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(See Page 14)

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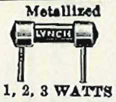

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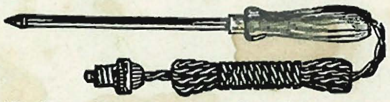

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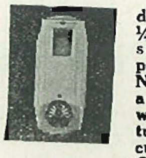

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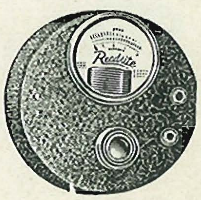

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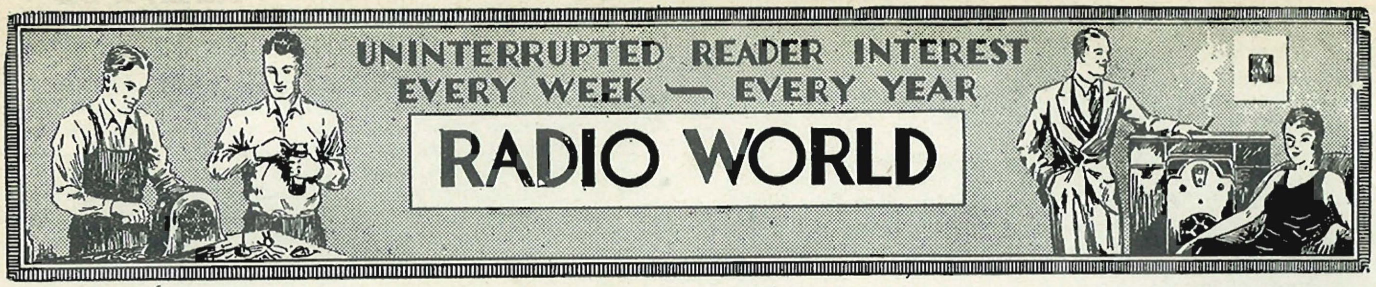

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175 kc Superheterodyne for Direct Current

By J. E. Anderson

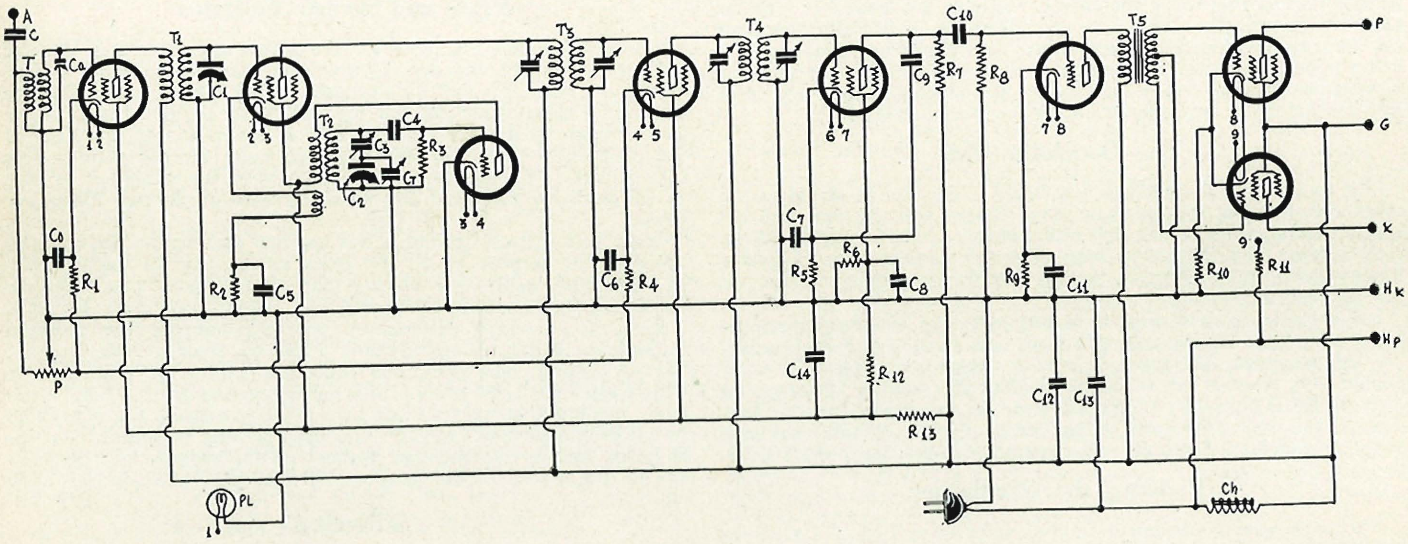

FIG. 1

This eight tube superheterodyne has been designed for operation on a 110 volt d-c line and automobile type tubes. The intermediate frequency is 175 kc.

THERE is a marked tendency toward the use of smaller tubes in receivers. This is especially the case in apartment houses where some people are considerate of their neighbors. Many radio fans have discovered that moderate volume is more pleasant than volume strong enough to shake the building. Another fact that favors the smaller tubes is that they are more economical to operate. This is an important feature in sections of the larger cities where the power supply is direct current. But sensitivity and selectivity have never been below par. They are just as desirable now as ever. In fact, fans are asking for more and more of them.

There is only one circuit which combines selectivity and sensi-

(Continued on next page)

LIST OF PARTS

Coils

T, T1—Two r-f transformers for 350 mmfd. condensers, as described
T2—One oscillator coil as described
T3, T4—Two 175 kc , doubly tuned intermediate frequency transformers
T5—One push-pull input transformer
Ch—One 30 henry choke coil.

Condensers

C, C4—Two 0.001 mfd. fixed condensers
Co, C5, C6—Three 0.1 mfd. by-pass condensers in one case
Ca, C1, C2—One gang of three 350 mmfd. tuning condensers, with trimmers
C3—One 700-1,000 mmfd. adjustable condenser, or one 760 mmfd. fixed condenser
C7—One 0.25 mfd. by-pass condenser
C8, C14—Two 0.5 mfd. by-pass condensers
C9—One 0.00025 mfd. condenser
C10—One 0.01 mfd. condenser
C11—One 1 mfd. by-pass condenser
C12, C13—Two 4 mfd., 200 volt d-c, by-pass condensers

Resistors

P—One 10,000 ohm potentiometer
R1, R4—Two 600 ohm bias resistances
R2, R5—Two 30,000 ohm bias resistances
R3—One 100,000 ohm grid leak
R6—One 1,000 ohm resistance
R7—One 250,000 ohm resistance
R8—One one megohm grid leak
R9—One 1,500 ohm bias resistance
R10—One 750 ohm bias resistance
R11—One 207 ohm, 25 watt, ballast resistance
R12—One 6,000 ohm resistance
R13—One 2,500 ohm resistance

Other Requirements

PL—One 2.5 pilot light (usually part of dial)
One dial
Nine UY type sockets (one for dynamic speaker)
One special 110 volt dynamic speaker
Six grid clips
One two-lead plug cable
Two 239s, two 236s, two 237s, two 238s.

(*Continued from preceding page*)

tivity in full measure, and that is the superheterodyne and the demand for these receivers is increasing. This is not alone due to the fact that most commercial receivers now are of this type, but rather to the recognized virtues of the super.

A Sensitive Super

In the January 30th issue we described an eight tube super for 110 volt d-c operation. Since that circuit appeared we have had requests for a more sensitive super of the same type, one using three tuning condensers instead of two and also one using a 175 kc intermediate instead of 400 kc. To meet these requests we have modified that circuit in a few essential particulars. These are, an added radio frequency tuner, cathode circuit modulation in the first detector, and the use of 175 kc intermediate frequency transformers. The use of a lower intermediate frequency requires a different oscillator coil and a different padding arrangement in the oscillator.

Any one desiring to build the receiver can use the layout of the eight-tube automobile superheterodyne published in the issue of Feb. 13, last week.

In the present circuit the two coils T and T1 are equal and are wound for 350 mfd. tuning condensers. They are standard coils as used in up-to-date midget receivers and are wound with 127 turns of No. 32 enameled wire on bakelite tubing one inch in diameter. The primaries are wound with No. 40 double silk covered wire over the ground end of the secondary, and separated from the secondary by several layers of insulating fabric or paper. The number of turns in the primaries of these coils varies according to the purpose of the set. Some have as many as ninety and others as few as five turns. The larger the number the greater the sensitivity but the less the selectivity so the choice in any case depends on the relative importance that is placed on these properties. Twenty-five turns is a good average.

These coils are placed inside metal cans measuring about 2.5x2.125 inches, the former being the height. Shields are available both in zinc and aluminum. There is no difference, essentially, between the two types of shield, except that the aluminum cans have a better appearance and the zinc ones have the advantage that soldered connections can be made directly to the shields. However, it is seldom that it is necessary to make such connections.

The Oscillator Coil

The oscillator coil should be put in the same type of shield as the other coils for the sake of symmetry. There are also standard oscillator coils available for 350 mfd. tuning condensers and 175 kc intermediate, and they have been designed for the type of modulation shown in this circuit, that is, for the cathode connection of the pick-up coil.

For those wishing to wind their own coils the following specifications are given: Diameter of coil form, one inch, wire for secondary No. 32 enameled, 102 turns, wire for tickler and pick-up No. 40 double silk, number of turns on tickler, 25, number of turns on pick-up 10. The tickler is wound over the ground end of the secondary and separated from it by several layers of thin insulator paper or fabric, and the pick-up is similary wound over the tickler.

Padding the Oscillator

The main tuning condenser in the oscillator is just like the tuning condensers Ca and Cl in the radio frequency tuners. It has a trimmer Cr across it just like those in the others, but it is adjusted to a different value. The series condenser C3 has a value around 760 mmfd. If a variable condenser is used it should have a range from 700 to 1,000 mmfd., and such a condenser is available. But it also may be a fixed condenser of 760 mmfd., which is also available. If the variable condenser is used the adjustment of the oscillator is simpler, but it can also be done quite easily with the fixed condenser, in which case the adjustment is made in the intermediate frequency transformers.

For a practical method of padding, or of adjusting the oscillator, the reader is referred to page 5, February 13th issue. This applies to the case when the series condenser C3 is adjustable. When it is fixed we have only the intermediate frequency adjusting condensers with which to effect the adjustment at the low frequency end of the tuner. The work is done in the same way as the adjustment when the series condenser is adjustable. First we have to find at what point on the r-f tuner some low frequency broadcast station comes in, say 570 kc. With this found, the tuner is set at this value and then each of the four intermediate frequency tuning condensers is adjusted for greatest volume. This will, in general, make the intermediate frequency different from 175 kc by a small amount, but that makes no difference. The important thing is to get perfect tracking at some intermediate frequency in the neighborhood of 175 kc. and to get all the intermediate tuned circuits adjusted to the same frequency.

Stabilizing Oscillator

C4 in the grid circuit of the oscillator has a value of 0.001 mfd. It is used to isolate the tuned circuit from the grid and to prevent considerable grid current from flowing. R3 is a 100,000 ohm grid leak which is used to establish a bias on the tube. The condenser and the grid leak together stabilize the oscillator frequency and at the same time they prevent excessive minimum capacity across the tuned circuit in the oscillator. The winding of the tickler over the ground end of the tuned winding and the winding of the pick-up over the tickler are also to minimize the zero setting capacity in the oscillator circuit.

The two intermediate frequency transformers with their tuner condensers are mounted in shields similar to those used for the higher frequency transformers, and they are of the same size.

The coupling between the detector and the first audio amplifier is by resistance. This is used to obtain as good quality as possible and also to allow the use of a screen grid tube for detector. The use of a 237 aaudio amplifier is for the purpose of permitting push-pull in the output, since a transformer cannot be used effectively after the screen grid detector.

Bias by Voltage Drops

Wherever grid bias is needed, which is on all the tubes with the exception of the oscillator, it is obtained by resistances in the cathode circuits. Thus in the first tube, which should be a 239 pentode, a 600 ohm bias resistance R1 is used. This is by-passed with a 0.1 mfd. condenser Co. In the modulator a 30,000 ohm bias resistance R2 is used, and this is by-passed with another 0.1 mfd. condenser C5.

The single intermediate frequency amplifier tube, which should be a 239 pentode, is biased with a 600 ohm resistance R4, and this is shunted with another 0.1 mfd. condenser C6. The detector tube, which is a 236 tube, is biased by means of a 30,000 ohm resistance R5. The by-pass condenser C7 across this resistance should be 0.25 mfd. or larger.

A 1,500 ohm bias resistance R9 is used on the 237 audio frequency amplifier tube. For effectiveness the condenser C11 across this resistance should be about one microfarad. In the output stage a common bias resistance R10 is used for the two 238 pentodes. The proper value for this bias resistance is 750 ohms. No by-pass condenser is needed across this resistance since the circuit is balanced. However, no harm will result if a one microfarad or larger condenser is used across it.

Plate and Screen Voltages

The only voltage available for the plates and screens is the line voltage, which is nominally 110 volts but may be somewhat higher. However, some of this is dropped in the filter choke Ch, the amount of drop depending on the resistance of the choke. If we assume that the line voltage actually is 115 volts and the drop in the choke is 5 volts, we still have 110 volts for the plates. This full voltage is applied to all the plates with the exception of that of the oscillator tube, and also on the screens of the two 238 power tubes.

With this voltage on the plates we are justified in applying 70 volts on the screens of all the tubes except that of the detector. We can also apply this voltage on the oscillator tube. On the screen of the detector we should not apply more than 10 volts.

With this voltage distribution we can compute the required resistances in the voltage divider. First we shall assume that the bleeder current, which we may choose at will, is 10 milliamperes. This makes R6 1,000 ohms. The screen current to this tube is entirely negligible so that we can also assume without any error that 10 milliamperes flow in R12. The drop in this resistance is to be 60 volts, that is, the required voltage on the screens less the voltage on the screen of the detector. Therefore R12 should be 6,000 ohms.

Filtering

Now we have only R13 left. In this the current is greater than 10 milliamperes because the screen current to the two 239 pentodes and the plate current of the oscillator also flow in it. The screen current in the modulator can be neglected, for it is extremely small. The oscillator plate current is not more than 4 milliamperes and the screen current in each of the r-f pentodes is not more than one milliampere. Hence the total current in R13 is approximately 16 milliamperes. The drop in this resistance is 110 volts less 70 volts, or 40 volts. Therefore R13 should be 2,500 ohms.

Very little filtering of the plate voltage need be done because the line voltage is comparatively free from hum in the first place. A 30 henry choke Ch, or even a choke of lower inductance, is sufficient, in conjunction with a couple of condensers C12 and C13 of about 4 mfd. each. It is not necessary to use electrolytic condensers. Indeed, it is not even desirable because of the danger of getting the polarity of the voltage wrong. This would damage the electrolytic condensers, whereas it will do no harm at all to ordinary paper condensers. Neither do the condensers have to be of high voltage rating since the voltage will never exceed 120 volts. Condensers rated at 200 volts d-c will do, and these are inexpensive. C8 and C14 across the voltage divider sections need be no larger than 0.5 mfd. each, and of course, the voltage across them will not be even as high as that across the others. Hence low rating condensers will do here too.

Since this circuit is to be used on a 110-volt d-c line it is best to connect the heaters of the tubes in series. The order in which they are connected is unimportant, and they may be connected in the order indicated by the numbers associated with each heater. These numbers run from 1 to 9.

Precautions

The pilot light should also be connected in the series, and it should be put between the chassis of the set and the first tube. The reason for this is that the pilot light is usually mounted on the dial and turns with it, thus being connected with flexible leads.

(*Continued on next page*)

A Four Tube A-C Set

Phonograph Amplifier Uses Two A-F Stages

By Constantin Merwin

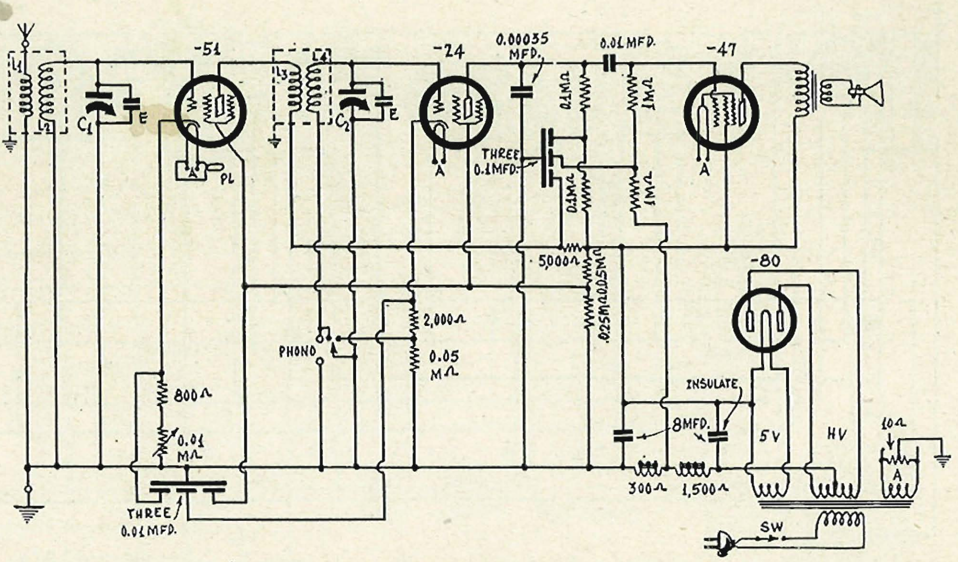

FIG. 1

A four-tube a-c receiver, pentode output, with a special switching arrangement for phonograph connection whereby the detector is converted into an amplifier, to give the required two-stage audio gain for satisfactory phonograph volume.

EVERY so often some one insists on a four-tube a-c design, wants to build it, and usually finds no diagram to point the way. But Fig. 1 shows the circuit as it has been built with excellent results in quality, but not as much selectivity as modern conditions require. In fact, the general lack of diagrams of four-tube models is due to the lower order of selectivity performance, as compared to the five tube model that costs only a very little extra and which is covered by Blueprint 627. While it is realized that some four-tube commercial midgets were on the market, the five-tube midgets took the business away from them, and for the reason stated, besides the extra sensitivity.

So it is not with any great encouragement that the circuit is presented, except that if one is particularly keen on quality, lives in a locality where half a dozen or so locals are transmitting, and does not want much volume, the circuit will fill the needs.

On the score of quality, there is no danger whatsoever of side-band cutting, as local stations 50 kc apart proved there was good transmission through the set at 25 kc. Each station came in alone, but just midway between two stations both heard.

Excellent Phonograph Amplifier

The radio performance may not be rated very seriously. However there is provision for phonograph pickup, so that two stages of audio amplification are used, and thus the phonograph service is excellent. The switching arrangement is not often shown, and therefore will be detailed.

The phonograph connection would be made to jack posts between ground and the intended ground end of the secondary of the interstage coupling transformer. If no pickup is used, then the switch is thrown to the left, and the r-f coil becomes grounded. So it makes no difference if there is a pickup in circuit or not, the radio purposes are served nevertheless, and if there is a pickup it may be left connected at all times to the phono post jack posts.

If it is desired to use the pickup connection, then the switch is thrown to the right, in which case the pickup winding will return the tube grid to ground, and the switch will short out the 0.05 meg. (50,000 ohm) section of the biasing resistor, leaving some smaller value in circuit, which may be from 2,000 ohms to 5,000 ohms. The object is to change the operating characteristic of the —24 tube. Primarily it is a detector, but for phonograph pickup we desire the tube to be an amplifier. The only change necessary is reduction in the negative bias. For amplification, with small input, as from a pickup, the bias may be only a fraction of a volt negative, but anything up to 1.5 volt may be used. The bias will be about 0.1 volt per 1,000 ohms.

More Volume

This pickup connection has its advantages, since connection simply to the input of the pentode will not result in enough volume to satisfy most persons. And yet so many sets have only one stage of audio—the output tube is the only audio amplifier because it is pentode, and therefore is highly sensitive—yet two stages are really required for phonograph work. So we change the detector to an amplifier and have our really necessary two stages in grand style. So the circuit may be regarded as a fine phonograph ampliger, with a little radio on the side.

The phonograph switch is of the single pole double throw type, and may be a toggle, although if a phone plug is used for the phonograph connection the switching may be done by a switch-jack. This is not to be confused with the phonograph jack previously referred to, which is moulded assembly with two pin jacks inset, to receive the phonograph pickup's tipped leads.

As for parts, L1L2 and L3L4 are alike, for 0.00035 mfd. for C1. They consist of 127 turn secondaries on 1 inch diameter, primaries wound over secondaries near one end, insulation between windings, and 15 turn primaries. For 1⅛ inch diameter the secondaries for this capacity consist of 120 turns, primaries same as before. For 0.0005 mfd. 1 inch diameter, 100 turn secondaries, 1⅛ inch diameter, 95 turn secondaries, primaries the same as previously. The wire for secondaries is No. 32 enamel or thereabouts. Primaries may consist of any kind of insulated wire.

Tone Control

All the resistors may be of the 1 watt type, except the 10 ohms across the 2.5 volt heater winding.

The field coil of the dynamic speaker is used as the B supply choke and bias resistor for the pentode. Therefore the resistor-capacity filters are necessary in the detector plate and pentode grid circuits, these consisting in this circuit of 0.1 meg. and 1 meg., the bypass capacities being 0.1 mfd., but capacities may be larger, if you happen to have larger capacities on hand, say, up to 1 mfd.

If the 1 meg. leading directly from grid of pentode is replaced by a potentiometer (used as rheostat), then you also have a tone control. A value of 0.5 meg. will do for the potentiometer. The device would have to be insulated from a metal chassis.

Expert Design of 110-Volt D-C Set

(*Continued from preceding page*)

If the light is connected next to the chassis, any short in the flexible leads will only short the pilot light. It will not stop the set from playing and it will not do any damage.

A ballast resistance should be placed at the other end of the series, that is, between the last tube and the positive side of the line. This ballast is R11. To determine its correct resistance value we have to take into account the total drop in the series, the line voltage, and the current that should flow. Each of the tubes takes 0.3 ampere, and the pilot light will carry the same. The drop in each tube is 6.3 volts, on the average, and the drop in the pilot light is 2.5 volts, for a lamp of this voltage rating can be used. Hence the total drop is 52.9 volts. We have assumed that the line voltage is 115 volts. Therefore the voltage to be dropped in R11 is 62.1 volts. Since the current is 0.3 ampere, the resistance value of R11 should be 207 ohms. It will do no harm if the resistance is 200 ohms, but if it is much more than 207 ohms, the sensitivity of the set will be considerably less than it should be.

The wattage dissipated in the ballast is 62.1x0.3, or 18.63 watts. Hence the rating should be at least 25 watts.

Anderson's Auto Super
It Brings in DX 10 KC from Locals
By J. E. Anderson

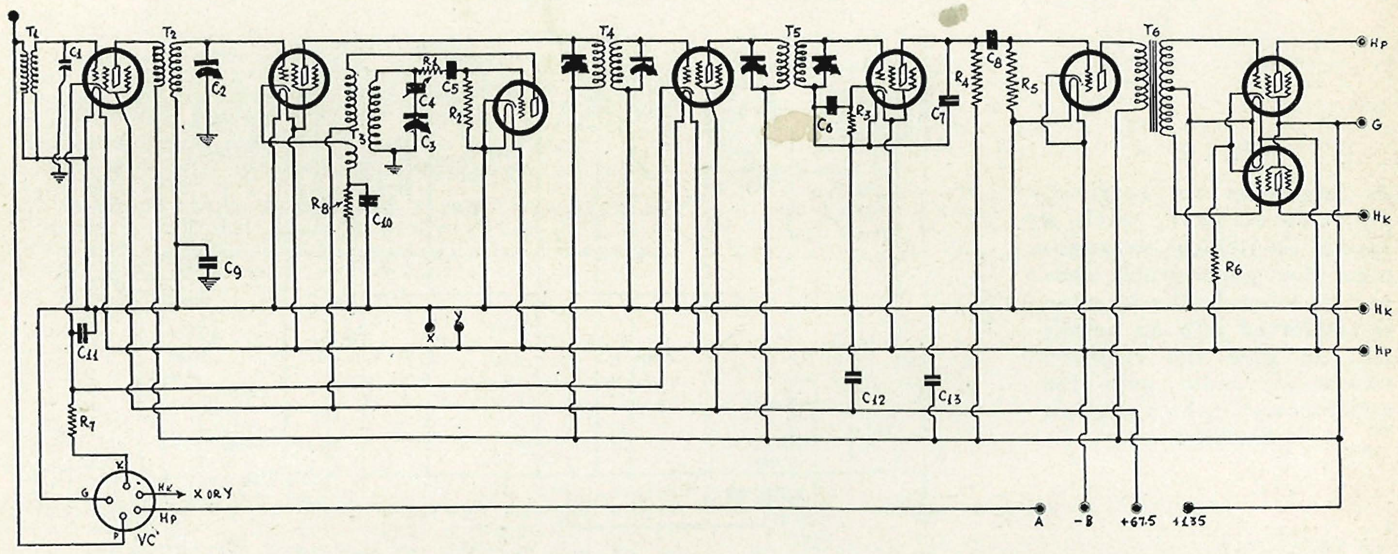

FIG. 1.

This 8-tube automobile set has a sensitivity of 10 micr ovolts per meter, uses 400 kc. intermediate frequency, is therefore "one spot" from 700 to 1340 kc., and works well even on a 6-foot aerial and no ground.

[The automobile set discussed herewith was analyzed in detail in last week's issue, dated February 13th. This week the parts are listed and a few additional details given. This is the best auto circuit we have ever published and is covered by Blueprint No. 631. —EDITOR.]

EXPERIMENTS with the 8 tube superheterodyne have demonstrated that the idea of a 400 kc. intermediate frequency is sound. The circuit was equipped with 239 tubes for r-f and i-f amplifiers, 236 tubes for detectors, 237 for oscillator and first audio frequency amplifier, 238 tubes for power amplifier, and the output was delivered to a special dynamic speaker designed for the push-pull 238 tubes and 6 volt field. The circuit was grounded but no other antenna than a six foot wire on the floor was used. Under these conditions all local stations came in with tremendous volume. But the fact that the set could bring in the local stations was no test, for if a circuit for an automobile does not bring them in with very good volume it may as well not be put in a car.

Test on DX

The tesst came when distant stations were tuned in through the locals. Thus WLW came in strong through WOR, a strong local separated only 10 kilocycles from WLW. WEAF is even a stronger local station in the locality where the set was tested, yet one station on each side of WEAF came through with strong volume without any interference from the local giant. No attempt was made to identify the stations but one of them is located in Chicago and the other in Nashville, each operating on 5,000 watts. There are several other stations on these two waves, 650 and 670 kc, but they are small and located at greater distances.

In turning the dial slowly from one end to the other the same story was repeated. Stations close in frequency to strong locals were tuned in with fair volume and no interference from one end of the dial to the other.

WMCA is a local operating on 570 kc. WFI is a Philadelphia station operating on 560 kc. Both came in without mutual interference.

Station on Every Channel

At the high frequency end of the dial there was a station on every channel. Not all of these came in clear because in several instances there were two stations operating on the same channel, though not on the same frequency. The beat between them could be heard as a fluttering. It was a tribute to the set that it could bring them in even in this manner. Next to one of these fluttering twins a station would come in strong and clear, the interfering station, if any, being too far removed, or too weak at the origin, to cause any noticeable interference.

It is quite customary to disregard any lack of selectivity on the high frequency end of the dial and dismiss it with the statement that there is no entertainment value in them anyway. This is just an excuse for a poorly selective set. With this set there was considerable entertainment value in many of the lower wavelength stations because most of them could be received without any disturbances from neighboring stations. It is often said that the 238 tubes, even when used with a speaker designed for them, do not give sufficient undistorted volume for home purposes. This is not so. The quality from this set was good and there was lots of volume.

LIST OF PARTS

Coils

One set of three shielded automobile coils, consisting of two identical t-r-f coils and one oscillator coil.
One set of two shielded intermediate frequency transformers, 400 kc, primary and secondary tuned, Hammarlund superheterodyne condensers built in.
One push-pull audio frequency input transformer.

Condensers

One three-gang 0.00035 mfd. tuning condenser, trimmers and sectional shields built in.
One set of four 0.25 mfd. tubular bypass condensers.
One shielded block containing three 0.1 mfd. condensers.
One 0.0015 mfd. mica bypass condenser.
One 0.00035 mfd fixed condenser.
One 0.1 mfd. tubular bypass condenser.
One Hammarlund adjustable padding condenser 350-450 mmfd.

Resistors

One set of eight pigtail resistors consisting of two 300 ohm, one 10,000 ohm, two 30,000 ohm, one 100,000 ohm, one 250,000 ohm, one 1,000,000 ohm.

Other Requirements

One set of ten wafer sockets consisting of one marked VC for remote control connection, one marked SPK for speaker connection, two marked 239, two marked 236, two marked 237 and two marked 238.
One set of six grid clips.
One remote control tuning and volume control unit, consisting of dial, two cables, 10,000 ohm potentiometer, pilot light, switch key, clamp, pulley, counterspring and UY plug.
One 7⅛ x 11 9/16 x 2¾ inch drilled steel chassis, one steel cover to fit over chassis, and one removable front for cover, front pierced at two places to receive remote control and speaker plugs, and one B battery box.
One four-lead cable, 8 ft. long., for A and B battery connections.
One set of six spark suppressors, to go on spark plugs, and one 1 mfd. bypass condenser, to be connected to commutator.
One dynamic speaker for autos, with 6 volt 4-ohm field, 1.5 amperes.
One special auto aerial, to go under the running board, two brackets to hold aerial 6 inches from board.
Two dozen 6/32 screws and two dozen nuts.
One set of four 6/42 Parker screws.
One roll of hookup wire, 25 feet.
Tubes: two 236, two 237, two 238, two 239.

Elimination of Hum

Causes of Nuisance and Ready Remedies

By Neal Fitzalan

HUM'S a common cause of a trouble in a-c receivers, even in these days, and also it is true that a receiver that does not hum at the factory may hum in a customer's home, so there must be some association of location with hum. It is not only the receiver that must be analyzed, therefore, but the location as well.

The principal causes of hum are: (1), poor filtration; (2), open grid circuit; (3), antenna-ground circuit of the receiver.

As for filtration, it is usually quite sufficient to use a B supply choke coil, with 8 mfd. capacity next to the rectifier and 8 mfd. at the output of the filter system. The choke has a nominal inductance of 30 henries, and it may be the field coil of a dynamic speaker. It is assumed that the heater circuit is grounded, and since nowadays the same 2.5 volt winding serves heater type and power tubes as well, grounding usually exists. It may be through a condenser and resistor, as where separate biasing of the output stage is provided, or, where the B choke is in the negative leg, the 2. volt center is grounded (Fig. 1).

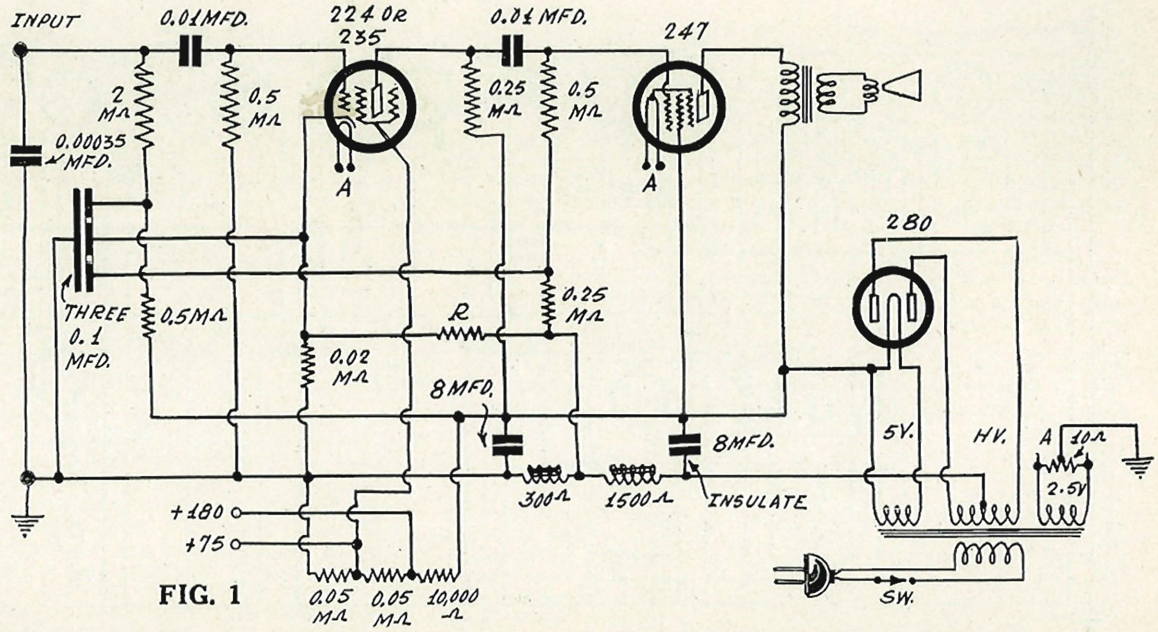

FIG. 1

Resistor-Capacity Filters

Wiith resistance coupled audio there is likely to be more hum than with transformer coupling, because frequencies of hum (60 and 120 cycles, particularly the latter), are well amplified. Therefore additional filtration is provided, resistor-capacity circuits, either in the power tube's grid circuit, or additionally in the detector plate circuit. The capacities, shown as 0.1 mfd., may be increased to 1 mfd. further to reduce hum. In fact, the hum is virtually killed.

If audio regeneration is used, as by including the resistor R, then the hum may go up a little, and to atone for it, the first audio grid circuit may be subjected to resistor-capacity filtration, the value of resistance not being so important as that of the capacity. In fact, resistors of from 0.02 meg. (20,000 ohms) up may be used.

Another alternative is to put a condenser from one B plus post of the voltage divider to another B plus post, this being a sort of hit or miss proposition, because it depends on dephasing the voltages, due to the condenser introduction from points of existing resistance. No set values can be given without foreknowledge of the resistances and other factors, but from 0.05 mfd. to 0.5 mfd. have worked satisfactorily, when the correct value is found.

Check for Open Grid

It should be noted that when the bias for the output tube is taken from the drop in a negative-leg choke, as in Fig. 1, that such part of the choke as is used for bias is in the power tube's grid circuit, and therefore the hum introduction will be greater than if the power tube were biased in the more usual way, through the voltage drop in an independent resistor through which only the power tube's fully filtered plate current flows. Hence the resistor-capacity filters previously discussed become imperative. But the circuit finally is one as free from hum as others.

An open grid circuit will cause hum, and careful check should be made for this cause, as the trouble is one that easily eludes the service man or experimenter. If the grid is open there is no bias, so connecting a wire from grid to B minus, with a meter in the tube's plate circuit, will disclose whether the open exists. The plate current through the tube will decrease considerably when an open circuit is closed that way.

The antenna-ground condition is an unusual one. If the chassis is metal, most likely it is grounded, and the return of the antenna coil is made to the chassis, e.g., to an uninsulated binding post thereon. The aerial circuit hum is peculiar in that hum exists on some stations, not on all, and has been called tunable hum.

Reason Disclosed

Until recently the reason for this hum was not known, but now it is pretty generally regarded as being caused by the capacity to ground in the power transformer. At certain radio frequencies the aerial return finds its path of least resistance through the power transformer, and thus the r-f input becomes modulated with the hum, meeting it, as it were, in wholly or partly unfiltered condition. At those frequencies where the chassis itself (external ground) affords the path of least resistance to ground, the hum is not heard. The proposed remedy is to isolate the external ground. Connect it to the end of the antenna winding only, and leave the chassis take such ground as is afforded through the capacity to ground in the power transformer. This method actually works, but it does reduce a little the r-f input to the receiver. It is better to have reduced r-f input, however, than intolerable and even otherwise baffling hum, especially as primary can be enlarged on r-f transformers, or on the antenna coupler alone, to build up the volume.

Additional Choke

One may also add another B choke to one already in the positive leg of a rectifier filter. A condenser always should be next to the rectifier, for minimum hum, as choke input methods are hum-provocative. It is also true that the midsection condenser, whatever capacity, sometimes adds to, instead of diminishing, the hum. Tests should be made as to inclusion and exclusion, and if exclusion is decided on, then the extra capacity may be added to the end of the rectifier filter.

One diagram shows the B plus lead taken from one side of the rectifier filament, another diagram shows it taken from center tap, but neither connection has any bearing on hum, and there is no object in introducing a center-tapped resistor. One side of the filament is fully as good as a center tap on the winding for taking off this voltage.

R-F Filtration

Radio frequency filtration should not be neglected. Resistor-capacity filters in screen and plate leads, along lines discussed in audio connection, will help, but if there is much hum the reason does not lie in this direction.

Ironing Out Som
in an All-Wav

By Fran

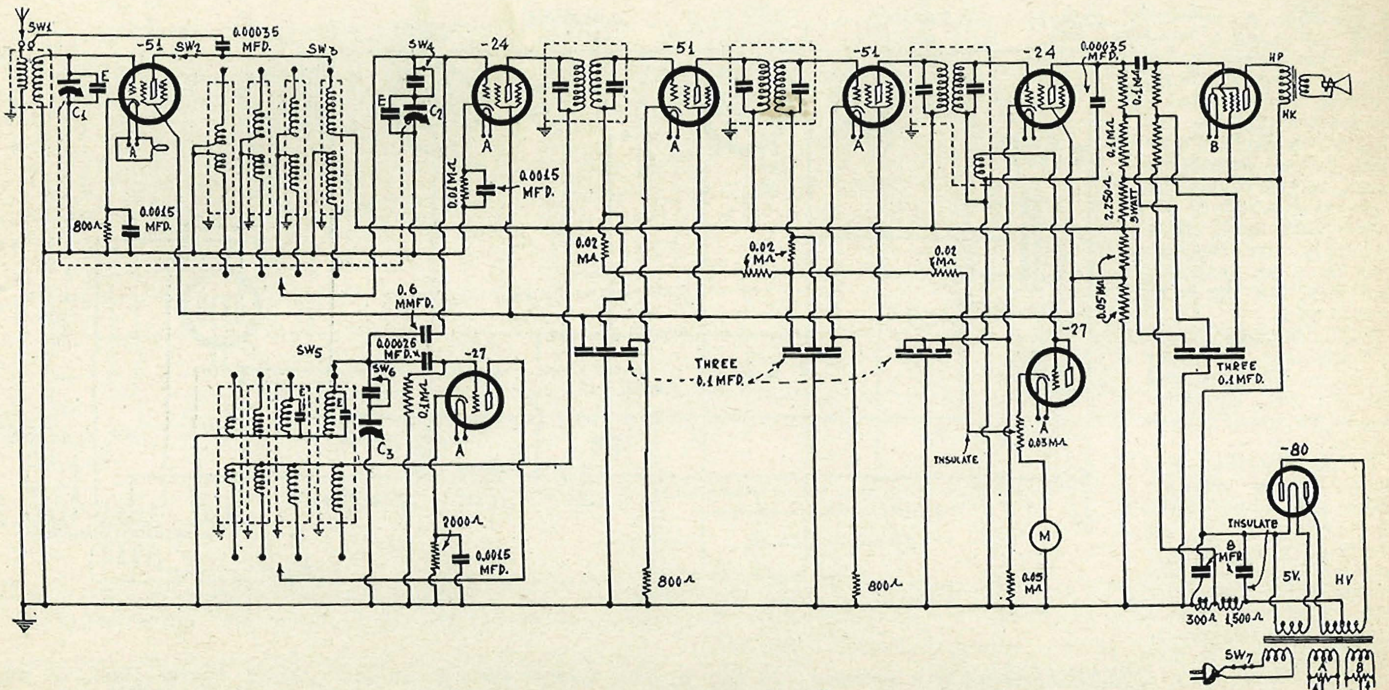

FIG. 1

Some of the problems of an all-wave superheterodyne, based on this diagram, are discussed in the article herewith.

THE problems associated with the design of an all-wave receiver, meaning from about 15 to about 550 meters, are many, so that the completion of a really satisfactory circuit is difficult. A solution to some of the problems will be found in Fig. 1, and it is the purpose to outline the circuit on the basis of the main difficulties.

A superheterodyne circuit was chosen because high selectivity thus could be attained, as well as much-needed sensitivity. For the broadcast band a stage of tuned radio frequency amplification is necessary, as the selection must be of a higher order than afforded by the modulator tuning alone, because the intermediate frequency is 175 kc. If it were higher the need would be less, but it has been found that even for 400 kc intermediate frequency it is still desirable to have the t-r-f stage.

Therefore the nine tubes of the circuit are worked for the broadcast band, but as soon as the short-wave band is reached there is no need for this extra tuning, principally because it would help, if at all, only on the basis of complicated switching. As it is, the switching is extensive enough.

Untuned Stage Avoided

The first tube is left lighted, but isn't used on short waves, for since there is no tuning, if the tube were used it would be in an untuned stage, and experiments have shown that untuned stages are a detriment on short waves. They may help over certain frequency spans, but over other spans they act more in the nature of a short circuit than anything else.

When the switch SW-1 is thrown to the left, Fig. 1, aerial connection is established at the primary of the antenna coupler. When the switch is thrown to the right the aerial input is through a fixed condenser of 0.00035 mfd. to the primary of the short-wave antenna couplers, one at a time. Thus the switching should be such that when short-wave coils are picked up the aerial is thrown automatically to the short-wave primary, and besides this primary then is grounded, whereas for broadcasts it goes to B plus. It is advisable for reasons of hum minimization to avoid a ground return for the antenna input through the B supply.

Whenever a primary is switched a secondary is switched. The primaries are proportioned correctly for the frequencies concerned. In this regard the tickler winding for the oscillator may be considered as a primary.

Since for the broadcast band tuning condensers of 0.00035 mfd. may be used, the secondaries are wound accordingly, but for short waves, except the first short-wave band, this capacity is too high, therefore two semi-fixed condensers are cut in as series devices, so that the capacity in circuit really is approximately halved. This change may be made automatically with a proper combination switch. Excellent condensers for this purpose are of the superheterodyne padding type, 350-450 mmfd. These may be adjusted once, on the second short-wave band, and left undisturbed.

The tuning condensers consist of a two-gang, for use on the broadcast band, and an independent for the oscillator, so that no padding would be necessary, yet to keep the dial readings nearly alike parallel padding is used in two instances to reduce the capacity ratio, hence frequency ratio, broadcast band and first short-wave band. The parallel condensers, E, are 20-100 mmfd. equalizers.

So the oscillator always is independently tuned. For the two remaining short-wave bands it is unnecessary to do any padding, as the dial settings are almost identical, in other words, 175 kc, the intermediate frequency, is a relatively small percentage of the original carrier frequencies being tuned in.

Capacity Coupling in Mixer

It would be better for image interference elimination if the percentage were higher, as would be true at 400 kc intermediate, but some intermediate frequency has to be selected, 175 kc is popular these days, many have transformers for this frequency, and besides the disadvantage, which is one concerning selectivity, is partly compensated by the individual oscillator tuning.

Coupling between the oscillator and the modulator is effectuated by a very small condenser, 0.6 mmfd., but that is plenty large enough for the broadcast band and therefore also for short waves. The advantage of using so small a capacity is that, while sensitivity is less, selectivity is greater on the broadcast band, where selectivity is of paramount importance. For short waves the coupling is sufficiently close by this method, to say the least.

The greater the electrical separation between the oscillator and modulator circuits, the greater the independence of tuning, hence the greater the selectivity, provided there is some coupling. The trouble with close coupling is that the two circuits tend to tune as one, that is, one pulls the other, and they become resonant really to only one frequency. The oscillator voltage being much greater than the modulator voltage, the oscillator pulls the modulator.

The intermediate amplifier is always a possible source of trouble, because of oscillation. Grid circuit filtration is used in conjunction with necessary connections to an automatic volume control tube (-27), but in addition the leads to and from the intermediate transformers have to be kept short, as well as the transformers being shielded, the shields connected to ground, which may be a grounded metal chassis. The voltage for the plates of the intermediate tubes must be below the maximum B voltage obtainable, therefore a resistor of 2,250 ohms is used to reduce the voltage to around 200 volts, while the 800 ohm cathode resistors supply a steady bias of 3 volts or a little more, necessary under the circumstances, especially

Common Troubles Superheterodyne

Forbes

when no signal is being received. When a signal is coming through, the steady bias thus provided is augmented by the extra bias from the a-v-c tube. It should be borne in mind that in reality the a-v-c tube provides a voltage negative even in respect to B minus, the usually considered negative lead of an a-c receiver.

Because of this automatic volume control the intermediate tubes should be of the variable mu type, either the -51, as imprinted on the diagram, or the -35. For selectivity objects, also, the first or t-r-f tube is of the same type. But the modulator must be a -24, as the -51 and the -35 are no good for modulation.

If there is oscillation in the intermediate amplifier then it will be necessary to put resistor loads in the screen leads and not bypass them. These loads would go from individual screens to the common screen lead and would consist of resistors of 0.02 meg. (20,000 ohms) or greater resistance value. It should not be necessary to filter the plate circuits under that condition.

Reversal of Leads

One precaution that should be taken, if squealing is experienced in the intermediate channel, is reversal of the leads on one of the coils in one of the intermediate transformers. For instance, reverse the primary or secondary of the first intermediate coil, whichever is handier, and if no improvement results, restore the lead and make a similar change in the last intermediate transformer. Reversing connections means that, for instance, the lead that went to plate now goes to B plus, and the one that went to B plus now goes to plate.

However, lead reversal is not of much use in some instances, and it may be that reversals will do no good but harm instead. It then tends to prove that the stray coupling between or among stages is entirely too great and may be due to excessive inductive coupling or to capacity coupling as well. If it were capacity coupling, neutralization could be effected by putting a small adjustable condenser, say of 20 mmfd., from plate of one tube to plate of either of the remaining tubes, ascertaining whether feedback is stopped by adjustment of this condenser.

It is well, in the beginning, to mount the intermediate transformers so that the second is at right angles to the first, and the third is at right angles to the second, as having each one at right angles to the two others is not handy with modern transformers that are to be mounted in a particular position, for instance, upright. However, if you can manage it in the total right-angle manner, do so.

Determination of Screen Voltage

On inspection it will be found most likely that the intermediate transformers consist of honeycomb coils, and that they are mounted parallel in respect to each other. Therefore turn the second transformer so that its coils are at right angles to the first, and the third so that its coils at right angles to the second. When this is done the reversal of connections may prove an effective remedy. Under conditions of unparticular mounting the suggestion for reversed connections is likely to prove of no benefit.

The screen voltage is something that has to be watched with a hawk's eye. Very few persons who build receivers at home really know what the screen voltage is. The resort to measurements taken with a voltmeter of even 1,000 ohms per volt sensitivity is likely to prove of little value, because of the error.

One way to determine the voltage, in the absence of an electrostatic voltmeter, is to put a less sensitive milliammeter in series with the voltage divider, between ground and the lower 0.05 meg. resistor at right, ascertain the current, multiply the current in amperes by the measured value of this assumtively 0.05 meg. resistor, and subtract the result from the voltmeter reading between the assumed 200-volt tap that feeds the tubes forward of the detector. If it is desired to lower the screen voltage, the resistor just discussed, 0.05 meg. connected toward ground, may be smaller instead, or another similar or larger resistor put in parallel with the 0.05 meg.

Lower Screen Voltage

While the standard recommendation is 90 volts for the screens, at 180 volts on the plate, it is all right to use a lower voltage, even 200 volts on plate, and it may be necessary to do so for complete stability in the intermediate channel.

The question of stability has some reference to the a-c line voltage, and as this is not sure, and even varies from time to time in suburban sections, experiments are necessary for a satisfactory determination of the correct value of resistor to use.

The output stage is more or less standard, two 2.5 volt windings are shown, but one may be used instead, if it will stand the drain, the B supply choke is in the negative leg, and it is the field coil of the dynamic speaker, while the connections for speaker and B choke, as well as pentode bias, are made through a tube socket so that a UY plug from speaker will pick up the leads. For this socket use P for ground, grid for tap on the field coil, K for B minus, heater-adjoining-plate for plate and heater-adjoining-cathode for B plus.

Coil Data

The antenna coupler and interstage coupler for the broadcast band consist of 25 turn primaries wound over 127 turn secondaries, for 0.00035 mfd. tuning, the diameter tubing being 1 inch, the secondary wire No. 32 enamel, or thereabouts. Put insulating fabric between primary and secondary and use shields of about 2 inch diameter, aluminum or zinc composition. The oscillator coil for the broadcast band has 107 turns of the No. 32 enamel wire or thereabouts for the grid winding and 25 turns wound over the secondary for the plate winding. Any kind of insulated wire may be used for the plate coil.

The antenna coupler and interstage transformer for the first short-wave band consist of 10 turn primaries and 40 turn secondaries, using No. 24 single silk covered wire on primary and secondary of the antenna coil, and on secondary of the interstage coil, any kind of wire on the interstage primary. The oscillator consists of 30 turns, No. 24 wire, grid winding, and 15 turn plate winding.

The second set of coils for the short wave band consist of 8 turn primaries and 20 turn secondaries, No. 22 wire on all secondaries and on antenna primary, but any kind of wire on the plate windings. The oscillator grid winding is like that for the others, but the tickler has 12 turns, and is wound alone. Primaries and tickler are wound alongside of, not over, secondaries, and there is 1/8 inch separation for the t-r-f coils and 1/16 inch for the oscillator.

The last set consists of 10 turn secondaries, No. 22 wire, primary of antenna coupler, 4 turns same kind of wire, primary of interstage coupler, 4 turns of any kind of wire, tickler 10 turns of any kind of fine wire. The separation between primaries and secondaries is 1/4 inch, and between tickler and oscillator grid winding, 1/8 inch.

Short-Wave Club

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Here is a list of new members. Almost every week such a list is published. There are no repetitions.

Richard Gumb, 61 Pleasant St., Methuen, Mass.
Irving Gross, 83 Sutter Ave., Brooklyn, N. Y.
Louis Gilbert, 8th No. & Roy St., c/o Puget Sound Power & Light Co., Seattle, Wash.
Elmer A. Haye, 82-70—88th Place, Glendale, L. I., N. Y.
Paul K. Peden, P. O. Box 212, Flat Rock, Mich.
Richard Temple Sargent, 205 South First Street, Ponca, Okla.
J. Brudeski, 4522 E. 15th St., Erie, Pa.
Sam Licata, 31 Philander St., Rochester, N. Y.
I. McLean, 3745 29th Ave., West, Vancouver, B. C., Canada.
Robert W. Stabenau, 3219 So. Kinnic Ave., Milwaukee, Wis.
Orval Floyd Shipley, R. F. D. No. 3, Box 573, Toledo, Ohio.
Samuel Brown, 517 Thatford Ave., Brooklyn, N. Y.
Frank Demiski, 7125 Union Ave., Cleveland, Ohio.
P. L. McDaniel, Fairmont, N. C.
Ralph L. Cleveland, 5 St. Paul St., Montpelier, Vt.
J. Warren Donahue, 1326 Oak St., Los Angeles, Calif.
C. E. Chambers, 2303 N. Mansfield Ave., Chicago, Ill.
R. C. Young (new address), Route No. 1, Box 309, Yakima, Wash.

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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SERVICE SHEET NO. 3—*MEASURING DEVICES*

RESISTANCE MEASUREMENTS

This is a continuation of the service sheet published Feb. 6, when the data for 0-0.5 and 0-1 milliammeters were given. The object of the graphs and the tables is to provide data for calibrating milliammeters as direct reading ohmmeters, or to read the resistance when the current is known. The tables enable plotting curves on larger a scale. Hence no resistance calibration is necessary on the meter. In each case a limiting resistance, which is given, is supposed to be connected in series with the meter and the battery, the voltage of which is also given. Last week the 0-1.5 ma and the 0-100 wa were discussed.

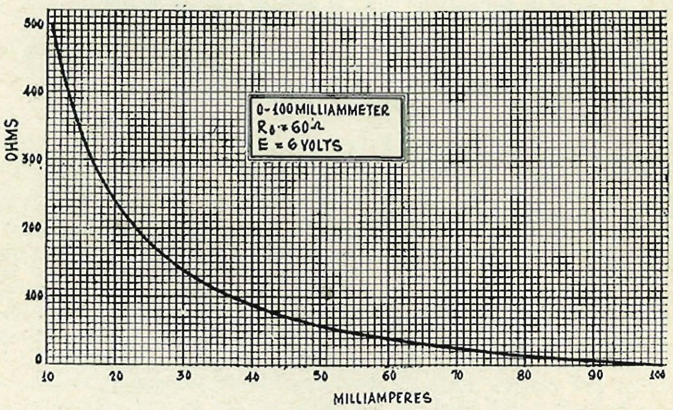

TABLE V.

Meter range, 0-100 milliamperes, E=6 volts, Ro=60 ohms.

Rx	*I*	*Rx*	*I*
0	100.0	120	33.3
5	92.4	130	31.6
10	85.8	140	30.0
15	80.0	150	28.6
20	75.0	160	27.3
25	70.6	170	26.1
30	66.7	180	25.0
35	63.2	190	24.0
40	60.0	200	23.1
45	57.1	225	21.1
50	54.5	250	19.35
60	50.0	275	17.93
70	46.1	300	16.67
80	42.9	350	14.63
90	40.0	400	13.04
100	37.5	450	11.77
110	35.3	500	10.70

If the battery voltage is 3 volts instead of 6, make Ro equal to 30 ohms. The currents will then be the same for half the value of Rx. Thus the scale will run from zero to 250 ohms. If the voltage of the battery is 1.5 volts make Ro equal to 15 ohms. The resistance will then be one-fourth the values in the table for the same current. In this case the scale will run from zero to 125 ohms.

Meters Read Current; Voltage and Resistance Terms Easily Derived

Meters are current-measuring devices, but also may read voltage and resistance by proper application. For voltage measurements a series resistor is used, and the current through the meter is proportional to the applied voltage. Therefore by the amount of current passing through the meter that has the series resistor the voltage may be ascertained from a voltage-calibrated scale. Likewise, if a known steady voltage is applied to a current meter that has a fixed resistor in series with it, the amount of current will change with the values of an unknown resistance additionally put in series with the limiting resistor. Hence it is possible to measure resistance values by using the meter.

Legibility of Reading

Either the meter may be made for the special purpose of providing resistance measurements, whereupon a resistance scale is on the meter, or a d-c current meter may be used with specified fixed resistance in series, and a specified steady voltage applied, so that by reading the current, reference may be made to a table or curve to ascertain the value of an unknown resistance. Last week the 0-100 milliammeter was discussed in conjunction with resistance measurement, with an applied voltage of 4.5 volts, but this week the voltage is shown as 6 volts, enabling reading to a higher resistance value, namely 500 ohms.

When values of high resistance are to be measured the current meter should be of the sensitive type. That is, at least a 0-1 milliammeter should be used. Whenever a scale is put on such a meter for resistance measurements to be read directly, or a table is given or curve shown for indirect reading of resistance values in terms of current values, high legibility obtains only over a part of the scale, as the high and low resistance values show crowding.

Computation for Accuracy

For instance, the 0-1 milliammeter might show readings plainly from 5,000 to 50,000 ohms, and no matter whether scale, table or curve is used, the readings in the crowded areas are likely not to be very accurate. However, many resistance measurements do not have to be highly accurate, for some part is to be used in a set, the resistance value is not critical, the desire being to ascertain whether it is approximately right. However, in all instances the voltage drop across a known resistance can be read when the meter is used as a voltmeter, the current can be read when a meter is used as a current-reading instrument (no series resistor), and the resistance then can be computed. It is equal to the voltage in volts divided by the current in amperes. When high accuracy is required, and measuring means do not readily provide this, the computation method should be followed, and it is the one commonly used by engineers.

Not only is it valuable to have current, voltage and resistance reading devices, but a great deal is thus added to the enjoyment of radio work.

Special Precautions Necessary for Making A-C Measurments

Most measurements made concern direct current, and voltages derived from the potential difference between two points where d-c is flowing. But often there are requirements for measuring alternating current. Different types of meter movements are used for a-c measurements, and in some instances a d-c meter is used with a rectifier element, such as copper oxide. However, when a-c is to be measured, precautions must be taken to have a meter suitable for the measurements of the frequencies involved. Meters that measure the line voltage, for instance, are common. The frequency normally is 60 cycles, and the meters work properly at this frequency. In fact, there may be a wide margin of frequency for satisfactory operation of an a-c meter. A popular copper oxide rectifier type of meter, for instance, measures well up to 10,000 cycles. It is practical to use a correction factor for higher frequencies, but soon the limitations of the meter become too great for continued extension of the frequency. In the measurement of radio frequencies, the current and voltage measuring meters must be of a delicate type, and are usually damaged easily. The factor that requires specialized choice of a-c meters for measurements at particular frequencies, or rather in certain ranges of frequencies, is the changing effect of the meter itself at the different frequencies. Thus the meter's opposition due to the flow of current at different frequencies becomes considerably different. In other words, the meter does not have the same impedance at all frequencies.

Meaning of Metric Units

An Easy Method of Conversion of Values

By G. A. Eklund

MULTIPLES and sub-multiples of electrical units often cause confusion among those who have not mastered the metric system of measurements, and there are many of them for most school children assume that the section on the metric system in their arithmetic has little connection with everyday work. Only those who go on and study physics are compelled to master the subject.

Prefixes such as centi, milli, micro, kilo, and mega are only sub-multiples or multiples in the metric system, and since the electrical units have been built up on the metric system, they occur continually in literature on all electrical subjects, including radio. Those familiar with the metric system know that there are many other multiples and sub-multiples which do not occur frequently in radio, or anywhere outside of the arithmetic books. Thus there are the prefixes, deci, deka, hekto, and several others.

Kilo means 1,000 and milli means 0.001, or one one-thousandth. That is, these two are reciprocal. Mega means 1,000,000 and micro means 0.000,001, or one millionth. Therefore these are reciprocal. These four prefixes are the only ones used in radio to any great extent.

Illustrating Meaning

As an illustration of the meaning of the prefixes, let us take the term kilocycle. For example, let us take a frequency of 550 kilocycles. Since kilo means 1,000, or one thousand, we can just as well express the frequency as 550 thousand cycles, or 550,000 cycles. We can only have multiples when we deal with cycles because when we deal with cycles per second, a sub-multiple of a cycle would not mean much. Still it would be perfectly logical to speak of one millicycle per second, but it would be preferable to speak of one cycle in 1,000 seconds.

The reciprocal term, or prefix, is used for currents, voltages, wattages, and inductances. Thus we speak of milliamperes, millivolts, milliwatts, and millihenries. Instead of speaking of so many millihenries we can speak of so many thousandths henries. Thus 85 millihenries would be the same as 85 thousandths henries, or 0.085 henries. The same applies to any other quantity, such as a voltage, a wattage, a current.

The prefix mega is used mainly in connection with resistance. We speak of megohms, for example. Since mega means one million, 5 megohms would mean 5 million ohms, or 5,000,000 ohms.

The prefix micro is used in connection with capacities and inductances. Thus we speak of microhenries and microfarads. Since micro means one millionth, one microhenry means one millionth henry and one microfarad means one millionth farad. One microfarad is a very large capacity and therefore it is customary to speak of micro-microfarad, which means one millionth millionth farad.

Why We Use Multiples

The only reason for expressing quantities in terms of multiples and sub-multiples is to avoid the use of large numbers, or extremely small numbers. It is easier to speak of 5 megohms than to speak of 5,000,000 ohms and it is also easier to speak of 50 microamperes than to speak of 0.000,05 ampere. The mind can grasp a whole number containing less than three digits more easily than a whole number having more digits and also more easily than a fraction. Hence we have multiples and sub-multiples to aid the mind in grasping the value of a quantity.

We use the prefixes for the same reason that we use inches, feet, yards, miles and leagues. It would be quite meaningless to express the distance between two cities in inches. Suppose the distance between New York and Chicago is 1,000 miles. That is equivalent to 63,360,000 inches. We have no difficulty forming an idea of the distance when it is expressed in miles, but when it is expressed in inches it has no meaning.

The fact that the multiples and sub-multiples in the metric system are based on 10 simplifies changing from one unit to another. We do not have to get out pencil and paper and figure out the relationship, for the relationship is stated in the prefixes. When we use the English, or any other ancient method of measurement, we do have to get out pencil and paper. There is nothing at all in the name of a foot to indicate that it is equivalent to 12 inches. Neither is there anything in the name of a yard to indicate that it is equivalent to 1/1,760 of a mile.

Although the relationship among the English units is complex and haphazard, they are of help in grasping various distances. The metric multiples and sub-multiples are just as useful, yet it requires no mental or physical effort to convert a quantity from one unit to another. In the metric system it is only a matter of moving the decimal point to the left or to the right, when the values are written down, or to change from English to Latin or Greek, or vice versa, when we change the units verbally.

Kilo means 1,000 in Greek. Hence, when we say 5 kilocycles and 5 thousand cycles we say the same thing. Milli means thousand in Latin but in the metric system it means one thousandth. Hence, when we speak of 5 milliamperes, we mean 5 one-thousandths ampere.

With one exception, micro, all the multiple prefixes are of Greek origin and the sub-multiple prefixes are of Latin origin. The following table shows the prefixes ordinarily used in the metric system, together with their meaning.

Deka	10	deci	0.1
Hekto	100	centi	0.01
Kilo	1,000	milli	0.001
Myria	10,000	....	....
Mega	1,000,000	micro	0.000,001

In changing the expression of a quantity from one unit to one of its metrical multiples or sub-multiples, it is only necessary to move the decimal point to the right or to the left. For example, suppose we have a resistance of one megohm and we want to express it in ohms. We set down unity and write six ciphers after it, which is equivalent to moving the decimal point six places to the right. Again, suppose we have a resistance of 0.03 megohm, and we want to express this in ohms. We again move the decimal point six places to the right and we obtain 30,000 ohms. Of course, moving the decimal point six places to the right is equivalent to multiplying by one million.

When changing from ohms to megohms we reverse the process and move the decimal point six places to the left. Thus let us assume that we have a resistance of 100,000 ohms and we wish to express it in terms of megohms. We move the decimal point six places to the left and obtain 0.1 megohm. When the decimal point is not actually given it is understood to be after the unit place. That is, 100,000 means 100,000.0.

Kilocycles to Cycles

In dealing with kilocycles the factor 1,000 is involved and we move the decimal point three places to the right or left. If, for example, we have a frequency of 570,000 cycles per second and want to express it in kilocycles we move the decimal point three places to the left and obtain 570 kilocycles per second. If we have kilocycles and want to express them in cycles we reverse the process and move the decimal point three places to the right. Thus is we have 1,000 kc, and want to express this frequency in cycles we move the point three places to the right and obtain 1,000,000 cycles.

When we are dealing with the sub-multiples the process is the same. Thus, we have an inductance of 160 microhenries and wish to express the quantity in henries, we move the point six places to the left because a henry is one million times as great as a microhenry. Therefore 160 microhenries equals 0.00016 henry. When we are dealing with the sub-multiple milli, we move the point three places one way or the other. Thus, if we have 10 milliamperes and want to express the quantity in amperes, we move the point three places to the left and obtain 0.01 ampere. If we have a current of 5 amperes and want to express it in milliamperes, we move the point three places to the right and obtain 5,000 milliamperes.

Sometimes we have to change from one sub-multiple to another, or from one multiple to another. In such cases the number of places the decimal point should be moved depends on the ratio between the two units involved. For example, suppose we want to change a quantity from milliamperes to microamperes. One milliampere is 1,000 times greater than one microampere and therefore we move the decimal point three places. Thus 50 microamperes equals 0.05 milliampere and 5 milliamperes equals 5,000 microamperes. The same relationship exists between megacycles and kilocycles and therefore in changing from one to the other we move the point three places one way or the other, depending on unit in which the quantity is expressed originally.

In changing from one unit to another the first thought should be which of the two units is the larger. A given quantity will be expressed by a smaller number when expressed in the larger unit. When a quantity is to be expressed in a smaller unit the decimal point must be moved to the right, and when a quantity is to be expressed in a larger unit the decimal point must be moved to the left. The number of places to move the decimal point in any case is determined by the ratio of the sizes of the two units involved. This ratio is always 10 or powers of 10, and it can be obtained from the table of prefixes given above. For example, suppose we want to express a quantity given in kilo interms of milli. The ratio of kilo to milli is 1,000,000. Hence we move the decimal point six places, for there are six ciphers in the number giving the ratio.

Test Oscillators Powered f
One Model Uses New Condens

By Herm

[This is the third of a consecutive series of articles on test oscillators. The first was published in the February 6th issue, the second last week in the February 13th issue. The test oscillators are of the adapter type, that is, obtain their power from a broadcast set. Previous articles had to do with plugging into a radio frequency or intermediate frequency socket. The present article concerns use of a special adapter that picks up the voltages needed from a pentode.—EDITOR.]

SO many sets now use pentode tubes that it is entirely practical to have radio devices that obtain their power from the receiver, without "killing" a tube. The heater and positive B voltages are desired. The heater voltage for the operated device will be the filament voltage of the pentode, while the positive B voltage will be the screen voltage of the pentodes that have their screens at the K terminal of the socket. These are the 247 and the 233, the latter being of the automotive series. We shall confine our discussion to cases concerning the 247.

While such devices would not be entirely dependable for field work, because one might not encounter a pentode set on a given job, nevertheless any one who has a pentode set can use the devices in his home or laboratory.

The test oscillator diagrammed in Fig. 1 is like the one published in the February 6th and 13th issues, except that the voltages are derived from the pentode socket. Plug-in coils are used, and the frequency range is dependent on the coil and condenser. Since only one condenser is shown, and it is assumed to be 0.00035 mfd., the intermediate frequency band can be covered, also the broadcast band in full, and the short waves, as far down as it is practical to obtain legible readings. A method of bringing the usefulness down to about 11 meters will be explained.

Low Wave Difficulties

The lower limit on short waves normally is governed by the higher capacity settings of the condenser, for, assuming a frequency ratio of 2.5 in this band, tuning in a given instance would be from 10 to 25 meters. Of course at 25 meters, full 0.00035 mfd. would have to be used, but that is an inordinately large capacity for so short a wavelength, and many thousands of kilocycles are quickly passed over by a slight displacement of the dial. The oscillator, to that extent, becomes virtually unworkable, until the lower settings are reached, that is, lower capacity, representing lower waves. But the unworkability at high capacity settings rules out the intended coil.

Another factor is that oscillation intensity is best supported by a high ratio of inductance to capacity. In general that is an injunction not to invoke 0.00035 mfd. capacity to attempt to tune in a given frequency whereby the number of turns on the tuned winding would be very few, say, five.

However, it is not adamant that the full dial be used, total capacity of the condenser, for short waves, and therefore a way out is provided by the following method:

Use the total capacity limits of the tuning condenser for the intermediate frequency band, for the broadcast band and for the first short-wave band. In wavelengths the ranges would be, say, 1,000 to 2,000 meters, 200 to 600 meters, 70 to 200 meters. An intermediate frequency of 175 kc, by the way, is equal to 1,713 meters. Use half the dial displacement, the lower capacity values, for the remaining short-wave bands.

Good Capacity On Short Waves

If the condenser is of the straight line capacity type, which is unlikely, the lower half of the dial would represent half the total capacity. If the plates are specially shaped, as is true in nearly all condensers manufactured to-day, the total capacity of the lower half would be less than half the total capacity displacement, a fair average being 0.00012 mfd. Now, this is a good capacity for short waves.

When this system is used it is not only a safe assumption that there will be no trouble from oscillation stoppage due to too low a ratio of inductance to capacity, but also that the calibration will prove easy, and good legibility of readings of the dial will prevail, that is, wave or frequency differences can be read well.

To achieve this result it is necessary only to wind a smaller coil for the second short-wave band that at 50 on the dial will be tuned to a wave a little higher than obtained at 5 on the dial with the previous coil. Also it is important to remember that for the second and succeeding short-wave bands as covered by the oscillator the dial should be read only from 5-50, even though waves could be tuned in at higher settings that would duplicate waves tuned in

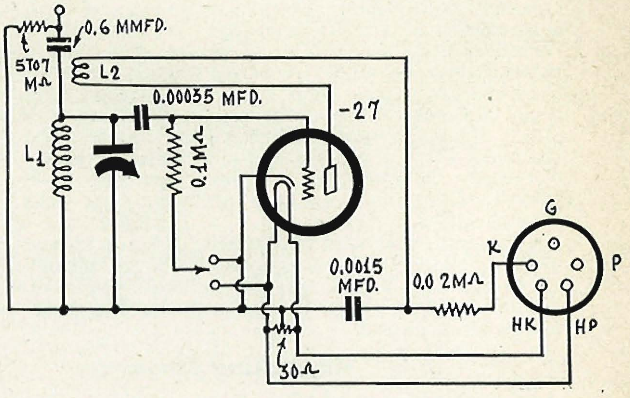

FIG. 1

A modulated-unmodulated test oscillator that derive its power from the pentode socket of a set and permits operation of the complete reciver nevertheless. Plug-in coils are used.

with the next largest coil. There is no harm, of course, in running the complete wavelength coverage curve for the coil primarily in tended to be of service only from 5-50 of the dial readings, as then some higher wave may be reached, without changing coils, for a hurried test, although some accuracy would be sacrificed.

Plug-in Coils

Since plug-in coils are used they may be of the moulded type with UX pins, outside form diameter approximately 1.25 inches The diameter is given at an approximate value because these forms are moulded, hence they are of slightly different diameters, a between extremes. The measured difference in circumference on a given form used in tests concerning these oscillators was 1/6 inch, equal to a diameter difference of about 1/190 inch. That difference permits getting the form out of the mould.

For the intermediate frequency band L1, Fig. 1, is an 800-turn honeycomb coil, outside diameter about 1.25 inch, wound on 3/ inch hub, while L2, the feedback coil, may be a similar coil, 30 turns, separation about 0.5 inch. The broadcast coil on the tube base diameter (whether 1.25 inch as specified, or 1 5/16 inche as sometimes prevails) may consist of 115 turns of No. 28 ename wire. The plate winding is put on near the pin end, with insulation fabric between it and the grid winding, and consists of 20 turn of any insulated fine wire. Normally the grid connection is taken from top, the ground connection from bottom, for grid windings and if windings are in the same direction, then plate is the bottom terminal of the tickler and B plus the top terminal. The pins o the form may be used as follows: grid for grid of coil, F minu for secondary return, plate for plate terminal of coil and filamen plus for B plus.

It is assumed the coils will be shielded, a single removable shield serving the purpose. A base such as used for tube shields there fore is mounted above the UX socket that is used as coil receptacle and the shield removed when a coil is to be changed. The oscilla tor can be worked, of course, without the shield, and the effect of an aluminum shield of 2 inches diameter or more will not require any change in the coil data, as the effect of the shield is to reduce the inductance 6 microhenries on the broadcast coil.

Why 0-5 Is Ignored

Since 0.00035 mfd. condensers afford approximately a 3-to-1 fre quency ratio, and as the number of turns is approximately propor tionate to the frequency, the first short-wave coil would have one third as many turns as the other, except for a desire to provide more overlap, therefore 40 turns would be used, the construction being

om a Set's Pentode Socket; r of 360 Degree Rotation Type

Bernard

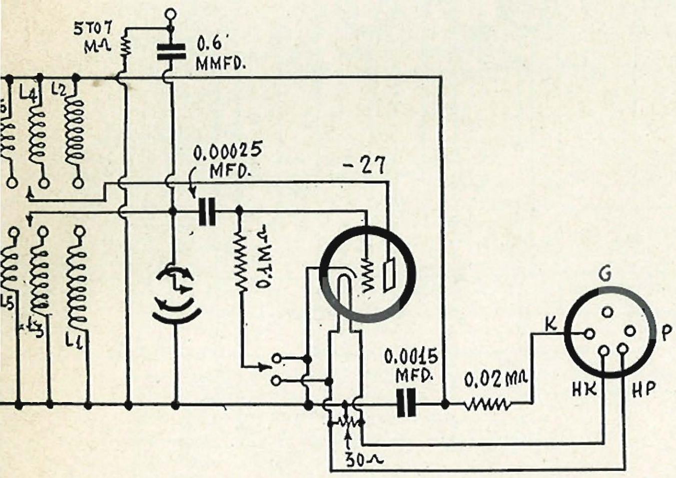

FIG. 2

A de luxe model pentode-adapter oscillator, with switch for coil connections to a special condenser.

as formerly, and the tickler having 15 turns. The test is that that maximum capacity setting (say, 100 on the dial) a wave is generated that is longer than that which obtained when the broadcast coil was used with dial representing minimum capacity.

Since condensers are of dubious value at the extremely low reading settings, 0-5 on the dial may be ignored, and 5 used as the starting point.

Since few turns are involved for the next coil, it may be wound so that at 50 on the dial it brings in a wave a little higher than that obtaining at 5 on the dial, when the next largest coil was used. The tickler turns may be total 10 in any case, for the second short-wave coil.

The frequency ratio now will be about 2-to-1, so having determined the number of turns for the second short-wave coil, the number of turns for the next will be one-half, but add an extra turn, and from then one exactly half may be used. Also, the wire may be larger in size for the two smallest coils.

Modulation Optional

The frequency ranges for the short waves therefore will be about as follows: 200 to 70 meters, 71 to 36 meters, 36.5 to 19.5 meters, 19.7 to 11 meters. The total is six coils, to cover these bands plus the broadcast and intermediate frequency bands.

The oscillator is provided with a switch so that a-c hum may be introduced as modulation. When the switch is thrown to connect grid return to the cathode there is no hum, when it is thrown to connect grid return to the one side of the heater of the —27 tube used as oscillator, hum is present. Some tests require modulation, others are made without it.

The pentode adapter type of test oscillator has an advantage over the types previously discussed in this series, in that overall testing is entirely practical, no tube being "killed" to permit the oscillator to function. Thus modulated oscillation may be introduced at the antenna post in lieu of a broadcast signal. Any time you want any of the frequencies within range of the oscillator you can have them, modulated or unmodulated, and know what they are. Moreover, after you have had such a test oscillator for a while you will wonder how you ever got along without an oscillator. In these days particularly, when superheterodyne circuits are so prominent, it is almost impossible to get along well without an oscillator, as a super can not be properly built or serviced without an external oscillator.

Uses Skeletonized

Considerable information on how to use the devices described in the February 6th issue were contained in that issue, and as the explanation was detailed, readers are referred to that copy for information additional to what is about to be given here along the same line of testing.

Briefly, the tests with the present test oscillator (Fig. 1) are:

Test of intermediate frequency: The desired intermediate frequency is known, or in case a set is to be serviced, the intended intermediate frequency is ascertained, the voltage connector introduced in the pentode socket, pentode restored to position, the set turned on, set oscillator tube removed, and the output of the test oscillator connected to plate post of the modulator tube, and test oscillator frequency established. Modulation is introduced and the transformers tuned until maximum response results. This may be determined by ear or with an output meter.

Test of modulator frequencies: Remove connections from the control grid of modulator and second detector, instead connect the coil terminal of the modulator to the control grid of the second and output of test oscillator to the same point. The oscillator tube is removed from set. Note the dial settings on the set for the various frequencies generated when the broadcast coil is in the test oscillator. Plot a curve, dial settings against frequencies. Have plotting paper handy.

Test for oscillator: Knowing the intermediate frequency, also the modulator tuning characteristics, you can register six or eight points on the curve, representing frequencies higher than the modulator frequencies, by the amount of the intermediate frequency. Thus, if 175 kc is the intermediate frequency, select 550 kc, 650 kc, 750 kc, 850 kc, 950 kc 1,050 kc and 1,300 kc, and register points 175 kc higher in frequency, thus; 725 kc, 825 kc, etc. Then draw the curve on the same sheet. You will then be able to read from the curve the dial settings as they should obtain for the the oscillator for the frequencies covered. Use the test oscillator to register zero beats and note the frequencies. How much, if any, the set oscillator is off, and in what direction, will thus be determined. Instead of the previous test, the modulated oscillator's output may be connected to antenna post of set (aerial disconnected), and the dial settings noted. These will be the set's oscillator settings. The frequencies will be higher than those put in by the amount of the intermediate frequency. That is, the lower positioned curve (higher frequency) registers what should be obtained, on the basis of subtracting the intermediate frequency from the test oscillator frequencies now generated. These data apply to padding superhetrodynes, and the reader is referred to the special article on this very topic in last week's issue (February 13th). Details of the pentode connector for the present test oscillator were given in the February 6th issue.

The test oscillator also may be used for lining up t-r-f sets by introducing the modulated signal at the antenna post.

Costs Estimated

The previously discussed oscillator may be built for around $5, while at around $15 the same circuit can be constructed with a special condenser and a real vernier dial, that is, a dial that can be read accurately to one part in 1,000. Also, a switching arrangement supplants plug-in coils. (Fig. 2).

The peculiar condenser diagram is supposed to reveal the fact that the condenser has two rotors and one stator, and that the stator is grounded, while rotors go to grid. No fear of body capacity need be experienced, as the condenser frame and shaft are grounded, and in that regard putting rotor to grid is just as good as putting stator.

The condenser is built in two semi-circular facing sections, for rotation the full 360 degrees, thus requiring a special dial, but National Company makes its true vernier dial with 360-degree scale. The rotor sections are dissimilar, the smaller being somewhat crescent shaped, and accounting for 26 to 100 mmfd., while the other is semi-circular except for a bulge at one end of the plates to provide a minimum capacity equal to maximum capacity of the smaller. So, half a turn of the shaft affords 26-100 mmfd., while the other half, 100-375 mfd. The capacity change is progressive. A switch built into the condenser, requiring no external wire, disconnects the unused part, so that the minimum capacity of the used condenser is not added to that of the unused condenser. The benefit of this condenser is dial readings are spread out, and that when short waves are to be tuned in tuning may be readily confined to the smaller capacity (26-100 mfd.), the larger capacity being ignored.

The dial readings are always taken at the same point, and if the numbers are progressive, and not reversed repetitions, the smaller capacity was read from 0-100 and the larger from +100 to 200.

A Seven Tube Porta
Sensitivity, Selectivity

By Charles

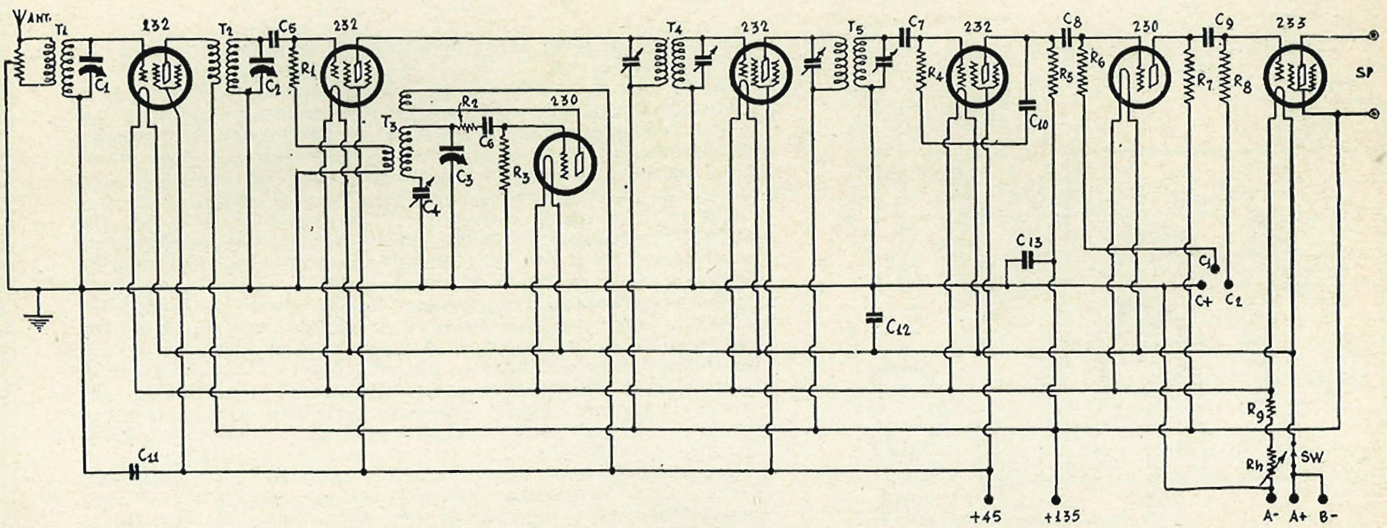

FIG. 1

This seven-tube 175 kc superheterodyne is suitable for a portable set where high sensitivity and selectivity combined with lightness of weight are essential.

RADIO fans are beginning to interest themselves in portable sets and many have asked for suitable circuits. Not only are these sets desired for easy portability but for home use in places where there is no electric power available.

The superheterodyne is in almost exclusive demand for this purpose because in former years fans have discovered that it is necessary to have a highly sensitive set as well as a selective one. Yet the circuits must be simple. The demand for simplicity in conjunction with the demand for selectivity and sensitivity is hardly consistent but the superheterodyne comes nearer meeting the demands than any other set. After all, now that standard parts are available for superheterodynes it is no more difficult to assemble a good set of this type than a t-r-f set of comparable performance. Indeed, there is really no comparison as to performance.

Portability Essentials

The main essential for portability is lightness of weight. Therefore we must eliminate all parts which add considerably to the poundage. The first thing we can dispense with is the audio frequency transformers. Resistance coupling is the logical thing to use. But this alone does not save a great deal when we consider the entire receiver. The main part of the weight lies in the power supply. We must reduce the weight of the filament and plate batteries as much as possible. This imposes the necessity of using small, low current tubes in the receiver.

The tubes most suitable for a portable set, or for a home set where battery economy is imperative, are the 2-volt tubes. In this series we have the 232 screen grid tube, the 230 three element tube, the 231 three element power tube, and the 233 pentode power tube. Of these the 231 is ruled out because the pentode has a greater power sensitivity as well as greater undistorted power output. It has the additional advantage that it requires less grid bias so that a smaller grid battery can be used.

The circuit in Fig. 1 can be followed in wiring up a receiver of this kind. It employs the 232 screen grid tube as radio frequency amplifier, modulator or mixer, intermediate frequency amplifier, and detector. The 230 tube is used for oscillator and first audio frequency amplifier. The 233 pentode is used in the power stage. Thus there are seven tubes in all.

Filament Supply

Each of these tubes, with the exception of the pentode, takes a filament current of 0.06 ampere. Therefore the six tubes take 0.36 ampere. The power tube alone requires 0.26 ampere, so that the total current required by the circuit is 0.62 ampere. Now the total current that should be taken from a No. 6 dry cell is 0.25 ampere, although a somewhat larger current can be drawn if frequent replacement is preferable to carrying extra batteries around. If we connect two cells in parallel each would have to supply 0.31 ampere, which is not greatly in excess of the rated maximum for the cells.

The voltage across the filaments should be 2 volts, but one cell gives only 1.5 volts. Hence it is necessary to use two cells in series, giving an excess of one volt. This is taken up in a ballast resistance and this drop is utilized for bias as far as it goes. The filament supply battery, therefore, should consist of four No. 6 dry cells connected in series-parallel. This is for portable use. For home use it is well to add at least two more in parallel. That is, the least number should be three in parallel and two of such groups in series.

An alternative for this combination of cells is to use a small storage battery. This may be either 2 volts, that is, one cell, or 4 volts, or two cells. In case a two volt cell is used the ballast resistance R9 should be omitted and the grid returns of the first four tubes should be made to minus 1.5 volts on the grid battery. In case a 4 volt battery is used the resistance of R9 should be doubled. The value of this resistance is given later. Incidentally, it is not practical to use a storage battery in a portable set because of the danger of spilling acid. However, if it is desired to use the circuit in a car, the filament current might be taken from the car battery. This does not mean that the set is recommended for use as an automobile receiver, but rather as a portable receiver to be connected temporarily to the car battery when the car is not in actual operation.

The Control of Volume

There are two means for varying the volume in the circuit. The first is a 10,000 ohm potentiometer P across the primary of the input coil. The slider of this potentiometer is connected to ground so that when volume is to be reduced the slider is moved toward the antenna. This control may not be quite sufficient. For that reason a rheostat Rh is put in the negative filament supply line. The value of the resistance of this rheostat need not be more than six ohms.

The rheostat should be employed as far as possible when the set is a portable one because the filament battery will last longer the more resistance is used. Of course, as more resistance is used the maximum undistorted output will become less, so the amount of resistance is determined by the quality obtained as well as by the volume.

It has been found in many instances that the 10,000 ohm potentiometer controls volume better when the slider is connected to the antenna and the low side of the primary is connected to ground. Which of the two connections works better depends on the type of antenna, as well as on the type of ground that is used. It only takes a moment to try both methods in any case.

The Antenna

It is customary to use a loop in portable sets. This could be done in this one, but then it would be necessary to use two tuning controls for it would be very difficult to make the loop tuner track with the other two when all are on the same control. In view of the high sensitivity of this type it is not necessary to use a loop because an adequate antenna can always be found. In a set of this type stations 1,000 miles away were brought in on a six foot wire placed on the ground but insulated therefrom, the set being about

ble Superheterodyne; and Lightness Featured

J. Endicott

LIST OF PARTS

Coils

T1, T2—Two radio frequency transformers as described
T3—One oscillator coil as described
T4, T5—Two 175 kc intermediate frequency transformers as described

Condensers

C1, C2, C3—One gang of three 350 mmfd. tuning condensers
C4—One 700-1,000 mmfd. adjustable padding condenser
C5, C7—Two 250 mmfd. grid condensers
C6—One fixed 0.001 mfd. condenser
C8, C9—Two 0.01 mfd. fixed condensers
C10—One 350 mmfd. by-pass condenser
C11, C13—Two one microfarad by-pass condensers
C12—One 0.1 mfd. by-pass condenser

Resistors

P—One 10,000 ohm volume control potentiometer
Rh—One 6 ohm rheostat
R1—One 1 megohm grid leak
R2—One 10,000 ohm resistor
R3—One 100,000 ohm resistor
R4, R6, R8—Three 2 megohm grid leaks
R5, R7—Two 250,000 ohm resistors
R9—One 1 ohm ballast resistor

Other Requirements

Six UX sockets
One UY socket
One filament switch (Sw)
One vernier dial for tuning condensers (pilot light omitted for current economy)
One magnetic or inductor speaker
Two 7.5 volt grid batteries
Three 45 volt B batteries, small size for portable receiver
Four No. 6 dry cells
Four grid clips
Eight binding posts

3 feet above the ground. A better arrangement is to use a wire of this length on the ground as a counterpoise and another of equal or greater length for antenna raised as far above the set as practicable. In case a car is handy the car chassis makes a good counterpoise. In this case the antenna wire should preferably be outside the car although a wire or ribbon antenna attached to the dome or ceiling will give fairly good results.

Intermediate Amplifier

Due to the availability of 175 kc intermediate transformers and oscillator coils for this frequency, it seems best to use this frequency in the intermediate frequency amplifier. Two of such transformers, T4 and T5, are needed. These are of the doubly tuned type, as will be noted on the drawing.

The 175 kc intermediate requires a special oscillator coil T3, one having a tuned circuit inductance of about 0.8 the inductance of the r-f tuned circuits. If the coil is wound on a one inch diameter with No. 32 enameled wire, it requires 102 turns for the tuned winding. The tickler winding should consist of 25 turns wound over the "ground" end of the tuned winding and separated from it by several turns of fabric or insulator paper to a thickness of about 1/32 inch. No. 40 double silk covered wire is suitable. The pick-up winding should be wound on top of the tickler and it should consist of 10 turns of the same wire as is used for the tickler. This coil assumes that the variable condenser C3 has a maximum capacity of 350 mmfd. In case it is not desired to wind the coil it may be obtained ready made mounted in a metal shield.

Padding the Oscillator

It should be observed that the series condenser C4 in the oscillator is not connected in the usual fashion but in series with the ground lead of the tuned winding. The coils, therefore, are not actually grounded. This connection has been made so that one side of the condenser C4 may be grounded to facilitate adjustment. Of course, the adjusting screw side of the condenser should be connected to ground while the other should go to the coil. With this connection there is no body capacity effect while adjusting the condenser.

The value of C4 is approximately 760 mmfd. but it is not quite the same for all circuits. Hence it is advisable to use an adjustable condenser having a range from 700 to 1,000 mmfd. This condenser is available and has been especially made for the purpose.

The padding, or adjustment, of the oscillator to track with the r-f tuners is a simple procedure if the right coils and condensers are used. The first step is to tune the intermediate frequency amplifier to 175 kc. This is best done with the aid of a calibrated oscillator covering this range. In case no such oscillator is available the tuning may be done anyway, although the frequency obtained may not be exactly 175 kc. Tune in a station near the high frequency end of the broadcast scale. A strong station must be used in most instances. First open the gang condenser as far as it will go. Try to pick up a station by adjusting the trimmers across all the condensers C1, C2, and C3. When the signal is as strong as it can be made the intermediate frequency generated is equal to the mean frequency of the four intermediate frequency circuits, and this mean is not far from 175 kc. Now tune each of the four i-f circuits until the signal is loudest. This done, the intermediate circuits are in tune with some frequency not far different from 175 kc.

Adjusting the Trimmers

When the intermediates have been tuned in this manner, reset the trimmer condensers so that a selected station near the high frequency end comes in where it is desired. For example, if a 1,500 kc station is available the tuning control can be set at 5 on the dial and then all the trimmers, including that of the oscillator, should be readjusted until this station comes in loudest.

Now we are ready to adjust the series condenser, C4. Set the tuning control on a high wave station where this station should come in on the dial. For example, 570 kc should come in at about 91 and 560 kc at 95 on the dial. Convert the receiver to a t-r-f set by killing the oscillator and skipping the intermediate frequency amplifier and tune in the selected long wave station. To skip the i-f connect the grid clip of the first detector to the cap of the second. Somewhere a long wave station will be tuned in between 90 and 100 on the dial. Leave the tuner in this position and restore the set to a superheterodyne. Now adjust the series condenser C4 until this station comes in as strong as possible. The circuit is then adjusted at both ends and the tracking in the middle is good.

If there is any indication of poor tracking in the middle, which will be indicated by weakness of stations, broadness of tuning, and possibly squealing, the adjustment of the high frequency end of the tuner should be made at about 1400 kc and the adjustment at the other end at about 600 kc.

As a means of keeping the minimum capacity in the oscillator circuit down, which is essential if good tracking is to be obtained, the tuned circuit is isolated from the tube by means of a 10,000 ohm resistance R2 and a 0.001 mfd. condenser C6. Moreover, a grid leak R3 of 100,000 ohms is used to prevent a high grid current. The effect of R2 and R3 is that of a voltage divider which impresses 90 per cent of the voltage across C3 on the tube. This also aids in keeping harmonics out of the generated current. The winding of the tickler over the low potential end of tuned winding and the pick-up winding over the tickler also helps to keep the minimum capacity to a low value. While a certain value of minimum capacity is needed, it is essential that it is low enough so that trimming with the trimmer across C3 is possible.

Modulation

Since the modulator tube is not of the heater type we cannot use the customary method of mixing. For this reason we have connected the pick-up coil in series with the grid leak R1, of the mixer tube. Thus the oscillator voltage is impressed in series with the signal voltage. It is for this reason that the grid leak and condenser type of modulation is used, since grid bias detection would not be suitable for grid circuit modulation. Actually, as the circuit is connected the bias on the modulator tube is one volt, but if positive return of the grid leak is desired it is only necessary to connect the low side of the pick-up coil to the positive end of the filament. It makes very little difference which method is used.

The grid condenser C5 should have the usual value of 0.00025 mfd. and the grid leak R1 should have a value of one megohm.

The detector operates on the grid leak and condenser principle. The condenser C7 should have a value of 0.00025 mfd. and the grid leak R4 should be two megohms. In the plate circuit of the detector is a by-pass condenser C10 of 350 mmfd.

The Audio Amplifier

The audio amplifier is a two stage resistance coupled circuit. The first tube is a 230 and the second is a 233. The two plate

(Continued on next page)

New Modulator Hookup

Method Adapted to Filament Type Tubes

(Continued from preceding page)

coupling resistances R5 and R7 are equal in value and each should be a 250,000 ohm unit. The grid leaks R6 and R8 should also be equal. Each should be a 2 megohm unit.

The two stopping condensers C8 and C9 should also be equal and each should have a value of 0.01 mfd.

As is well known, a resistance coupled amplifier is subject to the type of oscillation called motorboating. To avoid this trouble by-pass condensers of fairly high values should be used across the B battery. There are two of these, C11 and C12, and each should be at least one microfarad. The remaining by-pass condenser C12 works primarily at high frequency and for that reason it need not be larger than 0.1 mfd.

Even with the precaution of large values for C11 and C12 there may be trouble when the battery gets old. It is then time to replace it for the quality will not be good when a high resistance battery is used. However, if it is essential to drain the last bit of energy from the battery and still avoid the trouble, then a resistance of about 50,000 ohms may be connected in series with R5, between that resistance and the battery connection, and then connect a condenser of one microfarad between the junction of the two resistances and B minus.

The Speaker

In a portable receiver the only type of speaker that is practical is a magnetic, for there is no adequate source of field current for a dynamic. The inductor dynamic should be regarded as a magnetic in this case for it requires no field current.

If a storage battery is used to power the filaments, which may be the case when the set is used at home or in a car, a 6 volt dynamic speaker might be used. A speaker of the type designed for automobile sets is suitable. In case a speaker of this type is used, and it is of the push-pull type, there are two chances for getting good matching. The entire primary may be connected in the plate circuit of the output tube or only half of it. Use that one which gives the greater volume.

Bias

As the circuit is drawn the r-f and the i-f amplifiers, the oscillator, and the first detector are given a bias of one volt, or slightly more, depending on the setting of Rh. This is all right for all the tubes with the possible exception of the first detector, and what to do in that exception has already been explained.

The required bias on the 230 audio frequency amplifier is not critical but it should be at least 4.5 volts. If the low end of R6 is connected to a point "C1," 4.5 volts from "C+," on the bias battery, the effective bias on the tube will be about 5.5 volts, which is all right. The required bias on the output tube is 13.5 volts, but there is nothing against making it a volt or two higher or lower.

A suitable grid battery can be made up of two 7.5 volt batteries in series, giving a total voltage of 15 volts. These batteries are tapped at every cell so that the bias can be varied in steps of 1.5 volts. "C2" might be connected to a point where the voltage, measured from "C plus" is 12 volts. This will make the effective bias on the tube about right. Remember that the higher the bias the less the drain on the B batteries. Just what bias to use is determined by the output and by the quality.

The R-F Tuners

The r-f tuners are exactly alike. Each contains a 350 mmfd. condenser on the gang containing C3. The coils T1 and T2 may be obtained ready made and mounted in metal shields. They are wound on one inch bakelite tubing. The tuned windings contain 127 turns of No. 32 enameled wire and the primaries contain from 25 to 90 turns of No. 40 double silk covered wire. A value of 50 turns is a good average for a portable set where only a small antenna is possible, and 25 turns would be suitable for home use where a good outside antenna can be employed. When extreme sensitivity is required, and selectivity is a secondary consideration, 90 turns might be used.

Since lightness of weight is essential there is no better material for the chassis than aluminum. The shape of this is left to the ingenuity of the individual builder. A suggestion, however, is not out of order. If the set is to be carried around, the receiver assembly should be in the form of a suitcase. That is, it should be long and thin so that it will not interfere with the legs of the porter. The length of the gang condenser is about 4.75 inches so that the case might be 5 inches from front to back.

IN QUEST OF GOOD QUALITY

WHAT TYPE of output stage would you advise for a special receiver I have built when the very best quality is the main object? This set is a superheterodyne which has exceedingly high sensitivity as well as selectivity. I can afford to sacrifice gain in the interest of quality. I don't want to use 250 power tubes because the power transformer I have does not have high enough voltage, nor would it stand up under the heavy drain. I could use 247s, 245s, and smaller tubes.—M. McC., Ottawa, Canada.

A push-pull stage using two 245 tubes is about the best there is. The output is enough for all reasonable requirements and the quality is usually very good, provided that a good input transformer and good matching between the loudspeaker and the tubes are used. This combination is recommended because you state that you have enough gain in the circuit to sacrifice for quality. You will need a power detector ahead of the power stage or else an audio stage between the detector and the output stage. This should be a 227 tube coupled to the detector with resistance and a rather large stopping condenser. However, it is not necessary to use a larger condenser than 0.1 mfd.

New Variable Mu

A new variable mu tube has been announced by RCA Radiotron Company and E. T. Cunningham. This new tube is an r-f amplifier pentode and is an addition to the line of 2-volt tubes including the '30, '31, '32, and '33. It will be known as the 234.

This new tube is recommended for use as a radio-frequency amplifier, intermediate-frequency amplifier, and first detector in battery operated receivers. It is especially adapted for use in portable receivers.

Tentative Rating and Characteristics

Filament voltage				2.0 volts d.c.
Filament current				0.06 ampere
Plate voltage	67.5**	90	135	180 volts max.
Screen voltage, max.*...	67.5	67.5	67.5	67.5 volts
Grid voltage, variable...	—3	—3	—3	—3 volts, min.
Plate current	2.7	2.7	2.8	2.8 m.a.
Screen current	1.1	1.1	1.0	1.0 m.a.
Plate resistance	0.4	0.5	0.6	1.0 megohm
Amplification factor	224	290	360	620
Mutual conductance	560	580	600	620 micromhos
Mutual conductance at -22.5 volts bias	15	15	15	15 micromhos
Length, max. overall....				2.25 inches
Diameter, max. overall..				1 13/16 inches
Base, medium 4-pin				
Socket, Standard 4-contact				

*Under conditions of maximum plate current.

**Recommended values for use in portable receivers.

RADIO WORLD'S

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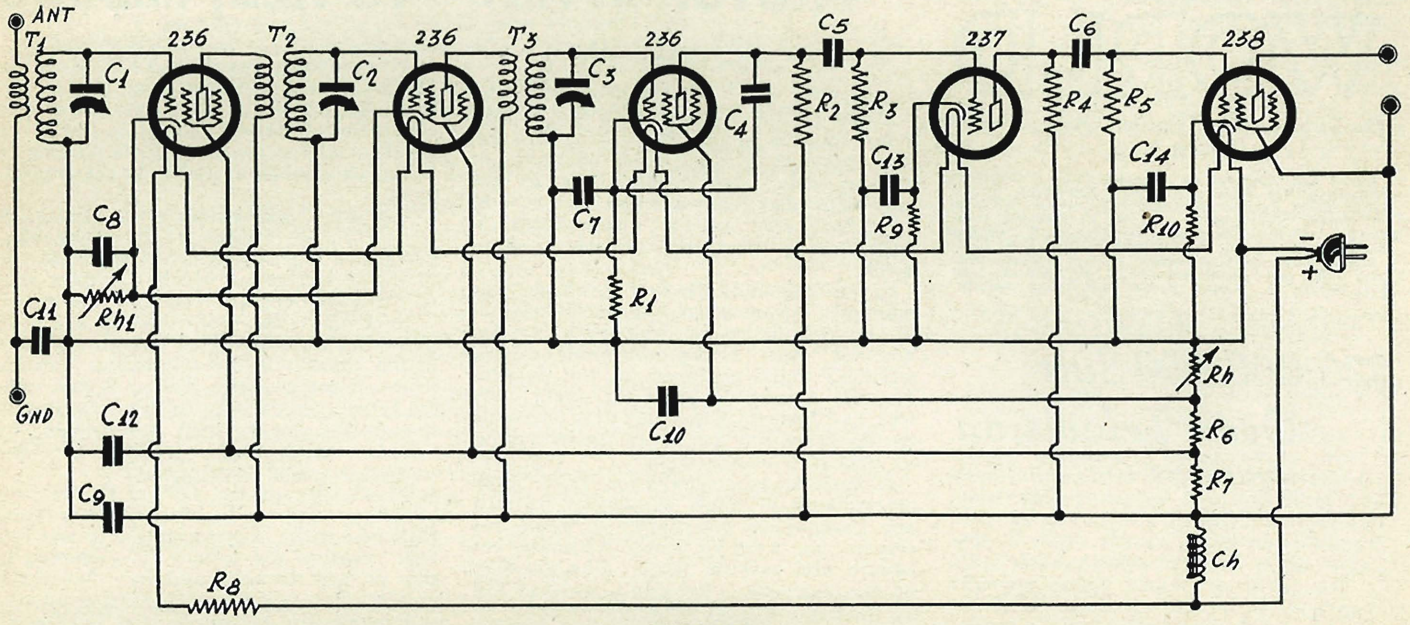


FIG. 991

When the power source for a receiver is a 110 volt d-c line the heaters of the tubes should be connected in series in the manner shown in this circuit and a ballast resistor should be used to drop the excess voltage.

Calibration of Intermediate Oscillator

WILL YOU kindly explain how it is possible to calibrate a 175 kc oscillator? I have built one which covers a considerable frequency range around 175 kc but I have no means of calibrating it, and without a calibration it is not of any use to me. I assume there is a way of using broadcast station signals in the work of calibration.—F. W. L., Wheeling, W. Va.

In case the 175 kc oscillator is not calibrated this may be done with the aid of the broadcast oscillator. If the broadcast oscillator is set at 700 kc and loosely coupled to the 175 kc oscillator, there will be a beat when the i-f oscillator is set just at 175 kc. If the dial setting of the i-f oscillator at which this squeal occurs is noted, this oscillator may be set at 175 kc subsequently. If the i-f oscillator covers a considerable frequency range there will be many points at which strong squeals will be heard, and care must be taken to make sure that the right point is obtained. The various major squeals will be heard at 700/1, 700/2, 700/3, 700/4, and so on. If the i-f oscillator should cover the range from 150 to 350 kc, there will be a squeal at 350, another at 263, and still another at 175 kc. This will be the first major squeal as the condenser of the i-f oscillator is turned from the maximum setting. There will be many lesser squeals between the major squeals. For example, there will be one at 280 kc, another at 200 kc, and still another at 156 kc.

Thus with a single broadcast frequency many points on the calibration curve of the intermediate frequency amplifier can be obtained. If more points are required, other broadcast frequencies can be tuned in and several points on the calibration curve can be derived from each.

* * *

AC on Plate of Oscillator

WOULD YOU recommend the use of a-c on the plate of a radio frequency oscillator? An oscillator of this type can be constructed with only a few parts and the a-c provides modulation directly without the use of an audio oscillator. If there are any objections to this will you kindly state them?—B. S., Milwaukee, Wis.

No doubt, this type of oscillator is very simple and inexpensive to build, and it is all right as long as you want only a modulated wave. But if you want to use the oscillator with zero beat the modulation is a nuisance. It makes it very difficult to find the zero beat position. For this reason we recommend an oscillator in which the modulation can be cut out by throwing a switch or by taking out the audio oscillator. This requires that pure d-c be used on the plate of the high frequency oscillator plate. However, you do not need a special audio oscillator to provide the modulation frequency. This you can well take from the a-c line if you have no objection to the low frequency. A low voltage winding on the filament transformer can be so connected that it may be put in series with the cathode lead of the r-f oscillator. This can be arranged so that a single switch will throw the winding in or out of the circuit. For example, a single pole double throw switch, with the pole connected to the cathode, can pick up either ground or the low voltage winding. The other end of this winding should be connected to ground. Do not connect the winding so that it is short-circuited by the switch when the modulation is not wanted.

* * *

D-C Operated Set

PLEASE publish a circuit diagram of a five-tube receiver will throw the winding in or out of the circuit. For example, a 110 volt d-c line. I have such a receiver hooked up with the exception of the heaters. I am not quite sure how to connect them so that they will be in series. What should the value of the ballast resistance be and on which side of the line should it be placed? What should be the wattage rating of the ballast?—J. J. O'B., Boston, Mass.

You will find such a circuit diagram in Fig. 991. The ballast resistance, R8, is placed in the positive side of the line. Its value depends on the number of tubes in the series and on the value of the line voltage. Since you have five tubes the voltage drop in the tubes should be 5 x 6.3 volts, or 31.5 volts. If the line voltage is 110 volts, the drop in the ballast resistor should be 110-31.5, or 78.5 volts. Since the current required by the tubes is 0.3 ampere the current through the ballast will also be this. Hence the value of the ballast resistor should be 78.5/0.3, or 262 ohms. The wattage dissipation is obtained by multiplying the current by the voltage drop. Hence the wattage is 23.55 watts. The wattage rating of the ballast should be greater than the dissipation. If you want it to run cool make the rating about twice the dissipation.

* * *

Errors in Capacity Measurements

IN THE JANUARY 30TH issue of RADIO WORLD you published an article on how to measure the distributed capacity in a tuned circuit. I have tried this method and the minimum capacity I obtain is so high that there is obviously a serious error somewhere. I know that the formulas are right. Where is the trouble?—G. S. C., Racine, Wisc.

Somehow you have introduced a large capacity which is not indicated on the condenser calibration. The method is correct but it does not take into account any errors that may be introduced during measurement. If you do not use the harmonic method it may be that the oscillator you use introduces errors. It may also be that you use long leads between the calibrated condenser and the tuned circuit under test. You might try the same method on a circuit in which you know the inductance. In that case you can find the distributed capacity which causes the trouble.

A THOUGHT FOR THE WEEK

CROON! Croon! Croon!
With never a bass tone there;
Just the feeble notes
From those weakling throats
That mumble their wails o'er the air.

RADIO WORLD
Trade Mark 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.

$25,000,000 Suit Over Television

A suit for $25,000,000 damages has been filed by William P. Cox and Television, Inc., against Television Laboratories, Inc., three of its directors, namely, Jesse B. McCargar, Philo T. Pharnsworth, and Albert B. Mann, International Telephone and Telegraph Corporation, Mackay Radio and Telegraph Corporation, Orange Securities Corporation, Radio Corporation of America, Wired Radio, Inc., and Philadelphia Storage aBttery Company. The suit was revealed when Television Laboratories, Inc., filed a motion for a bill of particulars.

William P. Cox and Television, Inc., charged that Television Laboratories, Inc., had repudiated a contract made with the plaintiff for exclusive license for use of television and radio inventions and patents owned or controlled by the Laboratories. After the contract was repudiated, it was charged, the defendants, Television Laboratories and Mr .McCargar, granted to the other corporate defendants licenses and contracts in violation of the agreement with the plaintiffs.

Unwearied After 5 Years

Your magazine certainly is the best radio publication to-day, as it has been in the years past. Although the depression is still with us there has never been any corresponding dearth of ideas or lack of solid value in RADIO WORLD and I hope that I will be reading it with as keen interest five years from now as I am at present and as I read it five years ago when it started me building my first modest one-lunger.

A. E. MACGREGOR.
34 Standish Ave., Toronto 5, Ont., Canada.

SUNDRY SUGGESTION FOR WEEK COMMENCING FEB. 21, 1932

Sun., Feb. 21:—Voice of St. Louis........................WABC—12:00 noon
Sun., Feb. 21:—Footlight Echoes..WOR—10:30 p.m.
Mon., Feb. 22:—Buick Revelers..WEAF—9:45 p.m.
Mon., Feb. 22:—With Canada's Mounted........................WJZ—10:00 p.m.
Tues., Feb. 23:—Musical Americana........................WABC—3:30 p.m.
Tues., Feb. 23:—Mr. and Mrs. Jarr........................WOR—7:45 p.m.
Wed., Feb. 24:—Willard Robison..WOR—8:00 p.m.
Wed., Feb. 24:—Margie the Steno..WJZ—9:45 p.m.
Thurs., Feb. 25:—Connie Boswell.WABC—6:30 p.m.
Thurs., Feb. 26:—Maxwell House Ensemble........................WJZ—9:30 p.m.
Fri., Feb. 27:—Carl Fenton & Bing Crosby........................WABC—7:15 p.m.
Fri., Feb. 27:—Jessica Dragonette........................WEAF—8:00 p.m.
Fri., Feb. 27:—Friendship Town...WJZ—9:00 p.m.
Sat., Feb. 28:—Little Symphony..WOR—8:00 p.m.
Sat., Feb. 28:—Music That Satisfies........................WABC—10:30 p.m.

WGY COMPLETES TENTH YEAR AS FACTOR IN ART

BY W. T. MEENAM

Schenectady, N. Y.

WGY is ten years old, an age within a few months of the life of broadcasting. Not more than nine other stations on the air today can claim to be as old and none has had a more active and important part in the development of broadcasting from the technical viewpoint.

In the days when the first feeble electromagnetic waves were finding translation in home-built radio sets with crystal detector and tricky, unstable "cat's whisker," radio engineers of the General Electric Company, most of them men who had been in communication divisions during the world war, were concentrating on improved transmission.

Already many concerns had made large investments in plant equipment to turn out headphones and parts for radio receivers, as well as some complete receivers and vacuum tubes. The question of the day was: "Is this a passing fad or the beginning of a new industry?"

The General Electric Company sought a station license to provide a medium to experiment with and to promote good programs.

Station Goes on Air

To Martin P. Rice was assigned the difficult job of directing the operation of WGY. Working in an uncharted field, with every problem a new problem, he was able, with the assistance of Kolin Hager, studio manager, to keep in advance of the art and thereby make the station one of the best known in radio.

WGY was the first station to incorporate crystal frequency control in its transmitter. By means of this control a station is held rigidly to its assigned frequency. WGY was the first station to use the condenser type microphone in studio and for outside pick-ups as well. Transmitter development necessarily involved elaborate and comprehensive tests in wave propagation, not only with different volumes of power, but with a variety of radiators or antennas. Listeners were asked to co-operate in reporting on reception and to this extent they became laboratory assistants and contributed their part to the promotion of the science.

First to Use 50,000 Watts

From WGY signals of 50,000 watts were heard for the first time. This power was then called "super-power." Later WGY put 100,000 watts into the antenna and more recently experimented for the first time with 200,000. watts.

Propagation tests also concluded investigation of frequencies much higher than the broadcast band. Little was known of the wavelengths below 100 meters and the field from 100 to 5 meters offered to the radio engineers all the thrills that the explorer experiences upon entering uncharted country. After many years of work, the engineers arrived at 31 meters for night-time transmission and 19 meters and vicinity for day-time operation. WGY today utilizes two short-wave transmitters, W2XAF, 31.48 meters, and W2XAD, 19.56 meters, which carry all the programs of the long-wave station.

Through these short-wave transmitters an international and even inter-continental audience is possible, dependent always upon atmospheric conditions. Through the use of these transmitters, WGY has been equipped to offer its listeners many unique and highly interesting programs. Prior to the time when commercial telephony was possible across the oceans, the Schenectady station presented two-way conversations with Sydney, Australia, and London, England.

Many listeners still recall with a thrill the special broadcast, carried by stations of the National Broadcasting Company network, and supplied by WGY, when the voice of Admiral Richard E. Byrd was brought from Dunedin, New Zealand, within a few hours after the explorer returned with his men from Antarctica. Admiral Byrd and Russell Owen, newspaper correspondent, were heard chatting with Adolph Ochs, publisher of the New York "Times."

In television also, WGY has acted the pioneer. Television signals were broadcast on a regular schedule nightly beginning May 10th, 1928, enabling experimenters working on a 24 line picture to test their equipment. In the same year WGY, for the first time anywhere, broadcast a television drama, using the broadcast channel for the picture signals and simultaneously a short wave channel for the voices of the actors. In August, 1928, engineers experimented with the first remote control television pick-up, the picture of Gov. Alfred E. Smith, as he delivered an address accepting the Democratic nomination to the presidency.

The WGY Players, the oldest group on the air, was organized in April, 1922, and have been heard nearly every week.

UNITED STATES MAILS BARRED TO XED, MEXICO

Washington.

A fraud order against XED, Reynosa, Mexico, denying the station use of the mails because it is alleged to have been conducting lotteries, has been issued by the Post Office Department, according to information made available by the Department.

The order was issued after Postal Inspector F. W. Reuter, of St. Louis, Mo., had heard a program broadcast from the Mexican station in which a lottery was said to have been advertised, it was stated.

Since the order was issued it has been found that thousands of Americans were taking chances in these lotteries. Letters from all parts of the United States, sent by Americans wishing to take chances in the games, have been intercepted by postal officials and returned to their senders, marked "fraudulent."

Postal laws of the United States prohibit any person in this country from using the mails in participation in any lottery, whether the lottery is conducted in this or any foreign country. The mails cannot be used for transmitting money orders paying prizes or for tickets on lotteries.

The Mexican station operates with a power of 10,000 watts on 977 kilocycles, which is next to the frequency of KDKA, Pittsburgh, which operates on 980 kc.

The Federal Government has no control over XED because it is in a foreign country, but regulations of the Federal Radio Commission prohibit United States stations from carrying on lotteries or other games of chance.

STATION SPARKS

By Alice Remsen

The Call of the East

FOR THE WEAVER OF DREAMS
(WOR, Thursdays 10:15 p. m.)

I can hear the East a-calling as upon my bed I lie;
I can feel the East a-drawing an' I know the reason why;
I'm afeared that I must leave you, to fulfill my rendezvous,
For I feel the East a-calling an' she's more to me than you.
Yes,—your lips are red an' luscious—an' I love their kisses warm;
An' your arms are soft an' tender—and voluptuous your form—
But I hear the East a-calling, an' she's vastly more to me
Than your charms of native beauty or your love could ever be.

Aye, your passion makes me tingle, it makes my blood run fire,
But that is only passing—a wandering desire.
I am leaving in the morning, so forget your soldier man,
For I feel the East a-drawing as only soldiers can.
I can hear the camels grumbling as they bend their weary knees;
I can smell the sweating natives, I can feel the biting fleas;
The temple bells are pounding in my ears the livelong day,
I must board a ship at daybreak an' sail across the bay.

For when the call comes to you no matter where you are,
You leave all things behind you an' journey wide an' far,
For the East just eats your heart up, you'd go through fire an' flood—
When you hear the East a-calling, for it gets into your blood.
So, goodbye dainty living an' love with gauzy wings,
For I can't stay here with you, I was made for other things.
Oh, I feel the East a-calling an' it's telling me to pack,
So I'm leaving in the morning an' I'm never coming back.
—A. R.

* * *

Basil Ruysdael Is The "Weaver of Dreams." His resonant voice lends itself charmingly to the reading of poetry, especially the Kiplingesque and "he-man" verses. Basil did the above poem of mine, "The Call of the East," on his program last year and received so many requests for copies that I have ventured to include it among my dedication. If you are fond of poetry, listen in to Basil; if you don't care for poetry listen anyhow, for Lee Cronican provides a beautiful musical background.

* * *

Max Smolen, Conductor of the "Evening in Paris" program over WABC, is by no means the only musical member of his family. His brother Sam is the cellist of Max's orchestra, and his brother Milan is a pianist of note. Each week-end the clan of Smolen gathers for a family dinner and the musical brothers are always asked to entertain. Maestro Max then unpacks his violin and forms a trio. A biography of the Smolens will be run on this page in a forthcoming issue.

* * *

Raymond Knight, Chief of NBC's Cuckoos, was initiated into the Early Worms DX Club of Canada recently at 2:30 a.m. He was called by long distance telephone from Toronto and the ceremony took place over the wire. His speech of acceptance was broadcast over station CKGW, Toronto.

* * *

Another Mysterious Personage has opened over WABC. "The Singing Chef" is sponsored by the makers of Kre-Mel dessert. He is heard every Monday, Wednesday and Friday from 12:30 to 12:45 p.m. His identity is kept secret, but your sleuth will probably dig up his cognomen one fine day. He may be Irving Kaufman; at least, that's my guess. And by the way, speaking of Irving Kaufman; he is not to be confused with Singin' Sam. He is known as Salty Sam, the Sailor, over WABC. Singin' Sam is Harry Frankel, the Barbasol Man, a veteran of the vaudeville and minstrel stage.

* * *

Bill Paisley of the NBC Music Library Staff in New York, recently passed through Galion, Ohio, en route to Arkansas for a vacation. He tossed a letter from the observation car to a young chap on the station platform and yelled. "Will you please see that Dick Maxwell gets that letter?" When Maxwell, NBC singer, also on vacation at his home near Galion, received the letter, eight of his old chums at Kenyon College, Ohio, had scribbled greetings on the outside of the envelope.

The Most Welcome News This Week is the fact that Ann Leaf and Ben Alley have gone commercial. They will be heard every Wednesday from 3:15 to 3:30 p.m. over a coast-to-coast network of 55 stations of the Columbia Broadcasting System. The program will be known as The Musical Revue.

* * *

Very Glad to Learn That O. O. McIntyre's favorite breakfast dish is sausages chopped up in scrambled eggs—and it's my favorite, too. In a short canvass I discovered that Maria Cardinale, Muriel Pollock, Vaughn de Leath, Arthur Tracy, Beth Challiss, Singin' Sam, Frank Parker, Ann Leaf, Ivy Scott and the Lockharts are crazy about it, too.

* * *

Sidelights

HARRY SALTER, orchestra leader of six weekly programs, in starting life as a chemist, made several important discoveries, the greatest of which was that he was cut out to follow music . . . WILFRED "BILL" GLENN is a yachting enthusiast . . . A flip of a coin decided JOHN S. YOUNG against a legal career and in favor of the drama, which finally led him to radio . . . MIKE CHILD, orchestra director, heard on the Barnsdall program, which originates at KMOX, the Voice of St. Louis, has one hobby, and that is hunting . . . BABY ROSE MARIE, began her professional career when three years old . . . JOHN S. YOUNG is an NBC bachelor . . . so is EDWARD THORGERSON . . . ditto GEORGE HICKS . . . also HOWARD CLANEY . . . RAY WINTERS, too . . . HOWARD PETRIE is also carefree . . . as are BEN GRAUER and ALLAN KENT . . . LESTER SCHARFF, new WOR production man, was formerly on the Shubert executive staff . . . MERLE JOHNSTON likes radio work because it brings out the best that is in an artist . . . BASIL RUYSDAEL is now scheduled to go on WOR with his old program, "The Beggar's Bowl," for which a great many people will be thankful . . . FRANK CAMPLAIN and AL BERNARD are the original Record Boys . . . JACK ARTHUR has been in radio for seven years.

* * *

ANSWERS TO CORRESPONDENTS

H. S. RHODES, N. Y.—Yes, the Piccadilly Circus program will continue over WJZ, as far as I know now, but it has been cut to fifteen minutes. Yes, I shall be on the program again when nothing else interferes.

G. JOHNSON, Garden City, L. I.—Peter Dixon writes the Raising Junior series. He also plays the part of Kenneth Lee. His wife, Aline Dixon plays Joan Lee and Raymond Knight doubles in several characters.

WILL THE GENTLEMAN who wrote asking about Col. Stoopnagle and Bud kindly repeat his request? I have mislaid his letter.

* * *

Biographical Brevities

ABOUT ARTHUR BAGLEY

Arthur Bagley is a philosophically happy physical culture crusader. For twenty-three years he has been spreading the gospel of physical culture, nine years of it on the radio. He has the largest gym class in the world today, estimated to number 2,500,000. His first broadcast was over a New Jersey station in 1923. On March 31st, 1925, he started the present Tower Health Exercises, heard over an NBC-WEAF network each week-day morning from 6:45 to 8:00 a. m., E. S. T.

Bagley was born in Rahway, N. J., more than fifty years ago. He looks much younger, however. He is of slight and wiry build, partly bald and has sparkling brown eyes. He is mentally alert and pleasant—characteristics which always are indicated in his broadcasts. He began his professional career in the Rahway (N. J.) Y. M. C. A. He conducted gym classes in Rahway and Newark, and also in Taunton and Lawrence, Mass., before beginning to broadcast health exercises from Newark. He is now a member of the National Board of the Y. M. C. A.

Bagley frequently does all the gymnastic exercises as he prescribes them during the broadcasts, including the imaginary bicycle ride. In nearly seven years of broadcasting the Tower Health exercises, he has been absent from the microphone only fifteen weeks, three of them for illness and the other twelve for six annual two-week holidays. He has never been late for a broadcast and has three alarm clocks set to ring at five minute intervals starting at 5:45 a. m. In addition, a hotel clerk rings his apartment at 5:40 and 6:00 a. m. After Bagley rises he never turns off any of the alarms, being fearful that he'll relax for a moment and fall back to sleep.

Bill Mahoney, the pianist on the broadcasts, uses the same number of alarm clocks and gets the same number of calls from a hotel clerk, to assure his early rising. Mahoney has appeared on the program for about five years.

Every morning when Bagley directs his huge physical culture class, his wife exercises for half an hour in their New York apartment the length of time he prescribes for his pupils. His son plays hand ball in a New York Y. M. C. A. gymnasium but his daughter takes no set exercises. "She is very busy with household duties," he says, "and gets plenty of exercise. I do not favor over-exertion."

The majority of Bagley's pupils are middle-aged women; then come fat men, then the younger element.

* * *

(If you would like to know something of your favorite artists, drop a card to the conductor of this column. Address her: Miss Alice Remsen, care RADIO WORLD, 145 W. 45th St., New York, N. Y.)

BILL IN SENATE ASKS TREATIES TO END RACKET

Washington.

Under the terms of a resolution offered in the Senate by Senator Dill, of Washington, the Department of State would be requested to negotiate treaties with Cuba, Canada, and Mexico for allocation of radio wave channels to avoid interference. Provision was made in the resolution for the Federal Radio Commission to assist the Department of State in negotiating agreements.

In offering the resolution, Senator Dill said that conditions are "bad and growing rapidly worse" in regards to interference by Mexican and Cuban stations. He said that there are approximately 12,000,000 sets in use in the United States, and that these and the stations intended to serve them become valueless if interference is allowed to grow.

Senator Dill informed the Senate that Mexico was granting permits for the construction of stations to individuals and corporations denied permits here, and that it has developed into a "racket." He said the situation is growing worse because the "racketeers" are "threatening" American stations with interference of broadcasts on their channels unless the operators in this country "buy off" the license holders in Mexico.

Senator Dill's resolution follows in full:

"Whereas, radio broadcasting stations in Mexico and Cuba are using frequencies being used by radio broadcasting stations in the United States, and thereby causing interference with the service of said stations to the American people, and it is reliably reported that a number of additional radio broadcasting stations are planned and under construction near the American border of Mexico, and

"Whereas, there is no international agreement or treaty dividing the use of frequencies for radio broadcasting among the nations of North America, and only by such an international agreement can the governments of these countries protect the radio broadcasting stations within their borders from interference by radio broadcasting stations in other North American countries, and

"Whereas the value of vast investments in the radio broadcasting business in the United States and good reception by the receiving sets of the millions of listeners in the United States are dependent upon the prevention of interference by radio broacasting stations located in adjoining countries;

"Now, therefore, be it resolved, That the Senate hereby requests the Secretary of State, with the assistance of the Federal Radio Commission, to negotiate international agreements with Canada, Mexico and Cuba, and any other countries he may deem advisable, either separately or by joint convention, for the protection of radio broadcasting stations in all of these countries from interference with one another, whereby a fair and equitable division of the use of radio facilities allocated for broadcasting under the International Radio Telegraph Convention of Washington in 1927 may be made."

Chattering Teeth

A set has to do more than merely bring in signals to be a signal success.

* * *

A service man will sell a customer a new set of tubes on the slightest provocation. Still, the tube manufacturers are losing money.

* * *

The trouble with midget sets is that people want them.

* * *

Aspire to rule the world or build the best all-wave receiver. In either instance you have a real job.

* * *

Inductance formulas do not hold for short-wave coils. The cut-and-try method has to be used. Therefore little is ever heard about the required number of turns. Mathematical hands are busier with pencils than with coil forms.

* * *

Radio celebrities don't remain favorites so long, but who wants them to?

* * *

More words are mispronounced by banquet speakers on the air than by announcers. It's becoming a disgrace to be the guest of honor.

* * *

Radio listeners hope that the two big parties have a time of it choosing their Presidential candidates. The more competition, the more there is that isn't interesting to listen to. Besides, some phrase has to supplant "24 votes for Underwood."

* * *

We shun tin cans for shields but gladly ride around in them.

* * *

The same radio voices in the home every day get tiresome. Sponsors with six-a-week features are warned that quarter hours eventually become annoying.

* * *

Radio is better than ever, better everything and more of it, plus a few somethings of the worse variety.

* * *

Formerly the family gathered 'round the table with earphones, and nobody must make the least sound, otherwise the program would be inaudible. Now—but you finish it.

Portables Perfected for Forest Service

Washington.

Portable radio broadcasting and receiving sets have just been perfected by an officer of the Forest Service in Portland, Ore., according to an announcement by the Department of Agriculture. A 60-pound set has been perfected that will broadcast the voice for 10 miles and send code messages 20 miles through dense timber in mountainous country, and a 10-pound set will send code messages 20 miles.

Neither set requires a ground wire, and ea chis ready for use as soon as the antenna is up. The larger set is designed for Forest Service fire lookouts on high peaks and the lighter one for fire guards and patrolmen.

STATION TAX; LIMIT ON 'ADS,' UP IN CONGRESS

Washington.

Proposals to take away from the Federal Radio Commission much of its broad power in determining what sort of broadcasting is "in the public interest," and imposing a heavy license fee on broadcasters, soon will be introduced in the House by Chairman Davis, Tullahoma, Tenn., of the Committee on Merchant Marine, Radio, and Fisheries, he has announced.

He said he had practically completed the drafting of the amendment to the Federal Radio Act and that it followed that offered in the Senate by Senator Couzens, of Michigan, which is designed to limit the use of radio for advertising.

Costs Much to Supervise

"When the broadcasting industry began operating there was comparatively little expense involved in handling licenses, supervising operations and policing the air," Representative Davis said.

"The whole thing has grown so rapidly that it now costs thousands of dollars annually for the Federal Government to protect the public's interest in the free privilege of using the ether. I contend that broadcasters who profit from the granting of these facilities should be made to share the financial burden of administration."

The limitation on advertising which Mr. Davis will propose, he said, would be based on time used and the character of the matter broadcast. He also said it would be imperative to place further restrictions on the different classes of stations.

Name and Business Only

Transmitters of more than 1,000 watts would be allowed to advertise only by identifying the sponsor of the program and the nature of his business, but less powerful stations would be allowed to give more information in behalf of the advertisers. He said that this formula should improve the calibre of programs presented by the networks and by the larger independent stations.

Lynch Manual Aids Service Man's Work

"The new Lynch Resistor Replacement Manual is a real shortcut to trouble-finding for the serviceman," says the Lynch Mfg. Co. "Repairs to radio sets ordinarily can be made in one-tenth the time it otherwise would take."

The book ,pocket size, gives the value and code of each resistor, and its position in the circuit, for neardly every popular make of radio receiver. More than 200 circuits are listed. This useful book of 60 pages, brimful of authoritative information, may be purchased direct from the Lynch Mfg. Co., Inc., Dept. WR, 175 Broadway, N. Y. C., and also there is a plan to obtain it free.

WMAL Getting Ready to Try Television

Washington

Following tests recently conducted by engineers of the Jenkins Television Corporation, installation of television equipment in WMAL has begun. Field tests have been made with a portable experimental transmitter W2XAP.

It is expected that the station will be on the air with regular sound and sight pictures within a month. Flood-lighting the stage and the pick-up with a new television camera will be used in place of the indirect, flying spot method of illumination and scanning.

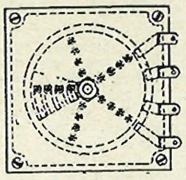
A detailed announcement is expected.

NEW PATENTS

(Those listed this week were issued February 2d, 1932.)

[Newly issued or reissued radio patents are recorded in this department. The number of the patent itself is given first. Usually only one claim is selected and the claim number also is cited. The code at the end of the title description (Cl., etc.) refers to the classification, the next number being the sub-division, which data define the nature of the patent. All inquiries regarding patents should be addressed to Ray Belmont Whitman, Patent Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.]*

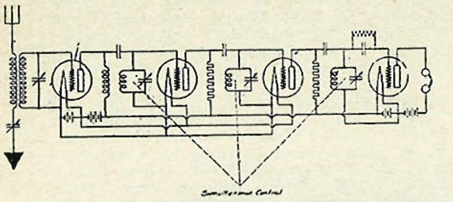
1,843,800. RADIO INDUCTANCE SWITCH. Andrew Brosnatch, Chicago, Ill. Filed March 19, 1930. Serial No. 437,185. 4 Claims. (Cl. 200—11.)



1. A switch comprising a rotative shaft, a plurality of spaced apart discs on and rotatable with said shaft and insulated from each other, a plurality of groups of stationary contacts and said groups being radially arranged about said shaft, a group of stationary brush contacts each having constant wiping engagement with one of said discs, and a wiping contact carried by each of said discs, said last named contacts adapted to have selective engagement as a group with any one of said first named groups of contacts upon rotation of said shaft.

* * *

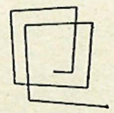
1,843,565. RADIO RECEIVING SYSTEM. Frederick A. Kolster, San Jose, Calif., assignor to Federal Telegraph Company, San Francisco, Calif., a Corporation of California. Filed Oct. 2, 1923. Serial No. 666,060. 3 Claims. (Cl. 250—20.)



1. A cascade radio frequency amplifier adapted to selectively amplify energy over a substantial range of radio frequencies comprising at least two electron emission tubes each having input and output circuits, an untuned element having a high radio frequency impedance coupling together the output of the first tube with the input of the second and having a high impedance throughout said range of frequencies, a similar high radio frequency impedance coupling together the output of the second tube with the input of a translating circuit, a variable selector connected in parallel with the input of the second tube, and a similar selector in parallel with the input of each electron tube circuit, each selector comprising an inductance element and a condenser element in parallel with the inductance element of each selector, one of said elements being simultaneously variable by operation of a single control whereby the system may be tuned for any one frequency within said range.

* * *

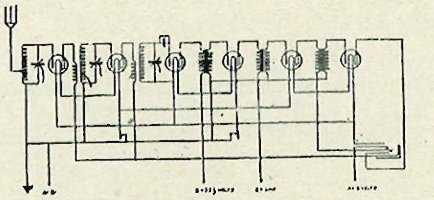
1,843,445. ANTENNA ARRANGEMENT. Henri Chireix, Paris, France, assignor to Societe Francaise Radio-Electrique, Paris, France, a Corporation of France. Filed April 28, 1931, Serial No. 533,397, and in France May 6, 1930. 6 Claims. (Cl. 250—33.)



1. Aerial comprising a number of series connected sections in the form of a helix each winding of which has a perimeter equal to twice the wavelength and the pitch of which is equal to one wavelength.

* * *

1,843,177. RADIO RECEIVING SYSTEM. Sol S. Sonneborn, East Orange, and Henry G. Richter, Roselle Park, N. J. Filed Jan. 13, 1926. Serial No. 81,129. 9 Claims. (Cl. 250—20.)



QUESTIONS ANSWERED

I FILED a patent application on my invention and afterwards improved the invention and asked the attorney to change the application accordingly. He said this could not be done. Please advise regarding this.—A. H. D., Raleigh, No. Carolina.

Your attorney was correct. New matter cannot be added to an application, as otherwise there would be endless confusion; inventors would get the benefit of several examinations for the one fee and the file would not show a proper filing date for all parts of the application. Your only recourse is to file an improvement application under a new number and date.

* * *

DOES the Patent Office guarantee the validity of claims in the patents which it issues?—L. G. New York, N. Y.

No. The Patent Office merely makes as thorough a search as possible and does the best it can with the facilities it has on hand to prevent the issue of invalid patents. It does a great work as far as its facilities permit, but since any publication anywhere in the world may be used to prove a priority to invalidate a patent they are frequently held invalid on such publications as well as on differences of opinion by the court and the Patent Office as to what is new in the field searched by Patent Office. Statistics show that patents are held valid and infringed in somewhat more than half of the total cases adjudicated.

* * *

WHAT IS the total cost for filing a patent application on a simple invention and how much more will it cost before the patent has been obtained?—E. G., New York, N. Y.

About $150 should cover the cost of preparing and filing the papers including the drawing, the attorney's fees and the Government filing fee of $25, thereafter two or three amendments at perhaps $25 each and a final fee of $25 to the Government. These latter expenses, however, are spread over several years, usually.

* * *

DOES IT PAY to take out many foreign patents?—L. T. A., Detroit, Mich.

It usually does not pay to take out many of them but often it is advantageous to protect the invention in the several most important foreign countries, such as Great Britain, Germany, France, Canada, Japan and possibly one or two of the South American countries. This advice, however, is general and much depends upon the specific circumstances.

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.*

Paul Hammond, 32 Bishops Hall, Andover, Mass.
C. J. Elliott, P. O. Box 145, Barberton, Ohio.
Glenn E. Mitchell, 625 So. 8th St., Cambridge, Ohio.
William Stein, 463 E. 135th St., Bronx, New York City.
General Radio Service (E. S. Waldron), 2750 Riverside Drive, Jacksonville, Florida.
Y. T. Kolver, 35 Jane St., Toronto, Canada.
Alfred M. Stump, Jr. (all kinds of radio apparatus), 301 N. Jefferson St., New Castle, Pa.
J. T. Rowley, 1524 Matthew Terrace, Portsmouth, Va.
Harvey R. Bonnelle, 163 Meadow St., Williamsett, Mass.
Darrell Ward, Montgomery Military Institute, Montgomery, Ala.
K. Hinchluter, 532 Smith St., Toledo, Ohio.
Jos. Couillard, St. Ludger, Riv. du Loup, Co. Temiscodata, Que., Canada.
Chas. A. Everett, 901 Munising Ave., Munising, Mich.
Ronald Marko, 1634 Marquette Ave., South Milwaukee, Wis.
Walter Dinnel, Ortonville, Minn.
Harry L. Watkins, Fairview, Okla.
H. C. Lee, 511 Simonton St., Key West, Fla.
H. Leonard Wilson, 831 Lincoln Ave., Cincinnati, Ohio.
L. M. Jones, c/o Arcade Hardware Co., 5170 Grand Ave., Detroit, Mich.
Walter R. Byer, c/o Hueblings, 847-849 Penn St., Reading, Pa.
M. Daly, 4005 Webb Ave., Detroit, Mich.
J. M. Smithers, 1595 E. Minnehaha St., St. Paul, Minn.

New Incorporations

Hyvac Radio Co., Newark, N. J., deal in radios—Atty., Benjamin Newman, Newark, N. J.
Checker Stores, New York City, garage, radios—Atty., S. E. Harwitz, 1440 Broadway, New York, N. Y.
Royal Battery Corp., New Brunswick, N. J., manufacture batteries—Attys., R. E. and A. D. Watson, New Brunswick, N. J.
Broadcast Producers of N. Y., New York City, radio broadcasting—Attys., Bernstein & Bernstein, 250 West 57th St., New York, N. Y.
Elco Engineering Co., New York City, electrical appliances—Atty., S. A. D. Jones, 43 Exchange Place, New York, N. Y.
Ja-Ro Sewing Machine and Electrical Corp., New York, N. Y.—Attys., Struckler & Levine, 85 West 42nd St., New York, N. Y.
Nu Lite Reflector Co., Brooklyn, N. Y., electric supplies—Atty., S. I. Aguinek, 290 Broadway, New York, N. Y.
Perry-Sherman Appliances, Syracuse, N. Y., electrical devices—Attys., Foley & Guile, Utica, N. Y.

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MIDGET RECEIVERS, A.C., COMPLETE, $14.95. Bargain Catalog Free. Imperial Radio Company, 16 East 23rd Street, New York.

EBY antenna-ground binding post assembly for all circuits. Ground post automatically grounded on sets using metal chasses. Assemblies, 30c. each. Guaranty Radio Goods Co., 143 West 45th St., New York, N. Y.

"1932 OFFICIAL RADIO SERVICE MANUAL," by Gernsback. Complete Directory of all 1931-1932 Radio Receivers. Full Radio Service Guide. Leatheroid binding, $4.00. Radio World, 145 W. 45th St., New York, N. Y.

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

"THE STORAGE BATTERY SIMPLIFIED," by H. E. Phillips. A practical book for the old-timer, the beginner, and all others interested in storage battery work, covering construction, operation, maintenance and repair of all types of storage batteries. 300 pages. 185 illustrations, 6 x 9. Flexible binding, $3.00. Radio World, 145 W. 45th St., New York, N. Y.

THE FORD MODEL—"A" Car and Model "AA" Truck — Construction, Operation and Repair — Revised New Edition. Ford Car authority, Victor W. Page. 703 pages, 318 illustrations. Price $2.50. Radio World, 145 W. 45th St., New York.

"AMATEUR MOVIE CRAFT," by James R. Cameron. A book dealing with the making and showing of 16 m/m pictures and equipment necessary for same. Paper cover, $1.00; Cloth, $1.50. Radio World, 145 W. 45th St., New York, N. Y.

BROADCASTING STATIONS TO DATE
Radio World of Dec. 19 and 26, 1931, and Jan. 2 and 9, 1932—4 issues—contains a complete list of U. S. Broadcasting Stations by Frequencies with ALL details given, corrected to date. 15c a copy. Radio World, 145 W. 45th St., New York, N. Y.

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

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8-TUBE AUTO SET

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

SHORT-WAVE CONVERTER

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

5-TUBE AC, T-R-F

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

A-C ALL-WAVE SET

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

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To do your radio work properly you need meters. Here is your opportunity to get them at no extra cost. See the list of nine meters below. Heretofore we have offered the choice of any one of these meters free with an 8-weeks' subscription for RADIO WORLD, at $1, the regular price for such subscription. Now we extend this offer. For the first time you are permitted to obtain any one or more or all of these meters free, by sending in $1 for 8-weeks' subscription, entitling you to one meter; $2 for 16 weeks, entitling you to two meters; $3 for 26 weeks, $6 for 52 weeks, entitling you to six meters. Return coupon with remittance, and check off desired meters in squares below.

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Enclosed please find $............for ....weeks subscription for RADIO WORLD and please send as free premium the meters checked off below

☐ I am a subscriber. Extend my subscription (Check off if true.)

- ☐ 0-6 Voltmeter D.C. ....No. 326
- ☐ 0-50 Voltmeter D.C ....No. 337
- ☐ 6-Volt Charge Tester D.C. ....No. 23
- ☐ 0-10 Amperes D.C. ....No. 338
- ☐ 0-25 Milliamperes D.C ....No. 325
- ☐ 0-50 Milliamperes D.C. ....No. 350
- ☐ 0-100 Milliamperes D.C ....No. 390
- ☐ 0-300 Milliamperes D.C ....No. 399
- ☐ 0-400 Milliamperes D.C ....No. 394

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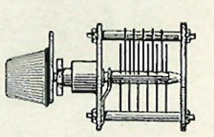
LOOKING FOR FINE GOODS AT BARGAIN PRICES? HERE THEY ARE!

MIDGET CONDENSER

The rotor has no end stop and therefore precision calibration of oscillators and tuners is not upset by dial-jarring.



A MIDGET condenser for high frequency work, equipped with knob and pointer, and including a milled bushing that can be attached for taking ¼ inch dial hub. This condenser may be used either as a trimmer for a main condenser or alone for tuning in the high frequencies. Particularly valuable for amateur wave reception, short wave converters and short wave sets generally, where wide dial spread is highly desired, and five coils are used for coverage of 200 to 15 meters. The capacity is 0.000045 mfd. (45 mmfd.). Cat. CHMG-45 @ $0.69

The same model condenser also is obtainable in 0.000055 mfd. (55 mmfd.) capacity. Order Cat. CHMG-55 @ .... .59

Oscillator coil for switching bands without plugging in, to cover 15 to 200 meters with 55 mmfd. Cat. M-55-C (coil only) $2.15

TAPPED COILS FOR BAND SHIFTING

TAPPED coils are proving very popular, as they make for economy of room and also afford good results. The Roland coils are obtained in two types, one for broadcast coverage, 200 to 600 meters, with tap for going down to 80 meters, so television, airplane talks, amateur and other interesting transmission may be heard, and the other for coverage from 200 to 15 meters only. (No broadcast band.) These coils are wound on 1⅛ inch diameter and are attached at the factory to aluminum screw bases, with lugs protruding at bottom. An aluminum cover (not illustrated) screws over the base.

The primary is wound over the secondary, with insulating fabric between, and the inductance is kept exactly equal for all coils by keeping the axial length of the winding identical, as well as the number of turns. Therefore at top (what looks like a separate winding) a space is "spun," as well as at bottom, to insure such identical inductance.

For 80-600 meters, for use with 0.00035 mfd. three gang, order Cat. M-35-C (three coils, three shields at this price) @ $2.45

For 0.00046 mfd. order Cat. M-46-C MSSC @ $2.45

For 0.0005 mfd. order Cat. M-05-C @ $2.45

The short wave coils, 15 to 200 meters, are listed herewith:

For 0.00035 mfd., two shielded coils, one with two windings for antenna coupler, other with three windings for sensitized detector. Order Cat. OSW-35-L @ $1.95

For 0.00015 mfd. two shielded coils, Cat. SW-015-L @ $2.05

PRECISION PARTS AND ACCESSORIES

WE carry a complete line of Rola dynamic speakers, all sizes, all purposes, as well as the exclusive Farrand inductor speaker for push-pull pentode output that requires no output transformer.

The Rola speakers are very popular in midget sets, both of the broadcast and short-wave type, as well as for all-wave coverage, and are used also to great advantage in automobiles.

The Rola speakers for home receivers are obtainable with field coils that may be used also as the B supply choke coil, and which field coil has a tap, so that bias for a pentode may be obtained from the field coil itself. This method introduces audio regeneration, which improves tone and sensitivity. The tapped coils have a total resistance of 1,800 ohms and the tap is at 300 ohms from the ground end. The grid return of the power stage is connected to the tap. This is the method used in all our a-c circuits. Rola dynamic speaker, 1,800 ohm field coil, tapped at 300 ohms. Output transformer matched to single pentode is built in. Diameter of cone is 7 inches. Cat. RO-18 @ $4.50

Same as above, except that cone diameter is 10.5 inches. Cat. RO-18-10 @ $5.85

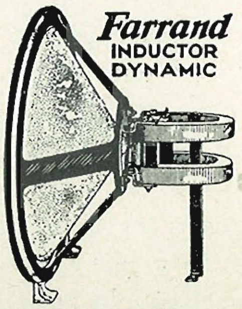
Same as above, except that cone diameter is 12 inches. Cat. RO-18-12 @ $7.25

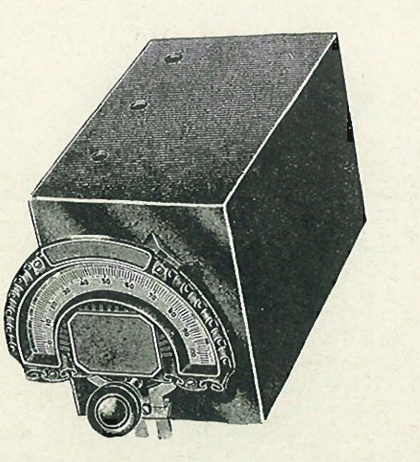
Rola dynamic 6 inch cone for automobile sets, 6 volt field to be connected to car's storage battery. Speaker fits on bulkhead under the instrument board. Shielded cable is supplied with each speaker. Cat. RO-AU @ $4.95

Magnavox speakers can be supplied, if desired, at same prices, same specifications. Use code "MA" instead of "RO", same letters and numbers otherwise, when ordering Magnavox speakers.

FARRAND inductor dynamic, for pentode push-pull requiring no output transformer. Simply connect the two tipped leads to the plates of the pentodes and connect the untipped (yellow) lead to the maximum B plus voltage. By this method no plate current flows through the winding, only signal current so there is no danger of burnout or premature saturation, and the tone quality is superb.

This speaker has one of the best audio curves of any ever produced, but it is not quite so sensitive as other type dynamic speakers, and therefore should be used on high powered sets. It is suggested therefore that it be used on a-c sets having no fewer than six tubes or battery sets having fewer than seven tubes. It is strongly recommended, however, that the speaker be used on all high powered sets using push-pull pentode output. These pentode speakers are not generally obtainable. We're privileged to have a source of supply that enables us to fill the needs of those most discriminating as to tonal values. Order Cat. FAR-PENT @ $8.75





MATCHED COMBINATION TUNING UNIT, to cover from 80 to 600 meters, using a coil system including a single tap on each secondary, and serving as the tuning adjunct in superheterodynes with an intermediate frequency of 175 kc. The tap need not be used if only the broadcast band is desired. The oscillator circuit is accurately padded for that intermediate frequency. The matched tuning unit includes a three gang, brass-plate, steel-frame condenser, with stator shields built in, the entirely shielded again, with extra partitions built inside to serve as rotor shields (illustrated). Low vibration factor to avoid grunting of some types of superheterodyne condenser construction. Three trimmers are built in. The three shielded coils, of the same general appearance as the one illustrated at upper position on this page, and dial are supplied. The oscillator coil is already padded. Order Cat. CMTU @ $6.65

Set of three shielded coils, padded for 0.00035 mfd., for use with 175 kc. intermediate amplifier. Tap is included. Cat. SUC-35 @ $3.10

Same as above (set of coils) except for 0.00046 mfd. Cat. SUC-46 @ $3.10

Same as above, except for 0.0005 mfd. Cat. SUC-5 @ $3.10

800 TURN HONEYCOMB coil, total diameter 1¼ inches; will tune to 175 kc. with 0.0001 mfd. (or 20-100 mmfd equalizer). Cat. HC-800 @ .... $ .50

300 TURN HONEYCOMB coil, same style, tunes to 450 kc. with 0.0001 mfd. Also may be used without condenser as antenna input coil, screen and plate choking, or two used inductively coupled for evening the amplification of t-r-f sets, in untuned stage feeding detector. Cat. HC-300 (each) @ .... $ .43

50 TURN HONEYCOMB coil, ¼ millihenry, for all short wave purposes. Cat. HC-50 @ .... $ .25

1 WATT PIGTAIL RESISTORS, all resistance values. Mention Cat. PGTR and state resistance in ohms thereafter. Price .... $ .15

5 WATT 2,250 OHM resistor to drop maximum B to B plus 180 volts for plates of r-f tubes in any t-r-f set. Cat. 5-W-2 @ .... $ .45

POTENTIOMETERS: 400 ohms at 27c; 5,000 ohms @ 95c; 25,000 ohms @ $1.25; 50,000 ohms @ $1.25; 100,000 ohms @ $1.25; 500,000 ohms @ $1.25.

POTENTIOMETER with a-c switch attached, 10,000 ohms, for variable mu grid bias as volume control. Cat. POT-5-SW @ $1.55

WALNUT FINISH ROLAND (illustrated upper left) **CABINET** for midget sets, cut for 7-inch cone. Cat. MDCB @ $4.90

THREE-GANG 0.0005 mfd., shielded. Cat. SH-SC @ $2.95

Tubes

227	@$0.60	245	@$0.66	240	@$1.80	236	@$1.65
224	@ .60	250	@ 3.60	112A	@ .90	237	@ 1.05
235	@ .96	U-99	@ 1.50	222	@ 2.70	238	@ 1.65
247	@ .93	V-99	@ 1.68	230	@ .96	239	@ 2.05
226	@ .48	120	@ 1.80	231	@ .96	280	@ .60
171A	@ .54	201A	@ .45	232	@ 1.30	281	@ 3.00
210	@ 4.20	200A	@ 2.40	233	@ 1.65	Neon	@ 4.50

Guaranty Radio Goods Co.

145 West 45th Street New York City

ACCURATE OSCILLATOR, a-c operated; plug-in coils; 15 to 550 meters; built-in filament transformer; requires 90 volts B supply extra, which may be batteries. National vernier dial. Completely wired, with tube. Cat. DN-OS @ $11.00

KELFORD 30 henry choke; stands up to 100 ma; in black shield case. Cat. KEL-30 @ $1.75

KELFORD 15 henry B supply choke; 60 ma; unshielded. Cat. KEL-15 @ .... $ .95

2.5 VOLT center tapped fil. trans., 8 amperes (will stand up to five heater tubes, when voltage is 2.25 v). Cat. FLT @ $1.62

HAMMARLUND 0.0002 mfd. variable condenser, junior midline; rotation is within 2-inch diameter; for short waves. Cat. H-20 @ $1.35

HAMMARLUND 60 mmfd. manual trimming condenser. Cat. H-60 @ .... $ .79

HAMMARLUND 20-100 MMFD. EQUALIZERS: adjusting screw works in a threaded brass stud, so excess force cannot damage the unit. Cat. 3-EQ-100 (price is for three) .... $ .60

CHASSIS for midget, fits in Roland cabinet; chassis is 13½ inches wide, 7½ inches front to back; flaps front and back 3 inches high; drilled for sockets and speaker plug and for volume control and switch at front. Cat. 5-TCH @ $1.75

CHASSIS for 6 tube midget. Cat. 6-TCH @ $1.75

TWO GANG 0.00035 MFD. straight frequency line condenser, brass plates; long ¼ inch shaft; nickeled frame. Cat. DJA-35 @ $1.95

THREE 0.1 MFD. condensers in one shield case; black lead is common; three red leads go interchangeably to destination; mounting screw built in. Cat. 31 @ ... $ .57

MIDGET POWER TRANSFORMER, for five-tube set, to handle three heater tubes, one 247 and one 280. Cat. MPT-5 @ $3.15

MIDGET POWER TRANSFORMER for six-tube set, to handle four heater tubes, one 247 and one 280. Cat. MPT-6 @ $3.55

8 MFD. WET ELECTROLYTIC condenser, for inverted mounting; washer and extra lug provides insulation from chassis for circuits with B choke in negative leg. Cat. LCT-8 @ .... $ .85

PHONOGRAPH motor, 80 r.p.m., synchronous. Cat. SYN-M @ $3.95

BLUEPRINTS

Blueprint No. 627, five tube a-c midget, broadcast band. Uses two 235, one 224, one 247, one 280. There is no 5 tube midget to compare with it. 80 meter tap coverage optional. Order Cat. BP-627 @ .... $ .25

Blueprint No. 628, six tube a-c all-wave set, no plug-in coils; 15 to 550 meters. Order Cat. BP-628 @ .. $ .25

ALL PRODUCTS ARE BRAND NEW. NO USED OR DISTRESS MERCHANDISE, DESPITE THE LOW PRICES.

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This binder is made of fine brown Spanish fabricoid and will hold 52 issues of Radio World. Year 1931-32 stamped in gold on front cover. A very limited supply on hand. Sent free to new yearly subscribers who send $6 before March 1, 1932. If already a subscriber, send $6 and 52 issues will be added to present subscription. No other premium with this offer.

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FIXED CONDENSERS

Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10¢	.001	12¢
.00025 mfd.	10¢	.002	12¢
.00035 mfd.	12¢	.006	12¢

.00025 with clips .... 15¢

All are guaranteed electrically perfect and money back if not satisfied within five days.

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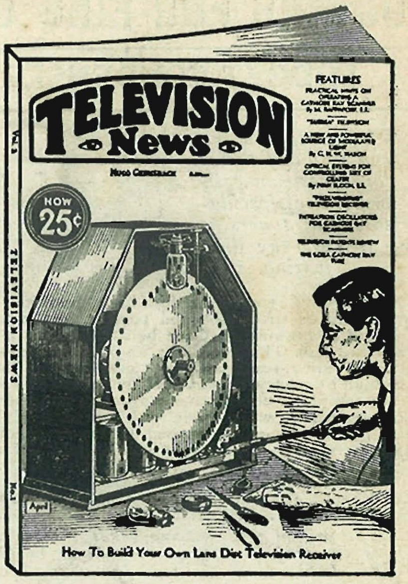

SHORT WAVE CRAFT

Rapidly increasing each day are the number of experiments in the Short Wave field—developments which are bringing to this branch of radio many thousands of new "thrill seekers." Experimenters, as in the early days of Radio, again have the opportunity to bring about stirring new inventions. Read in SHORT WAVE CRAFT, the Radio Experimenter's Magazine, how you can build your own Short Wave sets, both transmitters and receivers. SHORT WAVE CRAFT is exclusively a short wave magazine—the kind you have wished for so long.

TELEVISION NEWS

Timely developments in radio's latest wonder, TELEVISION, are published in every issue of TELEVISION NEWS—Mr. Hugo Gernsback's latest magazine. Rapid advancement in this art is becoming a repetition of the radio cycle of years ago. Daily broadcasts are becoming more numerous, and experimenters are following in quick order in building television sets for experimental purposes. Foresight of its development can be seen by the pioneers of radio—they are equipping themselves now with television experience.

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Short Wave Converters.
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Hints on A.C. Operation of Short Wave Receivers.

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