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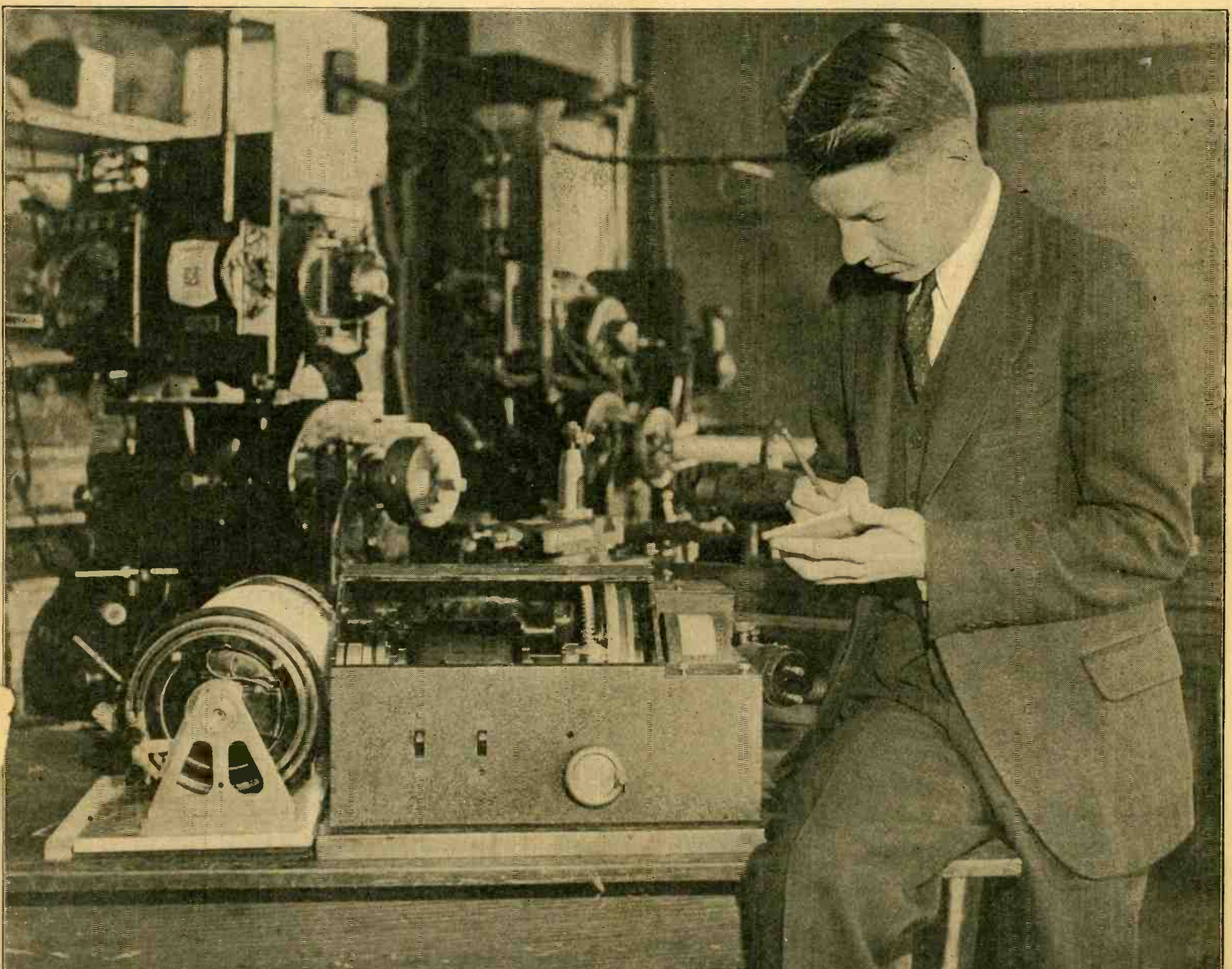

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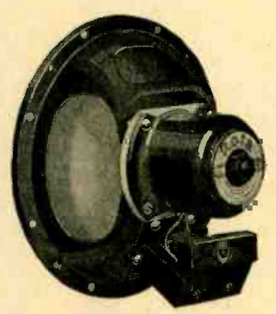

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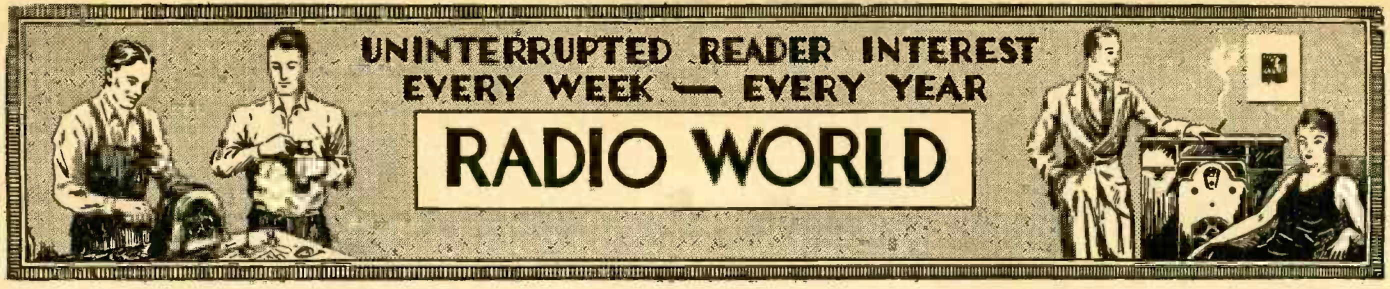

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Short Wave Tuners

Regenerative Circuits for Batteries and A-C

By Herman Bernard

EXCELLENT results are obtainable from battery operated short wave tuners. All that are needed are a stage of tuned radio frequency amplification and a regenerative detector. Plug-in coils of the tube base type may be used.

It will be noticed, in Fig. 1 that the antenna coil has four different connections, hence may be wound on a UX type base or similar plug. The grid return is not to ground but to C minus, hence the fourth connection. The interstage coil has three windings, and normally they would require six different connections, hence a six-prong socket and plug would be required. These sextette devices are hard to procure, and few manufacturers carry them. In fact, considerable correspondence with manufacturers elicited the information from all that they had none for sale, although some would make up large quantities, on special order, with considerable die charges.

Since regeneration really is necessary, hence three windings, and since six different connections cannot readily be made by plugging in, an alternative exists in using an r-f choke coil in the B plus lead of the r-f tube, where L3 is, then connecting a fixed condenser from the plate of that tube to the "high" side of L3, whereupon the return of L3 could be to ground. Then there would be five connections, since both L3 and L4 would terminate at the same point, and a UY plug could be used.

Choke is Discriminatory

But the r-f choke coil has its disadvantages. It has a certain inductance, it has a given distributed capacity, hence a natural period, and is frequency discriminatory, often to a most disappointing extent.

Another way of accomplishing the use of a UY socket is to return the two coils, L3 and L4, to the same point, but have it be B plus. This does not interfere with the detector grid bias in any way, if the leak-condenser method of detection is used, and the leak is put in parallel instead of in series with the coil. The only potential effective on the grid is that established by d-c, through the grid leak, if one neglects, as one may in this case, the effect of the signal voltage. At all events, the grid bias always is positive.

Now a five prong plug may be used, but the B batteries are in the tuned circuit. Since only radio frequencies are concerned, even a relatively small capacity condenser will serve for bypassing, but a value somewhat higher makes assurances doubly sure, so 0.1 mfd. is used. The tuned circuit is therefore completed through this capacity.

Only when B batteries are run down does their resistance become appreciable. Then, too, the resistance is a common coupling for all circuits fed by the batteries, and for audio frequencies would become a serious problem at times.

Case of Rundown Batteries

As for radio frequencies, if the battery resistance increases considerably, the harmful effect is there nevertheless, unless bypassing substantially removes it, and this is true whether the batteries are directly connected in the tuned circuit, as in Fig. 1, or not. The primary L3, for instance, is a resonant circuit, since a resonant frequency is fed to it and it is coupled to a resonant circuit, even more closely, in the direction of the detector grid. The impedance of the primary is therefore the same as that of the secondary under these circumstances, and since the batteries—in this case the A, B and C batteries—are in the circuit, they are really as much included.

(*Continued on next page*)

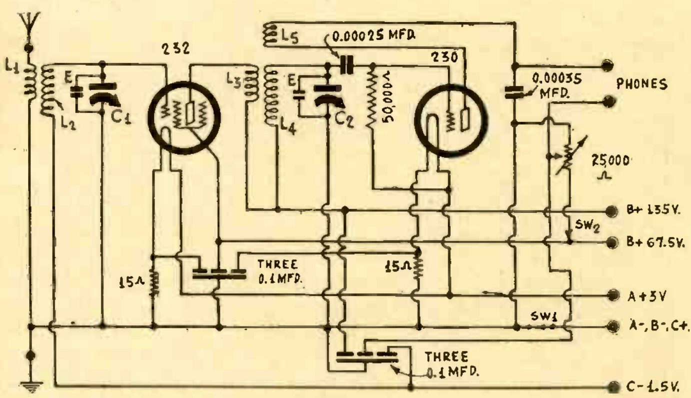

FIG. 1

For battery operation this tuner may be used for short waves, with plug-in coils. Note the method used in the detector coil to permit winding on a UY base or equivalent.

LIST OF PARTS for Fig. 1

Coils

Four sets of plug-in coils wound on tube base diameters, with two coils to a set, total, eight coils. Four plugs for antenna coils have UX bases, four for interstage coupler UY bases. Directions given in text..

Condensers

Two 0.0002 mfd. short wave tuning condensers (C1, C2).

Two equalizing condensers (E), of any usual small capacity for peaking.

One 0.00025 mfd. fixed condenser.

One 0.00035 mfd. fixed condenser.

Two shielded blocks, each block containing three 0.1 mfd. condensers; black, common, goes to A minus; reds interchangeable.

Two 15 ohm filament resistors.

One 25,000 ohm potentiometer.

One 0.05 meg. pigtail resistor (50,000 ohms).

Miscellaneous Other Parts and Accessories

One knob for potentiometer.

Two switches (SW-1, SW-2).

Two vernier dials.

One 5 lead battery cable.

Three UX and one UY sockets.

One twin assembly jack for phones.

Two posts for antenna and ground.

One pair of earphones.

One front panel, 7x10 inches.

One baseboard or chassis.

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UY Bases for Plugging

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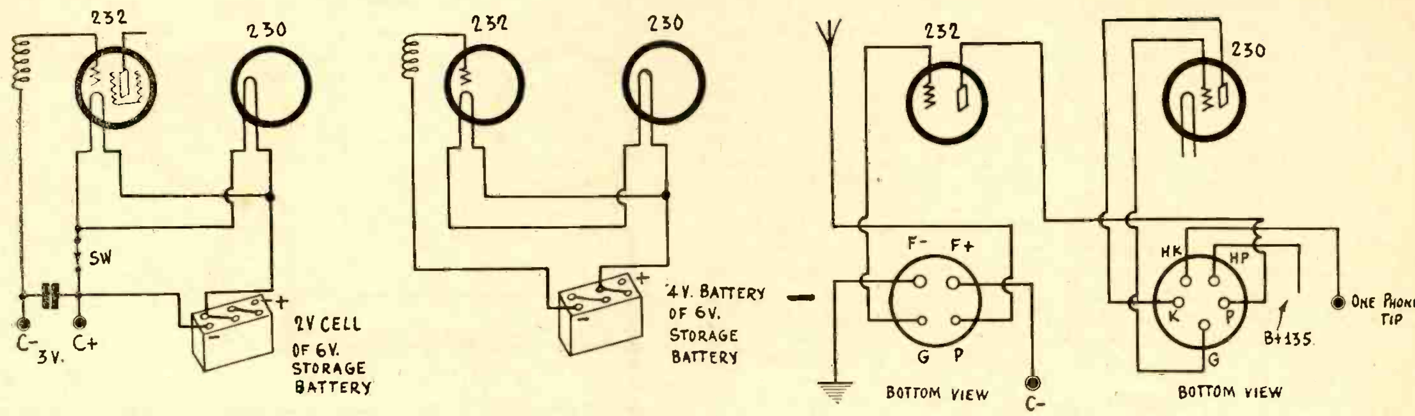

FIG. 2

The three illustrations represent (left) the use of the 2-volt section of a 6-volt storage battery to supply the tubes (center), the connection of two tubes with filaments in series, where a 4-volt section of the storage battery is used, and (right) the coil connections between plug and sockets, to be read in connection with coil winding data given in the text.

(*Continued from preceding page*)

as in the special grid return connection of the detector as shown in Fig. 1.

But there is no need to work a set from rundown batteries. When the set seems to lose its pep, when regeneration becomes more difficult, when crackling sounds are heard, and broad tuning is noticed, and when a suitable voltmeter across the batteries shows a low reading, then it appears to be time to get fresh batteries.

How low the reading should be is a matter of dispute, or, rather, no set minimum is given, as the battery manufacturers like to say that the batteries should not be discarded until they do not give satisfactory service. However, failure to satisfy, plus the low voltage test, constitute a good combination. A drop of one-third of the voltage certainly would be low.

Does the Voltage Itself Drop?

In this connection it is interesting to digress sufficiently to reveal the reason for the low voltage reading. Is it really a case of the battery voltage dropping as the battery ages? Of course age produces the change, even if the battery is never used, but use plus age is the usual combination that causes the alteration.

What has been altered? Has the voltage really dropped, or has merely the voltage *reading* dropped? Is there any difference?

As has been stated, the condition that changes is the resistance of the battery. It is quite unlikely that the voltage changes. When the worn-out, discarded B battery, even one resurrected from the ash can, is measured with an electrostatic voltmeter, the voltage is just as high as when the battery was fresh and new. But the resistance has increased.

We now have a circuit consisting of the same voltage as always, we draw approximately the same current as formerly, but we find the voltage reading is low. Obviously it is low because the resistance of the battery is in series with the load. When current flows the result is a drop in voltage across the resistance of the battery. So only when we draw current does the practically obtainable voltage decline, and since we never use B batteries except when we draw current, we have to watch the voltage.

Case of C Battery

With a C battery, from which no current is drawn, the situation is different. Cases have been known where C batteries have not been changed in three years, and good bias results obtained nevertheless, although this is not to be taken as a recommendation to retain a C battery as long as that, any more than one should consider using a set of tubes for three years, even though some reception is enjoyed with those old tubes and old C batteries.

Particularly when we are dealing with short waves do we desire to be a little more careful than usual. We recognize that tuning in short waves is more difficult, and is governed by more uncertainties, than tuning in the broadcast band. Batteries in good condition, tubes in good condition, circuit carefully wired, and we can begin to expect some real results. Otherwise we might fare rather poorly and probably would.

The circuit is shown with 3 volts specified for the A supply. This voltage may be obtained from two 1.5 volt No. 6 dry cells connected in series. The drain will be 120 milliamperes, and this is well within the capacity of the A battery, which will stand up to 250 ma of average use. The A, B and C batteries should last several months —the B and C batteries six to nine months.

Filament Power Source

The tubes used are of the 2-volt series, and the 3 volts are reduced to 2 volts (approximately) through the drop in the 15-ohm filament resistors. For short wave it is well to bypass filament resistors, as the plate current flows through them, and 15 ohms represent a considerable percentage of negative feedback at high frequencies. The drop will be about 0.96 volt, because the current will be around 64 ma, so 2.04 volts (approximately) through the drop in the 15-ohm filament resistors. For short waves it is well to bypass filament resistors, as the plate current flows through them, and 15 ohms represent a considerable percentage of negative feedback at high frequencies. The drop will be about 0.96 volt, because the current will be around 64 ma, so 2.04 volts (approximately will be on the filament. As the A battery becomes used the voltage will drop a little, so there is no danger of excess voltage.

If you have a 6-volt storage battery, you may connect the filaments directly to one cell of the battery (2 volts), omitting filament resistors, and increase the negative bias on the first tube to 3 volts. Or if you have a 4-volt storage battery, or want to use two of the cells of the 6-volt battery, connect the filaments in series across the 4 volts. Negative of detector would go to A minus, plus of detector filament to negative of r-f filament, positive of r-f filament to positive A, 4 volts. In this particular case no biasing battery would be needed, The diagram of the 4-volt service, Fig. 2, is incorrect, and these textual directions should be followed instead, as the connection of L2 to A minus would give suitable bias (2 volts). In Fig. 1 the negative bias is 1.5 volts plus the drop in a 15 ohm resistor, or approximately 2.5 volts.

As for the wiring, antenna and ground are connected to the primary of the antenna coupler. To be sure of running into no trouble because of d-c polarity collision it is well to adhere to some particular method of connecting the prongs. Suppose a UX socket is used in the antenna stage. The secondary goes with one side to grid, the primary with one side to ground, and as the two grid designations suggest each other, the grid connection for the coil may go to the grid prong, and as A minus is usually grounded, the A minus connection suggests ground end of the antenna winding. Then the filament plus would be the other end of the secondary, while plate prong would be the aerial connection. This is a good choice, too, since both aerial and plate suggest "hot" potentials.

The interstage coupler takes three windings. Again grid may be used as the grid connection. Here a plate may be used as plate connection on the coil, the heater adjoining plate (HP) as B plus, to which ends of both L3 and L4 are connected, so that these two may indeed be a continuous winding. Of course, there are two plates, and as only one can be used for the plug plate connection, suppose you select the r-f plate, because that is the one returned directly to B plus. We have left, cathode (K) and heater next to cathode (HK). Cathode may serve for plate of detector, while the end of the tickler coil may go to the heater adjoining cathode.

The circuit may be built either as single control or with two separate condensers individually tuned. There will be a little more sensitivity if the separation method is used. I do not see any reason why the convenience of single tuning control, that

into Regenerative Detector

R-F Choke Makeshift Avoided

listeners require for broadcast use, should be required by experimenters, technicians and short wave devotees, where sensitivity is much more important. However, you can make your own choice, and, if you have a two gang condenser, can put a small manual trimmer, about 50 mmfd. across either the antenna secondary or the detector secondary, for front panel compensation of differences that arise, and then the sensitivity will be about on the same level as that provided by the separation method. Where to put the trimmer will be disclosed by experience. Usually, since a long aerial may be used, the detector stage is the suitable position.

Another point in regard to sensitivity is that the regeneration control does not share the audio response with the phones. When a series variable resistor is used to control regeneration by plate voltage adjustment, the audio frequency drop is shared by the phones and by the control, unless a very large condenser is connected from the phone side of the series resistor to B plus, say, 8 mfd. No such capacities are used in small tuners like this device.

Signal Voltage Conserved

If the audio frequencies must drop in two series resistors, then the two units share the signal in the ratio of their impedences. Under these circumstances the phones get less than they would otherwise. The resistor control method shown is virtually free of audio frequencies. This is much better than if the phones had an impedance of 200,000 ohms at some chosen audio frequency and the resistor had an impedance of 100,000 ohms, whereupon one-third of the signal would be sacrificed in the resistor.

One point in favor of plate voltage adjustment for feedback control is that the frequency change is smaller than in most other systems. Persons who have made comparative tests of all popular systems report that the plate voltage method produces absolutely the smallest variation, while some say it produces no change in frequency, but the last-named claim is erroneous.

Since the plate voltage is to be varied, the recommended voltage need not be the maximum. The usually recommended value is 45 volts, for such a detector, in the tube charts, but here we have a low value of grid leak, which always permits considerable raising of the plate voltage, and besides the voltage can be varied from the maximum (say, 67.5 volts) to zero.

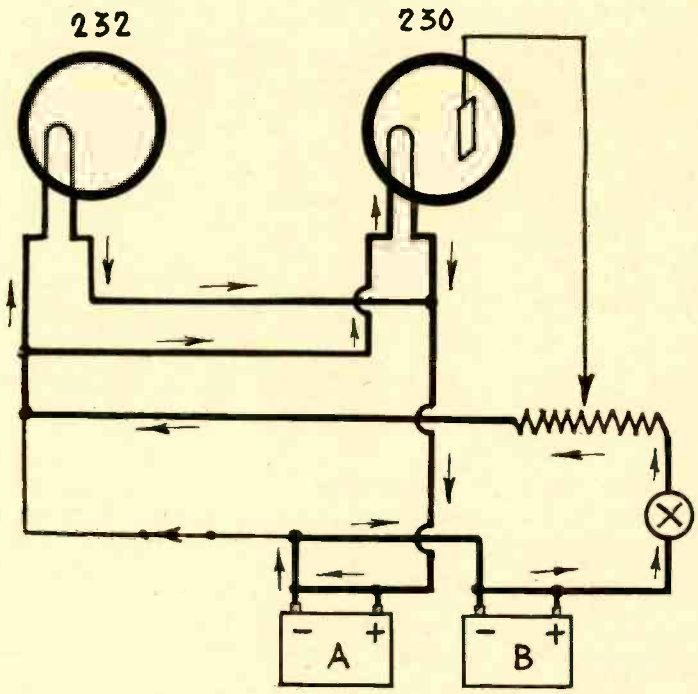

FIG. 3

The necessity for a switch (located at X) to control the potentiometer connection is proved by this diagram, whereby the path may be traced from B minus along the heavy lines, in the direction of the arrows, to show the potentiometer would be in circuit all the time were it not switched.

Switch for Potentiometer

Many will not desire to go near zero voltage. While it is true that some detection will result with even as little as 6 volts effective on the plate, nevertheless the working range of the volume control is less than its full rotation angle, and if any desire to spread out the regeneration control effect it may be done by putting a resistor in series with the 25,000 ohm potentiometer, toward the ground side. The horizontal line from the 25,000 ohm unit, running to the left from the general position of the phones in Fig. 1, would represent the limiting resistor. This may be a 1 watt resistor of a few thousand ohms. The steady bleeder current of the limiting resistor potentiometer circuit, plus the plate current of the tube, will flow through the limiting resistor.

The potentiometer should be switched, otherwise the device will be constantly across the B batteries. As 25,000 ohms will draw 2.7 milliamperes, it is foolish to put this constant draw drain on the batteries. A switch may be obtained commercially that makes or breaks the two circuits (two switches in parallel) so there will be no risk of forgetting to turn off a separate potentiometer switch.

Looking at the diagram one might be led to suppose that the potentiometer switch precaution is all in vain. Is not the potentiometer connected across to B plus 67.5 volts and grounded A minus in the set? And is not the switch SW-1 in the A minus lead to the filaments, thus breaking the connection, and likewise that of the potentiometer?

The switch SW-1 does break the lead for the filaments. That much is plain. The switch SW-2 does disconnect the potentiometer from the B battery.

Parts Discussed

Suppose SW-2 were not there? Suppose the set were turned off? The circuit then would be as follows: A minus connected to B minus at the batteries, the 25,000 ohm potentiometer to the A minus side in the set, which line has been broken. But the A plus line has not been broken. So from B minus we can trace the circuit through the B battery to B plus, through the potentiometer to filament minus, through the filament to A plus, from A plus to A minus in the battery, back to B minus. The A voltage backs the B voltage in this analysis, so 67.5-3 volts, or 64.5 volts, constitute the potential constantly across the potentiometer. Therefore the circuit is complete for the potentiometer, through the filament of the tubes, and the switch SW-2 is necessary.

The 1.5 volts for biasing may be obtained by a flashlight cell built into the set. The A voltage may be obtained from the No. 6 dry cells as explained, while the B batteries may be the medium sized ones, as the small ones cost more, and the large ones are not necessary, due to the small B current drain.

The 15 ohm resistors are commercially obtainable, or may be rheostats of higher ohmage, set to give 2 volts on the filaments. The 25,000 ohm potentiometer may be any commercial type, since the wattage is lower than the rating of any of them. The variable condensers should not be of high capacity for best results, even though smaller capacity requires the use of more plug-in coils to complete the coverage of 15 to 200 meters. The coil windings, particularly as to secondaries, will depend on the condenser capacity.

About as large a capacity as would be used would be 0.0002 mfd., which is manufactured in small physical size. The coil winding directions for this capacity condenser, using a form of the tube base type, are as follows:

R-f coil: antenna winding 10 turns, 1-8 inch separation, secondary winding 45 turns. No. 28 enamel wire is used.

Interstage coil: plate winding, 15 turns; 1/8 inch separation; secondary winding, 45 turns; tickler winding, 1/8 inch from secondary, 20 turns. No. 28 enamel wire used.

The Rest of the Coils

Experience has shown that the frequency ratio of such a condenser is 2.6-to-1, and the frequency is known to be approximately proportionate to the number of turns, provided the axial length of the winding is preserved. Therefore the coil as described will tune from 1,500 to 3,900 kc (199.9 to 76.88 meters), but as we desire overlap we can obtain it conveniently, with certainty, by using the ratio 2.5 to 1. Therefore we know that the secondary for the next pair of coils will contain 18 turns of wire, and since approximately the same shape factor is desired (axial length of winding to diameter), we may increase the size of the wire. Use No. 18 enamel wire for the secondaries, The primary may consist, for the antenna coupler, of 6 turns of No. 18 wire, while the primary for the interstage coup-

(*Continued on next page*)

New 239 Tube in a Set

Screen and Plate Voltages Equal, Stability Good

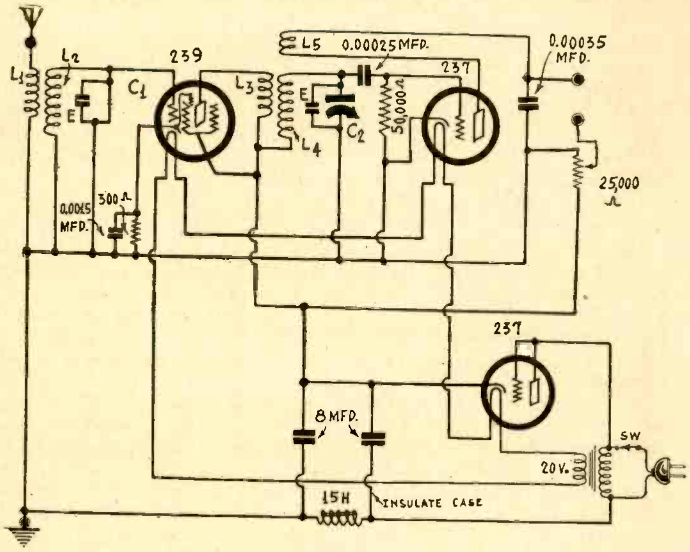

FIG. 4

The a-c model, using automotive tubes, including the new pentode 239 r-f amplifier, which may have its screen returned to the same voltage as the plate. There two other tubes are 237's, one as detector, the other as rectifier. Note the precaution about insulating the 8 mfd. next to the rectifier, if a metal chassis is used.

LIST OF PARTS for Fig. 4

Coils

Four sets of plug-in coils wound on tube base diameters, with two coils to a set; total, eight coils. Four plugs for antenna coils having UX bases, four for interstage coupler, having UY bases. Directions given in text, same as for battery model. One 20-volt filament transformer.
One henry choke coil.

Condensers

Two 0.0002 mfd. short wave tuning condensers (C1, C2).
Two equalizing condensers (E), of any usual small capacity for peaking.
One 0.00025 mfd. fixed condenser.
One 0.00035 mfd. fixed condenser.
One 0.0015 mfd. fixed condenser.
Two 8 mfd. electrolytic condensers, one with two insulating washers and a connecting lug, so insulation is possible if a metal chassis is used.

Resistors

One 300 ohm flexible biasing resistor.
One 25,000 ohm potentiometer with a-c switch attached.
One 0.05 meg. pigtail grid leak (50,000 ohms).

Miscellaneous Other Parts and Accessories

One knob for potentiometer.
One a-c cable with male plug.
One front panel, 7x10 inches
Two vernier dials.
Four UY and one UX sockets.
One baseboard or chassis.
Two posts for antenna and ground.

(Continued from preceding page)

ler has 10 turns and the tickler 12 turns, the wire for these two being No. 28 enamel, while the separation remains the same.

The first coil will tune, as stated, the second actually will have the 2.6 ratio, although we depend on it for only 2.5, but the ratio will change a little for the rest of the coils, therefore we wind the third set with 8 turn secondaries, No. 18 enamel wire, spaced the thickness of the wire, with similarly space would 6 turn primary for the antenna coil, same wire, and 10 turn r-f plate winding, and 6 turn tickler, these two of No. 28 enamel wire. The fineness of wire for the plate winding has no effect on the selectivity, because of the high resistance of the plate circuits.

The fourth coils would be: antenna coupler, 4 turn primary, ¼ inch space, 4 turn secondary, No. 18 enamel wire; interstage coupler, 4 turn No. 28 enamel primary, quarter inch separation, 4 turn No. 18 enamel space wound as previously, for secondary; quarter inch separation and 6 turn tickler, No. 28 enamel wire.

Ranges Covered

The approximate ranges are: largest coil, 1,500 to 3,900 kc (199.9 to 76.88 meters); second largest coils, 3,700 to 9,600 kc (81.03 to 31.23 meters); third largest coils, 9,000 to 18,000 kc (33.31 to 16.66 meters); fourth largest coils, 17,000 to 30,000 kc (17.64 to 9.94 meters).

These frequency or wave length results will not actually come out as stated in all circuits, for the two smallest coils particularly, because of the relative importance of small capacity differences that arise in wiring, minimum of tuning condensers, tube circuits, etc., but there has been an allowance for this, by making the inductance a trifle higher than required, and extra overlap is intended to take care of the discrepancies, including large lowering of frequency limits of the smallest coil.

Of course a ready test is open to all who use separate tuning. The largest coil is virtually foolproof. Therefore wind two coils for the circuit to cover this band. When the condenser of one circuit is at or near minimum a station should be tuned in on the next largest coil (say in the antenna circuit) with the condenser at or near maximena capacity. As a check, a coil for a succeeding stage should be put in the detector coil socket while one of the next lowest frequency range is in the antenna coil socket, and the same situation should prevail, except that the settings are reversed. Any necessary correction can be readily applied, as taking turns off will call for greater capacity of the tuning condenser for resonance. The windings of the coils after the first or largest pair are a little oversized to permit such removal, if desired, although none need be made, if the extra overlap is tolerable.

The A-C Model

The ac model uses the automotive series tubes, including the new 239, which is an r-f pentode amplifier. Since the screen and plate voltages of the 239 may be the same, extra resistors and bypass condensers, which would be required for a lower screen voltage, are omitted. This equality of voltages is rendered possible by the supressor grid connected in the tube to the cathode, and located between the screen and the plate. The secondary electron emission is thus cut down severely, and as such secondary emission is the influence that requires a higher plate voltage in other screen grid tubes, the lower-voltage requirement is absent.

The 237 tubes are the general purpose ones of the automotive series. All three tubes require 6.3 volts on the heaters, and a 20-volt transformer will furnish about that when the three heaters are in series, as diagrammed in Fig. 4. One of the 237's is used as rectifier, and the result is around 110 volts d-c on the plates, except that the plate voltage for the detector may be varied. There is no necessity here for a switch on the potentiometer to affect that instrument itself, as when the line switch SW turns off the juice there is no voltage across the 25,000 ohms, unlike the instance in the battery model, Fig. 1.

The coil data for the a-c model are the same as for the battery model. The tuning condensers and some of the other parts are the same, also, as inspection of the list of parts will disclose. The grid leak is 50,000 ohms here, too, as it was found in several tests that higher values, even only 100,000 ohms, resulted in a high-pitched squeal, or audio modulation, due to the insufficient rapidity of the leakage off the detector grid at high frequencies (above 10,000 kc). Since the same arrangement serves for all ranges the leak has to be small enough in value (high enough in leakage) to accommodate the highest frequency tuned in.

Television Improves

1931 Progress Noted in Board's Annual Report

Washington.

THE report of the Federal Radio Commission for 1931 shows that the Board had its biggest year, that broadcasting conditions improved, that for many services the Board is hard pressed to find room for important activities, and that television is progressing.

The volume of work done by the Commission during the year far exceeded that of preceding years. More than 30,000 formal matters required Commission action. Applications for permits and licenses were received at a rate averaging 550 per week. The Commission held 176 formal meetings; sat en banc to hear the proceedings or arguments in 30 cases; granted 27,747 applications and denied 584. During the year over 113,000 communications were received by the Commission.

There is popular belief that the principal duty of the Radio Commission pertains to radio broadcasting. Although the importance of broadcasting in the daily lives of our people is duly appreciated by the Commission, it is proper to state that this interesting use of radio is only one of a long list of radio services administered by the Commission under the provisions of the Radio Act of 1927.

Other Services Important, Too

Some of the other services are of very great importance to the commerce and industry of this country, to safety of lives at sea, in the development and operation of aviation, in the prevention of crime and the detection of criminals, in the scientific research and development of radio, and in other national services.

In addition to the broadcasters, our commercial radio companies, with their far-flung network of telegraph and telephone stations, reaching the uttermost parts of the earth, the great maritime fleet of the country, the rapidly growing aviation transport lines, the municipal and State police systems, the technical research laboratories, and many other services, all present problems to the Radio Commission in requests for additional frequencies. These requests present many technical problems.

The past year has been almost a complete revolution in the type of equipment used in broadcasting stations. By the Commission's General Order No. 111 all stations were required to have equipment which was capable of more than 75 per cent modulation. Such equipment results in the approach to an equalization between the service area and the nuisance area of a broadcasting station, thus extending materially the service area for most stations.

High Level of Station Service

In many cases the changes in equipment which were necessary to meet the requirements of this general order likewise resulted in improved quality of transmission. In less than a year all stations were brought to the high level of service of which only a few stations boasted at the beginning of the year. The broadcasting stations of this country should be congratulated upon their willing co-operation in bringing this condition about.

During the year 11 new broadcasting stations were authorized, while 20 were deleted from the active records. Of the 20 deleted, 5 were consolidated with other stations, 2 were consolidated into 1 new station, 2 voluntarily relinquished their licenses, 1 which had been inactive since 1928 was dropped and 10 were denied the renewal of their licenses

The problem of operating broadcast stations on the same frequency with exact or partial synchronization has been given attention by several broadcasting and engineering organizations. Many experiments have been carried on, and the engineering division of the Commission has co-operated in most of these experiments by making observations of test transmissions and in some cases giving engineering advice concerning the experiments and observations. The Commission has granted special authority for special transmissions and has endeavored in every way to assist and encourage such tests.

Better Phone Service

In the United States there are seven communication companies authorized to conduct public radiotelegraph communication service between the United States and other nations of the world. There are radio channels of communication to practically all nations of the world, either directly or indirectly, through foreign communication agencies. A continual effort is being made by the operating companies to extend their service by opening new circuits and improving the reliability of existing circuits.

International radiotelephone communication has had further growth and development during the year. To provide for an additional telephone circuit between the United States and Europe and to provide greater reliability of service, a permit was issued for the construction at Bradley, Me., of a second low-frequency transoceanic radiotelephone station.

This station will be used to augment the present circuits, particularly at times when the high frequencies become erratic in operation, due to magnetic storms or other peculiar phenomena which at times seriously interrupt the high frequency circuits. It has been determined, by systamatic observation, that a combination of low and high frequency channels leads to far more reliable radio-telephone service than either portion of the radio spectrum used separately.

Aviation Gets Its Share

The volume of traffic over the present trans-Atlantic radio circuits and estimates of future growth show that ultimately more circuits may be required to provide the necessary service to Europe and other parts of the world. At present about 92 per cent of the world's telephones are offered commercial interconnection in one network by the use of radio for the intercontinental circuits.

The application of radio to the needs of aviation has kept pace with the rapid development of aviation, and the Commission has made every effort to provide frequencies to meet the needs of the service. Because of the extreme congestion in all portions of the radio spectrum, great care had to be exercised in the frequency allocation to this new service. The needs of aviation have been met, however, by careful planning and through the co-operation of all users of radio frequencies, including Government departments, commercial radio operating companies, and the operators of air transport lines.

The increased safety in aviation and the increase in reliability of air transportation are in a large measure due to radio. Transport airplanes which are now flying over the air routes are in constant communication with the airports, reporting positions and other pertinent information and receiving instructions and assistance from the ground. Practically every established air transport line now flying a regular schedule is equipped with two-way radio communication.

Radio for Police Use

The use of radio by police departments for transmission of orders from police headquarters to policemen in automobiles patrolling the streets has developed rapidly. The first radio station for the exclusive use of a city police department was established in Detroit in 1927. In April, 1930, the Commission adopted the first organized plan (General Order 85) for the assignment of frequencies to municipal police in order to make possible an efficient service on the limited number of frequencies available.

At that time 29 cities had stations in operation. On June 30, 1931, there were 62 separately licensed police radio stations. In addition a State police service is maintained in Michigan, Massachusetts and Pennsylvania, the latter State carrying on only a point-to-point radiotelegraph communication service with State police barracks.

In the municipal police radio service, policemen patrol the streets in automobiles which are equipped with radio receivers permanently adjusted to the frequency of the transmitting station of that city.

How System Works

Orders are given in voice from a central point by a police officer, who dispatches the various cars to locations requiring police attention. There is consequently no delay in getting orders from headquarters to police in the vicinity of a crime or disorder. The frequencies used for the service are above 1,500 kilocycles, and the orders can not be heard on a broadcast receiver and there is no interference to broadcast reception.

A number of city police departments have established a police service to serve an entire metropolitan area. Each of these cities entered into agreement with surrounding municipal and county governments, under the provisions of which they agreed to furnish police service to all municipalities without discrimination. and the subscribing municipalities agreed, in turn, not to request independent broadcasting facilities. This agreement makes it possible to give a coordinated and efficient police service.

Only Eight Channels for Police

With only eight frequencies available for emergency police service it is obviously impracticable to authorize a different frequency for each municipality. The allocation plan, therefore, is based on a zone system of frequency assignment whereby all cities within the same zone are required to co-operate in the joint use of a common frequency.

It is believed also that the zone system of allocation is to be preferred, because it permits the interception of emergency broadcast messages by all police forces within the area, thereby increasing the efficiency of the system in combating major crimes. The use of several units of low power instead of a single

(Continued on next page)

Board's Biggest Year

Broadcasting Stations Improve, Says Radio Commission

(*Continued from preceding page*)
unit of higher power to cover a city has been encouraged as a means of avoiding interference and of giving better coverage of the city. This has been used in a few cities with good results.

Much Interest in Television

There has been a large amount of public interest shown in the development of visual broadcasting (television) and its possibilities for public entertainment and use. The public interest has stimulated the laboratories working in this field to increase their efforts to improve the art.

There has been in the past year very material improvement in the quality of the transmissions of visual broadcast stations and the detail of the image which is received. Many of the experimental transmissions consist of motion-picture films which provide ample opportunity for observation. However, there has been much development in the production of studio programs of public interest. The development of pick-up devices to include a complete scene and the production of plays especially for visual broadcasting purposes have received special attention. Several stations have coordinated the visual broadcasting with regular sound broadcasting.

Detail of Picture

The amount of detail which can be transmitted and received in an image is a function of the number of picture elements which are transmitted. The majority of the stations now operating in the visual broadcast bands between 2,000 and 3,000 kilocycles has standardized the transmissions for the present, and the images are made up of 60 lines per frame and 20 frames per second; but this has not been universally adopted.

In order to obtain greater detail in transmitted images, there have been developed methods of scanning which differ materially from the method used in the majority of visual broadcast stations. There has been no effort on the part of the Commission to require any standard method of scanning or a standardization of the number of lines per frame or frames per second which are transmitted. The experimental visual broadcast stations have been given complete freedom in developing the art.

Wider Channels Needed

In order to obtain an image of great detail it appears to be necessary, using the present methods of radio technique, to transmit higher modulation frequencies, which in turn require a wider frequency band to accommodate the transmissions of this type of station. The present band widths permitted for visual broadcasting on frequencies between 2,000 and 3,000 kilocycles are 100 kilocycles wide, or 10 times the band width allowed for a sound-broadcast station.

Consensus of engineers indicates that to transmit a picture having satisfactory detail the band width required will be many times that now available in this frequency range. The needs of other essential services for frequencies in this band appear to make it impossible to provide frequencies in this frequency range other than those now used for visual broadcasting.

Tests on Ultra Frequencies

The Commission has authorized a number of laboratories to investigate the possibilities of images in the following bands of frequencies: 43,000-46,000 kilocycles; 48,500-50,300 kilocycles; 60,000-80,000 kilocycles.

Preliminary reports indicate that these very high frequencies have good possibilities and many transmissions are now being observed. It is, however, too early to form an opinion as to the suitability of these bands. In view of the possibility of visual broadcast requiring very wide frequency bands, no limitation has been put on the band width to be used in the very high frequencies. Licenses in these bands are authorized for the present to use as great a portion of the band as is necessary in order to transmit the best picture possible.

There were on June 30, 1931, approximately 22,739 amateur stations licensed. These stations operate on the frequencies allocated for this service by the international radio convention of Washington, 1927, the North American agreement of 1929, and under regulations imposed by the international convention and by General Orders 84. Most amateur communications are carried on by radiotelegraph, but there is an increasing interest in radiotelephone transmissions, and portions of the amateur bands have been allocated for use by radiotelephone stations.

Amateurs Try Higher Frequencies

There has been some activity in the investigation of the ultra-high frequencies above 28,000 kilocycles, but to date there are practically no amateurs consistently communicating on these frequencies, although many experiments are in progress.

There were set for hearing and docketed 1,096 applications of all kinds. The greater portion of these were applications for new facilities, but they also included all other types of applications and had to be given a hearing date and opportunity to the applicant to present his case. Of this number 430 responded to the notice for hearing and requested that their applications be heard by the Commission, in accordance with General Order No. 93. Of the 430 actually set down and placed on the permanent docket, there were 46 defaults, 28 applications continued, 13 dismissed, and 343 finally heard by examiners, with counsel from the legal division handling the Commission's side of these cases.

Summary of Developments

Of the 343 cases heard throughout the fiscal year the examiners have submitted reports on 258 and the Commission has made its final decision and determination upon 212 applications. There are pending at this time 57 cases which have been heard and upon which the examiners have not made their reports.

The principal developments of the fiscal year from the standpoint of the legal division can be said to consist of:

1. The court decisions clarifying and applying the provisions of the Radio Act of 1927, as amended, in criminal as well as civil cases.

2. A marked improvement in the manner in which cases before the Commission are handled, due to—

(a) The creation of an examiners division, the members of which hear all but exceptional cases, relieving the Commission of this burden.

(b) The adoption of a code of rules governing practice and procedure.

(c) The preparation by the Commission of formal opinions in virtually all cases which go to hearing.

(d) The cooperation of parties having business before the Commission and the more careful preparations of their cases.

3. Active complaint and investigation work, making possible the deletion of stations not performing a public service, and the prosecution of those violating the criminal provisions of the act.

4. The elimination of duplication of effort and a corresponding increase in opportunity for specialization within the division, brought about by the establishment of sections with clearly defined duties and responsibilities.

Short Wave Club

THE following is a list of some of the new members of the Short Wave Club. Virtually every week new names are published. There are no repetitions.

Anthony J. Bieniasz (W2DDK), 1180 Jackson Ave., Bronx, N. Y. City
Alfred Frankel, 1736 Roslyn Terrace, Philadelphia, Pa.
W. A. Stine, Jr., Rock Hill, S. C.
Geo. H. Kenyon, Room 927, S. P. Bldg., San Francisco, Calif.
Charles R. Saum, 410 Collicello St., Harrisonburg, Va.
Joseph Konrady, 29 Maple Ave., Port Richmond, S. I., N. Y.
M. R. Witinok, R. F. D. No. 4, Rockville, Conn.
Edward P. LeMay, 213 W. Willow St., Chippewa Falls, Wis.
Douglas Mac Vicar, 182 High St., Sydney, Nova Scotia
Warnock Wm. Martin (W1BYD), 75 McKee St., East Hartford, Conn.
J. H. Weaver, 720 Main St., Stillwater, Okla.
A. D. Stevens, 8922—89th St., Woodhaven, N. Y.
Eckert Baillio, 902 W. Houston Ave., Marshall, Tex.
C. R. Arvidson, R. F. D.—885—Rt. 1, Port Arthur, Tex.
Astor A. Alenius, Astor, Fla.
Julius Happey, Fla. Power and Light Co., Sanford, Fla.
E. O. Christianson, Raton, N. M.
Theron Smith, 185 N. Dick Dowling, San Benito, Texas
A. C. Jorgensen (W9GKE), 503 A. W. Chambers St., Milwaukee, Wis.
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Lloyd N. Wolff, Radio Technician, 129 North Willow St., East Aurora, N. Y.
Stanley J. Solomon, 463 Superior Ave., San Leandro, Calif.
Geo. Underwood, 2109 North Mozart St., Chicago, Ill.
Louis Duigou, 76 James St., Torrington, Conn.
Earl Jacobs, 1508 Cleminson Ave., R1, Box 519B, Gardena, Calif.
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Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

Please enroll me as a member of Radio World's Short Wave Club. This does not commit me to any obligation whatever.

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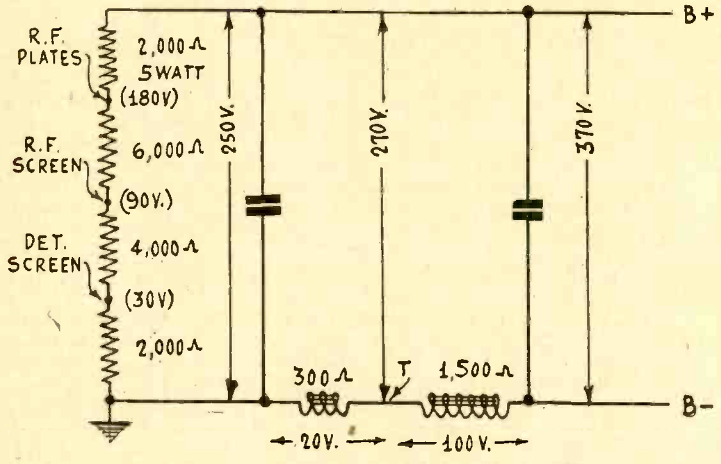
Easy Voltage Division

Simplified Distribution for A-C Sets

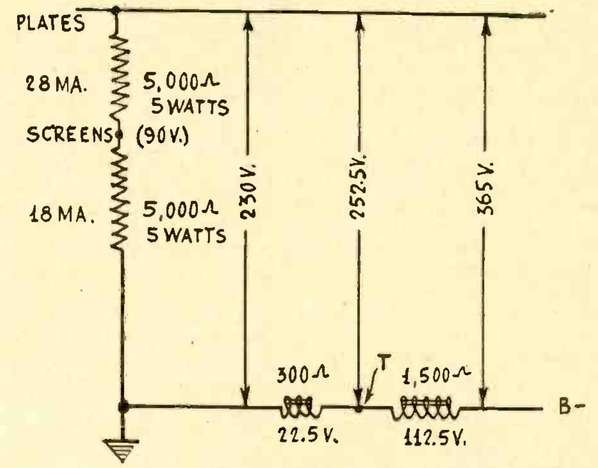
By Jack Tully



VOLTAGE DIVIDER WITH LOW WATTAGE RESISTORS (1 WATT UNLESS OTHERWISE SPECIFIED)

FIG. 1

The required voltages for a five or six tube set are afforded by this arrangement of resistors. Note that the rating of one resistor is 5 watts.



SIMPLIFIED VOLTAGE DIVIDER WITH MEDIUM WATTAGE RESISTORS

FIG. 2

If two resistors of equal value, 5 watts rating, are used, if approximately as stated, the single essential intermediate voltage is readily obtainable. In the upper resistor 5 watts is the absolute minimum. The actual wattage is just about that.

[Last week's issue contained an article on the solution of radio frequency coil winding problems, telling how to arrive at the correct solution even if you do not actually know the capacity of the tuning condenser used, and giving data for short waves as well as for broadcast waves. This week's article deals with solution of voltage division problems in a-c receivers. The series is intended to be exceedingly helpful to those who have a limited knowledge of radio, but who are eager to build their own sets and amplifiers, frequently using parts they have on hand, or making such parts as it is practical for one to make at home. Next week's article will deal with cures for oscillation at radio and audio frequencies, while subsequent articles in the series will concern power amplifiers, oscillator padding for tracking, short wave converter coupling and other interesting topics.—EDITOR.*]*

THE voltage divider in a modern a-c receiver may consist of low wattage or medium wattage resistors, or, if the output tubes are particularly "large," since the voltage they would require would be large, the voltage divider would have to be of high wattage rating. These relative terms may be defined as 1 watt for low wattage, 5 watts for medium wattage and more than 5 watts for high wattage.

The 1 watt resistor may be the familiar grid leak type, with or without pigtails, of about 1½ inch length and about ¼ inch thickness. The rating is not to be determined by the size, but by the manufacturer's specifications, yet the higher wattage resistors are always thicker and sometimes longer as well. The 1 watt resistors are usually carbon or made of some special resistance element and metallized, whereas the 5 watt resistors sometimes are of the same kind or, preferably, are wire wound. For high values of resistance it is not economical to use the wire-wound type, but when the resistance is only a few thousand ohms the wire-wound selection may be made at no great expense. Wherever and whenever wire wound resistors can be used they should be used, high resistance always being excluded, except for special purposes, such as voltmeter multipliers, when the heavy cost is unavoidable.

Why It Burns Out

The 1 watt resistor serves all right in a voltage divider. Applied to a 5 or 6 tube radio receiving set, the divider may be as shown in Fig. 1. The resistors are, from ground up, 2,000 ohms, 4,000 ohms, 6,000 and 2,000, of which only the last named need be more than 1 watt. Two watts would suffice, but the rating is given as 5 watts for an extra margin of safety, for this resistor is the one that burns out occasionally in all types of receivers, due to too low a wattage rating. It is the one that reduces the maximum B voltage to the B voltage desired for the plates of the r-f tubes.

Assuming that 235 or 551 tubes are used as radio frequency amplifiers, it is not imperative to use the 2,000 ohm 5 watt resistor. If it is used the resistance need not be exactly 2,000 ohms. If it were 1,800 ohms or 2,250 ohms the result would be satisfactory. The plate voltage of the r-f tubes is not critical. The tubes are built to take 275 volts, provided the bias negative is adjusted accordingly.

A given biasing resistor does not solve the problem automatically as the voltage is changed. If the same resistor were used for considerably different values of plate voltage, say, 275 volts and 90 volts, the bias if correct for one would not be correct for the other. If the voltage is high then the biasing resistor should be higher than if the voltage is low, because the plate current increases with disproportionate slowness, compared to the requirement in bias increase.

Disparity of Changes

For the 235 tube, for instance, for 180 volts on the plate the negative bias should be 1.5 volts, while for 250 volts the negative plate bias should be 3 volts. The screen voltage is held constant at 90 volts positive. Therefore the bias is twice as high when the plate voltage is increased only one-third. Under the 180 volt condition the plate current is 5.8 milliamperes, while under the 250 volt condition the plate current is 6.5 amperes, or the current increase is about one-eighth when the bias increase is doubled.

The tube data chart does not give the screen current, but only the plate current. However, the plate current and the screen current flow through the biasing resistor, which is connected between cathode and zero, and the screen current may be taken as one-third the plate current. So, allowing for 7.7 milliamperes in one instance (180 volts) and 8.7 milliamperes in the other (250 volts), the sum currents require biasing resistors respectively of approximately 190 ohms (for 180 volts) and 350 ohms (for 250 volts). For the first instance commercial values of 150 ohms are commonly used and for the second 400 ohms.

The value of the resistor used is not always important, because so often it serves merely as a limiting resistor, preventing the reduction of the negative bias beyond a certain minimum. The volume control is in series with this limiting resistor, and volume is changed by varying the amount of resistance in the cathode circuit, hence the bias. As the negative bias increases, the mutual conductance decreases, the plate resistance increases.

Slow Change in Conductivity

With the vari-mu tubes this change is not rapid, hence the rheostat serves as a suitable volume control. There is some mutual conductance even when the negative bias is as high as

(Continued on next page)

Bias Problems Solved

Up to 275 Volts May Be Ap

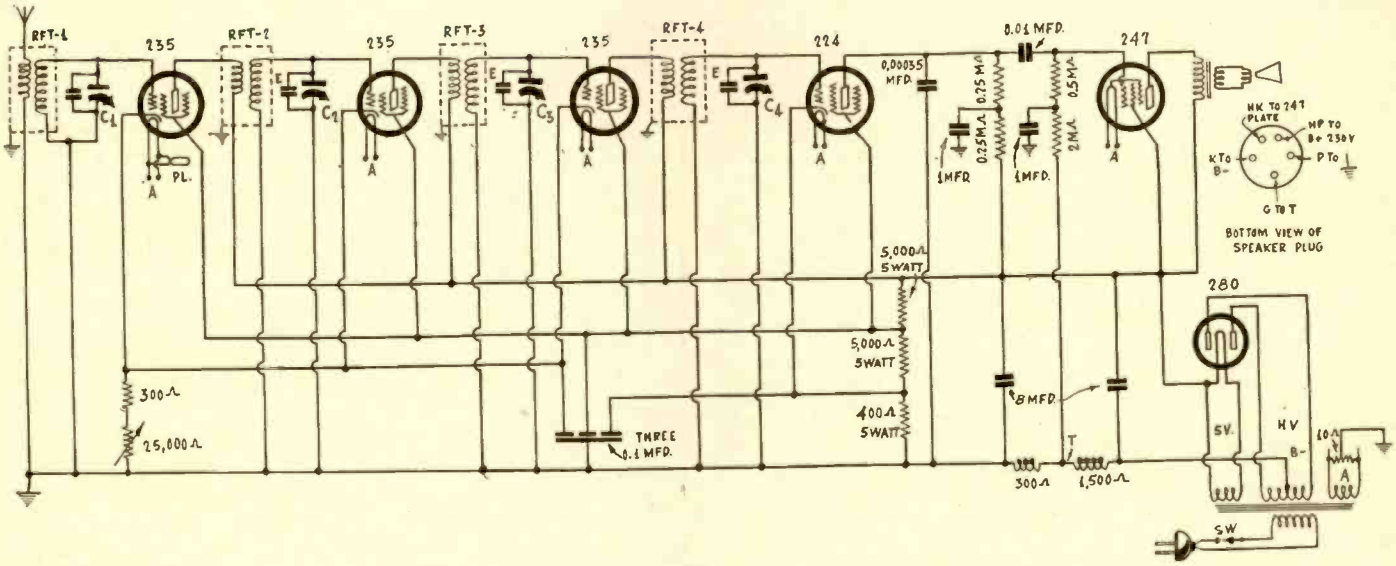


FIG. 3

A splendid six tube circuit, using a medium wattage voltage divider, detector bias being derived from the divider.

(*Continued from preceding page*)

45 volts, but in practice the bias usually does not go beyond 30 volts, and commonly not much beyond 20 volts. High bias readings, as obtained from a voltmeter, therefore need not cause any doubt or surprise.

With the voltage divider as shown in Fig. 1, the plate current values previously stated applied only to the conditions imposed. When those conditions are changed the current changes. For instance, as the bias increases, since the plate resistance increases, naturally the current is less, and therefore the amount of current through the 2,000 ohm 5 watt resistor decreases the the bias increases. There is some bleeder through the 5 watt resistance, but not enough to give more than a relatively small amount of stability to the current. In fact, the current is unstable, in the sense that the volume control changes it very considerably. Finally the current becomes almost zero, whereupon only a few volts are dropped in the 5 watt resistor. Consequently the plate voltage applied to the tubes governed by the volume control increases as the bias increases. If any change takes place it is preferable that it be in that direction, for the increased bias makes the increased plate voltage quite all right.

Confused Volt Readings

Therefore many might be confused at obtaining a reading of 180 volts on one occasion, 195 volts on another occasion, and perhaps 220 volts on another occasion, when all measurements were made between the same points, plate of tube or plate return of the primary, to minus. The reason is the volume control is at a different position.

When we say plate voltage, just what do we mean? In an r-f amplifier, since the primaries have negligible d-c resistance, and we need not distinguish between applied and effective voltages, we mean simply that the plate voltage is that between cathode and B plus. The grid bias voltage is that between cathode and zero (usually ground). Since the total B voltage, say 180 volts, is apportioned, for plate and grid bias voltage, as the cathode or bias voltage is increased the plate voltage would be decreased. What prevents actual net decrease is that the plate current reduction is rapid, compared to grid bias increase, that is the drop in the 5 watt resistor becomes greater at a faster pace than the bias becomes larger due to volume control increase of bias.

The plate current changes with bias changes are instantaneous, otherwise the system of bias control volume would be dangerous to tube life.

Oscillation Squelching

The limiting resistor may be 150 ohms, if three tubes are served, or may be even higher in resistance value, depending on the circuit. It is practical to get rid of incipient oscillation at radio frequencies by increasiing the value of the limiting resistor, and at the same time selectivity is increased. Some methods of stabilization decrease the selectivity, but this higher bias method not only increases it but the sensitivity drop is gradual, and it becomes easier to find a suitable value of limiting resistor, by actual test, to make r-f oscillation virtually impossible, and yet not drop the sensitivity much. That is, there is little danger of overshooting the mark, of making the bias much too negative for want of sufficient working range of resistance value selection.

The voltage divider, Fig. 1, is the one used in the five tube midget, Blueprint No. 627, and has stood the test of time, many thousands of sets with such a divider having been in home use for almost six months. As stated before, and emphasized now, the 1 watt resistors are entirely satisfactory, and nobody need have any doubts or fears that a grid leak type of resistor will not render the promised service. The only precaution is that the 2,000 ohm 5 watt resistor should be of that wattage rating, and if wire wound it will be, since no wire wound voltage divider resistors of lower wattage rating are generally manufactured.

Use of Full Plate Voltage

If any one finds it impractical to obtain the 5 watt resistor, then the full plate voltage (250 volts) may be applied to the r-f plates, with 400 ohm limiting resistor for one tube, 200 ohm resistor for two tubes, 150 ohm resistor for three tubes, or higher (not lower) values may be used, for reasons already stated.

The voltage divider affords approximately the voltage given in Fig. 1, if the power transformer is of the type generally used, and the B supply choke, normally the field coil of a dynamic speaker, is as shown. This has a value of 1,800 ohms, with a tap at 300 ohms, the lower resistance section being connected with extreme to the ground side, the higher resistance section with extreme to B minus, and the tap enabling grid return connection for the 247 pentode output tube for negative bias purposes. B minus, of course, is not grounded, for another potential is grounded, 120 volts higher. The electrolytic condenser next to the rectifier must not have its case grounded, and if a metal chassis is used this condenser must have insulating washers and a special connecting lug.

The bias for the pentode actually is sometimes at 20 volts, although the specification is 16.5 volts for 250 plate volts. This difference in bias voltage is of small consequence.

Untapped Field Coil

The current through the choke is 67 milliamperes, approximately, so the voltage drop in the 300 ohm section is 20 volts and that in the 1,500 ohm section is 100 volts, approximately. Hence there is the difference of 120 volts between B minus and ground, constituting the drop in the choke. If the center of the power tube filament is grounded, then if the grid return is made to the tap T, the grid is negative in respect to the filament

for Variable Mu Tubes

plied to Plates of 235 or 551

by the voltage drop in the 300 ohm section. Hence the bias arises.

If you haven't a tapped field coil, and even if the resistance value of the untapped choke is other than 1,800 ohms, you can still get the correct bias by using dissimilar high resistance values, 1 watt rating, across the choke, and connecting the power tube grid return to the juncture of the two resistors. This method was discussed fully in the December 12th issue, page 5.

The detector screen voltage may be lower than the r-f screen voltage, depending on the bias used on the detector, for if the bias is low the screen voltage may be low. So about 30 volts are available for detector screen, assuming a 224 detector with a plate load of at least 0.2 meg. (200,000 ohms).

Simplified Divider

The potential difference across the various points are shown in Fig. 1. The drop of 250 volts is the full applied plate voltage for the pentode only, since the pentode bias is taken from a drop in a part of the choke coil. From tap T of field coil to B plus maximum the potential difference is 270 volts, while at the rectifier output the voltage difference is 370 volts.

A simplified method of voltage division is shown in Fig. 2, where two 5,000 ohm resistors are in series, the juncture serving for screen voltages of r-f and detector tubes, the maximum fed to all plates. Due to the extra current flowing because of 10,000 ohms instead of 14,000 ohms voltage divider, the drops in the sections of the field coil will be larger and the output voltage from the rectifier itself will be less. The rectified output drop is due largely to the regulation curve of the power transformer, the effect of the higher current on the resistance of the high voltage secondary. An allowance of 5 volts was made for this drop, the current now being 75 milliamperes, instead of 67. Hence the pentode bias increases to 22.5 volts, although the plate voltage is down 20 volts, while the 1,500 ohm section of the choke drops 112.5 volts, instead of 100 volts, the total drop in the choke being 135 volts, instead of 120 volts, an increased drop of 15 volts. If it is desired to reduce the bias for the pentode, a resistor of 75 ohms, 5 watts rating, may be connected across the 300 ohm section of the voltage divider. However, the current through the resistor will not be subject to choke filtration. Moreover, the sysem as shown in Figs. 2 and 3 has been worked satisfactory.

The values are theoretical. Measured values are given in the table at right.

The two resistors need not be exactly 5,000 ohms, for the equal apportionment of resistance values hold satisfactory despite a difference of 35 per cent. either way.

Detector Bias

This system shown in Fig. 2 requires that the 230 volts be apportioned to the r-f tubes for negative bias and for positive plate voltage, and of course the detector tube, if a 224, resistance coupled, may take the same voltage for the plate. As there is usually only one audio tube in sets small enough for installation in midget cabinets, and by the way the volume is ample, the plate returns of all tubes are connected to the same B line. This does not mean that the plate voltages are exactly the same. Also note the effect of the volume control on plate voltage.

We have found that the 250 volts in one instance, comparable to the 230 volts in Fig. 2, constitute the plate voltage for the pentode, because the bias is obtained from a drop elsewhere. But all tubes save the pentode have the B voltage apportioned for grid bias and plate voltage. Thus the r-f tubes would get, normally, 3 volts negative bias and 227 volts plate voltage, and of course the distribution would change as the volume control changed the bias. However, a steadier state exists in the detector tube, for the bias virtually did not change, even with the signal. The sum of the screen and plate currents may be .25 milliampere, and to afford a negative bias of 7.5 volts the biasing resistor would be 0.03 meg. (30,000 ohms).

Why the High Detector Bias

This bias is not too high for the 224 tube, even though biases of 3.5 volts are also correct for detection, under different conditions. The screen voltage is high in the present instance, and therefore the bias must be high. Tube characteristic charts give the negative bias at "5 volts approximately," at 275 volts applied through a coupling resistor of 0.25 meg. (250,000 ohms), screen voltage 20-45 volts, plate current to be adjusted to 0.1 ma with no input signal. For the type of voltage divider used here the input signal becomes of little consequence, as an input of as much as 100 microvolts, compared to 15 microvolts, produced hardly any change in meter reading (0.-0.5 ma in cathode circuit).

The present case, however, is not one of bias selection by the tube chart method alone, but is that in addition to experimental findings, and the results herewith given may be followed with full assurance.

The circuit in which the voltage divider of Fig. 2 was used with modification is shown in Fig. 3. The modification is that of detector bias taken off the voltage divider. The circuit is, in general, that of the 5 tube circuit, Blueprint No. 627, but there is an extra stage of t-r-f, accounting for the sixth tube, the voltage divider is of the medium wattage rating, the resistor capacity filters in the detector plate and pentode grid circuits have higher capacities (1 mfd.), the resistor in the filter of the pentode grid is very much higher than in the previous instance, being 2 meg., and the detector bias is taken off the voltage divider.

The object of the 2 meg. resistor is to make the low note response stronger, and this substitution may be made in any resistance coupled amplifier, that is, increasing the value of the grid leak in any or all audio stages, the stopping place being when motorboating appears. Then a resistor of a little lower value is tried until the one is found that avoids motorboating.

The greater low note response is due to the larger leak value, even though there is a 1 mfd. condenser across the enlarged section, which has small effect on low audio frequencies. The 2 meg. might be moved up to the higher side, one extreme to grid, rather than being left at the lower side, thus transposing the two resistors, but the circuit is shown just as it was built, and it was a very powerful and distance-getting set, providing a tone that every one will like.

The changes, in respect to circuit No. 627, are not major ones, mechanically, and that blueprint can be followed in many particulars. as there is no blueprint of the present circuit.

Since there is an extra stage or t-r-f the primaries should not be so very large as in sets having only two stages of t-r-f, to otherwise oscillation might be troublesome. If the coils are wound on 1⅛ inch diameter tubing, 100 turns of No. 31 wire (or wire somewhere near that) for 0.0005, or 120 turns for 0.00035 mfd., the primaries, wound over the secondaries, with the same size or finer wire, may consist of 15 turns for either of the two types of coils.

Actual Voltage Readings on Fig. 3

Bias on r-f tubes, 2.5 to 3 volts with zero resistance of potentiometer, 20 volts at maximum resistance of potentiometer.

235 plate voltage (measured between cathode and B plus) approximately 250 volts at minimum bias, 150 volts at maximum bias.

Screen voltage, 90 volts throughout.

Detector bias (across 400 ohms) 7.5 volts or a little more, measurable by a 1000 ohms per volt voltmeter.

Voltage drop in 300 ohm section of filter choke, 16 volts; 1,500 ohm section, 80 volts (these will be slightly different with fields of different makes of speakers and different power transformers).

Effective voltage on 247 plate, 230 volts; applied voltage, 250 volts; effective detector plate voltage not measurable except with non-source current drawing instruments. Computed effective, 125 volts.

A-c voltage on heaters and 247 filament, 2.4 v r.m.s.

D-c voltage, rectifier filament to B minus, 346 volts (differs with different type filter chokes and power transformers).

A Sensitive Set f

80-200 Meters Covered—Broadca

By Clyde

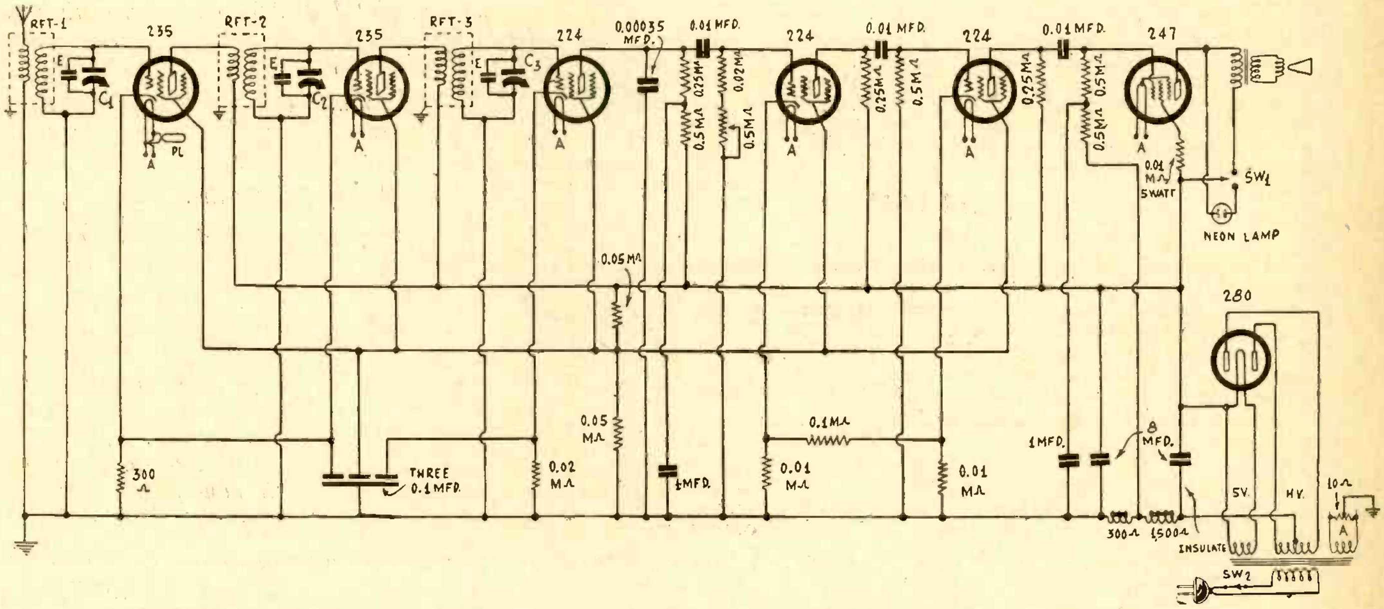


FIG. 1

Three stages of audio are used for sensitivity in this television receiver. The set may be used on the broadcast band as well, if desired, by winding broadcast coils. The set is supposed not to squeal but if it does, increase the 300 ohm resistor to 400 or 600 ohms.

IN many instances it is possible to hear television signals, the familiar buzz-saw whirling grind, but it becomes impractical to resolve these impulses into pictures. Assuming motor synchronization, correct disc, and other conditions ripe for vision, the trouble is simply lack of sensitivity. It becomes difficult to build up the sensitivity at radio frequency levels, for the receiver tunes from 200 to 80 meters, approximately, and there are squealing problems to consider. If more audio amplification is used these tempting sounds can become visible when the neon television lamp is cut in and the scanning disc is in operation.

The circuit, Fig. 1, includes therefore three stages of resistance coupled audio, and it also includes a switch that makes either the speaker or the neon lamp the load on the output tube. This method breaks a high voltage line, a practice not usually recommended, but has been worked for several months with such success that it is recommended.

If the neon lamp and the speaker are put in parallel, then the lamp will not light, except for momentary flashes on pentode overload, because the primary of the output transformer is a short circuit to the lamp. Besides, then, there would be no means of stopping the irritating sound of the signal from coming in all the time you were enjoying television pictures, except by switching also the secondary of the output transformer.

Other Connections

If the neon lamp and the primary of the output transformer are put in series, with a simple switch across the lamp to cut it out, again, the signals would be heard all the time, unless another switch were used. If the single switch in circuit shorted out the speaker transformer primary, instead of the lamp, then indeed there would be nothing heard when the switch was put at the "on" or closed position, when the glow of the lamp would be the sole result, but whenever the signal is desired to be heard, then the lamp is in series with the transformer primary, more voltage is dropped in the lamp than in the primary, and signals are so very weak that only the very loudest stations of any kind could be heard. The aural aid in tuning in television then becomes virtually lost. It is deemed better, therefore, for single switching operation, to put B plus at either the lamp or the primary, to make one effective while the other is completely out of circuit. A single pole double throw switch does it.

Pentode Output Tube Can Be Used

The 247 pentode is used as output tube, and this is not usual in a television receiver. However, judging by results actually obtained, it is obvious that the 247 is suitable. A suspicion about its disuse arises from the fact that the pentode has a fifth element, the screen, that causes trouble.

Suppose the 247 is hooked up in the usual manner, with plate returned to 250 volts positive, and the screen (K of socket) connected to the same potential. Now we have, usually, 250 volts actually on the screen, and 230 volts actually on the plate, for about 20 volts must be expected to be dropped in the primary of the output transformer. The tube manufacturers recommend that the screen and effective plate voltages be the same, but do not stress relatively small differences. However, there is a difference of nearly 10 per cent, which, while not serious, is nevertheless in the wrong direction.

What happens when a neon lamp is put in circuit, instead of the primary of the transformer, or when both the primary and the lamp are in series as a load on the output tube? The voltage drop in the combination may amount to 200 volts, there will be 50 volts effective on the plate, and yet the screen voltage will remain 250 volts, or five times as great as the effective plate voltage! Under these conditions, instead of the pentode drawing around 40 milliamperes of screen-plate current, it will draw around 100 milliamperes, will glare with a furnace-bed red, and will give justifiable reason for anxiety. So soon as the pentode burns out the anxiety is over, but this may not be immediately, as such a tube has been tried by this method for six continuous hours before the final curtain.

Suggested Common Resistor Method

It is suspected, therefore, that avoidance of the pentode has been due to experiences like the situation just related, and perhaps failure to appreciate the reason, hence absence of solution. However, if a limiting resistor is placed in the screen circuit, then around 80 volts may be dropped in a resistor of 0.01 meg. (10,000 ohms) for sound wave, and when signals are heard the effective plate voltage is still 230 volts, the screen

or Television Use

st Band, with Other Coils, Optional

J. Roth

LIST OF PARTS

Coils

One set of three shielded plug-in coils, to cover 80-200 meters, as described; extra set of three shielded plug-in coils, to cover broadcast band, optional, also as described.
One power transformer for five heater tubes, 247 pentode and 280 rectifier.

Condensers

One three gang 0.00035 mfd. variable condenser with trimmers built in.
One shielded block containing three 0.1 mfd. condensers, black lead common, reds interchangeable.
One 0.00035 mfd. fixed condenser.
Two 1 mfd. bypass condensers (200 volt rating or more).
Three 0.1 mfd. fixed mica condensers.
Two 8 mfd. electrolytic condensers, one with two insulating washers and an attachable lug.

Resistors

One 300 ohm pigtail resistor.
Two 0.02 meg. (20,000 ohm) pigtail resistors.
Two 0.05 meg. (50,000 ohm) pigtail resistors.
Two 0.01 meg. (10,000 ohm) pigtail resistors.
One 0.01 meg. (10,000 ohm) 5 watt resistor for 247 screen. This is minimum. Up to 0.025 meg. may be used.
Three 0.25 meg. (250,000 ohm) pigtail resistors.
Three 0.5 meg. (500,000 ohm) pigtail resistors.
One 0.1 meg. (100,000 ohm) pigtail resistors.
One 500,000 ohm potentiometer with a-c switch attached.

Miscellaneous Other Parts and Accessories

One chassis, 14 inches wide x 8.5 inches front to back, with 3 inch flap front and back.
Dynamic speaker, 1,800 ohm field coil tapped at 300 ohms; output pentode transformer built in.
Two UY sockets marked 235, three UY sockets marked 224, one UY socket marked 247, one UX socket marked 280 and one UX socket (for neon lamp) not marked.
One vernier dial with pilot lamp, escutcheon and scale.
One a-c cable with male plug.
One single pole double throw shaft type switch Sw-1.
Two knobs, one for potentiometer, one for switch Sw-1.
Two dozen 6/32 screws and two dozen nuts.
One roll of hookup wire.
One midget cabinet to contain chassis.
Tubes: two 235, three 224, one 247, one 280 and one television neon lamp.

voltage is 170 volts, there is a difference of 50 volts, but it is in the right direction, and the pentode performs well. When the lamp instead is put in the output circuit the plate current drops to 15 ma, or is less than half of what it formerly was, the lowering of the plate voltage increases the screen current, the drop in the limiting resistor increases, and effective plate and screen voltages are less different. A limiting resistor of 100,000 ohms will stop the lamp from lighting, due to insufficient voltage difference across it to produce arcing, a resistor of 50,000 ohms will give a dim lamp glow, while 10,000 ohms will produce satisfactory results, as a minimum, but up to 25,000 ohms may be used.

A method that should be tried is to connect the plate return to the screen, with a higher wattage but lower ohmage limiting resistor from screen to B plus, because of the sum current through it, then whatever change in voltage is produced in the one will be produced in the other, the screen and applied plate voltage will be the same always, but the effective plate voltage will be less than the screen voltage, due to the primary drop, as in commercial practice. The neon lamp itself may be tried as the limiting resistor by connecting screen and plate to one side of the lamp, B plus to the other. An objection is the feedback due to the common impedance of the limiting resistor or lamp, but if the set can stand the feedback (no motorboating, high-pitched continuous whistle or other audio oscillation), then it may be retained.

Location of Volume Control

The radio frequency portion consists of two stages of t-r-f and a negative bias detector, which has become almost a standard fundamental circuit. However, in the present case the volume control is not a rheostat in the common cathode circuits of the r-f tubes, because changing the d-c voltages changes the frequency, and as we are dealing with frequencies higher than the highest in the broadcast band, the change will be considerable in absolute value. It would be enough to tune out the signal completely by half rotation of the volume control. Therefore the control should be placed after the detector. There is nothing to concern you about detector overload, as the negative bias is almost 8 volts on the detector, more than twice what it is on the first audio tube, so the control should affect the signal input to the first audio and not the second audio tube.

Single tuning control is advisable for television work, as otherwise tuning in the picture becomes difficult, especially as you are usually working in the dark. The picture could not be seen if a single electric lamp were lighted in the room. Even the light from the receiver tubes constitutes interference, so a cabinet is no luxury for the television set.

Scenes Constructed by the Mind

Any method of lamp switching introduces some detuning, because of change in voltage distribution. When a value of 65 milliamperes constitutes the total plate and screen drain when tuning in aurally, and the reception is switched over to the neon lamp, the total drain drops to 50 ma, and all d-c voltages change. Thus one finds that when he has tuned in the television signal on the dot, by the ear test, and switched over to the lamp, only kaleidoscopic designs are floating on the viewing screen or parallel wavy lines, or a scene that indicates silhouetted persons dancing on a corrugated mirrored floor. The imagination conjures many different scenes and views due to the encouragement lent by unconscious mistuning, but when the resonance point is reestablished, then it is seen that a placard announces the call letters of a television station, or a girl is moving her head to and fro.

Regulator Tube

Since the voltage, hence the frequency, is changed, anyway, the question may be raised whether it is not well to include a voltage regulator lamp, or whether the volume control may not be put in the r-f cathode lead after all.

Of course a voltage regulator lamp would be fine, and also a voltage divider that bleeds a lot of current would itself be of some help, but more desirable is a combination of the two, and these run up the expense. The gain is after all one of convenience, to avoid retuning, but single control was chosen because it is known retuning will be necessary, hence easy.

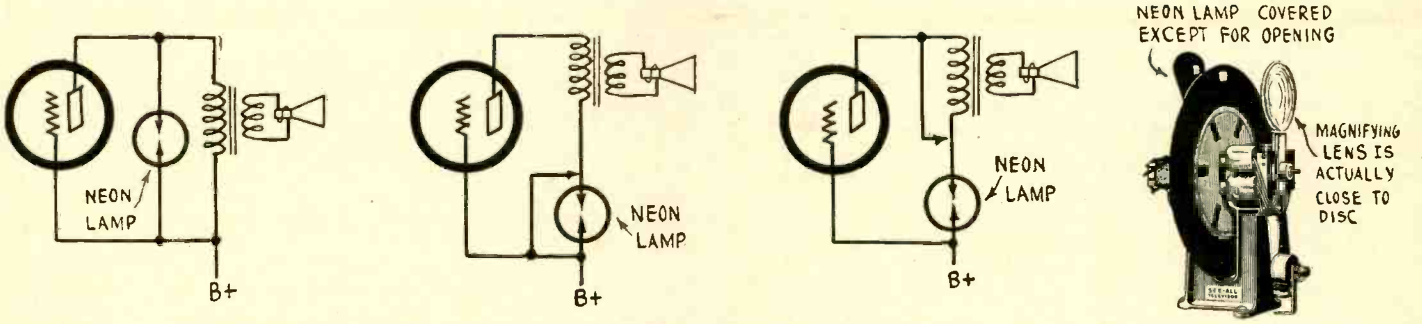
As for relocation of the volume control in the r-f cathode leads, this is distinctly disadvantageous, first, because the frequency change makes it impossible to use the volume control satisfactorily later on without retuning, and the object is to have the control independent of radio frequencies, and second because it is no argument to say that heaping more voltage hence frequency change on what already exists tends in any way to solve the problem. There is nothing serious about the slight retuning needed when the switchover is made to the lamp, principally because once that is done you are all set to spend a few hours in a dark room looking at the television presentations, and as you may want to tune in different television stations, and may have to use the volume control, you don't want the control then, when you're in the dark room and all warmed up over television enjoyment, whereupon the control will fool you over loss of the picture. That is, you will tune largely by sight, especially after you have familiarized yourself with the positions of the television stations on the dial.

A 1 foot disc will give a picture approximately ¾ inch wide

(*Continued on next page*)

Coils for Television Set

Wound on 1.25 Inch Diameter Tube Bases



PARALLEL CONNECTION DOES NOT WORK.
NO SCREEN VOLTAGE TROUBLE, BUT NO PICTURES.

SERIES CONNECTION MAKES AURAL TUNING IMPRACTICAL. SWITCH NEVER STOPS SOUND. SCREEN VOLTAGE TOO HIGH WHEN SWITCH IS OPEN.

SERIES CONNECTION WITH SWITCH ACROSS PRIMARY. SWITCH STOPS SOUND, BUT LAMP REDUCES IT, TOO. SCREEN VOLTAGE ALWAYS TOO HIGH.

A LENS MAKES THE PICTURE LOOK LARGER, AND THE INCLUSION OF THIS ACCESSORY IS RECOMMENDED. THE LAMP OPENING DEFINES THE WIDTH OF THE FRAME.

FIG. 2

Other connections of neon lamp compared and disc, lamp and lens assembly detailed.

(*Continued from preceding page*)

by 1 inch high, with fair illumination, and the picture is made to appear larger by putting a magnifying lense in front of the frame. Around the neon lamp a shield may be put, with cutout for the viewing space, and if this is done no frame need be interposed in front, between the disc and the lens.

Some manufacturers have cutout shields for their own systems and lamps. A few have small cylinders for the small neon lamps about 1.5 inch diameter, and if you have such a small shield but a large lamp, you may spread out the shield, as it is slotted in the back, and force it on the lamp without injury. Then the rest of the space should be covered with friction tape. The object of covering the lamp is to conserve the light and confine it to the viewing space, instead of having it dazzle you as luminous interference. The illumination at the lamp is very considerable, and if only the television systems could captialize what's there, instead of using less a fraction of a per cent. of the original illumination, there'd be a far, far better picture.

If the large lamp's plate is too high, beyond the disc, the lamp socket may be moved down either by rotating a screw intended for that purpose, or, if the screw is too long even after that test, measure the point desired and cut off half an inch lower with large pliers. Then reestablish the correct thread by turning the locknut over the cut portion.

If the wrong plate of the lamp glows, since you may have tape over the lamp, you can't turn the lamp around, even if the socket is pivoted on an eyelet connection to the supporting screw. Simply reverse the connections of the neon lamp to the set, doing this, of course, when all juice is shut off.

The receiver is intended for television use, but of course it tunes in police broadcasts and amateur code and voice, as well, besides some other transmissions. However, if one desires to use it for the broadcast band, this can be done, for the construction permits the use of plug-in coils. The shields fit on bases, and can be pulled right off, for any coil changing. It is even practical to go below 80 meters, due to shielding.

Naturally, at the television and higher frequencies, the effect of the shields in eddy current losses is far greater than on the broadcast band. Therefore it should not be surprising to find that the primaries are much larger than would be used in non-shielded coils, to build up the gain, and the number of secondary turns is larger to atone for the inductance shrinkage.

Using No. 36 single silk covered wire, 1.25 inch diameter form with tube base prongs, wind 108 turns for the broadcast band secondary, the primary being wound over the secondary, near one end of the secondary, and consisting of 15 turns of No. 36.

Using No. 24 single silk covered wire, wind 35 turns for the secondary, leave 1/8 inch space, and wind 20 turn primaries, No. 36 enamel wire.

Three coils are required for each band.

The shields should be no less than 2 1/8 inch diameter, 2 1/4 inches high.

What You Need to Receive Principal Television Transmission

Television transmission in the United States is principally from New York City, Chicago, Boston, Washington, D. C., and in the immediate locality of some of these cities.

One needs a short wave receiver that will tune from about 150 to about 135 meters, and from about 100 to about 110 meters, hence a receiver that covers 80 to 200 meters will take in the transmissions. Experiments also are being conducted on other frequencies, particularly the ultra frequencies, but as yet there are no receivers for these frequencies, nor is there anything save commercial experimental reception of them.

Besides the receiver it is necessary to have a scanning disc, a neon lamp, some device for defining the limits of the illumination, so there will be no light where there is no picture, and a motor. A magnifying lense is optional.

There is no standardization of scanning, and different systems are used, but most of the important transmitters send out pictures on the same basis, 60 lines, and commercially obtainable scanning discs are made for these. A hood for the neon lamp, with a suitable cutout, with no light being permitted to get out through any other means, will define the picture limits suitably. These are governed considerably by the size of the disc, but can easily be measured vertically by turning the disc, even by hand, with illumination behind. The holes are so small you might not know they were there unless they are held up to a light. The motor, if you have a-c, may be of the synchronous type, for 1,200 revolutions per second, especially as distant reception of television is unlikely, and power companies in a locality are one frequency. Fair results have been obtained in New York City even from Silver Springs, Md.

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A-C All-Wave Circuit

CAN you refer to any issue of RADIO WORLD in which have appeared an article on an a-c 2 tube receiver for broadcast use with phones, and an a-c three tube receiver for short waves?—S. R., Salada Beach, Calif.

The article beginning on page 3 of the present issue describes a three tube circuit (including rectifier) that will be serviceable on the broadcast band and for short waves, although on the broadcast band the performance is less, though no doubt fully adequate for your requirements. Therefore if you build the a-c receiver, Fig. 4 of that article, both your wants will be filled in one set. Two sets of coils will be needed for the broadcast band (four coils), 150 turn and 65 turn secondaries, respectively, No. 31 wire.

* * *

Converter Data

REGARDING the series heater circuit in the July 25th issue, what was used for intermediate frequency amplification? Kindly let me know what additional information you have on this circuit.—E. L. E., Wewanee, Ill.

This was a four tube short wave converter with B supply built in, using a stage of t-r-f, tuned modulator, tuned oscillator and rectifier. The tubes were two 236 and two 237. The intermediate frequency was established by putting an equalizing condenser of 20-100 mmfd. across a 300 turn honeycomb coil of small size, having an inductance of about 350 microhenries. The coil was coupled to another similar coil, which second coil had no condenser across it, the second coil being the output impedance. The only things that prevent reception, usually, are that the oscillator of a converter does not oscillate, or that coupling fails. Oscillation absence may be corrected by increasing the oscillator plate voltage, returning the plate winding of the oscillator to maximum B-plus, in this case about 110 volts. Another reason for non-oscillation would be incorrect polarities of connection of oscillator coil. Therefore try reversing the connections to the oscillator plate winding, putting to plate the terminal that now goes to B plus, and to B plus the terminal that now goes to plate, without any change in the plate voltage at first. A secondary consideration, in point of frequency of occurrence of trouble, is coupling. If you rely on inductive coupling, it may not be strong enough, so add 8 turns of wire at the ground end of the oscillator coil, and run the cathode of modulator, not direct to ground, but to the free terminal of this 8 turn winding, the other terminal of which is the present ground connection of the oscillator secondary.

* * *

Poor Quality Using Pickup

PLEASE advise me why I do not get quality of reproduction from records when I use a phonograph pickup of 4,000 ohms impedance on my radio through an adapter connected to the detector tube. Will a transformer be necessary? How should this transformer be connected? Is there a different way of hooking up this pickup?—J. F., Brooklyn, N. Y.

Just what connection is established when the pickup is adapted to the detector socket is not made clear, but at all hazards, unless special precautions are taken, the detecting characteristic of a tube that is intended to be used as an amplifier, as is the case when the pickup is connected, will bring about serious distortion. If the detector socket is to be the place of connection a special means must be provided for lowering the bias considerably, so the tube is worked on its amplifying and not on its detecting characteristic. It is not absolutely necessary to have a transformer. You can connect the pickup in the grid circuit of the first audio tube, from grid to ground, and no doubt will get much better results than from the present haphazard and uncertain method. Try it and report back.

* * *

Wants to Use 70 kc Transformers

A PREVIOUS issue of RADIO WORLD contained a diagram of a six tube all-wave tuner, using the superheterodyne principle. The intermediate frequency was high, in comparison to that of some intermediate frequency transformers that I have (about 70 kc.). Will you tell me please how I can use my intermediates, despite the big difference in frequency, in a set of this kind?—J. J. C., Pittsburgh, Pa.

The hookup would be no different no matter what the intermediate frequency was, but some of the values of constants would be, particularly any series condenser used for padding the oscillator, and the inductance of the oscillator secondary. We suggest that you use independent tuning controls for the r-f and oscillator circuit, thus two controls, so the oscillator can have the same number of secondary turns as the r-f coils. Then, also, you can get repeat points, which may be an advantage in the elimination of some forms of interference. You can therefore use the intermediate transformers that you have, the only limitation being that you probably will not be able to tune to as low waves as you might be with the higher frequency intermediate transformers. About 20 meters may be regarded as your minimum. If 20 meters are low enough for you, build the set as directed.

* * *

Constants for Converter

WILL you please send me information on your converter, published in the October 24th (1931) issue, page 12, Fig. 1. What is the position of the windings? Should grid of oscillator coil face grid winding of modulator or vice-versa? How far apart are the 300 turn chokes placed in the intermediate? Explain why 0.02 meg. is placed from screen to ground. Is this correct? Will you please explain why my 227 rectifier tubes in a similar model, built from a diagram obtained elsewhere, burn out after being lit a few minutes? The tubes are O. K. and there are no shorts. Am using 0.02 mfd. bypass condenser on screen. What is meant by padding the oscillator?—R. W. E., Cleveland, O.

The diagram referred to consists of a tuned modulator, tuned oscillator, stage of intermediate frequency amplification and a rectifier. The tubes used are one 224, two 235 and one 227, the last-named the rectifier. The mixer coils are inductively related. The intermediate frequency used on the receiver should be low, as that in the converter is more sensitive at the low end, say, from 600 kc down. The windings are put on one form, 1.25 inch diameter, 20 turns for the largest oscillator grid winding, then to the left 10 turns, then to the left 5 turns, ¼ inch space between. The plate winding is to right, and consists of 20 turns, ¼ inch away from largest oscillator grid winding. Next the largest modulator grid winding is put on, 25 turns, ¼ inch space, 10 turns, ¼ inch space, 5 turns. The wire is No. 28 enamel. The directions of the windings and connections are important only on the oscillator. With all windings in the same direction, the B plus connection faces the ground connections. These data are for 0.00035 mfd. specified in the diagram. The two 300 turn honeycomb coils are 1⅛ inches apart. The 0.02 meg. resistor is interposed between screen and ground to the screen voltage, particularly to make a reduction effective as soon as the converter is turned on. It is correct. The rectifier tube burns out because there is a short circuit. This may arise from a shorted load resistor, either the 0.01 meg. or the 0.02 meg., or because the condenser next to the rectifier has not been insulated or because either or both of the electrolytic condensers are bad. Put a d-c voltage of around 100 volts across each condenser, with meter in series, to see how much the leakage is. It should not exceed a few milliamperes at the very start. Also measure the current in the rectifier, which you will find begins quickly to exceed 20 ma, showing what amounts to a short circuit. Turn off the converter the moment the current exceeds 20 ma, to save the rectifier tube. Then carefully trace down the short with a meter and voltage course, a resistance meter (which is the same thing) or with a 1.5 volt flashlight cell and small lamp in series. The lighting of the lamp will disclose the short, or the full deflection of the needle will. The bypass condenser capacity is all right. Padding the oscillator consists of making its inductance and capacity different from that of the modulator, to provide for the higher frequencies the circuit must tune to, and yet have the same numerical dial settings represent the correct oscillator frequencies. These oscillator frequencies are to be higher than the r-f frequencies by the amount of the intermediate frequency.

* * *

What Set to Build

I WAS very much interested in theory of design given in J. E. Anderson's article in the November 14th (1931) issue. Would be pleased to see similar theory given in connection with the —35 and —47 tubes. The article by Randolph Roosevelt in November 21 issue is quite interesting and believe it would be profitable to have an article from Mr. Anderson showing how the microvolts per meter are measured and what advance in amplification from one tube to another should be obtained. In the Chicago district it is very difficult to eliminate the large stations, and from any number of stages shown the tuning has been rather broad when trying to cut through WGN for WOR. Have been watching development of the diode detector and expect to give it a trial in a few weeks. Considering the

(Continued on next page)

(*Continued from preceding page*)

location in Chicago, do you consider the superheterodyne of seven to nine tubes better for selectivity than a tuned radio frequency set with a similar number of tubes?—L. J. L., Harvey, Ill.

The theory of design, as applied to the automotive series tubes for both auto sets and for 110 volt d-c line sets, has been followed in the circuits presented recently for a-c operation, including the 5 tube midget (Blueprint No. 627), the 6 tube all-wave set (Blueprint No. 628-B) and the automobile receiver (Blueprint No. 629). The measurement of the microvolts per meter is one of the performances to be made by standard test methods which have been published in skeleton form in these columns, but since our articles were based on what is contained in the Year Book of the Institute of Radio Engineers, we suggest that you write to the Institute, at 33 West Thirty-ninth Street, New York, N. Y., for information regarding the Year Book. The amplification from one tube to another can not well be measured by the voltage test, because of the upsetting effect of the measuring device on the measured circuit, but the current can be measured and compared. These data are taken up also in the Year Book. The sensitivity of t-r-f receivers may be as great or greater than that of superheterodynes, but three stages of t-r-f may do so, and of course so will a superheterodyne of seven to nine tubes. We suggest you build a superheterodyne with a stage of t-r-f, tuned modulator, separately tuned oscillator, two stages of intermediate (three i-f coupling coils), pentode output tube and rectifier, for the seven tube model, or, for nine tubes, that you add another intermediate stage, 227 negative bias detector and push-pull pentode output. The diode detector is suitable indeed for superheterodynes, but it is not as sensitive as the more usual present-day types of detectors. The quality is first rate.

* * *

Less Noise Wanted in Super

AS the owner of a superheterodyne, a-c operated, I would like to know if there would be any reduction in noises if I used 235 tubes instead of 224 tubes, and also whether I should use 247 push-pull pentode output instead of 245 push-pull output. I would like to cut out as much noise and crosstalk as possible.—J. R. S., Sedro-Wooley, Wash.

Several persons who have superheterodynes have reported exactly the improvements that you desire when they substituted the 235 tubes for 224 tubes in the intermediate amplifier. The voltage requirements are not much different, and therefore it is practical to make the simple substitution of tubes without any wiring changes. As for the tuner portion, however, leave the oscillator tube as it is, and if you have a 224 modulator you can not well substitute for it a 235, but a 224 r-f tube can be replaced with a 235 tube, whereupon it would be advisable to have the volume control a 25,000 ohm rheostat, or a potentiometer used as a rheostat, connected with one side to ground, the other to a fixed resistor of 150 ohms, the other side of the fixed resistor to cathode of the r-f tube.

* * *

One Tube Converter

I AM interested in short waves now. I would like a diagram of a 1 tube converter for use with a 9 tube superheterodyne, with list of parts. I would like to mount the device in a steel cabinet 12 inches long x 9 inches front to back.—J. R. P., Dallas, Tex.

We do not encourage the use of single tube converters, as in general the experience with them is most unsatisfactory. We advise you to select instead a converter with B supply built in, and we are sending a diagram of such that was published in the December 12th (1931) issue. The parts are listed in that issue. If further information is desired, please write again and state your new questions. Follow the layout, but wire according to the schematic.

* * *

Set Squeals and Howls

HAVING built a battery operated Diamond of the Air I changed it over to a-c operation, with multi-mu tubes, and while I get results the set howls and develops other noises. I would like to have a suggestion for remedying the defect, as the set would be fine if the extraneous noise could be killed off.—C. J. W., Alhambra, Calif.

You have built the set, using one stage untuned r-f, one tuned stage of r-f, tuned detector input, and two transformer coupled audio stages, first 227, output 247. You have 90 volts applied to the r-f screens, through a common resistor of 3,000 ohms, by passed. But for the low current the 3,000 ohms might as well be left out, the difference being less than 10 volts. Increase the value of this resistance to around 10,000 ohms, particularly since lower screen voltage is a remedy for r-f squealing. However, audio feedback is to be considered. Therefore interrupt the plate return of the primary of the first audio transformer with a resistor of 100,000 ohms, and put a 1 mfd. condenser from the juncture to ground. Also interrupt the grid return of the pentode the same way, using 100,000 ohms, with a 1 mfd. condenser from juncture to ground. Thus both r-f and audio feedback precautions will be taken. In addition you might put r-f chokes of any convenient value in the plate return leads of the 235 tubes, with a condenser of 0.01 mfd. or higher capacity across them. Change your volume control so that it is connected, one side to a 600 ohm resistor that goes to common 235 cathodes, other side to ground. This puts the r-f squeal control within reach on the front panel if all else does not do the trick. Use shielded coils even if it appears that the trouble is just as intense with them as with unshielded coils. Ground the shields.

* * *

The Monitor Receiver

WILL you kindly let me know the results obtained on first ests of the laboratory receiver, 10-2,000 meters, appearing in RADIO WORLD of November 7th (1931)? If possible, I should like an idea of the approximate cost of parts to build this set.—P. J. S., Savannah, Ga.

The idea of getting up a monitor type receiver was inspired by the type of receiver used at the frequency monitoring station of the Department of Commerce's Radio Division, at Grand Island, Nebr., where individually tuned stages of r-f and two steps of audio are used. The receiver was discussed theoretically in these columns before it was built, and the statement made it had not been built, but that reports of progress would be printed. Then followed a reception report on nearly all of the broadcast band. This reception was very good. There were three stages of t-r-f, two resistance coupled audio stages, pentode (247) output and 280 rectifier. Since then the set has been developed to include the part of the broadcast band not tuned in by the larger coils, down to 80 meters, and it works excellently. It is hoped that the report can be printed in next week's issue, January 2d, and after that coil data will be given for the lower wavelengths, and finally for the waves above the broadcast band. The present type of construction is to have a small U-shaped shield that holds the condensers and dials at front, while at top provides socket holes into which the four coils are plugged for each band. The shields fit over bases like those used for tube shields, and only four shields are needed, although a total of as many as 32 coils may be necessary. The results on the short wave band are particularly strong and it is expected that once stations are tuned in below 80 meters that quite a respectable array of foreign stations can be hung up. However, time will tell, and we ask you please to wait a little while longer. The cost of parts (less speaker and tubes) should not exceed $35. See the issues of October 24th, October 31st and December 5th, besides the November 7th you have seen.

* * *

Oscillation Trouble

IN your November 28th issue, H. B. Herman has an article on a five tube a-c superheterodyne, using a dynatron oscillator. It occurred to me that the circuit might be adapted to the two volt tubes, on d-c, so it was hooked up experimentally. While the circuit seemed to be alive from antenna to output, the oscillator did not seem to function. Is the 232 tube adaptable to this purpose?—F. C. D., Portland, Me.

Evidently, as you intimate, the oscillator is not oscillating. While the dynatron oscillator requires a high ratio of inductance to capacity, this is well enough supported in the broadcast coils band by the coils used with the familiar tuning capacities, therefore you should have no trouble on that score with the 236. However, the voltage for oscillation can not be stated in advance with any certainty, and the recommended values of 45 on the plate, 135 on the screen, which you used, should be varied. A meter in the plate circuit of the dynatron, suitably bypassed, will tell you when the tube is oscillating.

NEW BOOKS

A completely revised and greatly enlarged second edition of "Radio Physics Course," by Alfred A. Ghirardi, has just been released by the Radio Technical Publishing Company, of New York. This course was originally published as a series of magazine articles and became one of the most instructive features. It was then published in book form and was adopted as a standard radio text by dozens of radio schools and technical high schools throughout the country, in addition to achieving considerable popularity among individual radio fans.

Mr. Ghirardi has completely revised the text from cover to cover. Many new chapters have been added, covering such subjects as super-heterodyne receivers, public address and sound amplifiers, automobile and aircraft radio equipment, radio servicing and testing, modern a-c receivers, new types of two-volt battery operated receivers, pentode tubes, photo-electric cells, etc. A complete course in elementary electricity, written especially for radio students, has been included. This is of special value to the many persons interested in radio but who lack the necessary background of fundamental electrical knowledge. The chapter on television has received special attention, and includes detailed descriptions of all the systems in use today, including that of Farnsworth.

Some idea of how completely "Radio Physics Course" has been revised and rewritten may be gained from the fact that the new edition contains more than 900 pages, while the first edition contained 362 pages. Throughout the new text Mr. Ghirardi uses the same clear style of writing that has won him distinction as a radio writer and instructor.

STANDARD FILM IS MADE USEFUL FOR TELEVISION

Chicago.

The film output of the moving picture studios of Hollywood, the East Coast, Europe, features, news reels and shorts, have been made available for broadcasting by television.

The perfecting of apparatus enables television stations to make use of standard commercial sight-sound films, such as are furnished moving picture houses. These are broadcast without distortion of the sound.

One of the greatest difficulties encountrede in the adaptation of the sight-sound film to television projection was caused by the difference in the rate of speed with which the pictures are taken on the movie lot, and that with which they are scanned in the television studio. The moving picture camera exposes 24 sections of film each second, whereas television laboratories have experimented with scanning systems that project a maximum of 20 pictures per second.

Slow Motion and Distortion Overcome.

The consequent slowing down of the film results in "slow motion" of the characters in the picture. What is more important, the slower movement of the sound track past the photo-electric cell creates a sound distortion such as that occasioned by rotating the turntable of a phonograph at a speed slower than that at which the recording was made.

Armando Conto, research engineer for Western Television Corporation, of Chicago, set about, 18 months ago, to perfect apparatus that would not only broadcast the pictures so that the figures move with normal speed, but would also permit the sound to be taken from the film undistorted.

The Western Television Corporation 3 spiral scanning system with which Conto worked divides any area to be broadcast into 45 horizontal parts at a speed of 15 times per second. This leaves a considerable gap between the 15 pictures per second, as broadcast by the television station, and the 24 pictures per second projected in the motion picture houses.

How Disc Is Made

Conto looked with disfavor upon the method by which the film is kept in motion as a part of the scanning operation, a practice used in previous technique. He decided that better results could be obtained if the film remained stationary, as it does in the projection of moving pictures, moving forward at a predetermined time. Consequently, it was necessary to design a disc that would combine the effects produced by an ordinary scanning device and the shutter on a moving picture projector.

The resulting disc is so constructed that the apertures through which the light penetrates are placed on radii that are four degrees apart instead of eight degrees, as in the ordinary 3 spiral 45 aperture disc. Thus, the 45 apertures occupy a 180-degree segment of the disc, leaving the other half blank to act as the shutter.

CUSTOMERS THANK POLO

Letters of thanks and reorders from consumer customers who bought the Polo Midget have been received by Polo Engineering Laboratories. This 5 tube midget has proved a splendid performer in all locations. It has been granted RADIO WORLD'S Certificate of Highest Merit.

TRADIOGRAMS

By J. MURRAY BARRON

The radio stores in New York City are enojying the effect of increased interest in television. Experimenters are buying scanning discs, lamps, synchonous and induction motors and parts for short wave receivers to bring in television frequencies. For the first time, not a store in the Cortlandt Street district is without its television complement.

* * *

A sensation was caused by the demonstration given by the Television Manufacturing Corporation of America in Stern Brothers department store, where a 10x9-inch picture was shown, using the See-All apparatus, manufactured by this company. The illumination was obtained from a crater lamp. Call letters could be read plainly 50 feet from the screen. The disc was the company's 60-hole type, with a lens at each hole. A couple of feet from the disc a screen was placed and on this screen the projected pictures could be seen clearly in a darkened room. The special installation included a modernistic cabinet, long and short wave receivers, so sound and sight could be synchronized. The standard model will be along the same lines, and production is under way at the factory, 473 Liberty Avenue, Brooklyn, N. Y.

* * *

Insuline Corporation of America is now a subsidiary of a new holding company, Standard Television & Electric Corporation. The holding company was created to finance the subsidiary due principally to enlarged activities in television. S. J. Spector is president of Standard, A. G. Heller vice president. The board of directors includes Brig. Gen. Brice P. Disque, director of the Anthracite Institute.

* * *

J. A. Fried, formerly an engineer with Dubilier and Sonora, has joined the engineering products division of the RCA-Victor Company, in charge of Faradon condenser sales. He is at the Camden, N. J., plant and offices.

* * *

Jerry Gross enlivened the window display of his Warren Street store with a "ham" outfit, done with great care, and the result was that crowds were attracted.

* * *

A completely assembled televsion outfit will be marketed soon by Pioneer Television Company, J. Leopold announced.

* * *

"Everything on the air with one receiver, at home or abroad," is the slogan used for the new Hammarlund all-wave superheterodyne, details of which are obtainable from Lewis Winner, Hammarlund Manufacturing Company, 424 West Thirty-third Street, N. Y. City.

* * *

Try-Mo Radio Company, 177 Greenwich Street, N. Y. City, startled the town with a very low price on RCA-Victor microphones, which can be used for home recording or for public address systems. The company has greatly enlarged its speaker department. Moe Lager is in charge of this, as he is an acoustical expert. His brother, Louis, is the financial genius.

NEW CORPORATIONS

Premier Refrigerating System, Inc., New York City, ice machinery cooling appliance—Atty. Prentice Hall, Inc., of Delaware.
Washington Electric Co., appliances—Atty. Exco Lawyers Albany Service, 116 Nassau St., N. Y. City.
Eugene Farley, Inc., New Brunswick, N. J., electricians—Atty. F. H. Dahmer, New Brunswick, N. J.
Columbia Electrical Co., New York City—Atty. O. A. Samuels, 300 Madison Ave., New York City.
W. H. E. C., Rochester, N. Y., radio broadcasting—Atty. Bly and Bly, Rochester, N. Y.
Canastota Refrigerating Co., Canastota, N. Y.—Atty. F. Hill, North Rose, N. Y.
Allagracia De Janelli Radio Broadcasting, New York City—Atty. D. G. Godwin, 1482 Broadway, N. Y. City.

2,500 IN TEST, 10 ARE CHOSEN AS ANNOUNCER

More than twenty-five hundred men aspiring to become radio announcers talked before microphones in auditions at the National Broadcasting Company studios during the last two years, but only ten were hired.

With few exceptions, all the applicants stammered or "whistled" on encountering the first sentence in the test script prepared by Patrick J. Kelly, supervisor of announcers, who tried each of the twenty-five hundred voices. The sentence was: "The seething sea ceaseth and thus the seething sea sufficeth us."

Foreign Names Cause Trouble

Most of the candidates fumbled names of foreign composers. Usually five groups—French, Spanish, German, Italian, and Russian—were written into the script.

Because so few persons can meet the requirements, the N. B. C. is giving auditions only to those who can speak one or more foreign languages and who have a broad musical education.

The ten announcers who passed the examination during the last two years are: John Holbrook, recent winner of the 1931 diction medal; Edward K. Jewett, Ray Winters, Howard Petrie, Bennett Grauer, William Warner Lundell, Ezra McIntosh, Allan Kent, Daniel Russell and Charles O'Connor. Russell, one of the latest additions to the staff, speaks five foreign languages.

New Sentence Used

"There is only one change in the form of our examination for the future," Kelly said. "We are no longer using the initial test sentence. It won't do an applicant any good to rehearse it in advance."

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.

C. J. Duke, 2014 W. Capitol St., Houston, Texas.
Herbert Atwood Wilson, Radio and Electrical Specialties, Niles, Ohio.
Frederick W. Puck, 427 84th St., Brooklyn, N. Y.
Clayton Shreeve, Lock Box No. 511, Midland, Mich.
C. R. Arvidson, R. F. D. 885, Rt. 1, Port Arthur, Tex.
Merle M. Bailey, R. F. D. No. 3, Box 221, Bessemer, Ala.
E. O. Christianson, Raton, N. M.
Alfred Frankel, 1736 Roslyn Terrace, Philadelphia, Pa.
W. A. Stine, Jr., Rock Hill, S. C.
Charles R. Saum, 410 Collicello St., Harrisonburg, Va.
Edward P. Le May, 213 W. Willow St., Chippewa Falls, Wis.
J. H. Weaver, 720 Main St., Stillwater, Okla.
Astor A. Alenius, Adtor, Fla.
Harry W. Gaunt, 524 Broad St., Meriden, Conn.
James A. Close, 1414 Euclid, N.W., Washington, D. C.
James A. House, Jr., 13701 Cormere Ave., Cleveland, Ohio.
Harry Mabjoubian, 616 So. 56th St., Philadelphia, Pa.
Charles E. Mosier, 776 Loretta St., Pittsburgh, Pa.
Thomas F. White, White's Radio Service System, 6124 Eberhart Ave., Chicago, Ill.
C. E. Kopisch, Tucumcari Lodge No. 1172, B. P. O. Elks, Tucumcari, New Mexico.
Paul Greigger, 3400 Ely Ave., Denver, Colo.
Fred O. Grimwood, P. O. Box 353, Hopkinsville, Ky.
Nelson and Tozier, Radio Technicians, 621 Klamath Ave., Klamath Falls, Oregon.

A THOUGHT FOR THE WEEK

THERE are holiday greetings aplenty over the air this happy season. Voices with smiles in them tell us that things could be worse and that they are going to be better. Speakers in 1931, with the spirit of 1928, assure us that we should stop worrying, look straight ahead and quit squawking. And we're with them— especially as we recall what that prime optimist, the late Theodore Roosevelt, said: "When things are as bad as they can be, and there's a change, it must be for the better."

RADIO WORLD

Reg. U. S. Pat. Off.

The First and Only National Radio Weekly
Tenth 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.

Industry Gives Reasons for Opposing Set Tax

Opposition of the radio industry to the proposal in Congress of a sales tax of five per cent. on radios, phonographs and accessories was announced. The Receiving Set Committee of the Radio Manufacturers Association, after a meeting at the Commodore Hotel in New York, issued a statement detailing the industry's opposition to the proposed special tax on radios and phonographs:

"The radio industry recognizes the revenue necessities of the Government and also the difficulties of equitable taxation.

"The radio industry always has placed its facilities freely at the disposal of federal, state and local governments, their officials and representatives for free public service. It has borne and will cheerfully bear its fair share of taxation.

United in Opposition

"The radio industry will, however, unitedly oppose the proposed discriminatory sales tax of five per cent. as an unfair, oppressive burden on the radio industry and public. The industry objects to being singled out, together with a few other industries, for special and discriminatory taxation.

"The radio industry would favor a general sales tax of a small fraction of a per cent. on all manufactured products, but vigorously objects to and will oppose the proposed special sales tax of five per cent on radio.

"A general small sales tax on all manufactures would produce much greater revenue than the proposed five per cent. sales tax on radio and a few other selected items. This year's federal deficit is estimated at $2,123,000,000. With our knowledge of the industry, under the greatly reduced radio sales in 1931 the Government's return from the proposed special sales tax on radio would probably be not more than one-third of one per cent. of the federal deficit.

Industry Can't Stand It

"The radio industry is in no condition to bear increased tax burdens and which are special and not general. A tax of this sort, therefore, becomes one which will be borne directly by the buying public as it cannot be absorbed by the industry.

"Radio cannot be fairly classified as a luxury, semi-luxury or non-essential. It is a great agency of communication, religion, education and daily individual and national development as well as entertainment. Its hourly service covers all fields of information, education and progress. During the present depression it furnishes low cost entertainment to the entire family, education in the home as well as the school, and religious aid to those in despair.

Relies on Congress

"To the farmer, harassed enough without special taxes, radio is his reliance for market, weather and other information. Like the daily newspaper, radio is a daily means of communication and civic progress. Its cost has been brought so low that its use is universal and we oppose a special tax on this great service to the millions of the radio public.

"The radio industry, represented by the Radio Manufacturers Association, with the support of the Radio Wholesalers Association, the National Federation of Radio Associations, including dealers and jobbers, and the National Association of Broadcasters, feels confident that its reasons for objecting to the unfair and discriminatory sales tax proposal will appeal to the fairness and sound judgment of Congress, the radio industry and the public. We desire to be fair to the Government and will ask that the Government be fair to radio."

Wants Recognition of the Ukulele by Musicians' Union

"Get the ukulele into the Union by Christmas" was the slogan of May Singhi Breen, who says she is ready for a final drive on the Musicians' Union for recognition of the ukulele as a musical instrument. A decision is expected soon.

The controversy began several weeks ago, when Miss Breen was denied a union card on the grounds that the "uke" is not a musical instrument. Miss Breen countered with the statement that she made her living playing the ukulele.

Union officials offered to recognize Miss Breen as a pianist, but she insisted she was a "uke-ist," not a pianist.

Since then Miss Breen has been acquiring ammunition in the form of affidavits from many prominent musicians, and practicing difficult compositions on the ukulele. She has even obtained oral encouragement from Walter Damrosch. After listening to a demonstration, the famous conductor told Miss Breen her playing was "as beautiful as raindrops in the sunlight," and that "in your hands the ukulele becomes a musical instrument."

Miss Breen received a final audition before a group of Musicians' Union officials.

The Diction Winners

The recent award to John W. Holbrook of the Diction Medal by the American Academy of Arts and Letters marks the third successive year that this honor has been won by an announcer who began his radio career with a Westinghouse radio station. After the award Miss Katherine Renwick, National Broadcasting Company actress, promised to become his wife. Milton J. Cross and Alwyn Bach were other former Westinghouse announcers who won the award in previous years.

WEVD UNDERWRITTEN

WEVD, run as a memorial to the late Eugene V. Debs, Socialist leader, has been underwritten by "The Jewish Daily Forward" for $200,000, said Joseph Viola, business manager of the broadcasting station.

Tibbett on Air Weekly

Lawrence Tibbett, Metropolitan Opera Company baritone, signed a contract for a series of radio concerts during the Voice of Firestone programs heard each Monday at 8:30 p.m., E.S.T., over an NBC-WEAF network. Tibbett will make his initial apppearance in the series on January 4th.

The contract was signed in Washington, D. C., between Harvey S. Firestone, Jr., vice-president of the Firestone Tire and Rubber Company, sponsor of the program, and the singer. It is the first time an active member of the Metropolitan staff has contracted for a radio series.

In addition to his early evening broadcast the operatic star will face the microphone at 11:30 p.m., E.S.T. each Monday night for the benefit of an audience outside the Eastern time zone. The Voice of Firestone networks include Canadian and Hawaiian outlets. These, with short-wave stations, will make Tibbett's voice available to the entire world.

Tibbett is known in the entertainment world as a pioneer in various phases of art. He was the first opera star to abandon excessive gestures, and later he startled and pleased his concert audiences with songs supposed to be beneath the dignity of a Metropolitan artist. The baritone was the first opera singer to be featured in talking motion pictures. In his broadcast series, Tibbett plans programs ranging from the classics to popular airs.

Radio City Experts Return

Radio City's studio construction experts have returned from a European tour, prepared to complete final plans for the 27 studios in the broadcast center.

They announced they were prepared to create the "last word" in studios, both from utility and artistry. One may have a seating capacity of 1,000 visitors and all will be built for easy access by the public. The party, consisting of O. B. Hanson, Gerard Chatfield and Wallace K. Harrison, visited broadcasting centers of England, Germany, Russia and France. They arrived aboard the S. S. Ile de France.

Station Sparks

By Alice Remsen

The Silent Heart

(For "True Story Hour," WEAF, Mondays, 10:00 P.M.)

I BARTERED my soul for a feathered bed,
My freedom for shackles of gold;
But the bed proved hard, and the shackles lead,
The fruit turned ashes as I was fed,
The wine was bitter as it was red,
And my singing heart grew old.

Forsaking the warm and feathered bed,
I struck off the shackles of gold;
But the streets were hard and my faith had fled,
And as I walked the stones were red;
I left a mark where my bruised feet bled—
And my silent heart stayed old.

—A. R.

* * *

Well Acted and Competently Cast, the dramatic sketches comprising the True Story Hour, featuring Mary and Bob, are well worth the listener's ear.

* * *

Ran Into Julius P. Witmark, Jr., the other day. He told me he was considering entering the radio transcription field. The breaking-up of the Witmark music publishing family was in the nature of a tragedy, a sure sign that the music business has deteriorated. Julius also informed me that his wife, Aline Witmark, is in the pajama business, specializing in children's lounging pajamas and negligees, which make delightful holiday and birthday gifts. She may be reached at 91 Central Park West, New York City. Julius is getting to look more like his late father every day and has the same lovable character.

* * *

The N.B.C. is Becoming a Regular Matrimonial Market. Two more marriages have come to light. Van Fleming and Don McNeill, the two professors of Coo-Coo College, heard mornings over an N.B.C.-KGO network, were recently married—Van Fleming to Julia Beth Calhoun, actress, and McNeill to Catherine Mary Bennett, of Milwaukee. And as if that weren't enough, William S. Rainey, N.B.C. production manager and actor, and Miss Frances Lynch, N.B.C. hostess, have announced their engagement. Here's congrats to them all! Oh! I almost forgot; on December 31st, Katherine Renwick, N.B.C. actress, will become the bride of John Wesley Holbrook, N.B.C. announcer and winner of this year's Radio Diction medal.

* * *

After Making a Wonderful Radio Reputation over N.B.C. chains, "Real Folks" will change sponsors and networks, beginning January 10th. Since its inception in 1928, this program has received nearly a million letters from radio listeners, attesting to the great popular interest shown in the affairs of Matt Thompkins and the rural citizens of Thompkins Corners. The general character of the sketch will remain the same, with George Frame Brown playing the part of Matt Thompkins. WABC and twenty Columbia stations will carry the program. Log Cabin Syrup will be the new sponsor.

* * *

Harry Frankel, "Singin' Sam," is playing ten weeks of vaudeville around New York. His personal appearances, however, do not interfere with his broadcasting schedule, so his many radio friends will not be disappointed, but will continue to hear Harry's rich voice and friendly chuckle at the usual time of 8:15 p.m., Mondays, Wednesdays and Fridays.

* * *

The Ballad Singers of N.B.C., a male quartet consisting of James Haupt, tenor, James Ewers, tenor, Darl Bethman, baritone, and Charles Pearson, bass, under the direction of George Dilworth, are all very good bridge players. So great is their love of the game (although Jimmie Haupt, with a twinkle in his eye, confesses to a sneaking regard for golf as against bridge), that the four singers sit around a bridge table while broadcasting their harmony. A long horizontal arm holds the microphone up in the air over the center of the table. One of these days I expect to hear Charlie Pearson boom "Four hearts!" over the ether, instead of George's favorite counterpoint.

* * *

Alma Kitchell, N.B.C. contralto, in private life is Mrs. Charles Kitchell, and a proud mother. Recently her young son started in kindergarten. Returning home after the first day he was asked by his mother how he enjoyed school. "Oh, fine," he replied. "I'm learning my N.B.C.'s."

* * *

When the Street Singer's (Arthur Tracy's) brother Bert, is married in Washington, D. C., late this month, Arthur's radio and theatrical engagements will keep him from being at the wedding in person. However, he will be there in spirit, having arranged to toast the bride and groom on his Columbia network program that night.

SIDELIGHTS

IRVING KAUFMAN, was born in Syracuse, N. Y. . . . RALPH KIRBERRY was born in Paterson, N. J. . . . NAT BRUSILOFF was born "somewhere" in Russia . . . WILLIAM WARNER LUNDELL, N.B.C. announcer, was born in Minneapolis, Minn. . . . GORDON GRAHAM, baritone of the Funnyboners, WABC, stands six foot in his socks . . . RAYMOND KNIGHT, N.B.C. funny man, stands six foot one and a half without socks . . . N.B.C.'S HAWAIIAN SERENADERS play and sing by ear . . . ANDRE BARUCH'S baby alligator, Agamemnon, is outgrowing Andre's apartment . . . PHIL DEWEY, baritone of N.B.C.'s Revelers, worked his way through college juggling books in the library and singing at church for $3 a Sunday . . . PETER DIXON'S "Raising Junior" is in danger of becoming a book . . . ODETTE MYRTIL, of N.B.C.'s Gaytee's program, has gone ping-pong mad . . . HUGO MARIANI is still wearing bright colored shirts . . . WEE WILLIE ROBYN, Columbia singer, drives an Austin almost as small as himself . . . WILLARD ROBISON was once staff pianist at WDAF, Kansas City. Now he and his Deep River Orchestra are famous from Coast to Coast. Willard is broadcasting three times a week over WOR . . . ARNOLD MORGAN, studio manager of WOR, hails from Portland, Ore. . . . GEORGE SHACKLEY, musical director of WOR, asked a press agent if a certain torrid singer was really hot. "Hot!" exclaimed the P.A., "Mister, she can start a fire in a bucket of cold water" . . . UNCLE DON CARNEY has gone vaudeville . . . MARIA CARDINALE is also taking a "flyer" on the vaudeville stage.

Biographical Brevities

A Few Facts About Alfred J. McCosker

In the first place, Alfred J. McCosker is a native New Yorker. He is a young man, born in 1886, and possesses those intrinsic qualities inherent in well-bred men—initiative and definite personality. It was initiative that sent him into radio and personality that helped him put it over.

He started life as copy-boy for Arthur Brisbane, when there was no such thing as a City News Association, when the news game was a battle arena, and beats on opposition newspapers called forth the exhibition of more brains and strategy than are required of army generals. It was thus that McCosker acquired the alertness which has placed him in his present enviable position of managing director of Station WOR.

He took the energy and alertness of a newspaper man into radio. During the years in which he had held every position on a newspaper from copy boy to editor, Alfred J. learned to judge human nature, to realize something of what the public wanted; and so as a radio director he put his theories as a newspaperman into practice, and the popularity of his station proves his ideas and ideals to be more than a mere "something" of what the public wanted; in fact, he has raised WOR to an unique position in the radio field, with the reputation of giving the most excellent programs of any station of its size and local importance.

Mr. McCosker entered radio via the press department. When wireless was in its swaddling clothes, he proceeded to lead that lusty infant by the hand, arranging spectacular broadcasts and regularly scheduled features that the press could not afford to ignore. The owner of the station took cognizance of his press agent's ability and soon made him director of the station.

Mr. McCosker has written extensively himself, his works including many short stories and scenarios for motion pictures. This was during the two years that he was editor of the "Exhibitors Trade Review," a motion picture class journal. It was at this time also that his cronies dubbed him "Hollywood" McCosker, because of his current motion picture review over WOR. His colleagues in broadcasting, during the early stages of his radio career, recognized his ability by electing him a member of the Board of Directors of the National Association of Broadcasters.

In appearance Mr. McCosker is of medium height and weight, slick dark hair and kindly dark eyes, olive skin and beautiful teeth. Wears conservative clothes, always well-dressed, with a white boutonniere and spats. Is married to a very charming lady who is seldom seen at the studios. Has one daughter, Angela Frances, whom he adores and rightly so, as she is a very beautiful creature.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING DECEMBER 27TH

Sun., Dec. 27: Moonshine and Honeysuckle, WEAF, 2:30 p.m.
Sun., Dec. 27: Footlight Echoes, WOR, 10:30 p.m.
Mon., Dec. 28: Singing Sam, WABC, 8:15 p.m.
Tues., Dec. 29: Eddy Brown & Symphony, WOR, 9:30 p. m.
Wed., Dec. 30: Sherlock Holmes, WJZ, 9:00 p.m.
Thurs., Dec. 31: Weaver of Dreams, WOR, 10:15 p.m.
Fri., Jan. 1: March of Time, WABC, 8:30 p.m.
Sat., Jan. 2: Miniature Symphony, WOR, 8:00 p.m.
Sat., Jan. 2: Jesse Crawford, Organ, WEAF, 11:15 p.m.

(If you would like to know something of your favorite radio artists, announcers or executives, drop a card to the conductor of this page. Address her, Miss Alice Remsen, care Radio World, 145 W. 45th St., New York, N. Y.)

N. Y. TO FLASH POLICE CALLS TO 250 AUTOS

The Police Department of New York City, completing plans for a radio system that will enable it to flash instructions to 250 squad cars cruising throughout the greater city, has contracted with the Western Electric Company for the installation of three transmitters.

According to the announcement made by Police Commissioner Edward P. Mulrooney, the main transmitter will be located at Police Headquarters on Center Street in Manhattan. This will have 1,000 watt capacity, but will actually operate at half that power. The two others will have a power of 400 watts. All three stations will operate on 2,450 kilocycles. One will be located in the Bronx, another in Brooklyn. The total cost of three stations will be about $46,000.

Crystal Controlled

Receivers are already being installed in the police cars. The system is expected to begin operation by the first of next year.

The 1,000 watt transmitter embodies the latest developments made by engineers of the Bell Telephone Laboratories in broadcasting equipment. It is crystal controlled. It produces a "flat frequency" curve over a range of from 30 to 10,000 cycles, which means that it responds with the same accuracy over the range of audible sound. As a result, tones high or low or in the middle register are put on the air with uniform fidelity. It can be adjusted to operate on any power output from zero up to its minimum.

The entire transmitter is on alternating current supply and consequently all batteries are eliminated. The apparatus represents such new developments that it has only recently been made available for use. A considerable number of transmitters of this type shortly will begin operating in broadcasting studios. New York will be the first city to have one for police use.

20 Cities Have Police Radio

The two 400 watt radio broadcasting transmitters are similar to those already in use by the police of about 20 cities throughout the country. Among these cities are Detroit, Pittsburgh, Minneapolis, Rochester, Louisville, Indianapolis, Toledo, Atlanta, San Francisco, Denver, Pasadena, Washington, D. C., Kansas City, Omaha, Memphis and Syracuse. Western Electric radio transmitters of a different type and of somewhat greater power are used by the police of Cleveland and Chicago, the latter operating three such stations.

The 400 watt transmitters are also developments of the Bell Telephone Laboratories. They may be adjusted easily and quickly to any frequency assigned for police work and crystal control assures that they will adhere to the assigned frequency to within .025 per cent. They can be fixed to operate on any frequency from 1,500 to 6,000 kilocycles.

Transmitters that generally resemble this type are in daily use by practically all the large air transport lines throughout the country, where they give 24-hour service in the radio-telephone network used for dispatching planes, giving weather information, etc.

Trade Show Next Month

Exhibit and demonstration rooms will be maintained at the Congress Hotel by manufacturers during the Chicago Radio-Electrical Show, January 18th to 24th.

Here manufacturers will hold sales conferences with jobbers an ddealers to evolve sales plans.

The Institute of Radio Service Men will hold its January convention concurrently with the show and, like the National Broadcasting Company and Columbia Broadcasting Sytsem, will make the Congress Hotel its headquarters.

The public will be received at the Coliseum where, for the past nine years, the annual show has been held.

HAILS ADVENT OF BIG VISION

The public interest in television as grown immensely with the reproduction of pictures large enough for the family to view together, marking the advance from the one-at-a-time peep-hole stage, says S. J. Spector. Discussing a projection outfit, he said the essential parts are a television motor, a neon lamp, a magnifying lens system, a "mirror screen," a shadow box and a compact, metal housing. He added:

"The scanning disc rotates in a horizontal plane. Along with the motor, it is below the deck, thus being protected from dust, moisture or inadvertent handling. A standard 60-hole, 16-inch disc is used, permitting the passage of maximum amount of light. The special type neon lamp is worked at low voltage, modulating readily and giving splendid light and dark contrasts.

"The lens system is arranged to give greatest possible enlargement. It is accurately corrected for spherical aberration, thus eliminating distortion. The image is viewed on an adjustable mirror screen. The transition from peep-hole to screen is of far-reaching importance. Naturally, the screen serves to widen the angle of vision considerably, allowing a larger group of persons to view the television programs. The reproduced pictures are very bright and clear and can be seen from almost any angle. A 5" square image is obtained, having three-dimensional depth. The mirror screen may be tilted so as to focus the pictures to suit the level of the observers' eyes. The shadow box brings out the fine details of the picture being received and also makes it seem brighter, since it shuts out extraneous light."

A. G. Heller, chief engineer of the Insuline Company, originated this device.

Ever since the one inch pictures came out users have been asking for projection.

239 Screen and Plate Voltages May Be Same

In announcing its 239 tube the Sylvania division of the Hygrade Sylvania Corporation points out that the screen voltage may be about the same as the plate voltage without serious loss. The voltage between heater and cathode should be kept low, the company states. The first announcement of the 239, by RCA and Cunningham, was printed in the December 12th issue. The Sylvania announcement follows:

"The 239 is an r-f pentode, having super-control characteristics. This tube belongs to the automobile series, which already includes the 236, 237 and 238.

"The 239 is a super-control pentode for use as a radio frequency and intermediate frequency amplifier in automobile receivers or any receiver operating from 110-volt power line. The term super-control is used to indicate that the tube is similar in characteristics to the variable or multi mu tubes, 236 and 551.

Advantages of D-C

'The 239 is designed with a suppressor grid between the screen and plate. The suppressor grid is connected to the cathode, thus operating at a much lower potential than the elements between which it is placed, and retarding the interchange of secondary electrons between these elements. It is this effect in the normal scren grid tube which makes it necessary to operate the plate at voltages well above the screen grid potential in order to secure high plate resistance. With the addition of the suppressor it is possible to operate the plate at the same, or even lower, voltages than that applied to the screen without serious loss in gain.

"The 239 is very effective in reducing modulation distortion and crosstalk. In the average automobile installation the advantages of this tube will not be as readily apparent, because of the relatively small antenna pick-up obtained due to the short antenna. The advantages of this tube will be more fully realized with d-c line operated receivers which employ longer antenna, and hence are subjected to considerably higher input signals.

"The cathode structure is similar to that employed in the 236. It is designed to insure adequate performance over the normal voltage variations of automobile battery during charge and discharge. This feature, together with that general freedom from microphonic and battery circuit disturbances of the heater cathode type, makes this new tube especially suited for use in automobile receivers. The voltage applied between heater and cathode should be kept as low as possible in order to minimize leakage effects in the insulator between heater and cathode.

Characteristics Given

The 239 is also well suited to the design requirements of radio receivers for operation from d-c power line. In such receivers the heaters of two or more 239 tubes may be connected in series to operate at 0.3 of an ampere. This is made possible by the design of the cathode, which will give satisfactory operation over the voltage range which will be encountered due to normal line voltage variations.

The tentative rating and characteristics are:

Heater Voltage			6.3 volts d-c.
Heater Current			0.3 amperes
Plate Voltage	90	135	180 volts maximum
Screen Voltage, Maximum.	90	90	90 volts
Grid Voltage, Variable...	—3	—3	—3 volts
Plate Current	4.4	4.6	4.65 milliamperes
Screen Current	1.6	1.7	1.75 milliamperes
Plate Resistance	300,000	450,000	680,000 ohms
Amplification Factor	285	450	700
Mutual Conductance	950	1,000	1,050 micromhos
Mutual Conductance at—			
—30 volts bias	15	15	15 micromhos
—40 volts bias	1	1	1 micromhos

BROADCASTING STATIONS BY FREQUENCIES—*Continued from Last Week*

1050 KILOCYCLES—*285.5 Meters*

Call letters	Main studo location	Licensee	Power	Time of operation
KFBI	Milford, Kans.	Farmers & Bankers Life Insurance Co.	5KW	Limited.
KNX	Hollywood, Calif. T—Los Angeles, Calif.	Western Broadcast Co.	5KW[15]	Unlimited.

1060 KILOCYCLES—*282.8 Meters*

WBAL	Baltimore, Md. T—Glen Morris, Md.	Consolidated Gas, Electric Light & Power Company of Baltimore.	10KW	Shares with WTIC.[15a]
WTIC	Hartford, Conn. T—Avon, Conn.	Travelers Broadcasting Service Corporation	50KW—LP	Shares with WBAL.[15b]
WJAG	Norfolk, Nebr.	Norfolk Daily News	1KW	Limited.
KWJJ	Portland, Oreg.	KWJJ Broadcast Co. (Inc.)	500W	Do.

1070 KILOCYCLES—*280.2 Meters*

WTAM	Cleveland, Ohio. T—Brecksville Village, Ohio.	National Broadcasting Co. (Inc.)	50KW—LP	Unlimited.
WCAZ	Carthage, Ill.	Superior Broadcasting Service (Inc.)	50W	Daytime.
WDZ	Tuscola, Ill.	James L. Bush	100W	Do.
KJBS	San Francisco, Calif.	Julius Brunton & Sons Co.	100W	12.01 a. m. to local sunset.

1080 KILOCYCLES—*277.6 Meters*

WBT	Charlotte, N. C.	Station WBT (Inc.)	5KW	Unlimited.
WCBD	Zion, Ill.	Wilbur Glenn Voliva	5KW	Limited. Shares with WMBI.
WMBI	Chicago, Ill. T—Addison, Ill.	The Moody Bible Institute Radio Station	5KW	Limited. Shares with WCBD.

1090 KILOCYCLES—*275.1 Meters*

KMOX	St. Louis, Mo.	Voice of St. Louis (Inc.)	50KW—LP	Unlimited.

1100 KILOCYCLES—*272.6 Meters*

WPG	Atlantic City, N. J.	WPG Broadcasting Corporation	5KW	Shares with WLWL.
WLWL	New York, N. Y. T—Kearny, N. J.	Missionary Society of St. Paul the Apostle	5KW	Shares with WPG.
KGDM	Stockton, Calif.	E. F. Peffer	250W	Daytime.

1110 KILOCYCLES—270.1 Meters

WRVA	Richmond, Va. T—Mechanicsville, Va.	Larus & Brother Co. (Inc.)	5KW	Unlimited.
KSOO	Sioux Falls, S. Dak.	Sioux Falls Broadcast Association (Inc.)	2½KW	Limited.

1120 KILOCYCLES (Canadian Shared)—*267.7 Meters*

WDEL	Wilmington, Del.	WDEL (Inc.)	250W 350W-LS[16]	Unlimited
WDBO	Orlando, Fla.	Orlando Broadcasting Co. (Inc.)	500W 1KW-LS	One-half time.
WTAW	College Station, Tex.	Agricultural and Mechanics College of Texas	500W	Shares with KTRH.
KTRH	Houston, Tex.	Rice Hotel	500W	Shares with WTAW.
WISN	Milwaukee, Wis.	Evening Wisconsin Co.	250W	Shares with WHAD.
WHAD	do	Marquette University	250W	Shares with WISN.
KFSG	Los Angeles, Calif.	Echo Park Evangelistic Association	500W	Shares with KMCS.
KMCS	Inglewood, Calif.	Dalton's (Inc.)	500W	Shares with KFSG.
KRSC	Seattle, Wash.	Radio Sales Corporation	50W	Daytime
KFIO	Spokane, Wash.	Spokane Broadcasting Corporation	100W	Do.

1130 KILOCYCLES—*265.3 Meters*

WOV	New York City. T—Secaucus, N. J.	International Broadcasting Corporation	1KW	Daytime until 6 p. m.
WJJD	Mooseheart, Ill.	Supreme Lodge of the World, Loyal Order of Moose.	20KW	Limited.
KSL	Salt Lake City, Utah	Radio Service Corporation of Utah	5KW	Unlimited.

1140 KILOCYCLES—*263.0 Meters*

WAPI	Birmingham, Ala.	Alabama Polytechnic Institute, University of Alabama and Alabama College	5KW	Shares with KVOO.
KVOO	Tulsa, Okla.	Southwestern Sales Corporation	5KW	Shares with WAPI.

1150 KILOCYCLES—*260.7 Meters*

WHAM	Rochester, N. Y. T—Victor Township, N. Y.	Stromberg-Carlson Telephone Manufacturing Co.	5KW	Unlimited.

1160 KILOCYCLES—*258.5 Meters*

WWVA	Wheeling, W. Va.	West Virginia Broadcasting Corporation	5KW	Shares with WOWO.
WOWO	Fort Wayne, Ind.	Main Auto Supply Co.	10KW	Shares with WWVA.

1170 KILOCYCLES—*256.3 Meters*

WCAU	Philadelphia, Pa. T—Byberry, Pa.	Universal Broadcasting Co.	10KW	Unlimited.

1180 KILOCYCLES—*254.1 Meters*

WGBS	New York, N. Y. T—Astoria, L. I., N. Y.	American Radio News Corp.	500W-LS	Shares with WCAC.
WDGY	Minneapolis, Minn.	Dr. George W. Young	1KW	Limited. Shares with WHDI.
KEX	Portland, Oreg.	Western Broadcasting Co.	5KW	Shares with KOB.
KOB	State College, N. Mex.	New Mexico College of Agriculture and Mechanic Arts.	20KW	Shares with KEX.
WMAZ	Macon, Ga.	Southeastern Broadcasting Co., Inc.	500W	

1190 KILOCYCLES—*252.0 Meters*

WOAI	San Antonio, Tex. T—Selma, Tex.	Southern Equipment Co.	50KW—LP	Unlimited.

1200 KILOCYCLES (Canadian Shared)—*249.9 Meters*

WABI	Bangor, Me.	Pine Tree Broadcasting Corporation	100W	Unlimited.
WNBX	Springfield, Vt.	First Congregational Church Corporation.	10W	Shares with WCAX.
WCAX	Burlington, Vt.	Burlington Daily News	100W	Shares with WNBX.
WORC—WEPS	Worcester, Mass. T—Auburn, Mass.	Albert Frank Kleindienst	100W	Unlimited.
WIBX	Utica, N. Y.	WIBX (Inc.)	100W 300W—LS	Do.
WFBE	Cincinnati, Ohio	Post Publishing Co.	100W 250W—LS	Do.
WHBC	Canton, Ohio.	St. John's Catholic Church	10W	Shares with WNBO Sundays.
WLBG	Petersburg, Va. T—Ettrick, Va.	WLBG Inc.	100W 250W—LS	Do.

(1200 *kilocycles continued on next page*)

[15] C. P. to increase power to 50 KW—LP
[15a] Synchronizes with WJZ on 760 kc. Also uses 760 kc.
[15b] Synchronizes with WEAF on 660 kc.
[16] C. P. to increase power to 500 Watts-LS. Also uses 660 kc

BROADCASTING STATIONS BY FREQUENCIES—*Continued*

1200 KILOCYCLES (Canadian Shared)—*249.9 Meters—Continued*

Call letters	Main Studio location	Licenses	Power	Tome of operation
WNBO	Washington, Pa.	John Brownlee Spriggs	100W	Shares with WHBC Sundays.
WCOD	Harrisburg, Pa.	Keystone Broadcasting Corporation	100W	Shares with WKJC.
WKJC	Lancaster, Pa.	Lancaster Broadcasting Service, Inc.	100W	Shares with WCOD.
WNBW	Carbondale, Pa.	C. F. Schiessler and M. E. Stephens, doing business as Home Cut Glass & China Co.	10W	Unlimited.
KMLB	Monroe, La.	J. C. Liner	100W	Daytime.
WABZ	New Orleans, La.	Samuel D. Reeks	100W	Shares with WJBW.
WJBW	do	C. Carlson	100W [17]	Shares with WABZ.
WBBZ	Ponca City, Okla.	C. L. Carrell	100W	Unlimited.
WFBC	Knoxville, Tenn.	First Baptist Church	50W	Do.
WRBL	Columbus, Ga.	WRBL, Inc.	50W	Do.
KGHI	Little Rock, Ark.	O. A. Cook	100W	Do.
KBTM	Paragould, Ark.	W. J. Beard, Beard's Temple of Music	100W	Daytime.
WJBC	La Salle, Ill.	Wayne Hummer & H. J. Dee, doing business as Kaskaskia Broadcasting Co.	100W	Shares with WJBL.
WJBL	Decatur, Ill.	Commodore Broadcasting Corporation	100W	Shares with WJBC.
WWAE	Hammond, Ind.	Hammond-Calumet Broadcasting Corporation	100W	Shares with WRAF.
KFJB	Marshalltown, Iowa	Marshall Electric Co. (Inc.)	100W 250W—LS	One-half time.
WCAT	Rapid City, S. Dak.	South Dakota State School of Mines	100W	Unlimited.
KGDY	Huron, S. Dak.	Voice of South Dakota	100W	Do.
KFWF	St. Louis, Mo.	St. Louis Truth Center (Inc.)	100W	Shares Shares with WIL.
KGDE	Fergus Falls, Minn.	Jaren Drug Co	100W 250W—LS	Unlimited.
WCLO	Janesville, Wis.	WCLO Radio Corporation	100W	Do.
WHBY	Green Bay, Wis. T—West De Pere, Wis.	St. Norbert College	100W	Do.
WIL	St. Louis, Mo.	Missouri Broadcasting Corporation	100W 250W—LS	Shares with KFWF.
KGFJ	Los Angeles, Calif.	Ben S. McGlashan	100W	Unlimited.
KSMR	Santa Maria, Calif.	Santa Maria Radio	100W	Do.
KWG	Stockton, Calif.	Portable Wireless Telephone Co. (Inc.)	100W	Do.
KGEK	Yuma, Colo.	Elmer C. Beehler, trading as Beehler Electrical Equipment Co.	100W	Shares with KGEW.
KGEW	Fort Morgan, Colo.	City of Fort Morgan	100W	Shares with KGEK.
KVOS	Bellingham, Wash.	KVOS (Inc.)	100W	Unlimited.
KGY	Lacey, Wash.	St. Martin's College	10W	Do.
WFAM	South Bend, Ind.	South Bend Tribune	100W	
WBHS	Huntsville, Ala.	The Hutchens Co.	50W	
WEPS	Worcester, Mass.	A. F. Kleindienst	100W	Shares with WORC.

1210 KILOCYCLES (Canadian Shared)—*247.8 Meters*

Call letters	Main Studio location	Licenses	Power	Tome of operation
WMRJ	Jamaica, N. Y.	Peter J. Prinz	100W	Shares with WCOH, WGBB, and WJBI.
WJBI	Redbank, N. J.	Monmouth Broadcasting Co.	100W	Shares with WCOH, WGBB, and WMRJ.
WGBB	Freeport, N. Y.	Harry H. Carman	100W	Shares with WCOH, WJBI, and WMRJ.
WCOH	Yonkers, N. Y. T—Greenville, N. Y.	Westchester Broadcasting Corporation	100W	Shares with WJBI, WGBB, and WMRJ.
WOCL	Jamestown, N. Y.	A. E. Newton	50W	Unlimited.
WLCI	Ithaca, N. Y.	Lutheran Association of Ithaca, N. Y.	50W	Do.
WPAW	Pawtucket, R. I.	Shartenberg & Robinson Co.	100W	
WSEN	Columbus, Ohio	Columbus Broadcasting Corporation	100W	Unlimited.
WJW	Mansfield, Ohio	John F. Weimer (owner Mansfield Broadcasting Association).	100W	Do.
WALR	Zanesville, Ohio	Roy W. Waller	100W	Do.
WBAX	Wilkes-Barre, Pa. T—Plains Township, Pa.	John H. Stenger, Jr.	100W	Shares with WJBU.
WJBU	Lewisburg, Pa.	Bucknell University	100W	Shares with WBAX.
WBBL	Richmond, Va.	Grace Covenant Presbyterian Church	100W	Certain hours Sunday only.
WMBG	Richmond, Va.	Havens & Martin (Inc.)	100W	Unlimited, except Sundays shares with WBBL.
WSIX	Springfield, Tenn.	Jack M. and Louis R. Draughon, doing business as 638 Tire and Vulcanizing Co.	100W	Unlimited.
WSOC	Gastonia, N. C.	WSOC (Inc.)	100W	Do.
WJBY	Gadsden, Ala.	Gadsden Broadcasting Co. (Inc.)	100W	Do.
WQDX	Thomasville, Ga.	Stevens Luke	50W	Do.
WRBQ	Greenville, Miss.	J. Pat Scully	100W 250W-LS	Do.
WGCM	Gulfport, Miss. T—Mississippi City, Miss.	Great Southern Land Co.	100W	Do.
KWEA	Shreveport, La.	Hello World Broadcasting Corporation	100W	Do.
KDLR	Devils Lake, N. Dak.	KDLR (Inc.)	100W	Do.
KGCR	Watertown, S. Dak.	Greater Kampeska Radio Corp.	100W	Do.
KFOR	Lincoln, Nebr.	Howard A. Shuman	100W 250-LS	Do.
WHBU	Anderson, Ind.	Anderson Broadcasting Corp.	100W	Do.
KFVS	Cape Girardeau, Mo.	Oscar C. Hirsch, trading as Hirsch Battery & Radio Co.	100W	Shares with WEBQ.
WEBQ	Harrisburg, Ill.	First Trust & Savings Bank of Harrisburg, Ill.	100W	Shares with KFVS.
KGNO	Dodge City, Kans.	Dodge City Broadcasting Co. (Inc.)	100W	Unlimited.
WSBC	Chicago, Ill.	World Battery Co. (Inc)	100W	Shares with WEDC and WCRW.
WCRW	Chicago, Ill.	Clinton R. White	100W	Shares with WEDC and WSBC.
WEDC	Chicago, Ill.	Emil Denemark (Inc.)	100W	Shares with WSBC and WCRW.
WCBS	Springfield, Ill.	Chas. H. Messter and Harold L. Dewing	100W	Shares with WTAX.
WTAX	Springfield, Ill.	WTAX (Inc.)	100W	Shares with WCBS.
WHBF	Rock Island, Ill.	Beardsley Specialty Co.	100W	Unlimited.
WOMT	Manitowoc, Wis.	Francis M. Kadow	100W	Do.
WIBU	Poynette, Wis.	William C. Forrest	100W	Do.
KMJ	Fresno, Calif.	James McClatchy Co.	100W	Do.
KFXM	San Bernardino, Calif.	J. C. & E. W. Lee (Lee Bros. Broadcasting Co.)	100W	Shares with KPPC.
KPPC	Pasadena, Calif.	Pasadena Presbyterian Church	50W	Shares with KFXM.
KDFN	Casper, Wyo.	Donald Lewis Hathaway	100W	Unlimited.

1220 KILOCYCLES—*245.8 Meters*

Call letters	Main Studio location	Licenses	Power	Tome of operation
WPRO	Providence, R. I.	Cherry & Webb Broadcasting Co.	100W	
KGMP	Elk City, Okla.	Bryant Radio & Electric Co.	100W	
WCAD	Canton, N. Y.	St. Lawrence University	500W	Daytime.
WCAE	Pittsburgh, Pa.	WCAE, Inc.	1KW	Unlimited.
WDAE	Tampa, Fla.	Tampa Publishing Co.	1KW	Do.
WREN	Lawrence, Kans.	Jenny Wren Co.	1KW	Shares with KFKU.
KFKU	Lawrence, Kans.	University of Kansas	500W	Shares with WREN.
KWSC	Pullman, Wash.	State College of Washington	1KW 2KW-LS	Unlimited.
KTW	Seattle, Wash.	First Presbyterian Church	1KW	

1230 KILOCYCLES—*243.8 Meters*

Call letters	Main Studio location	Licenses	Power	Tome of operation
WNAC-WBIS	Boston, Mass. T—Quincy, Mass.	Shepard Broadcasting Service (Inc.)	1KW	Unlimited.
WPSC	State College, Pa.	The Pennsylvania State College	500W	Daytime.
WSBT	South Bend, Ind.	South Bend Tribune	500W	Shares with WFBM.
WFBM	Indianapolis, Ind.	Indianapolis Power & Light Co.	1KW	Shares with WSBT.
KGGM	Albuquerque, N. Mex.	New Mexico Broadcasting Co.	250W 500W1LS	Unlimited.
KYA	San Francisco, Calif.	Pacific Broadcasting Corporation	1KW	Do.
KFQD	Anchorage, Alaska	Anchorage Radio Club	100W	Do.

17 license granted to increase power to this amount.

(Continued next week)

TWO NEW POLO PRODUCTS

Direct from Manufacturer to Consumer

Three-gang Stator-shielded Condenser with trimmers; full vision, illuminated dial; volume and switch control; tube shields for radio frequency and detector; 16 mfd. filter capacity. Rola dynamic speaker, 8", 1932 Model. Gothic Walnut Cabinet 19" high. Tubes used (2) 235; (1) 224; (1) 247; (1) 280. For 105—120 v., 50-60 cycles. Cat. PMT....$23.00
Chassis, Speaker, Cat. PMC..$14.95
Kit of Licensed Tubes, Cat. PT $4.05

CERTIFICATE OF HIGHEST MERIT AWARD FROM RADIO WORLD LABORATORIES

POLO MIDGET

$19.00

Complete with Kit of Arcturus or National Union Tubes $23.00

For $23.00 you receive a complete guaranteed and unequalled receiver, ready to operate

Our Unqualified Guarantee

We guarantee that the Polo Midget, Cat. PMT, is absolutely leader in its class, with unequalled Sensitivity, Thrilling Tone and Real Selectivity. Buy one—try it for five days. If you find as good a set at twice the price, or for any other reason don't desire to retain the set, we will promptly refund the purchase price. No other manufacturer thinks *that much* of his set.

If you desire a 5-tube set at a lower price we have it.

POLO JUNIOR MIDGET

The Polo Junior Midget, Complete with Arcturus Tubes (Cat. PJMT)

$18.00

Chassis with speaker, $12.95 Cat. PJC.

Full 5-tube set with 8" power dynamic speaker. The same tubes used as in the Polo Midget, with handsome Walnut Cabinet, 15½" high, 9" deep, 11½" wide. The same guarantee as on Polo Midget.

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