RADIO WORLD

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The First and Only National Radio Weekly

516th Consecutive Issue

TENTH YEAR

FEB. 13
1932

Price
15 Cents
Per Copy

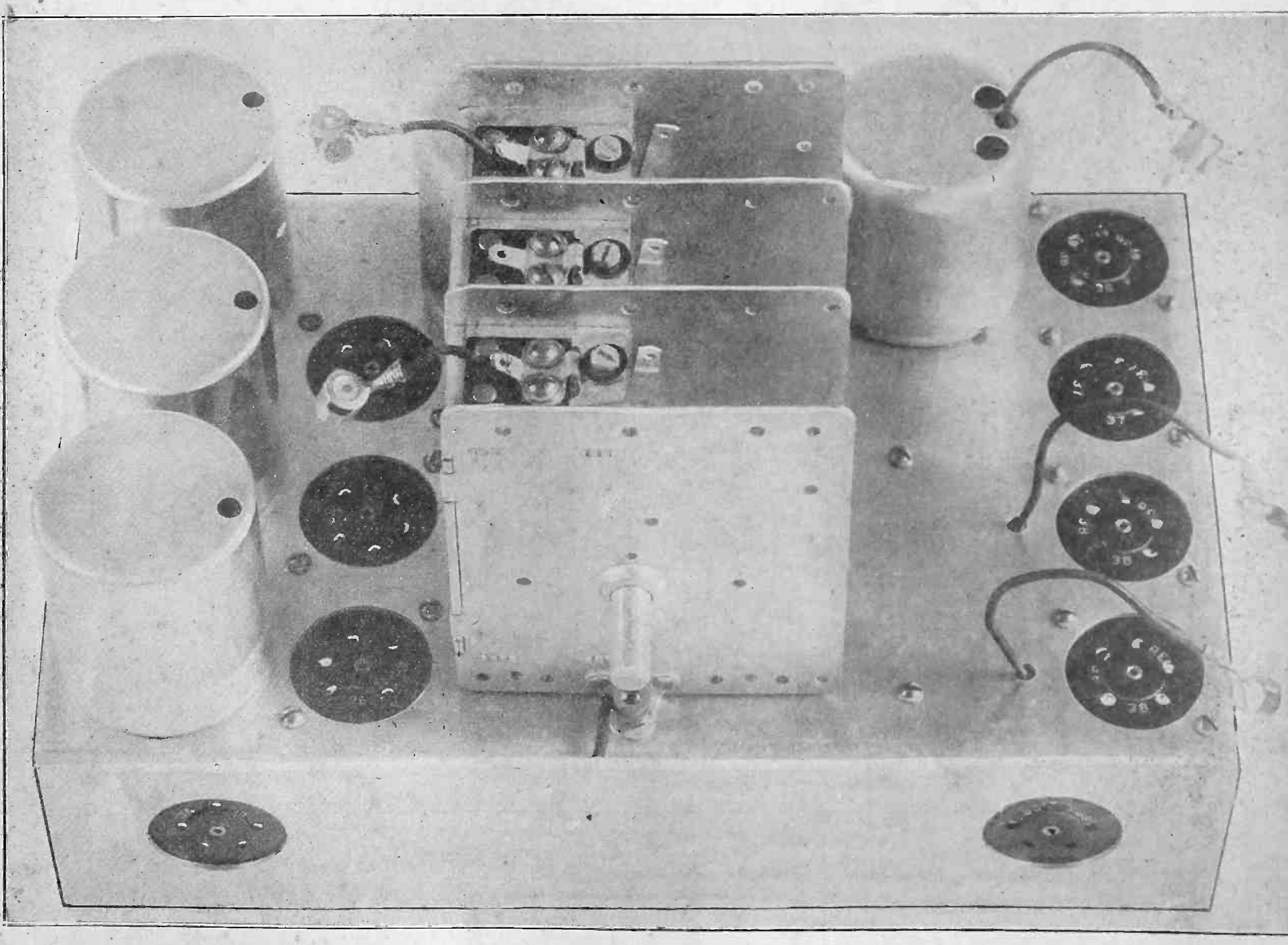
Short-Wave Converter for 247 Pentode Sets

Padding An Oscilliator

5-Tube Broadcast Super

10-Tube All-Wave A-C Set

8-TUBE AUTO SUPER!

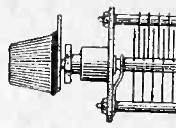


A six-inch aerial, no ground, resulted in good signal strength on this auto set. Moreover, automatic volume control is achieved in a new way, no extra tube. Total tubes, eight. See page 6.

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

MIDGET CONDENSER

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



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

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

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

TAPPED COILS FOR BAND SHIFTING

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

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

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

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

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

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

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

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

PRECISION PARTS AND ACCESSORIES

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

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

The Rola speakers for home receivers are obtainable with field coils that may be used also as the B supply choke coil, and which field coil has a tap, so that bias for a pentode may be obtained from the field coil itslf. This method introduces audio regeneration, which improves tone and sensitivity. The tapped coils have a total resistance of 1,800 ohms and the tap is at 300 ohms from the ground end. The grid return of the power stage is connected to the tap. This is the method used in all our a-c circuits.

Rola dynamic speaker, 1,800 ohm field coil, tapped at 300 ohms. Output transformer matched to single pentode is built in. Diameter of cone is 7 inches. Cat. RO-18 @ $4.50

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

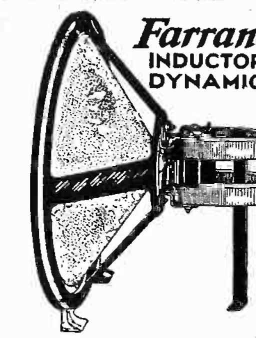
Same as above, except that cone diameter is 12 inches. Cat. RO-18-12 @ $7.25

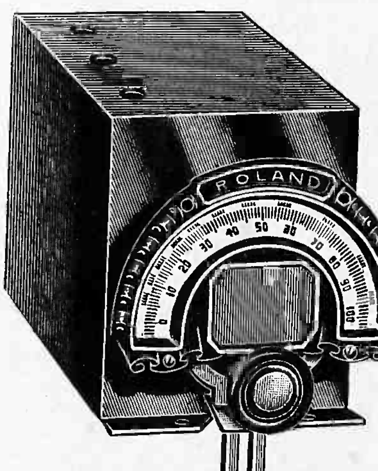
Rola dynamic 6 inch cone for automobile sets. 6 volt field to be connected to car's storage battery. Speaker fits on bulkhead under the instrument board. Shielded cable is supplied with each speaker. Cat. RO-AU @......$4.95

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

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

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





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

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

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

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

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

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

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

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

5 WATT 2,000 OHM resistor to drop maximum B to B plus 180 volts for plates of r-f tubes in any t-r-f set. Cat. 5-W-2 @...$ .45

POTENTIOMETERS: 400 ohms at 27c; 5,000 ohms @ 95c; 25,000 ohms @ $1,25; 50,000 ohms @ $1.25; 100,000 ohms @ $1.25; 500,000 ohms @ $1.25.

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

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

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

Tubes

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

BLUEPRINTS

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

Blueprint No. 628, six tube a-c short wave set, no plug-in coils; 15 to 200 meters. Order Cat. BP-628 @..$ .25

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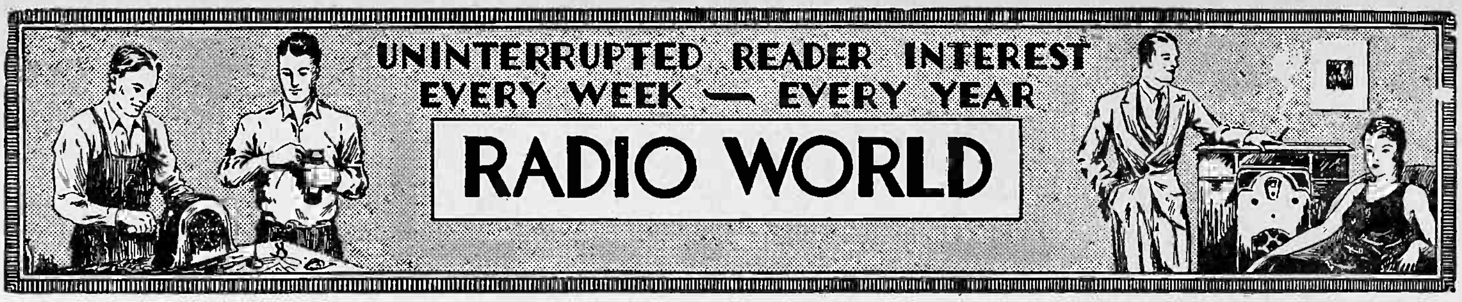

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A Pentode Set Converter

All Power Derived from Output Socket

By Herman Bernard

THOSE who have broadcast receivers with 247 output, single or push-pull, can build a good converter inexpensively, since the power for the heaters, plates and screens may be obtained easily from the set.

Since the pentode requires only a relatively low negative bias, 16.5 volts, for 250 volts applied, the same 2.5 volt winding is nearly always used for all the heater tubes in the set, as well as for the output tube or tubes. Where such common connection of heaters and filament is made, the radio frequency and detector tubes, as well as preliminary audio tubes, if any, have their heaters at a positive potential in respect to cathode, equal to the difference between the cathode voltage and the bias voltage. So 15 volts or less constitute the positive bias on the heaters, to which there is no objection.

Since the same 2.5 volt winding serves all tubes except the rectifier, it is possible to pick up this voltage to heat two more tubes, and besides pick up the maximum B voltage. This B voltage was stated to be 250 volts applied but the bias voltage for the pentode may have to be added, so that from set ground to pentode's grid return there will be a voltage difference of 267.5 volts. This is what will be picked up, except in cases where the B supply choke is in the negative leg of the rectifier, when the voltage is the difference between ground of the set and the B plus output of the rectifier, 250 volts or thereabouts. In either instance a series resistor of 0.01 meg. (10,000 ohms) will reduce the voltage satisfactorily for the mixer tubes, modulator and oscillator.

How to Make a Connector

Fig. 1 shows the circuit. At right is the representation of five springs of the 247 socket. If insulated wire is carefully bared at the ends where connections are to be made, and then looped without crossing the wires, and soldered and filed, the three leads thus can establish connections to the pentode tube's pins and be brought into the converter.

Another method is to use the small lugs familiar to radio workers, with holes in them just large enough to permit passage of the three tube pins, the two heaters (H) and screen (K), the lugs being bent up against the side of the tube base, and wires soldered to the small connecting holes in the lugs. Thinly stripped friction tape should be put around the protruding parts of the lugs to avoid grounding to a metal chassis.

Another method is to use the wafer of a UY socket, from which springs have been removed, and notch the three holes (two H's and the K) so that stranded wire may rest in the notch, protruding just a trifle into the opening that is to receive the tube pins. There will be holes left from which the anchorage of the socket springs has been removed, and the wire is passed through these, tightened and soldered. Thus there are three separate small pieces of wire.

Size Wire to Use

Another similar wafer is put on bottom, for protection, and the two wafers are then joined. The binding may be by 6/32 machine screws and nuts, the screw excess snipped off. A small bushing at each of the otherwise unusued holes will maintain the two wafers level. The two holes referred to are on the lower level wafer and are drilled oversize to accommodate the collar of the washer. Thus the boss type of washer is used, and friction is depended on for anchorage. Another method is to use a special wafer that has tiny phosphor bronze or similar spring connections for the three outlets utilized.

The connecting wire for the heaters should be No. 18 stranded, or larger size, not smaller. The wire for the plate feed should **not** be smaller than No. 24.

The method of picking up the voltages is direct, there being heater and maximum B plus at hand, but to reduce the B lead to around 200 volts or less, the 0.01 meg. resistor (1 watt) is used, and to provide the screen voltage two equal resistors are used, the screens going to the juncture. These resistors are shown as 0.02 meg. (20,000 ohms), but may be up to 0.05 meg. Bypassing the screen and B plus feeds is absolutely necessary.

The reason for the inexpensiveness of the outfit is that no rectifier is needed. The fact should be borne in mind, however, that the short-wave converter is for a-c pentode sets only. Since there are many such sets now in use, the application of the present system is wide.

Frequency Between 600 and 550 kc

The converter itself consists of a tuned modulator and a tuned oscillator, and it is intended for connection to a broadcast receiver tuned to some low frequency. The reason for selecting a low frequency is that there are fewer stations in that region, less likelihood of direct interference, and fairly good sensitivity on all sets having pentode output, since the r-f amplifiers in the set are screen grid tubes with large primaries. When the primaries are large the low radio frequency response is good.

The frequency used should be between 600 and 550 kc, and to get rid of any direct reception of a broadcasting station at the intermediate frequency when the converter is used, the aerial circuit of the converter has in it a wave trap. This trap, when tuned to the intermediate frequency, will kill off the possibility of interference, provided the station is not a very strong local. If strong local interference results, use another intermediate frequency in the prescribed limits and set the trap circuit for that.

Switches Discussed

There are four switches. Their purposes are as follows:

SW-1 is the antenna switch. When thrown to the left, referring to Fig. 1, this switch connects aerial to the primary of the antenna coupler feeding the converter. When thrown to the right the switch removes the antenna connection from converter input and puts it to the receiver input. Although the coil L10 remains across the antenna input of the set, it is extremely large in comparison to the inductance of the input of the receiver, and therefore the receiver input virtually shorts L10. Thus performance on the converter or on the set may be enjoyed, and switching from one to the other done on the front panel.

SW-2 is a coil switch, used for bringing either of three inductances into the tuned modulator circuit. These inductances are L2, L3 and L4, and they take care of higher frequencies, in that order. L1 is the antenna winding. All four windings are on one form and occupy the relative positions shown in Fig. 1, which also correctly discloses the polarities when all windings are in the same direction.

SW-3 is the coil switch for the oscillator, and picks up L5 when the other switch picks up L2, L6 when the other picks up L3, and L7 when the other picks up L4. The switches may be independent, placed at left and right of the front panel, and thereby reduce troublesome coupling, but if a metal panel is used they must be insulated.

SW-4 is the heater voltage switch, for turning the power to the converter on and off. When the tubes are not heated (switch is off)

(*Continued on next page*)

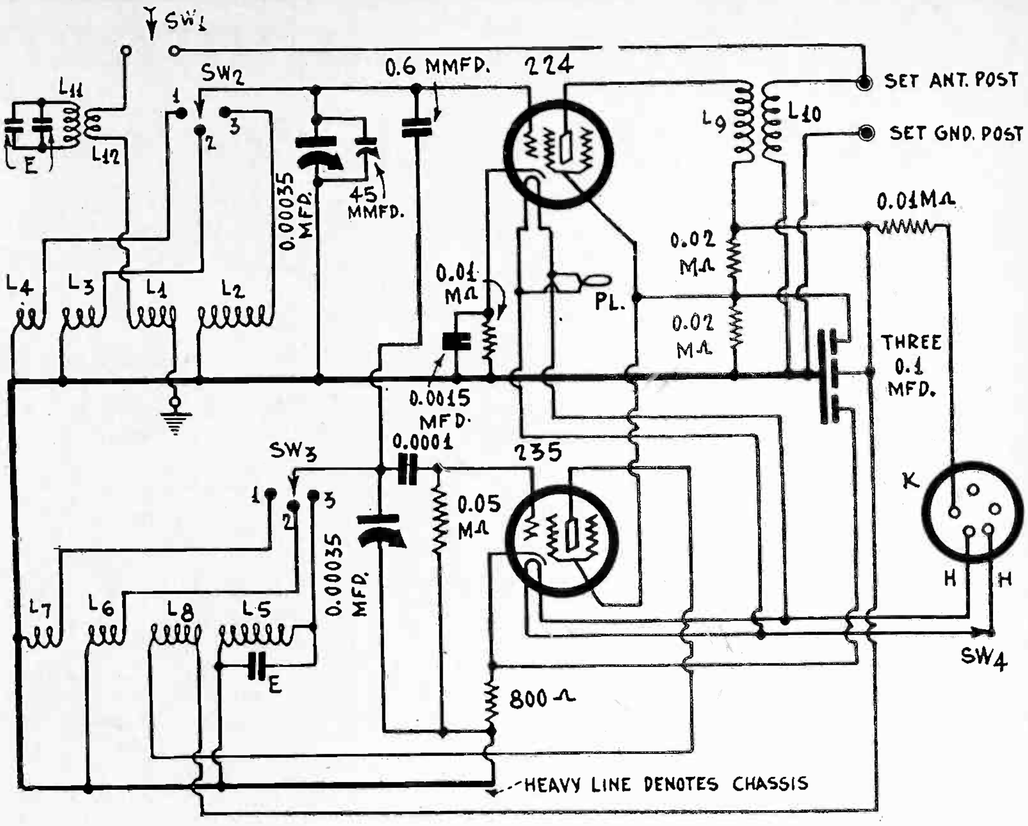


FIG. 1
This converter derives its operating power from a pentode a-c receiver by picking up the two heater leads and the pentode screen, which is K of a UY socket.

(*Continued from preceding page*)

though the broadcast set is being used, no current is drawn by the converter, except across the two 0.02 meg. resistors, and then not even a full 7 milliamperes if the voltage is full 275 volts. This current drain can be neglected. When the set and converter are turned off no current flows in either.

Coils and Condensers

The tuning condensers are 0.00035 mfd., satisfactory if the dial has a high reduction ratio. A popular ratio is 24-to-1. The constants can be determined from an analysis of the frequency.

Selecting 600 kc as the datum or reference point, then the modulator should begin tuning at 1,500 kc and the oscillator at 2,100 kc. The frequency ratio with 0.00035 mfd. is 3-to-1, so the modulator would tune to 4,500 kc while the oscillator would tune to 6,300 kc. It can be seen that at the high frequency extreme the oscillator would be off 1,200 kc, as compared to the modulator, a considerable difference. Therefore the oscillator ratio has to be retarded. What is required of the oscillator is tuning from 2,100 to 5,100 kc, a ratio of a trifle more than 2.4 to 1, on a frequency basis. The capacity ratio is the square of that, or 5.76.

We can obtain that ratio by putting a 20-100 mmfd. equalizer, across the oscillator's third grid winding. The minimum capacity in circuit—condensers, tube, wiring, etc.—is around 30 mmfd. The maximum capacity is really a little more than 350 mmfd., probably 360 mmfd. So we have 130 mmfd. minimum and 460 mfd. maximum. So, if we use 40 mmfd. of the trimmer, we have a ratio of 70 to 400, or a trifle greater than 5.7 to 1. We wanted 5.76-to-1.

Other Coils

Using a 2 inch diameter tubing, therefore, we can determine the number of turns now for the modulator, to cover 1,500 to 4,500 kc, and the oscillator, to cover 2,100 to 5,100 kc., with respective capacity extremes of 30 and 360 mmfd. and 70 and 400 mmfd. For No. 28 enamel wire the answer is: modulator, 18 turns; oscillator, 12.5 turns.

The subsequent windings are subjected to a frequency ratio of 2.5, due to a ratio decline at the higher frequencies, and as the number of turns is approximately proportionate to the frequency, the next grid winding for the modulator would have 7.2 turns, actually 7.5 would be used, and the next winding 3 turns. Since the percentage of difference between modulator and oscillator has become relatively small, a manual trimmer can take it up, for the last two bands, hence the oscillator would have the same number of secondary turns as the modulator.

So on a tubing 2 inches in diameter, for the modulator wind 10 turns primary, leave 1/8 inch space and wind 18 turns secondary to the right of the primary. Then, 1/4 inch to the left of the primary wind 7.5 turns, leave 1/4 inch space and, wind 3 turns. It will be noticed that this method reduces the antenna coupling for each secondary as the frequency increases, which is in a provision in the right direction.

For the oscillator, wind 10 turns for the tickler, leave 1/16 inch space and, to the right, wind 12.5 turns for the lowest frequency coil, L5. Then, to the right of the tickler, leaving 1/16 inch, wind 7.5 turns, and, leaving 1/16 inch again, wind 3 turns. Again does the mutual impedance decrease with frequency, as it should.

Polarities of Connections

All wire is No. 18 enamel, windings on any particular coil are in the same direction, and the polarities are as suggested in Fig. 1, that is, ground of antenna coil (not connected to chassis) is the terminal adjacent to the equivalent low potential end of the largest grid winding, etc. In the case of the oscillator coil, if windings are in the same direction on that coil, there will be oscillation at all frequencies, to bring in stations 1,500 to 30,000 kc, if the facing terminals of the tickler, L8, and the largest grid coil, L5, go respectively to B plus and chassis, L6 and L7 terminals being low potential at left and grid at right.

The object of the grid leak and condenser in the oscillator circuit (0.0001 mfd. and 0.05 meg.) is to stabilize the frequency and to reduce what would be otherwise a large minimum capacity due to grid current flowing. If audio oscillation is heard at all settings, which may happen on the small windings, the leak would have to be smaller. However, on actual test, while 0.1 meg., all

(*Continued on next page*)

LIST OF PARTS

Coils

Four-winding modulator coil, L1, L2, L3, L4, as described.
Four-winding oscillator coil, L5, L6, L7, L8, as described.
Wave trap coil L11, L12, as described.
Output r-f transformer, L9, L10, as described.

Condensers

Shielded two-gang 0.00035 mfd. straight frequency line condenser.
One manual trimming condenser, 45 mmfd. or thereabouts.
One 0.6 mmfd. (six-tenths of a micro-microfarad) fixed condenser.
Three equalizing condensers, 0-20-100 mmfd., two marked E, as grid condenser 0.0001 mfd., one used at full capacity.
One block of three shielded 0.1 mfd. condensers.
One 0.0015 mfd. fixed condenser.

Resistors

One 800 ohm pigtail resistor.
Two 0.01 meg. (10,000 ohm) pigtail resistors.
Two 0.02 meg. (20,000 ohm) pigtail resistors.
One 0.05 meg. (50,000 ohm) pigtail resistor.

Other Requirements

High reduction ratio vernier dial with pilot lamp (PL).
One metal chassis, drilled for two socket holes.
Two UY sockets.
One single pole double throw toggle switch, SW-1.
One single pole single throw a-c toggle switch, SW-2.
One three lead cable and pentode connector.
Two coil switches, SW-2, SW-3, shaft insulated; single pole triple throw each.
Four binding posts.
One dozen 6-32 machine screws, and one dozen nuts.

Padding a Superheterodyne

Useful Hints and Practical Procedure

By J. E. Anderson

THE work of trimming and padding a superheterodyne is not difficult, yet without the proper equipment and the correct mode of procedure it is likely to be very disappointing. It is usually stated that to trim at the high frequency end it is only necessary to tune in a high frequency station and adjust the oscillator trimmer, as well as the r-f trimmers, for maximum signal strength, and to trim at the low frequency end to set the tuner for the lowest frequency station available and to adjust the series padding condenser for maximum signal strength.

This sounds very simple, but the trouble is that it does not work, and the reason it does not is that there is no way of setting the tuner for the low frequency station. If an attempt be made to tune in the low frequency station the setting of the condenser is primarily determined by the oscillator, and the slightest touch of the series condenser adjuster will make the signal less intense. The method works all right at the high frequency end for here the series condenser has no appreciable effect. Therefore we must find some way of adjusting the series condenser after we have adjusted the circuit at the higher frequency end of the dial.

Use Set as T-R-F Receiver

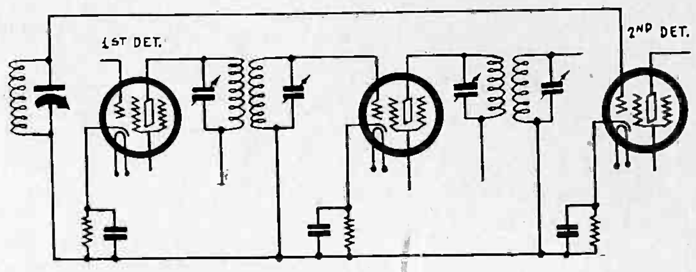
The correct way of going about adjustment of the series condenser is to use the set first as a tuned radio frequency receiver. This is done by killing the oscillator and skipping the intermediate frequency amplifier. The oscillator may be killed, or at least greatly detuned, by short-circuiting the oscillator tuning condenser. The intermediate frequency amplifier can be skipped, in the case when the second detector is a screen grid tube, but running a lead from the tuning condenser ahead of the first detector to the cap of the second detector. In any case the lead is run from the condenser to the control grid of the second detector. While doing this it is well to remove the first detector tube from the socket, or if it is a screen grid tube, to remove the cap connection. When this change has been made the receiver is a tuned radio frequency set, the oscillator and the intermediate amplifier playing no part. Tune in a station near the low frequency end of the tuner, say 570 kc, and carefully note the dial setting where it comes in loudest.

Now restore the circuit by opening up the short on the oscillator and making the various grid connections as they should be. Set the tuner on the point where the low wave station came in and then adjust the series condenser until the signal is loudest. At first, probably, there will not be a sound, but it will come in as the series condenser is adjusted. Make sure that the series condenser is adjusted for the same signal as that used before. After this adjustment the oscillator generates a frequency which is greater than the signal frequency by the intermediate frequency when the condenser is set where the t-r-f tuners are in tune with the signal frequency. That is, both the r-f and the oscillator are in tune. After this adjustment has been made it is well to go back to a high frequency station and readjust the trimmers. The circuit should not be adjusted for all settings of the tuning condensers.

Trimming with Laboratory Oscillator

This work can be done much more easily with the aid of a calibrated laboratory oscillator, for in this case we have at our disposal any desired signal frequencies. For example, suppose we want to adjust the circuit so that 1,500 kc comes in at 5 on the dial. We set the laboratory oscillator at 1,500, or at 750 kc, and then we set the tuner in the set under adjustment at 5. Then we adjust the trimmers on the various tuning condensers until the signal comes in loudest. We can adjust the oscillator trimmer at the same time as the others, and this would be the first one to be adjusted.

When this has been done we can set the laboratory oscillator at 550 kc, and using the receiver as a t-r-f set, we can tune in the 550 kc signal. The oscillator should be killed as was explained above.



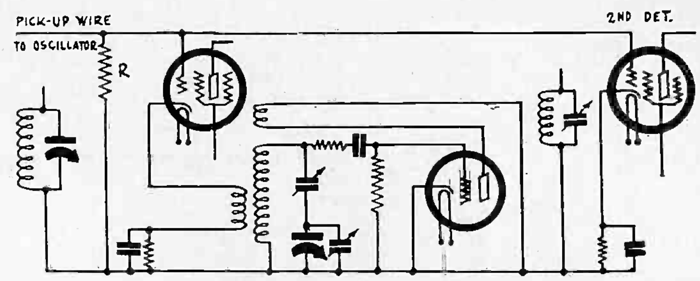


FIG. 1 (upper)

To calibrate the radio-frequency tuner of a superheterodyne short-circuit the oscillator condenser and connect grid of second detector to tune circuit ahead of the first detector and put the signal in at the antenna post.

FIG. 2 (lower)

Connect the grids of the two detectors together, first disconnecting the tuned circuits from them. Continue the wire, and couple it to the calibrated oscillator. Use grid leak R if blocking occurs without it.

When we have found where the 550 kc signal comes in on the r-f tuners, we leave it there and restore the circuit to a superheterodyne. Then we adjust the series condenser until the signal comes in loudest. The procedure is the same whether we use a signal from the laboratory oscillator or a signal from broadcast stations. The only advantage of the laboratory oscillator is that we can have any signal frequency we want when we want it. Then it enables us to set the trimmers so that 1,500 kc comes in where we want it to come in.

Adjusting the Intermediate Tuner

Good tracking may not be achieved if the intermediate frequency amplifier is not tuned to the frequency for which the oscillator coil was designed. And low sensitivity will be obtained if all the intermediate frequency circuits are not tuned to the same frequency.

The first step in the adjustment of the superheterodyne should be to tune the intermediate amplifier circuits. To do this, and to tune it to a desired frequency, say 175 kc, it is necessary to have a modulated oscillator which can generate this frequency. This oscillator is coupled to the plate of the first detector, or to the control grid provided that the r-f circuit is not left across the input, and then each intermediate circuit is adjusted for maximum signal.

Wave Trap Keeps Out Converter Interference

(*Continued from preceding page*)

right for broadcast frequencies, caused blocking at high frequencies, 0.05 meg. did not (50,000 ohms).

The modulator is of the power detector type, and therefore will take a strong oscillation output and handle it well. The output of the modulator is through a transformer consisting of two honeycomb coils, L9 and L10, in parallel position about ¾ inch apart. The inductance should be about 6 millihenries, which in some small type honeycombs, about 1¼ inch outside diameter, is comprised of a 600 turn unit.

Therefore the output is broadly tuned, and thus tuning permits choice of other intermediate frequencies, within limits as explained. Also the tuning effect makes for efficient transfer to the receiver through the output transformer.

The converter chassis is not grounded, as less noise resulted that way. The set chassis nearly always is grounded, and the ground post thereof is relied on for picking up B minus.

Having built the converter, tune the set to 600 kc and tune in a short wave station, say television buzz-saw sounds, or any other near the low frequency end of the converter's largest grid winding. With manual trimmer at minimum, set the equalizer across L5 and readjust oscillator setting until signals are loudest. Little of the equalizer's capacity will be needed. Check up at or near the other extreme of this coil condenser combination. Then adjust the wave trap, which consists of two equalizers across 150 turns of No. 32 enamel on 1 inch diameter, the primary, L12, wound over the secondary and consisting of three turns. The use of a small primary is imperative.

An 8 Tube Car Super, 400 kc Stations Come in

By J. E.

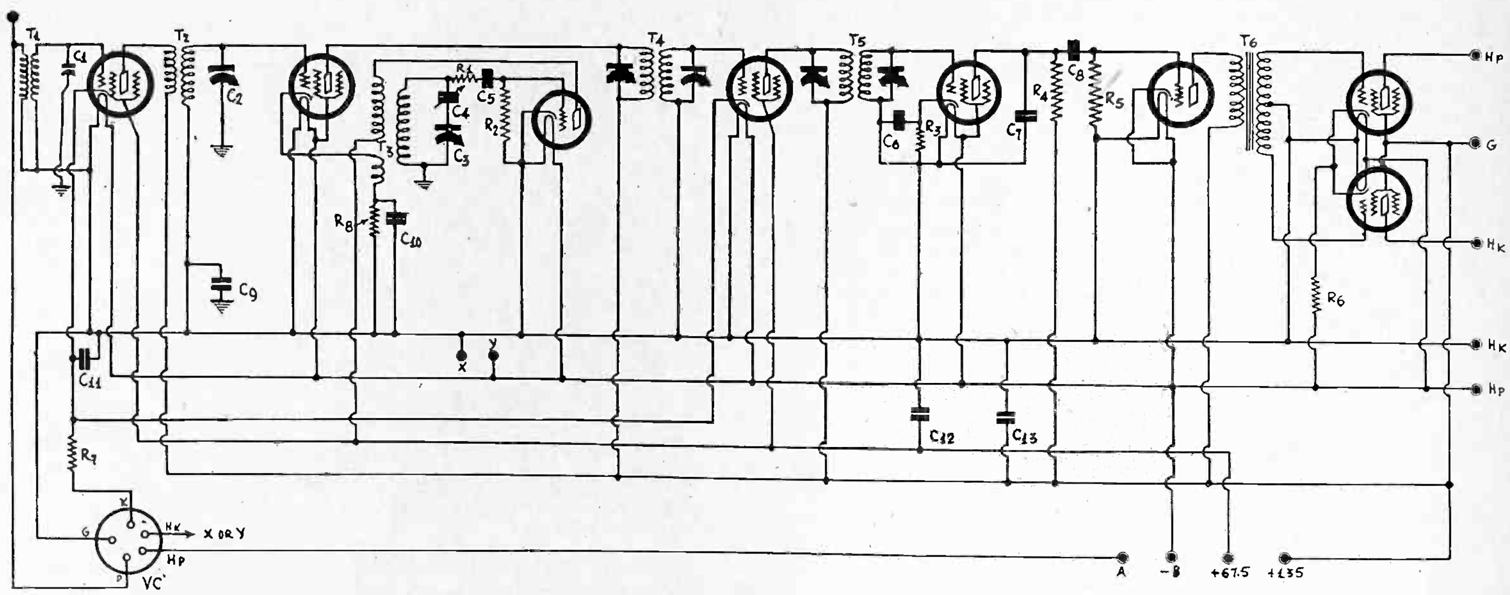


FIG. 1

The circuit diagram of an eight-tube automobile superheterodyne using the 6.3 volt tubes. A 400 kc intermediate frequency is a feature.

HERE is an eight-tube superheterodyne for automobiles, using the tubes especially developed for this purpose. A receiver of this type is needed in an automobile because high sensitivity is a necessity. Selectivity is not as important as sensitivity but if we can have both there is no reason why we should sacrifice either.

It has been found desirable in practice to have two radio frequency tuners in a receiver of this kind, just as it is desirable in a radio for the home. This is not because of lack of selectivity but because greater sensitivity can be obtained with the extra tuner.

In this receiver the intermediate frequency is 400 kc. This high value is used for two reasons. First, it is easier to eliminate image interference when the intermediate frequency is high, and second, quality will be better because it is not necessary to use as high absolute selectivity in the intermediate frequency amplifier, so that sideband cutting will not be so severe.

Squealing Minimized

It is well known that there is likely to be a great deal of heterodyning in a superheterodyne. This is greatly minimized when the intermediate frequency is high and when at the same time there is sharp tuning in the radio frequency tuner.

The present set was built for use with a short antenna, which is the only one possible in a car receiver. Hence the radio frequency tuned circuit is not as selective as it would have to be if a long outside antenna were to be used. Therefore, if this set is tried on a long antenna the circuit is tested severely for heterodyning and image frequency interference, and if it proves to be negligible under these conditions it will not even be noticed in actual car use.

This test was made and only a few weak squeals were heard, but in no case did they actually interfere with reception. At one high frequency setting there were garbled signals but these were obviously due to simultaneous operation of two stations on the same frequency. So far the circuit has not been tested on the road but it has been tested under conditions even more unfavorable.

For example, it was tested with a six inch pick-up wire for antenna without ground, and stations came in satisfactorily. One thing that was encouraging was that using an antenna comparable to that in a car a station could be picked up on almost every channel.

Padding of the Oscillator

The padding of the oscillator required special treatment, since the intermediate frequency was so high. Computation showed that the inductance of the tuned winding in the oscillator should be 140 microhenries, if the heterodyne frequency should be 400 kc at 1,500, 900 and 550 kc, and that the series padding condenser should be 436 mmfd.

Since the loss of inductance due to the shield around the coil is about 5 microhenries, the coil was wound to 145 microhenries. Using No. 32 enameled wire on a one-inch form, this required 83 turns. Over this winding was put a 25-turn tickler, near the ground end of the tuned winding and separated from it by several layers of thin insulator paper. On top of the tickler, and separated from it by several layers of paper, were put ten turns for pick-up, which, as will be noted, was connected in the cathode circuit of the modulator. No. 40 d. c. c. wire was used for the pick-up and the tickler.

The two radio frequency coils were standard for 350 mmfd. tuning condensers. They are wound on one-inch tubing with the same size wire as the oscillator coil and contained 127 turns each. The primary of each contained 50 turns of No. 40 d. s. c. wire, separated from the tuned winding by several layers of thin paper and placed near the ground end.

Calibration Curve

The padding was adjusted experimentally at 1,500 and 570 kc. This was done by the method explained elsewhere in this issue. A curve was run to check it. Fig. 2 shows the calibration of radio frequency tuner which shows that the tuner ran from 530 kc to 1,530 kc. Then the oscillator frequency was measured at various settings of the dial. From each measured frequency was subtracted 400 kc and the result entered on the curve in Fig. 2. The dots indicate the results. Although the points fall as much as 20 kc off the curve in some places, the actual tracking was much better than indicated, the error being due to a progressive error in the calibrated oscillator as well as to errors of reading the calibration chart. Such errors are to be expected when the beat is measured by the difference method.

However, these errors proved to be small and the main error was due to the error in the calibration of the oscillator. This is proved by the fact that the difference is closely 400 kc as long as the fundamentals of the two oscillators are compared, or as long as the second harmonics are compared. There was a sudden change in the measured difference frequency each time it was necessary to use a harmonic. This occurred once in calibrating the radio frequency tuner and once in calibrating the oscillator, and therefore two jumps are to be expected. These occur at 20 and 70 on the dial.

That the tracking was better than that indicated by the drawing is indicated by the fact that when stations of known frequency were tuned in they came in at the points expected from the radio frequency calibration. If there had been any considerable deviation the stations would have come in at different points because the oscillator determines where they come in.

The Circuit

The circuit diagram of the eight-tube super is given in Fig. 1. It is practically the same circuit as one previously published, except that several improvements have been incorporated. The extra r-f tuner has been added and the pick-up coil is connected in the cathode lead of the modulator.

T1 and T2 are two equal radio frequency transformers as de-

Intermediate; with 6-Inch Aerial, No Ground

Anderson

scribed above, and T3 is the oscillator transformer as described. Condensers C1, C2 and C3 are a gang of three 350 mmfd. tuning condensers. Across each is a trimmer for lining up the tuners at the high frequency end. T4 and T5 are two 400 kc intermediate frequency transformers, each being tuned both in the primary and the secondary. T5 is a push-pull audio frequency input transformer.

Grid bias detection is used in both detectors, the resistor in each case being 30,000 ohms. The by-pass condenser C10 across R8 in the modulator is 0.1 mfd. and C6 across R3 is 0.25 mfd. R6 is a 300 ohm resistance to augment the bias on the power tubes supplied by the voltage of the storage battery. A common bias resistance R7 of 300 ohms is used for the first radio frequency tube and the intermediate amplifier tube. The volume control is a 10,000 ohm potentiometer connected between K and P on the volume control socket VC. This potentiometer also controls the bias on the two high frequency amplifier tubes.

The Oscillator

The oscillator is a 237 tube. Its grid is not biased except by the drop in the 100,000 ohm leak R7 due to grid current. To limit the intensity of oscillation a 10,000 ohm resistance R1 is connected in the grid lead between the top of the tuned circuit and the 0.001 mfd. stopping condenser C5.

C4 is the series padding condenser. This is supposed to have a value of about 436 mmfd. There is at this time no variable condenser available covering this value. Therefore C4 was made up of two condensers in series, one a 0.001 mfd. fixed condenser and the other a 700—1,000 mmfd. variable. It could also be made up of a condenser of 350 mmfd. and a variable of 100 mmfd. on parallel. In case the series combination is used it is important to put the 0.001 mfd. fixed condenser between the top of the tuning coil and the variable condenser and to put the adjusting screw side of the variable to the tuning condenser C3. In case the parallel combination is used the adjusting screw side of the variable should still be connected to the tuning condenser.

Audio Amplifier

A radio frequency by-pass condenser C7 of 0.00025 mfd. is connected across the output of the detector. This is followed by a coupling resistor R4 of 250.000 ohms. The stopping condenser C8 is of 0.1 mfd. and the grid leak R5 is one megohm. The first audio amplifier is a 237 tube in the plate circuit of which the full voltage of 135 volts is applied. The bias is obtained by connecting the cathode to A plus and the grid return to A minus. This amounts to about 6 volts.

The output stage contains two 238 pentodes in push-pull. These also get 135 volts on the plates and on the screen. A bias of 6 volts is obtained from the storage battery and this is practically doubled by resistance R6, which has a value of 300 ohms.

C9 is a 0.25 mfd. by-pass condenser which also serves to complete the radio frequency tuned circuits when the positive side of the car battery is grounded. When the negative side is grounded this condenser becomes shorted. C11 is a by-pass of 0.1 mfd. across the bias resistance for the two radio frequency amplifiers.

The Screen Voltage

The screen voltage on the two high frequency amplifiers is 67.5 volts when these tubes are 236's. When they are 239's the screen voltage should be 90 volts. These tubes are interchangeable except that it is advisable to use the higher screen voltage on the r-f pentodes. It is also advisable to use the 239 pentodes because they will make the set much more sensitive than two 236 tubes. The two high frequency amplifiers are the first and the fourth tubes in the circuit.

The screen voltage on the two detectors is 6 volts, less the drop in the bias resistances serving these tubes.

The low screen voltage on the two 236 detectors is used for two reasons. First, it makes the tubes efficient detectors on weak signals. Second, it makes the circuit almost automatically controlled as to output. Before the second detector overloads to the extent of causing distortion the signal voltage on the power tubes is sufficient to cause distortion there, although the overloading point is reached in the two about the same time. As the signal voltage increases the first detector overloads, but all that happens is that the output is less. There is no distortion of the signal in the first detector. This volume limiting feature is quite marked on strong stations and it shows up in the manual volume control. As the control is advanced the volume increases gradually until a certain level is reached beyond which there is practically no change. Overloading often results in two peaks while tuning but in this circuit there was no evidence of this.

There is a four-lead voltage supply cable. One lead in this cable

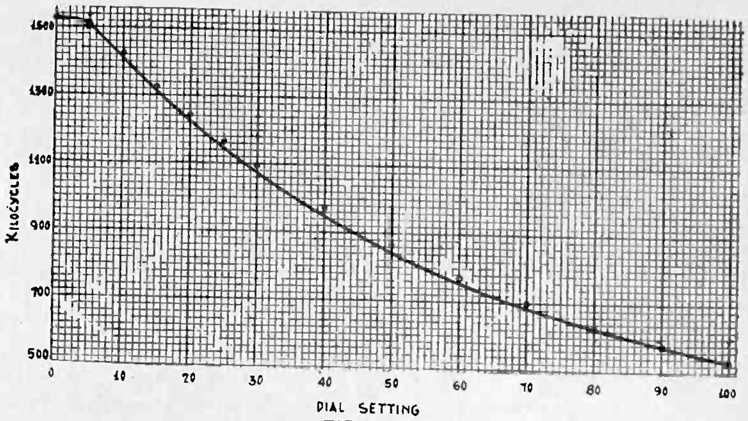


FIG. 2
The calibration chart of the tuner in the eight-tube superheterodyne.

is connected to the 135 volt tap on the plate battery, another to the 67.5 or the 90 volt tap, a third to B minus, which connects with the A plus side of the circuit. This connection could also be made externally between the two batteries.

The fourth lead, marked A in the drawing, connects to the live side of the storage battery in the car, whether this side is positive or negative. In the set this lead is connected to Hp on the volume control socket. From Hp on the socket the lead goes through the remote control cable and picks up the pilot light, the fuse, and the line switch. One side of the pilot light is connected to the case and thus completes the pilot light circuit as soon as the switch is closed.

Another lead in the remote control cable returns to Hk on the volume control socket. The connection of this in the set depends on whether the positive or the negative side of the car battery is grounded. If the negative is grounded connect Hk to Y, that is, the positive side of the filament circuit. In this case connect X to the chassis. If the positive of the car battery is grounded, connect Hk to X, that is, the negative side of the filament circuit. In this case connect Y to the chassis of the set. If these instructions are followed there will be no danger of shorting anything and there will be no change in the voltages applied to the tubes. The only essential difference in the circuit is that when the positive of the car battery is grounded C9 is a part of the tuned circuits while when the negative side is grounded this condenser is shorted.

In both cases the car battery voltage is added to the voltage of the plate battery. Thus in the case of the power tubes, since there is a drop of about 6 volts in R6, there are still 129 volts effective on the plates and screens. On the first audio amplifier the plate voltage is just 135 volts since the cathode is connected to the negative side of the plate battery.

Layout of Parts

The front cover illustration shows the layout of the parts in the super. The three-gang tuning condenser is placed in the middle of the 11½ x 7 inch chassis. At the left of the condensers are the first radio frequency amplifier, the oscillator, and the first detector, in the order named starting from the front. At the left of the tubes are the radio frequency coils in the same order. Back of the tuning condensers are the two intermediate frequency coils and the intermediate frequency amplifier tube. At the extreme right is a row of four tubes with the second detector at the back, the 237 audio tube next, and the two power tubes in front.

Fig. 3 shows the layout of the parts under the chassis. The various condensers and resistances associated with the oscillator are mounted over the oscillator tube socket and the coil. In the middle is a three section by-pass condenser, 0.1 mfd. to a section, and near the power tubes is mounted the audio frequency transformer. The small condensers and resistors are mounted wherever most convenient as close to the tubes to which they are connected as possible.

At the left on the front of the chassis is the volume control socket and at the opposite side the speaker socket.

Mounting of Tuning Gear

The remote control unit includes a driving pulley attached to the condenser shaft. However, it is not shown in the figure. A thin wire, moving in a sleeve of a separate cable from the volume control unit and attached to the driving drum, is connected to the pulley on the condenser. The chassis end of the sleeve is anchored to the

(*Continued on next page*)

How Remote Control Works in Car

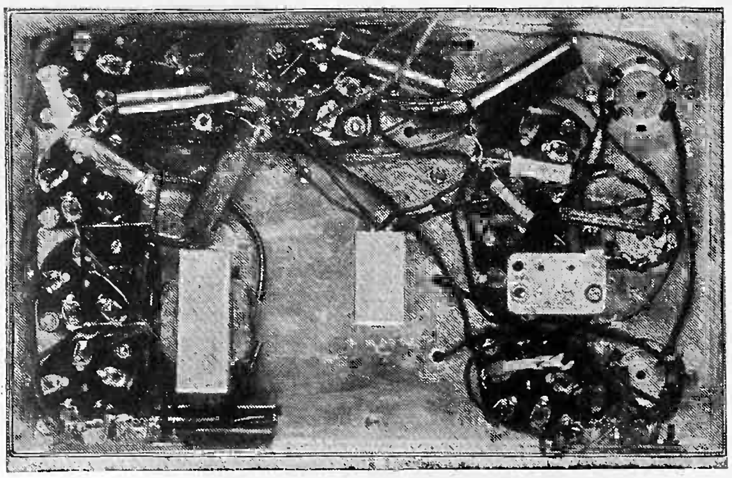


FIG. 3

Bottom view of the superheterodyne showing the location of the by-pass condensers, the audio transformer, and the resistors.

(*Continued from preceding page*)

receiver by means of a special chuck provided. This chuck may be mounted on the chassis container. However, room has been allowed between the tuning condensers and the radio frequency tubes for attaching a metal plate to which the anchor may be fastened. There are holes in the condensers which may be used for fastening the plate.

Short-Wave Club

ARE you interested in short waves? Receivers, transmitters, converters, station lists, trouble shooting, logging, circuits, calibration, coil winding—what not? If so become a member of Radio World's Short Wave Club, which you can do simply by filling in and mailing attached coupon. Or, if you prefer,, send in your enrolment on a separate sheet or postal card. As many names and addresses as practical will be published in this department, so that short wave fans can correspond with one another. Also letters of general interest on short wave work will be published. Besides, manufacturers of short wave apparatus will let you know the latest commercial developments. Included under the scope of this department is television, which is spurting forward nicely.

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

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Dick Leigh, Box 431, West Los Angeles, Calif.
R. D. LeFevre, Box 537, Farmersville, Texas.
George L. Davidson, 11 Acadia Park, Somerville, Mass.
F. C. Rotger, 451 5th St., Niagara Falls, N. Y.
Frank E. Habich, 6230 South Kedvale Ave., Chicago. Ill.
Dr. R. Spencer, Fort Hamilton Station, P. O. Box 54, Brooklyn, N. Y.
Leo E. Schwamm, 757 8th St., Douglas, Ariz.
T. E. Simpson, 718 E St., Sacramento, Calif.
Ray J. La Fortune, P. O. Box 543, Ottawa, Ont., Canada.
Emil Chotena, 1209 "P" St., Ord, Neb.
Francis J. Duvic, Jr., 435 S. Olympia St., New Orleans, La.
James O. Forrester, 423 Caldwell St., Clairton, Pa.
Norman Reich, 192 Columbia Ave., Irvington, N. J.
R. W. McGowan, 7107 Vernon Ave., Chicago, Ill.
Sol Gecho, 1534 S. Springfield Ave., Chicago, Ill.
Max Silber, 1509 So. Kedvale Ave., Chicago, Ill.
Edwin J. Killer, 10136 Nanford Rd., Cleveland Ohio.
Basil Semiginowski, 1932 N. Richmond St., Chicago, Ill.
Herbert Mallon, 920--2nd St., N. E., Canton, Ohio.
Fred F. Prewett, 5535 Ellis Ave., Chicago, Ill.
Alfonso Fabris Arce, 2008 Polk Ave., Houston, Texas.
Edmund F. Perls, Gettysburg Academy, Gettysburg, Penna.
Edwin K. Bruce, 16 "O" St., N. W., Washington, D. C.
Fred Wengrzyn, 29 Washington St., Ipswich, Mass.
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Ultra-Frequency Oscillators

By Redmond McNary

When oscillators which are to operate below fives meters are constructed, lumped inductances and capacities cannot be used because in order to reach the short waves it is necessary to reduce as much as possible both the inductance and the capacity in the tuned circuit. As a rule, the inductance consists of a single turn of wire or copper tubing a few inches in diameter and the capacity in the circuit is the capacity between the grid and the plate of the tube, as well as other distributed capacities which cannot be avoided. The fact that no variable condenser can be used, eliminates a ready means of varying the natural frequency of the circuit. Hence it is necessary to adjust the inductance to approximately the desired value.

The extremely small inductance required can be seen readily by making a simple computation using a reasonable value of the distributed capacity in the circuit. Suppose it is possible to reduce the capacity to 8 mmfd. and that we wish to reach a wave of 2 meters, or a frequency of 150,000 kc. This requires an inductance of 0.1405 microhenries. It is not easy to obtain such an inductance in a circuit because even the leads inside the tube add to the total inductance. It is still more difficult to vary the inductance for tuning purposes.

Wenstrom's Coil

In the balanced oscillator described by Lieut. Wenstrom and described in the Proc. I. R. E. for January, the plate coil consisted of a single turn 9 centimeters in diameter and made of 0.5 centimeter copper tubing. The grid coil was made of the same material and was a single turn 7 centimeters in diameter. The terminals of these coils were soldered directly to the grid and plate posts on the socket. The wavelength of the circuit was approximately 3.2 meters. Hence to get down to 2 meters, it would be necessary to reduce the diameters of the grid and place coils still further.

The inductance of a single turn 9 centimeters in diameter with 0.5 centimeter wire is 182 centimeters, or 0.182 microhenries.

The principal limitation in getting down to low wavelengths is the distributed capacity. Some of this may be reduced by soldering the inductances directly to the prongs on the tube or tubes. This will eliminate the capacity between the grid and plate posts on the socket. The capacity may be reduced still further by unbasing the tube or tubes, which will eliminate the capacity between the prongs and the leads to the prongs inside the tube. By taking these precautions it is possible to cut the capacity in half, and thus reduce the wavelength in the ratio of 1.41 to 1.

Screen Grid Tube Use

Another way is to use screen grid tubes, unbased and without a socket. Screen grid tubes have a low capacity between the plate and the grid. There are special tubes of this type for this purpose. The are without base and the leads have been brought out so as to make the distributed capacity as low as possible.

Another limitation is the grid current, which in a sense is equivalent to the capacity limitation, for the grid current flows in the capacity. In some circuits the grid current may be many times greater than the plate current.

In view of the rapid development of short waves for communication, and intense work in the field everywhere, there will undoubtedly be many special tubes offered to the public for short wave work so that anybody can indulge in the search for circuits and methods for short wave transmission and reception.

Special Tubes Employed

Reports from the Westinghouse organization in Pittsburgh state that a successful demonstration of communication on 0.42 meter has been given. A special tube was required during the tests. Likewise in the successful experiments between Dover, England, and Calais, France, last year special tubes had to be used. In this experiment the engineers succeeded in getting down to 18 centimeters.

For very short waves it is customary to use oscillators that work on an entirely different principle from that used for the longer waves. The ultra-wave oscillators are usually called Barkhausen-Kurz. In these the frequency of oscillation, or the wavelength, is determined by the time it is required for electrons to travel between the elements of the tube, and this time in turn is determined by the potential between the elements. Hence the wavelength generated by these oscillators is varied by varying the applied plate voltage.

Modulation of Oscillators

Service Instrument Readily Fed with Signal

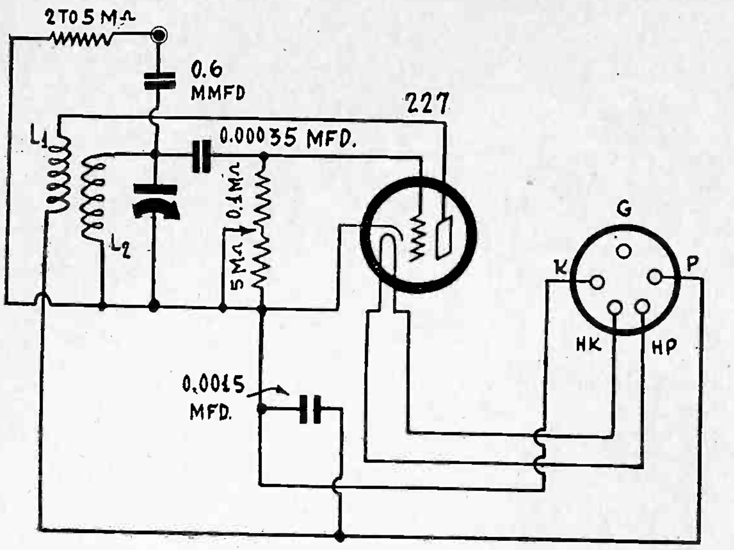


FIG. 1

Grid blocking, as caused by a very high resistance leak, will produce modulation of the high-pitched squeal type, although use of other values for the large resistor will produce different modulation frequencies. The switch gives modulated-unmodulated service.

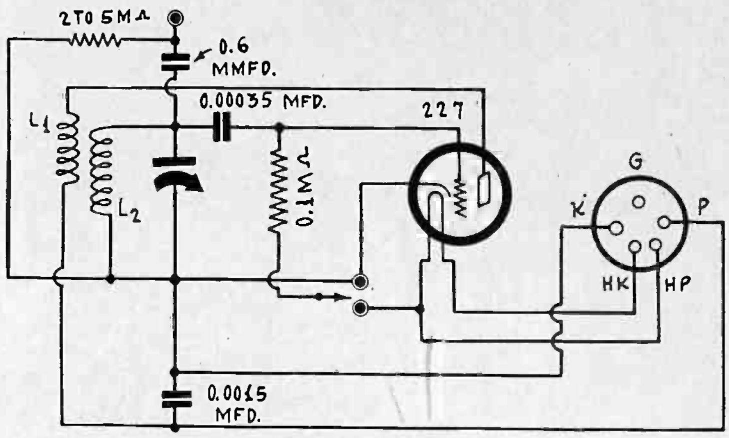


FIG. 2

A way of using the 60 cycle hum for modulation. When the switch is thrown to heater there are 1.25 volts of 60 cycle frequency in the grid circuit, enough to produce modulation. When the switch is thrown to cathode there is no hum.

IN building a service oscillator, such as the one described last week, it is desirable to obtain modulation sometimes, in fact it is absolutely necessary for some tests, and since an adapter type of oscillator may be confronted with battery, a-c or line d-c operated sets, a method applicable to all is useful.

Such a method is shown in Fig. 1, where substantially the same oscillator as depicted last week is used, but now there are two grid leaks in series, one of high value, the other of low value, with a switch to short out the larger one. Modulation will result because of grid blocking when the high leak value (5.1 meg.) is in circuit.

Two Adapters Handy

The idea of the adapter oscillator is that a five prong plug is used for inserting in a socket in an a-c received from which an r-f tube has been removed, and thus the A and B power is picked up. If the heater voltage is 2.5 volts then the oscillator is a 227 tube, normally additional to any tubes in the set. If the set has tubes of the automotive type, the 237 tube is used as oscillator with no changes. In other instances any type of set will serve as the source of power, provided that the general purpose tube of the series is inserted in the adapter. Therefore two adapter plugs are needed, for such universality, a four-pin plug with UY top holes, to go into set sockets requiring it, and a five-pin (UY) plug with four UX top holes, to go in the five-spring socket of the service oscillator.

Two principal ranges are taken care of by use of plug-in coils. One is the broadcast band, and a little extra, the other is the intermediate frequency band, 150 to 300 kc, to take care of the popular intermediate frequencies. Data on coils and calibration were published last week.

Another Modulation Method

If it is desired to use the 60 cycle hum for modulation, which restricts use to premises where this frequency is obtainable, then a single pole double throw switch may be used, pointer to the low end of the 0.1 meg. grid leak, the two optional connecting points being cathode and the heater. Then, in the case of 2.5 volts a-c on heaters, there will be a hum voltage of 1.25 volts introduced, and this will be sufficient to modulate the grid circuit. The practicality of this method was discussed briefly in last week's issue.

As can be gleaned from technical articles on the construction and servicing of superheterodynes, it is important to have a service oscillator, and here is one that can be built cheaply, say for $5, and yet will give good results.

Although only two ranges have been discussed, it is practical to go very high in frequency, and even lower than 150 kc, if desired. A calibration was made of a coil wound on 1.5 inch diameter, 50 turns of No. 28 enamel wire on the secondary, 20 turns of any fine wire on the tickler which adjoins secondary, and the extreme frequencies were approximately 1,300 and 4,000 kc with 0.00035 mfd. This is in line with the expectation from such a capacity, which develops a frequency ratio of about 3-to-1, due to a capacity ratio of 9-to-1, the one being the square root of the other.

0.6 Mmfd. Capacity Correct

Some doubt may arise as to the correctness of the fixed condenser used at the output of the test oscillator, as it is marked 0.6 mmfd. This capacity is correct. It is a series capacity and is equivalent to a parallel capacity of 0.05 mfd. at 1,000 kc, this parallel capacity being familiar in band pass filters where the low or otherwise grid return leads of two tuned circuits are grounded through a common condenser of 0.05 mfd.

The method of using the test oscillator was described in detail last week, along the same skeletonized lines of the special treatment in another article in this week's issue, which article also dispels some misassumptions that service men have on the subject of oscillator padding.

Indirect Measurement of I-F

The service oscillator is useful for lining up t-r-f receivers and for padding the oscillator of superheterodynes.

A point worth noting is that, if you can not directly measure the intermediate frequency, say, if it is outside the range of the low frequency coil, you can tune in repeat points of set oscillator, note the absolute value of frequency of the oscillator setting, by using the service oscillator for zero beating, and divide by two the difference between these two frequencies. Make this test for several pairs of repeat points, as a check, which is easy on low intermediate frequencies, to be sure you are not being confused by harmonics.

Plugs Into R-F Socket

It has been pointed out that this service oscillator plays into an r-f socket. This of course may include modulator. But do not confuse this with other circuits (see page 4) that have to do with connection to the socket of an output pentode.

A Band Pass Filter 5-
High Selectivity, Good Tone

By Enoc

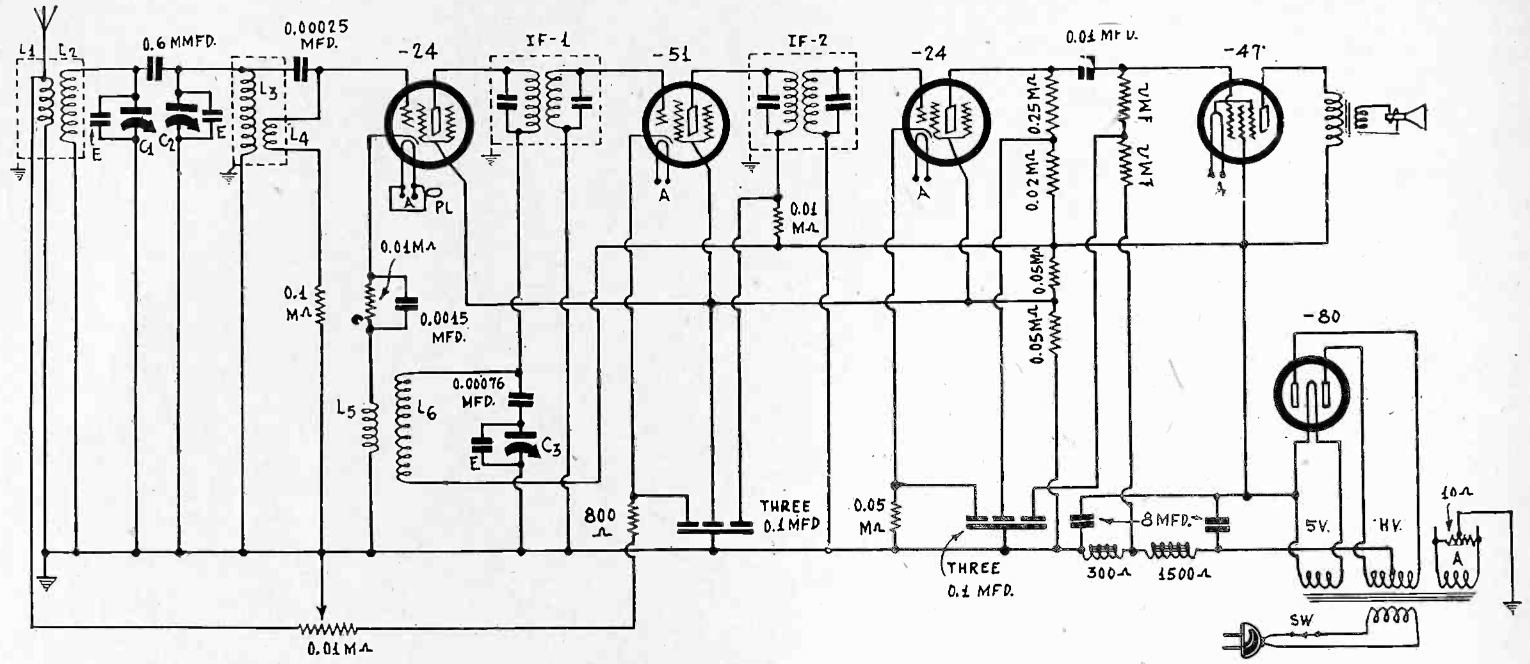


FIG. 1

The first -24 tube is used as an autodyne in this circuit, there are also a stage of intermediate, a second detector, pentode output and -80 rectifier. All told, the performance is worth while, especially the selectivity which, for a 5-tube set, will surprise many.

THE fewest number of tubes that can be used successfully in an a-c superheterodyne circuit is five. With five tubes a very respectable tuned radio frequency set can be built. Just what is the difference? Is one preferable to the other, especially as the superheterodyne will cost a few dollars more to build?

The answer lies in selectivity. If the requirement for selectivity in your location is greater than the amount obtained from the tuned radio frequency set, the five-tube super is the answer. Then the choice is simple and easy. If what you want is more sensitivity, and do not find selectivity so very important, you should choose the t-r-f set. Therefore, in general, the super is preferable in areas where there are numerous broadcasting stations, while the t-r-f set is preferable in outlying districts. This statement refers only to the choice between two different five tube sets, rectifier included among the tubes.

Aid to Selectivity

Even to build the super it is necessary to resort to some ingenuity. An oscillator and a modulator are necessary for mixing, but it is practical to combine the functions in one tube. This is done at a little sacrifice, it must be admitted, since the coupling between modulator and oscillator is virtually unity. Since that is true it is not necessary to feed a very high signal from a station into the combination tube or autodyne, for the selectivity will be higher if the coupling to antenna is loose, and a strong oscillation is relied on for feeding enough "hop" into the single intermediate amplifier tube. The intermediate frequency amplitude is the product of the amplitudes of the radio frequency and oscillation voltages.

Since the object is selectivity, and since interference due to intermediate response to a frequency definitely off the desired frequency is likely, pre-selection at the radio frequency level is highly advisable. This is the station frequency level, called "radio frequency" level, although oscillator and intermediate frequencies also are radio frequencies. Common radio terms are not always consistent.

A band pass filter therefore is used. The aerial is connected to the primary of the antenna coupler, the secondary is tuned in the usual way, the transformer is in a shield and isolated from the shielded tuned stage that directly feeds the autodyne tube, except for such coupling as results from introduction of a very small capacity between the high voltage ends of the tuned windings.

An Important Safeguard

What would be the secondary is the impedance coil input to the first tube, while the otherwise primary is connected in the grid circuit in series with a leak of 0.1 meg. The stopping condenser of 0.00025 mfd. and the leak are used for a stabilization circuit, to reduce frequency drift due to voltage changes, and also reduce the minimum capacity of the circuit. Those who have been amazed at the small frequency range of oscillator circuits supposed to cover the frequencies for bringing in the broadcast band should resort to this leak-condenser remedy and note the considerable improvement. The components are not there for detection, since power detection is used.

The first tube is a —24, and if the biasing resistor is from 6,500 to 10,000 ohms satisfactory modulation, or detection, will result. This tube is the first detector, as stated. But it is also the oscillaor, and this because the plate circuit's field is fed back to the cathode in the phase relationship that produces oscillation.

Frequency Analysis

Let us analyze the frequencies. First, there is the signal level frequency. This is fed into the tube through a twice-tuned circuit. The output of the tube would be the same, and there would be no frequency to energize the intermediate level. However, another frequency is introduced in the plate circuit by returning the primary of the intermediate frequency transformer through a circuit tuned to that other frequency. By feeding back into the cathode circuit, which is in both the grid and plate circuits, this second frequency is made one of oscillation. Therefore, if the intermediate frequency is 175 kc, the oscillation frequency may be 175 kc higher than the signal level or "radio" frequency, and then we have an output from the tube, at 175 kc, that finds a tuned circuit ready to pass it on to the intermediate frequency amplifying tube. This second tube is a —51 or —35.

Now, both the primary and the secondary of the intermediate frequency transformer are tuned. Indeed, although there is only one i-f stage, there are two i-f transformers, for one must couple to the second detector. Disregarding the unison of the tuned circuits, there are seven tuned circuits. However, three pairs are band pass filters.

Example of 10 kc Cutoff

The station frequency tuning is done through such a filter, as explained, while the modern intermediate transformers also are band pass filters, due to the precisely correct degree of coupling to achieve such result, as between two tuned windings. The selectivity becomes really high—much higher, for instance, than with four stages of t-r-f.

It is no trick at all to blot out a 50 kw station in your locality and bring in another and weaker powered station hundreds of miles away, 10 kc removed. It is being done by the author in New York, WOR being silenced to bring in WLW.

The same precautions as to padding have to be taken with this as with any other superheterodyne that uses gang tuning. Several articles on padding have been published, including mathematical

Tube Superheterodyne; in a Compact Assembly

Warren

treatment and practical applications. Here we shall give the number of turns and recommend the use of a highly precise fixed padding condenser that produces tracking when used with the recommended inductance. The capacity is 0.00076, for use with 0.00035 mfd. tuning condenser, and is made by several manufacturers.

The antenna coupler, L1L2, consists of 127 turn secondary, of No. 32 wire or thereabouts, wound on 1 inch diameter and has over it, insulation fabric between, 20 turns of the same kind or finer wire for primary, near the bottom of the coil. L3L4 have the same characteristics. Now, the oscillator consists of the same kind of a coil, too, with the single exception that the secondary turns are 117 instead of 127.

Tracking Adjustments

With even these simple directions it is possible to get signals fairly well. There may be some squealing, due principally to failure of the oscillator to track perfectly. However, there is an adjustment to make. The set is tuned to as low a frequency as possible, while the parallel condenser E, a trimmer across the oscillator capacity, is adjusted until response is loudest. Then some station at the other extreme is picked up, and the C1 and C2 trimmers are adjusted for best response there, without molestation of the parallel trimmer cross the oscillator.

This assumes that the intermediate frequency really is 175 kc and that the intermediate coils are lined up. You should be able to test your intermediate frequency, an independent oscillator, preferably modulated, being used. And of course if you also have a service oscillator for the broadcast band, feed its output into the antenna primary L1, instead of using broadcast stations for testing.

If you have no means of testing the intermediate frequency, or even the broadcast frequencies, you will no doubt assure yourself that you have intermediate transformers that can be tuned to 175 kc. and therefore you will tune in a high frequency station (say, 1,400 kc), adjust the signal level band pass filter for loudest response, and then adjust the intermediates for loudest response.

Why Quality Is Good

At first you may not hear anything, due to the intermediates being away off, so then you will adjust the intermediates first, then the signal frequency filter, then return to the intermediates and again to the other for final line-up.

The second detector is a -24 tube. Do not use variable mu tubes as modulator or demodulator in this circuit. Of the variable mu tubes only the automotive model, the 229 r-f pentode, is any good for modulation.

The detector feeds the pentode output tube, resistance coupling being used. The values of the resistors are familiar to most experimenters. But the screen voltage is purposely high, to enable high bias on the second detector, and is taken from the juncture of two 0.05 meg, leaks put between ground and B plus. If it is desired to lower the screen voltage this may be done by using 0.25 meg. (25,000 ohms) between joint and ground, instead of 0.05 meg. It is sometimes necessary to do this.

Stopping I-F Oscillation

However, the principal precaution is taken, as shown in the diagram, by introducing a resistor of 0.01 meg. in the plate lead of the intermediate tube. It is notorious that this tube will oscillate badly in the compact assemblies used, unless the plate voltage is cut down, or other precautions taken. One of the other methods is to use a higher value of biasing resistor than 800 ohms, indeed circuits have worked splendidly with thousands of ohms in this position (cathode to B minus).

As for the rest, the circuit follows the familiar pattern, of midget receivers, a pattern not to be scoffed at, since many thousands have marveled at the resultant fine tone and high audio sensitivity. The low note response is made particularly good by the use of the two 1.0 meg. leaks in the grid circuit of the pentode, even though one of these leaks is bypassed. Indeed, the bypassing is effective, as to audio signal, largely on the high notes, as a compensation for the high-note accentuation of the pentode.

That Third Harmonic

As for the much-discussed third harmonic distortion of the pentode, while some is present, the fact is that the ear does not notice it, and one listens with the ear, I believe. Any other output tube would require an additional audio tube, total six tubes instead of five. Also, the high content third harmonic is in battery or d-c operated types of pentodes, not in the -47.

The B supply choke is in the negative leg, the bias for the pentode is derived from a drop in part of this choke, two 8 mfd. electrolytic condensers are used to augment the filtration and to hold up the voltage, while the five points (pentode plate, B plus, B minus, tap of B choke and ground end of choke) are picked up by a cable with UY plug at the end. Thus an extra socket is included, usually at rear of chassis, for establishing these connections into the set. The B choke is the dynamic speaker's field coil.

Size of Output Transformer

The question has come up as to how such fine quality admittedly can be produced although perhaps a small speaker is used and the output transformer is not very husky. The smallness of the speaker is of no greater importance than the faithfulness of the audio amplifier, and even the absence of a large baffle can be compensated for by sort of tuned audio, whereby the lows are favored. As for the transformer, huskiness is not necessary. The problem is one of turns ratio, of matching impedances, and indeed even with a small transformer the impedance may look to the tube as virtually a pure resistance, which is the goal.

LIST OF PARTS

Coils

Two shielded radio frequency transformers
Two shielded 175 kc transformers, primary and secondary tuned
One power transformer (pentode type)
[Note: B supply choke is dynamic speaker's field coil]
One shielded oscillator coil

Condensers

One two-gang 0.00035 mfd. shielded straight frequency line condenser with equalizers (E)
One 0.6 mmfd. fixed condenser
One 0.0015 mfd. fixed condenser
One 0.00076 mfd. fixed condenser (accurate to 2 per cent).
Two shielded blocks, three 0.1 mfd. condensers in each block
One 0.01 mfd. mica fixed condenser
Two 8 mfd. electrolytic condensers, one with insulating washers and a special connecting lug
One 0.00025 mfd. fixed condenser

Resistors

One 10 ohm center-tapped resistor
One 800 ohm pigtail resistor
One 0.01 meg (10,000 ohm) potentiometer with switch attached
Two 0.01 meg (10,000 ohm) pigtail resistors
One 0.02 meg. (20,000 ohm) pigtail resistor
Three 0.05 meg. (50,000 ohm) pigtail resistors
One 0.25 meg. (250,000 ohm) pigtail resistor
Two 1 meg. pigtail resistors

Other Requirements

One chassis, 3 inches high, 14 inches wide, 7½ inches front to back
Four UY sockets and one UX socket
One vernier dial with pilot lamp and bracket
One dynamic speaker, with output transformer and 1,800 ohm field coil built in; field tapped at 300 ohms
One a-c cable and plug
Two—24 tubes, One—51 (or — 35) tube, one—47 and one—80

As stated, the bias on the second detector tube is high. Actually it is almost 9 volts. This exceeds by far the usual recommendation, however the standard method has to do with a lower screen voltage. By putting the screen voltage up, so that, as here, it is around 100 volts, the high negative bias is well supported, and there is a pleasing absence of distortion on loud signals. It must be remembered that there are two factors to consider: first, the signal level itself, as introduced into the first tube, and then the level of the output of that tube. The oscillation intensity may be so strong that it is very many times greater than the signal intensity level, and it would be possible to overload both the first and second detectors, even without any signal put in.

However, the oscillator intensity is kept below that mark. Moreover, while the first detector overloading would not be so serious, second detector overloading would be, hence the encouragement to use a high value of negative bias.

There is no simple relationship between the bias of the negative detector and the bias of the output tube. In voltage values these are respectively 9 volts (approximately) and 16.5 to 20 volts. The detector is gainful, and an arbitrary value of 2 working mu may be ascribed, in which case the power tube would overload before the second detector, which is as it should be. The mu assignment is theoretical, but the performance indicates some measure of correctness.

A Super with
Short Waves by Swit
Resistance P

By Rog

A TEN-TUBE superheterodyne for broadcast and short waves! Fig. 1 shows the diagram. The circuit is as follows:

(1)—Stage of tuned radio frequency ahead of the tuned modulator.

(2)—Power type modulator.

(3)—Two stages of intermediate frequency amplification.

(4)—Diode detector.

(5)—Resistance coupled audio feeding pentode push-pull output.

(6)—Automatic volume control tube.

The circuit is primarily for broadcast use. Circuits using switching methods, for covering broadcast and short waves, usually are primarily designed to give highest type results either on short waves or on the broadcast band. The additional advantage, whichever one it is, simply adds that much to what you already have, but outstanding results are scarcely attained in both spectra. In a superheterodyne, this is particularly true, because a definite intermediate frequency has to be selected.

Option of Plug-in Coils

While the diagram shows a switch method of band shifting, nevertheless plug-in coils may be used by those who want much better results on the shorter waves.

The usual method of putting coils in a set is to fasten them in, but if tube sockets are used where the coils are to go, even the tapped coils can be plugged in, and afford the convenience of switch operation when one desires, say, merely to hear some American relay broadcasting on short waves some police or amateur calls or the like, whereas plug-in coils for the short waves may be substituted, without taps. Then there is assurance of much better results, also of oscillation at the highest frequencies, or lowest waves, from 30 meters down.

Tapped coil systems have a habit of not performing much below 28 meters, although separately wound coils on the same tubing, one winding for each band, with even as little as 1/8-inch space between, will oscillate to 15 meters. However, here we can not well use the separate-winding method, single form type, and besides the entirely separate coil method is still better.

The reader will notice that the oscillator is padded for the broadcast band. A fixed condenser of 0.00076 mfd. is hanging from the oscillator grid circuit in the diagram, and at the extreme right-hand setting of the coil switch this padding condenser becomes a series condenser for C3, the oscillator tuning capacity. At the two other settings the full capacity of the oscillator condenser, C3, is usable. That is why two taps will provide frequency response to 15 meters, if the oscillator oscillates. While most tubes will stop oscillating, when this coil system is used, at around 28 meters, plug-in coils support oscillation to below 15 meters, as stated.

Effect of First Stage

So, since equal capacities of the three-gang condenser, C1, C2, C3, are to be used for short waves, with a small manual trimmer across the modulator sufficient frequency difference is established, since the difference need be only 175 kc, the intermediate frequency.

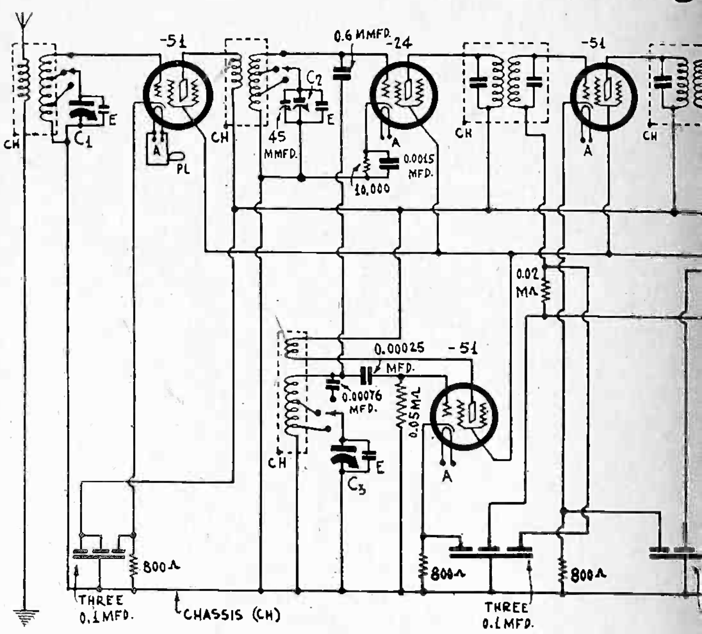
The relative selectivity of the first stage declines as the frequency increases, until the circuit finally becomes ineffective in suppressing image interference. The discrimination would have to be better than 350 kc at all times, and at 15,000 kc. this would be impossible, so alignment of the first circuit with the modulator at the high frequencies would be of no practical advantage. There is some discrimination, not much, and reliance is placed on the cumulative effect of the modulator for the image frequency reduction to as high a frequency as practical. There will be results on all frequencies, and the tuning of the first stage, even at the highest frequencies, is useful, as an untuned stage of whatever type is more often a partial short to the highest frequencies rather than a suitable impedance to them.

The grid leak and condenser in the oscillator circuit, not there for detection at all, for little detection results, on account of the high negative bias, improves greatly the results on the higher frequencies, because tending to stabilize the bias voltage even if grid current flows, as it will on strong signals.

Automatic Volume Control

The grid returns of the two intermediate stages are made to the volume control resistor in the automatic volume control tube circuit, after filtration. A steady value of negative bias is applied to the pair of intermediate tubes, so that there will be negative bias when no signal is tuned in, and the set is "on." Any bias by the a-v-c is negative in addition to the steady bias. Part of the output of the second intermediate stage is delivered to the a-v-c tube, the major part of course to the diode detector (or so-called second detector). As a meter is in the a-v-c circuit, this may be used for lining up and tracking, no output meter being necessary.

The automatic volume control results because when radio frequency voltage is fed to the tube from the tuned circuit above, the resultant current is rectified and flows through the 10,000 potentiometer P. On a very weak signal, one barely audible if bias is only steady, and tube were not in circuit, there is no noticeable effect, there being not enough current to develop a



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Short waves by plugging in or by switching, automat ci

voltage that is a factor. However, there is little power taken by the a-v-c tube, so that the voltage input to the diode detector is about the same as it would be otherwise. At this point we are interested not in current, but in voltage for the detector.

Push-Pull Resistance Coupling

The manual control of volume may be set at any desired volume, and in general then no station will come in louder than that. The volume of weak stations will not be diminished, neither will the volume be built up by the control to make the weakest station come in as loud as the strongest one. That situation only would arise if the strongest station, by use of the manual control, were reduced in volume to the sound quantity reproduced from the weakest station, which is something one hardly ever desires or does.

Since the detector is a diode, no return need be grounded, and therefore the diode is suitable for superheterodynes, for no manual tuning is done. The cathode is positive, the anode (combined grid-plate of a triode) is negative, so a resistor between anode return and cathode will develop a d-c voltage drop. The voltage is pulsating, due to the effect of remaining audio frequency, so isolating condensers may be connected from both cathode and anode return, to develop a voltage across a resistor the center of which is grounded. Thus the voltage at one extreme of the resistor will be the same as that at the other extreme, but the phase will be opposite. Hence the grids of push-pull tubes may be fed, a voltage equal but opposite being just what is required. It is a case of true push-pull, not practical with triodes because of the effective grounding of the plate resistors, unless a transformer is used.

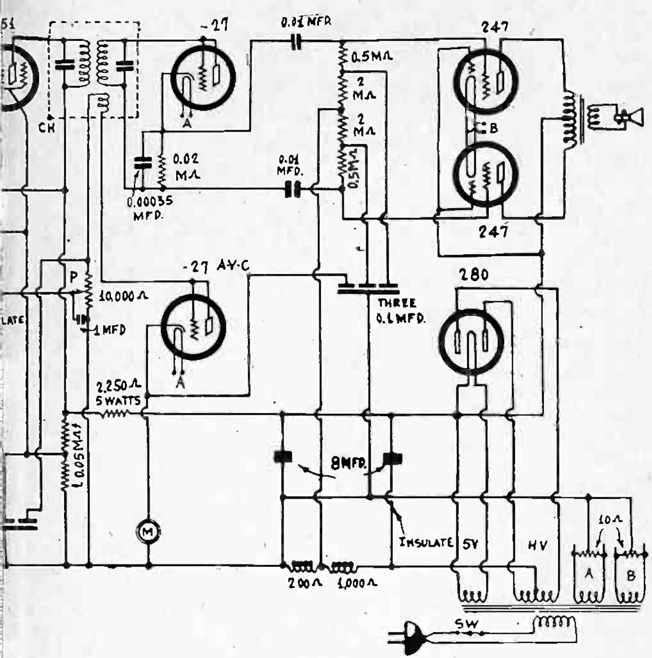
Hum Filters

Instead of a single resistor, with center to ground, in the grid circuits of the push-pull stage, individual leaks are used. Between grid and ground the resistance is 2.5 meg., of which the 0.5 meg. is between grid and a 2 meg. leak, the other extreme of which is grounded. A filter condenser of 0.1 mfd. goes from the joint of the 0.5 meg. and 2 meg. to ground and serves hum reduction.

This type of audio circuit, being one of most excellent quality, is likely to reproduce hum "better" than the average audio channel, and therefore precautions must be taken. The 0.1 mfd. capacity reduces the hum to allowable limits, but up to 1 mfd. may be used, of course equal capacity in equal position, and to still greater filtration effect. Besides, the filtration in the B

New Features
ng or Plugging In— 1-Pull Audio

Rouse



me control, push-pull resistance audio are in this

ply itself should be good. The field coil of a dynamic speaker afford this result, and if tapped at the right point may also used for biasing the push-pull stage.

he grounding of various stages has been referred to, although diagram shows external ground connected only to the pri-y of the antenna coupler. However, there is a large capacity ground through the power transformer, and the chassis is efore at about ground potential. The reason for isolating the ernal ground is that it may be at a lower potential, and usual-s, so that when one touches the chassis under the conditions ig. 1, the effect is heard in the speaker. At some frequencies ernally grounded chassis causes hum modulation because antenna current is returned through the power transformer.

8 Watts Output

ven not counting the effect of the automatic volume control, ch effect is removed when the pointer P is on the ground , the diode detector will not be overloaded. Since it will ld more than 20 ma as a rectifier, and no current even nearly great will be caused by any signal, the second intermediate e and the power tubes are the limiting factors, unless the llator's intensity is so great as to overload even the modu-r. This is unlikely at any frequency, as the 0.05 meg. leak ls down the intensity to a considerable extent. The very servative output power rating of the last stage is 8 watts. he tuning coils, as stated, are wound on plug-in bases, of UY type, and are 1.25 inches in diameter. Considering the and modulator coils, which are identical, the secondaries sist of 115 turns of No. 32 enamel wire, or wire of about that while the primaries are wound near the bottom, over the ndaries, and consist of 15 turns each, any size wire, in-ting fabric between. The secondaries are tapped in two es, and these taps, counting from the grid end, are at the turn and 102d turn. The oscillator coil has a secondary of turns, tapped at the 68th and 93d turns from the grid end. refore the modulator winding has 76 turns from grid to tap, 26 turns from first to second taps. The extreme used grid is not rated as a tap in these considerations. The oscil-r has 68 turns between grid or extreme and first tap, 25 turns ween first and second taps. The oscillator plate winding is on top of the secondary, with insulating fabric between, and ists of 25 turns. The grounded end of the grid winding is the bottom and the outside windings are put on near this t. As for the oscillator, if there is no oscillation simply rse the plate and B plus connections. But if a set rule is followed there will be no trouble. Windings in the same direction, the ends of the oscillator plate and grid windings should be oppositely polarized.

Connections to Make

The connections to coil sockets have to be made so that the right terminals are picked up. The antenna coil requires six connections, and the UY plug has only five, but the shields may be of zinc composition and the B minus coil terminal soldered to shield. The oscillator requires six connections, obtained in the same manner. In the antenna stage aerial may connect to P, external ground to heater adjoining plate, grid to G, first tap to K, second tap to heater adjoining cathode, and B minus (grid return) to shield. The interstage coupler at the radio frequency level has the same connections, except that P and B go respectively to plate of tube and B plus. Oscillator connections are like modulator connections, since the coil goes to the grid condenser even if the padding condenser is picked up by the switch.

For short waves, the plug-in coils should be wound as per previous directions for numbers of turns, so that there would be 39 turns secondary for the r-f and modulator stages, ¼-inch space between, and primaries of 12 turns wound next to, not over, secondaries. The wire on the secondaries may be No. 18 enamel. The oscillator plate winding, wound over the secondary of 38 turns, consists of 20 turns of any fine insulated wire, with insulating fabric between tickler and grid turns. Thus the form will be almost filled up with winding. The smallest coils consist of 13 turns secondaries, with No. 18 wire, for all three circuits, the primaries of 10 turns, and tickler of 13 turns, any wire. These secondaries and tickler are ⅛-inch away from the grid winding, beside it, not over it, and the secondaries are spaced by about the diameter of the wire used.

The coil switch is thrown to the first tap position when plug-in coils are used for short waves, for then the full capacity may be used in the oscillator circuit, that is, the padding is eliminated. Therefore the grid connection for the short-wave plug-in coils is K of the coil socket.

Other Coils

The intermediate frequency transformers are of the shielded type, the shield being at least 2 inches in diameter and 2.5 inches high, of aluminum. The primary and secondary are 800 turn honeycomb coils of an inductance of about 10 millihenries, and tuned by 20-100 mmfd. condensers. The two windings on each transformer are about 1⅛ inches apart. The coil feeding the detector has a pickup winding for the a-v-c tube, which winding consists of a 300 turn coil placed between the two others.

After the circuit is built the intermediate frequency should be established at 175 kc. by generating that frequency in a service oscillator, preferably modulated. One may be built simply on the basis of an article published last week, and concerning which there are further data this week. The oscillator tube is out of circuit and the service oscillator is connected to plate of the -24 modulator. The meter M may be read for maximum deflection. If a 0-10 milliammeter is used, and the reading isn't large enough for observation, move the pickup coil in the last intermediate transformer closer to the secondary. If a 0-1 ma is used and the reading is too large, move the coil farther from the secondary, and nearer to the plate winding, or put a limiting resistor in series with the meter until the reading is about midway.

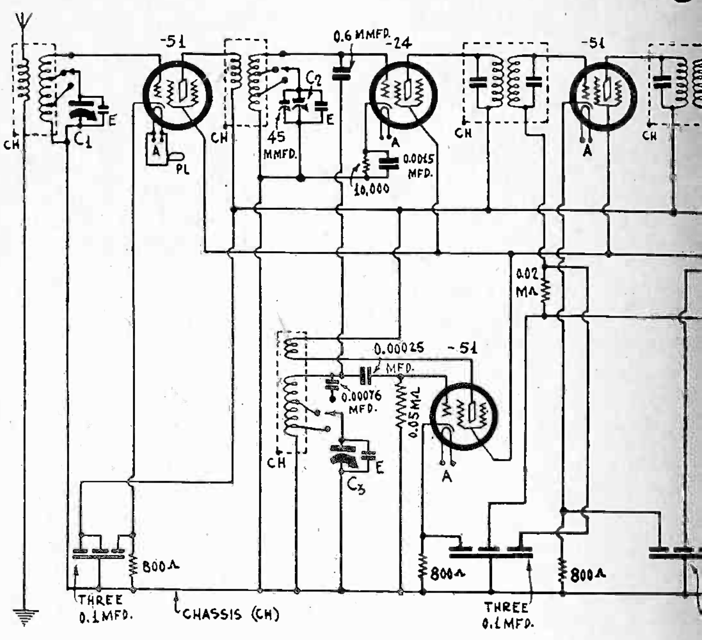
Having established the intermediate frequency, set up the receiver as a t-r-f circuit, removing oscillator tube, removing grid clip connection to the anode of the -27 second detector, and putting the grid clip of the -24 to anode of -27 by an extension wire. Use a service oscillator preferably, or tune in a local station near or at the low frequency extreme of the dial (550 kc), note the setting, and tune in at 1,300 kc. or a little lower. Now remove, install the oscillator tube in the socket of the super and connect a small condenser from oscillator until grid to diode anode. The two oscillator frequencies of 175 kc. higher than the modulator test frequencies should come in at the same dial settings as prevailed for modulator. Adjust E oscillator until this is true at least of the lower frequency tested. Note where much frequency, if any, the oscillator is off at the high end. The connection will be applied by trimmer readjustment of t-r-f and oscillator, using stations. However, if your service oscillator is independently powered, or if you plug into an i-f stage which has been stripped, but continuity established for the signal, the lining up can be done by putting the best oscillation into the antenna primary with nine tubes going. The modulator readings will obtain.

It is preferable to use a service oscillator, rather than broadcasting stations, particularly as ready means are present for testing at other frequencies after the two almost-extreme ones are tested. Turn the trimming condenser that is built into the oscillator tuning condenser until the signal is loudest for the low frequency test, then check up the high end, turning the t-r-f and modulator trimmers to bring in 1,300 kc. or thereabouts at maximum volume. The potentiometer P should be at B minus (extreme position) during these tests.

The subject of lining up is treated more extensively in a separate article in this issue.

A Super with
Short Waves by Swit
Resistance P

By Rog



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Effect of First Stage

So, since equal capacities of the three-gang condenser, C1, C2, C3, are to be used for short waves, with a small manual trimmer across the modulator sufficient frequency difference is established, since the difference need be only 175 kc, the intermediate frequency.

The relative selectivity of the first stage declines as the frequency increases, until the circuit finally becomes ineffective in suppressing image interference. The discrimination would have to be better than 350 kc at all times, and at 15,000 kc. this would be impossible, so alignment of the first circuit with the modulator at the high frequencies would be of no practical advantage. There is some discrimination, not much, and reliance is placed on the cumulative effect of the modulator for the image frequency reduction to as high a frequency as practical. There will be results on all frequencies, and the tuning of the first stage, even at the highest frequencies, is useful, as an untuned stage of whatever type is more often a partial short to the highest frequencies rather than a suitable impedance to them.

The grid leak and condenser in the oscillator circuit, not there for detection at all, for little detection results, on account of the high negative bias, improves greatly the results on the higher frequencies, because tending to stabilize the bias voltage even if grid current flows, as it will on strong signals.

Automatic Volume Control

The grid returns of the two intermediate stages are made to the volume control resistor in the automatic volume control tube circuit, after filtration. A steady value of negative bias is applied to the pair of intermediate tubes, so that there will be negative bias when no signal is tuned in, and the set is "on." Any bias by the a-v-c is negative in addition to the steady bias. Part of the output of the second intermediate stage is delivered to the a-v-c tube, the major part of course to the diode detector (or so-called second detector). As a meter is in the a-v-c circuit, this may be used for lining up and tracking, no output meter being necessary.

The automatic volume control results because when radio frequency voltage is fed to the tube from the tuned circuit above, the resultant current is rectified and flows through the 10,000 potentiometer P. On a very weak signal, one barely audible if bias is only steady, and tube were not in circuit, there is no noticeable effect, there being not enough current to develop a voltage that is a factor. However, there is little power taken by the a-v-c tube, so that the voltage input to the diode detector is about the same as it would be otherwise. At this point we are interested not in current, but in voltage for the detector.

Push-Pull Resistance Coupling

The manual control of volume may be set at any desired volume, and in general then no station will come in louder than that. The volume of weak stations will not be diminished, neither will the volume be built up by the control to make the weakest station come in as loud as the strongest one. That situation only would arise if the strongest station, by use of the manual control, were reduced in volume to the sound quantity reproduced from the weakest station, which is something one hardly ever desires or does.

Since the detector is a diode, no return need be grounded, and therefore the diode is suitable for superheterodynes, for no manual tuning is done. The cathode is positive, the anode (combined grid-plate of a triode) is negative, so a resistor between anode return and cathode will develop a d-c voltage drop. The voltage is pulsating, due to the effect of remaining audio frequency, so isolating condensers may be connected from both cathode and anode return, to develop a voltage across a resistor the center of which is grounded. Thus the voltage at one extreme of the resistor will be the same as that at the other extreme, but the phase will be opposite. Hence the grids of push-pull tubes may be fed, a voltage equal but opposite being just what is required. It is a case of true push-pull, not practical with triodes because of the effective grounding of the plate resistors, unless a transformer is used.

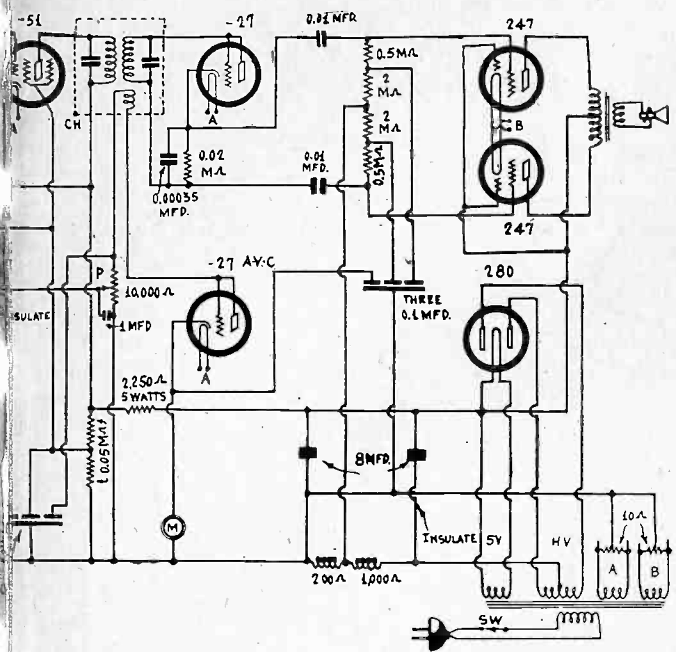
Hum Filters

Instead of a single resistor, with center to ground, in the grid circuits of the push-pull stage, individual leaks are used. Between grid and ground the resistance is 2.5 meg., of which the 0.5 meg. is between grid and a 2 meg. leak, the other extreme of which is grounded. A filter condenser of 0.1 mfd. goes from the joint of the 0.5 meg. and 2 meg. to ground and serves hum reduction.

This type of audio circuit, being one of most excellent quality, is likely to reproduce hum "better" than the average audio channel, and therefore precautions must be taken. The 0.1 mfd. capacity reduces the hum to allowable limits, but up to 1 mfd. may be used, of course equal capacity in equal position, and to still greater filtration effect. Besides, the filtration in the B

New Features
ing or Plugging In—
h-Pull Audio

J. Rouse



ume control, push-pull resistance audio are in this

pply itself should be good. The field coil of a dynamic speaker ll afford this result, and if tapped at the right point may also used for biasing the push-pull stage.

The grounding of various stages has been referred to, although e diagram shows external ground connected only to the pri- ary of the antenna coupler. However, there is a large capacity ground through the power transformer, and the chassis is erefore at about ground potential. The reason for isolating the ternal ground is that it may be at a lower potential, and usual- is, so that when one touches the chassis under the conditions Fig. 1, the effect is heard in the speaker. At some frequencies ternally grounded chassis causes hum modulation because e antenna current is returned through the power transformer.

8 Watts Output

Even not counting the effect of the automatic volume control, nich effect is removed when the pointer P is on the ground le, the diode detector will not be overloaded. Since it will and more than 20 ma as a rectifier, and no current even nearly at great will be caused by any signal, the second intermediate be and the power tubes are the limiting factors, unless the cillator's intensity is so great as to overload even the modu- tor. This is unlikely at any frequency, as the 0.05 meg. leak lds down the intensity to a considerable extent. The very nservative output power rating of the last stage is 8 watts.

The tuning coils, as stated, are wound on plug-in bases, of e UY type, and are 1.25 inches in diameter. Considering the -f and modulator coils, which are identical, the secondaries nsist of 115 turns of No. 32 enamel wire, or wire of about that e, while the primaries are wound near the bottom, over the condaries, and consist of 15 turns each, any size wire, in- lating fabric between. The secondaries are tapped in two aces, and these taps, counting from the grid end, are at the h turn and 102d turn. The oscillator coil has a secondary of 5 turns, tapped at the 68th and 93d turns from the grid end. erefore the modulator winding has 76 turns from grid to st tap, 26 turns from first to second taps. The extreme used grid is not rated as a tap in these considerations. The oscil- or has 68 turns between grid or extreme and first tap, 25 turns tween first and second taps. The oscillator plate winding is t on top of the secondary, with insulating fabric between, and nsists of 25 turns. The grounded end of the grid winding is ar the bottom and the outside windings are put on near this int. As for the oscillator, if there is no oscillation simply erse the plate and B plus connections. But if a set rule is followed there will be no trouble. Windings in the same direc- tion, the ends of the oscillator plate and grid windings should be oppositely polarized.

Connections to Make

The connections to coil sockets have to be made so that the right terminals are picked up. The antenna coil requires six connections, and the UY plug has only five, but the shields may be of zinc composition and the B minus coil terminal soldered to shield. The oscillator requires six connections, obtained in the same manner. In the antenna stage aerial may connect to P, external ground to heater adjoining plate, grid to G, first tap to K, second tap to heater adjoining cathode, and B minus (grid return) to shield. The interstage coupler at the radio frequency level has the same connections, except that P and B go re- spectively to plate of tube and B plus. Oscillator connections are like modulator connections, since the coil goes to the grid condenser even if the padding condenser is picked up by the switch.

For short waves, the plug-in coils should be wound as per previous directions for numbers of turns, so that there would be 39 turns secondary for the r-f and modulator stages, ¼-inch space between, and primaries of 12 turns wound next to, not over, secondaries. The wire on the secondaries may be No. 18 enamel. The oscillator plate winding, wound over the secondary of 38 turns, consists of 20 turns of any fine insulated wire, with insulating fabric between tickler and grid turns. Thus the form will be almost filled up with winding. The smallest coils consist of 13 turns secondaries, with No. 18 wire, for all three circuits, the primaries of 10 turns, and tickler of 13 turns, any wire. These secondaries and tickler are ⅛-inch away from the grid winding, beside it, not over it, and the secondaries are spaced by about the diameter of the wire used.

The coil switch is thrown to the first tap position when plug- in coils are used for short waves, for then the full capacity may be used in the oscillator circuit, that is, the padding is eliminated. Therefore the grid connection for the short-wave plug-in coils is K of the coil socket.

Other Coils

The intermediate frequency transformers are of the shielded type, the shield being at least 2 inches in diameter and 2.5 inches high, of aluminum. The primary and secondary are 800 turn honeycomb coils of an inductance of about 10 millihenries, and tuned by 20-100 mmfd. condensers. The two windings on each transformer are about 1⅛ inches apart. The coil feeding the detector has a pickup winding for the a-v-c tube, which winding consists of a 300 turn coil placed between the two others.

After the circuit is built the intermediate frequency should be established at 175 kc. by generating that frequency in a service oscillator, preferably modulated. One may be built simply on the basis of an article published last week, and concerning which there are further data this week. The oscillator tube is out of circuit and the service oscillator is connected to plate of the -24 modulator. The meter M may be read for maximum de- flection. If a 0-10 milliammeter is used, and the reading isn't large enough for observation, move the pickup coil in the last intermediate transformer closer to the secondary. If a 0-1 ma is used and the reading is too large, move the coil farther from the secondary, and nearer to the plate winding, or put a limiting resistor in series with the meter until the reading is about mid- way.

Having established the intermediate frequency, set up the re- ceiver as a t-r-f circuit, removing oscillator tube, removing grid clip connection to the anode of the -27 second detector, and put- ting the grid clip of the -24 to anode of -27 by an extension wire. Use a service oscillator preferably, or tune in a local sta- tion near or at the low frequency extreme of the dial (550 kc), note the setting, and tune in at 1,300 kc. or a little lower. Now remove, install the oscillator tube in the socket of the super and connect a small condenser from oscillator until grid to diode anode. The two oscillator frequencies of 175 kc. higher than the modulator test frequencies should come in at the same dial set- tings as prevailed for modulator. Adjust E oscillator until this is true at least of the lower frequency tested. Note where much frequency, if any, the oscillator is off at the high end. The connection will be applied by trimmer readjustment of t-r-f and oscillator, using stations. However, if your service oscillator is independently powered, or if you plug into an i-f stage which has been stripped, but continuity established for the signal, the lining up can be done by putting the best oscilla- tion into the antenna primary with nine tubes going. The modulator readings will obtain.

It is preferable to use a service oscillator, rather than broad- casting stations, particularly as ready means are present for testing at other frequencies after the two almost-extreme ones are tested. Turn the trimming condenser that is built into the oscillator tuning condenser until the signal is loudest for the low frequency test, then check up the high end, turning the t-r-f and modulator trimmers to bring in 1,300 kc. or thereabouts at maximum volume. The potentiometer P should be at B minus (extreme position) during these tests.

The subject of lining up is treated more extensively in a separate article in this issue.

SERVICE SHEET NO. 3 — *MEASURING DEVICES*

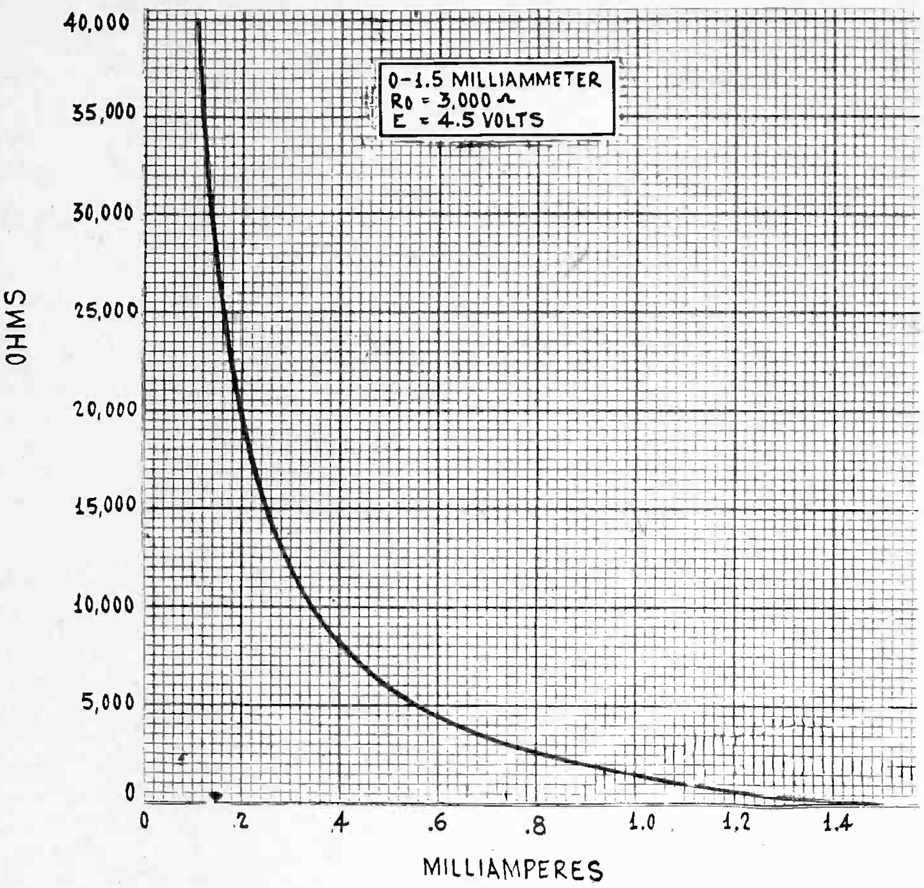
RESISTANCE MEASUREMENTS

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

TABLE III.

Meter range, 0-1.5 milliamperes, E=4.5 volts, Ro=3,000 ohms

Rx	*I*	*Rx*	*I*
0	1.500	7,000	0.450
100	1.450	7,500	.428
200	1.401	8,000	.409
300	1.363	8,500	.391
400	1.322	9,000	.375
500	1.286	9,500	.360
1,000	1.124	10,000	.346
1,500	1.000	11,000	.321
2,000	.900	12,000	.300
2,500	.818	13,000	.281
3,000	.750	14,000	.265
3,500	.692	15,000	.250
4,000	.643	16,000	.237
4,500	.600	17,000	.225
5,000	.562	18,000	.214
5,500	.529	19,000	.204
6,000	.500	20,000	.196
6,500	.474	25,000	.161



If the meter range is 0-1.5 ma (Table III), E 45 volts, and Ro 30,000 ohms, then each value of Rx is ten times the value given in Table III. The corresponding value of current is the same as in Table III. Thus in the last resistance would be 250,000 ohms and the current would remain 0.161 milliampere.

Table IV covers the resistance range 0-375 ohms with a 0-100 milliammeter, a limiting resistance of 45 ohms, and a battery voltage of 4.5 volts. If the limiting resistance be increased to 450 ohms and the battery voltage be raised to 45 volts, the values of Rx will be ten times greater for the same current. Thus with this combination the resistance range will be 0-3,750 ohms. In view of the high value of current required by the 0-100 milliammeter, the battery used should consist of three No. 6 dry cells.

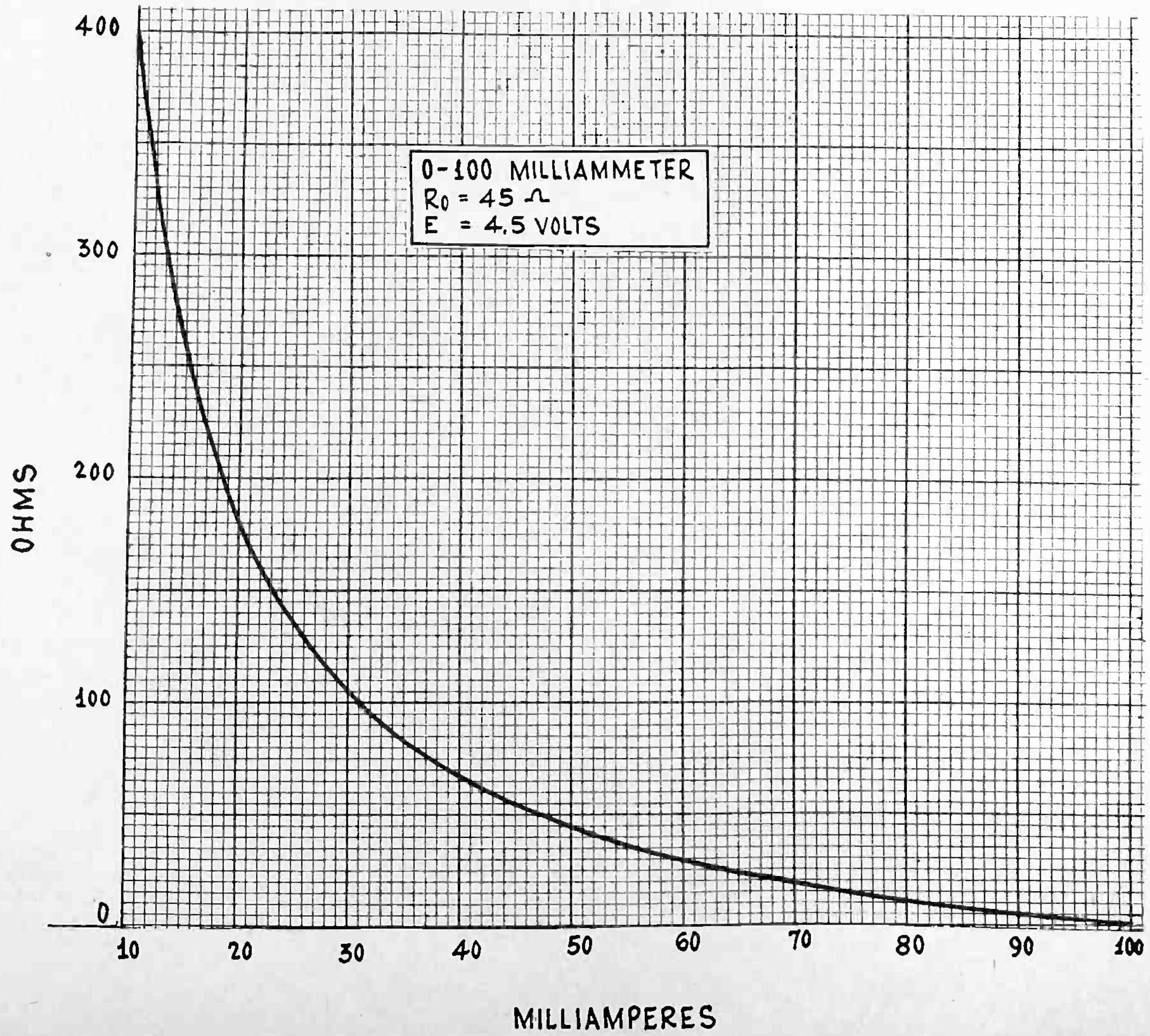


TABLE IV.

Meter range, 0-100 milliamperes, E=4.5 volts, Ro=45 ohms

Rx	*I*
0	100.0
5	90.0
10	81.8
15	75.0
20	69.25
25	64.3
30	60.0
35	55.7
40	52.9
45	50.0
50	47.4
55	45.0
60	42.8
70	39.1
80	36.0
90	33.3
100	31.0
125	26.5
150	23.1
175	20.45
200	18.4
225	16.7
250	15.25
275	14.05
300	13.03
325	12.15
350	11.4
375	10.7

Good Results on Converter

Outfit Works on All Sets, Including Supers

LIST OF PARTS

Coils

Two coils, one for modulator, one for oscillator; two windings on each; secondaries tapped.
One 300 turn honeycomb coil.
One 20 volt transformer.
One 15 henry B supply choke coil.

Condensers

Two 0.00035 mfd. tuning condensers.
Three 0.00025 mfd. fixed condensers (one with grid clips). Two others may be 0.00035.
Two 8 mfd. condensers, with mounting nut and lug for each.
One equalizer, 20-100 mmfd.
One 0.0015 mfd. fixed condenser.

Resistors

One 5 meg. grid leak.
One 1,200 ohm fixed resistor.

Miscellaneous Parts and Accessories

One a-c cable and male plug.
One 10x8x3 inch cabinet.
One a-c toggle switch.
Hardware: two dozen 6/32 machine screws, two "hex" dozen nuts, to match; one machine screw 2 inches long; two threaded bushings for mounting coil on socket screw; two right angle brackets for coils.
Two flexible leads, tipped at both extremes.
Two dials.
UY sockets (two used for coil switching).

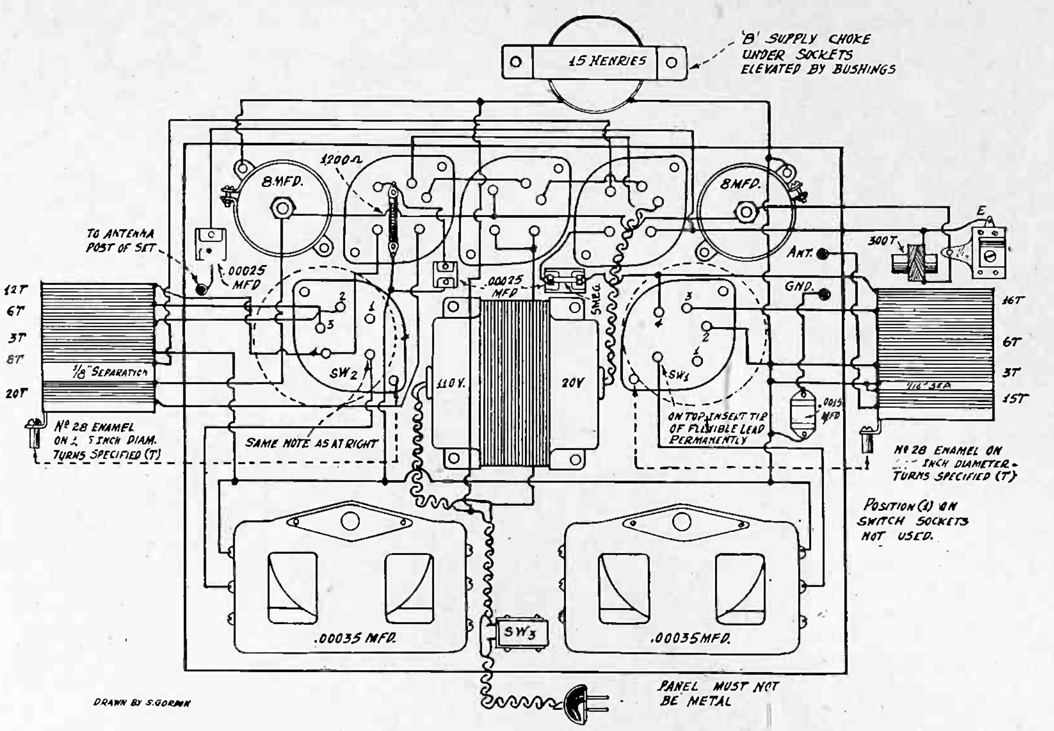


FIG. 1

The pictorial diagram of the economical converter, bottom view. The heaters of three 237 tubes are connected in series across a 20 volt transformer. Coil forms, 2 inch diameter.

HEREWITH are the pictorial diagram, Fig. 1, and the schematic diagram, Fig. 2, of the economical short-wave converter, 15 to 200 meters, that is a real performer, enabling the reception of far-distant stations, including foreign ones. The sensitivity is extremely high because the modulator and oscillator circuits are separately tuned and the output tube is of low impedance, so that it couples most satisfactorily to broadcast receivers. Therefore, since this is a first-class converter, it works on any type receiver, including superheterodynes. Any converter that is a good one will do that.

The converter uses three 237 tubes, because then the total cost of operation is not more than one-tenth of a cent per hour anywhere in the United States. This operation includes the supply of filament, plate and bias voltages to the tubes, for the economical converter is entirely self-powered. No risky and dubious connections need be made to the receiver in an attempt to obtain heater or plate voltage.

The same circuit was discussed in the January 2d issue and previously, but the demand for these numbers was so great we are publishing a new "slant" this week.

Use of the Three Tubes

One of the three tubes is the modulator. Its associated condenser-coil circuit tunes in the short waves at their transmission frequencies. Another of the tubes is the oscillator. This tunes to a frequency that differs from that of the modulator. The difference is whatever intermediate frequency you use in your set. Therefore when you turn your set dial to a position you know affords keen sensitivity, and where there is no direct pickup of an interfering broadcast station, leave the modulator dial at zero (minimum capacity) and pick up a station by tuning only the oscillator. Have your set volume control at full volume position.

When a station is picked up, turn the modulator dial until the station is heard loudest. Then leave the modulator dial alone, and change the intermediate frequency (dial setting of receiver), meanwhile adjusting the oscillator condenser to keep pace with the change in intermediate frequency. In this way by ear you can determine what is the most sensitive spot on your set dial. Stick to this always when using the converter. Then you can log the short-wave stations that you receive. Many of these stations will be in code. That is a sure sign the converter is working. Program transmissions are much fewer, but you will find them by experience.

The parts are assembled on a wooden cabinet as shown in Fig. 1. The two coils look somewhat alike, but the oscillator coil, at left in the diagram, has an extra tap on the large continuous winding. One end of this winding goes to cathode of the modulator and is the pickup coil that unites modulator and oscillator circuits. The first tap from this extreme goes to ground. The two remaining taps and the remaining extreme, or three connections, are made to three springs of a tube socket, but this socket is not used for a tube. Instead, stator of the oscillator tuning condenser is connected to one prong, coil taps and one coil extreme to three other prongs of this socket. One prong is left blank. Then when a flexible tipped lead is inserted with one end permanently in the stator condenser spring of socket, the other tipped extreme of the lead may be inserted in any one of the three remaining springs for covering different wave bands. Thus band-shifting by switching, rather than by use of plug-in coils, is used. The modulator uses the same system. The socket prongs for the coils correspond, modulator and oscillator, for respective bands.

Coil Mounting

Fig. 1 shows the connections clearly, but Fig. 2 is more easily read at a glance. The two circuits are identical in all respects.

The dash circles about the coil switch sockets represent where the coils actually will be placed. If a right angle bracket is attached to the coil form, and a short 6/32 machine screw used for fastening a threaded bushing, then the coil may be affixed beneath the proper coil socket by passing a 6/32 machine screw through a socket mounting hole to meet the unfilled end of the threaded bushing. Either one of the two socket mounting holes may be used.

The third of the three tubes is the rectifier. It has plate and grid socket prongs interconnected, going to one side of the a-c line. The twisted pair at lower center of Fig. 1 represent the a-c cable, which should be bared, a lead soldered thereto, friction tape wrapped

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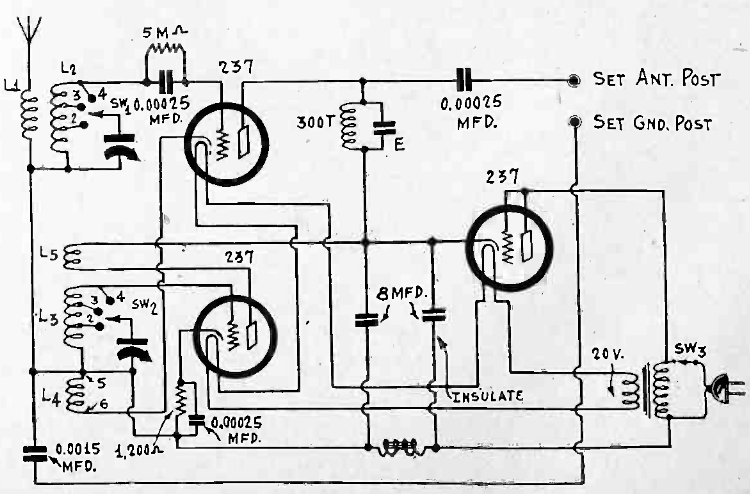

FIG. 2

The schematic diagram, conforming to the pictorial diagram. The warning "insulate" applies when a metal panel is used.

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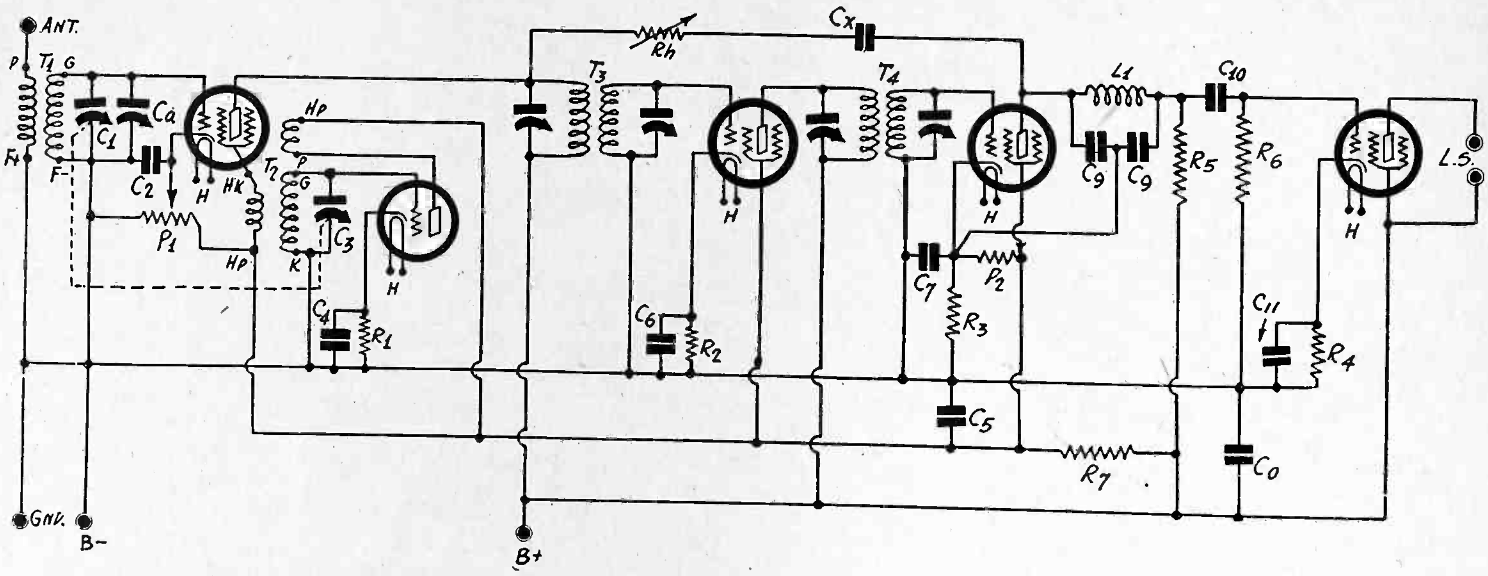


FIG. 989

The circuit diagram of a five tube short wave superheterodyne. A regenerative feature in the intermediate frequency amplifier provides a means for increasing the sensitivity to a high level.

A Short Wave Super

WILL YOU KINDLY show a short-wave superheterodyne, a tuned input detector, an oscillator, one stage of intermediate, a screen grid detector, and a pentode output tube? I should like to have a circuit for automobile type tubes. If it is possible to introduce regeneration in the intermediate frequency amplifier this feature would be welcome. I have a set of short-wave coils which I plan to use. Please suggest suitable intermediate frequency transformers.

In Fig. 989 is just such a circuit. Naturally, the tuning condensers should match the coils you have. Grid bias resistances are the usually for the type of tube used. Potentiometer P1 should have a total resistance of 25,000 ohms. By-pass condensers should have the following values: C2, C4, C5, C6, C7, 0.1 mfd. each; C10 and C11, one mfd. each; C9, C10, 0.00025 mfd. each. C10 may also be 0.1 or it may be 0.01 mfd. L1 is a small r-f choke. Cx should be a trimmer type midget and Rh, a variable resistance of 10,000 ohms or more. The intermediate frequency transformers T3 and T4 should be tuned to 450 kc.

* * *

Condenser Combinations

IS THERE a simple rule by which the capacity of two condensers in series can be obtained when the capacities of the two are known? If so, please give it? Also, suppose we wish a capacity of a certain value and we have one variable condenser and one fixed, both of which are larger than the desired capacity, is there a formula by which the capacity of the variable can be computed. If so, please give it?—F. E. L., Aurora, Ill.

To obtain the capacity of two condensers in series from the capacities of the two, multiply the two together and divide the product by their sum. The result is the capacity of the combination. To find one of the capacities in series in terms of the other and the capacity of the combination, multiply the two known capacities together and divide the product by their difference. Resistances in parallel are treated the same way as condensers in series, and also inductances in parallel are treated the same way. In the case of inductance there must be no coupling between the two coils. That is, the mutual inductance must be zero.

Peculiar Phenomenon

WHILE I WAS testing a receiver which had developed a strong hum, I explored the circuit with a large by-pass condenser, connecting the condenser across the various by-pass condensers. There was no effect until I touched one of the condensers across the supply line. There was a strong flash and the hum disappeared entirely, and it did not come back when I removed the condenser which I had just connected. After that the circuit worked fine. Will you kindly explain what happened?—G. A. E, New York, N. Y.

Undoubtedly, some contact, probably inside the condenser, had become open as a result of electrolysis or corrosion from soldering flux that had been left. During your exploration with the large by-pass condenser you had undoubtedly charged this to a high potential. When you touched the defective condenser there was enough voltage to break down the high resistance joint or open, and there was enough charge in the condenser to weld the contact. Welding by this means is often done intentionally especially when two very fine wires are to be joined.

* * *

Testing Calibration of An Oscillator

MEASUREMENTS MADE with my calibrated oscillator indicate that the calibration has been upset and I suspect that the capacity has changed because apparent errors are greater at the high frequency end. Will you kindly suggest a method of checking the calibration?—F. T. B., Detroit, Mich.

Set up another oscillator and couple it loosely with your calibrated oscillator. Set your oscillator at a low frequency and adjust the auxiliary oscillator until zero beat is obtained. Leave the auxiliary alone and turn the dial of your calibrated condenser to the zero beat point at the second harmonic. Note the dial reading of the harmonic and check it against the calibration chart. If there is a difference between the reading and the indicated reading on the chart there has been a drift, and the direction will indicate whether the capacity has increased or decreased. If your calibrated oscillator has so wide a range that you can get the third harmonic, use this in checking. If you have a strong local station of suitable frequency you can also use its signal in place of the auxiliary oscillator. Still another way is to check your calibrated oscillator directly against the frequencies of various broad-

How to Mount Coils on Converter Panel

(*Continued from preceding page*)

securely around the joint, and the wire brought up to the united grid-plate prongs. This lead is shown as passing over the core of the power transformer, which is of the 20-volt secondary type. Actually, the lead may be brought around the transformer.

The tubes have heaters connected in series. This is unusual, but effective, and the result is considerable economy of power consumption. Any desiring to use 227 tubes instead of 237 may do so by using a 2.5 volt filament transformer, and connecting the heaters in parallel instead of in series.

The coil data are imprinted on Fig. 1. The diameter is now 2 inches. The modulator coil consists of a 15 turn primary, 25 turn secondary. The taps, from the ground end, are at the 3d and 9th turns. Windings are in the same direction. The oscillator has a 20 turn tickler and a 29 turn continuous winding. The taps are at the 8th, 11th and 17th turns. Winding are in the same direction. The 8th turn tap is grounded.

All wire is No. 28 enamel, for both coils.

The panel cabinet is drilled, so that the top serves as the panel and accommodates the five sockets, cast stations. This is more accurate for by the first method you have to assume that the low frequency setting of your oscillator is all right. You might first check a low frequency against a broadcast station and then use the harmonic method for checking at the higher frequency.

* * *

Band Pass Couplers

IN A BAND PASS FILTER there are two equal tuned circuits coupled by means of a 0.05 mfd. condenser. I wish to couple with a small inductance in the same place. What should the value of the inductance be to give the same band width? If two band pass filters are used would it be practical to use capacity coupling in one and equivalent inductive coupling in the other? Are there any disadvantages in such a scheme?—A. B. N., Easton, Pa.

There can be equivalence at only one frequency. Suppose we select a frequency in the middle of the broadcast band, or 900 kc. The problem then is to find what inductance has the same reactance at 900 kc as a condenser of 0.05 mfd. The result is 0.625 microhenries. If you use two band pass filters, one of each type, the passed band will be approximately doubled. It is better to use the same type of coupling in both filters.

* * *

Small Changes in Frequency

IS THERE a simple formula by which the change in frequency can be estimated by the change of inductance or capacity? For example, suppose I know the inductance of a coil and the number of turns, is there a way of estimating the change in frequency produced by changing the inductance by one turn?—T. R. E., Binghamton, N. Y.

For very small changes the formula $dF=FdL/2L$ can be used. In this dF is the change in frequency, F is the frequency before the change in inductance, dL is the change in the inductance and L is the inductance before the change. If dL is positive, that is, if the inductance is increased, dF is negative, or it represents a decrease in the frequency. Suppose we have a frequency of 1,000 kc and if we change the inductance by one microhenry and the original inductance was 150 microhenries, then dF is 3,333 cycles. For capacity change the formula is the same except that we substitute capacity C for L. If it is a question of changing the turns of the coil then we may use the same formula except that the factor 2 is not used. That is, if N is the total number of turns on the coil and dN is the change in turns, then $dF=FdN/N$. As in the other cases the change in the frequency is opposite to the change in turns. Suppose, for illustration, that the inductance coil has 127 turns and that the circuit is tuned to 1,000 kc. What will be the change in frequency of resonance if we remove one turn from the coil. Here N equals 127, dN equals one, F equals 1,000 kc, and we are to find dF. The formula gives us 7.88 kc. Since we removed a turn the frequency was increased by this amount. These formulas do not hold when large changes are made.

* * *

Cause of Hum

WHAT IS MOST LIKELY to cause a hum in a receiver?—S. G., New York, N. Y.

Insufficient filtering is the cause of all hum. But there may be noises similar to hum.

* * *

Cause of Dead Tuner

ONE OF THE TUNED CIRCUITS seems to be dead, yet it is not completely so. The set plays but when I short-circuit the tuning condenser it stops. When I put my finger on the grid of the tube after this tuner there is no change in volume. When I do the same to the other r-f tubes the signal goes out completely. What is likely to be the trouble?—W. B. A., New Rochelle, N. Y.

It may be that the tuning condenser is open. It may be that the lead connecting the stator side of the condenser to the coil is open. Another possibility is that the coil inductance is so far different from inductances in the other circuits that the stage is badly detuned. If you have any means of testing the resonance of this circuit alone do so. Perhaps you will find that the inductance is too low, which would indicate shorted turns or the wrong coil. If the defective circuit is in the antenna you should not expect the same sensitivity nor selectivity.

* * *

Coupling Circuits with Resistance

IN BAND PASS FILTERS the tuned circuits are coupled with either capacity or inductance. In either case the band passed varies with the frequency. Is it not possible to couple the circuits with resistance and thus get the same band width at all frequencies? If so, will you kindly give the resistance necessary, first, when the resistance is connected across the circuits and second, when it is connected between two parallel tuned circuits?—F. R. C., Salt Lake City, Utah.

Coupling two circuits with a resistance does not make a band pass filter at all. There is only one resonant frequency and that is the one of either of the equal circuits. When two series tuned circuits are coupled with a resistance, the degree of coupling is determined by the value of that resistance and the high frequency resistance in the tuned circuits at resonance. When the two circuits are series connected the resistance joining them should be very small for otherwise the coupling will be close and the selectivity will be poor. When the resistance joins two parallel tuned circuits the resistance must be very high for the same reason.

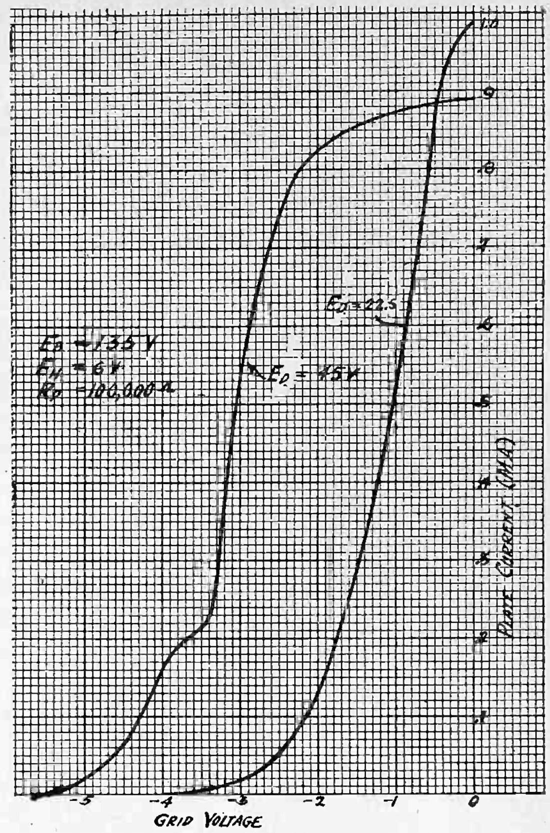


FIG. 990

These curves show the effect of the screen voltage in a screen grid tube in which the load is a pure resistance. Better output is obtained when the screen voltage is lower.

* * *

Effect of Screen Voltage on Detection

PLEASE PUBLISH curves or data showing the effect of varying the screen voltage on a screen grid tube operating as a detector on the grid bias principle? What is the difference in the maximum output? What is the effect on the required grid bias resistance?—F. G. R.

In Fig. 990 are two curves taken on a 236 tube with 135 volts in the plate circuit in series with 100,000 ohms. One curve is for a screen voltage of 45 volts and the other for 22.5 volts. You will note that the 22.5 volt curve is more regular and that it goes farther up at zero bias. Hence the output possible will be greater with the lower screen voltage, and there is also less distortion. The proper bias when the screen voltage is 22.5 volts is about 2.25 volts, at which point the plate current is 0.085 milliampere. The total current in the bias resistance is about 33 per cent greater than this. Hence to get the bias of 2.25 volts, we have to use about 20,000 ohms. When the screen voltage is 45 volts the best detecting point is about 4.5 volts. The total current through the resistance is about the same. Hence we have to double the bias resistance. By all means the lower screen voltage should be used. In case the load resistance is higher than 100,000 ohms the bias resistance should be still higher for the same bias because the plate current will be less. Also, when the plate load resistance is higher the screen voltage should be lower, for otherwise the curve would assume the shape of the 45-volt curve in the figure.

* * °

Effect of Wire Diameter on Inductance

IF AN INDUCTANCE COIL is wound to a given inductance on the supposition that the number of turns per inch is standard and the wire actually used is thinner by a small amount, what is the effect on the inductance, assuming that the same number of turns is used? Is the error great enough to justify a change in the number of turns? For example, suppose the diameter of the wire is such as to require 112 turns to the inch and the wire actually winds 115 turns.—F. C. Y., Los Angeles, Calif.

If the wire is thinner than supposed to be, the inductance will be greater, because the turns will be more crowded together. The variation met in commercial wire is sufficient to take into account when it is necessary to wind coils to an exact value. It is customary to separate a few of the turns at one end of the winding from the rest to allow for this difference and for differences of coil diameter and inaccuracy in winding. A coil wound on a one-inch diameter with 127 turns of No. 32 enameled wire has 0.945 microhenry greater inductance when the wire winds 115 turns to the inch than when it winds 112 turns to the inch. This change in inductance makes a difference of 2.77 kc at 1,500 kc in the tuner.

A THOUGHT FOR THE WEEK

SINISTER NEWS DESPATCHES from Honolulu have affected sailings from American ports to Hawaii. One steamer reports a cancellation on one sailing of 65 bookings for Honolulu. It will be interesting to note what effect the same news will have on the making of contracts by the broadcasting stations with Hawaiian singers and instrumentalists and whether there will be fewer Hawaiian compositions played by American musicians over the air. Women especially are said to resent anything that savors of Hawaii and its—shall we say—customs?

RADIO WORLD

The First and Only National Radio Weekly

Tenth Year

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

New License Decreed For Ground Stations

Washington.

The creation of a new radio operator license for operators of aeronautical ground stations was announced by W. D. Terrell, Director of the Radio Division of the Department of Commerce. It will be mandatory for operators of all aeronautical ground stations to hold this license, or in lieu thereof to hold license of other classes which have been indorsed as valid for this class of service. The indorsement is to be given only upon passing the aeronautical examination.

Holders of licenses of the aeronautical class must pass a test that includes examination of their knowledge of airplane dispatching, meteorology, international airplane regulations, and aid to navigation, in addition to the regular radiotelephoe requirements.

The Radio Division now issues the following licenses for radio operators: Commercial, third class commercial, aeronautical class, broadcast class, radiotelephone class, amateur first class, and amateur class.

Bill Bars Sunday Commercial Programs

Washington.

Representative Amlie, of Elkhorn, Wis., has introduced a bill in the House of Representatives that would prohibit commercial advertising on Sundays on radio broadcast stations.The bill would amend section No. 19 of the Radio Regulation Act of Feb. 23, 1927, by adding the following provision: "Provided, however, that on Sundays there shall be no commercial announcements, whether direct or indirect, broadcast by any radio station, except that the name of the sponsor of the program may be given at the beginning and at the end of each program and with a minimum period of one hour between such announcements."

Synchronization Continued

Washington.

The Federal Radio Commission has granted WBAL and WTIC permission to continue their synchronization experiments for ninety days. WBAL, Baltimore, Md., operates synchronously with WJZ, New York, on the 760 kc. channel, when the 1,060 kc. channel is used by WTIC, Hartford, Conn., and WTIC operates synchronously with WEAF, New York, on the 660 kc. channel when the 1,060 kc. channel is being used by WBAL.

Pointed Opinions

CHITTENDEN TURNER, KHJ, Los Angeles: "Dramas of the air have become tangible. The imagination of the people has been captured. Some may explain it by the same token that has made newspaper comic strips indispensable to the average American family, others by a new emphasis on sheer characterization, others by the abiding novelty of radio itself or its comforting contrast with more sensational screen fare. Perhaps there are enough shut-ins and lonely individuals to provide the bulk of fan mail in some cases. Whatever the prime causes, radio drama has clicked. It is here accomplishing a big work in entertainment and very evidently paving in solid concrete the approach to television."

* * *

RAY H. MANSON, chief engineer, Stromberg-Carlson Telephone & Mfg. Co.: "Television will be flashed about on very short wavelengths which travel in straight lines like light. Television will not render obsolete any existing broadcast receiver, because good images require bands many times wider than do sound programs."

* * *

E. L. DAVIS, Representative from Maine, Chairman of the Radio Committee of the House: "When two or three people get together the subject of radio comes up and there is always some expression of disapproval at some of the sales talks heard in the air. I have received a wide response to my recent utterances on this subject and I feel that certain restrictions should be laid down in regard to radi oadvertising. I do not hold forth much hope from the Federal Radio Commission, which has had plenty of time to act. So it is up to Congress."

NEW SILVER-MARSHALL SUPER

Silver-Marshall, Inc., 6419 West 65th St., Chicago, announces a new model 727 world superheterodyne, all-waves on one calibrated dial.

Cady Elected Head of the Institute

Dr. Walter G. Cady, professor of physics at Wesleyan University, has been elected president of the Institute of Radio Engineers for 1932. Prof. E. V. Appleton of King's College, London, England, was elected vice-president. O. H. Caldwell, former Federal Radio Commissioner and now editor of "Electronics," and E. L. Nelson of the Bell Laboratories were elected directors.

Dr. Cady is known in radio circles for his work with piezo crystals as frequency standards and stabilization of station frequencies. For his work along this line he was awarded the Morris Liebmann Memorial Prize in 1928. Professor Appleton is one of England's outstanding figures in radio reesarch.

New York Hotel To Provide Vision

Ralph Hitz, managing director of the Hotel New Yorker, and Arthur Freed, president of the Freed Television and Radio Corporation, announced that the New Yorker would be the first hotel to present television to its guests.

Arrangements have been made so that every de-luxe suite in the New Yorker will feature with its built-in radio speaker a small screen on which television pictures will be projected from a complete television receiver which will be built into the wall of the room.

Curb Is Voted On License-Selling

Washington.

In an effort to eliminate commercializing and trafficking in radio licenses and channel assignments, the Federal Radio Commission has adopted a motion by Commissioner Harold A. Lafount providing that in all applications for assignments of broadcasting station licenses there shall be submitted a sworn statement of the financial and legal transactions involved.

The new ruling will be beneficial to the radio industry and theg listenin public, Commissioner Lafount explained, because it will assure better programs by keeping advertising rates down, so more money will be available for employing talent, and because it will prevent individuals and concerns from selling Commission license permits for amounts out of all proportion to their value. This traffic in licenses is directly in opposition to the spirit and letter of the radio act, he said.

POLYMET OWN EXPORTER

Polymet Manufacturing Corporation, of New York, announces the formation of its own export department, which is already functioning from the home office. A. Prosdocimi has been appointed export manager.

BUCHER ELECTED

The Westinghouse Electric International Company elected George H. Bucher vice president and general manager.

STATION SPARKS

By Alice Remsen

The Nightingale

(For Maria Cardinale, WJZ, Thursdays, 8:30 p. m.)

Golden blossoms droop their heads as twilight shadows creep;
By the river weeping willows whisper in their sleep.
Lady Moon comes riding slowly o'er the silent hills;
Suddenly a nightingale her silver clarion trills.
In their dreams the birds and flowers hear that lovely tune,
And they thrill with rapture as she serenades the moon;
All of nature pauses then, and wakens with a start
To hear the lovely nightingale a'singing out her heart.

—A. R.

The Beautiful Voice of Maria Cardinale trills like a nightingale on the Golden Blossom program over WJZ. Heard her sing last week. It was a positive treat, for Maria is one soprano who respects the microphone. Her voice blended admirably with that of the Golden Blossom tenor, Willard Amison. They should do some excellent work together in the future. The opening and closing signature of this period was produced in a very novel manner, introducing each member of the cast. Milton Rettenberg and Jack Shilkret gave an excellent account of themselves in their two-piano work and accompanied the singers beautifully. These two boys are the last word in piano team work. Don't miss this very entertaining fifteen minutes.

* * *

And Speaking of Sopranos, Mary Coward is another one whose voice should be heard on the air more frequently. Mary is blind, but even with this heavy handicap she has made the grade as an entertainer in concert, opera and vaudeville. Tall and well built, with a lovely face and a charming disposition, a vivacious personality and a gorgeous voice, Mary Coward would be a find for some enterprising sponsor looking for real talent. She is opening in vaudeville shortly with a new act written specially for her by that talented author and composer, Arthur Behim.

* * *

A New Sort of Service for Radio Artists has been inaugurated by an enterprising young lady, who was formerly with the Witmark organization. Her name is Lillian Kaplan; her address is 2973 Decatur Avenue, New York; her telephone, Sedgewick 3-5570, and for a nominal weekly sum, she will take care of the fan-mail, correspondence and orchestrations of radio artists. It seems to me that this Service Bureau should take care of a long-felt want, for not every radio artist can afford a personal secretary, nor find time to answer all the fan mail.

* * *

A New Voice Will Be Aired Each Tuesday at 10:00 p. m. commencing March 1st, on the Pratt and Lambert Symphony of Color series, over WABC. The voice will be that of Jack Kerr, a musical comedy star noted for his distinctive rendition of popular melodies. This colorful personality will be known as "The Voice of a Thousand Shades."

* * *

Station KMOX, the Voice of St. Louis, is broadcasting a pretty nifty trio of girls' voices, known as The Debutantes, every Sunday morning at 10:15. The personnel of this trio is Linda Stuart, Jean Carlton and Betty Marshall. Their harmony arrangements are made and they are coached by Ted Straeter, popular KMOX pianist. who has coached some of radio's outstanding stars, including Irene Beasly, and Bernadine Hayes.

* * *

The Three Santley Brothers, Lester, Henry and Joe, might just as well be triplets so far as Ed Smalle, of Macy and Smalle, on WOR, is concerned. "I always have two strikes on me when I try to identify one of them," says Ed. "The other day I called for an orchestration of one of their greatest hits, 'Call Me Darling, Call Me Sweetheart, Call Me Dear,' and got Lester mixed up with Henry. 'That's all right,' he said, 'Call me Lester, call me Henry, call me Joe!'"

* * *

Sidelights

REVVA REYES, heard over NBC networks, is a native of Mexico . . . SENORITA SOLEDAD ESPINAL received her first musical training in Venezuela . . . FRANK BLACK was only four years old when he started picking tunes out on a piano, and started to study when he was six . . . TOM NEELY was a bad violinist before he became a good saxophonist . . . WALTER TETLEY, NBC juvenile actor, is taking bagpipe lessons from a Scotchman for $2.50 a day . . . GENE CARROL, of Gene and Glenn, broke into show business in Shakespeare, his first rolé being none other than "Cobweb" in "Midsummer Night's Dream" . . . NAT BRANDWYNNE, the 22-year-old leader of the Waldorf-Astoria Empire Room orchestra, rides a bicycle every day in the outskirts of Brooklyn . . . ALOIS HAVRILLA is an expert horseman . . . And now RICHARD MAXWELL has received a barrel of lobsters and clams from an admirer in Maine . . . HELENE HANDIN'S favorite supper dish is cinnamon French toast . . . VEE LAWNHURST includes a number of her own compositions in each of those new Wildroot programs on WEAF . . . WYOMING JACK of KMOX hails from a dude ranch in Wyoming where he used to wrangle horses for visiting "dudes" . . . HAROLD SANFORD of NBC was Victor Herbert's right-hand man for eighteen years . . . ELMER AND WALTER FELDKAMP are the Five-Boro Taxi boys on WOR Sunday nights; they do a good job.

* * *

ANSWERS TO CORRESPONDENTS

H. I. TRACHMAN, New York.—You may obtain information about Rush Hughes by communicating with his father, Rupert Hughes, at Elysee Hotel, New York.

J. I. BROWN, Flemington, W. Va.—No, we do not publish a monthly list of radio programs, but Radio Guide, weekly New York paper, publishes a very comprehensive weekly list.

B. WASHINGTON, Jackson Heights, L. I.—Will publish information on Harry Salter in an early issue.

* * *

Biographical Brevities

Facts About Nat Shilkret

Nat was born in New York City. He grew up in a musical atmosphere, for his father was a versatile musician and played the violin, drums, cello, flute and clarinet. At five years of age, Nat blew his first note, at seven he was a clarinet soloist with a boys' symphony. While still in his teens he played with such eminent artists as Elman, Heifetz, Safanov and others with the Russian Symphony Orchestra. He also played in the orchestras of the New York, Philharmonic, Damrosch, Metropolitan Opera, and the bands of Sousa, Pryor and Goldman. Simultaneously Nat mastered many instruments, like his father before him, and also studied voice, harmony and composition.

Into these crowded years Nat mixed music, athletics and the study of civil engineering. He managed to spend two years at college before he definitely abandoned science for symphony. He played in orchestras until midnight, exercised on the college open track in early morning, studied until four a. m. and answered eight o'clock roll calls. Then he married and quit work—at least he stopped all professional work except one hour a day and for two years studied the musical classics. Then he went back to work, became an arranger and writer of orchestrations, and at 23 was named a musical director of the Victor Talking Machine Company. He then became manager of the foreign department of the same concern, studying, arranging and directing for thirty-five countries. Since that time all the great figures of music have passed before Shilkret's baton in the studios, including Caruso, Bori, McCormick, Elman, Seidel, Bauer, Gigli, Pons, Ponselle and many others. He then founded the Victor Salon Orchestra and gave American jazz symphonic rhythm and purpose.

At this writing Nat has a perfect organization of symphonic instrumentalists and novelty artists. This group today produces the Chesterfield "Music That Satisfies" over the Columbia network. Among the men are his brothers Jack, pianist; Harry, cornetist; and Lou, pianist and business representative. It is a treat to watch Nat whipping his men or coaxing them through "Washboard Blues" or Bach's "B-Minor Mass" with equal effect.

Nat Shilkret is small but dynamic. He eats and sleeps sparingly; dislikes to be alone; once worked four days without sleep; would rather compose than do anything else on earth; forgets everything for music; once kept a sizable check for three years before cashing it; seldom worries and is rarely really tired; likes to work and does not think that it makes an awful lot of difference what happens in the future. His energy has enabled him to produce around 1,000 compositions and 20,000 orchestrations, many of them written overnight. He improvised his "Oriental Impressions" in one minute while riding from one subway station to another. He spent, in contrast, two years on his "Violin Poems" depicting the seasons. His first work was "Wee Bit o' Heart," a violin solo dedicated to his wife, Anna.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING FEBRUARY 14TH

Sun., Feb. 14:—Quiet Harmonies..WABC—6:00 p.m.
Sun., Feb. 14:—Footlight Echoes..WOR—10:30 p.m.
Mon., February 15:—Evening in Paris..........WABC—9:30 p.m.
Mon., Feb. 15:—Piccadilly Circus..WJZ—9:45 p.m.
Tues., Feb. 16:—Alice Joy.......WEAF—7:30 p.m.
Tues., Feb. 16:—Singin' Sam....WABC—8:15 p.m.
Wed., Feb. 17:—Willard Robison, Deep River Orch.........WOR—8:00 p.m.
Wed., Feb. 17:—Eno Crime Club.WABC—9:30 p. m.
Thurs., Feb. 18:—Golden Blossoms.WJZ—8:30 p.m.
Thurs., Feb. 18:—Weaver of Dreams..........WOR—10:15 p.m.
Fri., Feb. 19:—March of Time..WABC—8:30 p.m.
Fri., Feb. 19:—Friendship Town....WJZ—9:00 p.m.
Sat., Feb. 20:—Little Symphony..WOR—8:00 p.m.
Sat., Feb. 20:—Vaughan de Leath..........WABC—8:45 p.m.

* * *

(If you care to know something of your favorites radio artists, drop a card to the conductor of this page, Miss Alice Remsen, Radio World, 145 W. 45th St., New York, N. Y.)

4-TUBE A-C SET

Next week's issue, dated February 20th, will contain an article on the construction of an a-c set. Tubes, one 51, one 24, one 47, one 80.

DE FOREST FIRM WANTS TO OWN ALL OF JENKINS

Passaic, N. J.

Stockholders of both the DeForest Radio Company and the Jenkins Television Corporation are being asked by their joint president, Leslie S. Gordon, to approve a sale of Jenkins to DeForest by an exchange of stock, two Jenkins shares for one DeForest, and rename the DeForest company DeForest-Jenkins Radio & Television Corporation.

Although both companies have been operating as separate entities, DeForest owns a controlling interest in Jenkins, acquired several years ago by exchange of stock. In protecting its investment the DeForest company has been obliged to finance the Jenkins corporation of late.

Patents Now Valued at $2,000,000

The revaluation of Jenkins patents has been set at $2,000,000. A much higher valuation originally was placed on Jenkins patents.

Mr. Gordon states that the DeForest company owns 638,967 shares out of 952,000 Jenkins shares. Thus the DeForest company will receive back one share of its own stock for each two shares of Jenkins stock turned in. Mr. Gordon added:

"The management feels that, due to the advancement of the art and the public interest in television, the developments of the Jenkins corporation are about to bear fruit, and that it is absolutely necessary to protect the investment by insuring the future of the Jenkins corporation's assets, this being best done by combining the business of both companies in one corporate body.

"The Jenkins corporation has exhausted its working capital, and its sole assets are its patents, engineering experience and a small amount of machinery.

Would Have to Seek Elsewhere

"Unless this sale can be effected, it will be absolutely necessary for the Jenkins corporation to secure additional working capital, which at this time is extremely difficult."

Proxies have been mailed to DeForest and Jenkins stockholders of record, since the directors of both companies desire to make the proposed agreement subject to the approval of the stockholders, although attention is called to the fact that approval by the stockholders is not necessary in this case.

TRADIOGRAMS

By Jo. Murray Barron

A superheterodyne, 18 to 550 meters, tuned by a single knob, is announced by the Pilot Radio and Tube corporation, of Lawrence, Mass. It is called the DRAGON. There is a new audio amplifier.

* * *

Blair Radio Laboratories, 23-25 Park Place, N. Y. City, announces a new policy of dealing direct with the serviceman and experimenter. There is a listing of new transmitting apparatus.

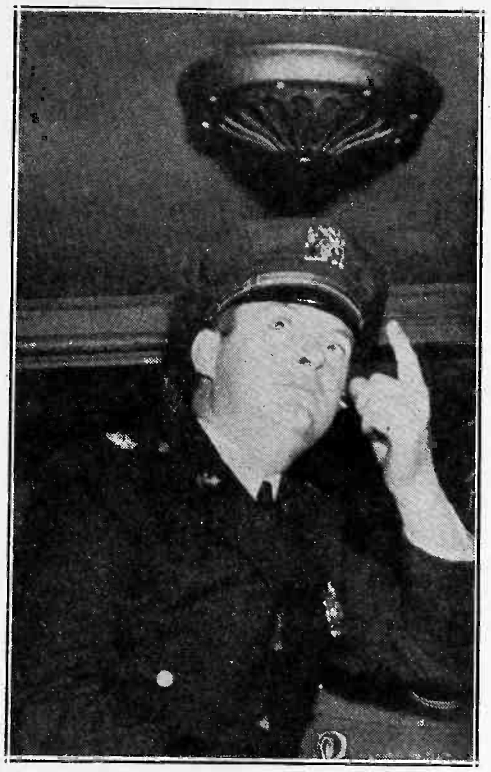
* * *

Emerson Radio & Phonograph Corp., 641 Sixth Ave., N. Y. City, has a new midget all-wave set, also a new midget super.

* * *

Harrison Radio Co., 187 Franklin St., N. Y. City, is featuring a new two-tube screen grid power pentode battery set.

SPEAKER SOLUTION



Acme

The New York City Police Department has instituted coded radio communication to police cars, called "cruisers." A receiver is in the car. The speaker is placed on the ceiling, forward of the dome light.

BETTER CATHODE RAY CLAIMED

Public views with respect to future television, particularly financing of entertainment, will be ascertained as the result of a symposium conducted by the Sanabria Television Corporation.

A coupon raises the question of willingness "to pay a small monthly sum, charged for much on the basis as gas and electric bills are today," to be able to see plays, movies, operas, athletic contests, and public events, brought to the living room by means of television broadcasts."

It was stated that U. A. Sanabria desires to direct his laboratory work along technical lines "which will help to make possible the television system most satisfactory to the general public, the broadcaster, the advertisers, and the radio manufacturers, distributors, and dealers."

The Sanabria organization revealed discoveries with relation to television system "radically different" from that used for his large auditorium projections. The large images are said to be more brilliant.

The cathode ray tube is used, but George Gruskin, executive director, hastens to add: "Cathode ray television systems have been known for almost twenty-five years, but they have had innumerable drawbacks which have been sufficient to discourage most research workers. The Sanabria cathode ray system, however, dispensing as it does with the majority of these previously unsolved difficulties, bears very little resemblance to former methods using cathode ray principles. Except for the basic use of the cathode ray tube, which dates back to 1907, the new development could no more be compared with the old than could an automobile be placed in the same category as a bicycle because both vehicles roll over the ground on wheels."

FEWER EXCEED SHIFT LIMIT OF ASSIGNED WAVE

Washington.

The cooperative work being carried on between the broadcasting stations of the United States and the Commerce Department's Radio Division is definitely improving the reception of programs through decreasing the number of stations operating outside their assigned channels, figures made public by Director W. D. Terrell of the Radio Division indicated.

The Division, through its monitoring stations in the nine radio districts, made 35,489 measurements of United States broadcasting stations in the last six months of 1931 and found a total of 401 deviations. In the same period of 1930, the Division made 30,052 measurements and found 922 deviations.

Reports Satisfy

"We are extremely pleased with this report," said Director Terrell, "as it indicates to us that the cooperative work we are doing is finding a ready response on the part of broadcasters to take advantage of our findings and correct whatever may be responsible for deviations from assigned channels..

"The decrease in the number of deviations found indicates quite clearly that throughout the country radio listeners are enjoying programs more because of the measurements taken by workers of the Division."

Radio broadcasting companies usually are quick to correct deviations when reported by the Radio Division, Director Terrell said.

Foreign Stations Measured

Besides the measurements taken of domestic broadcasting station signals, the Radio Division made 7727 measurements of stations other than broadcasting and found 988 deviations in the last half of 1931. This compared with 1156 such measurements in the same period of 1930 when deviations numbered 417.

The number of deviations increased in this classification, but in ratio to the number of measurements made, the number deviations showed a marked decline, Director Terrell pointed out.

The division also made 5,326 measurements of foreign stations in the last six months compared with 495 such measurements in the same period of 1930. Deviations in the past six months were 1220 compared with 197.

Lynch Mfg. Co. Offers Cabinet for Resistors

To enable jobbers, dealers and service men to keep an accurate check on their resistor stock and to facilitate the filling of orders by being able to find at a glance the resistors wanted, the Lynch Mfg. Co. supplies a useful, durable, 50-drawer steel filing cabinet with a special introductory deal on their metallized and precision wire-wound resistors. The drawers are 8x3x2½ inches wide. The case is 33x18½x8½ inches.

This is just a part of the company's sales service to the trade, as it also furnishes catalogue sheets, R.M.A. color code cards and service men's resistor replacement manuals. Communications should be addressed to A. E. Stevens, Lynch Mfg. Co., Inc., Dept. WR, 1775 Broadway, N. Y. City.

WESTINGHOUSE DEMONSTRATES AN ULTRA WAVE

Pittsburgh.

Communication on a 42 centimeter radio beam (wavelength of 16.5 inches) was demonstrated here to scientists and newspaper representatives.

The engineers of the Westinghouse Laboratories in East Pittsburgh conversed over the beam from W8XK on top of the Research Building to the roof of the Engineering Laboratory, more than a mile away, using small radio receivers as part of the equipment.

At the receiving end a metal paraboloidal mirror gathered the waves and sent them to a special detector tube, from which the signal went to an ordinary receiver.

At the transmitter end a similar paraboloidal mirror was used to focus the waves and send them out in a narrow beam, just as a searchlight sends out lightwaves from a point source of light located at the focus of the paraboloidal mirror.

Antenna in Focus

The transmitting antenna, which consisted of a pair of short wires, was placed in the focus of the transmitting mirror.

The new beam is practically immune from interference and cannot be "jammed" by an enemy, because the beam must first be found before it can be interfered with. By means of mirrors to direct the beam, it is possible by the new system to transmit over long distances.

In discussing the demonstration, L. W. Chubb, director of research at the Westinghouse laboratory said:

"At different times certain people have interested themselves in the possibilities of communication with the inhabitants of Mars, if there be such a people. If anything of this sort is ever to be accomplished, it will probably have to be done by means of ultra-short radio waves.

The 32,000,000 Mile Trip

"It is easily conceivable that the power we have succeeded in getting into our 42-centimeter beam is sufficient to pierce what is known as the Heaviside layer, an atmospheric layer about 100 miles from the earth, and to travel the 32,000,000 miles to Mars.

"A test for such a result, however, would have to be made in conjunction with the Allegheny Observatory, where through the big telescope the action of the Martians to any beam wave reaching their planet might be noted more quickly than by any other modern method."

New Incorporations

Pennsylvania Radio and Television Institute, Inc., Wilmington, Del., correspondent and resident schools.—Attys., American Guaranty and Trust Co.

Sam Silver, Inc., Philadelphia, Pa., radios, radio supplies.—Attys., Capital Trust Co. of Delaware.

Brooklyn Refrigerator Sales, Brooklyn, N. Y.—Atty., A. A. Sadowsky, 26 Court St., Brooklyn, N. Y.

Superior Eliminators, Middletown, N. Y., electric equipment.—Atty., C. Langan, Port Jervis, N. Y.

General Television Corp., Red Bank, N. J., servicing of television apparatus, etc.—Leo F. Meade, Red Bank, N. J.

Werco, Mount Vernon, N. Y., electric refrigerators.—Attys., Morgan, Bagg & Persons, Mount Vernon, N. Y.

Chi Aire Corp., Wilmington, Del., air cooling and refrigerating devices.—Attys., Corporation Trust Co.

CHANGE IN NAME

Midland Trading Company to Midland Electric Company, Chicago, Ill.—Attys., The Corporation Trust Company.

Literature Wanted

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

Ralph L. Arthur (Automobile radios and prices, Auto Radio "B" Battery Eliminators, Radio Parts Catalogs), 910 St. Joseph St., South Haven, Mich.
S. L. Siegner, 1410 High Street, Eugene, Oregon.
W. W. Baldwin, Malta, Texas.
Elmer A. Haye, 82-70—88th Place, Glendale, L. I., N. Y.
J. Weissert, Box 404, Springfield, N. J.
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H. H. Oates, 2258 E. 25th St., Oakland, Calif.
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E. A. Muench, 21 Mill St., Hornell, N. Y.
Philip B. Jorgenau, R. F. D. No. 6, Green Bay, Wisc.
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Edmund F. Perls, Gettysburg Academy, Gettysburg, Penna.
Wallace Tyler, 14 Macon St., Binghamton, N. Y.
Ray Franko, E. R. T., R. D. No. 1, Box 72, McClellandtown, Pa.
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Joe Campus, 1040 Oak St., Monessen, Pa.

U. S. OPPOSES FRENCH QUOTA

Washington.

The State Department issued the following:

"The Department of State has taken up with the American Ambassador at Paris the recent French decree establishing a quota system for the importation into France of radios and radio equipment. This government is definitely opposed to any system of quotas in international trade. This position is evidenced among other things by the fact that the United States signed and ratified a convention and protocol for the abolition of import and export prohibitions and restrictions. The information at present available indicates that the quota set up in France does not take due account of the present position of the American radio industry in the French market."

The Department of Commerce was advised in a cable that further radio imports from all countries had been suspended by France. It was said this was for the purpose of a check-up.

EXPECT 43,000 DAILY IN RADIO CITY ELEVATORS

The Westinghouse Electric Elevator Company has been awarded the contract to install 76 full automatic equipped elevators in the 70-story office building, the largest of the group of structures in Radio City, New York. These elevators will handle the 13,000 persons, comprising regular tenants and their employees, in addition to approximately 30,000 visitors.

1,423 STATIONS, NEARLY HALF IN UNITED STATES

Washington

There are 1,423 radio broadcasting stations in the world today, an increase of 33 since July, 1931, according to statistics made public by the Electrical Equipment Division of the Bureau of Foreign and Domestic Commerce, Department of Commerce. Of this number, 806 are foreign stations operating in 70 countries, and 617 are in the United States and its possessions.

Countries With Most Stations

This information was gathered by the Electrical Eqiupment Division of the Bureau for the use of exporters of radio apparatus. The study of the foreign markets revealed that 29 countries, including the United States, allow broadcasting to be carried on by any eligible party, 20 make broadcasting a monopolistic concession, and two have combined systems with certain desirable facilities the subject of a monopoly.

The other 20 countries are not classified because they have but one station each and the question of monopoly has not been a serious one.

The countries having the largest number of stations appear more strongly as competitive countries. These include United States with 617 stations, Canada with 85, Cuba with 53, Mexico with 47, Argentina with 38 and France with 31.

Queer Names

Russia with 73 stations and Sweden, with 33, are the monopoly countries appearing among the first 10 from the standpoint of the largest number of stations. Australia and New Zealand, with high-power monopoly and low-power-competitive systems, are also among the first 10.

The study prepared by the Electrical Equipment Division reveals that broadcasting is not immune to trick geographical names. Many of those listed appear sufficiently complicated to confuse many listeners. These names include Dniepropetrovsk, Chatelineau, Novorossiik, Guanabacoa, Tucuarembo, Llujbljana, Kalunborg, Ivanovo-Vosenesensk, Stchelkovo, Djokkjarta, Bloemfontaine and Tananarive. These names, as difficult as they may be to pronounce into a microphone so that a person unfamiliar with the names can understand them, the latest Hungarian contribution to the list—Szekesveherv—seemingly puts them to shame.

Large Demand

The demand for the complete study of "Radio Markets of the World," has not been restricted to the industry, the Electrical Equipment Division reports. The call for the publication for radio fans, publishers and advertising firms has been responsible for more than half the heavy deliveries of this study.

NOTABLES IN TELEVISION DEBUT

Chicago.

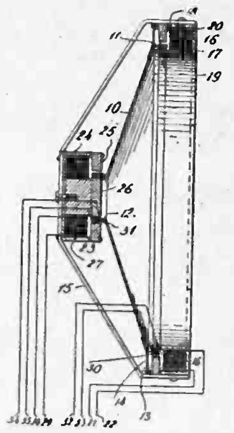
Some of America's best known orchestra leaders made their debut before television at the Chicago radio show when a Music Corporation of America program was given. Among the orchestra leaders who took bows and saw their images cast on a large screen were Ted Weems, Herbie Kay, Ben Bernie and Wayne King. Miss Doris Robbins, featured vocalist with Kay's orchestra, also made her first television appearance.

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

NEW PATENTS

(Those listed this week were issued January 26th, 1932.)

1,842,770. LOUD SPEAKER. Roy E. Thompson, Nyack, N. Y. Filed Aug. 22, 1930. Serial No. 477,089. 11 Claims. (Cl. 179—1155.)

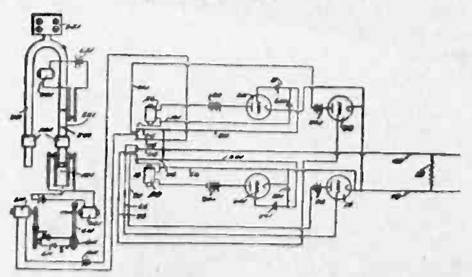


1. A sound reproducer comprising a diaphragm, a pair of coil windings attached to said diaphragm, means for producing a uniform magnetic field around each of said windings, means for impressing sound producing electric waves upon said coils in an additive sense and means for impressing uniform direct current upon said windings in an opposing sense.

7. A sound reproducer comprising a diaphragm, a coil winding attached in proximity to the outer circumference of said diaphragm, a coil winding attached in proximity to the center of said diaphragm, means for impressing signal currents upon said windings in such relative polarity that said windings are actuated in the same direction to vibrate said diaphragm, and biasing means for permanently adjusting the axial position of said diaphragm, said biasing means being solely electrical.

* * *

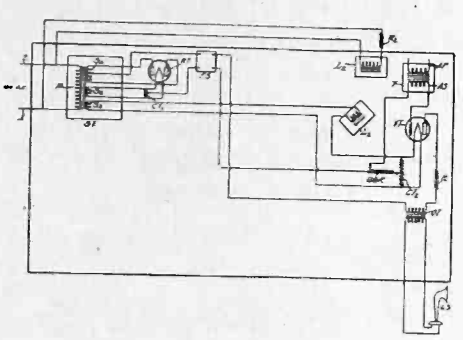
1,842,721. RADIO TELEGRAPH SYSTEM. Edward E. Kleinschmidt, Chicago, Ill., assignor to Teletype Corporation, Chicago, Ill., a Corporation of Delaware. Filed Apr. 7, 1928. Serial No. 268,238. 9 Claims. (Cl. 250—8.)



1. In a radio telegraph system, a transmitting station, a receiving station, means including a transmitter at said transmitting station for transmitting code combinations of impulses to said receiving station, said means being normally in a non-operating condition, a printer at said second station, a receiver at said second station operated while said transmitter is in its normal condition and is not transmitting any code, for operating said printer in accordance with alternate marking and spacing impulses, said means at said transmitting station operating to transmit code combinations of impulses to said receiver, means at said receiving station responsive to said received code combinations of impulses for stopping and normal alternate marking and spacing operations of said printer and operating said printer continually in accordance with the last either marking or spacing operation which preceded the receipt of the signal.

* * *

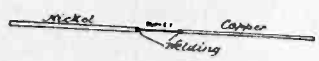
1,842,558. AMPLIFIER ENERGIZING SYSTEM. Benjamin F. Miessner, Short Hills, N. J., assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a Corporation of Delaware. Filed July 20, 1929. Serial No. 379,673. 16 Claims. (Cl. 250—27.)



1. In an amplifying system the combination of a chassis, an alternating current energy supply transformer mounted upon said chassis, an audio frequency transformer forming part of an amplifying system carried by said chassis, and means operatively associated with said supply transformer and in close proximity to said audio transformer for neutralizing the flux induced in said audio transformer by flux flowing through said chassis from said supply transformer.

* * *

1,842,631. MANUFACTURE OF LEAD-IN WIRES. Karl Rolle, Newark, N. J., assignor to De Forest Radio Company, Jersey City, N. J., a Corporation of Delaware. Filed July 20, 1929. Serial No. 379,694. 9 Claims. (Cl. 29—155.5.)

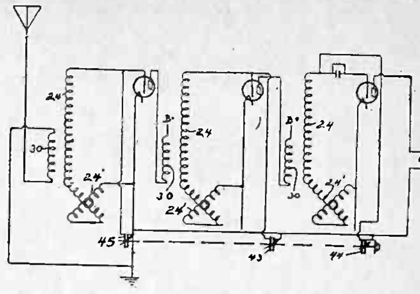


1. The method of forming vacuum tube lead-in wire in three connected sections, each of a diverse chemical composition from that of the other, which consists in feeding to a gauge point the wire for the central section and cutting it to length, feeding to a gauge point the wire for one end section and cutting it to length, preheating the end section which is to be welded to the central piece, welding said end section and said central section together, transferring the welded sections to a point in line with a third type of wire which is to be joined to the other end of said central section and welding the third wire to said central section.

* * *

1,842,937. RADIO SIGNALING. Marc A. Giblin, West Allis, Wis., assignor of one-half to Harry W. Bolens, Port Washington, Wis. Filed Feb. 26, 1926. Serial No. 90,787. 10 Claims. (Cl. 179—171.)

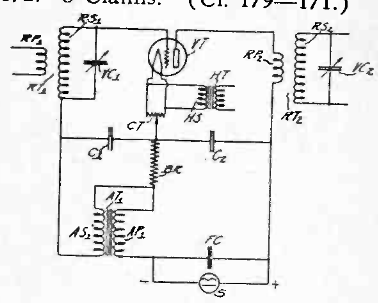
1. The combination operatively in the tuning circuits of a radio receiver, of an audion, a plurality of coupling transformers in the



input and output circuits of said audion having primaries and secondaries, said secondaries being substantially identical in predetermined capacity, means for adjusting the inductance value of the secondary of one of said transformers without varying the predetermined capacity thereof, and means subject to single control for varying simultaneously to resonance with a signal of a given frequency.

* * *

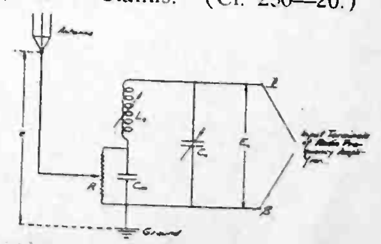
1,842,977. RADIO RECEIVING SYSTEM. Benjamin F. Miessner, Short Hills, N. J., assignor, by mesne assignments, to Radio Corporation of America, New York, N. Y., a Corporation of Delaware. Filed July 20, 1929. Serial No. 379,672. 8 Claims. (Cl. 179—171.)



1. In a radio frequency amplifying system, the combination of a vacuum tube having input and output circuits, a source of fluctuating unidirectional current, connections for energizing the plate and grid electrodes from said source, and means within the grid-filament and plate-filament circuits of said tube for varying the impedance of said tube in consonance with the fluctuations of said source whereby high frequency currents are amplified by said tube without modulation thereof by said source, said means consisting of a transformer, the primary of which is series connected within the plate-filament circuit of said tube, and the secondary of which is series connected within the grid-filament circuit of said tube the windings of said primary and secondary being relatively proportioned and poled to produce said tube impedance variation.

* * *

1,843,018. INPUT SYSTEM FOR ELECTRICAL AMPLIFIERS. Frederick H. Drake and William D. Loughlin, Boonton, N. J., assignors, by mesne assignments, to Radio Corporation of America, New York, N. Y., a Corporation of Delaware. Filed June 16, 1928. Serial No. 285,886. 2 Claims. (Cl. 250—20.)



1. A tunable input system for an audion amplifier comprising the combination with a tuned circuit including in series a fixed condenser, an inductance and a variable condenser, of a resistance shunted across said fixed condenser, and a variable tap on said resistance, said tap and the junction of said fixed and variable condensers serving as terminals across which is impressed the incoming alternating current voltage that is to be amplified, and terminals of said variable condenser serving as output terminals across which said amplifier may be connected.

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Temple dynamic speaker, in carved wood cabinet, with impedance matching device built in; AC operation; rectifier built in. Order Cat. TEM-DYN. @ $10.23

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"1932 Official Radio Service Manual," by Gernsback $4.00

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2250 ohm 25 watt resistor (Ward Leonard). Cat. WL-2 ....@ .10

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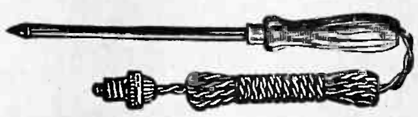

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