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RADIO WORLD

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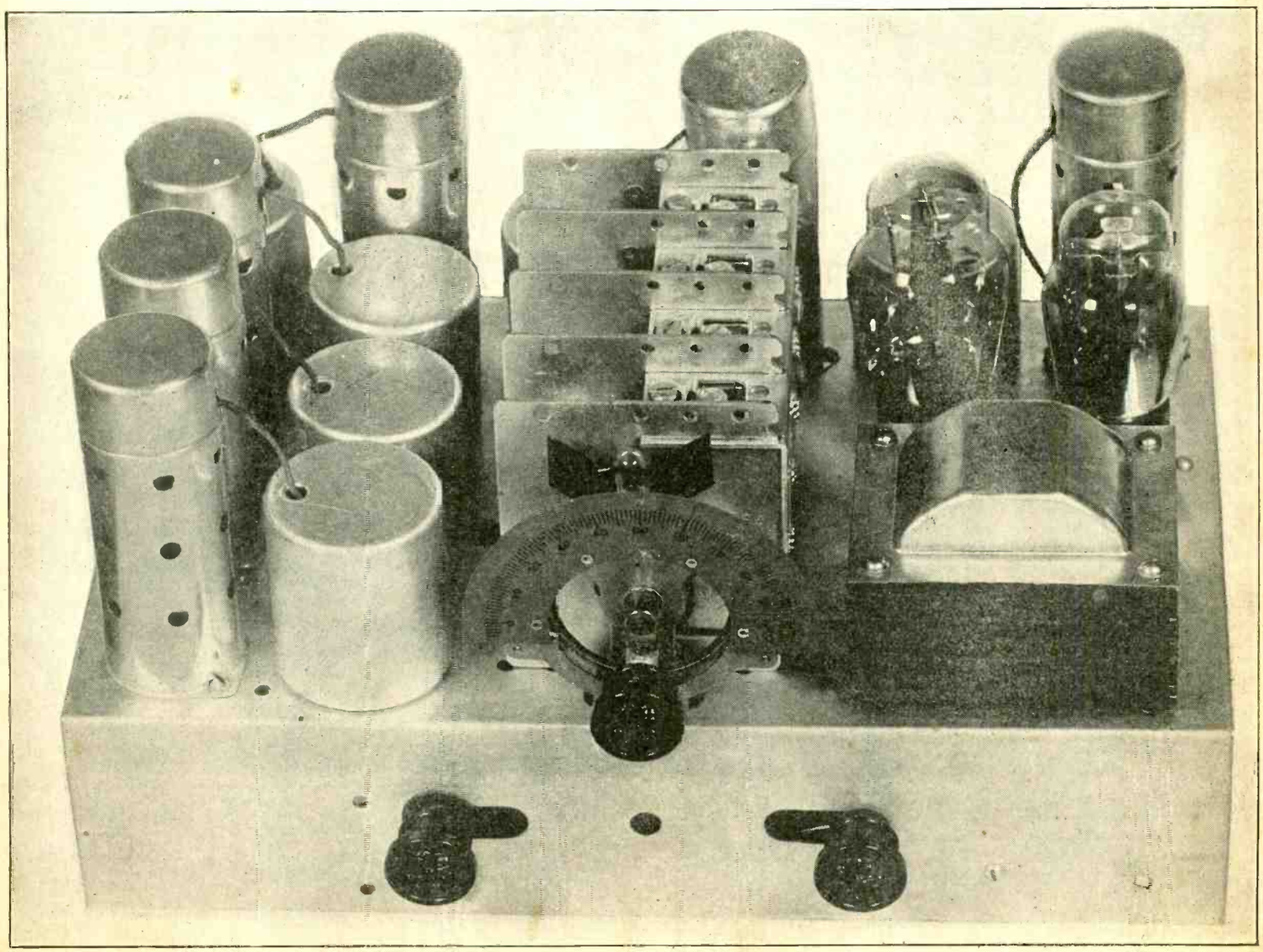
Twelfth Year *576th Consecutive Issue*

11-TUBE SUPER DIAMOND

Use of Universal Set with Batteries

HIGHLY SENSITIVE 8-TUBE SUPER



The 2B7 and 2A5 Tubes Are Used in This Super. See Page 7.

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One interstage high gain tuning coil	.80
One filter choke coil	.75
One 0.002 mfd. condenser	.09
Two 0.05 mfd. by-pass condensers	.20
One 0.0001 mfd. condenser	.09
One 0.001 mfd. condenser	.09
Two 0.006 mfd. condenser	.09
One gang of two 350 mmfd. tuning condensers	1.10
One 8 mfd. electrolytic condenser, 200-volt test	.65
Dual 4 mfd. electrolytic condenser, 200-volt test	.80
Dual 5 mfd. electrolytic condenser, 30-volt test	.60
One 250,000 ohm volume control	.75
One 300 ohm resistor	.08
One 35,000 ohm resistor	.08
One two-megohm resistor	.08
One one-megohm resistor	.08
One 1,500 ohm resistor	.35
One wire-wound ballast resistor	.75
One Rola Jensen or Magnavox Dynamic Speaker	2.75
Four five contact sockets (UY)	.30
Three screen grid clips	.15
One drilled and stamped chassis	1.00
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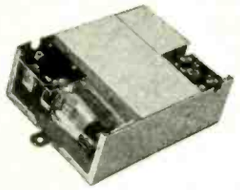

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CHARACTERISTICS CHART

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

11-TUBE PUSH-PULL DIAMOND

A dual-range receiver, 1550—535 kc, 1525—4200 kc, using a perfected superheterodyne circuit, frequency-stabilized oscillator and electron coupling between modulator and oscillator. Ten tuned circuits, four variable. Two stages of t-r-f, tuned modulator, tuned oscillator, with switch for wave-changing. Output 15 watts from 2A3's in push-pull. Full-wave second detector, with 56 driver of output. 52 mfd. of B filter capacity. Automatic volume control of two i-f tubes. Automatic inter-channel noise suppression. Selectivity enough to blot out strong locals 10 kc removed from distant station. No squeals whatever.

Tubes used: Five 58's; two 55's; one 56; two 2A3's; one 5Z3.

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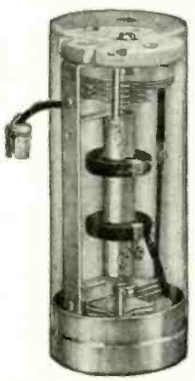

465 kc. model is used in 11-Tube Push-Pull Diamond

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The transformer is of the tuned primary-tuned secondary type, with both plate and grid coils being tuned by air-dielectric variable condensers of special design. These condensers are mounted on an Isolantite panel 1 15-16 inches in diameter. The rotor is carried in a single bearing in the Isolantite panel and consists of two circular and three semi-circular brass plates of ¾ inch radius riveted to the rotor shaft. The stator, also of brass, consists of two circular and two semi-circular plates soldered to stator support rods which in turn are soldered in the bushings in the Isolantite panel. Contact is made to the rotor plates by phosphor bronze spring under considerable tension. No locking device is necessary, as the tension of the contact spring is sufficient to maintain the setting of the rotor even where extreme vibration is present. A screwdriver slot is provided in the end of the rotor shaft to facilitate tuning.

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FULL-SCALE PICTURE DIAGRAM OF TWO-TUBE 15-200-METER BATTERY RECEIVER—Printed in Radio World dated April 2, 1932. This is the diagram asked for by so many readers who were interested in the short-wave receiver described in issue of Feb. 27, 1932. Both copies mailed for 30c. RADIO WORLD, 145 W. 45th

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The 11-Tube Push-Pull
SUPER DIAMOND

By Herman Bernard

A FREQUENCY-STABILIZED oscillator of the constant plate impedance type requires that the oscillator and modulator functions be separate, with the tubes now obtainable. An extra stage of tuned radio frequency amplification is valuable if a high intermediate frequency is used, because the selectivity becomes less as the intermediate frequency is increased, it being inversely proportionate to the frequency difference. Therefore, two more tubes are needed than if the circuit on which the present one is largely based, and we have the eleven-tube Push-Pull Diamond.

With such a circuit as this it is practical to get about everything that can be gotten, for the sensitivity rises to such a height after careful balancing of circuits as to be virtually unmeasurable, whereas the selectivity is great enough to provide full attenuation of a carrier 10 kc removed from resonance, and the power output (5 per cent. total harmonic distortion) is 15 watts.

Speaker Choice

With such a tremendous output it is advisable to have an equally tremendous speaker, but it should be emphasized that for home use not only will the smaller-proportioned special speaker fill the need, but that somewhere around 3 watts is about all the volume of sound one could stand in the home, and the smaller speaker will handle up to around 6 watts. Therefore the choice of speaker will depend on the use to which the set is to be put. If the receiver is to furnish dance music for 500 shuffling feet, the larger speaker is imperative. For home use it is not, although the more discriminating still will prefer the huskier speaker, which is the Rola Model R-AC 225, with special field coil (3,200 ohms tapped at 700 ohms) and with large output transformer matched to the impedance of the 2A3 output tubes in push-pull (5,000 ohms, plate to plate).

This large speaker will stand more than will be put into it, around 25 watts would be a safe rating, and therefore it is an amply-constructed device. The height is 11½ inches, the depth 9⅝ inches, the width 11 inches; the distance from base to center line of cone, 6 inches: the effective cone diameter, 9 inches; weight, packed, 33½ lbs.; the list price, $37.50.

While this large speaker is not a requisite, as already brought out, its advantages are numerous nevertheless, and some data on the technical aspects should be interesting to all.

Speaker Specifications

The output transformer is more than adequately suited to the power tubes, and, just as a comparison, as many as four 250 tubes in push-pull parallel could be loaded up without overtaxing the speaker.

The field is excited to an extraordinary density of approximately 120,000 lines per square inch. The impedance of the output transformer is 5,000 ohms at 60 cycles and the impedance ratio is approximately 660 to 1. The voice coil impedance is 12 ohms at 60 cycles and 24 ohms at 1,000 cycles.

The extraordinary output efficiency is obtained by the use of a very high flux density in the precision air gap, a density obtained this way without increase in the field energizing power. A highly refined moving coil structure is used, and extreme accuracy prevails in the spacing of the pole pieces.

The center pole piece is removable, to enable easy elimination of any magnetic particles that may enter the air gap.

Other Husky Speakers

The speakers, like all other cone reproducers, require adequate baffling for full radiation of the lower frequencies. The material used for the baffle should be of sufficient thickness to avoid any interference due to vibration of the baffle itself. There has been a general tendency toward the use of sound-absorbing materials for the baffle surfaces, without provision to correct for loss of efficiency due to excessive non-linear absorption, according to Rola, so when material of this kind is used the speaker manufacturer recommends that plywood be cemented securely to the front of the baffle to prevent this absorption.

A good many have high-powered speakers of various types, but they may be a-c operated with a rectifier tube or a dry rectifier element, or have field coils for separate exitation, as from the receiver, but the resistance of the field may be different than prescribed. Since the resistance value of the section marked 2,500 ohms is not critical, smaller or greater resistance field coils may be used, and the speaker equipped with proper output transformer. Then the 700-ohm section, not present, could be taken care of by a separate choke of 10 watts rating, of whatever d-c resistance it may be, which will approximate a few hundred ohms, anyway.

The difference in rating of this choke and the biasing resistor of 775 ohms, though the same current flows through both, is due to the commercial practice of manufacturers of wire-wound resistors being to rate them at the power at which they are to be used, whereas choke manufacturers sometimes are a little more optimistic.

Condenser Omitted

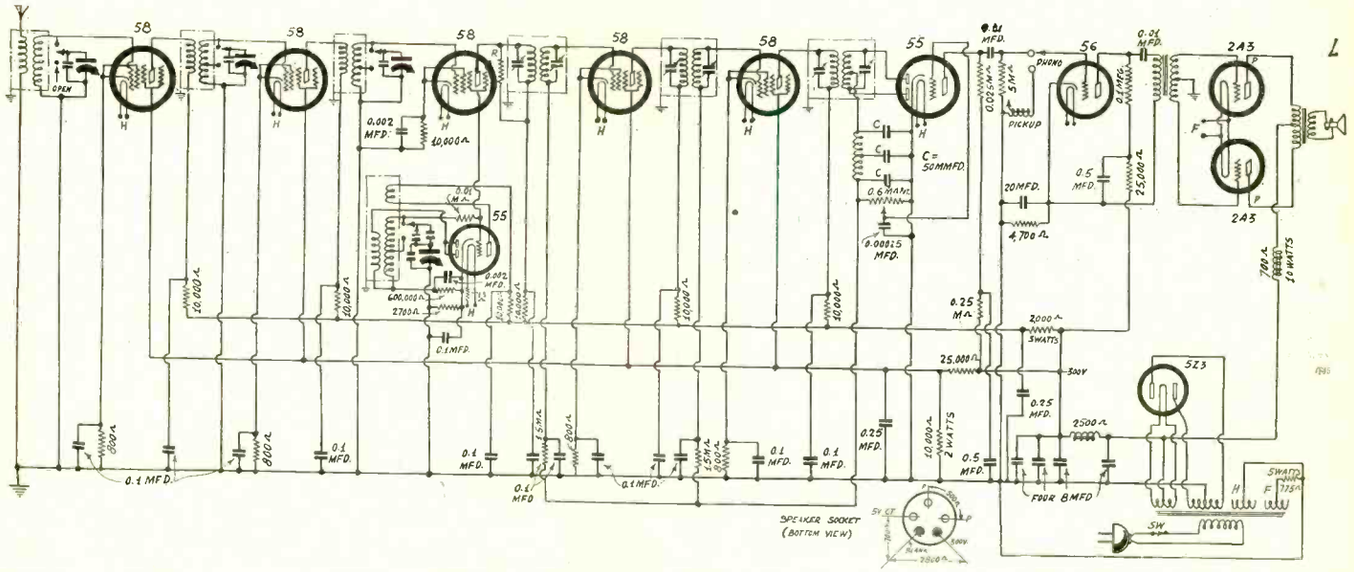
There is no bypass condenser across the biasing resistor because the signal current through it is equal and opposite at any instant, or, more strictly, there is no signal current, due to the cancellation condition. This obtains only if the push-pull circuit is truly symmetrical, but it is near enough so in present practice to justify the omission of the condenser, because actual tests showed that there was not as good balance with the condenser in (20 mfd.) as with it out. Moreover, the same applies to the 700-ohm section of the field coil, so no condenser actually is needed here.

The available capacity is shifted to the output of the filter in the direction of the intermediate and radio frequency tubes, where three 8 mfd. are in parallel. Since there are two 8 mfd. in each can, two cans account for the total of 32 mfd. used in the filter. One 8 mfd. section is at the common point, which goes to center of rectifier filament, or, if the winding is not center-tapped, then to either side of the rectifier filament.

The general subject of the circuit has

(*Continued on next page*)

465 kc I. F. in 11-Tube Diamond



The accomplishment many have awaited—a high-powered receiver with frequency-stabilized oscillator, electron coupling between modulator and oscillator, 465 kc transformers with air dielectric, final output 15 watts. This is the 11-tube Push-Pull Diamond.

(*Continued from preceding page*)
been treated in previous articles. The new features will be taken up, now, excepting those already discussed in the present article.

New Features

The extra stage of tuned radio frequency amplification increases the selectivity to the point where the input to the modulator, in the light of the degree of coupling to oscillator, will not produce squeals, though the aerial be long.

It has been the experience of builders of the nine-tube model that the aerial could be a certain effective height beyond which there would be squeals. This was stated in the original constructional articles, but the aerial length even so was great enough for a substantial input, hence enormous output. By the present method a still more enormous output is practical without squeals that would be due to too tight coupling between aerial and modulator, which a long aerial otherwise amounts to, but the extra t-r-f stage puts the impedance of an extra tube between aerial and modulator.

However, the switching arrangement for short waves has to be different. It is very well to have the extra t-r-f stage for broadcast reception, but it is not so easy to handle it for the 70-200-meter band, therefore the first stage is left untuned, or really semi-tuned, with a natural period broadly around 140 meters. This is a good compromise, and has the added advantage of avoiding detuning effects due to a swinging aerial, which otherwise begin to show up around 80 meters.

Padding Condensers

It should be observed that the switching method leaves the full secondary in the grid circuit under all circumstances, whereas only the tuning condensers are shifted, the stator being switched in three instances to terminated taps, and in the first t-r-f instance to an unconnected or "open" tap, to avoid any tuning here by the condenser. The only extra requirement is that the oscillator have its main padding condenser augmented by some capacity when the 70-200-meter band is to be tuned in, for the percentage difference between oscillator and modulator frequencies is less than in the broadcast band, therefore the series or padding condenser has to be higher in capacity. The approximate values are: for broadcast band, 355 mmfd., for other band, 465 mmfd. It so happens that 465 applies both to the capacity for the short-wave use and to the intermediate frequency in kilocycles. These two capacities may be derived from adjustable condensers of the "400" and "100" series, to give them their commercial ratings, which are of mean capacities, the variations being about 75 mmfd. either side. So 355 and 110 mmfd. would be the two capacities. Fixed condensers could be used, if of the extremely accurate type specially made for such purposes.

The oscillator tube is a 55, of which the triode is used for oscillation and the diode for half-wave rectification. The voltage that is rectified is the oscillation voltage, and therefore the bias on the tube will change with the amplitude of the oscillation, so that the higher the amplitude the higher the bias, and this keeps the plate impedance constant. The change takes place within one cycle.

While the 55 used as a constant-plate impedance or frequency-stabilized oscillator looks very fine in a diagram, it has the serious trouble of drawing grid current, even under the conditions just discussed. Of course it is possible to eliminate the grid current, and this would require nice proportion of the rectifier winding and the grid suppressor, as well as of the feedback winding. However, J. E. Anderson last week contributed an idea well worth while, and that is to reduce the heater voltage to a value that so limits the emission that saturation occurs for negative grid voltages and thus prevents grid current. When this is done the voltage on the plate should be higher than otherwise, and it will be found to be high enough here, around 250 volts.

0-1 Milliammeter as Check

This reduced heater voltage is obtained by putting a resistor in one leg of the heater, and it may be 1.3 ohms, to reduce the voltage to around 1.5 volts. Then no grid current should flow, and if none does, the grid suppressor has no bias effect, and indeed its total effect may be neglected. But if some grid current does flow, which might be true at the higher frequencies of either band, then the grid suppressor acts to eliminate the flow of grid current, because it is a sort of relay that acts on high frequencies rather than on low ones. Whether to include it at all will have to be left to the constructor, as even a 0-1 milliammeter may be used to check for grid current, though only the slightest needle movement would be present.

The 55 used as full-wave second detector and first audio amplifier has a 600,000-ohm load, not for any more serious reasons than that 500,000 ohms are usually recommended by tube makers, and 600,000 just happens to be the value of the series resistor in the author's voltmeter, so he can measure the detected component with his meter replacing the 600,000 ohms, in terms of voltage. The instrument is a 0-0.5 milliammeter, 300 volts full-scale deflection, hence 2,000 ohms per volt. Divide the number 1 by the current in amperes at full-scale deflection to obtain the ohms-per-volt rating of any voltmeter. Thus $1/0.0005 = 10{,}000/5 = 2{,}000$.

Parallel Feed

There is a new tube out, the 2B7, which is like the 55, except that it has a pentode amplifier instead of a triode, and has a much greater mu, but there would be no advantage in putting it in a circuit like this, especially as there is nothing critical about the 55, and this is not a circuit requiring a sensitive amplifier tube in the detector's envelope to load up an output tube, for we have a driver stage here, necessary also that a low-mu tube will present the proper impedance to the primary of the push-pull transformer.

The 56 has a parallel plate feed to the transformer. The only object is to keep the direct current out of the primary of the transformer. Then the primary may be returned to cathode of the 56. The inductance of the primary is kept somewhat higher by the method of eliminating the d. c. Also, the hum filter, consisting of 0.5 mfd. and 25,000 ohms, is located in the plate circuit of the 56, where it is more effective than in the output stage.

About 300 volts will be fed to the 125,000 ohms total d-c load on the 56 plate, and the current should run high enough to produce a drop of around 10 volts across the 4,700 ohms biasing resistor.

LIST OF PARTS

Coils

One antenna coupler, primary wound over secondary; enclosed in an aluminum shield, for 0.00041 mfd.; tapped for 70-200 meters.
Two interstage r-f couplers, primary wound over secondary; enclosed in aluminum shields; for 0.00041 mfd.; tapped for 70-200 meters.
One oscillator coil, for padded 0.00041 mfd., tapped for 70-200 meters; rectifier and feedback windings
Two 465 kc intermediate transformers enclosed in aluminum shields.
One 465 kc intermediate transformer with centertapped secondary; enclosed in aluminum shield.
One tapped 20-millihenry r-f choke.
One 12-inch dynamic speaker, field coil, 3,200 ohms, tapped at 700 ohms, field windings reversed, output transformer (5,000 ohms impedance) matched to the 2A3's in push-pull, 32-inch cable and five-pin plug attached.
One heavy-duty power transformer: primary, 110 volts, 50-60 cycles, 110 watts; secondaries: 2.5 volts at 8 amperes center tapped (H); 2.5-volt 5 amperes, c.t., for output tubes (F); 5 volts at 2 amperes, c.t.; high voltage at 375 volts d-c between rectifier filament and ground at 150 ma.
One push-pull input transformer

Condensers

One four-gang 0.00041 mfd. tuning condenser with compensators built in and with attached screws for mounting purposes; high shield walls between sections.
(Note: the condensers across primaries and secondaries of intermediate coils are built into these transformers.)
One 0.002 mfd. fixed condenser.
Three 0.00005 mfd. fixed condensers.
Two 0.01 mfd. mica fixed condensers.
Four 8 mfd. electrolytic condensers. These come two in a can; total, two cans.
One dry 20 mfd. electrolytic, 30 volts (smaller in size).
One "400" mmfd. padding condenser, isolantite base; brass plates; one "200" mmfd. padding condenser.
One shielded block containing nine 0.1 mfd. condensers and two 0.25 mfd. condensers. Equipped with mounting lugs. Shield is to be grounded. Black head goes to ground. Two outleads colored differently than others are the 0.25 mfd. Rest are 0.1 mfd. Block to be fitted on chassis front wall.
Two separate 0.5 mfd.
Two separate 0.1 mfd.

Resistors

Four 800-ohm pigtail resistors.
One 2,700-ohm pigtail resistor.
One 4,700-ohm pigtail resistor.
Seven 10,000-ohm pigtail resistors.
Four 0.025 meg. pigtail resistors.
Two 1.5 meg. pigtail resistors.
One 0.1 meg. pigtail resistor.
One 0.6 meg. pigtail resistor.
One 5.0 meg. pigtail resistor.
One 0.6 meg. potentiometer, insulated shaft type; tapered; a-c switch attached.
One 775-ohm 5-watt resistor.
One 2,000-ohm pigtail resistor, 3 watts.
One 10,000-ohm, 2-watt resistor.

Other Requirements

One chassis drilled for sockets, coils, tuning condenser, for electrolytics and for power transformer.
One steel front panel, finished in walnut color.
12 insulated bushings, ends tapped for 6/32 machine screws, so that bushings may be used as if nuts on socket mounting screws, and maintain insulation for parts mounted on top of bushings by means of lugs held by short 6/32 screws.
One frequency-calibrated dial with pilot lamp, and extension bushing.
One dozen lugs.
One antenna-ground twin assembly.
One phono twin post assembly.
One single hole double throw phonograph switch.
Two dozen 6/32 machine screws.
One roll of hookup wire.
Eight aluminum tube shields.
Seven grid clips.
Seven six-prong sockets, two UY sockets and three four-prong sockets (the extra UY is for speaker plug). Some speakers have UX plug.

This would be around 2 ma, but if the voltage drop is much greater across this resistor put another in parallel with it until the voltage does not exceed 15 volts.

The 20 mfd. condenser across this resistor aids in elimination of hum, and it is a small condenser in physical size, compared to the 8 mfd. This is because the voltage rating is low (30 volts).

There is a phonograph switch, and this may be put at the front center of the chassis, for at left is the short-wave, broadcast-wave switch, while at right is the volume control.

Speaker Connections

The actual connections required for the speaker are only four, since the fifth one is made in the speaker itself, by connecting one side of the 700-ohm winding to the center of the output transformer. However, it may be that a UY plug will be supplied, and if so the left-hand heater is not connected at the speaker socket (bottom view considered), and the ohmage readings and connections are as diagramed under the circuit wiring. P and P are the plates of the output tubes, the resistance between either P and center of the output transformer being around 250 ohms, but if there is a small difference, that does not matter, as the center tap is not taken on the basis of d-c resistance equality in the sections but, rightly, on the basis of voltage equality. The 5-volt center-tap connection on the speaker socket goes to center of the transformer secondary that supplies the 5Z3 filament, but if the transformer has no center tap you may use one side, as stated, although the tube manufacturers recommend that the winding for the 5Z3 rectifier be center tapped.

R is a resistor across the plate winding of the first i-f transformer, to be around 20,000 ohms, or such lower value as necessary to stop intermediate frequency oscillation, if any is present. Of course, first

(*Continued on next page*)

THE 11-TUBE PUSH-PULL SUPER DIAMOND

Has the Following Advantages:

Two stages of t-r-f and tuned modulator (three tuned stages at r-f level).
Frequency-stabilized oscillator, which means elimination of frequency shifting.
Electron coupling between oscillator and separate modulator.
Three of Hammarlund's 465 intermediate coils with air-dielectric condensers.
Push-pull 15 watts undistorted output, the great power serving as a reserve that avoids distortion on strong low notes of orchestras.
New tubes. The heavy-duty 5Z3 rectifier and the 2A3 output tubes are used. The power stage is a cross between Class A and Class B, but of the no-grid-current type.
Full wave duplex diode linear second detector. Stands up to 60 volts signal on second detector.
Both stages of intermediate frequency amplification subject to full automatic volume control.
Noise suppression control without an extra tube. This means no interchannel hiss or "hash" without elimination of which a.v.c. is a nuisance.
Selectivity affording non-interfered reception from a distant station though a local 10 kc away delivers 1,000 times as much antenna voltage.
Sensitivity of better than 0.1 microvolt per meter.
Volume control can completely eliminate signal, and has sound volume range from bare audibility to 400,000 times bare audibility.
Dual range. Broadcast and police bands by throwing a front-panel switch. Some amateurs, short-wave music and television can be received.
No cross-modulation or inter-modulation on either band.
Short-wave band as accurately treated as broadcast band, for unusually effective results on police signals.
Band-shifting by positive-contact, low resistance switch that improves with use.

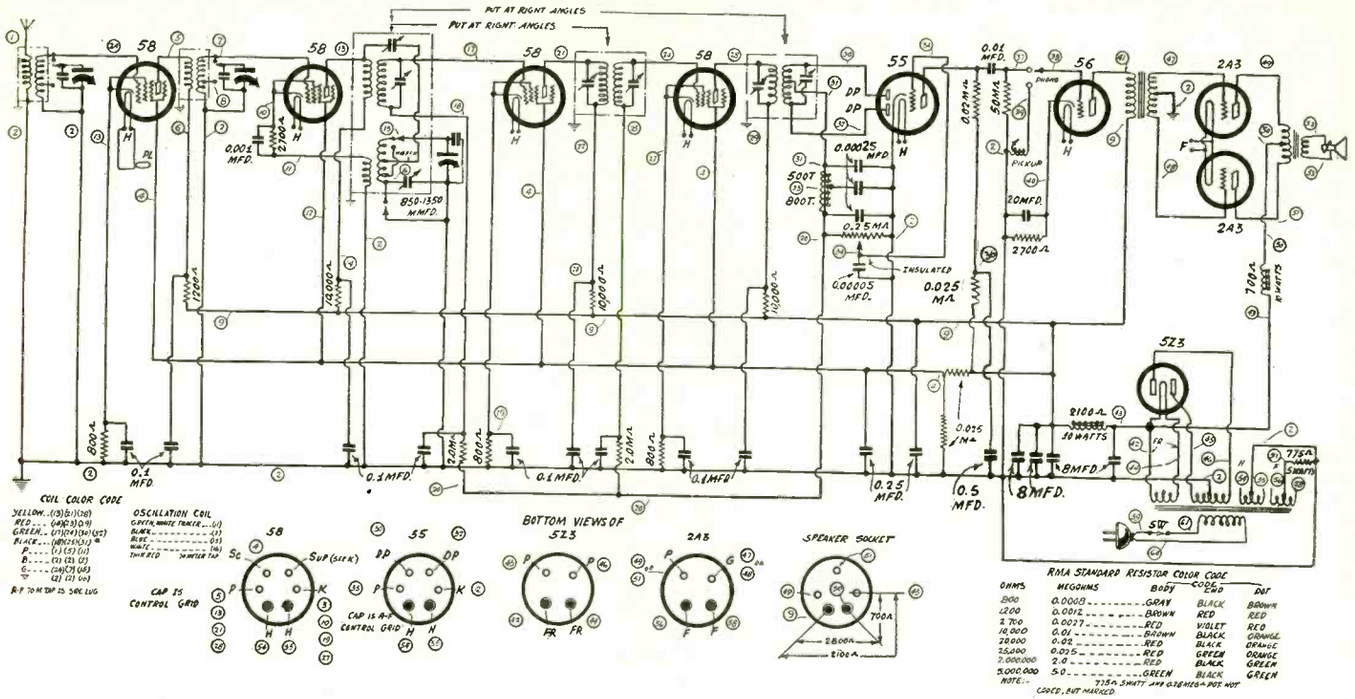


Diagram of the nine-tube model, for purposes of comparison with the 11-tube model.

(*Continued from preceding page*)

determine which tube is oscillating, and put the resistance across the plate winding of the oscillating tube. The resistor is shown across a particular tube only as symbolic representation. To determine which tube is oscillating, pinch the grid lead (to cap) with your finger. If the set becomes quiet, especially with a plopping sound, that tube is oscillating. Or, try the resistor across the plate windings of the three transformers until oscillation stops.

Large Power Transformer

There is always some danger of oscillation in a two-stage intermediate amplifier, but it is not difficult to stop it. The method suggested works well. An additional remedy is to put a 0.00025 mfd. fixed condenser from plate of the 55 triode to grounded cathode.

The power transformer for a set such as this should have a conservative rating of 150 milliamperes, which means that it will be husky and heavy, with good-sized thickness of wire for the plate winding and of course thick wires indeed for the low and high current heater and filament windings. This is a larger transformer by far than the one specified for the nine-tube Push-Pull Diamond.

Reduced Voltage on Heater Has a Wide Effect

THE use of a reduced heater voltage on the oscillator has the effect of increasing the plate impedance, due to diminished emission, and this tends to reduce or eliminate grid current. The circuiting of the oscillator in connection with rectification, and the automatic variation of bias proportionate to the amplitude of the oscillation, completes the work of grid-current elimination.

In any oscillator that is designed to have frequency stability all over the dial it is almost necessary to eliminate grid current, otherwise at the higher frequencies the stability disappears. Of course any grid current device has to have a leak, so that the current through the leak augments the bias, or, rather, keeps the bias from becoming too outrageously positive.

Grid Circuit Conditions

When there is grid current the grid impedance may be low. Take as an example the resistance aspect of the grid circuit. In some grid current oscillators the grid current may run to 0.5 milliampere, and the oscillation voltage may be 300 volts, so the resistance would be 600,000 ohms, quite a high value, yet a finite value of resistance in a circuit in which it is hoped to have an infinite resistance. In other examples the resistance of the grid circuit may drop as low as 2,000 ohms, and therefore there is power loss in the grid circuit as well as a condition inimical to high selectivity.

If a circuit is constructed in the usual way, with intermediate stages lined up, r-f stages peaked, and the oscillator padded, and then if the heater voltage on the oscillator is reduced below the standard recommendation, a sharp change takes place. The frequencies are higher. This is in line with the effect of resistance on resonance, an effect that is almost wholly ignored in mathematical considerations of resonance, although the subject is gradually coming to the fore.

Hence the circuit has to be realigned. It was found that the oscillator had to be repadded and that the first intermediate transformer had to be readjusted as well as the modulator circuit. The trimming or tuning capacities had to be increased.

Coupling Effect

Therefore not only the oscillator circuit itself, in which the reduction of the heater voltage was introduced, but also the modulator and the first intermediate had to be changed. This simply recalls that the modulator is coupled to the oscillator and likewise is coupled by the i-f transformer and the inter-relationship is brought home once more.

Not only does the oscillator undergo a change due to the increased plate impedance, but since the oscillator coil is wound for an intentional result at the high frequency extreme, the constants of that coil have to be based somewhat on the plate impedance of the oscillator tube, due to the effect of that impedance on resonance. More turns would be used to reach a certain high frequency than if the normal heater voltage were applied.

Coil Factors

This brings up the subject of oscillator coil design for a given intermediate frequency as well as signal frequency result in the light of inductance requirements for universal application. Evidently there is no universal aspect to the subject, for impedances will differ with actual biasing and d-c voltaging in general, therefore if any super is built according to specifications, with a specified oscillator inductance, that inductance should be related to the element d-c voltages on the tubes, as well as to the heater voltage, and the actual bias should be the same as recommended by the author or designer. This normally would prevail if a self-biasing resistor of the specified value were used, and voltages substantially followed.

Negative Saturation

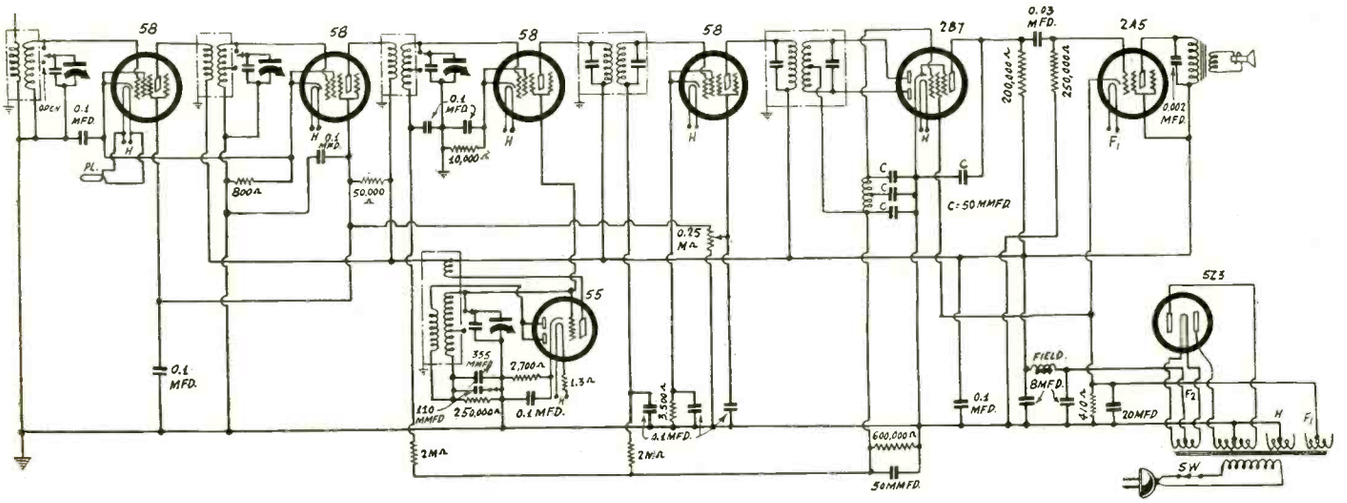
The whole idea of lowered heater voltage has to do with shifting the operating point and so working the tube that its saturation point is on the negative bias side. If that is accomplished, there can be no grid current, and if there is no grid current the first and perhaps most important step has been taken toward frequency stability.

The question may be raised as to the actual necessity of frequency stability in a receiver intended primarily for broadcast reception. Of course the requirement is not as important as in a monitor or some other such device, and yet it has been noticed by acute observers that dial positions of broadcast superheterodynes shift a bit, particularly at higher frequencies of a spectrum, and certainly it is advisable to have the greatest possible degree of accuracy in a receiver that has a frequency-calibrated dial. The importance and value of the frequency calibration is directly related to the frequency stability, for frequency stability means that not only will the same frequency be registered every time at the same setting but that the frequency once established—any frequency in the range—will not change. All activities in the direction of holding a frequency constant are important.

PEAK OF SENSITIVITY

In an 8-Tube Super with Newest Tubes

By Herman Bernard



A receiver so extremely sensitive that it is not conveniently operable. It is an 8-tube superheterodyne, with frequency-stabilized oscillator and electron coupling in the mixer. No more sensitive receiver ever has been described in these columns.

THE pleasant embarrassment of having a receiver so sensitive that the usual volume controls were insufficiently effective arose when the eight-tube superheterodyne diagramed herewith was constructed, using 2B7 duodiode pentode to feed the 2A5 pentode output tube. Under the existing voltage conditions the 2B7 may have a mu factor of around 700, while the power tube has a mu factor of 220. While in a sense these are "just figures," nevertheless it is amusing to multiply the two and produce the theoretical audio gain of 154,000.

Regarding the bias on the power tube as 20 volts, and allowing the conventional 1-volt differential, the detector voltage output need be only 0.025 volt (25 one-thousandth of a volt) to load up the output tube.

There is of course a disparity between the theoretical considerations and the practical working values, for the per-stage mu is always less than the mu of the tube, in a resistance-coupled amplifier, due to the division of the signal by the series circuit formed by the plate load resistor and the plate resistance of the tube itself. In general, the lower the load resistance the lower the per-stage gain.

Annoying Sensitivity

However, the practical circuit, as carefully tested out, proved that there was so much gain that problems associated with excess sensitivity became serious. For instance, from New York City, stations in Texas were tuned in with an aerial consisting of a three-inch bus of No. 18 wire projecting outward from the antenna post of the set, with volume control at minimum. What happened as to local stations may well be imagined.

The diagram in its present form is not to be taken literally for constructional purposes, for it merely represents what has been done, and requires that some of that work be undone. It is not practical to use a circuit of such great sensitivity, a tiny decimal fraction of 1 microvolt per meter, so it is necessary to reduce the sensitivity. Nevertheless it is a delight to start off with more than you can use, rather than to be stumped for adequate sensitivity, as sometimes happens.

The high sensitivity can not be ascribed exclusively to the two new tubes, but of course they bear a more important relationship to the net result than do the radio-frequency and intermediate-frequency amplifiers. A certain level of performance is familiar, when using tr t-r-f and i-f, but then when some new tubes come along to enable one to accomplish a great deal more (although at limited power output), the result is a keen receiver that can be constructed at relatively small cost, say, under $20 for parts.

Tube Data

The standard recommendations for the tubes are as follows:

2B7, diode detector-a-f amplifier, pentode unit: small seven-pin socket required (not the medium-sized one as used for the 59); heater volts, 2.5; heater current, 0.8 ampere; maximum plate volts, 250; maximum screen volts, 125; plate supply volts, 250; negative bias, 4.5 volts; normal screen voltage, 50; plate current, 0.65 ma; screen current 0.15 ma.

2A5, power amplifier; medium six-pin socket; heater volts, 2.5; heater current, 1.75; maximum plate volts, 250; maximum screen volts, 250; plate supply voltage, 250; negative bias, 16.5; screen voltage, 250 volts; plate current, 34 milliamperes; screen current, 6.5 milliamperes; plate resistance, 100,000 ohms; mutual conductance, 2,200 micromhos; voltage amplification factor, 220; ohms load, 7,000; power output, 3 watts at 7 per cent. total harmonic distortion.

Inside Facts on 2B7

As to the amplification factor, mutual conductance, etc. of the 2B7, these are not on the list above, because not given on the characteristics chart for audio use of the pentode, but they are given on that chart for the use of the pentode as an r-f amplifier, at mutual conductance of from 950 to 1125 micromhos, depending on voltage and load conditions; voltage amplification 285 to 730, also depending on conditions.

However, one of the first things that an experimenter may ascertain about the 2B7 with pentode used, as here, as an audio amplifier, is that when the circuit is set up with seeming correctness, nothing may be heard. This is because the relationship of the screen voltage to the effective plate voltage is critical.

The supply voltage is assumed to be 250 volts. If the load resistor is 0.2 meg., as recommended by the tube makers, and the screen voltage is fixed at 50 volts, nothing may come through. The reason would be that the plate current was greater than expected, the effective plate voltage was lower than the screen voltage, and though no signal might be heard, still something piercing might be heard, and that is a high-pitched squeal. The tube becomes an audio oscillator.

Since the secondary of an intermediate frequency transformer is associated with the control grid of the pentode unit of the 2B7 through the load resistor of the rectifier unit, if the audio oscillation is not audible before, it becomes so the moment an attempt is made to tune the condenser across that secondary. No matter how long the dowel of an insulated screwdriver, an unearthly shriek will let loose when an attempt is made to tune the winding.

The Adjustments

Of course this is not what prevails when conditions are right. In the first place the voltage apportionment must be such as to make the tube function properly, and it was found that of course the plate load resistor has a distinct bearing on this. If the screen voltage is too high, since the condition is relative, the effective plate voltage may be increased by using a smaller value of resistor. That is why experimenters at first baffled by the 0.2 meg. recommendation (with no results at all, not a sound) were helped materially when resistance loads of 0.02 and 0.025 meg. were suggested in these columns. Then the signal came through. But it is better to use a higher resistance load, and lower the screen voltage accordingly, for then the gain values are preserved.

Fortunately, with proper loading, the

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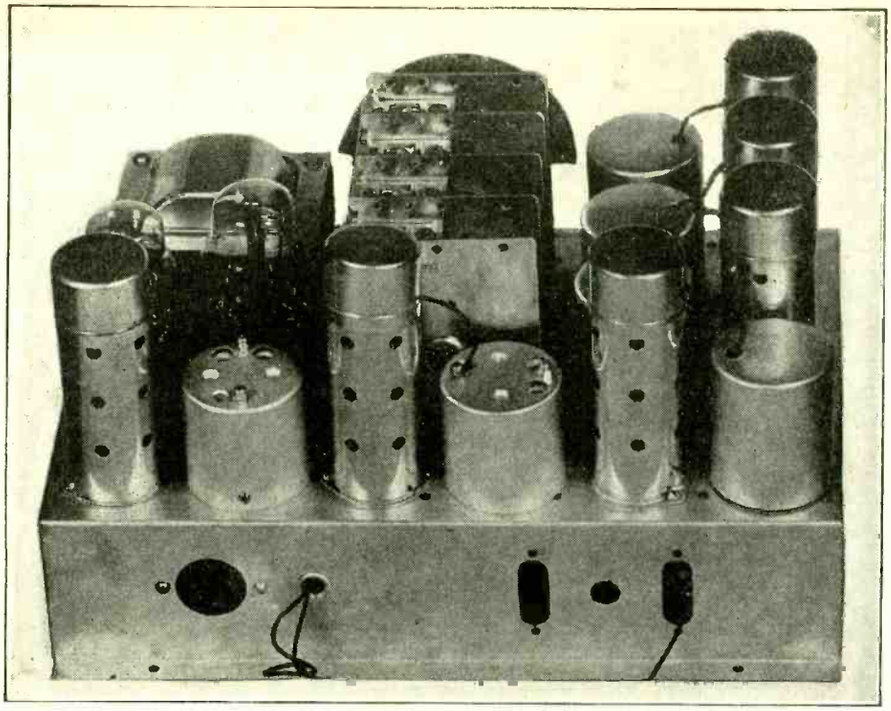


Rear view of the 8-tube superheterodyne.

(*Continued from preceding page*)

bias voltage on the 2A5 may be used as the screen voltage on the 2B7. This is a dangerous attempt if the bypass capacity across the biasing resistor is not high, for the common coupling results in motorboating and other manifestations of audio oscillation. But with 20 mfd., a compact dry unit, there is no such danger or trouble. The circuit is utterly stable, and moreover the output tube is the quietest one of the a-c type so far produced.

Remarkably Low Hum

The hum component due to this tube is considerably less than 1 per cent., and although the filtration does not exceed the usual standard, the hum is less than in a receiver using any other a-c operated power output tube. The method of tube construction, including the cathode independence of heater, accounts for this extremely low hum level.

The biasing resistor actually used in the experimental model was 387 ohms, and the voltage drop across it was 15 volts, so the total of screen and plate currents was about 40 milliamperes, which is correct. The biasing resistor should be raised to 410 ohms to produce approximately 16.5 volts.

The actual condition is cited as indicating that the 2B7 screen voltage, at 15 volts, is properly proportioned to an effective plate voltage of 300 volts. Actually a resistor of 0.25 meg. was used in the plate circuit of the 2B7, and at the time of the test the applied voltage was 300 volts, at nearly 1 ma plate current, so the effective plate voltage was 50 volts. If the screen voltage were 50 volts, then the two would be equal, and there would be peril of getting no amplification, but some audio oscillation.

Low Screen Voltage

Normally the total B current in the 2B7 would be 0.8 milliamperes, of which 6.5 milliamperes would be plate current, so a resistor of 0.2 meg. would drop 250 applied voltage to 120 volts, and 50 volts for the screen would appear to be quite all right, and if it is, well enough, but should the plate current be higher than expected (say, about one-third more, or 1 ma), then the effective plate voltage would be 50 volts, or the same as the screen voltage.

It has been the experience of the author that screen voltages for audio amplifiers and detectors always have been recommended at too high a value, and after J. E. Anderson had printed curves to this effect tube manufacturers began to recommend lower voltages under these conditions. It is assumed that as time goes on the lower voltages for the 2B7 screen will be recommended, too, more in conformity with the specifications of the present circuit, or about one-third of the present 50-volt standard. This should not be surprising to readers of these columns, long aware of excellent detection results from the 224 with 6 volts on the screen, compared to 50 to 90 volts that had been used previously. Not only was sensitivity better but the wave form of the detected component was purer.

Specific Values

The voltaging of the 2B7 may be as described, 300 volts applied, 0.25 meg. load resistor, screen connected to the 2A5 biasing voltage of 16.5 volts, or, if the supply is 250 volts, the plate load resistor may be 0.2 meg., the screen voltage 16.5 volts.

As to some other aspects, the diagram must not be read literally, as already stated. Besides the volume control being a makeshift, and not even a fair makeshift at that, the negative bias on the two r-f tubes would have to be raised, probably, because there was some r-f oscillation beginning at about 1,300 kc. To cure such oscillation several remedies may be applied. One is to use a higher value of biasing resistor than 800 ohms, as high as necessary for the purpose; another is to use a series resistor between maximum B plus and the B lead forward to the i-f and r-f tubes, bypassing it to ground with 0.1 mfd. from the plate return side of the tubes concerned; still another the use of a smaller potentiometer, say, 10,000 ohms, as this would reduce the screen voltage on the 58 tubes.

More Automatic Volume Control

Also the intermediate amplifier may oscillate, and if so the tube would be the only one in that channel, although the correction has been applied, a high value biasing resistor, 3,500 ohms, and the trouble should not be experienced. A resistor across the primary of the first or second intermediate coil, 20,000 ohms or less, although no smaller than necessary to stop squealing, is another remedy The circuit has automatic volume control applied to the intermediate tube, but it is practical to apply it in the same manner (resistor to second detector's 600,000 ohms, bypassed as in the intermediate channel), not only to both r-f tubes, but also to the modulator. This is in the direction of reducing the sensitivity, incidentally, and helps to quiet the set and make it operate with convenience.

As may be judged, the solution of the several problems is not difficult, but the particular methods have not been actually applied to this circuit, so readers are asked to wait until next week, when the circuit will be treated from a constructional aspect.

This is the circuit, by the way, which is intended for use as a broadcast receiver and 70-200-meter receiver, either independently or in connection with a converter that will enable band-spread tuning of short waves. A feature will be a step-tuned oscillator, a subject broached before in these columns. No work has been done yet on the converter, as the broadcast-police band receiver was tackled first, and the present article is a preliminary report on that. The object was to derive extremely high sensitivity from the circuit, with suitable selectivity, and this has been done, or overdone.

3,000 kc Bandspread

As for the short-wave feature, since the first short-wave band has been included in the broadcast set, it will be unnecessary to duplicate it in the converter. This simplifies the construction and operation. And still another consideration is that while it was intended originally to use a 1,000 kc bandspread, equal to the frequency span of the broadcast band tuning, with oscillator tuned in steps of 1,000 kc, it now becomes at least discussable to use the higher frequency band, 70-200 meters, for approximately 3,000 kc bandspread. There would be one-third as many steps in the step-tuned oscillator by this method, and if it can be worked out properly it will be applied, particularly as the variably-tuned intermediate frequency is trebled, which helps greatly in the suppression of images in the highest and second highest frequency bands of high frequency tuning.

Of course if a 3-inch aerial is so effective, as stated, then a problem arises as to coupling the converter to the receiver that is used as variably tuned i-f amplifier, but shielded wire, with sheath grounded, should help, and also a transmission line (matched impedances) may be used to boot.

One fortunate thing about the super is that it is absolutely free of squeals. This is attributed to the extra stage of radio frequency amplification.

Coil Directions

The coils used were wound on 1-inch diameter tubing and enclosed in aluminum shields 2 1/16 inches outside diameter, 2½ inches high, as to r-f and oscillator. The r-f primaries had 15 turns of fine wire (no particular diameter need be stressed) wound over secondaries consisting of 127 turns of No. 32 enamel wire. The oscillator coil consisted of 91 turns of 28 enamel wire on the same size tubing, with the tickler and rectifier windings consisting of 30 turns each of fine wire, wound over the secondaries. Between all primaries and secondaries was insulation wrapper, 0.02 thickness, or, for rough-and-ready home construction, might consist of five turns of wrapping paper.

The separation between primaries and secondaries, and between tickler and secondary, was therefore a little greater than usually prevails, necessitated by several considerations, one of them being the t-r-f level for the tuning for the 70-200-meter band requires such loose coupling.

CHANGING TO NEW TUBES

Improved Sensitivity Readily Accomplished

By Casper Ford

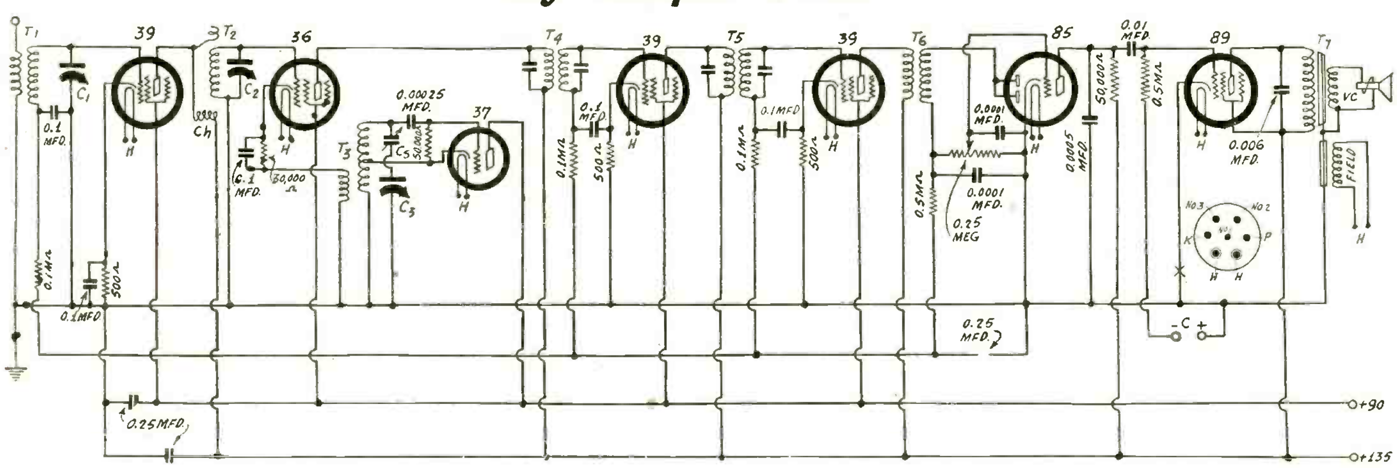


FIG. 1

A circuit of a seven-tube superheterodyne that can be modified easily to take the latest tubes in the automobile series.

THE question of fitting old circuits to the new tubes comes up frequently. For example, what changes are necessary to substitute a 44 for a 39, a 77 for a 36, a 6B7 for an 85, a 75 for an 85, and an 89 for a 38?

In some instances no other change is needed than the simple substitution. In others change of socket and voltages is necessary. As an example, let us consider the receiving circuit in Fig. 1. It is a receiver that can be used in an automobile on a six-volt heater supply or one that can be used on a-c or d-c if the heater circuit is suitably connected.

In this circuit the first tube is a 39, and the question is what changes are necessary to substitute a 44. No change in the circuit or socket is necessary for both tubes require about the same voltages on the various elements and the same socket. The 44, however, is rated at a higher plate voltage, so that if it is used the voltage may be increased to as high as 250 volts.

This also applies to the two 239 tubes in the intermediate frequency amplifier.

Change of Oscillator Tube

The oscillator in this instance is a 237. There is no substitute for this tube and there is no reason why another tube should be used, for the 37 is as good an oscillator as any other tube, insofar as the requirements in this circuit are concerned.

The first detector in this receiver is a 236. Here a change might be decidedly advantageous, for the 77 is a superior tube. The plate voltage may be increased to 250 volts on this tube, but it is not necessary. If the plate voltage is increased the screen and grid voltages should also be increased somewhat. However, since the tube is self biased there is no need of changing the resistance nor the condenser across it.

Change of Detector

The 77 requires a small six-contact socket whereas the 36 requires a small five-contact socket. Therefore a change of socket is necessary, and in changing this special notice should be paid to the fact that the socket must be a small six-contact one.

In the selection of a new detector tube we have two choices. There is the 6B7 duplex diode pentode and the 75 high mu duplex diode triode. Either tube will make the circuit more sensitive than it is with the 85, and of the two, the 6B7 is the more sensitive because the amplifying part of it is a high gain pentode.

In either case there is no need of changing the applied plate voltage, but an increase up to 250 volts may be effected if desired. The load resistance on the amplifier is only 50,000 ohms in this circuit. Greater amplifying efficiency will be obtained if this is increased. If the new tube is a 75 the resistance may well be increased to 250,000 ohms, or even more. If the new tube is a 6B7 the resistance could be increased to 200,000 ohms, for this is the recommended value.

If the pentode is used there should be a screen voltage of 50 volts, applied directly to the screen. Of course, the voltage can be made 45 volts. If there is no voltage of this value at the source, a resistor may be used in the screen lead to drop the voltage to that required. There should be a condenser from the screen to ground if the resistor is used, and it should be no smaller than 0.25 mfd.

Question of Grid Bias

The question of grid bias must be answered in either case. The 85 takes a bias of 20 volts, the 75 only 2 volts, and the 6B7, 4.5 volts, for the same applied plate voltages.

If the diode bias method is employed as indicated in the diagram no change should be needed, because the diode-provided bias will be right in all cases as long as the signal is not modulated over 100 per cent., and it will not be. The diode bias method, however, requires thorough control of the audio signal voltage applied on the grid in order to prevent overloading of the amplifier. An ordinary potentiometer usually does not have a low enough minimum to cut out the signal completely on strong stations. However, if the automatic volume control works all right, that should help a great deal toward this end.

Whether the 75 or the 6B7 is used, it would undoubtedly be better to use a fixed grid bias, but this would require a rather high grid bias resistor, well by-passed, because of the low current in the cathode lead. The cathode current for the 6B7 will be of the order of 0.75 milliampere, which would call for a bias resistance of 6,000 ohms to give the required 4.5 volts. The cathode current, which is now the same as the plate current, will be about the same value for the 75. Since this tube requires a bias of 2 volts, the bias resistance should be about 2,700 ohms.

Connection of Load

Whether the load resistance in these cases is connected directly to the cathode or to ground makes little difference because of the low value of the grid bias. A handicap of 4.5 volts is negligible, and 2 volts is still more so. If the fixed bias method is used, there should be a grid stopping condenser of 0.01 mfd. or more and a grid leak of 0.5 megohm. The volume control can remain where it is. The change, then, would be the insertion of a condenser of the above-named value in the lead to the control grid and a resistance of 0.5 megohm from the grid to ground. The bias resistance would be placed between the cathode and ground and the by-pass condenser across it, which should be of the order of 4 mfd., should be connected from the cathode to ground, that is, in shunt with the bias resistance.

The 85 and the 75 require six-contact sockets, small type, and the 6B7 a small seven-contact socket. Therefore it is necessary to change the socket when the duplex diode pentode is used.

Treatment of Power Tube

The 38 power tube takes a five-contact socket whereas the 89 takes a small six-contact socket. Therefore this change is essential in making the substitution. On each tube the metal cap on top is the control grid so no change is necessary in that respect. Grid No. 3 on the 89, which is next to the cathode on the socket, is tied to the cathode if the tube is to be used as a pentode power amplifier. No. 2 grid, which is next to the plate, is the screen voltage, and it is connected to the same voltage source as the plate return lead.

The diagram shows that the grid bias for the 89 should be obtained from a battery. But that is only for a special case. It will be more practical to derive the bias from a resistance in the cathode lead.

VOLTAGE DOUBLING

Alternate Charging of Condensers Builds up Potential

By J. E. Anderson

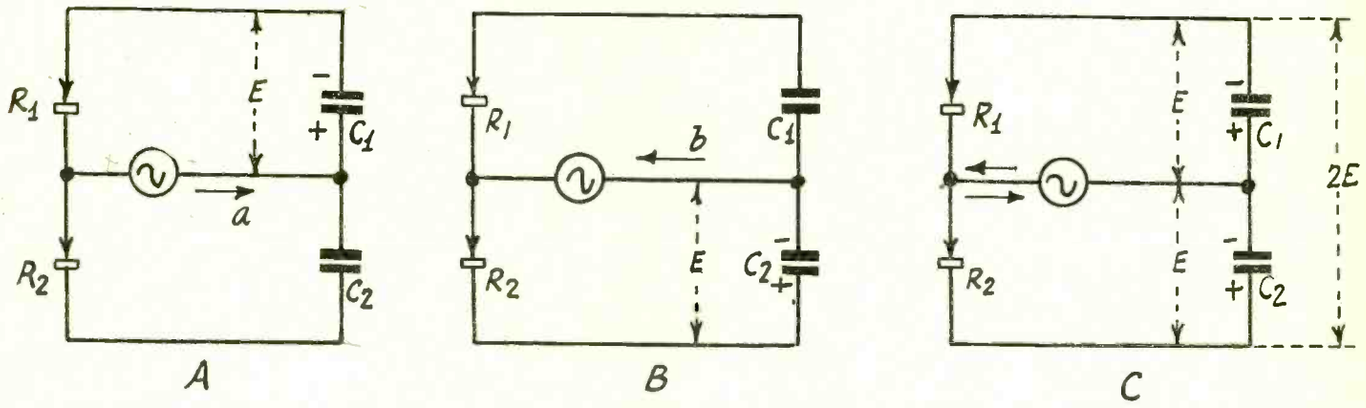


FIG. 1

These circuits show the principle involved in voltage doubling by means of two rectifiers. The input is a-c and the doubled output voltage is about twice the peak value of the input.

THE voltage doubler has lain dormant in radio books for over a decade. It is just emerging from its slumber. Just what is a voltage doubler? Many have asked that question. How does it double? Many have asked that, even after they have just read about it. Perhaps just a little bit more writing will help to answer the questions.

Refer to Fig. 1, *A*. Let R1 and R2 be two equal rectifiers of any type, and let them be connected so that they will conduct in the direction of the arrows. Connect two equal condensers C1 and C2 in series across the two rectifiers. Between the junction of the two rectifiers and the junction of the two condensers, connect a source of alternating e. m. f. Let the maximum value of this voltage be E.

First assume that the voltage is acting in the direction of the arrow *a*. Condenser C1 charges up to a voltage E because R1 conducts in the direction that permits the condenser to charge up. Let the voltage subside to zero. The charge on the condenser remains because there is no way in which it can escape. It cannot discharge through R1 because it will not conduct in the proper direction. Therefore after the voltage has subsided there is a potential difference E across C1.

Charging Second Condenser

Now let the voltage act in the opposite direction, as shown by arrow *b* in Fig. 1, *B*. R2 now conducts in the direction that permits condenser C2 to charge up. When the voltage has again subsided to zero the charge remains on that condenser because it cannot escape through R2. It is trapped. Hence there is a potential difference E across that condenser. The polarities of the charges are indicated by appropriate signs.

When the supply is rapidly alternating in direction, both condensers are charged to the potential E, as indicated in Fig 1, C. The potentials across the two condensers are in the same direction so that they add up, and therefore the voltage across the two condensers is 2E, or twice the value of the amplitude of the supply voltage. That is why the device is called a voltage doubler.

Effect of Leakage

It was assumed that the charges will remain on the condensers. This is not strictly true because of leakage, so if the supply voltage were turned off the potential would gradually drop to zero. But when the voltage is alternating rapidly, as in the case of 60-cycle supply, the leakage between charges is inappreciable. It is the potential that has the value 2E, and in order to test the theory it would be necessary to use a static voltmeter or a vacuum tube voltmeter. Any current-drawing voltmeter would read less than twice the peak of the supply voltage.

The voltage doubler would be of little value in a radio receiver unless it could sustain a considerable leakage. The current required for the plates, screens, and the speaker field in a radio set constitutes a heavy leakage. In order that the voltage shall be maintained when a heavy current is drawn it is necessary that the two condensers C1 and C2 be of large capacity. In rectifiers using the voltage doubler it has been recommended that the capacity of each condenser be at least 16 mfd. if the circuit is to deliver a current of 40 milliamperes.

Another object of using such large condensers is to reduce the ripple to as low a value as possible. The frequency of the ripple is twice that of the supply voltage, as is the case for all full-wave rectifiers. The amplitude of the ripple is approximately inversely proportional to the capacity of each condenser. As a means of further reducing the ripple a choke can be used in series with the load line, as is done in other B supply circuits.

A B Supply Doubler

The 25Z5 rectifier tube has been so designed that it can be used as a voltage doubler. The reason why it may be so used is that it is two independent cathodes and two independent anodes. That is, it is two independent rectifiers contained in the same glass envelope. The connections for a voltage doubler with this tube are shown in Fig. 2. It will be noticed that the cathode of one element is connected to the anode of the other. To this lead is connected the a-c supply, just as in Fig. 1. The other side of the a-c line is connected to the junction of the two condensers. The positive side of the output line is that which is connected to the cathode not previously used, and the negative of the output is the anode not previously used. A choke coil is connected in the positive lead to the load.

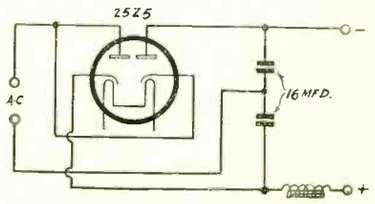


FIG. 2

This illustrates how the principle of voltage doubling can be applied with a 25Z5 rectifier tube. Large capacity condensers are essential for good voltage regulation.

Rating of 25Z5

One advantage of a circuit like this is that it is often possible to dispense with the power transformer, for if a 110 volt line is connected directly to the rectifier the output voltage will be about 220 volts. Indeed, if the drain is not great the voltage may be higher, because the limiting value is twice the peak of the line

(*Continued on next page*)

UNIVERSAL AMPLIFIER

Portable Public Address System Using High Voltage Tubes

By Brunsten Brunn

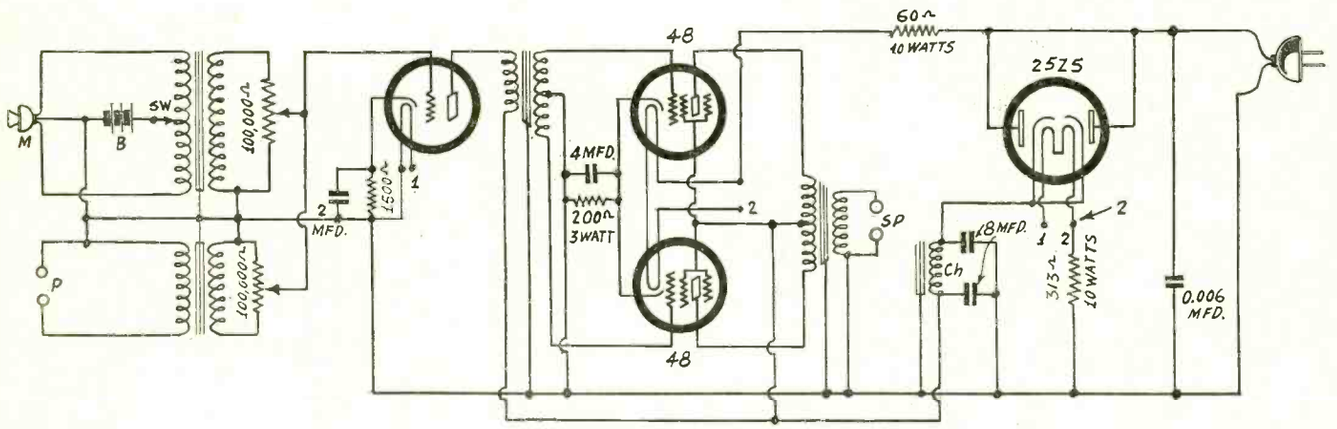


FIG. 1

A small public address amplifier that can be used on either a-c or d-c lines.

THERE are many uses for small public address systems, amplifiers that are light enough to be carried around by a man. An output of about 5 watts is often sufficient, and a high gain is not needed because they are usually used with either a phonograph pick-up or with a sensitive microphone. A circuit consisting of two stages, one a single side amplifier with a 37 tube and one a push-pull with two 48 tubes, is about right. It should preferably be a universal type circuit so that it can be used equally well on a-c and d-c lines. Such an amplifier is shown schematically in Fig. 1.

The input to this circuit is arranged so that it can be switched easily from phonograph to microphone and back again. The control consists of two 100,000-ohm potentiometers. If these are mounted on the same shaft there need only be one volume control on the set. Further, if they are wired so that they work in opposite directions the control will fade out the phonograph and in the microphone, or the other way about, by merely turning one way or the other. Or both may be on at the same time in various degrees.

Optional Connection

The wiring may also be done so that the two are turned on or off at the same time, but in this case it is necessary to turn off the microphone switch when the phonograph is to be on alone or to disconnect phonograph pick-up when the microphone is to be on alone. The microphone is of the double button type and it is actuated by a battery B. A microphone-to-tube transformer is needed for coupling the microphone and it should be one with centertapped primary. The transformer between the phonograph pick-up and the tube may not be needed, for the usual pick-up will deliver a signal that is ample for an amplifier of this type without any step-up. If none is used, the volume control potentiometer can be connected directly across the output terminals of the pick-up.

LIST OF PARTS

Coils

One microphone-to-tube transformer for double button microphone.
One phono pick-up to tube transformer.
One push-pull input transformer.
One push-pull output transformer.
One 30-henry choke coil.

Condensers

One 2 mfd. by-pass, or larger.
One 4 mfd. by-pass, or larger.
Two 8 mfd. electrolytic condensers, or larger.
One 0.006 mfd. condenser, optional.

Resistors

Two 100,000-ohm potentiometers.
One 15,000-ohm bias resistor.
One 200-ohm, 3-watt bias resistor.
One 313-ohm, 10-watt resistor.
One 60-ohm, 10-watt resistor.

Other Requirements

One double button microphone.
One switch, single pole, single throw.
One medium, 5-contact socket.
Two medium, six-contact sockets.
One small, six-contact socket.
One cable and line plug.

A self-bias resistor of 1,500 ohms is used for the 237 tube and it is shunted with a condenser of 2 mfd. Of course, this condenser may be much larger and could well be one of the small electrolytics that have been developed for this service.

An ordinary push-pull input transformer is used between the 237 and the push-pull stage.

The two 48 tubes are biased by a common resistor of 200 ohms. This value is slightly greater than the value that is ordinarily used for such a stage but the amplifier is intentionally overbiased in order to reduce the total plate current to that which can be delivered by the rectifier without overloading it. Since the amplifier is push-pull higher bias is permissible because it gives the amplifier the nature of a Class B amplifier. Indeed, the tubes could be biased still more if necessary, but if the bias is increased much more the by-pass condensers in the filter should be increased to improve the regulation.

By-pass Well

Across the 200-ohm bias resistor is a 4 mfd. condenser. This should be considered as the minimum. A large electrolytic condenser would be preferable, and it is needed if the bias is excessive.

In the B supply filter are two 8 mfd. condensers. These also should be regarded as the minimum. Condensers of 16 mfd. are not too large, especially if the bias is higher than normal. It is more important that the second of these, than

(*Continued on next page*)

Why the 25Z5 Doubles Voltage

(*Concluded from preceding page*)

voltage. Assuming that the line voltage is sinusoidal, the limit is 331 volts. If the set does not require a great deal of current the voltage will be at least 220 volts, and that is sufficient for most purposes.

The 25Z5 tube is rated at 125 volts R.M.S. maximum per anode and a maximum current of 100 milliamperes. Thus it can be used safely in a set using two 48 tubes provided that the 48s are slightly overbiased and the other tubes do not take a great deal of current. However, with combination there would be nothing with which to actuate the field of a magnetic speaker, unless some of the available voltage were dropped in the field, that is, if the field coil were connected as a choke.

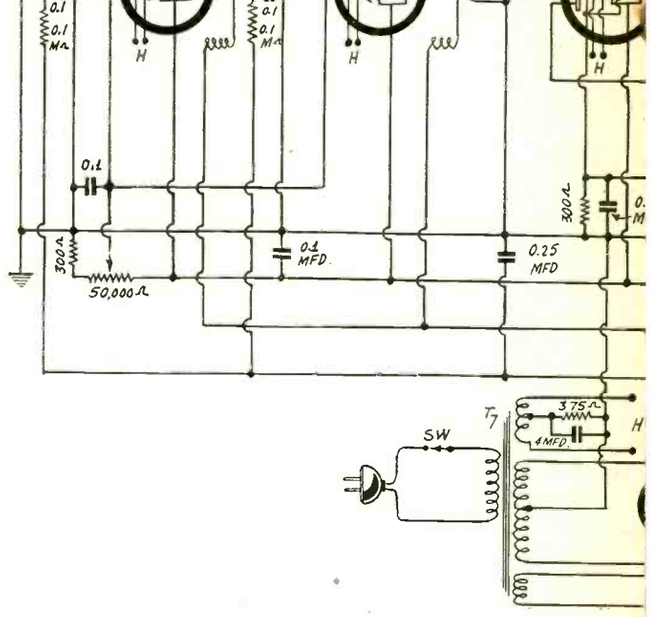
A rectifier of this kind is particularly useful in midget sets.

A T-R-F SET W

The 2A3's in Push-

2B7—523

By Anso



THE tuned radio frequency receiver has been neglected since the superheterodyne became popular. Yet there are many who prefer the t-r-f receiver because they are of the opinion that better quality is possible with it, and also because it is easier to construct and adjust. Few t-r-f receivers incorporating the latest tubes have been described. The object of the present receiver is to fill the requirement.

The principal feature of this circuit is the unusual application of the 2B7 tube. This use of the tube is suggested in the technical data supplied by the manufacturers of the tube but no circuits have been given for it. The customary use of the tube is as full-wave rectifier and audio amplifier. In this application the tube functions as a radio frequency amplifier and then as a full-wave detector. In other words, the tube is inverted in a sense.

Selectivity of Set

If a tuned radio frequency receiver is to be selective it should have many tuned circuits. In the present case there are four. It should be pointed out here that a selector having four equal tuned circuits is more effective in separating stations and less effective in cutting sidebands than a receiver having fewer tuned circuits even though the selectivity near the resonant frequency may be equal near the resonant frequency. Four gang condensers suitable for a tuner of this kind are available and are coming into use more and more.

The first tuning coil is a regular antenna coupler, using a primary and a secondary. The next two are of the so-called high-gain type, which means that the plate choke coil is selected so that it resonates with the plate capacity at a frequency just below the lowest frequency reached by the tuner and that the coupling between the plate and the tuned circuit is by means of the capacity between the small open winding and the high potential side of the tuned circuit. The third is special in the sense that the primary is tuned and the secondary centertapped and untuned. The tuned winding, of course, has the same inductance as any one of the tuned windings in the previous coils. A regular coupler, like that used in the antenna circuit, can be used for the fourth coil provided that a centertapped winding is added. Such coils are available.

Shielding and Filtering

A radio frequency amplifier that is as sensitive as this one is likely to oscillate unless precautions are taken against. It is not possible to predict whether or not the circuit will oscillate because there is an infinite number of ways in which the wiring may be done. There are certain things that must be done, however. First of all, the tuning coils should be well shielded from each other. In the second place, the sensitive leads should be shielded from each other, or at least should be kept apart. Any plate lead running from a tuned coil is sensitive, and any grid lead between the tuning coil and the grid or between the coil and condenser is still more sensitive. If oscillation occurs it can frequently be stopped by pushing a pair of these leads apart or by shielding one from the other. The leads coming from the coils to the caps of the tubes, or from the condenser stators to the caps, are particularly sensitive.

More radio frequency by-passing may be necessary in bad cases, that is. of the supply leads, or it may even be necessary to put a radio frequency choke in each plate and screen lead of the r-f amplifiers. Also, the 300-ohm bias resistance may have to be increased. But these remedies should not be applied unless a particular amplifier oscillates.

The Amplifier-Detector

Returning to the 2B7, it will be noticed that it acts as a radio frequency amplifier, feeding into the tuned circuit in its output. The centertapped secondary on this coil is then connected in the diode circuit and the centertap is connected to the input of the audio amplifier. When the tube is operated in this manner the screen of the tube takes the full voltage applied to the other screens, or even more.

The load resistance on the diode circuit is a 0.5-megohm resistor which occupies the position of the usual plate coupling resistor, except that it is connected to the cathode of the rectifier tube instead of to the plate supply. Therefore the bias voltage on the pentode part of the tube does not act as a handicap on the detector. Even if the load resistance were connected to ground the handicap would only amount to 3 volts, which would not be serious. A filter condenser of 0.00025 mfd. is connected across the load resistance to take out the rectified pulses.

Amplifier with

(*Continued from preceding page*)

is, the one next the amplifier tubes, should be large than that the other should be large.

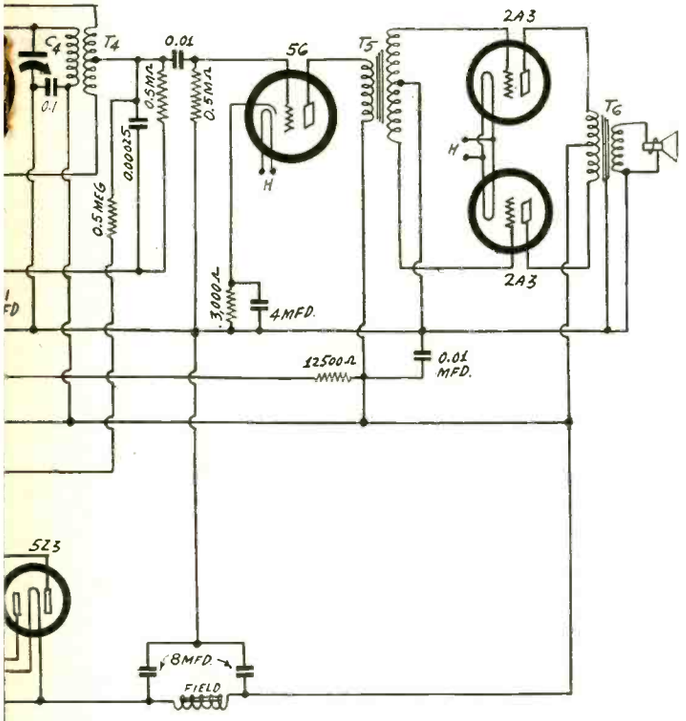
A regular output transformer is used between the push-pull stage and the speaker. Since the rectifier is overtaxed by the push-pull stage alone, there is nothing left for a field. For that reason the speaker used should be of the inductor, magnetic, or permanent field type. With a suitable output transformer any of these speakers can be used efficiently with the two push-pull tubes.

The heaters of all the tubes are connected in series. Since two of them require 0.4 ampere and two 0.3 ampere, a special arrangement is needed. One side of the heater of the 37 is connected to one side of the line. The other terminal of that tube, marked (1), is connected to one terminal of the 25Z5, also marked (1). Terminal (2) of the rectifier heater is connected to a 313-ohm resistor and to terminal (2) on one of the 48 filaments. The 48 filaments are connected in series and one terminal is connected to the 60-

ITH NEW TUBES

Pull Output, Fed by is Rectifier

n Winslow



A 0.01 condenser is connected between the centertap of the coil and the grid of the first audio tube and a half-megohm grid leak is used to maintain the grid of that tube at the proper operating potential. If the audio amplifier following the diode were resistance coupled to the next stage the 0.01 mfd. condenser and the grid leak would not be necessary, for the diode load resistance would bias the tube sufficiently. But with a transformer load on the tube the plate current would be excessive on weak and no signals. Or, if the self bias resistance is used, the diode bias would cause the tube to become overbiased on strong signals.

Series Heaters

ohm ballast resistor. The function of the 313-ohm resistor is to take the 0.1 ampere needed by the 48s but not needed by the other tubes.

Since the 313-ohm resistor is to carry 0.1 ampere and is to drop a voltage equal to the drop in the 25Z5 and the 237, which is 31.3 volts, 313 ohms is the proper value. The wattage dissipation in this resistor will be 3.13 watts normally but is specified at 10 watts for safety.

The ballast resistor is to drop the voltage difference between the line voltage and the voltage required by all the heaters. Each of the 48 tubes takes 30 volts. Hence the total drop in the heaters is 91.3 volts. If the line voltage is assumed to be 115 volts, the excess voltage is nearly 24 volts. Since the current through the ballast is 0.4 ampere, the resistance should be 60 ohms. The wattage dissipation will be 9.6 watts and therefore the rating of the resistor should be at least 10 watts.

The 0.006 mfd. condenser across the line is for the purpose of removing some high frequency noise. Its use is not essential in an audio amplifier.

The Output Stage

The output stage contains two 2A3 power tubes in push-pull. These tubes, operated in the manner shown in the diagram, will give a maximum undistorted output of 7 watts or more, assuming proper matching of the tube resistance to the speaker.

The power tubes are biased by means of a 375-ohm resistor in the lead to the center of the 2.05-volt heater winding. This resistance is based on the fact that the normal plate current of each of the 2A3 tubes is 60 milliamperes and that the required bias is 45 volts. A condenser of 4 mfd. is connected across the bias resistance. In a truly push-pull circuit this should not be needed but it is very difficult to get two tubes and two push-pull transformers such that the circuit is 100 per cent. push-pull. Of course, there is nothing against using a very large electrolytic condenser, say one of 30 microfarads.

The supply used with the set is typical insofar as connections are concerned. However, the rectifier tube is a 5Z3, for this is the smallest rectifier tube that will stand the heavy current that this set will normally take, which is of the order of 150 milliamperes.

The speaker field is used for choke in the filter. Since the current will be close to 150 milliamperes the field should have been designed for that current. Assuming that the wattage dissipated in the field is 15 watts, which is not much for a speaker that will take the output of two 2A3 tubes, the field resistance should be around 670 ohms, which will cause a voltage drop of 100 volts. If a speaker with such a field coil is not available, a regular choke capable of carrying the 150 milliamperes should be substituted and the field of the speaker should be actuated by some other means.

Two 8 mfd. electrolytic condensers are used in the filter, but larger values would be advisable when there is any hum in the output.

Volume Control

The volume is controlled automatically by varying the amplification in the first two tubes. The negative bias is taken from the centertap of the diode input winding and a resistor of 0.5 megohm is used to prevent shorting of the audio signal. In the bias lead to each of the controlled tubes is a filter consisting of a 0.1 mfd. condenser and a 0.1 megohm resistor. A 0.25 mfd. condenser filters the common lead.

The automatic bias is measured from the cathode of the rectifier tube, which is about 3 volts above ground. Therefore if the minimum bias on the controlled tubes were also 3 volts, the minimum bias on these tubes would actually be zero. In order to prevent this the bias on the controlled tubes is made higher than three volts. That is one reason why the bias resistance for the first two tubes is the same as that for the detector pentode. If oscillation should occur on weak signals the limiting bias resistance for the first tubes can be made still higher.

There is also a manual volume control on the first two tubes. This operates so that the grid bias and the screen voltage change in opposite directions as the slider on the 50,000 ohm potentiometer is moved. The amplification decreases as the bias is increased and also as the screen voltage is decreased. Both changes occur as the potentiometer slider is moved toward the right. As it is moved in the opposite direction the grid bias is decreased, the screen voltage increased, and the amplification increased. Regardless of the position of the manual control the automatic bias is effective, provided there is any signal at the diode input.

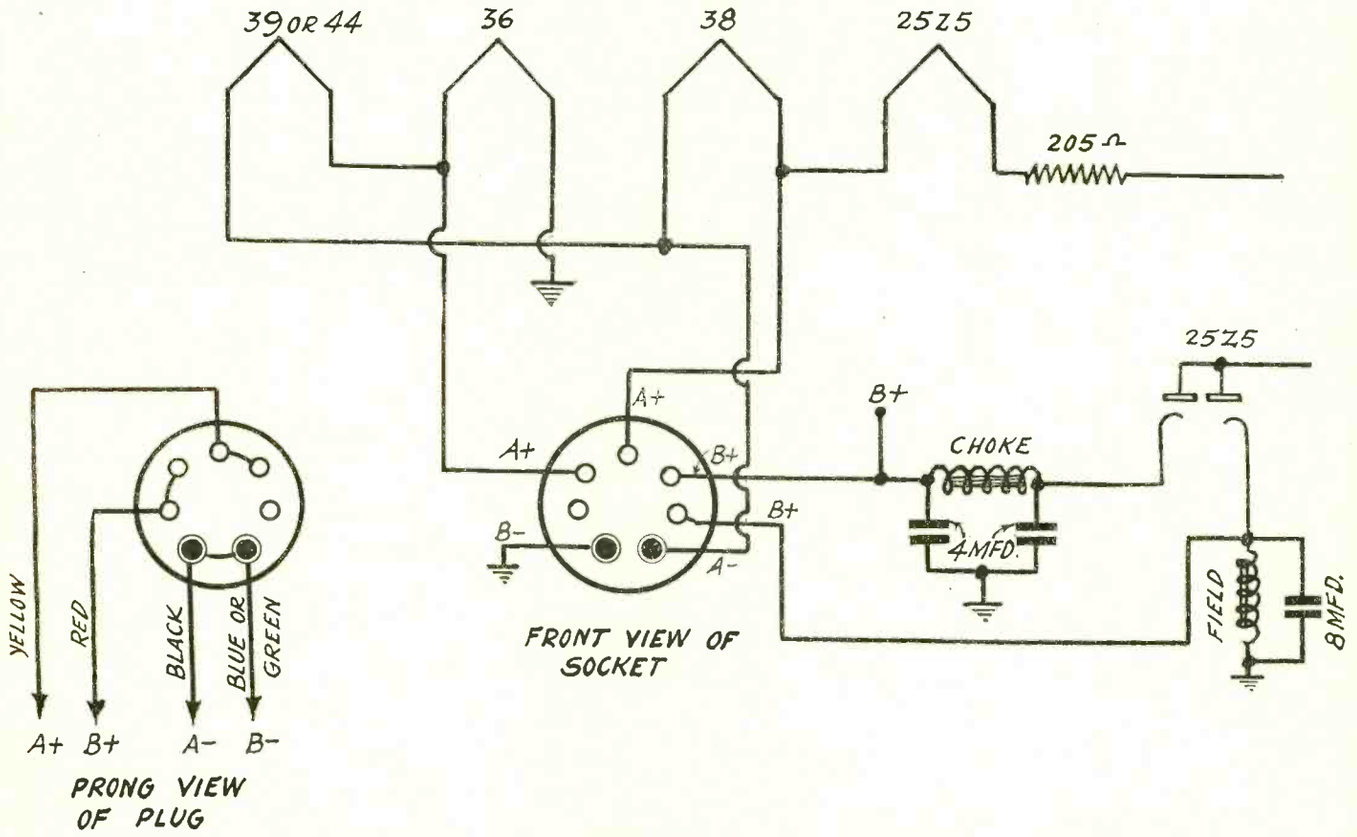
Optional Operation of 2A3 Tubes

The 2A3 tubes are often operated with such high bias that the amplifier approaches a Class B stage. The grid bias resistor should then be 775 ohms. This naturally decreases greatly the current drawn by the receiver, for the plate current in the power stage is practically cut in two. This also greatly increases the power handling ability.

UNIVERSAL ON BATTERIES

Receiver Used with 6- or 32-Volt Source

By Thomas Crossley
Consultant, Postal Radio Corp.



This shows how a universal receiver can be converted into a battery operated set by simply inserting a special plug into a socket built into the receiver.

EVER since the small universal receivers came out, many have expressed a desire to use these circuits also on batteries, both 6-volt storage batteries and cars and motorboats and 32-volt batteries. To use these sets on storage batteries becomes a simple matter provided that a plug which converts the circuit is employed.

Every one of these receivers is now built with a socket at the back which is wired in such a way that when a plug to match, which has been wired in a certain way, is inserted the circuit immediately can be operated on six volts. The socket and plug now provided are of the seven-contact type. The manner in which the heater circuit and the plug are wired to bring about the change is shown in Fig. 1. Note that one terminal of the 36 heater is connected to ground and that the other is connected to a contact on the socket marked A plus. One terminal of the 39 (or 44) is also connected to the same plus terminal. The remaining terminal of the 39 is connected to one terminal on the 38 and the two are then connected to a terminal on the socket marked A minus. The remaining terminal of the 38 is connected to a second contact on the socket marked A plus. One end of the heater of the 25Z5 is also connected to this terminal, not that it is needed but left connected in that manner and it does no harm.

Connections of Plug

Now look at the plug and compare it with the socket. The two pins which contact with the two A plus terminals on the socket are shorted, so that if the positive of the battery is connected to this short the two A plus terminals on the socket become positive to the extent of the filament battery voltage used. Thus one end of each of the tubes in the set becomes positive.

The two pins marked A minus and B minus are also shorted. If A minus and B minus of the batteries are connected to these pins the heater terminals not previously made positive become minus with respect to both batteries. The ground connections must be taken into consideration at this point.

The advantage of the arrangement is that when the plug is not in the socket all the heaters, including that of the rectifier, are in series, and when the plug is in the socket all the heaters are in parallel, except that of the rectifier, which is not in the circuit at all. With the socket empty, the set can be operated on either a-c or d-c, 110 volts. With the plug occupying the socket, the set can be operated on a six-volt battery and any source of plate voltage.

Use of Rectifier B Supply

Two of the terminals on the plug are marked B plus. There are two corresponding contacts on the socket. One goes to the plate returns, the other to the field of the speaker. One side of the field is grounded and so is, naturally, B minus. Therefore any source of voltage connected across B plus and B minus will operate both the tube and the loudspeaker field.

The source of voltage may be a battery, but it may as well be a B battery eliminator. Particularly, it may be an eliminator operating on a six-volt storage battery. Therefore if the set is to be operated in a car or in a motorboat no change is necessary except the insertion of the plug and connecting the voltage source available to the appropriately marked terminals on the cable.

The question of current capacity of the particular B supply available is one for the user to decide. There are six-

(Continued on next page)

volt battery operated eliminators which will put out sufficient current to operate both the set indicated by the heater circuit and the loudspeaker field.

The rectifier built into the universal set is floating when the set is operated on batteries or a B battery eliminator, but that is all right for it is not needed. It is only there for use when the set is to be operated off a 110 volt line, a-c or d-c.

Operation of 32 Volts

When the receiver is to be operated on a 32-volt line it is necessary to put in a ballast resistor in the positive lead of the heater circuit, that is, between the A plus terminal on the plug cable and the positive terminal on the battery. Since the three tubes require a current of 0.9 ampere and the excess voltage is 13.1 volts, the ballast resistance should be nearly 15 ohms, and it should be capable of dissipating 12 watts or more.

If the set is to be operated permanently on a 32-volt supply it would be advantageous to get a speaker with a field that would require just 0.9 ampere and 13.1 volts. This could then be connected in place of the ballast instead of where it now is. The wattage that must be dissipated is approximately that needed for a medium size speaker. For example, a speaker ordinarily used on a six-volt battery has a field wattage of 10 watts.

This method of activating the field is not advisable when the set is to be used frequently on other voltage sources because it requires a change in the circuit not provided for by the plug.

The Plate Supply

The plate supply on the 32-volt operated receiver can be a dry cell battery giving the necessary voltage, or it may be a B battery eliminator operating from the 32-volt battery. Again, since there is already 32 volts available with its negative to the proper point in the circuit, the 32 volts in the battery could be used as part of the B supply. To do this a booster battery is needed with its negative connected to the positive of the storage battery and its positive to the B plus on the cable.

There is still another way of operating the receiver on a 32-volt source. The plug may be removed from the socket and the set made ready for operation on 110 volts. That is the normal mode of operation. It is then only necessary to supply a booster battery to make up for the deficiency. Since the battery voltage is 32 volts and the set requires about 110 volts, the booster battery should have a voltage of 78 volts. It would be all right to use 90 volts, for the circuit will safely work on 125 volts total.

Either way the circuit is operated on a 32-volt battery and a booster battery, the drain on that battery will not be serious. The most economical way of operating is that in which a special speaker field is used as the ballast. This, however, tampers with the universality of the set.

Choice of Tubes

The first tube in the circuit is indicated as either a 39 or a 44. Both take the same heater voltage and current and both are of the control type. The 44 is a later tube and is somewhat more efficient. It is recommended to be used with 250 volts on the plate, but it will function all right with the lower voltages that will obtain in a universal set.

A receiver having these universal features is especially useful to the salesmen who travel from place to place and stop at different hotels where supply voltages vary. They can always plug into the power socket available with the assurance that the voltage will be right for the set. Moreover, if they travel from place to place by automobile, they can still use the set.

Quality and Noise Suppression

DOES a noise suppressor in a receiver affect the quality of the output adversely, or is it just as good as if there were no noise suppression?—W. R. H., Pittsburgh, Pa.

Correctly designed, the noise suppressor should not appreciably affect the quality adversely, but if the adjustment is not the best there is likely to be distortion, sometimes serious distortion.

* * *

Doubly Tuned Coupler

IF a doubly tuned transformer as used in superheterodyne circuits has two frequencies of resonance, which one determines its response?—M. M., Yonkers, N. Y.

Both determine its response. If the impressed frequency coincides with one maximum it will be amplified in a maximum degree. If the impressed frequency coincides with the other, that will be amplified most. If the coupling between the two tuned circuits is close there will be two distinct peaks, which can be noticed in tuning a superheterodyne, but neither peak will be very high. If the coupling is just a little bit closer than critical coupling there will be only one apparent peak, as the two merge into one. The coupling should be a little closer than critical for then the quality will be good and the gain will not suffer. If the coupling is less than critical the selectivity will be high but the gain will be low.

* * *

Long Line Radio Transmitter

PERHAPS you can help me with a problem of radio transmission. My problem is to transmit radio signals from one room to another without radiation and with practically no loss. Is there any practical way. I have tried to run wires from the transmitter to the receiver but I have had no luck at all.—A. B. N., Mineola, L. I.

A line will solve the problem very easily provided you use the right line. If the frequency is high, the line could consist of a brass pipe with a wire in the center of it. The wire should be kept concentrically as near as possible by good insulators such as mica or Isolantite or hard rubber. The wire might be No. 14 copper and the diameter of the pipe might be half inch to one inch. If the frequency is lower you can use a cable in which there is an insulated wire inside a metal sheath. The secret of success with a transmission line of this type lies in the use of proper terminal impedences. The tube impedence should be matched with the line impedence with a suitable step-down transformer, and the receiver input impedance should be matched to the line impedance with another transformer. With proper matching the losses in the line will be negligible. The transmitter might well consist of the smallest receiving tube if the receiver is a regular broadcast set. Indeed, the smallest tube will give more than the receiver will take, possibly 1,000 times more if the set is sensitive.

* * *

What Suppressor Does

WHY is a tube having a suppressor between the plate and the screen much more efficient than a tube without the suppressor and why can it be used in a resistance coupled circuit with a relatively high screen voltage whereas a tube without a suppressor cannot so be used unless the screen voltage is low?—S. G., New York, N. Y.

The suppressor reduces secondary emission from the plate. If this is not reduced the plate resistance is much higher because the electrons going to the plate must overcome those that have bounced back from the plate. The reduced resistance causes an increase in the mutual conductance and that in turn has the effect of producing greater efficiency. If the secondary emission is not suppressed it is possible that when the effective plate voltage is lower than the screen voltage the plate current will actually flow away from the plate, that is, in the wrong direction. This must be prevented, and if it is not done with the suppressor it must be done by increasing the plate voltage or by decreasing the screen voltage.

Standard Resistor Code

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

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

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Capacity Between Windings

WHAT IS THE EFFECT of capacity between windings of a radio frequency transformer? I have noticed that if the primary be connected one way the transformer is more effective than when it is connected the other way, and I have been wondering whether the capacity is responsible for the difference.—R. T. N., Albany, N. Y.

When the primary is connected one way the capacity aids the inductive coupling and when it is connected the other way it opposes. That is the reason why there is a difference. When the coil is connected in an oscillator circuit the connections must be such that the two aid. This does not mean that the circuit would not oscillate if there were no capacity between the windings but that it tends to oscillate more readily. It just happens that the mutual inductance must be negative and capacity reactance is always negative. It may also be in some cases that the difference is due to regeneration.

* * *

Electron Coupling

JUST WHAT CONSTITUTES electron coupling? This expression has appeared in many articles describing circuits but it is not very clear to me just why the coupling is electronic and not one of the three well-known types.—W. H. C., New York, N. Y.

Perhaps it is not clear because there is no agreement as to just what it is. But perhaps a better term for it, in so far as understanding it is concerned, is potential coupling. In ordinary coupling—resistive, inductive, and capacitive—two circuits are coupled when they have an impedance in common. But if the coupling is effected in the electron stream by means of potential variation it cannot be called by one of the three types, unless, perhaps, it is resistive. In that case the resistance would be that between the elements that are at different potentials. If no current is involved it cannot be called resistive either. The question is as to what kind of coupling is used between the tuned grid circuit of an amplifier and the plate. It can only be called potential. When the term was first used by Dow it referred to the coupling between the plate and the screen when the plate was affected only by the variation in the plate current that the screen permitted to get through. There seems to be no better name for this than electron coupling.

* * *

Time Constant of Circuit

IS IT A FACT that a condenser of given size is more effective as a by-pass across a large resistance than across a small one? If so, why?—G. J., Sandusky, Ohio.

It is a fact. The question of time constant enters. The larger the time constant of the combination the more effective is the condenser, relatively, and the time constant can be increased by increasing the resistance. However, regardless of the capacity of the condenser, the impedance of the combination can never be lower than the reactance of the condenser.

* * *

Output of Oscillator

RECENTLY YOU DESCRIBED an oscillator in which the filament current was abnormally low for the purpose of avoiding grid current. How does this affect the output of the oscillator? It seems to me that the limitation of the plate current by limiting the emission would seriously reduce the output.—J. M. B., Brooklyn, N. Y.

Yes, it does reduce the output greatly. The purpose of the oscillator was not to yield a high output but rather to yield an output that was relatively pure and of constant frequency. The same idea can be applied, as was suggested, to an oscillator in which the filament emission is not so limited. It is only necessary to increase the plate and grid voltages. However, since the tube is likely to become damaged if the plate voltage is increased greatly, it is well to strike a mean, reducing the emission a little and not increase the plate voltage quite so much. As was stated, the essential thing is to keep the entire non-saturated portion of the curve on the negative side.

* * *

T-R-F Receiver

WILL you kindly publish a circuit diagram of a six-tube tuned radio frequency receiver employing either 48s or 89s in push-pull in the output stage. Please give all necessary constants. The receiver is to be used on a d-c line. If you do not have such a circuit one intended for batteries will do for I can easily change the heater circuit.—R. F. W., Boston, Mass.

We reproduce the circuit diagram of the No. 486 t-r-f receiver which we have described in detail previously. The necessary constants are given on the diagram.

* * *

Resistance of Wire

IS it safe to assume that the radio frequency resistance of wire is inversely proportional to the square of the diameter, the law that applies to direct current resistance? If not, in which way does the resistance deviate?—T. S. H., Bridgeport, Conn.

It is not safe if the radio frequency is high. The resistance of a heavy wire may be 25 or more times higher at radio frequencies whereas that of fine wire may not be more than a few per cent. higher. It depends on the diameter and on the frequency. The finer the wire the more nearly correct is the assumption.

* * *

Cost of Operating a Receiver

HOW much does it cost to operate a radio receiver that takes 100 watts from the line?—W. C. J., Baltimore, Md.

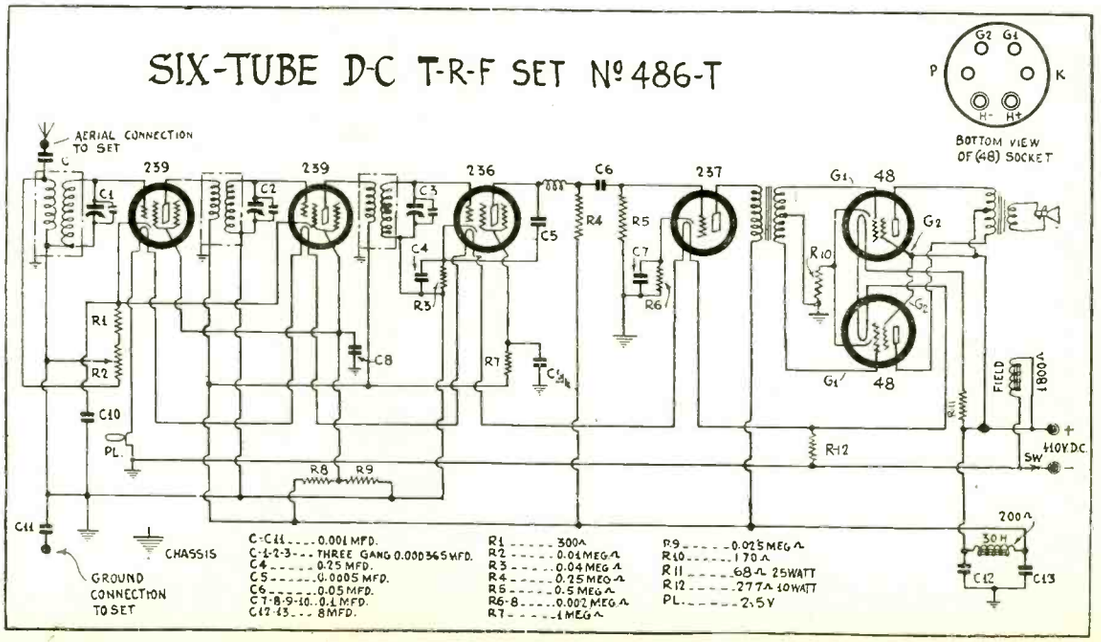
It depends on how much you pay for electrical energy. If you pay 9 cents per kilo-watt hour, it will take 0.9 cent every hour, for the power is 0.1 kilowatt.

* * *

Superiority of Air Condensers

WHY is a condenser with air dielectric superior to a condenser that has any other kind of dielectric? —J. A. D., Springfield, Ohio.

It is difficult to answer that query without merely rephrasing the question. Saying that there is less loss in air than in any other dielectric is just restating the question, but that is about the only answer there is.



The circuit of a tuned radio frequency receiver employing six heater tubes in which the filaments are connected in series and arranged so that the set can be used on a 110-volt d-c line.

Electrolytic Condenser?

IS an electrolytic condenser really a condenser or does it merely act as one? I have difficulty in reconciling known facts about electrolytes and the ordinary conception of condensers.—R. T. A., Milwaukee, Wis.

It merely acts as a condenser. The device is more like a primary cell that has no depolarizer in it, or a storage battery which would polarize. As the current is first turned on in one direction the device conducts but quickly builds up an impenetrable barrier at the surface of the aluminum. When the current is reversed, the barrier is broken down in part. If the reverse voltage is greater than the forming voltage the break-down is complete but this does not do any harm if the voltage is alternating because at the next half cycle the barrier will be built up to the required strength. The building up and tearing down of the barrier cannot keep pace with a high frequency current and for that reason an electrolytic condenser is not good at radio frequencies. A condenser that measured 30 mfd. at 60 cycles measured only 5 mfd. at broadcast frequencies.

* * *

Removing Hiss

IT has been my experience that if a condenser of 0.006 mfd. be connected across the plate circuit of the output tube the objectionable hiss present in many sensitive receivers is practically eliminated. Just why does a small condenser have this effect?—T. W. J., Newark, N. Y.

A small condenser connected across a relatively high impedance is effective in cutting out high frequencies by shunting them around the output, in this case the loudspeaker. Hiss is made up of very high audio frequencies, and undoubtedly many superaudible frequencies. Therefore the condenser removes the hiss from the speaker. A condenser placed elsewhere across the line should have the same effect, and in some places a much smaller condenser would be equally effective, for example, if it is placed across the grid leak preceding the power tube.

* * *

Buffer Choke With Mercury Rectifiers

WHY is is necessary to use a radio frequency choke in rectifier circuits employing mercury tubes and why is it necessary to use buffer condensers in circuits employing gaseous rectifier tubes?—G. H. E., Chicago, Ill.

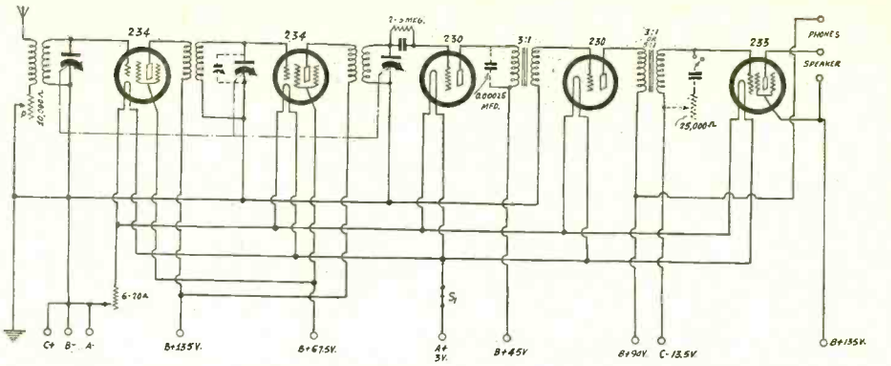
The object of the buffer condensers and the buffer chokes is the same. In these rectifiers there is a certain break-down voltage which must be exceeded before any current will flow. When the break-down occurs the current starts suddenly with a burst. It is usually stated that the wave front is steep. Any sudden change in current can occur only if there are many high frequencies present. The object of the buffers is to prevent the sudden rise in the current. In the case of the mercury rectifier the steep wave front gives rise to hiss. Hence the practical effect of the choke is to remove this hiss.

* * *

No Control of Volume

My receiver is so sensitive that it is impossible to control the volume. I have tried many methods of cutting down the amplification but all seem to fail on the strong local stations. What can you suggest?—H. B. N., Atlanta, Ga.

You might try different antennas. If you have a long one for distant stations you might use a very short one, or none at all, on the local stations. A very sensitive receiver should be able to pick up all the local stations with a wire only six inches long. If the receiver is not shielded as a whole variation in the antenna length may not have the desired result for the wiring in the set amounts to more than an antenna six inches long.



This is a diagram of a universal receiver showing how a triode like the 237 or the 227 can be used as a rectifier with the use of a power transformer.

Selectivity of Supers

WHY is it that the selectivity of a superheterodyne using a high intermediate frequency is not nearly so great as that of a super using a low intermediate frequency? Is there any way of increasing the selectivity of a high intermediate frequency circuit?—R. C. S., Knoxville, Tenn.

The selectivity is largely a matter of frequency ratio. When the intermediate frequency is low, say 50,000 cycles, the highest sound frequency, 10,000 cycles, say, is 0.2 of the carrier. If the intermediate frequency is raised to 500,000 cycles the same audio frequency is only 0.02 of the intermediate frequency. In the former case the effective selectivity is just ten times as great. If the selectivity of the high intermediate frequency super is to be made equal that of the low frequency super, the selectivity of each tuner must be increased proportionately to the increase in frequency, or else the number of tuned circuits must be increased. For high quality it is better to leave the selectivity of each tuner the same and to increase the number of tuners. Obviously, though, it is not practical to increase the number of tuners in the ratio of 10-to-1, or even in the ratio of 3.16-to-1, which is about the proper ratio for the maintenance of the same effective selectivity. When the only reason for increasing the intermediate frequency is to remove image interference, the same effect can be obtained by increasing the number and selectivity of the r-f tuners.

* * *

D-C Mixer Tubes

WHEN a d-c tube like the 232 is used as a mixer in a superheterodyne, where is the best place to impress the voltage from the oscillator? We have the choice of the grid circuit, the plate circuit, and the screen circuit.—W. H. C., New York, N. Y.

It depends on the coupling between the oscillator coil and the pick-up coil. If the effective coupling is the same in all cases the results are the same. But the same pick-up coil will not give the same coupling in the three cases. If the pick-up coil was designed to go in the cathode lead of a 57 or a 24, the logical place would be to put it in the plate circuit of the 232. It cannot very well be put in the grid circuit. In most cases, perhaps, the pick-up coil is put in the screen circuit of the battery tube.

* * *

Obtaining High D-C Potential

IS there any way in which a high d-c potential can be obtained using a vacuum tube oscillator in the same manner as a high d-c voltage is obtained with a B supply? If there is a way, please explain it?—W. E. W., New York, N. Y.

We have already described several times how a grid voltage can be obtained in this manner. In one case a 55 was used both as oscillator and rectifier. The same thing can be done with higher voltage, preferably using a separate rectifier that will stand the higher voltage. The 25Z5 voltage doubler could be used to advantage. An oscillator-rectifier of this type has been described in which the generated voltage was about 50,000 volts. The only limit is the insulation of the oscillator and the rectifier elements. In building such an oscillator-rectifier for high voltages it is important to make the inductance high and the capacity relatively low, for then the oscillator will oscillate more vigorously.

* * *

Triode as Rectifier

PLEASE SHOW a circuit how a triode like the 237 or the 227 can be used as a rectifier in a converter. No transformer is to be used in the circuit. I presume that this is possible, in view of the fact that universal receivers do not use any transformers.—W. L. A., Wheeling, W. Va.

In the figure herewith is the circuit of a universal set in which a 237 is used as rectifier. It would be used in the same way in a converter. It is no longer necessary to use a triode for this purpose because the 25ç5 has been made for this service. It would be much more economical in view of the fact that it requires 25 volts across the filament and therefoer makes use of a larger proportion of the energy taken from the line to operate the set. Moreover, the 25Z5 has a much greater current capacity, and when it is used, there will be no danger of overloading the rectifier.

Large numbers of money orders were received by mail order houses during the bank holiday. Some of the stores in lower Manhattan did a very excellent business and a new store showed fine activity.

* * *

Obsolescence of Set Analyzers

SINCE the new tubes came out my set analyzer has become obsolete since the circuit does not contain provision for all the new elements and since the sockets will not fit the new tubes. Is there anything that can be done about that without going to the expense of buying a new analyzer?—S. G., New York, N. Y.

As soon as the adapter manufacturers get tools ready there will be adapters that will fit the new tubes to most of the old analyzers. In the meantime it is best to use the meters in the test as individual meters. It is always possible to make tests with suitable voltage and current meters if the leads are available for external connection. Moreover, adapters can be improvised with little trouble. It only takes a plug that will fit a given socket for making the leads in the socket available. Perhaps, also, that the analyzer can be fitted with new sockets without much trouble or expense.

A THOUGHT FOR THE WEEK

WHERE are the crooners of yesteryear? Of course, some of them are with us still (very still, let it be noted), but the annual output is 'way below the totals of other years. Most folks don't regret this, for, after all, crooning came into disfavor with millions of listeners-in, and the strong-voiced artists have come into their own again. We're a pretty virile old public in this land, so all's well that ends well!

RADIO WORLD

The First and Only National Radio Weekly

Eleventh Year

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

OH, SECRETARY PERKINS!

IT was ungracious of Frances Perkins to intimate that she had no use for radio, which she did in a mass interview just before leaving New York City to take office as Secretary of Labor in President Roosevelt's cabinet. She is the first woman to hold a cabinet post in this country. Previously she was Industrial Commissioner of the State of New York, in charge of workmen's compensation administration.

Miss Perkins is a Lucy Stone League follower, being in private life Mrs. Paul Wilson, and the mother of a girl in her 'teens. She has served in political office under Governors Smith and Roosevelt and has won recognition for her administrative ability.

However, even the great and near-great among us may run astray on leading topics, and all of us have our idiosyncrasies. Miss Perkins dislikes noise. "I hate telephones," she said at the mass interview, "automobiles, airplanes and anything that makes noise. That includes the radio. No, I do not possess one."

Not having a receiver, naturally Miss Perkins was unable to listen to proceedings of the Democratic Convention at Chicago that nominated Franklin D. Roosevelt for President, the proceedings therefore that made it possible for her to become Secretary of Labor. Of course the election came between the two events, and it was impossible for her to listen to the radio speeches of her candidate for President, for those speeches, like the whirring of the airplane that carried him to Chicago for acceptance of the nomination, may have been just so much noise, not to us, of course, but to her.

It is not necessary for us to take up the cudgels of the airplane industry, or to point out that the popular acceptance of the automobile and the telephone is at variance with Miss Perkins predilections, but it is well to consider the fact that many thousands of radio workers, in factories, stores and offices, voted for Roosevelt for President, but not with the hope that any member of his cabinet would set an example that might discourage the purchase of radios. At present Secretary Perkins is the most prominent woman in the United States, and what she says may lead others, and a sort of snobbishness about radio might reduce, and certainly wouldn't increase, sales. So perhaps a Secretary of Labor, presumably eager to reduce unemployment, might be more circumspect in making remarks that by no means could possibly increase employment. The telephone, airplane and automobile industries can speak for themselves, but the same incontestable logic applies.

As if to add a touch of delightful humor to the situation, the speeches at a dinner given in honor of Secretary Perkins in New York City, before she had been in office a full six weeks, were broadcast. And of course the guest of honor was heard on the radio. The fact that she spoke into a microphone willingly was a tacit invitation to listeners to tune her in. Now, how in the name of the great Secretary of Labor could any one tune her in who, like herself, did not have a radio set? Maybe Secretary Perkins can offer some statistics showing how it can be done, for reformation of statistics is one of her pet objectives of the hour.

Secretary Perkins really ought to take back her remarks reflecting on radio, as they scarcely befit an official of her standing and competence.

PASSING OF W2XAB

THE discontinuance of television broadcasting by the Columbia Broadcasting System is regrettable, for W2XAB was used by many experimenters as a test station. However, the reason ascribed seems sound enough, that not much progress with the limited technique permitted by installation appeared likely. Better means will be sought, and meanwhile Columbia will keep in close touch with television methods and improvements.

No doubt a better technique is highly advisable. One improvement would be direct pickup, instead of the indirect or flying spot method. The scanning mechanism could be improved, using existing systems. Then, too, much assistance has to come from the receiving end, where more light, and better light, are still problems of considerable concern.

It is expected that when economic conditions improve Columbia will be back on the air with bigger and better television, but meanwhile W2XAB surely will be missed.

SUN SPOTS AHOY!

HERE we are about to enjoy the finest radio reception, comparable to that of ten years ago, so there is solace among our troubles. Every 11.1 years the sun makes a complete rotation about its own axis, and the recurrence of this cycle, presenting to us the phenomenon of sun spots, makes for improved, in fact, almost ideal radio conditions.

The sun spots indicate greater radiation. There are mysteries concerning the dark areas on the sun, but since there is coincidence between these spots and best radio reception, we are eager to accept the benefit without too deep attempts at penetration of the causes.

Improved radio conditions carry a world of economic significance, for when stations from great distances come in extraordinarily well, listener interest in radio increases, more sets and parts are sold, and a whole army of new followers of radio specialties comes into being. Take for example the influx of short-wave enthusiasts, which eventuated within the past few months. Not only constructors who have some radio knowledge and skill, but persons who heretofore were content with broadcast-band listening, unequipped with any technical background, turned to short waves as if by unanimous resolution. And yet there was no concerted action at all, probably nothing more than the spread of the good news that foreign stations were coming in well and regularly.

Floods, holocausts, earthquakes and the like, in contract law, are rated as "acts of God," against which the promissor is excused if prevented by them from fulfilling his promise. May we not also accept a cyclic phenomenon, such as sun spots, and rate some of the favorable experiences as "acts of God," also? Why should only disasters be so associated?

SUPERS SUCCEED

EVIDENTLY a considerable amount of engineering and experimental work in tube factories and other factories and laboratories has resulted in the elevation of the superheterodyne to the point where a constructor with a fair knowledge of radio can obtain excellent results. Only within the last year has the circuit been raised to such position of promise and importance for the experimenter and home constructor. Earlier circuits of the same type had only two variably tuned circuits, each independently controlled, but with gang tuning come difficulties, and now these are practically overcome.

The contribution of the tube factories is important because as new tubes are announced circuit designs for best use of these tubes are recommended, and besides licensed set manufacturers have a common laboratory to turn to, the one operated by their licensor, to help in the solution of any special problems. The information thus released gets around quickly, especially as the resultant circuits receive publicity, hence the radio technician gets an abundance of excellent assistance.

SHORT WAVES CARRY PROTEST

A mass meeting under the auspices of the American Jewish Congress, protesting against treatment accorded to Jews in Germany, was broadcast from New York City through three of the four large local stations, carried by chains, and also sent by short waves, in an unadvertised effort to get the protests of Protestants, Catholics and Jews direct into Germany.

Literature Wanted

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

R. B. Jordan (radio set and accessories), Cross Plains, Texas.
Gale R. Poston, New Richmond, Wisc.
Emil Dananay, 1335 4th Ave., Arnold, Penna.
R. W. Davenport, P. O. Box 1308, Detroit, Mich.
Reed Novelty Co., 320 Center St., Salina, Kans.
Ovide Bertrand, Gallivan, Sask., Canada.
Wallace Kirkman, c/o Schramm-Johnson Drugs, Caldwell, Idaho.
Eddie J. Chernosky, 1411 Ruth Ave., Houston, Texas.
William Stanford, Route 2, Honey Grove, Texas.
Wesley Hending, 4009 N. Hampshire, N. W., Washington, D. C.
Wm. Henry Spohr, 77 Fairmount Ave., Chatham, N. J.
W. C. Harris, 704 Oak St., San Francisco, Calif.
Stephen W. Rebeil, Radioland Electric Co., 620 N. 6th Ave., Tucson, Ariz.
George Willig, 354 Murray St., Rochester, N. Y.
Al. Strasser, 2156 Santa Rita St., Oakland, Calif.
Harold W. Campbell, 105 West 9th St., McCook, Nebr.
Harold Hamilton, 68 Prospect St., Kingston, N. Y.
G. B. Leckonby, Jr., 36 Pine Woods Ave., Troy, N. Y.
Robert Perri, 107 School St., Groveland, Mass.
Wagatha Grocery, Box 106, Mississippi City, Miss.
J. W. Mitchell, 701 McIntyre Blk., Winnipeg, Man., Canada.
G. Coxhill, 30 Daws Lane, Mill Hill.
H. R. Hooper, 15351 Muirland Ave., Detroit, Mich.
Bill Barr, 805 Dodge St., Dubuque, Iowa.
G. A. Buseck, Radio Service, 10½ Sixth Ave., Gloversville, N. Y.
John C. Brubaker, 1038 Helen Ave., Lancaster, Penna.
Albert F. Hunt, 6626 Yale Ave., Chicago, Ill.
V. Manjoney, Ph.G., 666 N. Main St., Bridgeport, Conn.
B. McCain, 785 Market St., Santa Clara, Calif.
Radio Service Engineers, 5500 Canal Blvd., New Orleans, La.
Elmer C. McChesney, P. O. Box 810, So. Bend, Ind.

SHORT-WAVE CLUB

L. J. Furlong, 400 N. E. 11th Ave., Portland, Ore.

KPO'S 50-KW PLANT BELOW LEVEL OF SEA

SAN FRANCISCO.

KPO completed preparations for the use of its new NBC 50,000-watt transmitter, which makes KPO the most powerful radio station in this area. The transmitter stands in the marshes of the San Francisco Bay, near Belmont, San Mateo County. It was in process of construction since last November. The site, according to A. H. Saxton, Pacific Division engineer of NBC, offers maximum transmitting efficiency with a minimum of interference. The twenty-five acre tract of land on which the transmitter stands is actually below high water level, but is protected by dikes, thus presenting an ideal ground for radio transmission purposes since the permanent water level is never more than twenty-four inches below the surfaces of the soil.

Battery Equipment

The white building, visible from the Bay Shore Road, is the transmitter building, a two-story affair of reenforced concrete, standing upon 104 ninety-foot piles. Above it tower two great steel cones, each of them a spider network of metal, three hundred feet high. Between them stretches KPO's vocal cord—the antenna wire, which terminates at the tuning house midway between the towers.

Like a lighthouse of the ether, the transmitter building, is a compact edifice in which every necessity of life, as well as broadcasting, has to be provided for the station crew. C. D. Peck is the station engineer in charge and with the transmitter in operation he became a virtually permanent resident in the bay marshes.

The first floor of the transmitter house contains a two-car garage, all of the motor generator units and all the high voltage power equipment. A battery room containing twelve-volt five hundred-ampere-hour "A" batteries and 400-volt two-ampere-hour "B" batteries, also is situated on this floor as is the pump room from which water is circulated through the outside cooling pond and through pipes surrounding the transmitter on the second floor. At least a hundred gallons of distilled water a month will be used in this process of keeping the transmitter tubes cooled.

Cost $100,000

On the second floor is an acoustically controlled room where programs on the air are monitored, a frequency measuring device to check the station in maintaining its assigned frequency, the vacuum tube storage room, a locker room and living quarters and office for Station Engineer Peck.

The new transmitter itself is the latest standard RCA Victor 50-kilowatt transmitter, built by the General Electric Company. There are thirty-seven tubes utilized in the transmitter, ranging from a giant tube more than four feet high as it stands in its socket which has a 100-kilowatt capacity, using 20,000 volts on the plate.

After-midnight tests of the new transmitter continued until the transmitter went into active service, but listeners who stayed up late to hear KPO "rehearsing" were sometimes disappointed, for following the playing of a single record a repair was necessitated now and again that required the rest of the night.

Permission to construct the 50,000-watt transmitter, the only one on the coast besides KFI, Los Angeles, was granted to KPO in December, 1931, and assigned to the National Broadcasting Company last June. The transmitter, building and other equipment represent an investment of more than $100,000.

Forum

Wants Loftin-White Amplifier

ISN'T it about time that you gave us a diagram of the Loftin-White amplifier using the 57 and the 59 tubes? Quite a few of us are using this kind of output for radio service as it sure is a devil for quality. We would like to see interest enough in this circuit to have the application of the newer tubes to it displayed.

Using the heater type tube for the last tube should enable reduction of hum troubles sometimes present in the older circuits.

Also we should be able to get further gain in amplification than with the earlier setups.

Then, after this has all been done, we would like to see the new types of six-volt tubes applied in this same circuit. It strikes me that there is possibility of tube combinations that would enable the use of lower plate voltages so as to put the thing in the range of the transformerless circuits.

The season is now approaching when radio news items seem to lag and this would make excellent, attractive reading matter with which to keep a running interest up this season.

The very best thing to do would be to get the makers of this circuit to work out the idea if they have not already done so.

Otherwise the work would have to come from your own laboratory. That is something for you to work out.

Contrary to general usage and thought on this subject, I have been able to work this amplifier as a detector and amplifier with good results and I feel confident that still better results can be attained by the use of the heater type tubes.

Anything that you can give us in the RADIO WORLD will be appreciated by myself and many others who are interested in the Loftin-White circuit. Portable public address apparatus is in this field also and that makes portable radio a possibility.

With our very best regards.

E. F. KRIEGSMAN.

212 Pawtuxet Avenue,
Edgewood, Rhode Island.

RCA Victor Combining with Radiotron Company

J. R. McDonough, assistant to the President, was elected executive vice-president of the Radio Corporation of America.

As a step toward the consolidation of two of the corporation's wholly-owned subsidiary companies, the RCA Victor Company, Inc., and the RCA Radiotron Company, Inc., Elmer T. Cunningham, now president of the RCA Radiotron Company, Inc., was also elected president of the RCA Victor Company, Inc., succeeding Mr. McDonough in that position.

The RCA Victor and RCA Radiotron Companies are engaged in radio research, engineering, manufacturing and sales activities, RCA Victor in the field of radio broadcast receiving instruments, phonographs and other radio equipment, and the RCA Radiotron in the radio tube field.

WHITTEN WITH WINS

Philip F. Whitten, for the past two and a half years account executive with Columbia Broadcasting System, has been engaged as general sales manager for WINS, at 114 East 58th Street, New York City. Mr. Whitten has had wide experience in advertising and merchandising.

'QUAKE MOVIES ARE BROADCAST BY TELEVISION

LOS ANGELES.

For the first time in history motion picture scenes of a major disaster were transmitted to the nation by television, when W6XS, Don Lee television station at Los Angeles, broadcast scenes of the Long Beach-Compton earthquake area within a few hours after the tremor.

Under the direction of Harry R. Lubcke, director of television for the system, the film, obtained through Pathe News, was transmitted not only by the 1,000-watt W6XS, but by the ultra-short-wave sister-station, W6XAO, both stations operating simultaneously.

Scenes of debris, survivors, wrecked buildings and the general havoc wrought were included in this unusual television broadcast, the event presaging a new era in the speedy distribution of such scenes in the future when perhaps thousands of homes throughout the nation may not only hear of disasters, but witness pictures soon after the catastrophe has occurred.

Both W6XS, and W6XAO are located in the Don Lee Building at Seventh and Bixel Streets, Los Angeles, and the televised scenes were reported received in several homes and stores throughout the country.

"It is the transmission of scenes such as those of the earthquake damage, and the availability of this type of broadcasting, that will undoubtedly lend impetus to the desire of radio fans to own television receivers," said to Lubcke.

Color Guides Control of Receiver's Tone

As an entirely new contribution to the field of radio receivers, General Electric has announced "color radio," in which the relation between color and musical tone has been embodied.

The new "color radio" combines color visual indication with color control of noise, tone, and volume. A new type of double-action tone control is used making it possible, for the first time in radio, to control the low and high notes independently of each other. There are two knobs with a rainbow-colored path of light between them.

This rainbow arch, on the left, representing the bass register with a dark blue color, merges gradually through red to a golden yellow color on the right, signalizing the treble. As the left knob is turned and the bass notes diminish, the amount of blue light visible in the color path is proportionally reduced. Similarly, as the right knob is turned and the treble notes are affected, the amount of yellow light in the path is lessened.

Prices Reduced on Six Types of Tubes

RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., have announced list price reductions on six types of radio tubes, as follows:

	Old	*New*	*Reduction*	
Type	*Price*	*Price*	*Amount*	*%*
01A	$ .80	$ .70	.10	12.5
26	.85	.75	.10	11.8
27	1.05	.80	.25	23.8
45	1.15	.85	.30	26.1
71A	.95	.85	.10	10.5
80	.90	.80	.10	11.1

kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc	kc or m	m or kc
10	29, 982	1, 010	296. 9	2, 010	149. 2	3, 010	99. 61	4, 010	74. 77	5, 010	59. 84	6, 010	49. 89	7, 010	42. 77	8, 010	37. 43	9, 010	33. 28
20	14, 991	1, 020	293. 9	2, 020	148. 4	3, 020	99. 28	4, 020	74. 58	5, 020	59. 73	6, 020	49. 80	7, 020	42. 71	8, 020	37. 38	9, 020	33. 24
30	9, 994	1, 030	291. 1	2, 030	147. 7	3, 030	98. 95	4, 030	74. 40	5, 030	59. 61	6, 030	49. 72	7, 030	42. 65	8, 030	37. 34	9, 030	33. 20
40	7, 496	1, 040	288. 3	2, 040	147. 0	3, 040	98. 62	4, 040	74. 21	5, 040	59. 49	6, 040	49. 64	7, 040	42. 59	8, 040	37. 29	9, 040	33. 17
50	5, 996	1, 050	285. 5	2, 050	146. 3	3, 050	98. 30	4, 050	74. 03	5, 050	59. 37	6, 050	49. 56	7, 050	42. 53	8, 050	37. 24	9, 050	33. 13
60	4, 997	1, 060	282. 8	2, 060	145. 5	3, 060	97. 98	4, 060	73. 85	5, 060	59. 25	6, 060	49. 48	7, 060	42. 47	8, 060	37. 20	9, 060	33. 09
70	4, 283	1, 070	280. 2	2, 070	144. 8	3, 070	97. 66	4, 070	73. 67	5, 070	59. 13	6, 070	49. 39	7, 070	42. 41	8, 070	37. 15	9, 070	33. 06
80	3, 748	1, 080	277. 6	2, 080	144. 1	3, 080	97. 34	4, 080	73. 49	5, 080	59. 02	6, 080	49. 31	7, 080	42. 35	8, 080	37. 11	9, 080	33. 02
90	3, 331	1, 090	275. 1	2, 090	143. 5	3, 090	97. 03	4, 090	73. 31	5, 090	58. 90	6, 090	49. 23	7, 090	42. 29	8, 090	37. 06	9, 090	32. 98
100	2, 998	1, 100	272. 6	2, 100	142. 8	3, 100	96. 72	4, 100	73. 13	5, 100	58. 79	6, 100	49. 15	7, 100	42. 23	8, 100	37. 01	9, 100	32. 95
110	2, 726	1, 110	270. 1	2, 110	142. 1	3, 110	96. 41	4, 110	72. 95	5, 110	58. 67	6, 110	49. 07	7, 110	42. 17	8, 110	36. 97	9, 110	32. 91
120	2, 499	1, 120	267. 7	2, 120	141. 4	3, 120	96. 10	4, 120	72. 77	5, 120	58. 56	6, 120	48. 99	7, 120	42. 11	8, 120	36. 92	9, 120	32. 88
130	2, 306	1, 130	265. 3	2, 130	140. 8	3, 130	95. 79	4, 130	72. 60	5, 130	58. 44	6, 130	48. 91	7, 130	42. 05	8, 130	36. 88	9, 130	32. 84
140	2, 142	1, 140	263. 0	2, 140	140. 1	3, 140	95. 48	4, 140	72. 42	5, 140	58. 33	6, 140	48. 83	7, 140	41. 99	8, 140	36. 83	9, 140	32. 80
150	1, 999	1, 150	260. 7	2, 150	139. 5	3, 150	95. 18	4, 150	72. 25	5, 150	58. 22	6, 150	48. 75	7, 150	41. 93	8, 150	36. 79	9, 150	32. 77
160	1, 874	1, 160	258. 5	2, 160	138. 8	3, 160	94. 88	4, 160	72. 07	5, 160	58. 10	6, 160	48. 67	7, 160	41. 87	8, 160	36. 74	9, 160	32. 73
170	1, 764	1, 170	256. 3	2, 170	138. 1	3, 170	94. 58	4, 170	71. 90	5, 170	57. 99	6, 170	48. 59	7, 170	41. 82	8, 170	36. 70	9, 170	32. 70
180	1, 666	1, 180	254. 1	2, 180	137. 5	3, 180	94. 28	4, 180	71. 73	5, 180	57. 88	6, 180	48. 51	7, 180	41. 76	8, 180	36. 65	9, 180	32. 66
190	1, 578	1, 190	252. 0	2, 190	136. 9	3, 190	93. 99	4, 190	71. 56	5, 190	57. 77	6, 190	48. 44	7, 190	41. 70	8, 190	36. 61	9, 190	32. 62
200	1, 499	1, 200	249. 9	2, 200	136. 3	3, 200	93. 69	4, 200	71. 39	5, 200	57. 66	6, 200	48. 36	7, 200	41. 64	8, 200	36. 56	9, 200	32. 59
210	1, 428	1, 210	247. 8	2, 210	135. 7	3, 210	93. 40	4, 210	71. 22	5, 210	57. 55	6, 210	48. 28	7, 210	41. 58	8, 210	36. 52	9, 210	32. 55
220	1, 363	1, 220	245. 8	2, 220	135. 1	3, 220	93. 11	4, 220	71. 05	5, 220	57. 44	6, 220	48. 20	7, 220	41. 53	8, 220	36. 47	9, 220	32. 52
230	1, 304	1, 230	243. 8	2, 230	134. 4	3, 230	92. 82	4, 230	70. 88	5, 230	57. 33	6, 230	48. 13	7, 230	41. 47	8, 230	36. 43	9, 230	32. 48
240	1, 249	1, 240	241. 8	2, 240	133. 8	3, 240	92. 54	4, 240	70. 71	5, 240	57. 22	6, 240	48. 05	7, 240	41. 41	8, 240	36. 39	9, 240	32. 45
250	1, 199	1, 250	239. 9	2, 250	133. 3	3, 250	92. 25	4, 250	70. 55	5, 250	57. 11	6, 250	47. 97	7, 250	41. 35	8, 250	36. 34	9, 250	32. 41
260	1, 153	1, 260	238. 0	2, 260	132. 7	3, 260	91. 97	4, 260	70. 38	5, 260	57. 00	6, 260	47. 89	7, 260	41. 30	8, 260	36. 30	9, 260	32. 38
270	1, 110	1, 270	236. 1	2, 270	132. 1	3, 270	91. 69	4, 270	70. 22	5, 270	56. 89	6, 270	47. 82	7, 270	41. 24	8, 270	36. 25	9, 270	32. 34
280	1, 071	1, 280	234. 2	2, 280	131. 5	3, 280	91. 41	4, 280	70. 05	5, 280	56. 78	6, 280	47. 74	7, 280	41. 18	8, 280	36. 21	9, 280	32. 31
290	1, 034	1, 290	232. 4	2, 290	130. 9	3, 290	91. 13	4, 290	69. 89	5, 290	56. 68	6, 290	47. 67	7, 290	41. 13	8, 290	36. 17	9, 290	32. 27
300	999. 4	1, 300	230. 6	2, 300	130. 4	3, 300	90. 86	4, 300	69. 73	5, 300	56. 57	6, 300	47. 59	7, 300	41. 07	8, 300	36. 12	9, 300	32. 24
310	967. 2	1, 310	228. 9	2, 310	129. 8	3, 310	90. 58	4, 310	69. 56	5, 310	56. 46	6, 310	47. 52	7, 310	41. 02	8, 310	36. 08	9, 310	32. 20
320	936. 9	1, 320	227. 1	2, 320	129. 2	3, 320	90. 31	4, 320	69. 40	5, 320	56. 36	6, 320	47. 44	7, 320	40. 96	8, 320	36. 04	9, 320	32. 17
330	908. 6	1, 330	225. 4	2, 330	128. 7	3, 330	90. 04	4, 330	69. 24	5, 330	56. 25	6, 330	47. 36	7, 330	40. 90	8, 330	35. 99	9, 330	32. 14
340	881. 8	1, 340	223. 7	2, 340	128. 1	3, 340	89. 77	4, 340	69. 08	5, 340	56. 15	6, 340	47. 29	7, 340	40. 85	8, 340	35. 95	9, 340	32. 10
350	856. 6	1, 350	222. 1	2, 350	127. 6	3, 350	89. 50	4, 350	68. 92	5, 350	56. 04	6, 350	47. 22	7, 350	40. 79	8, 350	35. 91	9, 350	32. 07
360	832. 8	1, 360	220. 4	2, 360	127. 0	3, 360	89. 23	4, 360	68. 77	5, 360	55. 94	6, 360	47. 14	7, 360	40. 74	8, 360	35. 86	9, 360	32. 03
370	810. 3	1, 370	218. 8	2, 370	126. 5	3, 370	88. 97	4, 370	68. 61	5, 370	55. 83	6, 370	47. 07	7, 370	40. 68	8, 370	35. 82	9, 370	32. 09
380	789. 0	1, 380	217. 3	2, 380	126. 0	3, 380	88. 70	4, 380	68. 45	5, 380	55. 73	6, 380	46. 99	7, 380	40. 63	8, 380	35. 78	9, 380	31. 96
390	768. 8	1, 390	215. 7	2, 390	125. 4	3, 390	88. 44	4, 390	68. 30	5, 390	55. 63	6, 390	46. 92	7, 390	40. 57	8, 390	35. 74	9, 390	31. 93
400	749. 6	1, 400	214. 2	2, 400	124. 9	3, 400	88. 18	4, 400	68. 14	5, 400	55. 52	6, 400	46. 85	7, 400	40. 52	8, 400	35. 69	9, 400	31. 90
410	731. 3	1, 410	212. 6	2, 410	124. 4	3, 410	87. 92	4, 410	67. 99	5, 410	55. 42	6, 410	46. 77	7, 410	40. 46	8, 410	35. 65	9, 410	31. 86
420	713. 9	1, 420	211. 1	2, 420	123. 9	3, 420	87. 67	4, 420	67. 83	5, 420	55. 32	6, 420	46. 70	7, 420	40. 41	8, 420	35. 61	9, 420	31. 83
430	697. 3	1, 430	209. 7	2, 430	123. 4	3, 430	87. 41	4, 430	67. 68	5, 430	55. 22	6, 430	46. 63	7, 430	40. 35	8, 430	35. 57	9, 430	31. 79
440	681. 4	1, 440	208. 2	2, 440	122. 9	3, 440	87. 16	4, 440	67. 53	5, 440	55. 11	6, 440	46. 56	7, 440	40. 30	8, 440	35. 52	9, 440	31. 76
450	666. 3	1, 450	206. 8	2, 450	122. 4	3, 450	86. 90	4, 450	67. 38	5, 450	55. 01	6, 450	46. 48	7, 450	40. 24	8, 450	35. 48	9, 450	31. 73
460	651. 8	1, 460	205. 4	2, 460	121. 9	3, 460	86. 65	4, 460	67. 22	5, 460	54. 91	6, 460	46. 41	7, 460	40. 19	8, 460	35. 44	9, 460	31. 69
470	637. 9	1, 470	204. 0	2, 470	121. 4	3, 470	86. 40	4, 470	67. 07	5, 470	54. 81	6, 470	46. 34	7, 470	40. 14	8, 470	35. 40	9, 470	31. 66
480	624. 6	1, 480	202. 6	2, 480	120. 9	3, 480	86. 16	4, 480	66. 92	5, 480	54. 71	6, 480	46. 27	7, 480	40. 08	8, 480	35. 36	9, 480	31. 63
490	611. 9	1, 490	201. 2	2, 490	120. 4	3, 490	85. 91	4, 490	66. 78	5, 490	54. 61	6, 490	46. 20	7, 490	40. 03	8, 490	35. 31	9, 490	31. 59
500	599. 6	1, 500	199. 9	2, 500	119. 9	3, 500	85. 66	4, 500	66. 63	5, 500	54. 51	6, 500	46. 13	7, 500	39. 98	8, 500	35. 27	9, 500	31. 56
510	587. 9	1, 510	198. 6	2, 510	119. 5	3, 510	85. 42	4, 510	66. 48	5, 510	54. 41	6, 510	46. 06	7, 510	39. 92	8, 510	35. 23	9, 510	31. 53
520	576. 6	1, 520	197. 2	2, 520	119. 0	3, 520	85. 18	4, 520	66. 33	5, 520	54. 32	6, 520	45. 98	7, 520	39. 87	8, 520	35. 19	9, 520	31. 49
530	565. 7	1, 530	196. 0	2, 530	118. 5	3, 530	84. 94	4, 530	66. 19	5, 530	54. 22	6, 530	45. 91	7, 530	39. 82	8, 530	35. 15	9, 530	31. 46
540	555. 2	1, 540	194. 7	2, 540	118. 0	3, 540	84. 70	4, 540	66. 04	5, 540	54. 12	6, 540	45. 84	7, 540	39. 76	8, 540	35. 11	9, 540	31. 43
550	545. 1	1, 550	193. 4	2, 550	117. 6	3, 550	84. 46	4, 550	65. 89	5, 550	54. 02	6, 550	45. 77	7, 550	39. 71	8, 550	35. 07	9, 550	31. 39
560	535. 4	1, 560	192. 2	2, 560	117. 1	3, 560	84. 22	4, 560	65. 75	5, 560	53. 92	6, 560	45. 70	7, 560	39. 66	8, 560	35. 03	9, 560	31. 36
570	526. 0	1, 570	191. 0	2, 570	116. 7	3, 570	83. 98	4, 570	65. 61	5, 570	53. 83	6, 570	45. 63	7, 570	39. 61	8, 570	34. 98	9, 570	31. 33
580	516. 9	1, 580	189. 8	2, 580	116. 2	3, 580	83. 75	4, 580	65. 46	5, 580	53. 73	6, 580	45. 57	7, 580	39. 55	8, 580	34. 94	9, 580	31. 30
590	508. 2	1, 590	188. 6	2, 590	115. 8	3, 590	83. 52	4, 590	65. 32	5, 590	53. 64	6, 590	45. 50	7, 590	39. 50	8, 590	34. 90	9, 590	31. 26
600	499. 7	1, 600	187. 4	2, 600	115. 3	3, 600	83. 28	4, 600	65. 18	5, 600	53. 54	6, 600	45. 43	7, 600	39. 45	8, 600	34. 86	9, 600	31. 23
610	491. 5	1, 610	186. 2	2, 610	114. 9	3, 610	83. 05	4, 610	65. 04	5, 610	53. 44	6, 610	45. 36	7, 610	39. 40	8, 610	34. 82	9, 610	31. 20
620	483. 6	1, 620	185. 1	2, 620	114. 4	3, 620	82. 82	4, 620	64. 90	5, 620	53. 35	6, 620	45. 29	7, 620	39. 35	8, 620	34. 78	9, 620	31. 17
630	475. 9	1, 630	183. 9	2, 630	114. 0	3, 630	82. 60	4, 630	64. 76	5, 630	53. 25	6, 630	45. 22	7, 630	39. 29	8, 630	34. 74	9, 630	31. 13
640	468. 5	1, 640	182. 8	2, 640	113. 6	3, 640	82. 37	4, 640	64. 62	5, 640	53. 16	6, 640	45. 15	7, 640	39. 24	8, 640	34. 70	9, 640	31. 10
650	461. 3	1, 650	181. 7	2, 650	113. 1	3, 650	82. 14	4, 650	64. 48	5, 650	53. 07	6, 650	45. 09	7, 650	39. 19	8, 650	34. 66	9, 650	31. 07
660	454. 3	1, 660	180. 6	2, 660	112. 7	3, 660	81. 92	4, 660	64. 34	5, 660	52. 97	6, 660	45. 02	7, 660	39. 14	8, 660	34. 62	9, 660	31. 04
670	447. 5	1, 670	179. 5	2, 670	112. 3	3, 670	81. 70	4, 670	64. 20	5, 670	52. 88	6, 670	44. 95	7, 670	39. 09	8, 670	34. 58	9, 670	31. 01
680	440. 9	1, 680	178. 5	2, 680	111. 9	3, 680	81. 47	4, 680	64. 06	5, 680	52. 79	6, 680	44. 88	7, 680	39. 04	8, 680	34. 54	9, 680	30. 97
690	434. 5	1, 690	177. 4	2, 690	111. 5	3, 690	81. 25	4, 690	63. 93	5, 690	52. 69	6, 690	44. 82	7, 690	38. 99	8, 690	34. 50	9, 690	30. 94
700	428. 3	1, 700	176. 4	2, 700	111. 0	3, 700	81. 03	4, 700	63. 79	5, 700	52. 60	6, 700	44. 75	7, 700	38. 94	8, 700	34. 46	9, 700	30. 91
710	422. 3	1, 710	175. 3	2, 710	110. 6	3, 710	80. 81	4, 710	63. 66	5, 710	52. 51	6, 710	44. 68	7, 710	38. 89	8, 710	34. 42	9, 710	30. 88
720	416. 4	1, 720	174. 3	2, 720	110. 2	3, 720	80. 60	4, 720	63. 52	5, 720	52. 42	6, 720	44. 62	7, 720	38. 84	8, 720	34. 38	9, 720	30. 85
730	410. 7	1, 730	173. 3	2, 730	109. 8	3, 730	80. 38	4, 730	63. 39	5, 730	52. 32	6, 730	44. 55	7, 730	38. 79	8, 730	34. 34	9, 730	30. 81
740	405. 2	1, 740	172. 3	2, 740	109. 4	3, 740	80. 17	4, 740	63. 25	5, 740	52. 23	6, 740	44. 48	7, 740	38. 74	8, 740	34. 30	9, 740	30. 78
750	399. 8	1, 750	171. 3	2, 750	109. 0	3, 750	79. 95	4, 750	63. 12	5, 750	52. 14	6, 750	44. 42	7, 750	38. 69	8, 750	34. 27	9, 750	30. 75
760	394. 5	1, 760	170. 4	2, 760	108. 6	3, 760	79. 74	4, 760	62. 99	5, 760	52. 05	6, 760	44. 35	7, 760	38. 64	8, 760	34. 23	9, 760	30. 72
770	389. 4	1, 770	169. 4	2, 770	108. 2	3, 770	79. 53	4, 770	62. 86	5, 770	51. 96	6, 770	44. 29	7, 770	38. 59	8, 770	34. 19	9, 770	30. 69
780	384. 4	1, 780	168. 4	2, 780	107. 8	3, 780	79. 32	4, 780	62. 72	5, 780	51. 87	6, 780	44. 22	7, 780	38. 54	8, 780	34. 15	9, 780	30. 66
790	379. 5	1, 790	167. 5	2, 790	107. 5	3, 790	79. 11	4, 790	62. 59	5, 790	51. 78	6, 790	44. 16	7, 790	38. 49	8, 790	34. 11	9, 790	30. 63
800	374. 8	1, 800	166. 6	2, 800	107. 1	3, 800	78. 90	4, 800	62. 46	5, 800	51. 69	6, 800	44. 09	7, 800	38. 44	8, 800	34. 07	9, 800	30. 59
810	370. 2	1, 810	165. 6	2, 810	106. 7	3, 810	78. 69	4, 810	62. 33	5, 810	51. 60	6, 810	44. 03	7, 810	38. 39	8, 810	34. 03	9, 810	30. 56
820	365. 6	1, 820	164. 7	2, 820	106. 3	3, 820	78. 49	4, 820	62. 20	5, 820	51. 52	6, 820	43. 96	7, 820	38. 34	8, 820	33. 99	9, 820	30. 53
830	361. 2	1, 830	163. 8	2, 830	105. 9	3, 830	78. 28	4, 830	62. 07	5, 830	51. 43	6, 830	43. 90	7, 830	38. 29	8, 830	33. 95	9, 830	30. 50
840	356. 9	1, 840	162. 9	2, 840	105. 6	3, 840	78. 08	4, 840	61. 95	5, 840	51. 34	6, 840	43. 83	7, 840	38. 24	8, 840	33. 92	9, 840	30. 47
850	352. 7	1, 850	162. 1	2, 850	105. 2	3, 850	77. 88	4, 850	61. 82	5, 850	51. 25	6, 850	43. 77	7, 850	38. 19	8, 850	33. 88	9, 850	30. 44
860	348. 6	1, 860	161. 2	2, 860	104. 8	3, 860	77. 67	4, 860	61. 69	5, 860	51. 16	6, 860	43. 71	7, 860	38. 14	8, 860	33. 84	9, 860	30. 41
870	344. 6	1, 870	160. 3	2, 870	104. 5	3, 870	77. 47	4, 870	61. 56	5, 870	51. 08	6, 870	43. 64	7, 870	38. 10	8, 870	33. 80	9, 870	30. 38
880	340. 7	1, 880	159. 5	2, 880	104. 1	3, 880	77. 27	4, 880	61. 44	5, 880	50. 99	6, 880	43. 58	7, 880	38. 05	8, 880	33. 76	9, 880	30. 35
890	336. 9	1, 890	158. 6	2, 890	103. 7	3, 890	77. 07	4, 890	61. 31	5, 890	50. 90	6, 890	43. 52	7, 890	38. 00	8, 890	33. 73	9, 890	30. 32
900	333. 1	1, 900	157. 8	2, 900	103. 4	3, 900	76. 88	4, 900	61. 19	5, 900	50. 82	6, 900	43. 45	7, 900	37. 95	8, 900	33. 69	9, 900	30. 28
910	329. 5	1, 910	157. 0	2, 910	103. 0	3, 910	76. 68	4, 910	61. 06	5, 910	50. 73	6, 910	43. 39	7, 910	37. 90	8, 910	33. 65	9, 910	30. 25
920	325. 9	1, 920	156. 2	2, 920	102. 7	3, 920	76. 48	4, 920	60. 94	5, 920	50. 65	6, 920	43. 33	7, 920	37. 86	8, 920	33. 61	9, 920	30. 22
930	322. 4	1, 930	155. 3	2, 930	102. 3	3, 930	76. 29	4, 930	60. 82	5, 930	50. 56	6, 930	43. 26	7, 930	37. 81	8, 930	33. 57	9, 930	30. 19
940	319. 0	1, 940	154. 5	2, 940	102. 0	3, 940	76. 10	4, 940	60. 69	5, 940	50. 47	6, 940	43. 20	7, 940	37. 76	8, 940	33. 54	9, 940	30. 16
950	315. 6	1, 950	153. 8	2, 950	101. 6	3, 950	75. 90	4, 950	60. 57	5, 950	50. 39	6, 950	43. 14	7, 950	37. 71	8, 950	33. 50	9, 950	30. 13
960	312. 3	1, 960	153. 0	2, 960	101. 3	3, 960	75. 71	4, 960	60. 45	5, 960	50. 31	6, 960	43. 08	7, 960	37. 67	8, 960	33. 46	9, 960	30. 10
970	309. 1	1, 970	152. 2	2, 970	100. 9	3, 970	75. 52	4, 970	60. 33	5, 970	50. 22	6, 970	43. 02	7, 970	37. 62	8, 970	33. 42	9, 970	30. 07
980	303. 9	1, 980	151. 4	2, 980	100. 6	3, 980	75. 33	4, 980	60. 20	5, 980	50. 14	6, 980	42. 95	7, 980	37. 57	8, 980	33. 39	9, 980	30. 04
990	302. 8	1, 990	150. 7	2, 990	100. 3	3, 990	75. 14	4, 990	60. 08	5, 990	50. 05	6, 990	42. 89	7, 990	37. 52	8, 990	33. 35	9, 990	30. 01
1, 000	299. 8	2, 000	149. 9	3, 000	99. 94	4, 000	74. 96	5, 000	59. 96	6, 000	49. 97	7, 000	42. 83	8, 000	37. 48	9, 000	33. 31	10, 000	29. 98

The conversion table printed herewith is highly accurate, because worked out by the factor 299,820. Most tables are based on the factor 300,000, which is erroneous to 6 parts in 100,000.

The table is entirely reversible, for instance, 10 meters equal 29,982 kc., or 29,982 meters equal 10 kc. Any quantities not included in the table may be read by shifting the decimal point. If moved to the right for frequency the point is moved to the left for wavelength, and vice versa. The shift is therefore in opposite directions.

The factor 299,820 is based on the velocity of a radio wave, which is equal to the velocity of light, or 299,820,000 meters per second. By dropping the three ciphers (dividing by 1,000), the factor 299,820 is used, and the answer reads in kilocycles.

Wavelength in meters is equal to velocity divided by frequency. Frequency in cycles is equal to the velocity divided by the wavelength.

[*Prepared by Bureau of Standards, Department of Commerce. Reprinted by permission of Government Printing Office.*]

STATION SPARKS

By Alice Remsen

The Two Birds

FOR THE WOODBURY PROGRAM

WEDNESDAYS, 9:30 P. M., WJZ

The forest dreams! A drowsy elf
Stretches its tiny little self.
The midday sun, high in the sky,
Watches two songbirds as they fly
From tree to tree, their feathered coats
Rival the beauty of their throats,
From whence each trills his thrilling theme,
As lovely as a poet's dream.

In friendly rivalry they vie,
And sing as if they fain would die—
Each tiny breast with rapture swells.
Cascading o'er the hills and dells,
A silver shower of music falls
And trembles through the leafy halls.
They sing themselves to silence, then—
The sleepy forest dreams again.
—A. R.

* * *

And if you tune in on the Woodbury program you will be reminded of two birds, as you listen to the lovely voices of Morton Downey and Donald Novis. They each have their distinctive style, Downey leaning toward the popular, and Novis the semi-classical. It is only natural that there should be a semblance of good-natured rivalry when two singers of a somewhat similar nature are together on the same program. Listen in to this rather unique program. You'll like it!

* * *

The Radio Rialto

When the Waters Surge

Well, I am in the midst of something which I never thought I should ever see—a flood; the old Ohio River has been cutting up and has risen even higher than during the flood of 1913. Yesterday Charles and Alice Terry drove me up the river and I saw unforgettable sights—poor people forced out of their homes—houses covered entirely with water—people paddling along in boats down what was once a highway, and the inexorable water gradually rising higher and higher. It is dreadful to watch, for there is nothing to be done about it; the people of Cincinnati must be fatalistic, for they take things so calmly; no weeping and wailing or disorders of any kind; the militia and marines, aided by the police and fire departments, are cooperating well together, helping to move people from the danger zone. Business is going on as usual; radio is still carrying on from the different stations; the chief sign of something unusual is the fact that every once in a while a program will be interrupted by an appeal for a motor-boat, for clothing, and what not, or by a river report when it is predicted that the river will continue to rise for another five days and then gradually subside. . . .

Honor for Little Jack Little

This has been a most eventful year so far; the one thing that is necessary now is for prosperity to come back with a great big bang; and I think it will; the passing of the beer bill has created renewed optimism among radio folks, for radio will receive some benefit, as the breweries are sure to advertise—and when these people spend, well, they really spend. So, in spite of all the disasters, there is plenty of hope for the future. . . .

I went to see the Flower Show the other day; what a gorgeous sight! By the way, learned there that John Leonard won first prize in the home garden class; perhaps he doesn't know it, as this is being written, as he is in New York; you probably don't know that John Leonard is really Little Jack Little; his friend, Mr. McBreen, told me of it; said the gardens were judged last summer; I'm sure Little Jack will be happy to learn of his good luck. . . . There's a very big client interested in the WLW program, "Notes in the Business." This program has done much to restore confidence to the public mind with its optimistic notes on the business world. J. Ralph Corbett is to be congratulated upon his fine judgment in the selection of data used in the program, and his crisp, concise way of delivering his own messages over the radio. . . .

A New N. B. C. Program

The National Broadcasting Company inaugurated a series of programs called The Richfield Country Club, sponsored by the Richfield Oil Corporation of New York. This program combines golf instructions by Alex Morrison, with music, songs and comedy by a cast of stage and radio stars, including Ernest Glendinning, who acts as Master of Ceremonies; Betty Barthell, charming Southern blues singer, and the Richfield Quartet, composed of James Stanley, Paul Parks, Walter Scanlon and Carl Mathieu. Jack Golden's Orchestra will officiate as the musical background. You may hear this fine program, each Friday at 10:30 p. m., EST, over an NBC-WEAF network. . . . And so Lily Pons has sung a torch song; it has always been her ambition to do this; George Gershwin made a special arrangement of his famous song, "The Man I Love," to suit the voice of Miss Pons and she sang it, and liked it, too. . . . Frances Lee Barton's cooking lessons have made a hit with no less than seventy-five thousand housewives; at least, that is the total, to date, of women who have enrolled in her cooking school. Mrs. Barton has the faculty of sounding sincere when she gives out a recipe; you'd almost swear she is really cooking the cake or whatever dish she happens to be describing; she goes on the air each Tuesday and Thursday morning at 11:15. . . .

Where Lord Got His Inspiration

It is interesting to know that Phillips H. Lord's grandfather and James A. Herne, the famous actor-playwright of another generation, were great friends. It was after several visits to the elder Lord's farm in Maine that Herne wrote "Shore Acres," the great rural classic. Phillips was raised by his grandfather and absorbed material for his Down East sketches and characters heard on NBC when a boy in that locale. . . . Vincent Lopez has an absorbing ambition—he wants to have his own theatre on Broadway. Well, Vincent, you should be able to pick one up at your own price nowadays; better hurry up, though, for times are getting better and show business should soon be booming again. . . . From Pittsburgh comes the word that Smith Ballew and his boys, who have been such a success at the William Penn Hotel there, where they have been playing for the past five weeks, are remaining indefinitely; this is rather unusual for Pittsburgh, for they are in the habit of changing bands quite frequently; Smith Ballew always was one of my favorites, so I think Pittsburgh is showing good judgment. . . .

Has Anybody Told You?

Do you know that Julia Sanderson dreads crowds? Howard Claney, handshakers? Leonard Joy, studio pranksters? George Hicks, that final moment before taking the air? Ford Bond, to miss a meal? Paul Whiteman, loaded elevators? Amos 'n' Andy, studio audiences? Ed Wynn, autograph hunters? Frank Black, red tape? Frank Munn, bridge? Jack Pearl, a dressing room whistler? Nellie Revell, studio loafers? Ben Bernie, Walter Winchell? Walter Winchell, Ben Bernie? Irene Taylor, to answer letters? I could go on forever, but why? . . .

Singin' Sam Has a New One

Not much news from the Columbia Broadcasting Company, except that Singin' Sam and his accompanist, Emil Seidel, have written another song which is now being published; it's called "Don't Overlook the Little House That Overlooks the Bay"; it was done on a recent Barbasol program. . . . Edwin C. Hill's new book, "The American Scene," was released Inauguration Day; I saw a copy on Margaret Maloney's desk last week, glanced through it—and it looks extremely interesting. . . . Gretta Keller and Francis Lederer are good friends; they will soon take part in a special program broadcast for foreign listeners. . . . Did you know that Les Reis, of Reis and Dunn, made his living for eight years selling underwear? . . . Bing Crosby has three letters from England to prove that his broadcasts are being heard there from WCAU in Philadelphia, the newest link in the Columbia Broadcasting System. . . . Glen Gray and his Casa Loma Orchestra have a fat contract for the entire summer at Glen Island Casino on Long Island Sound; they will air their shimmering music several times weekly over the entire CBS network. . . . Irving Mills has left for Chicago; he'll probably spot Duke Ellington or Cab Calloway for the World's Fair.

* * *

Biographical Brevities

ABOUT HENRY THEIS

This well-known maestro, Henry Theis, famous for his original treatment of dance tunes, was born in Chicago of a musical family. His father was a crack clarinet player and saw to it that his son received a musical education. At the age of five years, Henry Theis could already tuck a violin under his chin and coax music out of it. There were not many preliminaries for Henry before he became a leader, for at the age of sixteen we find the youthful genius at the College Inn, Hotel Sherman, Chicago, conducting his own orchestra; just broke right into the business and has kept going ever since.

For some time Henry had his own place, the Ritz Cafe and Restaurant, in Detroit. Then he heard the call of radio. While playing at the Hotel Sinton in Cincinnati about four years ago, he obtained two commercial accounts, the Druro Pump and the Studebaker programs. This made WLW sit up and take notice and they invited Henry to move into their studios; he did so, staying there two and a half years.

During this time he had the following commercial programs: Dayton Thorobreds, Tangee, Willy's Memory Hour, Kool Motor, Studebaker Champions, Crosley Saturday Knights and others. Henry Theis established himself from coast to coast with his famed Sunday night program, an entire hour of delightful music; this was during the craze for symphonic arrangements of popular tunes; and did Henry have them? Well, yes, to the tune of about twenty-five thousand dollars worth. The majority of these arrangements are still in the library at WLW, as the station purchased them when Henry departed from thence; every once in a while somebody listening in will say: "That's a Henry Theis arrangement"; that's how distinctive they were.

(*Continued on next page*)

TRADIOGRAMS

By J. Murray Barron

"The purchasers of kit and radio parts appreciate clear, definite and simple statements in advertising copy, something understandable. An illustration further aids to convey the idea of the merchandise offered. This with a logical layout should always be foremost in the mind of the advertising man."

This is quoted from Sydney Bass, the advertising specialist of the Try-Mo Radio Corporation. Mr. Bass brings to radio many new and clever ideas in layouts, copy and illustration and is doing much to elevate the radio mail order idea to the plane now ejoyed by other fields.

* * *

To the many who thought that the a-c and d-c Universal Radio Receivers was just another fad it must be indeed a great surprise to find daily that the demand is becoming stronger. Improvements are necessarily making their appearance. As the spring with its fine weather comes upon us we find the outdoor life ever competing to keep the family or individual at home to listen to radio. The natural result is to sell a set one can take along. Radio sales through the convenience and adaptability of the "little fellow" or universal receiver are increasing. Shortly one may find he loses caste to be without "that portable" to slip into the week-end bag.

* * *

Some users of short-wave converters should bear in mind at least several very important facts. There are certain types of sets even a good converter will perform best with, a good ground and aerial are quite essential and that patience, practice and skill will aid greatly in getting that evasive station. Program schedules likewise should be consulted, for otherwise one might waste needless hour and consequently blames the converter and everything else when the real trouble was perhaps with himself.

* * *

Already radio receivers with the R.M.A. seal are making their appearance in the retail stores. Only members may use this seal and even they must pass certain requirements. The object is to aid and elevate the industry and protect the public with a standard that will set an example of excellence as a guide for the buying public.

* * *

A number of radio experimenters and some servicemen have complained that they have experienced difficulty in obtaining the latest tubes. This might sound humorous, as one can hardly tell at times how late is late, however a guide and chart of the latest tubes was published in the April 1st isue of RADIO WORLD, which chart is a boon to the serviceman. Getting back to the source of supply, it should interest those in the metropolitan district to learn of an unusual shelf display of the latest tubes now at Thor's, 167 Greenwich Street, New York City. Such odd numbers as 2A3, R1, 77, 78 and all the rest of the known new numbers are there. It is a great satisfaction to know where you can get something when you want it. The experimenter is a progressive fellow and has done more than his share in developing radio, like his brother the amateur.

* * *

Ward Leonard Electric Co., Mount Vernon, N. Y., has an interesting circular listing voltage dividers, bleeder resistors and general purposes resistors. There is much interesting and useful information for the serviceman.

* * *

H. H. Elby Mfg. Co., of Philadelphia, Pa., has opened a Chicago office at 154 East Erie Street. Ed. R. Peel will represent the firm and carry a complete line of the Eby products.

* * *

It might be surprising to many to learn that in this day and age it is possible to go into dozens of small communities throughout the country and not be able to purchase even a small radio receiver, much less the most simple radio parts or aerial wire. Here is a market just waiting for some live wire. There are a number of manufacturers of radio receivers and small equipment who would make a satisfactory arrangement with a fellow who is prepared to jump into this uncovered territory and grab the sales that are being neglected.

Station Sparks

(*Continued from preceding page*)

At this writing Henry is back at his old stand, the Hotel Sinton, Cincinnati, and he is drawing plenty of people. His music is still as popular as ever.

In appearance Henry Theis is of medium height and weight, has reddish brown hair, blue eyes, and is quite good looking, with small regular features, and a nice smile. Is a conservative but smart dresser. Is in his early thirties. . . . Is married to Frances Rosenthal, a petite, demure little lady. Has one son who attends Ohio Military Institute. His only hobbies are his wife, his boy and his music. His sports are fishing and golfing, when he gets the time. His favorite composer is Debussy. Easy to get along with. His boys swear by him and he seldom changes musicians.

* * *

For those kind folk who have been inquiring about my Sea Poems: they are now ready for distribution. Fifty cents a copy. Limited edition and they won't last long. Have a few copies left of "Roads." . . . Well—guess I'll stop and put on the kettle for a good old-fashioned cup of tea. So long until next week!

CORPORATE ACTIVITIES

CORPORATION REPORTS

Kellogg Switchboard and Supply Company—Net loss for 1932 after amortization, depreciation, interest, taxes and other charges, $749,818. For 1931 the net loss was $492,946.

Stewart-Warner Corporation—Net loss for 1932 after depreciation and expenses, $2,445,197. The net loss for 1931 was $1,830,171. Current assets for 1932, $6,213,127, and current liabilities, $782,892. For 1931 the current assets were $9,250,867, and current liabilities, $947,764.

BANKRUPTCY PROCEEDINGS

Petitions Filed Against

Knox Radio Stores, Inc., 842 Saratoga Ave., Brooklyn, N. Y., dealing in retail radios and radio parts, by Samuel Frost for $31.60; Halson Radio Mfg. Corp., $99; Marko Storage Battery Corp., $52.50; G. J. Seedman, Inc., $349.25. George F. Picken, 32 Court St., Brooklyn, appointed by Judge Inch as receiver.

SUBSCRIBE NOW!

RADIO WORLD, 145 West 45th St., New York City. Enclosed please find my remittance for subscription for RADIO WORLD, one copy each week for specified period.

- ☐ $10.00 for two years, 104 issues.
- ☐ $6 for one year, 52 issues.
- ☐ $3 for six months, 26 issues.
- ☐ $1.50 for three months, 13 issues.

$1.00 extra per year for foreign postage.

- ☐ This is a renewal of an existing mail subscription (Check off if true)

Your name .....

Address .....

City .....

115 DIAGRAMS FREE

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

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

Circuits include Bosch 54 D. C. screen grid; Balkite Model F, Crosley 20, 21, 22 screen grid; Eveready series 50 screen grid; Erla 224 A.C. screen grid; Peerless Electrostatic series; Philco 76 screen grid.

Subscribe for Radio World for 3 months at the regular subscription rate of $1.50, and have these diagrams delivered to you FREE!

Present subscribers may take advantage of this offer. Please put a cross here ☐ to expedite extending your expiration date.

Radio World, 145 West 45th St., New York, N. Y.

BLUEPRINTS

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

RADIO WORLD

145 WEST 45TH ST., NEW YORK, N. Y.

SOLDERING IRON FREE!

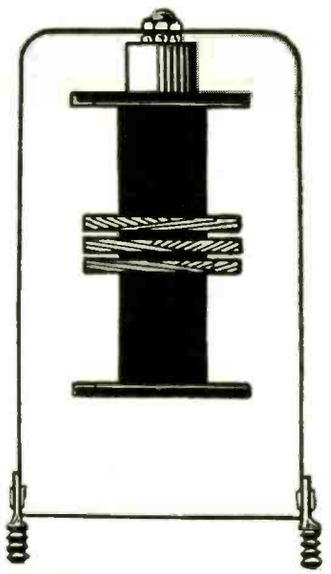
Works on 110-120 volts AC or DC, power, 50 watts. A serviceable iron, with copper tip, 5 ft. cable and male plug. Send $1.50 for 13 weeks' subscription for Radio World and get these free! Please state if you are renewing existing subscription.

RADIO WORLD

145 West 45th St. N. Y. City

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

Semi-Tuned Coupler



Special semi-tuned coupler, for a variety of uses. It consists of three inductively related windings in an aluminum shield, 1¾ inches diameter, 3 inches high overall, broadly resonant at the lower frequency extreme of the broadcast band. Secondary is center-tapped.

The semi-tuned transformer may be used as a so-called untuned stage of r-f feeding the detector, to make the amplification more nearly even throughout the band of radio frequencies by increasing the gain at the low frequency end. For general use the effected center tap on the secondary may be ignored.

If the duplex diode-triode is to be used in t-r-f sets, this transformer may be connected for full-wave detection with primary in preceding plate circuit, extremes of secondaries (green and green with white tracer) to anodes of the diode (55, 85), center (see below) to cathode through a resistor of 0.5 meg. This is one of the most practical ways of applying the diode to t-r-f sets, with or without automatic volume control, as the problem of a grounded rotor of a condenser and a return that cannot be directly grounded is avoided.

The coil also may be used for a-v-c pickup, by putting one choke winding in the plate circuit of the detector, with no condenser from plate to ground, but condenser from other end of this coil to ground, and thus using the pickup of the secondary to feed the a-v-c circuit.

The transformer may be used as antenna coupler.

The windings consist of special honeycomb coils of low distributed capacity, with wire not too fine for this the intended purposes. The color code: red and yellow are primary; green and blacks are one secondary; green with black tracer and black with red traced other secondary. Connect black and black with red tracer for center-tapped secondary. Cat. STC @.....75c

Matched Combination of Dial, Condenser, Coil

Dial obtainable with either of two numerically divided scales or with frequency scale.

Travelling light dial, bulb, escutcheon, 6-to-1 vernier, smooth action. Hub is for ⅜-inch shaft but ¼-inch reducing bushing is supplied. This dial is obtainable with either type numerical scale (100-0 is illustrated) or with frequency-calibrated scale, marked 500 to 150. The frequency scale requires 0.00037 mfd. condenser and 250 microhenries inductance for the broadcast band, or 0.00037 mfd. condenser and 20 millihenries inductance for actual 500 to 150 kc. fundamentals.

Cat. DJAD—0-100 for condensers that increase in capacity when turned to the right. Scale, 0-100 ..... 75c

Cat. DJAD—100-0 for condensers that increase in capacity when turned to the left. Scale 100-0 ..... 75c

Cat. DJADF — Frequency calibrated 94c

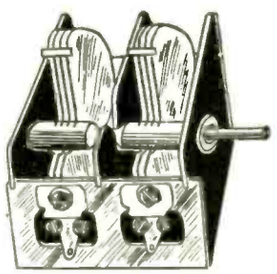
Cat. RFCH — (TH) — Honeycomb coil of 20 millihenries inductance. Two extreme lugs for total winding. Center lug is tap..... 45c

Cat. TRF-250—Radio frequency transformer 2½-inch diameter shield; primary and tapped secondary. Tap may be used for oscillation in cathode leg of beater tube 45c

Cat. DJA-14-D—Two gang 0.00014 mfd. short-wave condenser with compensators $1.96

Cat. DJA-37—Single tuning condenser, compensator built in; 0.00037 mfd. 98c

Short-Wave Condenser



Two-gang condenser for short-waves. Low minimum. Sturdy construction. Ball race at front and back of Shaft. Compensators built in at side. Shaft is ¼-inch Aluminum plates. Useful with all standard make short-wave coils. ⅜-inch bushing supplied.

DIRECT RADIO CO., 143 West 45th Street, NEW YORK, N. Y.

BLUEPRINTS OF STAR CIRCUITS

8-TUBE AUTO SET

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

SHORT-WAVE CONVERTER

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

5-TUBE AC, T-R-F

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

A-C ALL-WAVE SET

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

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

Short-Wave Plug-in Type

Cat. SWB—Four plug-in coils, 6-pin base; primary, secondary, fixed tickler..... $1.40

Cat. SZ—Six-spring wafer socket for use as coil receptacle for six-pin coils..... 11c

Cat. SWA—Four plug-in coils, UX base, primary and secondary; primary may be used for feedback if condenser connects aerial to grid..$1.20

Cat. SX—Four-spring (UX) wafer socket for use as coil receptacle for four-pin coils..... 10c

CONDENSERS

Cat. DJA-14—Single 0.00014 mfd. condenser with compensator built-in. ¼-inch shaft. Supplied with bushing to take ⅜-inch dial hub..98c

Cat. DJA-25—Single 0.00025 mfd. feedback condenser. Useful where 0.0002 or 0.00025 mfd. is specified $1.02

Cat. DJA-14-D—Double (two-gang) 0.00014 mfd. condenser with compensators built in, ¼-inch shaft. Supplied with bushing to take ⅜-inch dial hub $1.90

SPECIALS

Two coils for 4-tube Diamond. Cat. DP...$ .90

Three coils for 5-tube Diamond. Cat. DT..$1.35

Five coils in four shields for Super Diamond. Cat. SDCK $3.95

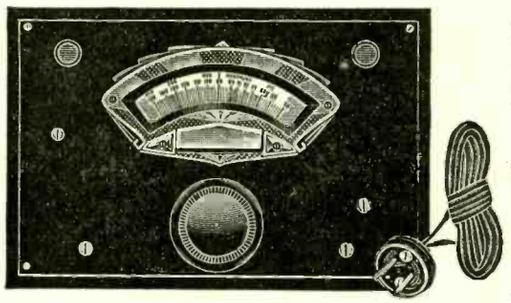
Two r-f coils and separate oscillator coil for Anderson's Auto Super. Cat. AUSU..... $1.45

Two r-f coils and separate oscillator for 175 kc. supers. Cat. 175-SU..... $1.45

Screen Grid Coil Co.

145 W. 45th St., N. Y. City

All-Frequency Service from a Test Oscillator



The test oscillator has a frequency-calibrated dial, registering 50 to 150 kc, while above this tier of frequencies are registered all the popular commercial intermediate frequencies. So just consult the dial scale.

A COMPLETELY self-operated a-c test oscillator, fundamental frequencies from 50 to 150 kc, with the line frequency, 60-cycle hum, used as modulation but not heard except at resonance, affords all-frequency service, from 50 kc up. This is true because the fundamental may be used as registered on the exclusively frequency-calibrated dial, and harmonics may be used for any higher frequencies, almost without limit. All oscillators are tested up to the 28th harmonic, but response of sufficient ntensity may be obtained even beyond he 50th harmonic, and there are roven cases of good results up to the 50th harmonic.

Therefore when fundamental frequencies are low, as here, you may set down the lowest, 50 kc, as one extreme, while the harmonic orders give almost unlimited service to line up short-wave receivers, converters and broadcast receivers that respond to police frequencies.

Average Accuracy 1% or Better

The a-c test oscillator, 105-120 v., 50-60 c., uses a 56 tube, a frequency-stabilized grid circuit, Hartley oscillator and a-c on the plate. Special pains have been taken to assure accuracy, and the test oscillator is guaranteed to be accurate to within 2 per cent. However, at some settings the accuracy is almost perfect, while the average accuracy is 1 per cent. or better. The 2 per cent. rating is the extreme deviation, present in only a few instances.

Therefore in possessing one of these oscillators one knows that he has an instrument of a degree of accuracy more than sufficient for the purposes to which the oscillator will be put, i.e., lining up intermediate amplifiers and padding, in superheterodynes, or lining up condenser gangs in t-r-f systems.

The oscillator will yield sharp zero beats with carriers, and the accuracy may thus be checked at any time against broadcast carriers, using the tenth harmonic (500 to 1,500 kc). This harmonic is used for all broadcast frequencies.

If any particular frequency setting that is a multiple of 50 is ascertained for a receiver or other tested device, frequencies separated therefrom in steps of 50 kc may be registered by setting the test oscillator at 50 kc and tuning the tested device. This is particularly handy in frequency calibration, and for finding frequency extremes in receivers that cover some of the police frequencies.

Get One of These Test Oscillators *Free!*

The oscillator is self-powered as an a-c device, but may be obtained also in battery model. The circuits used are simplifications of the Hartley oscillator and the construction of all oscillators is under the supervision of graduates of the Massachusetts Institute of Technology, who test each oscillator to verify its accuracy.

The a-c model is constantly modulated and yields zero beats at all times. The battery model has a switch at left for modulated-unmodulated service, and yields zero beats on unmodulated but not on modulated service.

The a-c test oscillator parts may be obtained free with a one-year subscription for RADIO WORLD, 52 issues, one each week, at $6.00, the regular subscription price, while the cost is $1.50 extra for wiring and calibrating. The $1.50 is turned over by us to an outside laboratory. Order Cat. PRE-ACOW and remit $7.50 with order. The 56 tube is 72c extra.

The battery model requires a 230 tube, a 22.5-volt small B battery, and a 1.5-volt dry cell. Order Cat. PRE-BATOW and remit $7.50 with order. The 230 tube is 78c extra. Batteries not supplied.

The main scale of the frequency-calibrated dial reads from 50 to 150. The bars are 1 kc apart from 50 to 80 kc and 2 kc apart from 80 to 150 kc. Thus for broadcast work, using the 10th harmonic, the separation as registered by the bars is 10 kc from 500 to 800 kc and 20 kc from 800 to 1,500 kc. On an upper tier the intermediate frequencies are printed: 175, 260, 400 and 450 kc, with a bar to the left of 175, representing 177.5, and a bar to the right of 175, representing 172.5. These, with 130 on the fundamental, represent all the popular commercial intermediate frequencies. Any other intermediate frequency may be obtained either directly from the fundamental, or by dividing a higher desired frequency by the nearest whole number to yield a frequency represented on the fundamental.

SHIELDED OSCILLATORS, $1 EXTRA

DIRECTIONS FOR USE

Remove the four corner screws and the cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service at broadcast frequencies. No other coupling is necessary, as radiation is strong enough. Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired frequency. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the bared end of a wire to the output post of the test oscillator, other bared end of this wire to plate of the first detector socket. The first detector tube may be removed and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way, except that output lead may have to be wrapped around the aerial near set for a few turns to effectuate coupling at broadcast frequencies. The modulation is a high-pitched note, instead of hum.

RADIO WORLD, 145 West 45th Street, New York, N. Y.
ALL SHIPMENTS MADE EXPRESS COLLECT.

PADDING CONDENSERS

Either capacity, 50c

A HIGH-CLASS padding condenser is required for a superheterodyne's oscillator, one that will hold its capacity setting and will not introduce losses in the circuit, for losses create frequency instability. The Hammarlund padding condensers are of single-condenser construction on Isolantite base, with set-screw easily accessible, and non-stripping thread. For 175 kc. intermediate frequency use the 850-1350 mmfd. model. For i.-f. from 460 to 365 kc., use the 350-450 mmfd.

0.0005 HAMMARLUND S. F. L. at 98c.

A sturdy, precision straight frequency line condenser, no end stops. The removable shaft protrudes front and rear and permits ganging with coupling device, also use of clockwise or anti-clockwise dials, or two either side of drum dial. Front panel and chassis-top mounting facilities. True straight line. This rugged condenser has Hammarlund's high quality workmanship and is suitable for precision work. It is a most excellent condenser for calibrated radio frequency test oscillators, any frequency region, 100 to 60,000 kc., short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction, rigidity; Hammarlund's perfection throughout.

Order Cat. HOS @.....98c net

Guaranty Radio Goods Co., 143 West 45th Street, New York, N. Y.

NEW SERVICE EQUIPMENT

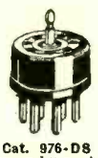
Cat. 907 WLC De Luxe Analyzer Plug, with 5-ft. 8-lead cable attached. Price $3.23

De Luxe Analyzer Plug, with new seven-pin base, with 5-ft. cable (not shown), two alternate grid connector caps and stud socket at bottom that connects to both grid caps. Eight-wire cable assures adaptability to future tube designs, including tubes with 7-pin bases and grid cap soon to be released to the public (2A7, 6B7, 2B7 and 6A7).

The eighth lead connects to the two grid caps and stud socket which is a latch lock. Standard adapters for the De Luxe Analyzer Plug are 7 top to 6 bottom, 7 top to 5 bottom and 7 top to 4 bottom, thus reducing to required number of pins and enabling testing of circuits using all popular tubes. Special adapters, as for UX-199, UV-199, etc., obtainable.

Latch in Analyzer Plug base grips adapter studs so adapter is always pulled out with Analyzer Plug (adapter can't stick in set socket). Pressing latch lever at bottom of Analyzer plug releases adapter. Analyzer Plug is of smaller diameter than smallest tube and thus fits into tightest places. Made by Alden.

Analyzer Plug, 7 pin, with 8-lead 5-foot cable attached, (adapters extra). Cat. 907-WLC @.....$3.23

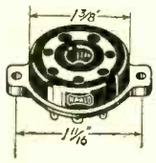


Cat. 976-DS New plug-in adapter, 7-hole top, 6-pin base, with locking stud that fits into 907-WLC latch. Price ..... .73

Cat. 975-DS New plug-in adapter, 7-hole top, 5-pin base, with locking stud that fits into 907-WLC latch. Price ..... .73

Cat. 974-DS New plug-in adapter, 7-hole top, 5-pin base, with locking stud that fits into 907-WLC latch. Price ..... .73

Above three adapters essential for 907-WLC to test UX, UY and 6-pin tubes, including such tubes with grid caps.



CAT. 456-E In the Analyzer end, use a 9-hole universal socket, that automatically takes UX, UY and six-pin tubes, with errorless connections. Price..... .35

CAT. 437 E To accommodate 7-pin tubes, which will not fit into Cat. 456-E universal socket, use Cat. 437 E, a seven-pin companion socket, same size. Price .24

If instead of using two sockets, the universal Cat 456-E and the Cat. 437, the universal alone may be used, with an adapter that has six-pin bottom and 7-hole top to enable putting 7-pin tubes into the universal socket. A 6-inch lead with phone tip is eyeleted to the side. A pin jack you put on Analyzer, connected to seventh lead of 907-WLC cable, picks up control grid of 7-pin tube through the eyeleted lead. Cat. 976-SL .....$ .73

MULTIPLE SWITCH

For switching to nine different positions, enabling current, voltage and other readings. Any one position opens a circuit and closes another. Thus the opener, by interruption, gives access to plate, cathode, etc., leads, for current readings, while the closer puts the current meter in the otherwise open circuit. Opener is disregarded for positions used for voltage measurements. Switch has detent for "snappy" action. Cat. 2NS9-KP-9-B9 .....$ 2.65

Double pole, nine throw switch. Cat. 2NS9-KP-9 @ $2.18

DIRECT RADIO CO.

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SHORT-WAVE COILS and FORMS

Precision short-wave plug-in coils, wound on 1¼" diameter. Form has gripping flange. Four coils to a set for each tuned circuit. Approximate frequencies with 0.00014 mfd. are 1400-3080 kc, 3000-6600 kc, 6000-13200, 13000-30000 kc.

Two-winding coils, UX base. Cat. SWA (four coils) $1.20

Three-winding coils, 6-pin base (tickler interwound with part of secondary) Cat. SWB @ $1.40

UX sockets for use as coil receptacle, Cat. 5X, @ 10c each. Forms, four for 60c, either UX or 6-pin. Six-spring sockets. Cat. SZ. @..... 11c each.

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