter or that it was due to a rapid movement to and fro of electrons about some neutral position. The drift applies to current, either alternating or direct, in conductors. whereas the oscillation idea applies to current in non-conductors, such as the current through a condenser, for example. This view is still held, but it has been developed further. It is now believed that matter consists mainly of electrons.

The atom, the smallest unit of an element of matter from the chemical viewpoint, is now regarded as a minute planetary system consisting of a central neucleus, the proton, and of one or more electrons revolving around the central neucleus. The number of electrons in the system determines the nature of the element, as the chemist knows the element. There is a vast amount of experimental and theoretical data supporting this planetary view of the atom. Most modern work in physics deals with the study of this structure of the atom as related to radiation of energy, tranmutation of elements, degeneration of matter, and even the recreation of matter.

Transmutation of Elements

During the dark ages scientists of the day attempted to transmute matter, mainly attempting to convert base metals into gold. Of course, they were chasing rainbows. During the nineteenth century scientists scoffed at the idea of transmutation and denied its possibility. Now in the twentieth century scientists take transmutation seriously, and they are quite agreed that it is possible. Many have attempted to do it, and some have claimed success.

The change of view came about as the result of study of radiation from radio-active metals and from the electron theory of matter. If the electron theory of matter is correct, transmutation of one element into another should not only be possible theoretically, but practically. By practically we do not mean that we can change lead into gold and make a profit, but that it can actually be accomplished in the laboratory.

The possibility hinges on the structure of the atom. If an electron can be jarred out of an atom, permanently, than that atom would change into that of some other element. Thus if there is a base metal having a larger number of electrons per atom than gold, it should be possible to knock out the required number of electrons to make gold.

But how can there be an electron drift, and hence electric current, if the electrons are attached permanently to the proton? Would not a drift indicate a continual change of the element into some other element, or else a drift of the entire atom? If the atoms move there would be a physical transfer of the position of the conductor. Well, there is some evidence that this occurs, although this is not the explanation offered. The idea of free electrons is brought in. An electron may be loosely attached to the proton. Under the influence of an electro-motive force it can leave one atom and move to the next. But the one that just gave up one of its electrons receives another one from its neighbor. Thus in a circuit there can be a continuous drift of electrons without permanently altering any atom.

Alternating Current

Alternating current can be explained in the same way, for at any instant there is no difference between alternating and direct current. But current in dielectrics must be viewed differently. The supposition is that in non-conductors the electrons are not free to move. But they can oscillate to and fro under the influence of an electromotive force. We might think of this as a distortion of the planetary system constituting the atom. At one time the electrons may all be forced in one direction and at another time in the opposite, the proton always remaining in the same position. Or it

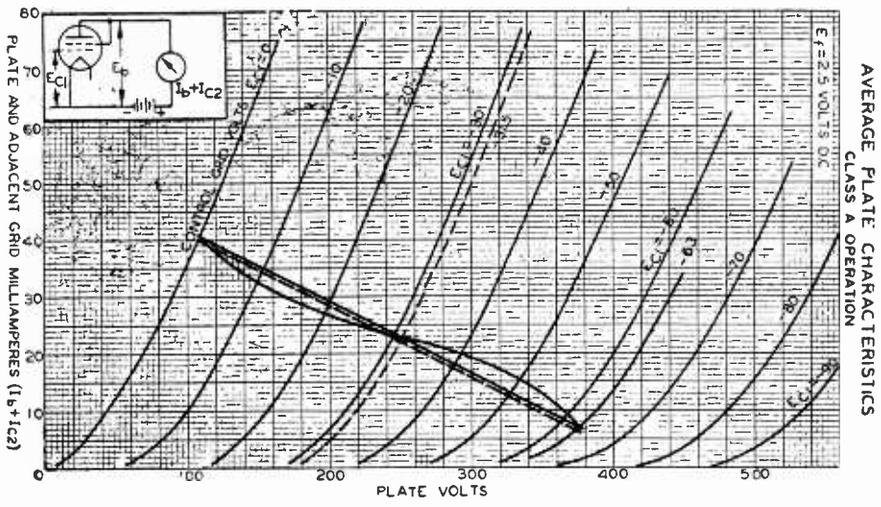


FIG. 1.

A family of plate current plate voltage curves, showing how the electrons are controlled by the potentials on the elements.

may be that there is only a relative movement of the proton and the electrons. That is, the proton may move in one direction and the electrons in the opposite. But these are conjectures. Of course, the entire electron theory is a conjecture, but one that is based on so much experimental evidence that no scientist doubts its correctness.

The natural transmutation of elements by radiation is universally accepted. It is known that radium gradually changes into lead, through a number of intermediate stages. Uranium and polonium also change. One way of estimating the age of the earth is based on this change. The rate at which a radio-active metal changes into lead is known. Hence if the percentage of radio-active metal to lead is determined in a given sample of rock, it can be computed how long it required for the change to take place, on the assumption that at the beginning all was radio-active metal. This method of estimation checks well with other methods which are entirely independent.

But during this change what becomes of the electrons? Well, what is an electron? May be it can go places by itself without leaving a trail, or may be it has the power of changing itself into something else. For example, just plain energy. Well, what is energy? One manifestation of matter, according to one phase of the theory.

Degeneration of Matter

When matter, that is, the atom, is emitting light, or any other form of radiant energy, part of the matter disappears. It is estimated that the sun is losing hundreds of thousands of tons of matter every day by the light that leaves. Some scientists believe that ultimately this will mean that the sun will disappear, in fact that all stars will. According to them the universe is destined to annihilation, or to heat death. This simply means that every speck of the universe will be at the same temperature so there can be no radiation from or to any other point. We may also assume that matter will be uniformly distributed, providing matter and energy are one and the same thing. If every point in the universe were at the same temperature, there would be no activity anywhere. Indeed, there would not be anything, for in order that there be something, there must be differences from point to point.

Some of the leading scientists take this gloomy view of the ultimate fate of the universe. And what an end? We are all loath to think about it, although we are assured that it will not come to pass within the next few billion years. Incidentally, this gloomy view is accepted by the majority of the scientists who have a right to an opinion by virtue of study, Eddington and Jeans, two of England's greatest mathematical physicists, hold this view and are the main proponents.

Re-creation

But there is a bright side to the question also, and Robert Andrews Millikan is the champion. His view is that the universe is recreating itself just as fast as it is tearing itself down. His evidence is not based on mathematical analysis, but on experimental data. The reason his view is not yet accepted widely is that there is doubt about the interpretation of the evidence. Mathematical analysis based on well-demonstrated facts and the high standing of the "heat death" champions militate against the re-creation theory. Everybody wants to believe that Dr. Millikan is right, but sentiment does not rule in science.

Millikan has made out a good case so far. In the first place his theory does not deny the "heat death" theory, so it is not necessary to discard any of the evidence on which that theory is based, some of which Millikan himself dug up. In the second place he has some direct evidence, which he has gathered from the sea, from the ground, from the atmosphere, and from the heavens. He maintains that hydrogen atoms, the smallest of all the atoms, are being built up out in space from the debris of other atoms torn up in the process of radiation. As one thing in favor of this view he points to the fact that in every direction hydrogen may be seen with the spectroscope.

The fundamental unit of matter from the chemist's point of view is the atom. The physicist has broken this up into

# of Electrons as Tests Go On

Anderson

the proton and the electron. But the physicist has another building block which fits closely into the picture. This is the quantum, which is the smallest unit of energy. It is not a unit like a pound, or a meter, or an ohm, or anything arbitrary and conventional. It is rather like a pea, a discrete entity or inseparable unit. Of course, a pea is not indivisible, but as soon as it is divided it is no longer a pea. It is possible that even the quantum can be divided, but its components will not be energy.

The quantum is the thing that carries light and heat from one body to another by radiation. It is the heat or the light, but of course there must be many quanta to produce much of an effect. When a quantum leaves an atom an electron revolving around the atom suddenly jumps to another orbit, or what is called another energy level. After that the atom is less active, contains less energy, and is colder. If all the electrons jump to the lowest energy level the atom is dead. That should mean absolute zero temperature. While the electron is in the act of jumping it vibrates and sends out waves of light or heat. This conception of radiation is due to Nils Bohr, a Danish physicist, and is accordingly called the Bohr theory, and the atom so conceived is known as the Bohr atom. Whether the conception is correct or not, it has led to the discovery of a great amount of facts about the structure of matter and the relation between matter, electricity, heat, and radiation.

Chasing Rainbows

While the scientists in the dark ages were figuratively chasing rainbows while attempting to transmute metals, the modern scientist uses the rainbow actually. Nearly all the work done along this line are on spectra of the various elements. They are hunting for lines in the spectra, and are measuring the wavelengths these lines represent. While the finding of lines expected by theory does not transmute metals, the possibility of transmutation is indicated by the lines and the theory. The rainbow is the spectrum of sunlight as produced by refraction in tiny raindrops.

All this talk about transmutation, recreation, spectra, quanta, and "heat death" seem a long way from radio reception and transmission, but actually the relation is very close. Radio waves, especially the short ones, follow the same law as light waves. Electrons produce both. And the quantum has the same value in connection with a radio radiator, the antenna, as it has in connection with the atomic radiator. The energy in a radio wave that escapes the earth and goes on into interstellar space may turn into hydrogen atoms.

Conservation of Energy

One of the strongholds of scientists has been the law of conservation of energy. This states that in any energy transformation exactly as much energy is gotten out as is put in, provided we count all forms of energy that come out. And there can be no more come out than is put in. All perpetual motion devices conceived by would-be inventors have been based on some trick that failed to take this law into consideration. That is why all have failed. That is why the patent office refuses to consider any patent application on any device that pretends to work without external source of power.

But does the law of conservation of energy hold universally? Are there no exceptions to it? Some authorities on physics have scoffed at the idea for some time, although they have not attempted to join the ranks of the perpetual motion machine inventors. One professor of physics asked how the law applies to the case of radiation where the light or heat radiates into space forever and ever. We put a certain amount of energy in to the device, but what do we get out of it? We get a small amount of light or heat and the rest goes on its way. But the law applies to a system, when we count all forms of the output. If we consider the energy radiated into space and which goes on forever and ever, we must regard the universe as the system, and eternity as the time for the completion of the process. There is no evidence that the universe gains any energy in any process.

But of late, since the development of the new physics, including the transmutation of elements and the developments of the various ramifications of the electron theory, many others have cast doubt on the validity of the principle. There are energy levels in the atom and if by some means the level can be changed, enormous amounts of energy can be released, and it takes less to release it than comes out. How does the law apply to such cases? Well, many versed in the subject say it does not. But does it not? There is a certain amount of energy locked up in a chunk of coal. If we burn it we get most of it out in the form of heat. If the law applies to a lump of coal why does it not apply to the atom? Energy is stored in both. Why say that it applies to one fuel and not to others?

Electrons in Vacuum Tubes

In a vacuum tube we are accustomed to speak of the space current. This is nothing but a stream of electrons leaving the cathode and traveling to the plate. They are released from the cathode by the heat and they are attracted to the plate because the plate is positive and the electrons are negative. They fall to the plate just as a stone released from a high point falls to the earth. But their fail can be controlled by setting up a counter force, that is, a negative force which partly neutralizes the attraction of the plate. That is what the grid does, and the grid is negative so that it repels the electrons. Only those electrons that have the highest velocities succeeds in getting through the grid, or those which happen to be shot out midway between two grid wires. The more the grid is negative the harder it is for any electrons to get through, and therefore the plate current is zero when the grid bias is high. But once an electron is through the grid, the grid aids it in getting to the plate. It is subjected to both a push and a pull in the direction of the plate. If there is a screen near the plate, positively charged, that too will help the electrons traverse the space. But the screen takes some of them for itself, leaving less for the plate. If the screen voltage is much higher than the plate voltage, it will take all of them, it may even draw electrons from the plate. In that case the space current is negative. Curves on screen grid tubes show this effect. The addition of still other grids, such as the suppressor grid in the latest tube, is to prevent this flow in the reverse direction, by suppressing electron emission from the plate.

In photoelectric cells we have a similar situation to the emission of electrons from a heated cathode. In this case, however, the electrons are emitted from the cathode by the action of light, but in both cases energy quanta are responsible for the release. One of the strongest evidences for the existence of the quantum is in the photoelectric equation, and one of the fundamental equations of the thermionic vacuum tube is of exactly the same form. This is not an accident, but testifies to the close relationship between heat and light, electrons and quanta, and even between matter and energy.

The effect of potential on the flow of electrons in a vacuum tube is clearly shown by a family of plate current, plate voltage curves, taken for various voltages on the grid. Take that of the 46 power tube, for example, as reproduced in Fig. 1. The number of electrons reaching the plate under a given combination of plate and grid potentials is proportional to the plate current as measured by the milliammeter. Hence the current is a measure of the number of electrons that succeed in getting to the plate.

Following any one curve we note that the current decreases as the plate voltage is reduced. On any one curve the grid potential is fixed so the only variable is the plate voltage. The attraction by the plate is greater the higher the potential and therefore the current increases as the voltage is increased. This holds for any potential on the grid, as long as the saturation current has not been reached. No part in Fig. 1 covers the saturation range because the plate voltage has been limited so that the current is always less than 80 milliamperes.

Variation with Grid Voltage

If we follow any ordinate, say the one at 200 volts, we cross many curves in going upward. This leaves the plate voltage constant and only the grid bias, or grid potential, varies. As we go up we cross curves of lower and lower bias. Hence the current increases as the bias is decreased. The grid, being negative, will repel electrons and this prevent them from reaching the plate. Therefore the greater the negative potential the fewer electrons succeed in getting to the plate. There is a terrific struggle going on inside the tube. The positive plate tries to attract as many of the electrons as possible, but the grid stands guard between the plate and the source of the electrons, the cathode, and tries to send them back. The higher the voltage, for a given negative grid potential, the more successful is the plate in capturing them. And the more negative the grid, for a given plate voltage, the more successful is the grid in keeping them away from the plate. Once an electron is through the grid, however, it is sent to the plate at a high speed both by a push by the grid and by a pull by the plate. So great is the speed of some of them that their impact on the plate heats the plate and some of them succeed in dislodging electrons in the plate. In case there is another grid near the plate, charged positively, these dislodged electrons leave the plate and fall into the other grid. In such cases the plate current is negative. This occurs only in screen grid tubes. In three element tubes the dislodged electrons only add to the plate resistance.

The cathode does not do much to send the electrons along. The heat merely releases them and sends them out a short distance. Most of them fall back into the cathode, except when the grid and plate voltages are such that saturation is reached. Then all the electrons released succeed in getting to the plate.

Tube List Prices

Type	List Price	Type	List Price	Type	List Price
11	$3.00	'31	1.60	56	1.25
12	3.00	'32	2.30	57	1.60
112-A	1.50	'33	2.75	58	1.60
220	3.00	'34	2.75	'80	1.00
'71-A	.90	'35	1.60	'81	5.00
UV-'99	2.75	'36	2.75	82	1.25
UX-'99	2.50	'37	1.75	'74	4.75
'200-A	4.00	'38	2.75	'76	6.50
'01-A	.75	'39	2.75	'86	6.50
'10	7.00	'40	3.00	'41	10.00
'22	3.00	'45	1.10	'68	7.50
'24-A	1.60	46	1.50	'64	2.00
'26	.80	47	1.55	'52	28.00
'27	1.00	'50	6.00	'65	15.00
'30	1.60			'66	7.50

NEW TUBES IN 5-TUBE T-R-F A NOVEL

By Capt. Peter

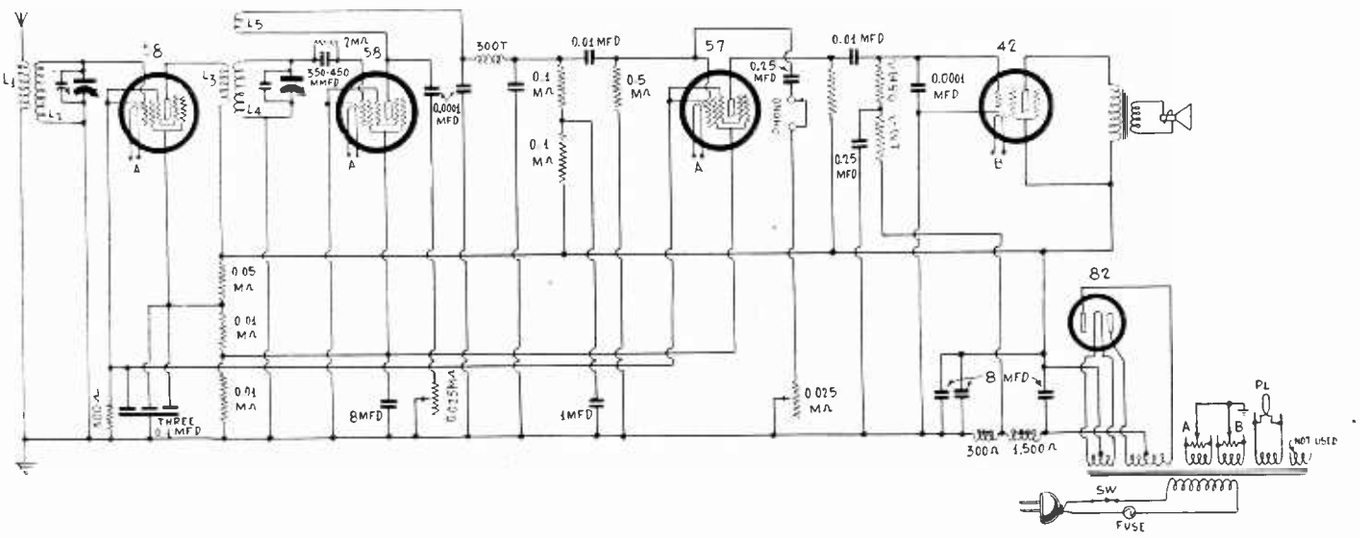


FIG. 1.
In this five-tube set regeneration is controlled in a novel manner.

A FIVE-TUBE a-c set that costs little and yet is good on short waves is something in which there is always interest, and this interest is growing. Hence it is pardonable to discuss again the familiar stage of t-r-f and regenerative detector for short waves, with an audio channel and rectifier, particularly pardonable as there are two new features offered: (1) a regeneration control that does not affect the d-c voltages, and (2) a method of eliminating a high capacity condenser otherwise necessary.

We have to decide right away about the coil system. On the one hand it is said that the public likes convenience and there is nothing like a switching system to serve that weakness. On the other we hear that the public must get results. Well, there is nothing like the plug-in coil for results. One may compromise results in favor of convenience, or one may retain highest results at the expense of some undeniable convenience in pulling coils out of sockets and pushing others into the sockets. This time we shall select the push-and-pull system, especially also as economy is served, as the switch alone costs more than a set of plug-in coils.

He Didn't Come Back

I know an Italian who was greatly interested in listening to his native Rome and therefore invested in a switch type short-wave device, which worked well. He complained, however, that reception was not quite as constant or as good as on another set. The same manufacturer made both models (he had an eye to business). So when the Italian complained to his dealer, "I want to get Roma better," the dealer reminded him that the customer's first insistence was not that any particular station should come in exceedingly well, but that there must be no plug-in coil nuisance.

"Now, whatever you want," said the dealer deferentially, "I'll accommodate you: Rome louder and clearer, or no plug-in coils?"

Well, the customer thought he'd like both, but the dealer finally asked him to try out the plug-in model, and the customer did not return. Afraid the customer may have died, the dealer sent a messenger to inquire, but the messenger found that the customer "could not be disturbed" as he was listening to "Roma" loud and clear on the speaker!

So let's talk about one of those let's-hear-Rome sets!

Consider the circuit tube by tube.

Trimmer Adjustment

The radio frequency amplifier is standard and the coil is of the UX or four-pin base type. There is a small manual trimmer across the main tuning condenser, for front-panel operation, and the fixed trimmer on the detector is to be set so as to insure effectiveness of the manual one. That is, the capacity across the detector tuned circuit should slightly lead that across the other when the manual trimmer is set at minimum capacity.

The voltages for the r-f tube are derived from a low-wattage voltage divider. Full 250 volts are applied to the plate, the screen voltage is around 100 (reading considerably less even on a 1,000-ohms-per-volt voltmeter), the bias voltage is around 2.5 volts.

The coupling medium between r-f tube and detector is a plug-in coil with three windings, primary, secondary and tickler, and as all terminals go to different potentials, a six-pin coil form and six-spring socket are needed. The primary is connected as usual, and its polarity is not of any considerable importance. The secondary has to be so connected in respect to the tickler that feedback results, so if there is no regeneration possible, reverse the connections to either secondary or tickler, not to both.

Leak Detection

The grid-leak-condenser method of detection is used, with the leak outside the tuned circuit and in series with the grid. This is the preferable method from the viewpoint of selectivity, especially if a lower value of leak is used than specified. However, the location of the leak, whether thus in series, or in parallel with the tuned circuit, does not alter its grid-current corrective function, which is in addition to its detection purpose.

The Feedback Control

But the plate circuit is rather unusual. Instead of using a variable tickler coil, which doesn't exist on plug-in forms, or a capacity varied for bypassing, a fixed condenser is inserted in series with a variable resistor. Thus when the variable resistor is at zero setting, when the condenser is grounded, there is a capacity of 0.0001 mfd. from plate to ground and that stops regeneration. As the resistance of the rheostat (or potentiometer used as rheostat) is cut in the bypassing effect of the condenser is cut down, and regeneration is permitted to go on, at maximum resistance in circuit, virtually without diminution. Therefore by the proper setting of the rheostat regeneration may be controlled, and moreover controlled from a grounded potential, which does away with body capacity arising from use of regeneration control.

The second point is that the 57 tube is used as first audio amplifier without requiring a large bypass condenser across its biasing resistor. The way this is done is simply by using the same biasing resistor as supplies the bias for the r-f tube. If the bypass condenser across this resistor is connected, as shown, right at the r-f tube from cathode to ground, there is no objection whatever to the resulting somewhat long lead.

Screen Voltages

Whenever you have a resistor at any point in the screen or cathode leg of a tube handling audio frequencies, or in the B circuit for biasing any such tube, the bypass condenser across it should be large if the resistor is large. Anything more than 1,000 ohms may be regarded as large in this sense. All the capacity you can find purse and room for probably will not reduce the impedance below 300 ohms at, say, 100 cycles, so why

SET; CONTROL OF REGENERATION

V. O'Rourke

not use the r-f bias for the audio tube, and avoid the large capacity?

The tubes with resistive plate loads usually work better on lower screen voltages than do r-f tubes with low d-c plate resistance loads; indeed, if you are not careful to keep the effective screen voltage lower than the effective plate voltage you may run into audio oscillation of a pernicious type. So, at a lower screen voltage for the detector we may also use the same screen voltage for the first audio tube, and combining the two to one potential point permits the use of one large condenser to bypass the audio. Here 8 mfd. of capacity is used.

The 57 is akin to the '24, except that its secondary emission is kept down, which is economical. The secondary emission results when the plate itself causes a rebound of the electrons that have penetrated the control grid, and naturally this counter current reduces the effectiveness of the tube, limiting its performance. The suppressor screen of the 57 greatly reduces, almost entirely prevents, secondary emission, hence a greater grid swing is possible.

Welcome to 57

Yet the 57 is principally serviceable, in audio amplification, where there are low signal levels at the input and high levels desired at the final output. With any short-wave set of the t-r-f or regenerative variety it must be taken for granted that the signal level will be low, and a tube intended to pick up these small values of amplitude and reproduce them at great magnification is highly acceptable. The theoretical amplification obtainable is the mu of the tube, given as "greater than 1,500." but the net gain is not achieved in practice, and half of it would be great. The negative bias is recommended at 3 volts, but 2.5 will be plenty, in view of the short-wave service, or, it actually may be nearer 3, due to the currents from the audio tube in the 300 ohms.

Hum should be at a minimum, and therefore means are adopted for providing such service. First, a good filter is used. This is the field coil of a dynamic speaker. The same winding affords bias for the output tube. Second, the tube used is of the indirect heater type, with cathode separate from the heating element, as distinguished from filament type tubes that combined the two in one. There will be heater type power tubes on the market in the Fall, however, at present some of the smaller manufacturers have their own models. The larger manufacturers, as well as the smaller ones, will be along later on with a pentode of the heater type, requiring a seven-pin socket: 1, control grid; 2, screen grid; 3, suppressor grid; 4, cathode; 5, plate; 6 and 7, heater. The diagram would be the same as the one shown for the 42, the power tube now available, except that the suppressor grid would come out to a separate base pin. The 42 requires a six-spring socket.

Tune Control Included

The maintenance of the detector cathode at the same potential as the heater center is another contribution to hum reduction, as are the resistor-capacity filters in the detector plate and in the output tube grid circuits.

A tone control is located in the grid circuit of the first audio tube, with a switch to cut out the control, because volume is somewhat diminished even at maximum resistance

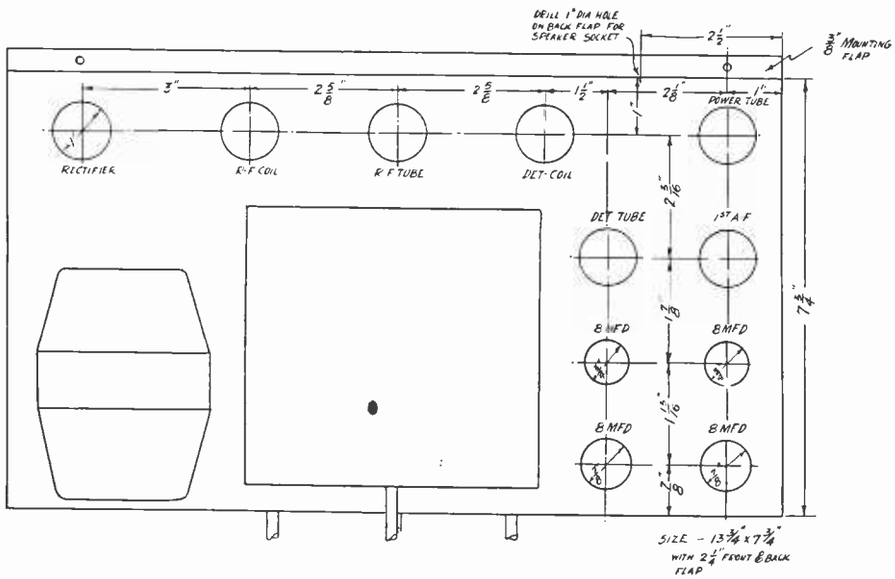


FIG. 2

Plan for the chassis top. The front elevation need not exceed 1¾ inches, although a 3-inch height is common for chassis.

setting. Also, for some DX work it is necessary to pile up all the volume you can, and you want the control out, in such a case, unless static is bad, when the control tends to cut out the most objectionable part of the static, at the expense of volume all around. However, the higher audio frequencies are sacrificed much more, hence the signal to static ratio is effectively higher.

Note that 16 mfd. of capacity are used at the reservoir position of the rectifier filter, and 8 mfd. next to the rectifier.

Coil Information

The heater voltage for thte 58 and 57 tubes is, of course, 2.5 volts, but for the 42 it may be from 5 to 6.3 volts, not being critical, the reason being, it is assumed, that there is some variation of the resistance of the heaters. This was found to be true of other 6.3 volt tubes, in a 110-volt d-c set, although in the present instance the application of previous experience to a tube of another make is pure assumption.

Measure the d-c resistance of heaters of the 6.3 volt type and ascertain for yourself.

If straight frequency line condensers are used the capacity may be 0.00035 mfd. Then only three coils will be needed for each tuned circuit to cover the band from 200 to 7.5 meters, except that some overlap is necessary, and the lower limit of wavelength is raised on that account to around 13 meters. Then, if broadcast coverage is desired, the total broadcast band may be tuned in without coil shifting, except that of course a fourth pair of coils is required for this lower frequency coverage.

Winding Data

There are no commercial plug-in coils now generally available for 0.00035 mfd. capacity for all-wave coverage. However, if you have coils intended for 0.00014 mfd. capacity and have the double 0.00035 mfd., connect aerial through a fixed condenser to plate of the r-f tube, plug in the detector input coil, and remove secondary turns until about 95 on the dial brings in 200 meters. Then see what frequency comes in at 5 on the dial, insert the next smallest coil, and remove secondary turns until the frequency that came in at five with the larger coil now comes in at 95 on the smaller one. For the last coil repeat the process. Then fix up the r-f antenna coils with secondaries on the basis established.

For winding your own coils you may follow these data:

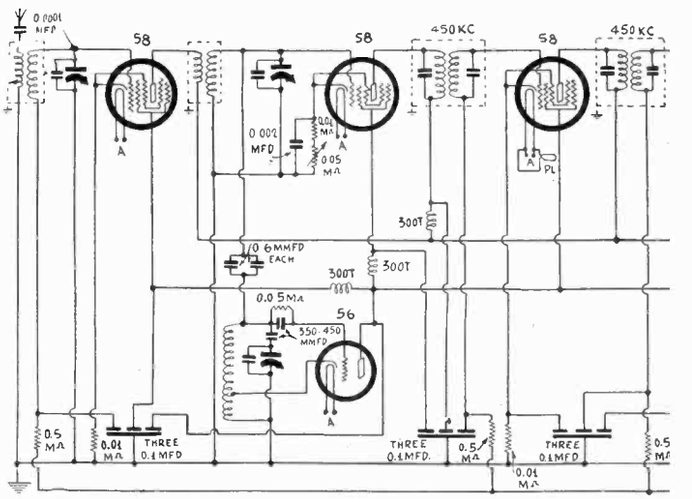
Antenna Coil		*Interstage Coil*		
Pri.	*Sec.*	*Pri.*	*Sec.*	*Tick.*
20	100	20	100	30
10	28	10	28	15
6	10	6	10	8
4	4	4	4	4

The wire for the broadcast coil (at top) is No. 32 enamel, all windings. Primary is wound over secondary. Tickler is wound over other end of secondary (either end). The separation is by insulating fabric. For the second coil from top the wire is No. 28 enamel throughout, same locations as before. For the third coil the wire is No. 18 for secondaries, No. 28 enamel for other windings, same locations. For the smallest coil all windings are No. 18 enamel wire, separation between primary and secondary and secondary and tickler is 1/5 inch, and windings are side by side, not one atop the other. Different physical types of construction may be used, also different numbers of turns for different sizes of wire. The foregoing, however, will be helpfully suggestive to wind-your-own-coilers.

There is a phonograph jack in the tone control circuit. If no pickup phonograph is used this jack must be shorted by a piece of wire. A flexible lead, 3 inches long, such as tinsel cord with phone tip jacks at extremes, does the trick nicely. When the pick-up is functioning the tone control is not effective.

THE 55 AS DETECTOR AND DANGER OF PO

By Herm



FI

All new tubes, save the output tube, in this 8-tube s in the fall. It is a diode-detector and triode ar

THERE is a general rush to use the 58 tube to replace the '35, and to use the 56 to replace the '27, because of the superior characteristics of the new tubes, due to the extra grid, the suppressor. These new tubes are pentodes, in that they have five elements: control grid, which emerges at cap; screen grid, suppressor grid, plate and cathode, which are brought out to base pins, as are the heater leads. The heater is not one of the elements of a tube.

It can be safely predicted that the 55, not yet officially announced, and which will not reach the market until the Fall, also will be a favorite. It is described as a duplex-diode triode. All discussions of this particular tube are tentative, the only certainty being that it will have a cap and six pins. It may or may not have a dome-shaped bulb. Probably it will be of the medium-sized glass envelope type, like the automotive tubes and the 82 and 56.

In all four instances, of the three new tubes with suppressor grids separately brought out to base pins (56, 57 and 58, in which the 57 resembles the '24), and of the 55, probably it will take two years before there is any firm establishment of uses. The reason is that these tubes permit of variations of their characteristics by differences in connections and voltages, beyond the difference normally found in tubes. If the experience with the '22, which finally was found to be not much good, the '24, which was hailed as a great-gain r-f amplifier, to be discovered as a vicious cross-modulator that could not be worked practically at anything near the theoretical gain, is any guide there will be improvements over what is known and recommended to-day. But these improvements will not be in the form of new tubes, rather of new and special uses. Circuits built now can be adapted later to these new special uses.

Use of the 55

The circuit, Fig. 1, uses four 58 tubes, one, 56, one 55, one '45 and one 82, total eight tubes. It is a superheterodyne in theoretical form, and presented as a basis of the discussion of the tubes. Actual construction is to be made as a laboratory undertaking and further reports will be published.

Since the 55 is used as a single-wave detector, with automatic volume control and a stage of amplification, it is preferable to analyze the operation at that point. The intermediate frequency is fed to the diode's two plates, interconnected for this purpose, and in series with the tuned circuit is a resistor to the cathode. The heater being assumed functioning, the diode operation is now complete as to detection, as the current will flow in only one direction, from positive cathode to negative plate inside the tube and from negative plate to positive cathode outside the tube.

This is a flow in the same direction, the polarities being distinguished because the current might seem, by definition, to be going in two different directions. Imagine the tube as the upper half of the face of a clock and the external circuit as the lower half. When the hour hand moves clockwise from 9 (called negative) to 3 (called positive), it moves from negative to positive, but when it moves from 3 to 9 it moves from positive to negative, and yet the hand is going in the same direction, around a circle.

With the diode rectifier, provided the series resistance is large compared to the tube resistance, we can now have linear detection.

This series resistance is shown as 0.5 meg. The drop in this resistor is the input to the amplifier part of the tube. Pulsating direct current thus is flowing through a load resistor. Hence it would be possible to connect the grid of the amplifier directly to the negative (left-hand) side of the 0.5 meg. resistor, except that the bias on the amplifier would be severely affected by the signal amplitude. The higher the signal amplitude, the higher the bias, which is fine in theory, and experiment will determine whether it is preferable in fact. But meanwhile the same condition, for which the ugly word instability is sometimes used, is recalled as it existed in the Loftin-White direct-coupled amplifier, hence it is deemed preferable to insert a stopping condenser of 0.01 mfd. between the two points under discussion and insert another load resistor to utilize relatively steady bias.

Hum has to be safeguarded against, and it is therefore highly advisable to maintain the heater at the recommended zero potential difference in respect to cathode, or, if there must be a difference, that it should be negative. Ordinary practice would result in a heater positive in respect to the cathode, due to the same secondary winding being used for power tube and all other tubes except rectifier.

When the power tubes with 2.5-volt filaments came out there was a general dash toward unified and simplified circuits—one secondary winding where there had been two—but since then tubes have been developed to produce much higher gain, circuits are more sensitive, greater shielding precautions are necessary, and heaters and cathodes should be unipotential (d-c) at the detector. Small differences otherwise resulting, due to all other tubes save output and rectifier being on the same secondary winding, may be neglected. The principal consideration is the detector.

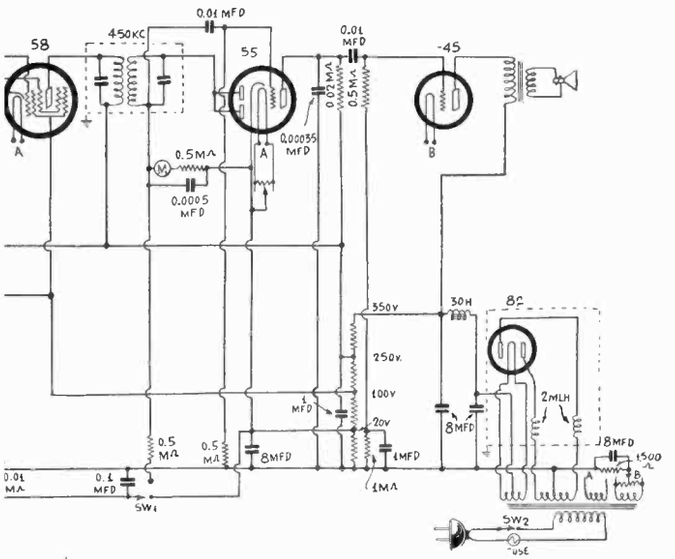
Now, to consider the automatic volume control. We have found that there is a unidirectional voltage drop in the 0.5 meg. resistor connected between cathode of the 55 and one side of the secondary of the last intermediate transformer. We know the polarities. Cathode is positive, the other side of the resistor is negative. Now, we have biased the cathode negatively, but that applies only to the amplifier. The rectifier circuit is complete from cathode to anode through the coil and resistor load, and what d-c potential is applied to the cathode has no bearing on the rectified voltage, since there is no continuity to ground for direct current in the diode, except the very high resistance of the controlled tubes and grid filter resistors. Moreover, the diode part is electrically separate from the amplifier or triode part.

But when we come to consider the automatic volume control feature we must take into account the positive bias applied to the cathode of the triode. Assume it is 20 volts, as obtained from the voltage divider. This voltage is correct and so is the load resistor of 20,000 ohms in the triode's plate circuit. At no signal there will be virtually no voltage drop across the 0.5 meg. load resistor in the diode circuit. When SW-1 is thrown up (referring to the diagram, lower center) the voltage drop across the diode resistor is effective for biasing the r-f tube and two intermediate tubes.

Tracing the d-c voltage from ground, starting at the voltage divider, we find the cathode of the 55 lifted 20 volts above ground, and from the cathode to the united anodes of the diode the voltage drops, externally to the tube, also somewhat

A-V-C TUBE; SITIVE GRIDS AVOIDED

n Bernard



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erheterodyne. The 55 tube is expected to be released lifier. The tuning condensers are 0.00035 mfd.

within the tube as well. So when the current through the diode resistor is 40 microamperes the drop in the diode resistor (0.5 meg.) is 20 volts, and the a-v-c does not change the bias on the controlled tubes beyond the negative amount applied through the resistors in the cathode legs of those tubes.

But suppose there is no drop across the diode resistor. Then (omitting the steady bias applied to the three controlled tubes) there would be a 20-volt positive bias on the three grids. To overcome this condition the steady value of voltage drop is lifted for the controlled tubes by 20 volts plus the amount of the desired negative bias. Therefore the 20-volt positive condition must be prevented, and if the drop in the steady-bias resistors is increased to 23 volts, there will be a 3-volt negative bias at no signal, and extra bias, as developed by the a-v-c, depending on the signal amplitude.

One way to test for the proper values of resistance in the cathode leg of the controlled tubes is to take one tube, say the first or r-f tube, and hook it up the usual way, with 300 ohms between cathode and ground, grid returned to ground, and measure the plate current in that tube. Then restore the circuit as shown, throwing SW-1 to the cathode of the 55, tune in a weak station and insert the value of cathode resistor that gives approximately the plate current formerly obtained. This value of resistance may be used for the two other controlled tubes. It is given as 0.01 meg. (10,000 ohms), but if the current is not as large as under the test conditions, decrease the value of this resistor, or if the current is too large, increase the resistance value. From experience with other tubes it is assumed that value should be around 10,000 ohms. And what goes for the first tube goes again for the two others.

In considering the actual bias it should be remembered that it is equal to the voltage difference between cathode and grid return. Since the grid return may be to a positive value the cathode resistor is increased.

Surveying the circuit we find that the input is to the primary of a radio frequency transformer. The antenna series condenser is there because of the extra selectivity resulting and also the minimization of the effect of antenna capacity on the tuned circuit. A set has to be sensitive to support the inclusion of such a small condenser at broadcast frequencies, but a set with two intermediate stages and two stages of audio is bound to be sensitive if made properly. Moreover this circuit is adaptable to short waves and therefore the series condenser has the effect of relatively increasing the input as the frequencies increase.

The suppressor grid and the cathode are interconnected in all instances where the 58 is used in this circuit, and such is the standard practice. The grid return has a resistor-capacity filter to prevent feedback, regenerative or degenerative, while the cathode resistors are bypassed to prevent degenerative effects.

The oscillator is of the type developed by E. M. Shiepe and is a modified Hartley. The old saying is that if you can't get an oscillator to oscillate try the Hartley. This is good advice. Also, this oscillator keep oscillating even at high frequencies. Up to 30 mgc. was tried. This is higher than the highest frequency to which the set would be tuned even if the short-wave feature is to be included.

The new tube, 56, an excellent oscillator, is used, with the same voltage as on the screens of the 58's used for the plate of the 56. Note that the plate circuit of the oscillator is virtually non-reactive. This removes one contribution to frequency instability in an oscillator. Besides, the grid circuit is frequency-stabilized with a leak-condenser combination, so that when grid current flows the bias on the tube becomes negative, and the flow of grid current is thus minimized, for the voltage drop in the tube is held virtually constant, and it is the voltage change that upsets frequency stability.

Between the oscillator and the modulator grids are two parallel condensers of 0.6 mmfd. each. One alone may be used, but if stronger coupling is desired, the two may be included. A capacity of 0.6 mmfd. (six-tenths of one micro-microfarad) is correct for designating these tiny condensers. The looser the coupling the greater the selectivity. Of course, since capacity coupling is used, there will be an increase of coupling with frequency, but since the signal level is much lower at short waves this increase comes in handy.

The detector should be kept as free as possible from the influences of currents in the other tubes, therefore the lead to the screen of the r-f tube has a choke-condenser filter, and so has the lead to the modulator screen. Besides, the modulator plate circuit is so equipped. Then the filtration is good.

The 58 is all right as a modulator even though it is a glorified '35. In fact, it is recommended for this use, with a 10-volt negative bias, and the manual volume control is suggested in the cathode leg, to increase the bias and thus cut down the output from this tube. The control is smooth because of the remote plate current cutoff characteristic of this tube. Cross-modulation tendencies are almost wholly eliminated by this method, also.

The intermediate amplifier is standard, except perhaps for the a-v-c, already discussed.

As for choice of an output tube, the '45 is shown, as a tube is needed that will stand a big swing, and the '45 will do that. Its grid circuit has a hum-eradicating filter, consisting of a condenser of 1.0 mfd. across a resistor of 1 meg.

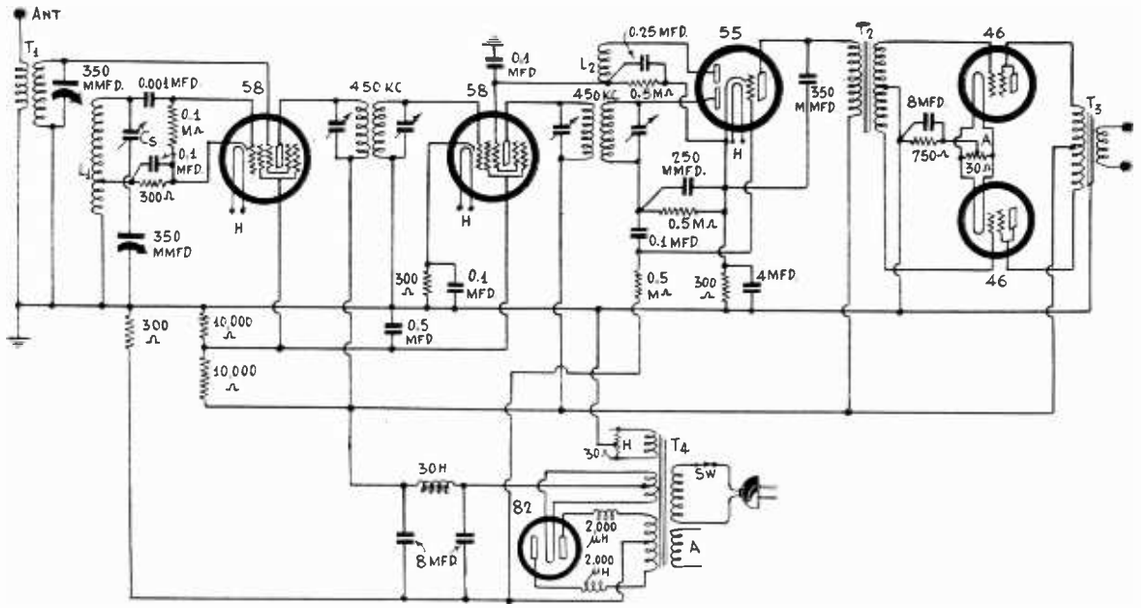
Two r-f chokes that will stand 100 ma are used in the anode legs of the 82 rectifier, and tube and chokes are put into a shield, which may be perforated. These chokes are advisable to prevent the radio frequencies from modulating the rectifier.

The intention is to use plug-in coils for the r-f and mixer. It can be seen a padding condenser is necessary in the oscillator for the broadcast frequencies. For the first short-wave band it should be of different capacity—larger than specified. For the third and last band it would not be necessary. One padding condenser has to be substituted for the other, and for the coil system shown the plug-in form would have to be of the six-pin type: 1, ground; 2, cathode; 3, grid side to which the two padding condensers are connected; 4, one side of one padding condenser; 5, one side of the other padding condenser; 6, stator of tuning condenser. By suitable connections on the coil itself the stator is automatically joined to either padding condenser, or, where no padding condenser is necessary, to grid.

It is intended to build the set on a large chassis, with tuning condenser and mixing coils ranging from the left-hand side. A large oblong shield will run the length of the chassis rear, and there will be seven compartments, coil and tube in each, for the r-f and mixer, also for the two intermediates and detector, while the rectifier will be in another compartment.

DIRECTORS FOR YOUR EXPER WITH

By Eina



A six-tube experimental superheterodyne employing the new tubes in novel fashion.

DURING the next few months there will be a great deal of experimenting with the new tubes, comprising the 46, 55, 56, 57, 58 and the 82, and undoubtedly several others. At this time we are interested only in the 46, 55, 58 and the 82. Let us see what can be done with the tubes. We might attempt to design an experimental superheterodyne containing six of the tubes, including two tubes in push-pull in the output stage. Not only that, but let us attempt to put in an automatic volume control. This is a suggestive circuit rather than one that has been worked out in practice. The main object of it is to acquaint the readers with the requirements and possibilities of the new tubes. Any one wishing to build it should do so on an experimental basis, on an old chassis or on a breadboard. It is not advisable to put it on a good chassis until all troubles, if any, have been ironed out.

In the first stage we have a 58, and it combines the function of oscillator and detector. In the first place the oscillator is of the Hartley type. There is nothing experimental about that, for it is an old standby that works well if given any chance at all. But it is operated with a 58, which is not an old standby but may be a future favorite. It is a good amplifier, and therefore it will make a good oscillator.

Oscillator Detector Combination

There is nothing experimental about combining the functions of detector and oscillator, for it has been used in many successful receivers. The connection of the input circuit, however, is a departure from the common. In this case the signal is impressed on the suppressor grid. Ordinarily the suppressor grid should be connected directly to the cathode, and was so connected inside the structure of certain old tubes. But now it has been brought out and we might as well put it to some use. If we were to connect the low side of the tuning coil to ground without using a grid bias resistor the suppressor grid would be effectively connected to the cathode in respect to steady voltages. But since there is a bias resistor the suppressor grid is a little negative, approximately three volts when a 300 ohm resistor is used. That changes the degree of suppression because any change in the voltage on this grid will do that.

We also have a tuned circuit between the grid and ground. If, therefore, a signal is coming in there will be a variable voltage on this grid, and therefore a variable suppression. This means that the plate current will be modulated by the signal. But the tube is also an oscillator and the plate circuit will contain oscillator current. Therefore there will be mixing and if the tube detects, there will be generated a current of difference frequency. Hence the i-f transformer in the plate circuit has something to do.

Grid Current Current

But we do not want to spoil the selectivity of the r-f tuner by allowing a lot of suppressor grid current to flow. It is for this reason that we use the 300 ohm resistor. Whether this is the best value or not remains to be determined, for this is an experimental circuit.

Incidentally, the type of Hartley oscillator shown will not oscillate if there is a high impedance in the plate circuit to the generated frequency. The tuning condenser across the primary of the first i-f transformer is large enough to act as a by-pass, but ordinarily this is not connected in the right way for by-passing, and is not in this circuit. But just the same it is in the place where it belongs.

We depended on the second 8 mfd. condenser in the filter to complete the by-passing, but it is said that an electrolytic condenser does not function well at radio frequency. Hence to be sure in this respect we should connect a condenser of about 0.1 mfd. from B plus to ground. It will be noticed that the two electrolytic condensers are not connected to the chassis. They were meant to be at first,

BiographicalBrevities

About George Olsen

Born in Portland, Oregon, with a permanent grin—still has the grin. Father was head of a storage and moving firm—plenty of pianos to move, but George decided he'd rather play on them than juggle them—and so—by the time he entered high school, Olsen, Jr., played three instruments—piano, violin and drums. At the University of Michigan he was the first drum major. Returning to Portland he organized his first dance orchestra. Then he went into vaudeville, where he met Fanny Brice, who obtained for him an engagement with Ziegfeld in "Kid Boots." That made George and his music famous. During this time he doubled in the "Follies". Then came "Sunny," where he met the beautiful blonde, Ethel Shutta, who eventually became his wife.

Another "Follies" followed; then "Good News" and "Whoopee." In New York he delighted dancers at his own clubs and at the Hotel Pennsylvania. A visit to the Pacific Coast brought him and his band into three moving pictures—"Whoopee," "Happy Days," and "Follow Through." While there he opened his own club which became a rendezvous for film stars. Back in New York he returned to night clubs and the NBC studios.

As a dance leader he is unique. Most of the time he wanders around the room talking to guests. Between rehearsals, broadcasts and dance engagements he plays golf; recently he broke into the seventies.

A great fellow, well liked by his fellow artists and musicians. A fine host and a swell entertainer.

IMENTS THE 46, 55, 56, 57, 58 AND 82

Andrews

but then we had to put in a 300 ohm resistor to overcome a difficulty that arose later in the circuit. From the point of view of mounting the electrolytics on a metal chassis it is desirable to connect one side of them to ground. But then it is also desirable to have them the way they are in order the better to filter the current through the 300 ohm resistor. The chassis connection probably will win.

Skipping by the i-f transformer because there is nothing to say about it in particular, we come to the only intermediate amplifier, a 58 tube. It has the usual bias arrangement, 300 ohms with a 0.1 mfd. condenser across it, and the voltages on the screen and the plate are those recommended not to be exceeded. But the suppressor grid is not connected to the cathode, but to a variable negative voltage. A condenser of 0.1 mfd. from it to ground is used for the purpose of filtering. This arrangement of the suppressor grid is for the purpose of automatic volume control. This part is strictly experimental, like most automatic volume controls, but this particular method has been discussed and recommended by the makers of the tube. The experimental part, then, pertains rather to the amount of negative voltage than to the connection. Let us leave this a moment.

The Diode Detector

Again we pass by an i-f transformer because we are anxious to get to the detector, which is the most interesting part of the circuit. The tube used is the 55 duplex-diode triode, and it serves three functions, namely, half wave rectifier for detection, half wave rectifier for automatic volume control, and as a regular triode amplifier.

One of the diode plates is connected to the secondary of the i-f transformer. Between the cathode and this transformer is a 0.5 megohm load resistor. Across this resistor is a 250 mmfd. condenser to remove the component of the signal frequency. This size condenser is quite effective at 450 kc when across such a high resistor. The detected component, that is, the audio frequency voltage across the load resistance, is impressed on the grid of the amplifier part of the circuit in the usual way through a 0.1 mfd. condenser and a 0.5 megohm grid leak. The leak, by the way, is the one that connects to the negative side of the B supply circuit. The grid is connected to the junction of this leak and the stopping condenser. There is nothing unusual about the arrangement except in the drawing.

We have already passed the detector and entered the audio amplifier without having left the detector tube. So let us go on. In the plate circuit of the 55 amplifier is a condenser of 350 mmfd. This is not really necessary, for there should be no signal current left at this stage of the circuit. But there may be and the condenser does not do any harm, for it is too small to by-pass any appreciable amount of audio.

Biasing 55 Triode

There is a 300 ohm resistor, with a 4 mfd. condenser across it, in the cathode lead of the 55. This is not enough to bias the tube, for it would require a resistance of 2,500 ohms and a bias of 20 volts. The drop in the 300 ohm resistor is only 2.4 volts. The rest of the bias is obtained from the drop in the 300 ohm resistor placed in the negative B lead. The total bias will be about 20 volts, provided all the currents are of normal value.

Why all this round-about way of getting the bias? There are several reasons. In the first place it is desired to get a negative bias on the heater in respect to the cathode, but not too much. Since the center of the heater winding is connected to ground and as the cathode of the tube is raised 2.4 volts above this, the bias on the heater is 2.4 volts. But we would have had a negative bias, and not of excessive amount, even if we had put the entire bias resistor in the cathode lead, so this was not the most important reason. We also wanted the suppressor grid of the i-f amplifier at the same potential as the cathode of that tube, when there is no signal coming in, or when the signal is weak. Now, ultimately the suppressor grid is connected to the cathode of the 55. Hence, if we raise the cathodes of the two tubes by the same amount above ground, we satisfy the desired condition. It will be noticed that all the cathodes are raised above ground a little. Hence each heater is negative with respect to its cathode. This is a recommended condition for low hum, especially in the detector tube.

Class A Output

In the power stage we have two 46 tubes in the push-pull, working as Class A amplifiers. We need one ordinary push-pull transformer and one push-pull output transformer. We say ordinary input transformer because the same type will do which is used for all tubes other than the 46 when employed as a Class B amplifier.

We also have the usual centering of the filament with a 30-ohm resistor, a 750 ohm bias resistor, which will give a bias of 33 volts, and an 8 mfd. condenser across this resistor. A separate heater winding is used for this stage in order not to give the heaters of the other tubes a positive bias.

For automatic volume control the second plate of the diode is used. The load on this rectifier is also a 0.5 megohm resistor, but it is shunted with a 0.25 mfd. condenser. The voltage for rectification in this circuit is derived from a third winding on the i-f transformer. This is an experimental feature to the extent that no commercial transformers of this kind are available yet. But a third winding can easily be put on an existing one. The same kind of spool may be used. Or well insulated wire may be wound around the transformer between the two spools.

Operation of A. V. C.

When no signal is coming in the controlled amplifier is at its most sensitive adjustment because the suppressor grid is effectively connected to the cathode. But as soon as a signal comes in a current starts to flow in the a. v. c. rectifier circuit. This sets up a steady voltage across the 0.5 megohm resistor and the 0.25 mfd. condenser. This makes the supressor grid more negative and decreases the amplification. As the signal increases the bias increases and the gain decreases still more. Thus there is a check on the amplification. When the signal decreases the reverse action takes place. The degree of automatic control can be varied by changing the coupling between the third winding in the i-f transformer and the other windings. This is easiest done by adding or removing turns. Once the adjustment has been effected there is no need of varying it. It can also be done by varying the voltage on the suppressor grid when no signal is coming in. This might be done by changing the relative values of the bias resistors of the controlled and the control tubes. Either a positive or a negative starting voltage can be obtained by making adjustments of values and connections. Just what is needed is one of the experimental features of this circuit, for it depends not only on the tubes involved, but also on the signal and the desires of the experimenter.

Pointed Opinion

HOMER KUNKLER, sales manager, U. S. Radio & Television Corporation: "Radio now is, and will continue to remain a feature of American home life. Radio programs are becoming better, more diversified and more universal in appeal. Radio receivers are constantly being improved and the two factors of good programs and good radios guarantee against loss of interest by the public. The slightest upturn in the economic situation should immediately find reflection in a better demand for radios."

Station Changes

Changes in the "List of Broadcasting Stations by Frequencies," published in our issue of June 4th, 1932:

660 kc—Delete WTIC.

760 kc—Delete WBAL.

1260 kc—WLBW. Change owner to Broadcasters of Pennsylvania, Inc.

1270 kc—KGCA. Change power to 100 W.

Change in "Time Table of Television Transmitters," published in our issue of May 28th, 1932:

2000-2100 kc—Add W9XX, 100 W, State University of Iowa, Iowa City, Ia.

Heard 1296 Stations, Amateur Tells League

Chesley B. Pickle, Hawaiian amateur, has reported to the American Radio Relay League the logging of 1,296 amateur stations in nearly 60 countries of the world.

If all this listening had been done in one stretch about six weeks of work would have been accomplished—provided not one minute was lost!

Modernizing an Old Set

Changes Necessary for Using New Tubes

By Heinrich von Elben

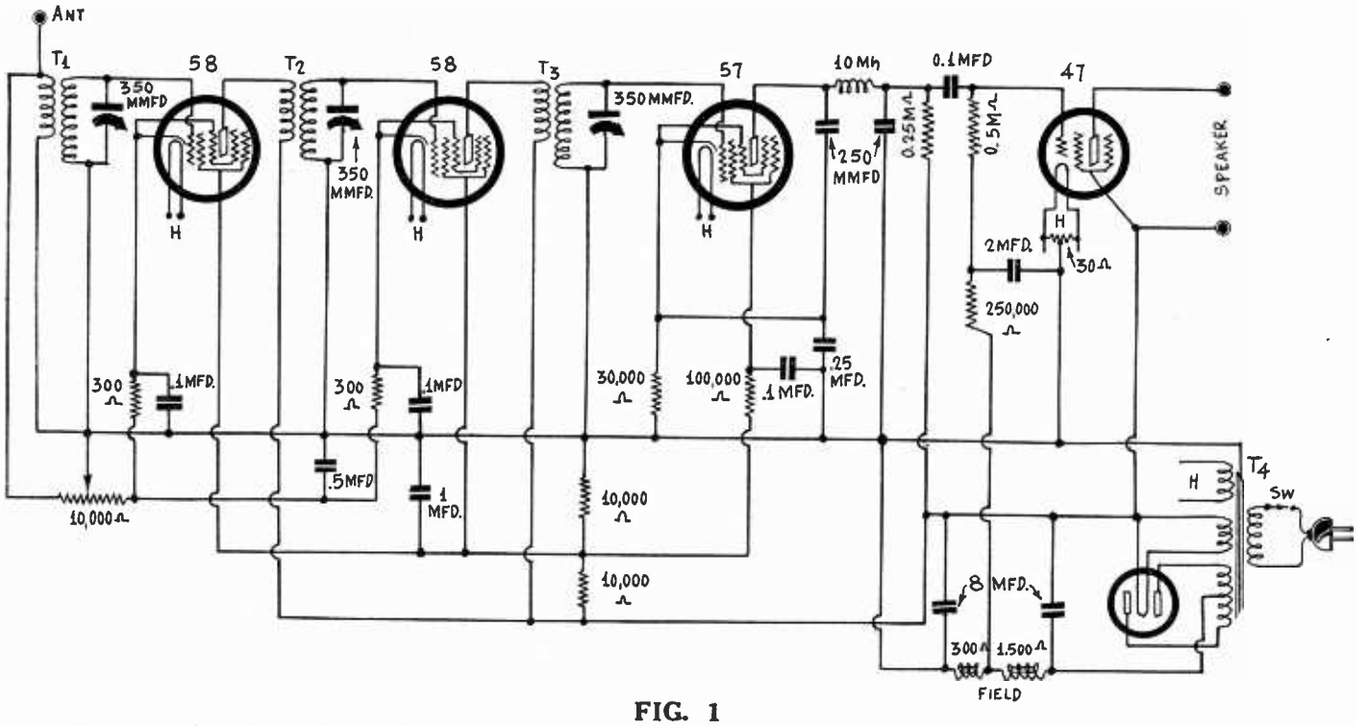


FIG. 1

The diagram of a five-tube midget receiver in which three of the new tubes are used. Only small changes are required to adapt an old set of this type to the new tubes.

WHAT CHANGES are necessary to adapt a five tube midget receiver to the new tubes? Well, that depends on how many of the new tubes are to be used in the old circuit. If we are to use a 46 in place of the 47 we have to make so many changes that it would be cheaper to build a new set. This is because the 46, when used as a Class A amplifier, requires a much higher bias than the 47, so that we would have to change the loudspeaker, since the midget sets take their bias from a drop in the speaker field. If we are also to use an 82 rectifier we would have to have a different power transformer, too, because the 82 requires a 2.5 volt filament voltage.

Since the object is to change the five tube midget to adapt it to the new tubes, and not to build a new receiver, let us retain the 47 and the 280 rectifier. That leaves three tubes to be changed, and that does not require a great deal of rebuilding. The new tubes would be two 58s for r-f amplifiers and a 57 for the detector.

Socket Changes

These new tubes are all of the six-pin type and therefore require six-contact sockets. That would be the first change. After the sockets have been put in, slight changes in the wiring are necessary. There were five leads to the old sockets. Let us assume that they have been connected to the proper terminals. There is one terminal open, and it should be connected to the cathode to complete the job.

The two heavy pins on the tube are the filament terminals. The two opposite pins are grids, the screen grid and the suppresser grid. The two other pins are the cathode and the plate. The relative arrangement of the terminals is the same as for the 227, provided we regard the two grids as one. Now the grid nearest the cathode should be connected to the cathode and the one nearest the plate should be connected to about 100 volts. The control grid is the cap and no changes are required in the wiring for this.

LIST OF PARTS

Coils

T1, T2, T3—Three shielded midget tuning coils for 350 mmfd. condensers
T4—One midget type power transformer
One loudspeaker with tapped field coil for grid bias (300, 1, 500 ohms)
One 10 millihenry choke coil

Condensers

One gang of three 350 mmfd. tuning condensers
Two 250 mmfd. fixed condensers
Three 0.1 mfd. fixed condensers, all in one case
One single 0.1 mfd. condenser
One 0.25 mfd. by-pass condenser
One 0.5 mfd. by-pass condenser
One 1 mfd. by-pass condenser
One 2 mfd. by-pass condenser
Two 8 mfd. electrolytic condensers

Resistors

One 10,000 ohm potentiometer, with line switch attached
Two 300 ohm bias resistors
One 30,000 ohm bias resistor
Two 10,000 ohm fixed resistors
Two 0.25 megohm resistors
One 0.5 megohm grid leak
One 30 ohm center-tapped resistor

Other Requirements

Three six-contact sockets
One five-contact socket
One four-contact socket
Three grid clips
Two binding posts, antenna and ground

Bias Required

The bias required on the r-f amplifiers is approximately the same as that required for a 35 tube, but the current is slightly higher, so that the bias resistance should be slightly less. However, the difference is so small that it is not worth while to make any changes in this respect, especially since it may be necessary to increase the resistance afterward in order to stabilize the circuit. Hence we leave the 300 ohm resistance, or whatever values are used.

The same thing applies to the bias resistor for the detector, the 57. The 30,000 ohm resistor may be left. However, it is permissible to put in a larger value, one as high as 100,000 ohms.

The voltages on the screens and the plates should be changed. But this does not necessarily mean that the voltage divider must be changed. If the voltage on the plates is increased, the voltage on the screens will be increased in about the right proportion. The recommended voltages are 100 for the screen and 250 volts for the plates. In the 235 tube the voltages are about 70 and 180 volts. The ratio is very nearly the same.

Voltage Division

In Fig. 1, which gives the connections of a typical midget receiver with the new tubes, the voltage divider consists of two 10,000 ohm resistors in series with the screens connected to the junction. Taking the bleeder current as well as the current to the screens into consideration, with these the voltage will divide so that the

(Continued on next page)

Selectivity Rating

By Brunsten Brunn

THE selectivity curves of the Rev. J. J. Daley's 6-tube constant-coupling receiver, reproduced here, are not plotted on a decibel basis as usual. However, we can easily convert the field strength ratio to decibels by multiplying the logarithm of the ratio at any frequency off resonance by 20. For example, at the top of the curve the ratio is 1,000. Hence the logarithm is 3, and the number of decibels is 60. At 100, where all the curves depart noticeably, the number of decibels is 40, since the logarithm of 100 is 2. At 50 all the curves are together and at this point the number of decibels is 34. When the curves are expressed in decibels the powers are compared rather than the voltages. This is necessary because the inputs are measured for constant power in the output of the set.

Relative Powers

Plotted on the decibel scale the curves show the relative powers of the signals of two stations of equal strength at the antenna when separated by a small amount in frequency. Suppose the set is tuned to one of the stations and there is another station separated by 10 kc, and the field strengths at the antenna are equal. The 10 kc line crosses the curve for 600 kc at 550, which is the voltage ratio of the two stations. This represents a level difference of 54.82 decibels, or a power ratio of 302,500.

In case the two stations differ in strength at the antenna we have to add the number of decibels of the station difference in strength to the sensitivity ratio decibels. Suppose a distant station is ten kilocycles away from a local station and that the carrier of the distant station is only 0.01 as strong as the local. Then the decibel difference is —40.

High Suppression

If we add this, algebraically, to the attenuation, which we found to be 54.82, we get 14.82 db. Therefore the logarithm of the ratio of the two powers in the speaker is 1.482, which represents a power ratio of 30.25. This is high enough to suppress the local without interference with the desired station. We can arrive at the same result by dividing the field ratio for equal strengths by the ratio of the strengths of the two and taking the square of this quotient. We have a sensitivity ratio of 550 and a signal ratio of 100. Hence the voltage ratio is 5.5, and the power ratio is 30.25. In case we wish the local station we have to multiply. We get 55000 as the voltage ratio. The power ratio is the square of this, which obviously is so large that the distant station cannot interfere, except possibly the heterodyne between the two stations, which would be a 10,000 cycle note.

Small Difference

The difference in the sensitivity of two stations separated by only 10 kc is so small that it need not be taken into consideration, as is shown by the sensitivity curve in Fig. 2.

The curves apply to Father Daley's six-tube design described last week (June 25) and not to the 4-tube model, the curves of which were shown last week and April 18th.

5-Tube Set

(*Continued from preceding page*)

screen voltage is 100 when the plate voltage is 250. There is no resistor between the high voltage line and the leads to the plates of the first three tubes, which means that as much voltage is applied to these tubes as to the power tube. This is all right, provided the voltage on the 47 is not excessive. The voltage should be about 250 volts, or slightly more, measured from ground.

Those who wish to build a new midget receiver with the new tubes may safely follow the diagram in Fig. 1 and use the values specified thereon. All necessary data are given with the exception of the coils. Three identical coils are needed, and they should be wound for 350 mmfd. tuning condensers.

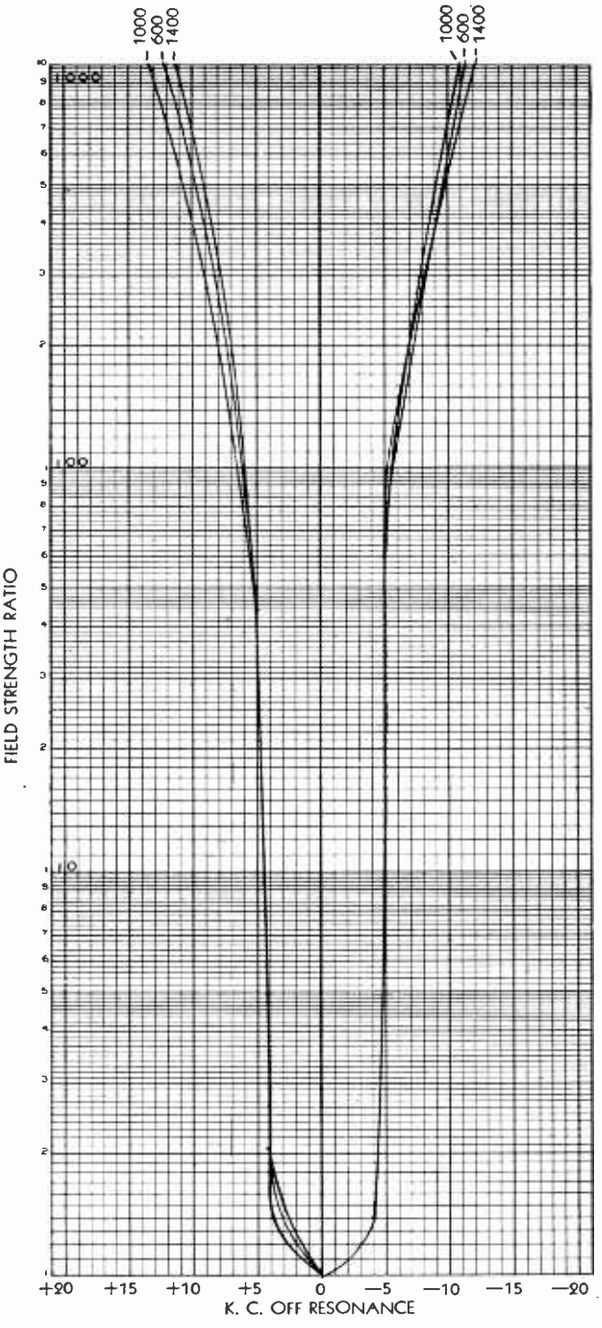


FIG. 1

The high order of selectivity of the six tube circuit of Father Daley is shown by these curves. Yet up to 4,000 cycles there is little attenuation, showing little loss of essential side frequencies.

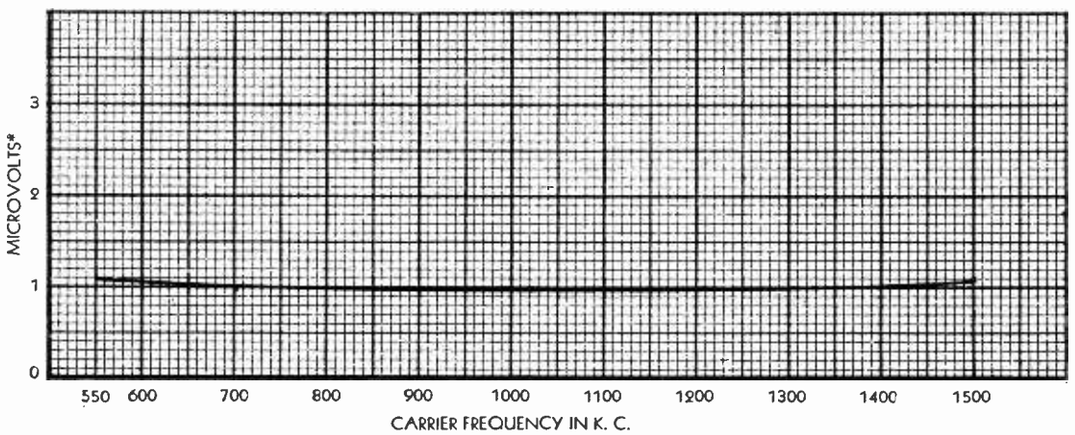


FIG. 2

The sensitivity of the Daley six-tube circuit is of the order of 0.25 microvolts throughout the broadcast band. The curve shows the sensitivity multiplied by four.

Radio University

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

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

Wants to get Rid of Hum

I AM TROUBLED with hum in my receiver and have tried everything. It is a five-tube midget, with B choke in the negative leg, bias for the pentode obtained from the drop in part of this tapped choke. Two 8 mfd. are used for filtering.—C.H., New Rochelle, N. Y.

Put another 8 mfd. next to the rectifier, that is, in parallel with the present 8 mfd. The case of the condenser, supposing an electrolytic condenser, should be insulated from a metal chassis. Did you insulate the other one next to rectifier, too? If not, the choke is shorted out so far as its choking is concerned. Check up on this carefully. Put two resistors in series, instead of one alone, in the pentode grid circuit. Leave the present one there, add another, 100,000 ohms or so, the value is not critical, and connect a condenser of 0.1 or 0.25 mfd. from the joint to ground. Also connect 0.1 mfd. or 0.25 mfd. from B minus (center of high-voltage winding) to ground. Reverse the connections to the primary of the output transformer. Keep the choke leads as far apart as practical where they emerge from the speaker beside the primary leads of the output transformer. Ground the case of the speaker if it is not grounded already. Use a higher capacity than at present to bypass the resistor that drops the voltage for the screens of r-f and detector tubes (screen voltage to ground). Try different values of capacity across the detector biasing resistor. The lowest hum, if 20,000 to 50,000 ohms are used for biasing, may be expected with 0.002 mfd., compared to the much larger capacities. Low notes will not be so strong when the smaller capacity is inserted. Measure the resistance between center of the power transformer's high-voltage winding to one extreme and then to the other extreme, and if there is much of a difference, an off-center condition, on an impedance basis, may be suspected, and the power transformer should be equalized or replaced. Ground the center of the 2.5-volt heater winding through a small potentiometer, 20 ohms or less, arm to ground, extremes to the 2.5-volt drop, and adjust the arm for least hum. Ground the frame or case of all audio transformers and power transformer.

* * *

Pentode Tone Quality

WILL YOU PLEASE COMPARE the tone quality of the pentode tubes with the '45 and otherwise discuss the topic for the benefit of a novice. The reason I ask is that the pentodes are now said by a tube manufacturer to produce great volume, but at the expense of some distortion, whereas the '45 produces low volume (this is my comment), but how about the distortion?—R.W., Springfield, Ill.

The tube manufacturer's statement regarding the pentode is in line with the fact. Where sensitivity is a most important consideration and not otherwise readily attained the pentode has an advantage, as in auto sets. However, for home use, especially with the duplex-diode triode about to be marketed, it is doubtful whether the pentode need be used for its volume of sound, since the diode part of the new tube can be used for detector, and also for automatic volume control, and the triode part as an amplifier of something like the characteristics of the '27. Thus the triode in the envelope will serve to feed an output tube, which may be a 46, used as a class A amplifier, (the plate current is 20 ma), and moreover the output impedance (a-c plate resistance) is only 2380 ohms, while the mutual inductance is high, 2350 micromhos. The highest mutual conductance of all the power tubes is that of the '47, which has 2500, but the a-c plate resistance is 35,000 ohms. If the plate resistance is high one difficulty is to get an output transformer with a suitably high impedance primary. We believe that the pentode will pass out of the picture, except for use in automotive sets. Now as to the 46. This power tube can be used in the last stage. This tube takes a 2.5 volt filament voltage, the same as the 55, and takes a 5-prong socket, the same as the 247. It also takes a plate voltage of 250 volts when used as a Class A amplifier. It requires a negative bias of 33 volts and a bias resistor of 1,500 ohms. This resistor should be connected to the center of the filament transformer secondary, or to the center of a 30-ohm resistor connected across the winding. One end of the resistor should go to ground, or to B minus. A 4 mfd. condenser should be connected across the resistor. To make it work as a Class A amplifier the grid next to the plate should be tied to the plate. This is the grid that occupies the usual position of the cathode in a 227 type tube.

The output of the 46 as a Class A amplifier is 1.25 watts when the peak of the signal voltage on its control grid is 33 volts. Since there is a triode amplifier in front of the power stage the necessary input voltage can easily be obtained without overloading the detector. The voltage amplification in the triode is about 6 times so that the peak voltage on the triode part of the 55 need only be 6.6 volts. This is easily within the limits of the diode rectifier detector.

If the same 2.5 volt winding is used for the 55 and the 46 and a bias resistor is used for the 46, the heater of the 55 will be 33 volts positive with respect to the ground. And if the bias on the 55 triode grid is 20 volts the cathode of that tube will be 20 volts positive with respect to ground. Hence the cathode of the 55 will be 13 volts negative with respect to its cathode. The manufacturers of the tube recommend that the voltage between them be zero, or that the cathode be negative by not more than 45 volts. Hence the potential difference between them is in the right direction and within the specified limits.

* * *

Auto Tubes Economical?

WOULD IT BE ECONOMICAL for me to use the automotive tubes in my home battery-operated set? I have a 6-volt storage battery but wonder whether I would have to charge it too often.—U.W.G., Windsor, Ont., Can.

It would be all right to use them, for many persons do, as the drain is only a little more than that from the —01A tube (0.3 compared to 0.25 ampere). But whether it is economical would depend as much on the user's opinion as on that of any outside agency. The 2-volt series tubes draw 0.06 ampere filament current. Therefore five such tubes would draw no more such current than one automotive tube. Certainly it can be said that the operation of the 2-volt tubes is economical, although the power tubes of the series draw about twice as much current. As for B current there is not much difference.

* * *

Set Picks up Static

JUST BEFORE, during and for a while after a thunderstorm or other storm I hear terrific static in my set. I wonder what is the matter with the set, as it plays beautifully otherwise.—P.O., New York, N.Y.

Evidently there is nothing the matter with your set. Static is to be expected under these circumstances on all sets. In fact, power companies use single-frequency receivers to which are attached meters that register relatively the amount of static, and thereby the companies are warned of the approach of a storm and can prepare for an extra-heavy use of power by consumers, if it is a day-time storm, because of the thousands of lights to be suddenly turned on.

* * *

Noise on Short Waves

ARE SHORT WAVES noisy, or am I justified in expecting reasonably quiet reception? Is there any difference between the broadcast band and the short waves as to receiver behavior? I don't see why the same tubes and condensers should be noisier on one set of frequencies than on another.—H.R.A., Waco, Tex.

There is more noise on short waves than on the broadcast band for several reasons, some of which perhaps are not fully understood. For a certainty there is more power input at the antenna for broadcast frequencies, due to the closer proximity and the greater power used at the transmitter. Therefore the noise level is lower. Also, because of the generally weaker input, sets are made more sensitive for short waves, and the higher amplification means that the tubes contribute a greater proportion of noise to the net result, considering noise as against signal. The shot effect evidently has something to do with this, and it is greatest when the voltages are highest and amplification greatest. When two conductors are near each other, and carry a-c, there is current between the two, accompanied by the dislodgment of small particles from the conductors. It is believed the particles from one conductor strike the other, that this action is mutual, and that the physical impacts cause the modulation that is heard as noise. Also, the frequencies of reception being high, they are often more sensitive to local disturbances, such as man-made static, as from electrical machines of various types, including motors, commutators, thermostats etc. Still, the noise is unbearable only on some occasions. The general rule is that reception is good on a good receiver. A mass of indifferent material in a passable circuit may be all right for broadcast use, but would not do for short waves. Also, the carrying power, hence the noise, differs with different frequencies. Some short-wave frequencies are good for daytime reception only. This disappearance of signals as the amount of solar illumination changes is called selective fading.

* * *

Grid Leak Power Detection

IS IT POSSIBLE to use power detection with a grid leak. Some one told me so, yet I have always contrasted power detection and grid leak detection.—R.D.C., Roanoke, Va.

Power detection with grid leak may be used if the plate voltage is about as high as for bias detection, and the leak and condenser values are low. The leak may be 20,000 ohms, the condenser 0.0001 mfd. or 0.0002 mfd. The leak should be in

series with the grid (from coil to grid) and the condenser across the leak, to avoid having such a low resistance in shunt with a tuned circuit. By grid leak detection, unless special mention is made of the circumstances just stated, is usually meant 0.00025 mfd. condenser and 2 to 5 meg. grid leak at low plate voltage, if broadcast frequencies are concerned. Grid leak power detection is excellent and should be tried by all experimenters. The connections are the same for a-c circuits, cathode to ground, and there should be no voltage difference between filament center and cathode.

* * *

The Coming Circuits

WILL THE CIRCUITS for the coming season be an improvement over those of the declining season?—K.G., Saratoga, N.Y.

Yes. For powerful sets there will be, besides the new r-f amplifier, modulator, audio and oscillator tubes, Class B amplification, which permits some distortion at low signal levels with hardly any increase at tremendously greater signal levels, which is one improvement. Except for intensely powerful sets the Class B amplifier serves no good purpose. The Class A amplifier is truer to tone values, within its limits, and overloads faster, but these facts may be considered in circuit design. The 58 tube has a more remote cutoff, hence the low audio frequency attenuation by volume control of cathodes is avoided, and besides cross-modulation is lessened.

* * *

Color Code of Resistors

THE COLOR CODING of resistors, by standard practice, is a most commendable undertaking, but the definition by words alone seems hard to follow, and I wonder if you would print the actual resistance values from 500 ohms to 10,000,000 ohms? —J. E., Dubuque, Ia.

The list is published herewith.

* * *

Neon Tube Oscillator

PLEASE LET ME HEAR from you about the neon tube as an r-f oscillator, and show a circuit using it, for wide frequency range, also with modulation and an amplifier.—P. E., Philadelphia, Pa.

The neon tube is used as an audio oscillator to provide modulation, not as a radio frequency oscillator. Fig. 1017 shows the diagram of a four-tube hookup. The 56 tubes are used in the r-f oscillator and the amplifier stages. The other tubes are the '80, and the neon which is of the night lamp type purchaseable in almost any radio or electrical store (110 v). While some of the 110-v a-c neon lamps do not light on 110 volts d-c, the only reason is that 110-volts d-c is not a high enough voltage, and from the rectifier herewith some 300 volts are obtainable, therefore you can adjust the voltage until the neon tube glows. You will find the glow setting not critical, but as for oscillation, the setting is a little critical. Thus an adjustable resistor is used to produce the oscillation voltage, which is just before the glimmer disappears. The variable condenser across the lamp (0.0002 mfd. up to 0.000' mfd. maximum) makes possible the selection of different frequencies of audio oscillation. This may come in handy for audio tests. With the four-coil system, and 0.0005 mfd. capacity, you can cover a frequency ratio of about 150-to-1, so if you start with 10 meters you can reach to 1,500 meters. Honeycomb coils would be used for long waves.

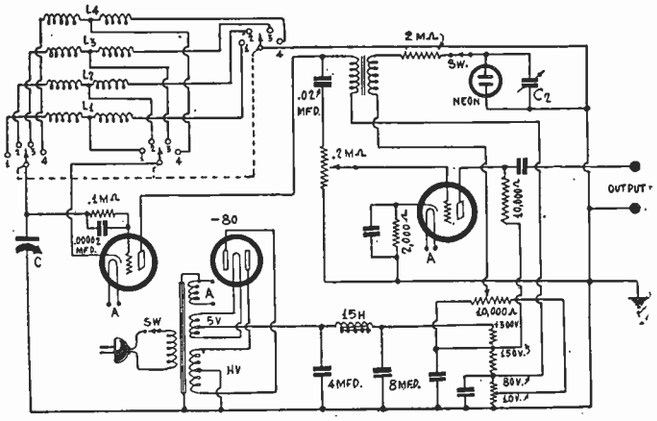


FIG. 1017
An oscillator for wide coverage of frequencies. Modulation is provided, using a neon lamp. A stage of amplification is built in. Four tubes are used, including the neon bulb.

Megohms	*Ohms*	*Body*	*Dot*	*End*	*Megohms*	*Ohms*	*Body*	*Dot*	*End*
.005	500	Green	Brown	Black	.075	75,000	Violet	Orange	Green
.00075	750	Violet	Brown	Green	.09	90,000	White	Orange	Black
.001	1,000	Brown	Red	Black	.1	100,000	Brown	Yellow	Black
.002	2,000	Red	Red	Black	.15	150,000	Brown	Yellow	Green
.003	3,000	Orange	Red	Black	.2	200,000	Red	Yellow	Black
.004	4,000	Yellow	Red	Black	.25	250,000	Red	Yellow	Green
.005	5,000	Green	Red	Black	.3	300,000	Orange	Yellow	Black
.006	6,000	Blue	Red	Black	.5	500,000	Green	Yellow	Black
.007	7,000	Violet	Red	Black	.75	750,000	Violet	Yellow	Green
.008	8,000	Gray	Red	Black	1.	1,000,000	Brown	Green	Black
.009	9,000	White	Red	Black	1.5	1,500,000	Brown	Green	Green
.01	10,000	Brown	Orange	Black	2.	2,000,000	Red	Green	Black
0.12	12,000	Brown	Orange	Red	2.5	2,500,000	Red	Green	Green
0.15	15,000	Brown	Orange	Green	3.	3,000,000	Orange	Green	Black
0.2	20,000	Red	Orange	Black	4.	4,000,000	Yellow	Green	Black
.025	25,000	Red	Orange	Green	5.	5,000,000	Green	Green	Black
.03	30,000	Orange	Orange	Black	6.	6,000,000	Blue	Green	Black
.04	40,000	Yellow	Orange	Black	7.	7,000,000	Violet	Green	Black
.05	50,000	Green	Orange	Black	8.	8,000,000	Gray	Green	Black
.06	60,000	Blue	Orange	Black	9.	9,000,000	White	Green	Black
					10.	10,0000,000	Brown	Blue	Black

The standard adopted for resistors, whereby they are color coded, comprises ten colors, with numbers from 0 to 9 for each different color. The location of the color gives the digit sequence. The body color represents the first figure, one end is colored for the second figure, while a stripe or dot designates the number of ciphers to follow. The above table gives the colors, with two expressions for the resistance, megohms and ohms.

The Seven Amateur Bands

with 'Phone and Picture Restrictions

GENERAL (C-W Telegraphy)			*'PHONE RESTRICTIONS*			*PICTURE RESTRICTIONS (Television, Etc.)*		
Kilocycles	*Meters*	*Operator's License Required*	*Kilocycles*	*Meters*	*Operator's License Required*	*Kilocycles*	*Meters*	*Operator's License Required*
1,715— 2,000	174.82 —148.9	Regular	1,875— 2,000	159.9 —149.9	Regular	1,715— 2,000	174.82 —149.9	Regular
3,500— 4,000	85.66 — 74.96	Regular	3,900— 4,000	76.88 — 74.96	Unlimited			
7,000— 7,300	42.83 — 39.98	Regular						
14,000— 14,400	21.42 — 20.82	Regular	14,150— 14,250	21.18 — 21.04	Unlimited			
28,000— 30,000	10.708 — 9.994	Regular						
56,000— 60,000	5.345 — 4.997	Regular	56,000— 60,000	5.345 — 4.997	Regular	56,000— 60,000	5.345 — 4.997	Regular
400,000—401,000	0.7496— 0.7477	Regular						

Note: All bands unrestricted as to continuous wave telegraphy. No 'phone permitted except as listed under "'Phone Restrictions," nor pictures, except as listed under "Picture Restrictions." Amateurs do not operate on individually assigned frequencies, but may use any frequency in the authorized bands.

A THOUGHT FOR THE WEEK

PIERRE BRUGNON must have been happy at his farewell appearance on the "Evening in Paris" program at the Columbia studios in New York City recently preparatory to his going abroad for a summer vacation in Paris. Our own Alice Remsen joined the noted radio stars in wishing M. Brugnon bon voyage, among these well wishers being the Boswell Sisters, Lanny Ross, Morton Downey, Stoopnagle and Bud, Norman Brokenshire and Singin' Sam, and several members of the newspaper craft. 'Twas a great night, with the studio crowded, a great program and a collation at a smart nearby hotel for about fifty especially invited guests. All's well that ends well—at 3:00 A. M.

RADIO WORLD

The First and Only National Radio Weekly

Eleventh Year

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

Still Pictures Received by Inventor on Liner

Bela Guth, a Hungarian engineer living in Switzerland, arrived on the North German Lloyd liner Bremen on which he had been conducting long distance experiments with a system of transmitting pictures and facsimiles by radio which he had invented. Pictures had been sent by his assistants in Zurich, Switzerland, and he had received them on the liner a few seconds after they had been sent. He was elated with the highly successful results of the experiments.

He calls his device the "radiotype," the result of many years of work. Eventually, he predicted, ships will carry both transmitters and receivers of pictures so that passengers may send letters in their own handwriting to friends on land or so that they may receive written messages. Another possibility is the reception of entire newspapers for the benefit of those on board.

Fingerprint Facsimile Interests N. Y. Police

The Fultograph system of facsimile or picture transmission by wire or radio, invented by Captain Otho Fulton, of England, was demonstrated recently before Commissioner Mulrooney at Police Headquarters, New York City! A photograph of Mr. Mulrooney was transmitted and was reproduced on a revolving cylinder about 40 feet away. The reproduction was good and the Commissioner appeared to be pleased with the result.

The Police Department is interested in the system as a possible means of broadcasting fingerprints of criminals who are wanted. It only requires about three minutes to send a small picture. The system invented by Captain Fulton has been in use in many Continental countries and in England for some time, and it has been officially adopted by the British army and navy.

Demonstrations of the system are to be repeated soon.

Forum

He's Keen on Coils

DURING the last four months that I have been reading your weekly publication, I have become strongly attached to it. The reason for this in my particular case is chiefly because it gives most of the information that a set builder needs, and also because your designs are always such as to get reasonable performance if not the best with the simplest construction and at minimum expense. For instance in the line of coils, I can't see anything much more simpler and cheaper than the one inch coil form which you advocate for the r-f coils. A home set builder can easily build these coils at little cost.

The one thing, however, that I have always found lacking is the design of intermediate frequency coils for superheterodynes. If for some reason you have purposely omitted these constructional data from your articles on superheterodynes, and will continue in the same way, it would please me very much to see an article on r-f coil construction of the solenoid type, on about 1 or 1¼ inch forms, for various frequencies in which both primary and secondary are tuned.

JOSEPH F. SABOL.
1406 Ravine St., Munhall, Pa.

* * *

Enjoys Articles—Asks Questions

I CERTAINLY enjoy your very complete magazine and especially appreciate the excellent articles on the new tubes, enabling me to keep posted on new developments.

Whatever became of the development of the set that was to be a copy of the government's receivers at Grand Island?

H. M. LYALL,
Leominster, Mass.

* * *

SQUIRREL?

I GOT A GREAT KICK out of the article by Paul Erwin on the Running Board Aerial. Does the aerial board also run or it is the running board that runs, or does the wire around the board on the running board run? I suggest putting a revolving squirrel cage on top of the car with a good live fox squirrel in it. A generator could be fastened to one end to supply emf for the radio. Of course a periscope would be necessary so the squirrel would be able to see the nuts (in the car). Jokingly,

D. E. BECKER,
Alma, Mich.

Radio City's First Broadcast to be Made

The first broadcast from Rockefeller Center in the heart of New York, where the steel work of Radio City is now rising into the sky, will be heard over a coast-to-coast network of the National Broadcasting Company on Saturday, July 2d. The occasion is the laying of the cornerstone of the British Empire Building, which will form a part of the Fifth Avenue side of the Center.

Lord Southborough of Great Britain, and Hon. H. H. Stevens, Canadian Minister of Trade and Commerce, will be the principal speakers to be heard on the broadcast, which will be carried over an NBC-WJZ network at 11:00 a. m., E. D. S. T. Arthur Woods, president of Rockefeller Center, Inc., and former Police Commissioner of New York, will preside. The program also will be short-waved across the Atlantic to England, for rebroadcast by the British Broadcasting Corporation.

Radio Business Is Good— In Politics

With Henry Field having defeated Senator Brookhart for the Republican Senatorial nomination in the Iowa primaries, and Dr. Brinckley about to run for Governor of Wisconsin, can't say that the radio business is so bad, politically speaking.

* * *

New common aerial serves up to 3,000 sets. Quite different from 40 different grounds used on one set by a DX hound.

* * *

How fine is radio abroad is told to us frequently by those from abroad, but we'd like to hear it from somebody from home.

* * *

Temptation is great to send complaints direct to Federal Radio Commissioner Harold A. Lafount, Washington, D. C., against excessive advertising blurbs, as he has yet to receive, he says, a definite complaint in writing about this nuisance.

* * *

If Crosley doesn't get anywhere with 500,000 watts on 700 kc he might try 5 watts on 7,000 kc.

* * *

A station is responsible for libelous statements made by a speaker before its microphone. Now, if the speaker could only get the station to pay his other bills!

* * *

Political conventions are not nearly so interesting as their broadcast narrators make them.

* * *

Statement is made that result of the Presidential election will depend on the air popularity of the candidates. Would be funny if a coupon contest were won by the man defeated in the election.

* * *

All the world's a super and the men and women in it loudspeakers—particularly the politicians.

* * *

A few words from the show business knocking radio, would start something, seeing as the two are about one these days—engaged but not yet married.

* * *

Anybody who wants to be an announcer on a chain these days had better get a Ph.D. first and then forget all he learned.

* * *

Do you remember the numbers of the four latest tubes officially announced, the two new tubes unofficially announced and the three not yet even thought of?

No Need for KWEA, Examiner Tells Board

Washington.

In a report to the Federal Radio Commission Examiner R. H. Hyde recommends that KWEA, owned by the Hello World Broadcasting Co., Shreveport, La., be deleted because there is "no evidence whatever of a public need for the services of KWEA." It was also said that the station had failed to comply with Commission regulations. The station came back with a protest on the report as unfounded in fact and asked for a hearing before the full Commission.

In the same report Examiner Hyde recommended that the application of W. H. Allen, Eugene Levy and S. B. Pearce, Alexandria, Va., be denied. They had asked for a construction permit for a station to use the facilities of KWEA.

STATION SPARKS

By Alice Remsen

The South Wind

For the Boswell Sisters

(WABC, Mondays and Thursdays 10 p.m.)

The south wind murmurs through the pines,
So soft, so sweet, so low.
Caressingly it stoops to kiss
The rippling brook below.

The kind south wind! Its soothing voice
Is lighter than a sigh,
As to the sleepy flower-buds,
It sings to a lullaby.

O sweet south wind, my heart would send
A message to my dear!
Just whisper as you go along
Into my lover's ear.

Just whisper that I'm waiting still
An answer to obtain;
And, dear south wind, bring back my love
When you return again.

—A. R.

* * *

And just as soft and sweet as the south wind is the gentle harmony of those charming girls, the Boswell Sisters. They have a style entirely their own, an unique rendition, thoroughly Boswellian, utterly delightful and soothing to the ear. Don't miss them; they're a treat.

* * *

News of the Studios

WABC

The most welcome news from Columbia is that "March of Time" will be back on the air in September. It will be a sustaining feature from September 9th until November 4th, when Time magazine will again take it over, continuing until the middle of March. Another good piece of news is that David Ross is now airing poetry, with a background of music by Emery Deutsch's orchestra. Yes! Poet's Gold is back again and you poetry lovers may listen to your favorites, each Sunday at 5:30 p.m., delivered in the inimitable style of David Ross.

* * *

Chesterfield has renewed its contracts with Ruth Etting, the Boswell Sisters, Norman Brokenshire and Nat Shilkret's Orchestra, in the "Music That Satisfies" series. Incidentally, they increased Brokenshire's salary $250 per week—this was a voluntary gesture.

* * *

Artells Dickson, baritone and character singer, known also as "The Singing Vagabond," is now portraying a new role every Wednesday morning at 8:45 a.m. As Banjo Bill, he sings negro dialect songs on the Diplomat program, a series sponsored by the Diplomat Products Corporation of New York.

* * *

Mabel Jackson, became a radio star in a rather unusual way. Living in Cincinnati with her parents, she passed a radio audition and was heard regularly over local stations there. Coming to New York some years later to study for the operatic stage, Miss Jackson continued her broadcasting with only one idea in mind—to make enough money to continue her voice study for opera. The longer she remained in radio, however, the more she was convinced that she should stay there. It was not long before she gave up her operatic ambitions altogether, and determined to remain a radio singer. It was a wise choice, for Mabel has gone far in radio and will go further. At present hers is the sweet soprano voice heard on the Dupont "Today and Yesterday" program, every Friday at 8:00 p.m., via WABC and network.

* * *

NBC

Whispering Jack Smith is back on this side of the pond again, after triumphs in Europe. Jack was the first of that infectious tribe, the male crooner, and one of the pleasantest. He may be heard on a new series of programs sponsored by Absorbine, Jr., Monday and Wednesday evenings at 10:15 p.m., over an NBC-WJZ network.

* * *

Roy Atwell, veteran musical comedy comedian and famous word-garbling master of ceremonies, is now presiding over the weekly Mobiloil concerts every Wednesday evening at 9:30 p.m. John S. Young is at the microphone. "The Men About Town Trio" have also joined the cast for the summer. Nat Shilkret's orchestra and Gladys Rice are continuing as featured attractions. NBC-WEAF network.

* * *

Too bad that the Republican convention cut in just as Donald Novis, the latest build-up singer for NBC, started his theme song; anyhow, Donald proved by the few tones heard, that he has a very pleasing light lyric tenor voice. Tune in on him if you get a chance.

* * *

WOR

In 1918 the Military Intelligence Department was confronted with the problem of ferreting out a spy who was causing no end of trouble. Letters intercepted from one suspect written to a friend abroad were turned over to a young girl in the service who had distinguished herself by a genius for the solution of cryptograms. Innocently worded, these letters revealed nothing suspicious to several trained investigators, but under the scrutiny of the girl proved the identity of the wartime enemy, who was caught and sent to Leavenworth prison. The girl, whose identity was disclosed only just recently, was offered a permanent place in the Department; however, art had the stronger call, and she resumed voice culture, to become, in due time, soprano on the Moonbeams program, over WOR. She is charming Annette Simpson.

* * *

The fine tenor voice of Tommy Weir is now heard every Sunday morning at 11:15 a.m. over WOR, accompanied by that excellent pianist, Lee Cronican. Why Tommy isn't heard more frequently over metropolitan stations is a mystery to me. He's worth a bushel of ordinary crooners.

* * *

Mackensie Reid, who controls the switches and other gadgets at WOR's remote broadcasts, was motoring in from Morristown, N. J., and pulled up to inquire of a small boy the price of lilacs the lad was selling.

"Fufty cents a bunch and muckle cheap," said the lad, a Scot.

"Hoot mon, I'll gie ye a quarter," replied Mac, himself born near Edinburgh.

"Oooh," said the wee merchant, "so you're a Scotchman, too. Well, I'll tell you what I'll do. You ride me up to the end of the road an' it's a deal." "Sold," agreed Mac, who knows when he's licked. "Hop in."

Sidelights

More than 300,000 persons visit the NBC New York studios at 711 Fifth Avenue each year to view programs. . . ALLYN JOSLYN got a great kick out of playing Diomedes in the Players Club production of Shakespeare's "Troilus and Cressida". . . ANN LEAF made her own curtains for her swanky new apartment, but admits she prefers playing the organ to sewing. . . ARTHUR ALLEN recently remodeled his Long Island garden; did it all himself, too. . . BILL GLENN goes on fishing trips each week-end. . . LEONARD JOY intends to spend his vacation in the NBC music library—of all places. . . FLOYD NEALE will make a flying trip to Ireland for his vacation. . . EDDIE WALTERS is an expert in panama hats. . . EDDIE LAMBERT arranges all of Beth Challiss' music. . . VERNA OSBORNE'S brother is an officer on a battleship. . . MILDRED BAILEY and JUNE PURSELL were both Hollywood voice doubles a few short years ago. . . GRACE MOORE refreshes herself with cold pineapple juice when broadcasting. . . LARRY FUNK was born in St. Louis, Mo. . . RALPH COLLUCIO is the master of about every stringed instrument. . . ARNOLD BRILLHEART is one of the best "musician-golfers". . . ABE LYMAN was a great favorite with the British nobility when he played the Kit-Kat Club in London. . . MARIO BRAGGIOTTI once played the piano for Ruth Etting in the "9:15 Revue". . . DON BALL, the announcer, once took vocal lessons from Willard Amison, Bath Club tenor. . . LANNY ROSS is the son of a Shakespearian actor. . . HARRY VONZELL is the son of an advertising man. . . ABE LYMAN is the son of a fruit grower. . . ALICE REMSEN'S father was a major in the British army . . . the father of LOUIS DEAN is a railroad man. . . . FRANCES ALDA is an Australian and so is the NBC announcer, PAT KELLY. . . . ALICE JOY is thoroughly enjoying (no pun intended) her vaudeville tour. . . . NORMAN BROKENSHIRE is a southpaw. . . . TED BREWER has a trunk specially equipped to carry twenty-one different musical instruments, and—he is master of all of them. . . . ANDRE KOSTELANETZ was at one time chorus master of the St. Petersburg Imperial Opera, where one hundred and fifty voices were under his tutelage. . . . SYLVIA FROOS collects lifesize woolen dogs. KATHLEEN STEWART dotes on ducks and has a specially built pool for them at her Nyack, N. Y., home. . . . . . WILFRED "BILL" GLENN has developed a remarkably good memory and, therefore, does not entirely depend on his score during broadcasts. . . . Pennsylvania claims a great many radio artists; f'r'instance: Scranton, LANDT TRIO & WHITE, and MILDRED HUNT; Pittsburgh, ED WEEMS, CAROLINE GRAY and RAY DEL RAE; Sharon, PAT BARNES; Lebanon, MART HOPPLE, and "JOLLY" BILL STEINKE.

* * *

ANSWERS TO CORRESPONDENTS

JACK FLICK, N. Y. City.—Shall listen in to the Rev. Lee Ashton, as you suggest, and report accordingly. Thanks for the suggestion.

LILY ROOT, Hollywood, Calif.—The "Evening in Paris" broadcast resumes its Coast to Coast broadcast in the Fall. At present it is heard over Eastern and Middle Western stations.

* * *

If you would care to know something of your favorite radio artists, drop a line to the conductor of this page. Address: Miss Alice Remsen, care RADIO WORLD, *145 W 45th St., New York City.*

NEW RECTIFIER, HIGH VOLTAGE, IS DUE IN FALL

The need for a high-voltage full-wave rectifier, exceeding the characteristics of the '80 and the 82, is to be met by the production of the 83, a mercury vapor rectifier. Heretofore high-voltage rectifiers have been of the half-wave type, and two were needed for full-wave rectification, e.g., the '81.

The new tube, it is expected, will be in the dome-type envelope, as are the 57 and 58. This type of dome is required by the construction of the tube, which will have oval-shaped plates, about three times as far apart as in the case of the '80. The separation of the plates is indicative of the high voltage that the new rectifier is intended to stand.

Mercury vapor operation has been selected because of the low voltage drop in the tube and the consequent excellent regulation possible.

Mica insulation is used between the electrodes of the new rectifier, and there is a glass support to hold the elements in place.

The 5-volt filament requirement is expected to be retained, because used in the general run of rectifiers for receivers, although the '81 is of the 7.5-volt filament type. Shielding of the tube, as well as r-f choking of each lead to plate, the chokes inside the shield, is expected to be recommended.

The official announcement of the 83 will not be made for perhaps a few months, and the tube is not expected to be ready for delivery to set manufacturers until October.

NEW INCORPORATIONS

Kaufman-Miller Corp., Elmira, N. Y., garage, radios—Attys., Phillips & Garey, Elmira, N. Y.

Aeradio Corp. of America, Belleville, N. J., operate broadcasting stations—Attys., Registrar and Transfer Co., Dover, Del.

General Electronics Corp., Belleville, N. J., radio apparatus—Attys., Registrar & Transfer Co., Dover, Del.

Domestic Maid Sales Division, Inc., Wilmington, Del., electrical apparatus—Atty., Franklin L. Mettler, agent, Wilmington, Del.

Mohawk Giro, New York City, electrical generators—Attys., Laughlin, Gerard, Bowers & Halpin, 57 William St., New York City.

Fareri Electric Co., Yonkers, N. Y.—Atty., L. D. Posner, Yonkers, N. Y.

CORPORATE CHANGES

Bankruptcy Proceedings

Petition Filed—Against

Polymet Manufacturing Corp., manufacturers of radio and electric parts, 829 E. 134th St., New York City, by Banner Folding Box Company, Inc., for $745; Sterling Products Company, $1,500; Easton Trust Co., $40,000. The petition states that receivers were appointed in the Court of Chancery in Delaware recently.

Assignments

United Retail Radio, Inc., retail radio dealers, 4912 Broadway, New York, have assigned to Charles Solodkin, 261 Broadway, New York City.

Lyric Radio Co., Inc., radios, 806 Flatbush Ave., Brooklyn, N. Y., has assigned to Harold J. Kraft, 480 Lexington Ave., New York City.

Dissolutions

Utica Electrical Supply Co., Utica, N. Y.

Mohawk Electric Supply Co., Utica, N. Y.

Buffalo Electrical Show, Buffalo, N. Y.

CORPORATION REPORTS

Grigsby-Grunow Company and subsidiaries, including Columbia Phonograph Company—Quarter ended March 31: Net loss, after depreciation and all charges, $747,026. Net sales for quarter were $3,186,508. Comparison unavailable, as company recently changed fiscal year, and this is the first time operations of Columbia are included in the consolidated report.

National Union Radio Corporation and subsidiaries—Year ended April 30: Consolidated net loss, after interest, depreciation and other charges, $11,970, against $25,573 loss in preceding fiscal year.

Tradiograms

By J. Murray Barron

AUTO SETS ARE SELLING

Many retail stores are finding the increasing demand for automobile radio receivers this Summer a much-welcomed addition to their business. After several years of experimental work and development a number of manufacturers are now offering a worthwhile job. If anyone thinks that sets are not being sold, a walk through any radio retail district will soon convince him to the contrary. It is a daily common sight to see actual installations taking place right on the public highways.

Where there are a large number of retail stores in one section, at times cars are waiting their turn to pull into the curb for the installation.

The sales are increasing in most sections. One can hardly appreciate the greatly increased demand that has taken place during the past three months.

At first many retail dealers did not take on the sale of automobile receivers, but as their more progressive and foresighted brethren began getting the business and dropping these extra dollars into the till it dawned upon the others that here was a real new department that could be added to the regular business with practically no additional expense.

There are many servicemen throughout the country who have seen the light and are making a specialty of auto sets and keeping up their business income that may have fell off on the regular merchandise. To many who have not even given this installation idea a thought, it might be well to tell them that it's an excellent bet right now. Every proper installation is a recommendation and advertisement for future business. The field has not been scratched as yet and there is plenty of room for many servicemen. Daily the demand for automobile radio receivers is growing, and the market is large and the profits good.

* * *

Through the courtesy of Radio Corporation of America Gimbel's Department Store in New York City is window-displaying an historic display of radio receivers. Starting with the Westinghouse single circuit detector and amplifier receiver using WD-11 tubes, which covered from 180 to 700 meters, and with a special loading coil for Arlington time signals, as used in 1922 and 1923. Of course before this, was the Radio, Jr., a crystal receiver that sold for $25. Then came Radiola 5 in 1923 and Radiola Grand, the latter considered a very high grade receiver in those days, and the price was $325. This, too, was in 1923. Radiola 3, a regenerator receiver, detector, single circuit, with four selectivity taps, and with one step of audio, a dry cell job, came along for use in 1924, 1925 and 1926. About the same time the RCA semi-portable superheterodyne, a second harmonic set, became popular. This was a dry cell job using 199 tubes and sold around $116.

The Radiola 25 followed in the years 1925 and 1926 and 1927. From these battery sets we find the electrics Radiola 16, 17 and 18 through the 33's and 44's, 60s and so on down the line until we arrive at 1932 with the 12-tube Victor Bi-Acoustic Radio Receiver.

* * *

Some intermediate amplifiers are equipped with an adjustable degenerative circuit for suppressing second order modulation. This circuit prevents the production of "phantom stations" in the amplifier. All vacuum tubes used in these amplifiers are the indirectly-heated cathode type. This prevents the production of power hum usually experienced with filament type vacuum tubes directly a-c heated.

OLYMPIC MEN'S MESSAGES GO 'VIA AMATEUR'

Pleading that the thousands of athletes from all over the world, gathered at Los Angeles to compete in the Olympic Games, will want to keep their relatives and friends informed of their progress, Walter A. Lippman, Jr., young California radio amateur, obtained authority from the Federal Radio Commission to operate W6USA during the next three months.

Messages will be accepted from any enrolled Olympic athlete and transmitted via amateur radio to any part of the world without cost, in accordance with the international radio treaty limiting amateur traffic-handling to non-commercial participation. A staff of selected California amateurs will aid Lippman in manning the station.

A special cottage in Olympic Village was assigned to radio by the managing committee. It is an ideal location, atop a high knoll near the center of the village. The cottage number is 301. From this point will be transmitted the messages to all corners of the earth, over the relay networks of the American Radio Relay League in cooperation with other national amateur societies.

Selected stations in various sections of the country are already being lined up for the relay work. Harold Churchill, operator of transatlantic amateur beam station W2ZC, Little Silver, N. J., has been assigned the job of European contact. Communication with other continents is being arranged through similar points, all amateur stations working without remuneration.

WOR Announcers Limited to Initials

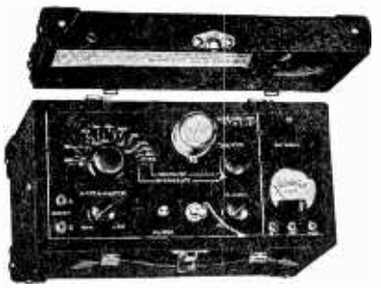
Mere announcers at WOR, Newark, N. J., which station has studios in New York City, are to be semi-anonymous, experimentally. The station announced that the announcers will not identify themselves by name any more. However, the change as noted by listening has been that the announcers use code initials instead.

If an announcer writes a continuity or sketch or otherwise deserves credit as an author he will receive it, the same as any other author.

The trial of the semi-anonymous system is the result of criticism of announcers pushing themselves forward too much and making it appear as if they were more important than the program. However, when a reporter canvassed the WQR announcers none of them found himself in this class. Nevertheless the new method prevails, and if it succeeds it may be retained, or even the initials will be omitted, making for complete anonymity, except so far as listeners now recognize the voices of announcers they've been hearing for years.

The station's announcement about announcers included the following:

"We feel that radio has progressed beyond the novelty stage. It is the program and not the announcer that the audience is interested in. For that reason, the announcer, for station purposes, will sign off using simply a three-letter call word. In such cases where the continuity has been compiled or annotated by an announcer he will be allowed to use his name."



OSCILLATOR

Licensed by A. T. & T. Co.

No. 551 $18 Net to dealer $30 list

No. 550 $21 Net to dealer with output meter

A sturdy modulated instrument carefully made. Completely shielded with separate battery compartment. Furnished with 22½-v. and 3-v. batteries and one '30 tube. Direct reading broadcast band (550-1500 kc.) and intermediate band (120-185 kc.). Sharp 2nd and 3d harmonics for 260 and 475 kc. Operating instructions attached in case cover with shielded wire leads. Very compact. In leatherette case, 6x11½x5½ in. Weighs but 8 pounds. Built to high standards. Every serviceman should have the No. 550 oscillator to align r.f. gang condensers, locate defective r.f. transformers, adjust i.f. transformers, check oscillator stage and determine sensitivity of a receiver. A necessary instrument. Get yours today.

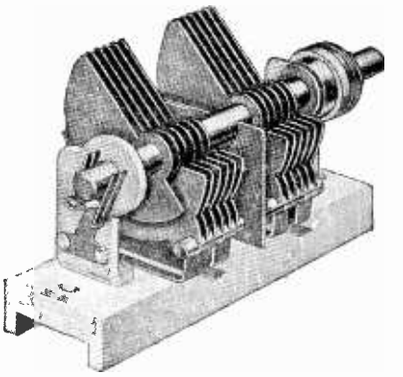
Guaranty Radio Goods Co.
143 West 45th St. New York City

START RIGHT! Use These . . .
Superb Condensers for Short Waves!

Single 0.00014 mfd. Hammarlund condenser; non-inductive pigtail; single hole panel mount and two-point base mount; Isolantite insulation; brass plates.

Single 0.00014 mfd. sent free with a 3-months subscription for Radio World (13 issues, $1.50). Double 0.00014 mfd. sent free with a 6-months subscription (26 issues, $3.00).

THE most popular capacity for short-wave use, and the one for which virtually all commercial short-wave coils are wound, is 0.00014 mfd. The Hammarlund condensers of this capacity, both single and double, are compact and efficient. They have Isolantite insulation and Hammarlund precision workmanship. See offer at lower left. Present subscribers may extend their subscriptions under this offer.



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

BLUEPRINTS OF STAR CIRCUITS

8-TUBE AUTO SET

Sensitivity of 10 microvolts per meter characterizes the 8-tube auto receiver designed by J. E. Anderson, technical editor of Radio World, and therefore stations come in with only six feet of wire for aerial, and without ground. Most cars will afford greater aerial pickup, and besides the car chassis will be used as ground, so with this receiver you will get *results*. The blueprint for construction of this set covers all details, including directions for cars with negative A or positive A grounded. The circuit features are: (1) high sensitivity; (2), tunes through powerful locals and gets DX stations, 10 kc either side; (3), latest tubes, two 239 pentode r-f, two 236 screen grid, two 237 and two 238; push-pull pentodes, all of 6-volt automotive series; (4), remote tuning and volume control on steering post, plus automatic volume control due to low screen voltage on first detector; (5), running board aerial. The best car set we've published. This circuit was selected as the most highly prized after tests made on several and is an outstanding design by a recognized authority. Send for Blueprint 631, @ 50c

SHORT-WAVE CONVERTER

If you want to build a short-wave converter that costs only a very few dollars, yet gives good results, furnishing all its own power from 110 volts a-c, and uses no plug-in coils, you can do so from Blueprint 630. Price.....25c

5-TUBE AC, T-R-F

Five-tube a-c receivers, using variable mu r-f, power detector, pentode output and 280 rectifier, are not all alike by any means. Forty circuits were carefully tested and one selected as far superior to the others. This prized circuit was the 627, and if you built it, you will always be glad you followed our authentic Blueprint, No 627. This is the best 5-tube a-c t-r-f broadcast circuit we have ever published. Price 25c

A-C ALL-WAVE SET

An all-wave set is admittedly what many persons want, and we have a circuit that gives excellent broadcast results, and is pretty good (not great) on short waves. No plug-in coils used. Cost of parts is low. Send for Blueprint, No. 628-B, @.....25c.

In preparation, an 8-tube broadcast superheterodyne for 110v d-c. Write for particulars.

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A SINGLE BUTTON RECORDING and HIGH GAIN SPEECH "MIKE"

which can be used for phone work on all radios. Worth its value in entertainment. No Fan or Experimenter should be without one.

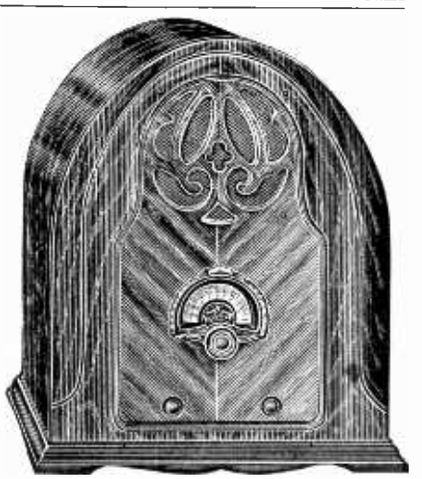
Your price..... **$1.95**

80-550 Meter Set, No. 627

THE famous 627 kit is for a five-tube tuned radio frequency circuit of extremely high sensitivity, covering 80 to 550 meters, using our 80-meter coils and condensers. The wave band is shifted by a long panel switch. Stations come in loud and clear. The kit includes everything, with full-scale blueprint (less tubes). The tubes used are two 235 (or 551), one 224, one 247 and one 280. The circuit is hum-free and is a most astonishing performer. Tone and selectivity are excellent. We know of no other 5-tube circuit that excels it.

Complete kit of parts, including Dorset cabinet as illustrated; blueprint, long switch, and tubes, (Cat. 627-KAT) @ $23.50

Blueprint 627 alone, (Cat. BP-627) @.....$ .25



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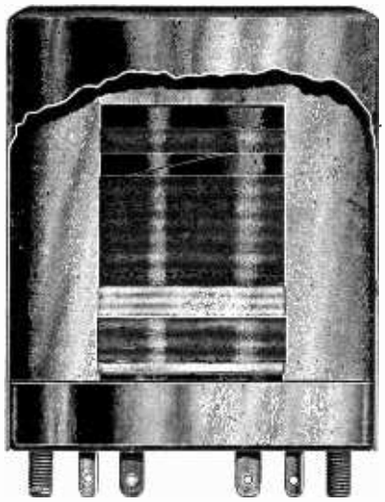
EBY Ant.—Ground twin binding post assemblies, 30c each. Guaranty Radio Goods Co., 143 W. 45th St., N. Y. C.

Coils That Exceed Your Requirements for Precision

Secondary Inductances Accurate to plus or minus 0.6 microhenry



CAT. NO. 1—Three matched shielded t-r-f transformers, for 0.00035 mfd., with 80-meter tap. $1.35

CAT. NO. 2—Three matched shielded t-r-f transformers, for 0.00046 mfd. (Scovill condenser), with 80-meter tap.....$1.35

CAT. NO. 3—Three matched shielded t-r-f transformers, for 0.0005 mfd., with 80-meter tap. $1.35

Three-deck long switch for above coils, $2.50

Tuned Radio Frequency Coils

THESE coils are for two stages of screen grid radio frequency amplification, using any type screen grid tubes, including the newest ones, and any type of detector tube. There are three coils to a set. Each coil is wound on a 1-inch diameter tubing and anchored to an aluminum shield base, to which base the shield proper makes a tight fit.

The bases have punched openings through which four lugs protrude, and also are provided with rigid 6/32 machine screws for mounting. These screws protrude downward and are 1 11/16 inches apart. The coils may be mounted on chassis cut for the wafer type tube socket, or may be mounted by means of threaded bushings, elevated half an inch from a chassis top, requiring no cutout chassis.

The shield has a small protected opening at top so the lead for the grid cap may be brought through. The opening is bevelled. This constitutes the protection against fraying the insulation of leadout wire to grid cap. The shield cover is 2⅛ inches outside diameter and 2½ inches high.

Inside the shield base are stamped designations as follows: P, B, G and ground symbol. These stampings are near openings through which the corresponding lugs protrude downward. Besides, there is a side lug, protruding outward near the bottom of the form. P and B are always the primary connections, P going to plate an B to B plus, except in the case of the coil used for antenna coupler, when P goes to aerial and B to ground. G is always the connection for grid cap of the r-f tubes, also grid cap of the detector if it is a screen grid tube, otherwise to G post of socket of the detector tube.

The side lug is the grid return connection, usually grounded in circuits. The stamped ground symbol is not the ground connection but represents a tap on the secondary for tuning to 80 meters. The broadcast band is covered in full with the entire secondary—G and side lug—while from 200 to 80 meters are covered when the ground symbol tap is picked up by condenser stator.

To accomplish 80-550 meter coverage, therefore, a three-deck switch, two positions for each deck, is required, and must be of the insulated type. The moving arms connect to condenser stators, and pick up either the full secondary or the tap, which is about one-quarter of the secondary, in number of turns. The full secondary is always in the grid circuit, wired as previously stated, but the tuned circuit is made to consist either of the full secondary of one-quarter of the secondary, by switching the condenser stator to either point.

The 80-meter tap does not have to be used, but is advantageous to those desiring to tune in television, amateurs, police calls, some relay broadcasting and other interesting transmissions in a band of frequencies replete with novelties for the usual broadcast listener.

High impedance primaries are used, the number of turns chosen so that the same coils may be used for antenna coupler and interstage couplers.

All coils are guaranteed to cover the wave band when condensers of the specified capacity are used.

All coils are sold on a 5-day money-back guarantee. We pay the postage on all coil orders, on basis of remittance with order.

Precision Coils for Double Detection Circuits

Tuner-Mixer Coils

THE tuning coils for superheterodyne construction are for a stage of t-r-f, modulator and oscillator, with oscillator secondary inductance accurately chosen on the basis of specified capacity of padding condenser. These coils are for broadcast band coverage only.

The coils are of the same type of mechanical construction as the t-r-f coils. Since there is no secondary tap, the code for connecting the t-r-f coils of the superheterodyne combination is different: P and B, primary; G and ground symbol, secondary. P would go to plate or antenna, G to grid cap, while B and ground symbol are the returns.

The oscillator has a smaller inductance secondary, for padding, and moreover is a three-winding coil. The three windings are: pickup, secondary and tickler. Th. pickup winding consists of 10 turns, and is brought out to two side lugs. The polarity of its connections unusually is of no importance. The secondary is represented by G and ground symbol. G going to grid and ground symbol to grid return, usually ground. The tickler connections for oscillation require that the lug at B be connected *not to B plus but to plate,* hence the P lug goes to B plus. In any case, if no oscillation results, reverse the tickler connections.

Tuning Coils for 175 kc Receivers

CAT. NO. 4—Three shielded coils, two for modulator and r-f and one for oscillator, for 0.00035 mfd. three-gang condenser. Oscillator coil has pickup winding. Intermediate frequency intended, 175 kc. Price includes padding condenser, 700-1000 mfd. $1.80

CAT. NO. 5—Same as Cat. No. 4, except that this set is for 0.0005 mfd.....$1.80

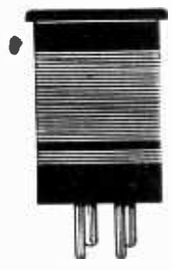
CAT. NO. 6—Same as Cat. No. 4, except that this set is for the 0.00046 mfd. Scovill condenser $1.80

Tuning Coils for 365-465 kc Receivers

CAT. NO. 7—Same as Cat. No. 4, except padding is for 365-465 kc and padding condenser is 350-450 mmfd.....$1.80

CAT. NO. 8—Same as Cat. No. 6, except padding is for 365-465 kc and padding condenser included is 350-450 mmfd.....$1.80

Short-Wave Plug-in Coils

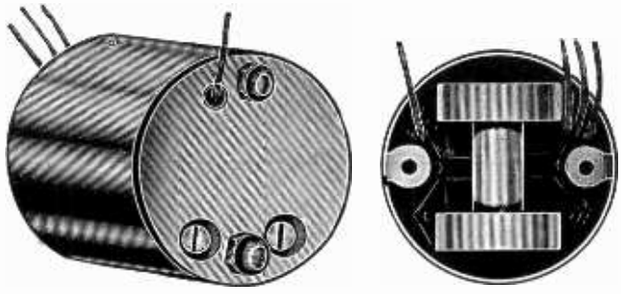


WOUND on 1.25 inch diameter finest bakelite forms, with flange for gripping, these short-wave plug-in coils afford high efficiency. Tube sockets serve as receptacles for these coils. The coverage with four coils is 13 to 200 meters with 0.00014 mfd. capacity. Also 0.00015 mfd. may be used without change. The coils may be used for any of the popular short-wave circuits.

CAT. SWA—Four plug-in coils, UX base, primary and secondary; primary may be used for feedback if condenser connects aerial to grid.....$1.35

CAT. SWB—Four plug-in coils, 6-pin base; primary, secondary, fixed tickler.....$1.70

UX wafer sockets or 6-pin wafer sockets, 11c. each



The intermediate frequency transformers are in an aluminum shield and consist of two loosely-coupled low r-f resistance honeycomb coils, with compression type Hammarlund condensers that hold their setting.

Intermediate Transformers

THE intermediate transformers consist of two honeycomb coils, wound with low resistance wire, coils spaced 1 inch apart, and thus affording loose coupling, stability and high selectivity. The coil assembly is enclosed in an aluminum shield, with open bottom. The shields are 2⅛ inches diameter, 2 inches high. At bottom are two small rigid brackets, tapped for 6/32 machine screws. The taps are 1 11/16 inches apart. Four outleads, 6 inches long, are wired to the coils. Their colors are green, black, yellow and red.

The primary consists of the yellow and red leads, yellow to plate, red to B plus. The secondary consists of the green and black leads. Green emerges through a protected small opening in the top of the shield and goes to grid cap of a screen grid tube. Black is the return for the secondary, usually to ground. Both primary and secondary are tuned, and thus the coils are for screen grid tubes exclusively, except the second detector may be any type tube. The condensers for tuning the coils are Hammarlund's compression type, on an Isolantite base. The set-screws for adjusting these condensers with a screwdriver are accessible from the top of tbe shield.

CAT. FF-175—Shielded intermediate frequency transformer, 175 kc.....$1.10

CAT. FF-450—Shielded intermediate frequency transformer, affording choice by condenser adjustment of frequencies from 365 to 450 kc.....$1.30

Padding Condensers @ 45c Each

CAT. PC-710—For 175 kc intermediate. Put in series with oscillator tuning condenser. Capacity 700-1000 mmfd. Hammarlund, Isolantite base.

CAT. PC-3545—Same as above, except 350-450 mmfd. for 365-400 kc intermediate.

Prompt Service

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