NOV. 28
1931

15c
Per Copy

RADIO WORLD

REG. U.S. PAT. OFF.

The First and Only National Radio Weekly

505th Consecutive Issue

TENTH YEAR

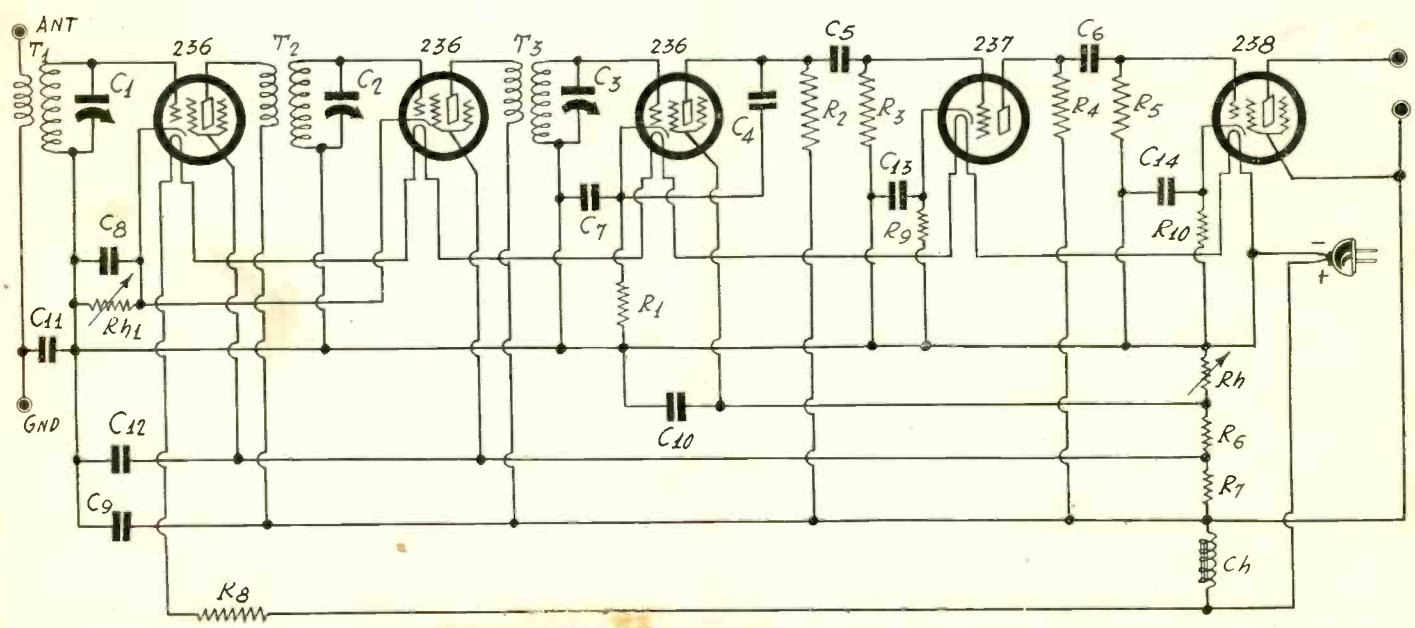
How to Pad Oscillator of Superheterodynes

1,600 kc All-Wave 6 Tube Super

2-Volt Battery Set

Where Should the Volume Control Be Located?

(See page 3)



The placement of the volume control in the cathode circuit, as illustrated, is all right, but only under certain circumstances. See page 3.

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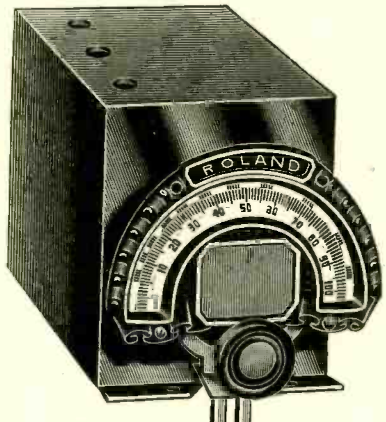
175 KC Superheterodyne Matched Tuning Unit

Consisting of Three Gang Shielded Condenser and Three Shielded Coils
Oscillator Precisely Padded



Cat. SSWD, illustrated; price......$4.20

Please remit 10% on C.O.D.

THE problem of precisely padding the oscillator for gang tuning of a superheterodyne requires engineering training and laboratory equipment. We use $1,600 test apparatus for this work, besides fixed condensers accurate to ½ of one per cent.

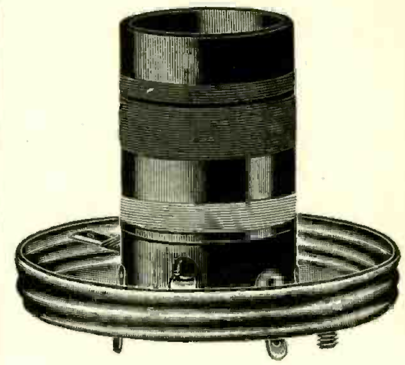
Our Super Matched Tuning Unit provides the complete, accurate tuning for one stage of r-f, modulator and oscillator, to be used with 175 kc. intermediate frequency for the broadcast band. A tap is provided on all three coils for optional extension of tuning down to 80 meters, by switching.

The Super Unit includes a three gang 0.00046 mfd. Scovill shielded condenser with brass plates; three trimmers; aluminum shielded r-f, modulator and oscillator coils.

SUPER UNIT, including shielded condenser, coils and ¼ inch reducing coupler (less dial). Cat. SUCCR, @ **$5.51**

WITH DIAL (as illustrated). Cat. SUCCRD, @ **$6.80**

THREE DECK, two point rotary selector switch, to enable 80 meter tap use. Cat. SW-3-2, @ **$1.95**



The coils are fastened to an aluminum screw base into which the shield proper (not shown) fits snugly. Two riveted screws serve for mounting. Lugs protrude at bottom. Primary is P. B, secondary is G and shield. The (—) lug is the tap. Terminals are marked. Ground the shields.

Please remit 10% on C.O.D.

MATCHED CONSTANTS FOR TUNED RADIO FREQUENCY

A Superb combination of expertly engineered products comprises the Roland Combination Matched Tuning Unit, consisting of a thoroughly shielded three gang tuning condenser, a vernier dial and three aluminum-shielded matched coils for screen grid tubes. With trimmers at minimum the coverage in frequencies is from 1,740 to 543 kc, or in wavelengths, 172 to 552.2 meters. Besides, there is a tap on the secondary that may be used with a switch to afford coverage from 80 to 200 meters.

The condenser has a steel frame, brass plates, and stator shields built-in. A separate steel shield encompasses the condenser (except at bottom) and has steel partitions for rotor shields. The capacity is 0.00046 mfd. Mounting facilities for both condenser and shield are provided. The shaft extends at both extremes, so dial reading in either direction may be used. The shaft is ⅜ inch and can be accommodated to ¼ inch dial hub by use of a reducing coupler. The condenser has tension adjusters. Trimmer condensers are built in and are accessible to a screwdriver through small holes in the shield.

SHIELDED CONDENSER alone (less dial) is Cat. SHSC @.....**$2.95**

VERNIER DIAL, with full dial equipment. Cat. VND @........**$1.25**

SHIELDED CONDENSER WITH DIAL is Cat. SSWD @........**$4.20**

REDUCING COUPLER, to use dials with ¼ inch shaft. Cat. RDC @ ....**$ .15**

MATCHED SET OF THREE COILS FOR THE 0.00046 MFD. condenser, with aluminum total shields, for coverage of more than the broadcast band with full secondary, and with tap to go down to 80 meters. Order Cat. MSCC (three shielded coils at this price) @..**$2.45**

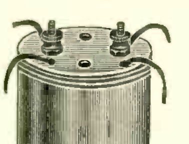
MATCHED SET OF THREE COILS as above, for 0.00035 mfd. Cat. M35C @ **$2.45**

SIX THREADED BUSHINGS for elevated mounting of coils above chassis, to avoid drilling the large hole. Order Cat. THRB (six at this price) ....**$ .25**

COMBINATION MATCHED TUNING UNIT, consisting of the three-gang 0.00046 mfd. condenser with trimmers built in; condenser shield, set of three matched coils, with 5-to-1 vernier dial of the traveling light type, (illustrated) including scale, escutcheon, bracket, pilot lamp and knob. Order Cat. CMTU @..**$6.65**

INTERMEDIATE TRANSFORMERS

Doubly tuned fixed-frequency transformer, 1 to 1 ratio, 175 kilocycles. Band pass filter characteristic. Tuning condensers across primary and secondary accessible. Aluminum shield (must be grounded) 2¼ inches diameter, 2½ inches high, removable bottom. For screen grid tubes. Order Cat. FF-175 @ **$1.50**



Same as above, for 450 kc, Order Cat. FF-450 @ **$1.50**

Same as above. for 1 6000 kc, particularly suitable frequency for short wave work. Order Cat. FF-1600. @ **$1.65**

CHASSIS for 5 tube midget, fits in above cabinet; chassis is 13½ inches wide, 9½ inches front to back; flaps front and back 3 inches high; drilled for socket 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; nickled frame. Cat. DJA-35 @ **$1.95**

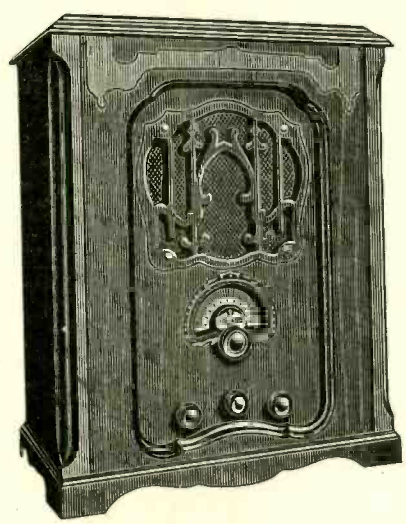
THREE 0.1 MFD. condensers in one shield case; black lead is common; three red leads go interchangeably to destination; mounting screw built in. Cat. 31 @..........................**$ .57**

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

WALNUT CABINET

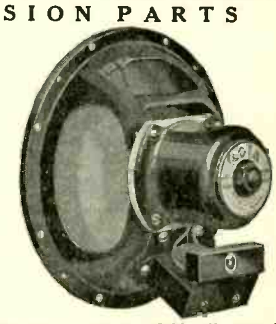


Beautiful mantel type walnut cabinet (illustrated), suitable for housing any chassis up to 13½ x 9½ inches; for 7-inch dynamic speaker. Less dial, knobs, speaker. Cat. MDCBT @ **$4.90**

With dial and two extra matched knobs, Cat. MDCK @.........................**$6.45**

PRECISION PARTS

NEW SERIES F, ROLA DYNAMIC SPEAKERS FOR MIDGET OR CONSOLE SETS



ROLA DYNAMIC SPEAKER, 1,800 ohm field coil, tapped at 300 ohms; field coil may be used as B supply choke and the 300 ohm section for biasing a 247 pentode. Output transformer for pentode built in. Diameter of cone, 7 inches. Series F, 1932 model. Cat. RO-18 @......**$4.50**

SAME AS ABOVE, except that cone diameter is 10.5 inches. Cat. RO-18-10 @........................**$5.85**

MAGNAVOX speakers of same specifications can be supplied at same prices.

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. transf., 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**

Tube Prices Lowered

Eveready-Raytheon 4-Pillar Tubes

Heater Tubes Start Playing in 7 Seconds

227	@$0.70	245	@$0.77	200A	@$2.80	233	@$1.83
224	@ 1.12	247	@ 1.09	240	@ 2.10	236	@ 1.83
235	@ 1.12	250	@ 4.20	112A	@ 1.05	237	@ 1.23
551	@ 2.20	V-190	@ 1.93	222	@ 3.15	238	@ 1.93
226	@ .56	U-199	@ 1.75	230	@ 1.12	280	@ .70
171A	@ .56	120	@ 2.10	231	@ 1.12	281	@ 3.50
210	@ 4.90	201A	@ .53	232	@ 1.61	BH	@ 3.10

Send for our list of principal short wave stations by hours on the air. Ask for Table W. No charge.

Roland Radio Co

35-W Hooper St., Brooklyn, N. Y.

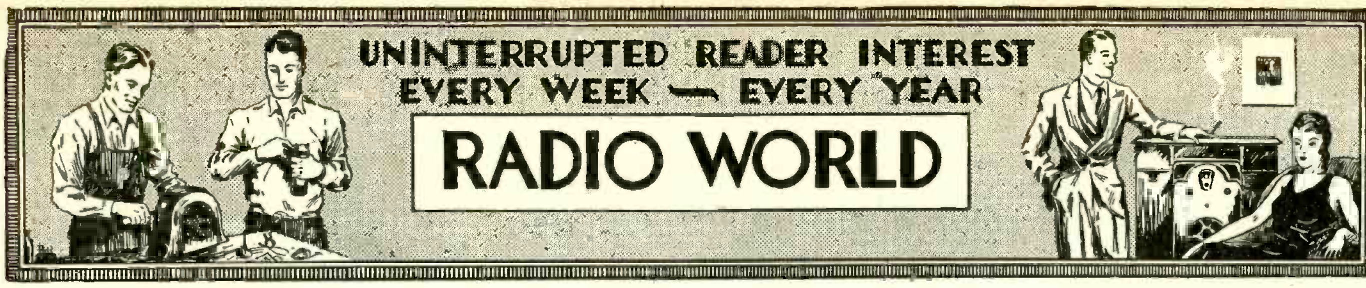
Authentic Blueprints

Get our new full-scale blueprint, Cat. BP-628-B, covering a six-tube short wave super, 12 to 200 meters, at an intermediate frequency of 1,600 kc for highest sensitivity. Tubes: (2) 224, 235, 227, 280, 247. No plug-in coils. Order Cat. BP-628-B, @..........................**$ .25**

Five-tube AC Midget Set, 200-550 meters, with option of 80-550 meters. Same full-scale blueprint serves both purposes. No plug-in coils. Cat. BP-627, @........**$ .25**

Six-tube Auto Set, full scale. BP-629, @.........**$ .25**

ALL BRAND NEW—NO USED OR DISTRESS MERCHANDISE!



Vol. XX No. 11 Whole No. 505
November 28th, 1931
[Entered as second-class matter, March, 1922, at the Post Office, at New York, N. Y., under act of March, 1879]
15c per Copy. $6 per Year

TENTH YEAR
Technical Accuracy Second to None
Latest Circuits and News

A Weekly Paper Published by Hennessy Radio Publications Corporation, from Publication Office, 145 West 45th Street, New York, N. Y.
(Just East of Broadway)
Telephone, BRyant 9-0558 and 9-0559

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

1,600 kc for All Waves

Easy to Cover 10-550 Meters, Also Long Waves

By Herman Bernard

A SMALL set was built to cover the broadcast band and short waves, from about 550 meters to about 10 meters, and the volume control was the usual rheostat in the cathode leg of the only intermediate amplifier used. The intermediate frequency was 1,600 kc. The volume control detuned the intermediate frequency. Therefore the control had to be put elsewhere, and it will be found in Fig. 1 as a potentiometer in the pentode grid circuit.

A few days after this fact of detuning was established, some tuning was done with a television receiver on demonstration in a radio store. The volume control was in the cathode leg of two tuned radio frequency amplifier 235 tubes. Again there was detuning, so much so that control adjustment would make the picture entirely disappear from the screen, and retuning the dial that actuated the gang condenser resulted in the reappearance of the picture.

Change Depends on Resonance Frequency

Therefore the detuning effect may be regarded as present in all receivers using this method, although on the broadcast band it is not serious, nor of course is it serious if the intermediate frequency is low, that is, beyond the lower limit of the broadcast band. It shows up considerably where high frequencies are involved, such as the television band (the so-called 150 meter band) and at a high intermediate frequency (as the 187.4 meter wave used in the present instance) because the change is not always the same, but depends on the resonant frequency.

The detuning may be ascribed to a change in the plate impedance. It is well known that at ultra frequencies, those with a behavior characteristic of that of light frequencies, it is difficult to get a sufficiently high ratio of inductance to capacity, for coils act as condensers, and condensers may become unduly critical, so frequency may be changed by d-c voltage alteration. The situation, therefore, is nothing new, although one requiring some attention.

The tuning condensers used in the present instance were 0.00035 mfd. (C1 and C2), with a permanent series condenser slightly in excess of 0.0001 mfd. used in the oscillator circuit, and individual series condensers in the modulator circuit, where needed.

Intereference on Broadcast Band

At first the circuit was tried with modulator untuned. A resistor replaced the coil system there. The broadcast reception was pretty good, but on very strong locals there was some cross-modulation. Code interference was at a minimum. Such interference always is to be expected, but it was low and infrequent. The interference is due to the oscillator setting for a difference in frequency in respect to the modulator also bringing in a station at the sum frequency. So, if to bring in 1,000 kc the oscillator were set at 2,600 kc, it would also bring in a station, if there, and loud enough to be heard, of a carrier frequency of 4,200 kc.

Short Wave Volume Less

On the broadcast band, therefore, it is advisable to have the modulator tuned, for the upbuilding of the amplification at the desired incoming frequency and for the rejection of the undesired frequencies. Since the interfering frequencies are so far removed, the rejection will be complete.

The extent of this removal can be computed. Assuming 1,500 kc and 550 kc as the extremes, the oscillator tuning would be from 2,150 kc to 3,100 kc, and the interfering frequencies would be from 3,750 to 4,700 kc. Modulator tuning in the broadcast band (1,500 to 550 kc) is a virtual short circuit to such high frequencies.

The use of a single intermediate stage works out all right, even with one stage of audio. On the broadcast band the volume is of the usual order with six tube sets (including rectifier), but on short waves the volume is less, of course, as is true of any set that covers these bands, because the field about the antenna is much less. So one will have a set of good broadcast performance, up to the requirements of volume, sensitivity and selectivity, but on short waves will have to put up with less volume. This is said for the benefit of those who, not having had any experience with short waves, believe that in general they come in with as much volume as the broadcast waves. They don't.

Modulator Circuit

Negative bias is used instead of grid leak and condenser for the modulator circuit, because the intermediate frequency is high, and therefore there is always danger of oscillation where it is not wanted, in the intermediate channel. The use of the negative bias modulator tends to lessen the squealing. But should this trouble still be experienced, a radio frequency choke coil of the 50 turn honeycomb type may be used in series with the 235 plate, between the end of the primary and the B plus lead without a condenser across it, to correct this trouble, or the screen voltage may be lowered by using a series resistor of around 0.05 meg. in the screen circuit only, without a bypass condenser across it. This value is also expressed as 50,000 ohms.

The full B voltage being applied to the 235, there should be considerable amplification. When the intermediate stage is working properly the gain is about 125, which is very high for a single stage in actual practice, although theoretical gain affords larger figures on paper.

Tuning Characteristics

The circuit as built at first tuned from 1,500 kc to 580 kc, a frequency ratio of 2.58, whereas the broadcast band requires a frequency ratio of 2.72, therefore the series condenser was too small in the oscillator's tuned circuit. The frequency ratio depends on the capacity ratio, and the capacity ratio changes because of the fixed minimum capacities, due to the tuning condenser itself at zero dial setting, the tubes, the wires used for connections, etc. Therefore the ratio decreases as the series capacity is increased.

Any one who has experimented with series condensers knows the large effect of what seem to be small changes in capacity, therefore the series condenser must be accurately adjusted, and also the intermediate stage (having two tuned circuits) must be lined up.

As about the only real problem here is to get the circuits lined up properly, attention will be given to that subject in detail.

(*Continued from preceding page*)

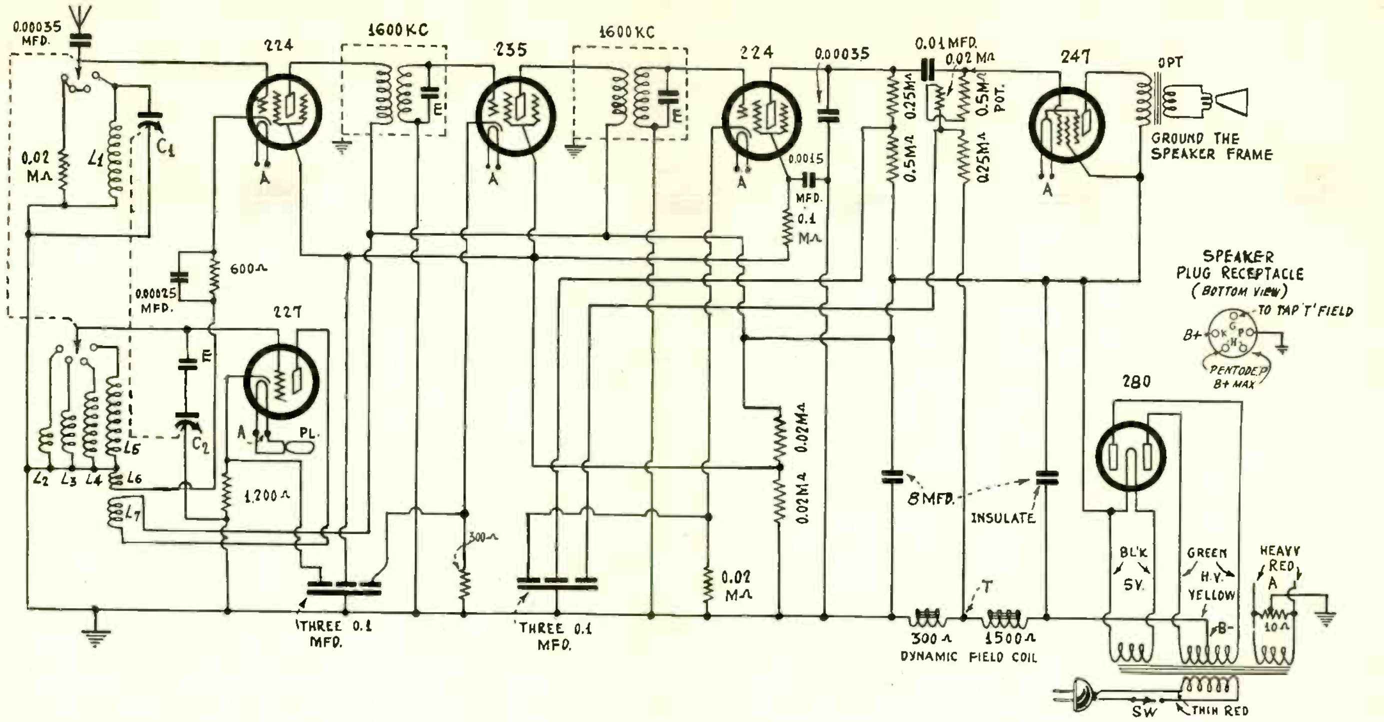


FIG. 1
The 1,600 kc six tube superheterodyne.

LIST OF PARTS

Coils

One set of two No. 628 coils, consisting of oscillator coil with six windings, and modulator coil with one winding.
One power transformer for 6 tube set; primary, 105-120 v. a-c; secondaries: 2.5 volt at 8 amperes; 267 v. d-c high voltage after filtration through 1,800 ohms; 5 volts, 2 amperes.
Two shielded coils for 1,600 kc.

Condensers

One two gang 0.00035 mfd. variable condenser, brass plates; straight frequency line tuning characteristic; shield.
One bushing to fit over ¼ inch condenser shaft, to take dial hub of ⅜ inch diameter.
Two blocks of shielded 0.1 mfd. condensers, three condensers in each case; black common; reds interchangeable.
Four equalizing condensers, 20-100 mmfd.
Two 0.00035 mfd. fixed condensers.
One 0.0015 mfd. fixed condenser.
One 0.01 mfd. tubular fixed condenser.
Two wet electrolytic condensers for inverted mounting; insulating washers and connecting lug for one.
One 0.00025 mfd. grid condenser, with clips.

Resistors

One .1 meg. pigtail resistor; six 0.02 meg. (20,000 ohm) pigtail resistors; one 1,200 ohm pigtail or wire wound resistor; one 300 ohm pigtail resistor; one 0.5 meg. (500,000 ohm) pigtail resistor; two 0.25 meg. (250,000 ohm) pigtail resistors. Total, 12 resistors.
One 7 x 2 inch mounting strip, with two brackets, two nuts and two screws.
One 10 ohm center tapped resistor.
One 500,000 ohm potentiometer, with a-c switch attached.

Miscellaneous Other Parts and Accessories

One chassis for 6 tube set; 13½" x 7½" x 3"—7th hole for speaker plug; pierced for all sockets, electrolytic condensers, power transformer.
Set of seven marked sockets, including speaker socket.
One support for protecting the a-c cable under chassis.
One two deck, four point rotary selector switch (double pole, quadruple throw); shaft insulated from everything.
One a-c cable and male plug for convenience outlet.
One dynamic speaker, 7 inch cone, 1,800 ohm field coil, tapped at 300 ohms; field coil used as "B" supply choke and Pentode bias; equipped with speaker cable and UY plug attached, according to speaker plug receptacle specifications on blueprint.
One knob for vol. control, to match knob on switch.
One vernier dial, traveling light type, with pilot bracket, 2.5 volt lamp; scale and escutcheon.
Two soft rubber grommets, to protect outlets at rear.
One set of tubes for 628A circuit: one 227, two 224, one 235, one 247, one 280.
One walnut finish cabinet, oblong type, drilled for dial and for volume control and coil switch.
One roll of hookup wire.
Two dozen 6/32 machine screws and 2 doz. nuts to fit.
Four tube shields, with bases.

(*Continued from preceding page*)

Looking at the diagram, we see that, with oscillator neglected, and with the broadcast coil in service in the modulator, we have what can be considered a tuned radio frequency set, with the first tube acting simply as an input device (disregarding the modulation), and with the intermediate coils tunable well into the broadcast band. So, to get some idea of how the intermediate condensers have to be set, it is an excellent and easy device to tune in a broadcast station, preferably a distant one. From Mt. Vernon, N. Y., on the outskirts of New York City, an attempt was made to pick up a broadcast station, and an announcer was heard to say something about "the best department store in Mt. Vernon." Fortunately, it turned out to be Mt. Vernon Hills, Va., and the station was WJSV, Alexandria, Va., operated by the Mt. Vernon Independent Publishing Company, on 1,460 kc. The station does not exceed 50 cycles deviation, as reported by the Radio Division of the Department of Commerce, August measurements. Mt. Vernon is near Alexandria.

Therefore the intermediate channel was lined up on this basis, the modulator tuning condenser being out of circuit, a resistor of 0.02 meg. supplanting the modulator coil. Therefore we had two stages of r-f, one tuned; tuned detector; audio and rectifier. The oscillator tube was in the socket, but the grid return was left open. This work was done before the wave-changing switch was put in, as it is advisable to get the set working well on the broadcast band before attempting to hook up the smaller inductances or include the switching.

Coupling the Circuits

Everything was very fine about this DX reception on the t-r-f principle, and so the set was tried as a superheterodyne on the broadcast band, with the 1,460 kc intermediate retained, since it was peaked.

There was a moaning background sound, and whistles attending the reception of broadcast stations, being due of course to the wave of WJSV riding through the intermediate channel along with the locally generated intermediate wave. This merely shows again the advisability of getting outside the broadcast band for an intermediate frequency, since stations on low waves may cause interference, even if they are 1,000 miles away. Moreover, the interference was a tribute to the sensitivity of the intermediate amplifier.

Notice that a good form of coupling is used between modulator and oscillator. There is a coil load on the modulator cathode circuit, inductively related to the oscillator coil, and consisting of a few turns of wire.

The coupling is strongest for the highest waves, due to the location of the pickup winding, which is a continuation of the oscillator grid coil. But the pickup winding adjoins the plate winding, so if there is plate back coupling there is also cathode coupling, but in some instances receptions may fail on the higher waves, and that would be due to too loose coupling, and can be corrected by connecting a very small condenser from the high potential end of L6 (not ground end) to the index or moving arm of the oscillator coil switch. This capacity should be around 6 mmfd. and is a commercially obtainable unit.

Establishing the Intermediate Frequency

It is assumed that a coil of the correct inductance is used (discussed later) and therefore the only problem remaining is to estab-

Fig. 1 of this Article Covered by Blueprint 628-B

A full scale blueprint is obtainable, showing the layout of parts, coil relationship, the pictorial wiring, schematic diagram, as well as giving the itemized classified list of parts, for the short-wave set, 15 to 200 meters (Fig. 1, page 4.) Order Cat. BP-628B, and send 25 cents in coin, stamps, check or Post Office money order, to RADIO WORLD, *145 West 45th Street, New York, N. Y.*

lish the intermediate frequency at 1,600 kc. This may be done with an oscillator that tunes in the broadcast band, setting the oscillator at 800 kc, and feeding the oscillation into the modulator, so that the intermediate couplers may tune in the second harmonic, or 1,600 kc. The stations on 800 kc, in case you can tune them in with an oscillating receiver, and feed the output to the intermediate amplifier as described, are WBAP, Fort Worth, Tex.; WFAA, Dallas, Tex.; XEU, Vera Cruz, Mexico, and XFC, Aguascalientes, Mexico. Or, 810 kc. may be used, for setting at 1,620 kc, the stations being WCCO, Minneapolis, Minn., and WPCH, New York City. If 790 kc is handier (for tuning 1,580 kc), use CMBS, Havana, Cuba; CMHC, Tuinucu, Cuba; KGO, San Francisco, Calif., or WGY, Schenectady, N. Y.

It is not adamant that the intermediate frequency be exactly 1,600 kc, and it may be either of the two other frequencies, or even some other, though no wide leeway is practical. It may be advisable to use some slightly different intermediate frequency than 1,600 kc, in the event the second harmonic of some broadcasting station interferes, whereupon you can readjust for some other intermediate frequency that does not bring in this interference.

Preliminary Tuning

The highest broadcast frequency will come in at about 5 on the dial, while the lowest will come in at about 98, so these two positions account for 1,500 kc and 550 kc. There are thirty-one stations in Cuba and the United States on 1,500 kc, and seven stations in the United States on 550 kc. A station at only one extreme need be used, or at some other frequency, if you have a curve for the tuning condenser you will use, that may be made to coincide with the 2,150 to 3,100 kc oscillator tuning.

It is not vital to pick out any particular frequency for tuning in, so the way is open for all. Using any of the intermediate frequencies, 1,600, 1,620 or 1,580 kc, with coupling condenser between modulator and oscillator nearly at zero setting, and with the modulator tuning condenser temporarily out of circuit, simply see whether the tuning encompasses the band. If you use a straight frequency line tuning condenser remember that the higher wavelength stations are closer together on the dial, and the lower ones farther apart, than with other condensers, and that the Geometric means of the broadcast band (about 900 kc) should come in at around 50 on the dial.

Data for Broadcast Coils

With any station tuned in, the intermediate channel may be tested again, to determine whether volume can be increased by any trimmer adjustment. The changes in capacity must be very slight. Use an insulated rod, not a metal screwdriver.

It is easy to lose resonance and not hear any signals. This fact may lead some to suppose, in early tests, that the set isn't hooked up properly, although it may be rightly wired, but the intermediate channel not lined up.

To obtain the results as described use an oscillator coil for the broadcast band consisting of a secondary of 47 turns of No. 28 enamel wire on a 1⅛ inch diameter, tightly wound; leave ¼ inch space and wind a tickler coil of 20 turns of the same kind of wire, in the same direction. Then the adjoining terminals go respectively to ground and B plus. This will insure oscillation. Connected the other way, or if the windings are in opposite directions, connected as prescribed, there will be no oscillation. If none is present, reverse the connections of the plate winding, putting to plate the terminal that previously went to B plus, and to B plus the terminal that previously went to plate.

Coverage

The frequency ratio has been stated for one equalizer set at maximum, under 0.0001 mfd. in series with 0.00035 mfd. It was 2.58, while 2.72 was required, but it can be easily raised to 2.75 by use of full capacity in series with the oscillator variable condenser, readily provided simply by turning down the screw of the equalizers to maximum. It is then that the dial reading previously stated will obtain.

To avoid oscillation at the incoming carrier equal to intermediate frequency, the coil system will be blank for reception thereof, and will start the continental band, say, at 1,800 kc. The tuning would be, therefore, for the broadcast coil: 200 to 550 meters, for the first short wave band, adjoining, 177 to 64 meters; next, 65 to 25 meters; next 26 meters to 10 meters. Since the frequency ratio is approximately equal to the ratio of the number of turns, the coils may be wound experimentally from these data.

The modulator coil for the broadcast band has 100 turns of No. 31 wire, while the coils for short waves may have the same number of turns as for the oscillator, because the intermediate frequency is a smaller percentage of the original carrier frequency, and any discrepancies that arise in tuning the largest short wave coil can be taken up by a small manual trimmer, C1. This trimmer is not absolutely necessary, but is suggested for the benefit of those who can not pad circuits with precision, and who therefore will lose no sensitivity if the padding is not quite accurate.

Modulator Tuning

It is not absolutely vital to tune the modulator for short waves, nor is the tuning close or sharp, so that a resistor of 0.02 meg. up may supplant the three coils. It is well to do this experimentally, since then the oscillator dial settings and frequencey coverage can be fully checked.

Knowing the intermediate frequency, you can calibrate the oscillator in terms of its own frequencies for each coil, by adding the intermediate frequency to the carrier frequencies tuned in, and ascribing the dial numbers to these sum frequencies. Then the oscillator alone may even be used for calibrating the modulator coils when you get around to them.

It can be seen, of course, that the range in frequencies can be extended downward (higher waves) by the addition of another winding, or the use of an extra oscillator coil, consisting of honeycomb primary and honeycomb secondary. The ratio being 2.75, the coverage could be quite easily from 727 to 2,000 meters, which would include the long wave broadcasting frequencies of Europe, 160-224 kc 1,874 to 1,338 meters), as well as frequencies below 224 kc that are used in such countries as Belgium and Holland. There would be no need to cover from 550 to 727 meters, as only code is heard there.

Questions and Answers

Lamp Socket Antenna

IS IT all right to use a lamp socket aerial? I live in an apartment house in a large city and it would be most unhandy for me to have an outside aerial. If I hear the local stations plainly that is all I want.—N. C. A.

Yes, a lamp socket antenna is a satisfactory substitute for a situation such as you have. The amount of pickup will vary. In some locations there is plenty, in others not much, so a sensitive set may be desirable. Even when a lamp socket aerial is used there should be a good ground connection to the set.

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Quality of Midgets

THERE is much talk about the fine programs now receivable being spoilt for listeners using midget sets, because the midgets are such bad distorters. This is variously ascribed to the pentode tubes, bad audio transformers, insufficient baffling and the like. Is it true that the midgets are as described?—G. D. W.

No, it is not true. The midgets manufactured by reputable makers of radios are good, their tone is satisfactory, and it is indeed remarkable that at such low prices such fine performance is obtainable. Some bad midgets have been made, but to utter a sweeping attack on all midgets on the basis of some poor specimens of early products of some tinkering manufacturers is grossly unfair. Not only are the commercial midgets excellent, but so are the kit-sets for midgets, and the performance is so good that purchasers and builders have gotten back into their old habit of sending enthusiastic letters to manufacturers.

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Mistaken Identity

WHEN working my oscillator on my set, testing my t-r-f set with it, I find that the oscillator tunes broadly from about 1,000 kc up, whereas it is sharp as the deuce at the lower frequencies. How come?—H. E.

The oscillator has no selectivity. It simply generates different frequencies. What seems to be the selecitvity of the oscillator is really the selectivity of the tested set. So it is your receiver that tunes broadly in the region stated, and not the oscillator.

A Five Tube A-C

Dynatron Oscillator-Modulator Used and

By Henry B.

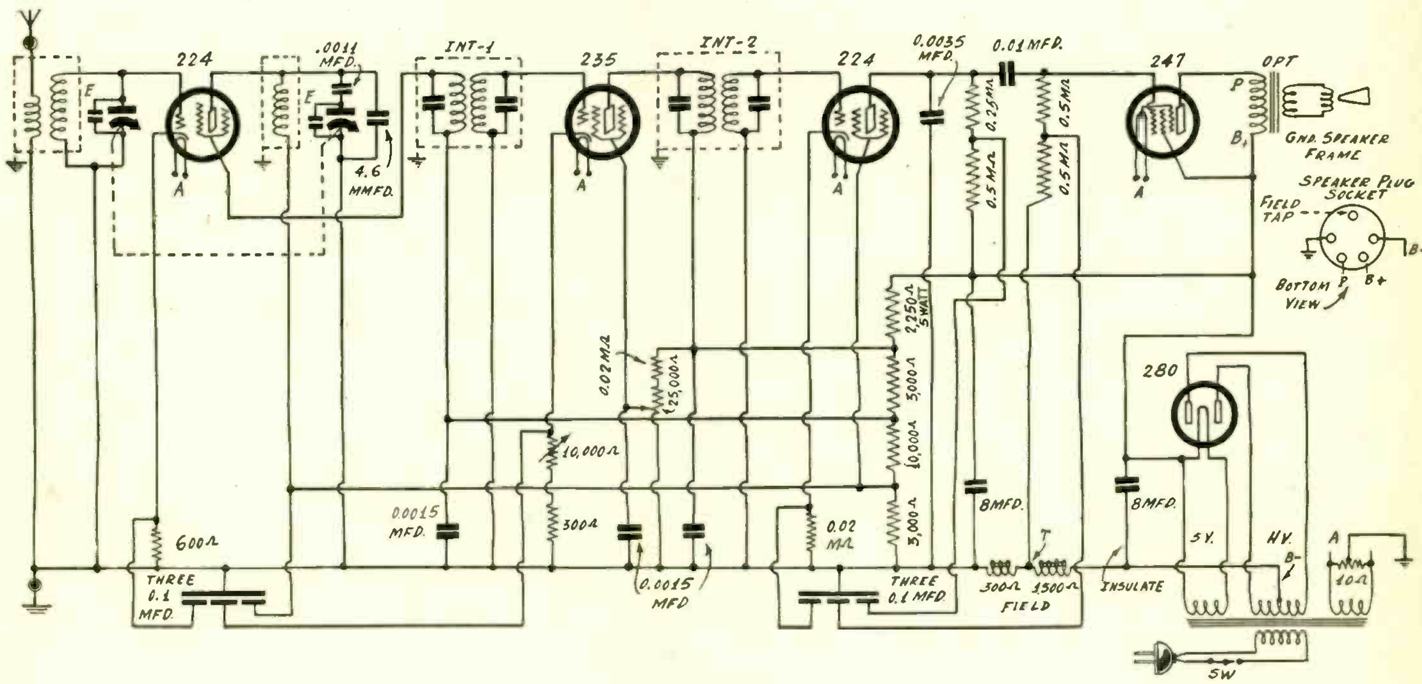


FIG. 1

A five tube super, using the dynatron- autodyne circuit.

As superheterodynes are about to reach the market using only five tubes for broadcast coverage, let us see what can be done about such a circuit.

The requirements are as follows:

(1)—A single tube must be used as combined modulator and oscillator. This is generally called an autodyne circuit.

(2)—There can be only one stage of intermediate frequency amplification.

(3)—Likewise, the audio amplification is restricted to a single stage.

From the foregoing we can construct the circuit requirements as follows, for a-c operation: 224 oscillator-modulator; 235 intermediate; 224 demodulator, or so-called second detector; 247 pentode output; 280 rectifier.

The 224 is a good tube for combination use, since it is easy to make it oscillate, and only a small increase in bias voltage over what usually obtains will make it modulate. However, the value of the biasing resistor well may be doubled, as compared to amplification alone, so instead of 300 ohms we use 600 ohms.

Tuning Difference

There is a little problem in respect to the tuning. One condenser must tune to the signal frequency. The other condenser must tune to a frequency higher than that by the amount of the intermediate frequency. So, while the modulator condenser tunes from 1,500 kc to 550 kc, for an intermediate frequency of 175 kc, the oscillator condenser must tune from 725 kc to 1,675 kc.

Striking the difference suitably will be taken up later. The problem mentioned has to do with segregation of the tuning, using the one tube. Here we use the 224 as a dynatron, so constituted because of the screen voltage exceeding the plate voltage. What the proportion should be will depend to some extent on the tube, for if the recommended voltages do not produce oscillation, then there will have to be a voltage change, so that oscillation does result.

But the plate voltage in all cases must be lower than the screen voltage.

It makes little difference, as to oscillation, what the grid bias is, even whether negative or positive, but the recommended voltages for screen and plate are not infallible, as the gas content of the tube has something to do with them, and what that content is for a particular tube can not be foretold. However, you are at liberty to try several good 224 tubes, and you will probably find one out of three that will work at the specified voltages, while the two others also will work, but at different voltages.

Screen Circuit is Output

Fig. 1 reveals that fact that the input is tuned in the usual way, but that the output is taken from the screen circuit, while the plate circuit determines the frequency of oscillation. A two gang condenser therefore would take care of the grid and plate circuits, while the primary of the intermediate input transformer would be connected in the screen circuit.

The cathode circuit is separated from the plate circuit by the plate resistance of the tube, so from this viewpoint the two circuits are prevented from tuning as one. The screen circuit, here used as output, also carries the plate current, so these two may be regarded as in parallel, and the coupling proportional to their respective currents, or about 33 1-3 per cent.

The tuning condenser frame must be grounded, if a gang is used, so a bypass condenser (which would be included anyway) completes the tuned circuit, from ground to the B plus plate voltage. Since this plate voltage is low it may be used also as the screen voltage of the demodulator, while the intermediate tube screen (235) will take around 80 volts, in view of the high plate voltage there, which is in the neighborhood of 200 volts.

Oscillator Coil

As the capacity to be used for modulator tuning is a 0.00035 mfd. variable condenser, as a gang is used that has two equal tuning condensers, the capacity of the other section has to be reduced. While it is usual to state the value of inductance, in conjunction with the padding of the condenser circuit, it is hard to decide from the inductance information how many turns to put on a shielded coil, as there are no formulas for inductance in shields. So the capacities will be given, plus the advice to remove turns from the oscillator coil until the padding is completed. In the beginning the oscillator coil, a single winding, has as many secondary turns as has the grid winding, and then turns are taken off.

An idea of how many turns to take off may be gleaned on the following basis. If you are tuning the broadcast band with 0.00035

Super-heterodyne

0.00035 Mfd. Two Gang is Padded

Herman

mfd., the inductance is around 245 microhenries. For the oscillator circuit, padded with 0.0011 mfd. and 4.6 mmfd., the inductance should be 183 microhenries. The inductance is approximately proportional to the square of the number of turns. Therefore, the number to take off is proportional to the square roots. So the number of turns is about 86 per cent. of that used for grid circuit tuning.

Suppose, therefore, that we have a radio frequency transformer wound on 1 inch diameter, having 20 primary turns wound over 127 secondary turns, shielded. The wave band is fully covered. Now the oscillator, for the padding circuit shown, should have 108 turns. The wire is No. 28, 30, 31 or 32.

Padding Capacities

As for obtaining the capacities for padding, while these are purchasable commercially if one desires to buy a ready-padded mixer circuit, it is possible to duplicate the results in home construction. The series condenser has to be very accurate, and it is manufactured for commercial purposes to an accuracy of 1 per cent. or better. For home construction commercial fixed condensers, if used, may vary as much as 10 per cent. Therefore we have to find a way out, whereby results will be entirely satisfactory.

It is easy to obtain a 0.001 mfd. fixed condenser. If this is 10 per cent. off it may be 0.0009 or 0.0011. If it errs on the side of addition, to the full 10 per cent. tolerance, we shall be in great luck. If it errs extremely on the other side we have to supply more than the intended extra 0.00001 mfd.

The 4.6 Mmfd. Condenser

Therefore a tuning curve should be taken for the modulator circuit, which may be done by regenerating it and putting earphones in the output. Then you will have dial settings and frequencies. Select some low frequency and some high frequency. Note the dial settings. Then work the set as shown, except not tuning the modulator at all (removing stator connection), and put the 0.001 mfd. condenser in series, with a 20-100 mfd. equalizer across the series condenser (in parallel with it).

Now turn the oscillator dial until the test low frequency station is heard. Compare the dial setting with that obtained in the previous test. If it represents more capacity, put a 20-100 mmfd. equalizer across the series fixed condenser and increase the capacity thereof until the station comes in at about the same dial setting as it did in the first calibration.

Use two insulated pieces of thick wire, about 5 inches long, twisted tightly together for the 4.6 mmfd. value. This will not affect the low frequency setting much. Now turn the oscillator dial until the test high frequency comes in. Compare the dial setting with the calibration. If the setting shows more capacity in use than in the first calibration, twist the wires some more, if the setting shows less capacity in use, untwist the wires, until you get coincidence of readings for the high frequency. Then compare again at the low frequency as a final check-up.

The foregoing test will work out all right on the basis of 127 turn secondary on 1 inch diameter for the grid and 108 turn plate coil. In some instances it will be found, due to the larger inherent capacity in the plate circuit, that the 4.6 mmfd addition is not absolutely necessary.

Rating of Resistors

All the resistors used may be of 1 watt rating, except the 10 ohm resistor and the 2,250 ohm resistor, the latter being 5 watts, and the former being manufactured only in values of suitable wattage, so requiring no further attention. The 0.02 meg. resistors may be of one-half watt rating. These are about ¾ inches long in the pigtail type, while the 1 watt resistors are about 2 inches long. The size stated does not include the pigtails.

It is all right to apply the full voltage of the B supply's output to the detector load, because the bias is suitable for that value, and besides the d-c load is 750,000 ohms, although the signal is removed from three-quarters of that load.

The volume control is a rheostat of 10,000 ohms that changes the grid bias voltage on the 235. It will be found that there will be good response almost down to the zero resistance at the grounded end, because the tube works on low bias voltages.

A Push-Pull High Frequency Oscillator

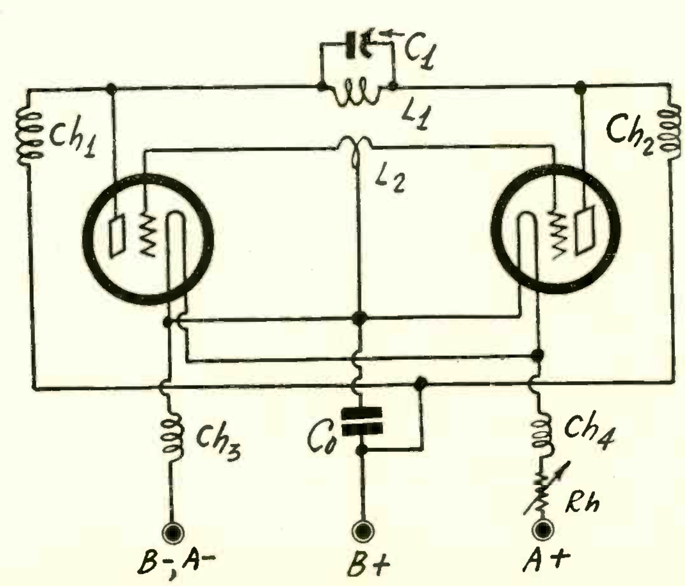
By Edward J. Burke

SOMETIMES it is necessary to set up an oscillator circuit which will operate at extremely high frequencies, of the order of 60,000 kc and higher. Just any circuit hooked up in the form of an oscillator will not oscillate at such frequencies because of capacities in the tubes. It has been found that if two equal tubes are arranged in a push-pull fashion with the tuned circuit connected between the two plates, the frequency of oscillation can be raised materially. In this way the plate to filament capacities of the two tubes are in series and they are also in series with the tuned circuit consisting of L1 and C1 in Fig. 1.

As a means of preventing the plate supply from shorting the feed back two small choke coils are connected in the plate circuits. These are marked Ch1 and Ch2. If these are to be effective at 5 meters, or 60,000 kc, they must be very small as chokes go, for their natural frequency must not be so low that each choke acts as a condenser at the frequency at which the circuit is to oscillate. A dozen turns of wire on a dowel the size of a lead pencil would make a good choke. The use of this does not prevent the use of another choke in series with each, a choke having an inductance of as high as 5 millihenries.

It will be noticed that even the filament leads are filtered in order to confine the oscillating current where it belongs. If the tubes in the circuit are of the 230 type, or other 60 milliampere lament tubes, the chokes Ch3 and Ch4 may be similar to those in the plate circuits except that they should be wound with somewhat heavier wire. About 20 turns of No. 26 double cotton cover wire will do for these chokes, assuming the diameter is about one fourth inch.

The tuned circuit C1L1 depends on the frequency. But for the five meter frequency the tuning condenser may be a cut-down midget having only three plates. The variable plates should be turned with a long insulator rod, for both sides are alive. The coil L1 may be a single turn a few inches in diameter. Naturally heavy wire should be used so that the coil is self-supporting. The secondary L2 should be similar to the primary. That is, it may consist of a single turn coupled to L1. The grid return should be connected to the center of this turn. It will be found that a simple oscillator of this type can readily be hooked up in a few minutes using a couple of 230 tubes. The choke coils may be air core entirely and may be wound a finger if the wire is stiff enough. A test for oscillation would be the putting of a very small lamp in series with condenser C1. If the lamp glows the circuit oscillates vigorously.



The circuit of a push-pull oscillator which will oscillate readily at frequencies of 60,000 kc and higher.

Making Oscillator

Formulas for the Padding of the Ocillat

By J. E.

IT is usually said that in a superheterodyne in which the oscillator condenser is ganged with the radio frequency condensers it is possible to pad the oscillator condenser so that there will be exact line-up at two different frequencies. Actually it is possible to do better and align them correctly at three different points by the suitable choice of the capacity of the condenser in series with the variable condenser, of the capacity of the small shunt condenser, and of the inductance of the coil in the oscillating circuit. To do this theoretically it is only necessary to set down the equations which express the true relationship among the various factors at the three desired frequencies. Having these equations it is only a matter of solving them.

This is comparatively simple work to one who is familiar with simultaneous algebraic equations, but it is rather tedious and we shall only give the results with directions for applying them to particular cases.

In Fig. 1 we have two tuned circuits, one the radio frequency tuner comprising a capacity Cx and a suitable inductance, and the other comprising an inductance L, a variable condenser Cx, which is the same as the variable condenser in the r-f circuit, a fixed condenser Cs in series with Cx, and a shunt condenser Cm. The problem is to find L, Cs and Cm in terms of Cx, the intermediate frequency, and the three frequencies at which the difference between the resonant frequencies of the two circuits is exactly equal to the intermediate frequency.

Padding Formulas

In order to apply the formulas in an orderly manner so as to eliminate chances of error in the arithmetical work a good deal of formulation is necessary. The orderly work not only eliminates chances of error but it also eliminates a great deal of work and duplication.

Let the three frequencies at which the line-up is to be exact be F, F1, and F2, given in the order of increasing value, and let the intermediate frequency be f. Let C, C1, and C2 be the corresponding values of the capacity in the radio frequency circuit, and hence of Cx in the oscillator circuit. Let K be the total effective capacity in the oscillator circuit corresponding to the capacity C or to the frequency F. K, therefore, is a combination of C, Cs and Cm.

The first step in the work is to find R1 and R2 as defined by equations (1a) and 1b). It will be observed that these equations involve only the frequencies concerned, the first the first two tie-down frequencies and the intermediate frequency, and the second the first and the third tie-down frequencies and the intermediate frequencies. The pure numbers R1 and R2 can therefore be obtained as soon as the intermediate frequency is known and the three tie-down frequencies have been chosen.

Finding Values of Capacities

The second step in the work is to find the values Cx for the three different tie-down frequencies, that is, of C, C1 and C2. These are found from the maximum capacity in the radio frequency circuit and the ratio of the lowest frequency to which the circuit tunes with this capacity and the tie-down frequency. For example, the maximum capacity in the circuit may be 500 mmfd. and the lowest frequency 550 kc. Then the capacities are determined in terms of 500 mmfd., and 550 kc, and the three tie-down frequencies. Let the maximum capacity be designated by Co and the corresponding frequency by Fo. Then formulas (2a, (2b), and (2c) can be used for determining C, C1 and C2.

Now we would be ready to determine the value of the series capacity Cs if we could not simplify the work some more, for Cs depends on R1, R2, C, C1 and C2. However, to simplify the work and to avoid errors we shall define a coefficient B as given in equation (3). We first compute the value of B from the three capacities obtained by equations (2) and the two frequency ratios as obtained by equations (1).

Having obtained B from (3) we can obtain the value of the series capacity by equation (4). It will be noticed that this involves C1, C2 and B. As both the numerator and the denominator in (4) involve differences of two numbers it is absolutely necessary to perform the work up to this point accurately. This is particularly necessary if it turns out that B is only slightly different from unity, for then a small error in the computation of B will introduce a large error in Cs.

Obtaining L and Cm

As soon as we have found the value of Cs we can obtain the value of K, the total effective capacity in the oscillating circuit at the tie-down frequency F. Formula (5) should be used.

As soon as K has been obtained we can find the inductance L in the oscillating circuit by means of formula (6), and we can also find the shunt capacity Cm by means of formula (7).

It will be observed that K involves Cs, C, C1 and R1, all of which have been determined previously. L involves F, f and K, and all of these have already been determined. Likewise Cm is expressed in terms of quantities, all of which have been determined. It will be noted that Cm is expressed as a difference of two numbers which are very nearly equal. Because of this near equality it is necessary that the computation be done accurately or there will be a large percentage error in Cm.

Comment on Units

Formulas (1) contain only frequencies and each R is a pure number. Hence the F's may be expressed either in kilocycles or in cycles. In formulas (2) the F's may also be expressed in either kilocycles or cycles but the capacities will be expressed in the same units as Co. For example, if Co is expressed in micromicrofarads, C, C1, and C2 will also be expressed in these units. B is a pure number, as are R1 and R2, so that the capacities may be expressed in any consistent units, which may as well be mmfd. In (4) Cs will be expressed in the same units as C1 and C2, since B is a pure number. In (5) K will be expressed in the same units as the four capacities involved.

In (6) L will be expressed in henries if F and f are expressed in cycles per second and K as expressed in farads. If F and f are expressed in kilocycles per second and K in mmfd., L will be given in microhenries. In (7) Cm is expressed in the same units as K and the other two condensers involved.

Now we have found the three unknown quantities required for padding the oscillator circuit in general terms and we can apply the formulas to any special cases we desire. To illustrate the use of the formulas let us apply them to the case of a superheterodyne which is to cover the broadcast band with a 350 mmfd. tuning condenser and an intermediate frequency of 175 kc. In this case the maximum capacity in the circuit is 390 mmfd., 40 mmfd. being allowed for the capacity of the coil and that of the tube.

Choice of Tie-down Frequencies

It is customary to pad this circuit so that one tie-down frequency is 600 kc and the other is 1,400 kc. Let us chose the third so that it is near the geometric mean of these two, that is, 915 kc. Then we have Co=390, Fo=550, F=600, F1=915, F2=1,400, the capacity being expressed in mmfd. and the frequencies in kilocycles. Applying (1a) we get R1=0.495 and applying (1b) we get R2=0.758.

$$R_1 = \frac{(F_1-F)(F_1+F+2f)}{(F_1+f)^2} \quad \text{(1a)}$$

$$R_2 = \frac{(F_2-F)(F_2+F+2f)}{(F_2+f)^2} \quad \text{(1b)}$$

$$C = \frac{C_0F_0^2}{F^2} \quad \text{(2a)}$$

$$C_1 = \frac{C_0F_0^2}{F_1^2} \quad \text{(2b)}$$

$$C_2 = \frac{C_0F_0^2}{F_2^2} \quad \text{(2c)}$$

$$B = \frac{R_1(C-C_2)}{R_2(C-C_1)} \quad \text{(3)}$$

$$C_s = \frac{C_1B-C_2}{1-B} \quad \text{(4)}$$

$$K = \frac{C_s^2(C-C_1)}{(C_s+C)(C_s+C_1)R_1} \quad \text{(5)}$$

$$L = \frac{1}{4\pi^2(F+f)^2K} \quad \text{(6)}$$

$$C_m = K - \frac{C_sC}{C_s+C} \quad \text{(7)}$$

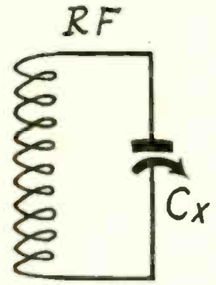
$$K_1 = \frac{C_s\,C_1}{C_s+C_1} + C_m \quad \text{(8)}$$

$$F = \frac{1}{2\pi\sqrt{LK_1}} \quad \text{(9)}$$

Condenser Track

or Condenser In a Superheterodyne

Anderson



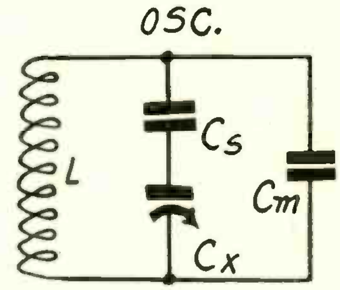
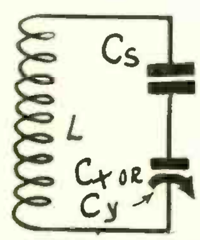


Fig. 1, upper left shows r-f tuned circuit. Fig. 2, upper right, shows padded oscillator condenser. Fig. 3, lower left, shows simplified padded oscillator. The formulas, lower right, pertain to the simple method of padding.



$$K_x = \frac{C_s C_x}{C_s + C_x} \quad \text{------------ (10a)}$$

$$K_y = \frac{C_s C_y}{C_s + C_y} \quad \text{------------ (10b)}$$

$$5.38 = \frac{C_x}{C_y}\left(\frac{C_s + C_y}{C_s + C_x}\right) \quad \text{------ (11)}$$

Applying (2a) we get C=390x(550/600)^2, or 328 mmfd. Applying (2b) we get C1=141 mmfd. and applying (2c) we get C2=60.2 mmfd.

Now we use (3) to get B. Using the values we have already found for R1, R2, C, C1 and C2 we get B=0.934. Using this value in conjunction with C1 and C2 in formula (4) we get Cs=1,080 mmfd.

Now let us find the value of K as a preliminary of finding the inductance. Applying formula (5) we get K=258.2 mmfd., which enables us to compute the inductance by using formula (6). It gives L=163.1 microhenries.

Cm is obtained by applying (7), which gives 6.4 mmfd. Now we have found the three unknown quantities provided that our arithmetical work is correct. We can check this with the aid of formula (8) for K1 and with this and the inductance compute the oscillation frequency at the second tie-down frequency. It should be 915 plus 175 kc, or 1,090 kc. K1 turns out to be 132.1 mmfd. and therefore the oscillating frequency is 1,080 kc. The check is off 10 kc, due mainly to the fact that a slide rule was used in the computation. The error is mainly due to the fact that Cm is slightly large.

Checking Other Frequencies

It is interesting to know how much the error is at other frequencies. Let us compute the oscillating frequency at the geometric mean between 600 and 915 kc, or 740 kc. Cx now is 215.5 mmfd. and Kx is 186.2 mmfd. Hence the oscillating frequency is 912 kc, which makes the difference 172 kc. Therefore the frequency is off only 3 kc, which is quite satisfactory. At other frequencies in the tuning band the matching is of the same order of closeness. Therefore the padding may be considered quite satisfactory.

But can this padding be achieved practically? It will be observed that the minimum capacity in the oscillator circuit is only 6.4 mmfd., and we have reason to suppose that even this is slightly large. Now the least possible minimum is the sum of the self capacity of the oscillating coil and of the input circuit of the oscillating tube. This is likely to be somewhat higher than 6.4 mmfd. Hence it is not likely that in this particular case it is possible to effect the high degree of padding that the computation calls for. But we can come very close by making the oscillating coil so that it has a very low order or self capacity, and then using the natural minimum in the circuit. The only effect is that the tie-down frequencies will be shifted slightly.

When to Use Cm

It will be noticed that the variable condenser in the oscillator circuit is assumed to be the same at all settings as the variable in the radio frequency tuner. But the capacity in the radio frequency circuit not only consists of the capacity of the condenser but also the capacity of the coil and that of the tube. Only the condenser is transferred to the oscillating circuit. Hence it is necessary to connect a trimmer condenser across the variable in the oscillating circuit and then adjust this trimmer so that its capacity is equal to the sum of the coil capacity and the tube capacity in the radio frequency tuner. This is very easily effected. But the trimmer must have a rather small capacity. We assumed that the capacity in the r-f circuit was 390 mmfd. instead of 350 mmfd. Therefore we have added 40 mmfd. to allow for coil and tube and other stray capacities. Therefore we should have a trimmer across the variable condenser in the oscillating circuit which may be set to a value about equal to 40 mmfd.

The practical work of trimming would consist of adjusting the small capacity across the variable condenser, adjusting the series condenser capacity and the inductance of the coil. If the shunt capacity comes out to be larger than that in the oscillating coil and the tube, it would also be necessary to adjust this for closer trimming. When the intermediate frequency is high it may be necessary to use the shunt condenser Cm, but for the broadcast band with an intermediate frequency of 175 kc and a tuning condenser of 350 mmfd. it seems unnecessary to use the shunt.

Practical Adjustments

For approximate work in padding a much simpler method of obtaining the series capacity and the inductance is available. This is based on frequency ratios and the fact that the series condenser is so large in comparison with the minimum capacity of the variable that the minimum in the circuit is practically unaffected by the series condenser.

Let us suppose again that the padding is to be done for a broadcast receiver having an intermediate frequency of 175 kc, with a variable condenser of 350 mmfd., or a maximum capacity of 390 mmfd. The ratio of the maximum to the minimum frequency in the radio frequency tuner is 1,500/550, and the capacity ratio is the square of this ratio. That is, the maximum capacity is 7.45 times the minimum. If the maximum is 390 mmfd., the minimum is 52.6 mmfd.

Inductance Computation

In the oscillator circuit the maximum frequency is 1,675 kc and the minimum is 725 kc. The ratio is 2.31, the square of which is 5.34. Hence, if the minimum capacity in the oscillator circuit is 52.6, the maximum should be 281 mmfd. We can use this capacity in conjunction with the maximum capacity of the tuning condenser for determining the series capacity. The variable has a capacity of 390 mmfd. and the combination a capacity of 281. This series capacity is 390Cs divided by (Cs+390) and this should be equal to 281 mmfd. Solving this equation for Cs we obtain 1,005 mmfd. This compares with 1,080 obtained with the more laborious method.

The inductance in the oscillating circuit should be determined on

(*Continued on next page*)

Oscillator Padding

Formulas for Approximate and Precise Padding Given

the basis that the frequency should be 725 kc when the capacity is 281 mmfd. This gives us an inductance of 171.8 microhenries. This compares with 163.1 obtained by the more accurate process.

Tracking

The tracking is not so good when the simpler method is used. Let us see how it is at 1,500 kc. The frequency of the oscillating circuit is obtained by first computing the capacity in the circuit at 1,500 kc. We found that the minimum of the condenser was 52.6 and that the series capacity was 1,005 mmfd. The capacity of the two condensers in series is 50.2 mmfd. This we combine with the inductance just obtained, namely, 171.8 microhenries. Applying the frequency formula, or (9), where L and K1 are the inductance and capacity, we get a frequency of 1,711 kc. It should be 1,675 kc. Therefore the tracking is off 36 kc. This would be very serious in a superheterodyne that was tuned sharply both in the r-f and i-f channels, but as is usually the case, if the i-f is tuned sharply and the r-f not so sharply, the only effect of the inaccurate padding would be to make the set less sensitive at the higher settings. The circuit would operate with the r-f tuner nearly 38 kc off resonance. This may be a desirable feature to offset the higher sensitivity of the circuit at the higher frequencies, provided that image interference does not show up to impose the necessity of greater selectivity in the r-f tuner. In many good practical superheterodynes the tracking is no better than that indicated above.

Common Practice

It is common practice to use a series capacity of 746 mmfd. If this is used in conjunction with a 350 mmfd. tuning condenser and if we allow a stray capacity of 20 mmfd. the total capacity at maximum setting will be 258.5 mmfd., and the required inductance in the oscillator would have to be 196 microhenries. At minimum setting the variable condenser has a capacity of about 10 mmfd., that is, 1-2 of the total maximum. Then the minimum capacity would be 29.86 mmfd. The highest frequency would therefore be 2,080 kc. Here the frequency is no less than 405 kc too high. But this, of course, is due to the assumption of too low minimum capacity.

If the shunt condenser Cm can be neglected the solution of the padding problem becomes quite simple and may be done as follows:

Let Cs be the required series capacity and let Cx and Cy be the maximum and minimum capacities in the radio frequency tuner at 550 and 1,500 kc. The ratio of Cx to Cy is then 7.45, very nearly. The capacity in the oscillating circuit at 1,500 kc. is given in (10a) and that at 1,500 is given in (10b). When the capacity in (10a) is used in conjunction with the inductance of the oscillating coil we should have a frequency of 725 kc. If we use (10b) in conjunction with the same inductance we should have a frequency of 1,675 kc. If we divide (10a) by (10b) we should have the square of the ratio of 1,675/725, or 5.38. This is given in (11).

Now if we put in the ratio of Cx to Cy we have the value of Cs in terms of Cx, which is known. Therefore we have Cs. Solving the equation we obtain Cs=2.115Cx. If Cx is 390 mmfd., Cs is 825 mmfd. Now we can obtain the inductance in the oscillating circuit by combining Cs and Cx by (10a) and putting the resulting capacity in the frequency formula. Equation (10a) gives Ko equals 264.8 mmfd. which is combined with 725 kc. to determine the inductance. We obtain L=181.8 microhenries. This should tie the two circuits down at 1,500 and 550 kc. provided the arithmetical work is correct.

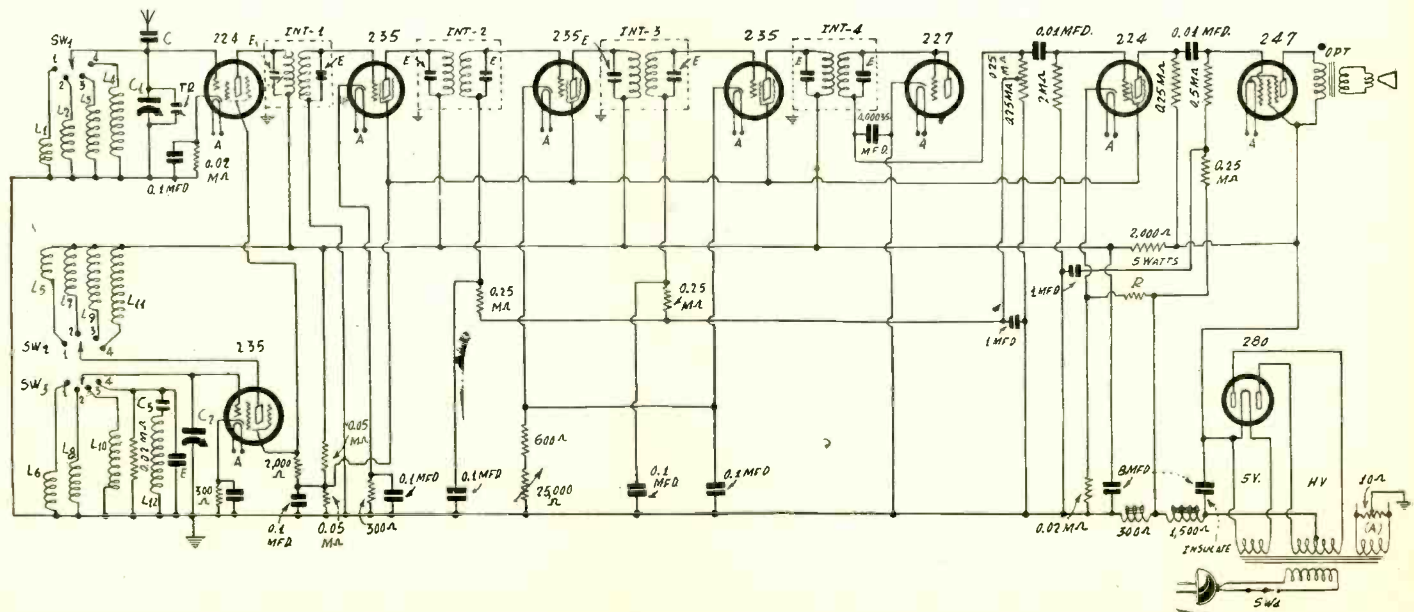
Magnitude of Error

Let us see how far in error the padding is at the geometric mean frequency of 915 kc. The oscillator should have a frequency of 1090 kc. The value of the capacity in the r-f circuit at 915 kc. is 141 mmfd. If we let Cx in (10a) be this value we can get the capacity in the oscillating circuit. It turns out to be 120.4 mmfd. With this capacity and the inductance we can get the frequency, which is 1,073 kc. It is only 17 kc. off the desired value, which is not at all serious.

In this padding as in the preceding the variable capacity in the oscillator circuit is equal to the variable capacity in the r-f circuit and for that reason it is necessary to put a trimmer across the variable condenser in the oscillator to compensate for coil and tube capacities. There is an error in this, of course, for the coil and the tube in the oscillator also have capacities, which are across the series combination. These will make the frequency of the oscillator lower than that computed. This may be compensated for by making the oscillator inductance slightly less, or preferably by making the series capacity and the trimmer capacity across the variable slightly less. In this connection it should be remembered that it is not absolutely necessary to have a 175 kc. intermediate, and it may be that the line-up will be all right as computed for some other i-f, slightly different from 175 kc. It is then only necessary to retune the intermediate amplifier circuits.

Practical Padding Hints

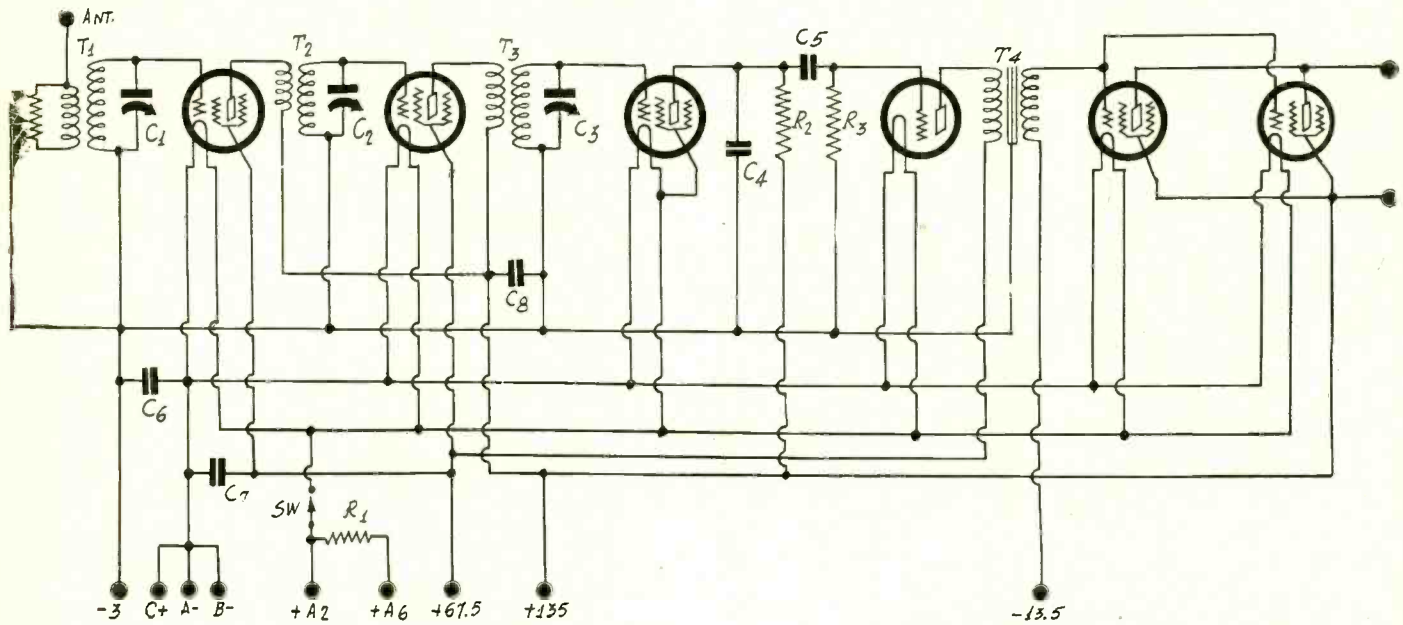
In a practical case of padding without instruments, choose a series condenser of capacity approximately that computed. Start with an oscillator coil having too many turns. Set the tuner of the receiver at a station near 550 kc. Change the oscillator inductance by removing a turn at a time until the signal comes through loudest. Try the circuit by tuning in other stations. It may be improved by retuning the intermediate frequency amplifier as the padding may be just right for a slightly different intermediate frequency.



When the superheterodyne is to cover several frequency ranges without changing the intermediate frequency, it is necessary to pad each oscillator system independently.

Stopping Double Image

Solution for Television Trouble Sought in Layer



Even if a set is battery operated, double image reception of television is present occasionally, so the trouble can't be ascribed to the line a-c. Nor would the audio transformer be to blame. The upper atmosphere, more likely.

THE problem of elimination of the double image in television, which has troubled scientists and engineers since first experiments in visual broadcasting, may be solved within the next year by the co-operative effort of Federal scientists studying the Heaviside layer, it was stated at the Federal Radio Commission.

Radio experts at the Bureau of Standards, the Naval Research Laboratory, and at television experimental stations reporting to the Commission, hope that by becoming more familiar with variations of the layer, and combining these findings with those of other experiments, they may discover some method of eliminating the double image, it was said.

The Heaviside layer, a body of ionized gaseous material about 70 to 200 miles above the earth, refracts to the earth all sky waves from transmitting sets. If, by thorough study of the layer, scientists may become familiar enough with its variations to adjust transmitters so they won't be influenced by the layer's action, the double image probably will be done away with.

How It Is Caused

The double image effect is caused by ground and sky waves from a transmitter arriving at the reception point at slightly different times. When they arrive simultaneously, that is, when the cycles of both sky and ground waves arrive in phase, the image is clear and distinct. However, when the cycle of one wave varies a fraction of a second before or after that of the other wave, two pictures are received.

When waves are received in this way, they are called "out of phase." Such variation is responsible for fading signals in broadcast reception.

Refraction from the Heaviside layer is responsible for waves arriving "out of phase." The layer varies in height daily and seasonally, and is constantly in slight motion. The higher it is, the better is reception. The layer is high at night, low during the day; high in Winter and low in Summer.

Study in Far North

Studies of the layer are now being carried on at the Bureau of Standards and at many television experimental stations. The Naval Research Laboratory will sponsor an Arctic expedition in 1932 to study the layer in the far north. Scientists and engineers of the Federal Radio Commission are watching developments closely, and are helping in every possible instance.

From this cooperative study may come knowledge which will cause the end of the double image, says "The United States Daily."

Other experiments in methods of eliminating the two picture effect are being carried on at television experimental stations throughout the country. These stations report to the Commission, telling of developments and progress.

One recent experiment consists of placing a large metal sheet over the antenna of the transmitting station. This sheet absorbs all sky waves or refracts them back to earth before they emanate far from the transmitter, and causes the ground wave to be sent out alone.

Sky Wave Affords DX

Although it is possible to eliminate the double image in this way, signals sent under these conditions may be heard only a short distance from the transmitter. It is the sky wave which travels farther and remains strong longer.

In the high frequencies, which at the present stage of development seem most suited to television, the ground wave becomes weaker, and the sky wave is lowered somewhat, taking the form of a beam cast from a searchlight. When the metal sheet is placed over the antenna of a transmitter whose signals are sent out on frequencies between 43,000 and 80,000 kilocycles, the weaker waves are absorbed, and the beam-like wave emanates intensely.

Although experiments in this field have not been carried far enough to show definite results, it is possible that this may be a solution of the problem. When only one wave goes out from the transmitter, there is no chance of receiving a double image at any distance from the emanating point.

Television still is in an experimental stage. With future study and research by scientists and engineers, it is possible that before many years it will become as universal and important in the home and commercially as radio broadcasting is today.

Operation of Screen Gric

Proper Relation Must Exist Among t

By Bruns

THERE seems to be a great deal of misunderstanding about the proper operation of screen grid tubes in resistance coupled circuits, whether the tube is functioning as a detector or as an amplifier. The general theory that the amplification increases with the load resistance until it reaches the product of the load resistance by the mutual conductance of the tube is apparently responsible. This theory, of course, is true when it applies, but when does it apply? It applies when the effective plate voltage on the tubes is considered rather than the voltage applied in the plate circuit. It would be necessary to apply an almost infinite voltage in the circuit when the load resistance is extremely high. In practical circuits we are definitely limited as to the voltage we can apply and therefore we must consider the operation of the tube from the point of view of a fixed applied voltage in the plate circuit, and a comparatively low voltage at that.

Decreasing the Load

We can easily increase the effective voltage on the plate of the tube by decreasing the load resistance. But what does this give us? Nothing but decreased amplification or detection efficiency. It is the load voltage variations that count, and if we have a low load resistance we cannot get much variation. While it is true that the output voltage of the tube is really the variation in the voltage in the tube itself, this variation is due to the variation in the plate load resistance. As a matter of fact, we can consider either the voltage variation across the tube or the voltage variation across the load resistance as the output voltage. One is the complement of the other. If one is high for a given signal input the other is also high, referring only to the variations, and they alone count.

For a given applied voltage in the plate circuit, the steady drop in the load resistance is higher the higher that resistance, and hence the effective voltage on the plate is lower, since the two are complementary of the other, considering steady values only.

Considering Power Output

If we were to consider power output there would be one load resistance which would give the greatest output for in that case we woud have to consider current. The power output is the product of the effective values of the plate voltage variations and the current variations. This product is maximum when the load resistance is equal to the internal resistance of the tube.

But in a resistance coupled circuit, whether it be an amplifier or a detector, we are not in the least concerned with power output. All we are interested in is potential variations, that is, voltage variations. These are greater the greater the load resistance is in comparison with the internal resistance. This is a general proposition and applies to generators, batteries, transformers, and tubes. A transformer gives the highest voltage across the secondary terminals when these are open. Likewise the output voltage of a battery is highest when the terminals are open. This can easily be tested by measuring the voltage of an old dry cell battery with two different voltmeters, one with high resistance and the other with low resistance. The high resistance voltmeter will read higher because it puts a higher resistance load on the battery. With a true potentiometer the voltage measured would be the electromotive force of the battery, which is the open circuit voltage.

Tubes the Same

Vacuum tubes behave in the same way and the effect is greater because of the high internal resistance. When it comes to three element tubes there is no difficulty and all recognize the fact that the output increases with the load and for that reason compartively high resistances are used in the plate circuits.

The situation is also the same with screen grid tubes except in these there is a complicating factor, the screen voltage. The function of the screen voltage is to increase the effect of a given control grid variation. The screen voltage controls the plate current just as the grid and the plate voltage control the current, and hence the output voltage. As the screen voltage becomes high the plate current assumes a constant value as shown in Fig. 1. The effective voltage on the plate should always be higher than voltage on the screen. As soon as the screen voltage becomes equal to or higher than the plate voltage

FIG. 1

Static curves taken on a 236 screen grid tube under the conditions stated. The screen voltages are 6.3, 22.5, 45, and 67.5 volts. A low screen voltage is necessary both when the tube is operated as an amplifier and as a detector. The static curves are virtually the same as the dynamic curves when the load is a pure resistance.

there is no further change in the plate current or the plate output voltage as the control grid voltage changes. Obviously the higher the applied screen voltage is for a given applied voltage in the plate circuit, the sooner will the screen voltage exceed the effective voltage on the plate, and the sooner the limiting value of the plate current is reached. This may be changed by decreasing the plate load resistance and thus permit a wider swing of the grid. But to what gain? A gain in the plate current variations to be sure, but no gain in the plate output voltage. There is no gain in increasing the plate current when we are interested only in potential variations.

Curves Show Effect

The curves in Fig. 1 show the effect of limiting the plate current by the screen voltage. As indicated on the drawing the applied plate circuit voltage was 135 volts and the load resistance 250,000 ohms. The limiting value of the plate current is about 0.235 milliampere. For other conditions fixed this limiting value could be increased by increasing the plate voltage. The limiting value indicates that the effective internal resistance of the tube is 325,000 ohms.

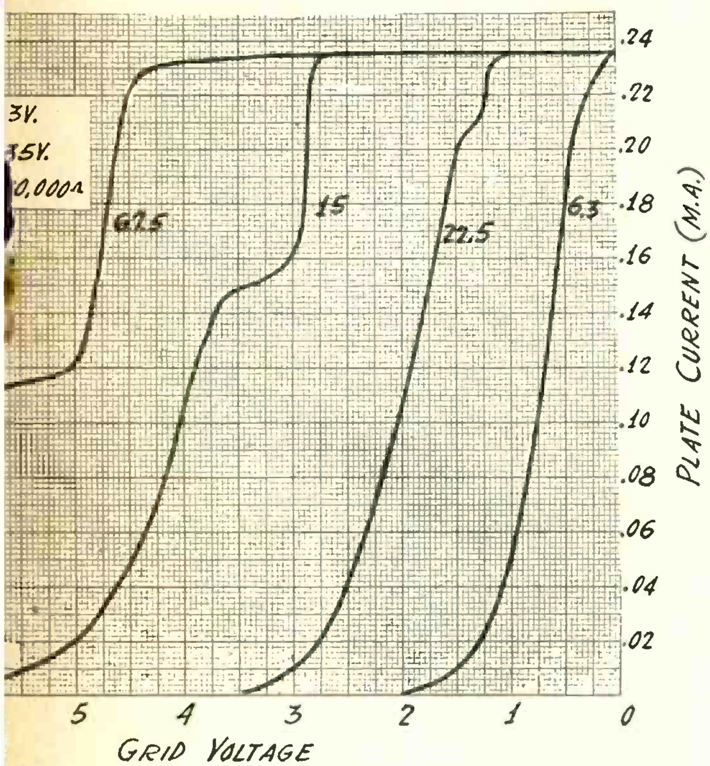
It may be said that the curves are static and not dynamic and that they do not show the true operation of the tube. But the circuit is resistance coupled and for that reason the dynamic curves would be about the same, especially when there is no choke or other impedance in the screen circuit. It is easily determined what the output will be when the grid bias, for example, is 3 volts and the screen voltage is 67.5 volts. The curves show that nothing should be obtained from the tube and experiment bears this out. There is no variation in the plate current and therefore there can be no variation in the plate output voltage. The same applies when the screen voltage is 45 (marked 15 on the cut) except that the limiting current region is not so wide. Again it applies when the screen voltage is 22.5 volts but here the flat top range is very narrow. It is not until the screen voltage is 6.3 that there is practically no flat top while the grid bias is negative. The screen voltage could even be reduced below this with good effect, for example, to 5 volts.

We could flatten out the curves by putting a high resistance in the screen. This would lower the effective value of the screen voltage for the screen current varies in the same direction as

d Tubes in Audio Circuits

ne Screen, Grid, and Plate Voltages

ten Brunn



the plate current. At the bottom of the curves there would be practically no change but toward the higher values of plate current there would be a considerable change for there the screen current would be relatively high and therefore the screen voltage would be cut down. Doing this would permit a wider swing of grid voltage in an amplifier. There is no advantage of doing this, however, when the tube is used as a detector. The detecting region is at the bottom of the curves where the curvature is greatest and there the screen circuit resistance has little effect. The detecting efficiency would be cut down, as is the amplification efficiency. The detecting efficiency is higher for the lower screen voltages, assuming correct grid bias for detection.

Using Tube as Amplifier

The only difference between an amplifier circuit and a detector circuit is in the operating bias, except that when the tube is used as an amplifier we must use either a low screen voltage or a high resistance in the screen lead. A resistance of about 100,000 ohms straightens it out very well. Referring to the curves in Fig. 1 we may use the 6.3 volt curve for amplification provided that we adjust the grid bias to about 0.7 volt. At this point a change in the control grid voltage of 0.4 volt produces a change in the plate current from 0.174 to 0.07 milliampere, or 0.104 milliampere. Therefore one volt will change it 0.26 milliampere, if we could swing the grid bv this amount without encountering distortion. Since the plate load resistance is 250,000 ohms, the voltage amplification is 65 times. The peak output voltage would be 0.2 x 65, or 13 volts. This is enough to load up a power pentode of the 233 type or of the 238 type.

Using a Higher Screen Voltage

If it is necessary to increase the possible output voltage to load up a larger tube, this can be done by increasing the voltage in the plate circuit of the 236 tube. Of course, a 236 tube would not be used with a 247 pentode or other large tube, but the principle applies just the same to a 224 tube, or a 235. We have to increase the voltage in the plate circuit of the tube to get sufficient undistorted voltage out of the amplifier. Of course, in the 6.3 volt curve in Fig. 1 we could increase the grid swing a little more so as to get sufficient signal voltage out of the tube to load up a 247 tube without appreciable distortion if it were necessary.

If we use the 22.5 volt screen we could get pretty good amplification by adjusting the bias to 2 volts, around which we could swing the grid one half volt in either direction. The plate current would swing from about 0.2 to 0.04 milliampere, or 0.16 milliampere. The swing in the plate voltage would be 40 volts. The mean amplitude would therefore be 20 volts, which is more than enough to swing the grid of a 247 power pentode.

There would, of course, be some distortion in the output because the negative swing would not produce as much change in the output voltage as the positive swing. This distortion is partly compensated for in the output tube for the distortion in that tube is similar and works in the opposite direction. That is, the power tube would amplify the weaker half of the input more than the stronger. In any amplifier containing two tubes in which the first is coupled to the second in such a manner that there is a phase reversal, this compensation occurs. It would not occur in an amplifier of two tubes in which the coupling is by means of a transformer and when the secondary leads are so connected that there is no phase reversal. Transformers are usually connected so that there is no phase reversal. In such circuits the harmonic distortion is considerably larger than that obtained when measuring it on the last tube alone.

Still Higher Screen Voltages

The use of higher screen voltages than 22.5 volts is obviously not practical when the tube is to be used as an amplifier. There is no region in which the curve is straight enough for distortionless amplification. While there is a straight portion of the curve about where "67.5" is on the graph, the tube is unstable there, the slope apparently is no greater than on the best portion of the 6.3 volt curve, and the straight region is much more limited.

Regarding the detecting efficiency it clearly appears that it becomes less as the screen voltage is increased, keeping the plate load resistance and the voltage in the plate circuit constant. The detecting efficiency depends on a combination of curvature and the slope at the operating point. The point where the curve bends upward most rapidly is not the most sensitive detecting point but rather a point at a slightly lower bias.

Effect of Low Plate Current

It has been said that when the load resistance on a tube is very high there is not enough plate current to support the grid swing. How, it is asked, can there be distortionless amplification when the plate current is measured in terms of a few microamperes when there may be serious distortion when the resistance is so low that the current will be of the order of several milliamperes? If there is any difference in the amount of distortion, there will be less when the resistance is high and the current is low. This, however, does not mean that the output characteristic becomes straight by increasing the load resistance. This is an old fallacy which can be exploded by plotting two curves, one with zero load and one with a very high load, all other conditions remaining the same. If they are plotted to the same scale the resistance curve appears to be straight, but if they are plotted so that the curves coincide at zero bias they will coincide nearly all the way. There is a slight difference and that is in favor of resistance.

Magnitude of Plate Current

The magnitude of the output current has very little to do with the undistorted output voltage. The product of the current by the load resistance does, and that shows no more distortion for a high resistance and low current than for a low resistance and high current, except for the minute effect just referred to. When there is a question of power output the situation is entirely different, but the only tube that operates under power conditions is the last tube in the receiver, the one that delivers power to the speaker. The other tubes deliver voltage to the succeeding tubes. If it were possible to operate a tube on open circuit, so that no plate current flowed, that would be the ideal case. But we must have a load and an applied plate voltage or we cannot get anything out of the tube. The nearest we can come to an open circuit is to use a very high load resistance.

A Battery Operated

New System of Using Same

By Herman

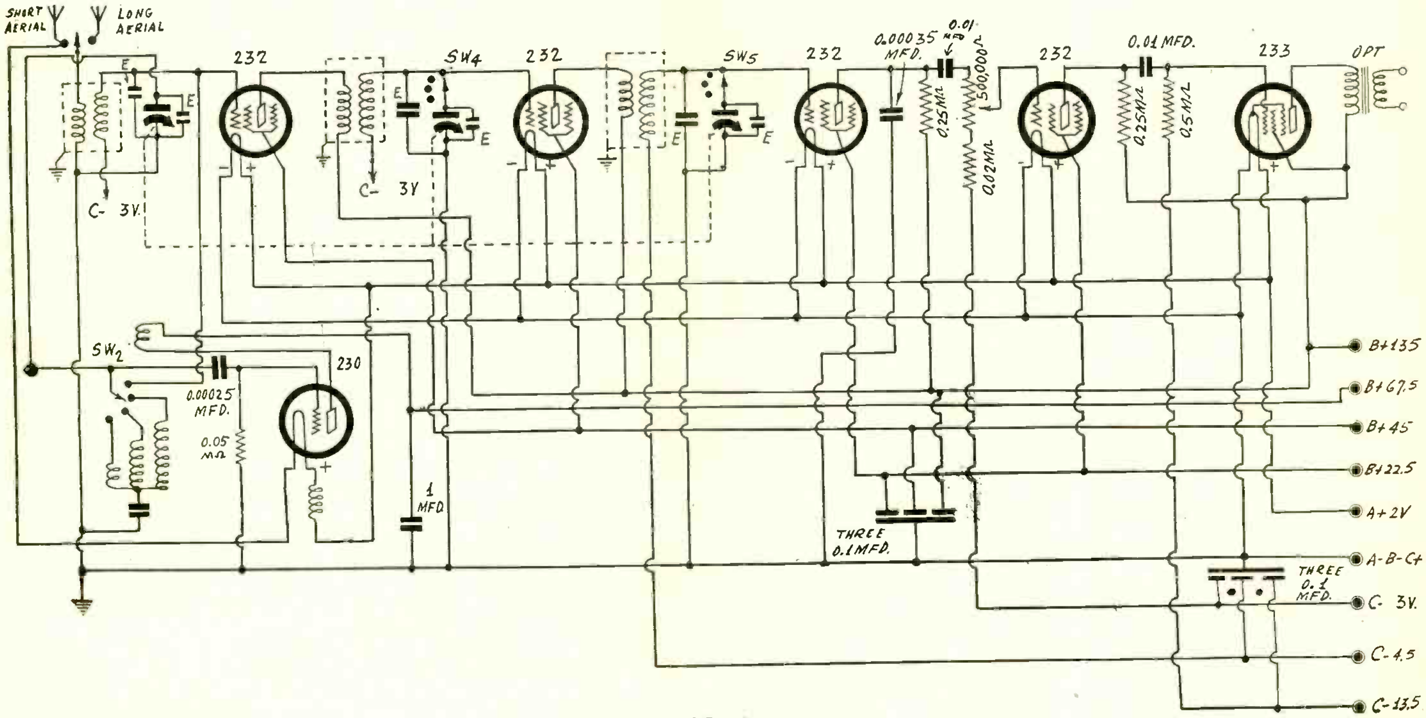


FIG. 1

This set, for battery operation, represents an economical way of tuning in both broadcast and short waves.

[*In last week's issue, dated November 21st, was published an article on a new method of the construction of a tuned radio frequency receiver with built in converter, whereby the same dial is used for tuning short waves as for broadcasts. This is a valuable contribution to convenience and simplicity. This week the system is applied, with slight changes, to battery operation.*—EDITOR.]

WHEN one has no electricity in the home one must use batteries, and a choice has to be made as to the type of tubes. Since the automotive tubes came out it has become popular in some quarters to use them, as the full 6 volts of a storage battery may be applied to the heaters. The automotive tubes are of the heater type, like the 224, 235 and 227, and so the circuits have in some respects a resemblance to a-c diagrams.

Filament Supply

However, the 2 volt series tubes require less power, and when one must use batteries, the question arises how far does he have to go to get his storage battery recharged, and how free does he feel about renewal of B batteries? The circuit, Fig. 1, is based on the assumption that one desires to economize on power, although the performance is up to standard. For instance, the filament current drain is only .56 ampere, and as 2 volts are needed to heat the tubes, one cell of a 6 volt storage battery, or merely a 2 volt storage battery, may be used. With the larger voltage battery a shift may be made from one cell to another, from week to week, and again economy is achieved. Of course an air cell battery, if obtainable, may be used. The plate current is less than 30 milliamperes.

Circuit Operation

The operation of the circuit is as follows:

(1)—When the A battery switch is turned "on," and the aerial switch SW-1 is thrown to the right, the receiver is a tuned radio frequency circuit: two stages of t-r-f, tuned detector input and two stages of audio with pentode output.

(2)—When the antenna switch is turned to the left it picks up the short aerial and also completes the filament circuit for the oscillator tube (lower left). Then a three deck, four point rotary selector switch, previously set at extreme right, is thrown to the adjoining position. The variable condensers and trimmers across them are removed from the t-r-f channel. The first tuning condenser, at left, is then used in the oscillator circuit, which is automatically done, and two more positions of the switch are available. These two, like the previous one, represent blanks for the t-r-f portion, so that after the extreme right hand position the only change introduced by switching is in the oscillator, where a different coil is picked up for each of three bands.

Why the Separate Equalizers

Mention has been made of the tuning condensers and trimmers across them, but the diagram shows individual equalizers also across those coils. The reason is that when the rotary switch is thrown to left position the former t-r-f channel becomes the intermediate channel, and should be resonant at about 1,600 kc. It is vital to sensitivity that full resonance be achieved, as being only a little off is a serious hurt to sensitivity. Therefore, while the variable condensers need equalizing, the peaking for their

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

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George J. Pasek, Kettle River, Minn.
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Sherman Ford, 25 Chesapeake Ave., Phoebus, Va.
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William Gutendorf, 100 Freeland St., Pittsburgh, Pa.
Edward Lakes, 630 Highland Ave., S. E., Roanoke, Va.
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Jay Mosshammer, Stillwater, Okla.
Raymond F. Brown, 101 Prospect St., Gloucester, Mass.
E. Krehmhoff, Wathena, Kans.
H. L. Houghton, East Leroy, Mich.
Armando Troconis, Maracaibo, Venezuela, So. Amer.
Frank T. Greene, 6 Washington Place., Helena, Mont.

13-550 Meter Receiver

Dial for All Bands Is Included

Bernard

purpose might not hold good for 1,600 kc, indeed the chances are very strong against it, so the 1,600 kc trimmers are permanently in circuit, and the variable condenser's trimmers have to be set as additional capacity to that supplied by the others. In other words, there is a peaking at 1,600 kc and also at some broadcast frequency. It is usual to peak around 1,000 kc for the broadcast band.

The tube heretofore referred to as the oscillator is also the modulator. Oscillation is readily obtained by a feedback winding. Modulation results from the grid leak and grid condenser. A B voltage of 67.5 volts is usually quite enough, and if not, rather than increase the B voltage, put on more tickler turns, as increasing the B voltage increases the current drain.

Filament Choke Coils

The primary in the antenna stage and the r.f. choke in the positive leg of the 230 are wound of No. 18 wire, since the filament current flows through these two coils, so they must not have much resistance. Therefore they should be wound of heavy wire. The coil at left, in the primary, has 15 turns of No. 18 wire, while that in the positive leg has 20 turns of No. 18 wire. The diameters of the two tubings is 1 or 1⅛ inches.

A series condenser, another equalizer, is put in the common radio frequency return of the short wave grid coils, to cut down the condenser's tuning capacity, ordinarily 0.00035 mfd., but made about 80 mmfd. This is plenty capacity for tuning short waves, particularly as the capacity ratio will be nearly 7 to 1, giving a frequency ratio of a little better than 2.6 to 1. Hence the first coil for tuning the lowest frequency band of short waves would tune from 1,500 to 3,900 kc (199.9 to 76.88 meters), the second or middle coil from 3,700 to 9,620 kc (81.03 to 31.17 meters), and the last coil from 9,500 to 24,700 kc (31.56 to 12.14 meters).

O.K. on Very High Extreme

It is a fact that the system does produce response at the very high frequencies, where some other converter systems fall down badly. Constantly reception is obtained around 20 meters, but it is noticed that the grid leak has to be low for the high frequencies, and therefore it is made low enough to serve them, while the low value has to suffice for the other short waves. The value is 0.05 meg. (50,000 ohms). It was a curious fact that 0.02 meg. stopped oscillation, while 0.1 meg. made the converter sound like an audio oscillator at the higher frequency settings for the smallest coil.

The coil system for the t-f-f section may consist of 25 turn primaries wound over 100 turn secondaries, on 1⅛ inch diameter, for 0.00046 mfd., or of 30 turn primaries and 127 turn secondaries on 1 inch for 0.00035 mfd. The wire is No. 30 or thereabouts, enamel covered, except for the No. 18 antenna primary.

Coil Data

The object of using the two aerials is that direct interference from broadcasts will come through when short waves are desired, unless the aerial is made so short that it does not supply sufficient pickup to the intermediate channel. For short waves the short aerial is better from all angles. For broadcasts an outdoor aerial 100 feet long, including leadin, may be used. For short waves 12 feet of wire along the moulding or under the carpet will suffice.

The oscillator coil system may consist of a 20 turn tickler on 1⅛ inch diameter, ⅛ inch space, largest grid winding, 30 turns, on one side, the middle grid coil on the other side, separated ½ inch, consisting of 12 turns, the smallest coil next to the preceding one, 5 turns. The wire is No. 28 enamel.

The correct polarities must obtain or oscillation will fail. Note the plate terminal of the feedback winding, whichever terminal is used. In each case the grid connection must be nearer the plate terminal, if windings are put on in the same direction. Thus the large short wave grid winding will have relatively opposite connections in respect to the other grid windings, because of the locations on opposite sides of the plate winding.

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.

Short Wave Editor, RADIO WORLD, 145 *West 45th St., New York.*

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

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Color Code Designations of Resistance Values

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

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

A Question and Answer Department conducted by Radio World's Technical Staff. Only Questions sent in by University Club Members are answered. Answers printed herewith have been mailed to University Members.

Radio University

To obtain a membership in Radio World's University Club for one year, send $6 for one year's subscription (52 issues of Radio World) and you will get a University number. Put this number at top of letter (not envelope) containing questions. Address, Radio World, 145 West 45th Street, New York, N. Y.

Annual subscriptions are accepted at $6 for 52 numbers, with the previlege of obtaining answers to radio questions for the period of the subscription, but not if any other premium is obtained with the subscription.

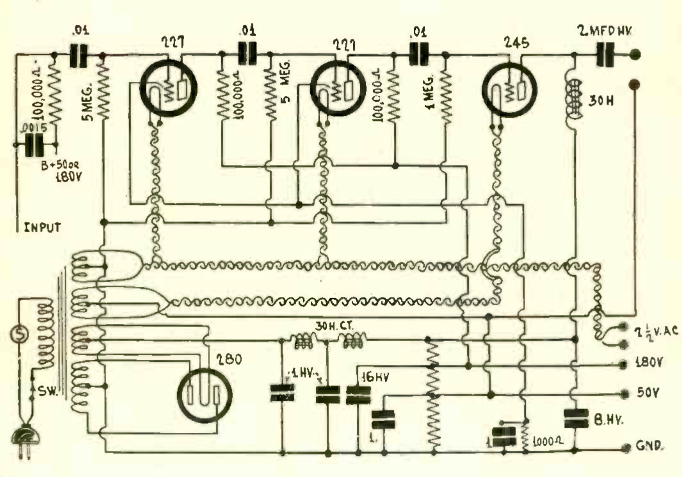

FIG. 969

A three stage resistance coupled amplifier and power supply for a a-c operation, using a 245 output tube, and furnishing power also to a tuner to be used in conjunction with the power amplifier.

Power Amplifier

PLEASE show a standard three stage resistance coupled amplifier diagram, for a-c operation, with 245 output tube. Heater voltage for a tuner, as well as B voltages, therefore, is desired.—O. U.

See Fig. 969. The constants are imprinted on the diagram. The letter S in a circle designates a fuse, which may be of the 2 ampere automobile type.

* * *

Automatic Bias for 235

AT present I am using a 235 tube, with 180 volts on the plate through an r-f transformer primary, in which there is virtually no voltage drop. As I have seen it stated that 250 volts may be used, naturally I want to try that. Must I increase the value of the bias resistor?—U. R.

No; if anything, decrease it. At present you are using 300 ohms, presumably. This affords a bias of about 1.5 volts negative, since the plate-screen current amounts to 5 milliamperes. As you increase the plate voltage the current increases more rapidly, therefore the bias increases more rapidly, hence while the result is automatic, the actual bias voltage does not necessarily stay just right. You can determine what bias value resistor to use by the ear test, as the volume of sound changes sharply for relatively small bias resistance changes, due to the rapid change in current.

* * *

Padding for 175 Kc

IN setting up a mixer for 175 kc intermediate frequency, using a two gang condenser, will you please let me know some simple method to make the two tuned circuits coincide fairly well?—J.H.E.

An easy method, although not the most precise one, is to calibrate the condenser in connection with the coil to be used at the radio frequency level, so you will obtain frequencies plotted against dail settings, and then adjust the oscillator circuit until the same numerical settings bring in the same frequencies as before. To do this, when the set is built, have the input to the modulator untuned, as the oscillator will disclose its own settings very accurately and nicely. Select a frequency at or near the low extreme of the band (high wavelength), and, with the oscillator at the same numerical setting as prevailed for the modulator, adjust a series capacity in the oscillator tuning condenser until the station is heard. Check against some high frequency, say, 1,500 kc. By this method the inductance of the two coils is the same. The series condenser will be relatively large, so that the minimum capacity of the circuit is affected very little. The higher frequency end may be said to take care of itself for this reason.

* * *

Coupling Trouble

RECENTLY I built a small superheterodyne, and it worked fairly well, but since then, in an attempt to institute improvements, I experimented with the coupling between the modulator and the oscillator, and now have it very loose. However, the oscillator does not oscillate, as I know, because no click is heard when I touch its grid. The circuit is otherwise the same as before. Also, the tube used in the oscillator socket does oscillate in other circuits, so that can't be at fault. There is no open or short circuit, either.—Y. E. D.

When the coupling was stronger you heard a click when you touched the oscillator grid, for the tube was oscillating, and now the coupling is so loose that you do not hear the click, even though the tube is still oscillating. Although you do not specifically say so, at present you do not hear any signals. This may be inferred from your diagnosis that the oscillator is not oscillating, but it is obvious also from the fact of too loose coupling. The click is not heard because there is no coupling to communicate any oscillator effects to the modulator tube and thence to the output. Your test for oscillation is not infallible. It would be better to use plate current reading instead. The value of current at oscillation should remain the same or increase from an average value, whereas a considerable decline in current shows oscillation stoppage.

* * *

Which Side to Ground

FOR a battery operated set, is it preferable to ground A minus or B minus? I have seen both methods shown and would like to know what advantage one has over the other.—H. F. W.

Either A minus or B minus may be grounded. It is more usual to ground A minus, because grid returns are usually made to that point, unless the grid bias voltage is high, as for output tubes, when a biasing battery is used and grid return is not directly grounded. Also, A minus and B minus are usually interconnected, therefore grounding A minus also grounds B minus.

* * *

What to Do with Extra Tube

FOR short wave reception with a converter is it preferable to use a stage of untuned radio frequency amplification ahead of the modulator tube, or a stage of intermediate frequency after the modulator tube, and if the latter, what intermediate frequency?—H. T. C.

In general it is prererable to use the built-in intermediate stage, if your receiver is itself somewhat lacking in sensitivity, but the untuned stage, while contributing little to amplification, gets rid of considerable radiation that otherwise would get to the aerial. The intermediate frequency to select depends on the most sensitive region of your set. If you get strong signals at the low frequency end, put the intermediate frequency somewhere near that point, otherwise use a high intermediate.

* * *

Auto Set Sensitivity

CAN sufficient sensitivity be developed in a six tube set of the tuned radio frequency type, with push-pull pentode output (238) to warrant the construction of an automobile receiver? What shall I use for an aerial? What for ground?—J. G.

Yes, you can develop a sensitivity of around 15 microvolts per meter, which is satisfactory. Such a circuit is covered by our Blueprint No. 629. The aerial may be one of the special types that stretches across the car's top. The car's chassis (frame) is used for ground. You will find such a circuit highly satisfactory, particularly if a 6 volt dynamic speaker is used, the power supplied to the field coil by the car's storage battery.

* * *

Resistor-Capacity Filters

WHAT is the purpose of the resistor-capacity filters found in detector plate and pentode grid circuits of modern receivers?—H. G.

The purpose is to stop the hum from backing into the tubes. As hum suppressors these devices are remarkably effective.

* * *

Apparatus for Television

CAN a simple tuned radio frequency set, with suitable output tube, be used for television, by reducing the number of primary and secondary turns? Then will I need anything besides the disc, motor and neon lamp? What size pictures will be obtained, and what is the definition?—H. S.

Besides the set, which may be as you describe, you will need what you list, plus a condensing lens to go in front of the frame, to make the picture appear larger than it really is, and strengthen it. The impression gained is that the picture is about 3 inches square, although actually it is about half that size. The definition will be good. You must live not very far from the station that is sending out the pictures to be assured of reliable reception. Then you will be able to distinguish the features of those appearing before the televisor. This is rendered easy because many radio and stage celebrities, with whose features you are familiar because you see them in the public prints, are television subjects. Then, too, there are "television girls."

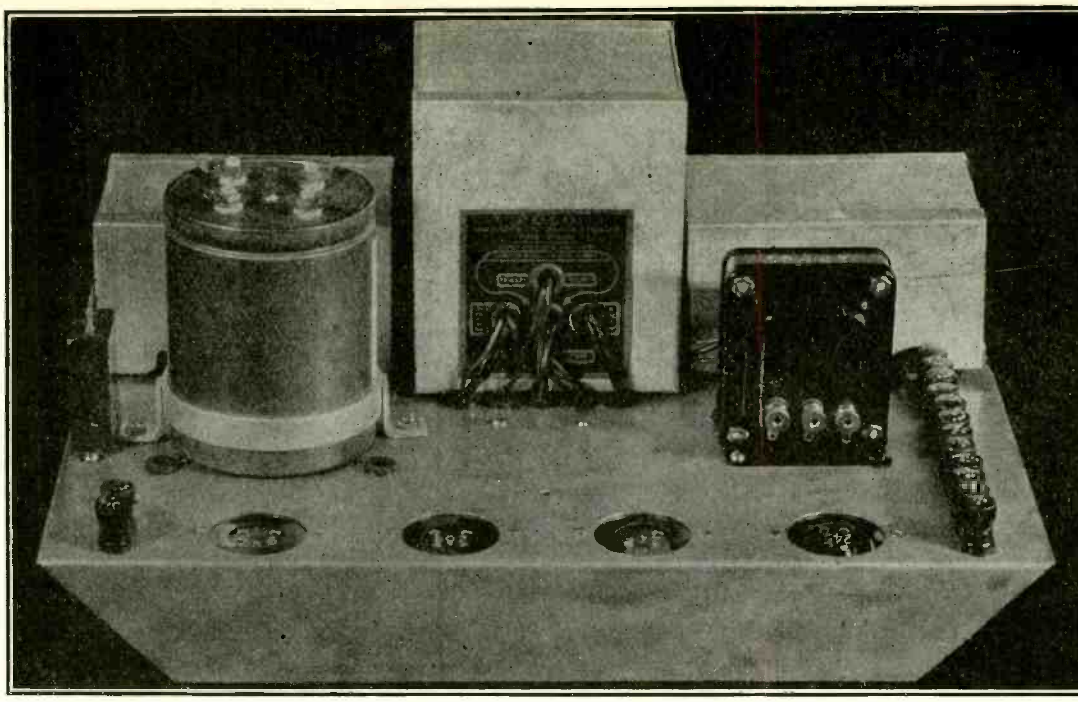

FIG. 970

Layout for a power amplifier, using one stage of resistance audio, push-pull output and a rectifier tube. It is well to have the first audio tube next to the condenser.

Power Supply Layout

AT HAND I have some parts to build a power amplifier and will include push-pull. There will be four tubes, including rectifier and first audio (resistance coupled). The filter capacities will be in one can (electrolytic). Please show a suitable layout.—M. S. G.

The layout is shown in Fig. 970. The push pull tubes may be at right, the rectifier next and the first audio at left, to avoid much heat next to the condenser. The parts shown are, right rear, output transformer; center, power transformer; right, B supply choke. The push-pull input transformer is the smaller black part at right center.

* * *

Synchronization Methods

HOW can synchronization be achieved, if the motor of the television outfit is not on the same a-c line as is the motor used by the transmitter?—T. G. F.

Several schemes have been put forward for accomplishing this. One is the sending of a synchronizing signal. The motor is equipped with a phonic wheel and a speed control, so that when the wheel is synchronized with the special signal the motors are synchronized.

* * *

Object of Condensing Lens

WHAT is the object of the condensing lens as used in front of the television frame, so you have to look through the lens to see the picture?—V. C. D.

The object is to magnify the picture. That gives the picture greater size. One of the problems of television is that of obtaining sufficient illumination or getting full advantage of what illumination there is. Therefore, anything that improves the effect of illumination is desirable.

* * *

Other Scanning Systems

COULD not some means be used for scanning that, while mechanical, would not resort to the scanning disc as at present constituted, but would produce results even without mirrors, with their low efficiency?—J. G.

Mechanical systems not strictly according to the present flat disc have been tried. One of them uses a drum. This one also has small mirrors on it, at different angles. The idea that mirrors are inefficient is erroneous. They are comparable to transformers in their efficiency, being well over 90 per cent. Pinholes are inefficient, and that is why up-to-date discs have a lens at each hole. The illumination problem is still one of great importance. Any method that does better in the way of illumination is valuable. There is considerable illumination present now, but not nearly all of it is in final use. Perhaps some day a system will be devised for full utilization of all the illumination supplied.

* * *

Is Television Worth While Yet?

DO you think it is worth while to have a television receiver in the home at this time, with great improvements imminent? Is it not advisable to wait until projection is easily obtained, instead of restricting one's self to peep-hole vision?—R. D.

It is a matter of personal choice. See a television set on demonstration. Manufacturers of television apparatus will tell you where you can do this, or inquire at radio stores, many of which have demonstrators in their back rooms. Then decide for yourself whether you think it is worth while to have such an outfit in the home. You will notice that in a dark room you can stand 12 feet from television condensing lens and still see the pictures plainly. That enables two or three persons to look at once. The peep-hole stage is the only one now extant for home use. Projected television is much more expensive and not ready for the home. If you must have projection you will have to wait, but meanwhile you may be missing a great deal of enjoyment. Any one experimentally inclined, and not asking too much, will get real satisfaction out of television in its present state. Really, the chief objection is at the sending end, where the same film is put on again and again, or merely the placard announcing the call letters, and never anything else. There will be more enjoyment when there is more variety and more interesting matter sent out.

* * *

Overload's Effect on Picture

WHAT is the effect of tube overload on the television picture, and what means may be used to correct it? Does the sensitivity of the receiver greatly affect the definition and reality of the picture?—G. D. C.

The effect of overload is to blur the picture or to cause what seem like dark clouds to be dropping constantly from the top of the field. This may be corrected by the volume control. The picture is not greatly affected by the sensitivity, as is proved by the fact that the volume control may almost cut off the amplication before the effect of the control on the definition is evident.

* * *

Oscillator Stops Oscillating

IN my dynatron oscillator I use a 0.0005 mfd. condenser for tuning, and it works all right down to about 60 meters, when the oscillator goes dead. What is the trouble?—H. D. R.

The reason is that the capacity is too high for the low wavelengths for this system of oscillation. If you will test again you will find that, while it is true that below 60 meters the oscillation stops, it will resume again at about 35 meters (assuming 60 meters comes in near the 100 setting of the dial. The resumption of oscillation is due to the increased ratio of inductance to capacity. For the waves below 60 meters, therefore, with no dead areas, cut in a series condenser of 0.0001 mfd., and rewind your coils accordingly. You will then enjoy oscillation at all settings.

* * *

Pentode's "Filament Grid"

DIAGRAMS of the pentode show a wavy line from the filament, as of an extra grid or something, but no provision is made on the sockets for connection thereto. Does any external connection have to be made, and if not, why do your diagrams show a connection that is not a connection?—L. D.

There is a screen or grid inside the tube, attached to the filament, and the filament connection itself takes care of that screen connection. The pentode has grid and plate as other tubes, a high voltage screen and a filament with this extra screen or grid, called the suppressor or accelerator grid. The accelerator is so-called because it speeds the electrons, or the name suppressor is applied to it because the speeding-up is accomplished by suppressing the secondary emission of the filament, which would be due to electron rebound from plate. The wavy line at the filament, suggesting the accelerator grid, is shown in the diagram because the grid is there. The fact that no external connection is necessary is disclosed in the diagram itself. It is not a case of showing what does not exist. The connections for pentode, then, are: P, plate; G, control grid; H and H to filament voltage; K (cathode in other tubes) to the same effective B voltage as exists at the plate. In practice, the K and plate return connections are to the same point, as the difference in voltage between that applied and that effective on the plate is relatively small. That is, the drop in the load resistor is small.

A THOUGHT FOR THE WEEK

TED HUSING, noted sports announcer over the air, uttered some strong criticism of two Harvard football players during a recent broadcast. The Director of Athletics at Cambridge forthwith announced that Mr. Husing would be barred from Harvard. Isn't the gentleman taking himself pretty seriously? Since when did an appointment to the post of Director of Athletics confer also the title of Censor of the Air?

P. S.—Mr. Husing, the word "putrid" really does look very unpleasant when viewed in Mr. Webster's tome on wordology.

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 45th Street, New York, N. Y.

Roland Burke Hennessy, editor, Herman Bernard, managing editor and business manager; J. E. Anderson, technical editor.

KALEIDOSCOPE

A television image that would be transmitted and received distinctly requires that it be threshed into 250,000 electrical pieces in one second. The assembling is done in the same space of time. The present machine at its utmost is able to dispatch a picture at about a speed of 25,000 particles per second. This is a case where multiplying the breakdown is a smashing job.

* * *

The growing vast number of listeners to air programs and news marks the town crier as the historical introduction to broadcasting. His hour of the day and all's well are now superseded by the ether crier's. How immense would the crier's lungs have to be if he had to make the same average without the aid of radio?

—A. B.

STUDIO NOTES

With the marriage of Wallie Butterworth only two Chicago NBC announcers are left single—Charles Lyon and Ted Pearson.

* * *

Several years ago Richard Gordon, who now plays "Sherlock Holmes" in the radio sketches, was performing in a Spanish-American War melodrama. His grandmother was in the audience. She watched intently the scene in which a Spanish soldier waited in ambush for the American boy, the hero, played by Gordon. Unaware of the lurking danger, the hero sauntered through the stage brush. The Spaniard raised his rifle, aimed and his finger tightened as the entire house waited breathlessly. Then a sharp voice screamed out:

"Look out, Dick. Behind the tree! Dick, there he is!"

There, standing up in the audience, was his grandmother pointing at the startled Spaniard and saving her dear boy.

Synchronizer Sought As Cure for Fading

DR. JOHN H. DELLINGER, in charge of the radio division of the Bureau of Standards, Department of Commerce, has been conducting experiments on fading elimination for the last year. He has reported his discoveries to the Naval Research Laboratory, which is now planning a polar expedition to study the same problem in the far North.

The Bureau and the Laboratory will collaborate in studying the situation. Engineers of the Federal Radio Commission, although they conduct no experiments directly, are keeping in touch with developments, and will aid in the effort to solve the problem.

The whole problem hinges on variations of what is known as the Heaviside layer, a stratum of ionized gaseous atmosphere surrounding the earth, at a distance varying from 70 to 200 miles from the earth's surface.

Believes There Are Two Layers

Scientists differ in opinion as to whether there is one layer or are two layers. Dr. Dellinger, in recent experiments, has come to the conclusion that there are two layers, one about 70 miles above the earth, and the other varying from 130 to 200 miles above. Other scientists believe that there is but one very thick layer, varying from 75 to 150 miles above the ground.

Certain experiments with transmission and reception indicate that there are two definite layers. The sky waves transmitted from the ordinary broadcasting station sometimes are refracted by the lower layer, and sometimes by the upper, depending upon which is more highly ionized.

When waves are refracted, they return to the earth at some point away from the place where they emanated. When the layer is high, they are refracted at a greater distance from the point of transmission than when the layer is low.

The distance of the layer from the earth varies daily and seasonally. It is low during the day, high at night; low during the Summer, high during Winter. This variation accounts for the fact that radio reception is better at night than during the day; better during Winter than in Summer. Especially does this variation influence long-distance reception. When the layer is high, distant stations are received better and more clearly than when it is low.

Cause of Fading

Fading is caused by variation in position of this layer, or, if there are two layers, of the refracting layer. When a sky wave is refracted back to the earth "out of phase" with a ground wave from the same transmitter, it causes interference. Waves are said to be "out of phase" when the time required for transmission of one wave causes the other wave to arrive a fraction of a second before or after the first.

The refracting layer acts as a conducting strip against which the wave hits, then rebounds. The action of the sun on gases causes them to become ionized to give the atmosphere this quality.

It is to determine how transmitters may overcome the influences of the variations of the refracting layer that Federal scientists are experimenting. Should they evolve some method whereby transmission might be adjusted to the height of the layer, fading and "out of phase" reception, causing interference, might be eliminated.

The Bureau of Standards has furnished the Naval Research Laboratory with data regarding equipment necessary for making these observations near the North Pole, says "The United States Daily." The Laboratory will sponsor an experition to Old Fort Conger, about 600 miles from the Pole, where they will make continuous measurements of the height of the layer, and will try to determine its effects and possible cures for fading.

Williams to Head Expedition

The expedition, which will leave Washington early in 1932, will be lead by Capt. F. H. Williams, of the Naval Reserve. Dr. H. B. Maris, of the Laboratory, will be scientific director.

This body is preparing apparatus to make continuous measurements of the movements of the layer. After these measurements are secured, a report will be made on findings to the Bureau, and the results of the experiments of both organizations will be collaboratd in an effort to arrive at some definite conclusion regarding the problem.

The expedition, which will not return until 1933, will have its headquarters on Ellesmere Island, at Old Fort Conger. From this point their findings will be broadcast daily to scientists in the United States.

By comparing results of experiments of the Bureau with those of the expedition and discoveries of radio engineers and scientists, it is hoped that there may be found some way to eliminate fading. Should fading be done away with, it would be a most significant step in the development of the science of radio.

186 Welds Are Made in Producing a Tube

That the production of a radio tube parallels a tremendous industrial task, in miniature, was pointed out by George Lewis, vice-president of the Arcturus Radio Tube Company.

Aside from the numerous fine elements used in the construction of a tube which could be termed analagous to minute girders, braces, cross-members, etc., there are 186 various spot welds in the final assembly of the elements.

"It is hardly believable," says Mr. Lewis, "that this great number of welds is necessary in a small article like a radio tube. But fine wire and small parts are used which require a weld no larger than a pin-head."

He said a tube is precisely made.

Station Sparks

By Alice Remsen

ERIN! O ERIN!

(Tales of the Emerald Isle, WEAF, 11:30 a. m. Sunday)

ERIN! O Erin! the sky is blue above you,
The grass is green upon your bosom fair;
Your lakes of silver reflect the shining beauty
Of sunkissed hills and valleys nestling there.

In dreams I see you as when I last beheld you,
Your lovely picture forms thru misty tears.
When shall my poor feet press upon your meadows?
My heart has ached for you these many years.

Erin! O Erin! the sky is blue above you,
The grass is green upon your bosom fair.
The look of you within my heart is graven,
My happiness is buried with you there.

—A. R.

* * *

Lovers of Old Ireland should not miss the Sunday morning broadcasts of Tales of The Emerald Isle. These dramatized legends are very well produced and enacted by an extremely competent cast.

* * *

Armistice Day 1931 was the tenth official birthday of Station KYW, the Herald and Examiner Station in Chicago, operated by Westinghouse, and marked the rounding out of ten full years of service to the midwestern public by this pioneer station.

* * *

Kolin Hager, known as "The Voice of WGY," as a result of his early affiliation with that pioneer station, returned on Nov. 16 to Schenectady as manager of WGY, after an absence of two years. During the intervening time he was vice-president in charge of programs for the Buffalo Broadcasting Corporation.

* * *

This Year the Radio Diction Medal was awarded to John W. Holbrook, New York announcer of the N.B.C. Holbrook is a 25-year-old Bostonian, educated in Toronto and Quebec. In 1926 he graduated from Bishop's College School, Lennoxville, Quebec, and two years later entered radio in Boston, joining the N.B.C. staff last May.

Hamlin Garland, chairman of the radio committee of the American Academy of Arts and Letters, said Holbrook's voice combined "the best of English english and American english" and commended his taste, pronunciation, grace and authority in its use.

Honorable mention was made of the voices of David Ross, of Columbia, William Abernathy, of Washington, D. C. N.B.C., and Sen Kaney, of the Chicago division of N.B.C.

This is the third year of the award. Winners of the medal in previous years were Milton J. Cross and Alwyn Bach, both of the N.B.C. staff.

* * *

Three Outstanding Song Hits can be attributed to Herman Hupfield, pianist and vocal soloist of the Trumpeters on WABC. In the past 12 months he has turned out "Sing Something Simple" and "When Yuba Plays The Rumba on the Tuba," among other favorites. His latest offering is "As Time Goes By," from "Everybody's Welcome," which the author presented over the air five days before the show opened on Broadway.

* * *

Tony Colluchio, who plays the Hawaiian guitar for Singin' Sam, also plays banjo in Bob Haring's orchestra. Tony has put a new white calfskin head on his banjo and intends to fill it with the autographs of radio celebrities. At the rate he is going it will be filled in a week. Charter signers were Singin' Sam, Nat Brusiloff, and, of course, Bob Haring.

* * *

Speaking of Bob Haring, don't forget that he has a wonderful little wife, Jean, who is his "right hand man." She takes care of his music, times programs, stop watch in hand; attends to fan mail, interviews clients, and in fact, Jean practically manages the genial Bob, who doesn't mind it, and rather seems to like it. When asked about things, Bob will reply, with cigar in mouth and a twinkle in his eye, "Oh, I leave that to Jean."

* * *

This Should Be the Proper Season of the year to remind you that many of radio's elite are former stars of the gridiron—especially the stars of WABC. Ted Husing, Ben Alley, Andre Baruch, Fred Uttal, Freddie Rich, Budd Hulick, Teddy Bergman, and Harry Von Zell are only a few of the microphone artists who made names for themselves on school and college football fields.

* * *

It Is Now the Fad among radio folk to be photographed by the fashionable and exclusive artist, Howard Green, who has studios at 24 West 58th St., New York City. I saw recently pictures he made of Nat Skilkret. They were absolutely works of art. The famed maestro seemed about to speak, so lifelike were the reproductions.

* * *

SIDELIGHTS

B. A. ROLFE, veteran yachtsman, can't swim. . . . NAT SHILKRET, N.B.C. director-composer, has three brothers—Jack, Lou and Fred. Each of the Shilkrets is a pianist. . . . CHARLIE LYON and TED PEARSON are the only unmarried announcers at N.B.C. Chicago headquarters. . . . PAUL WHITEMAN has a new ambition—he wants to ride in an Austin. Paul now tips the scale at 203 pounds. . . . SINGIN' SAM and PARRY BOTKIN both hail from the same town in Indiana. . . . PIERRE BRUGNON is the master of more than thirty operatic roles. . . . BARBARA MAUREL was born in Alsace. . . . BRADFORD REYNOLDS studied at Washington University, St. Louis, for an M. D. degree. . . . RUSS COLUMBO has written four new ballads. . . . EUNICE HOWARD has a turtle and several frogs as pets. . . . HERBERT LIVERSIDGE was a boy soprano at Grace Church, New York, when he was twelve years old. . . . THE BOSWELL GIRLS are three-quarters French. . . . RAOUL MARLO, of WOR, was a dramatic critic on the Daily Mercury, in San Jose, California when he was eighteen years old. . . . SINGIN' SAM is a veteran blackface man of minstrelsy and vaudeville. . . . WILLARD ROBISON, now heard over WOR, is a composer, arranger, conductor and singer. . . . . WALTER J. NEFF has just purchased a house in Russell Gardens, Great Neck, Long Island. The reason? He is going to marry in February Claire Pohley, one of WOR's beauties.

* * *

ANSWERS TO CORRESPONDENTS

MISS MARIE KEMP, Rochester, N. Y. . . . Glad you like the page. Shall run Andy Sanella's biography in a future issue. Keep your eyes open for paragraphs about your other favorites—Lew Conrad, Tom Brown and Clarence Hayes.

E. GORDON, Long Island City. . . . You may purchase Bing Crosby records at any music store. . . . Vaughn de Leath is planning a new radio vehicle.

* * *

Biographical Brevities
About Carl Fenton

Carl Fenton, the new radio find of the Cremo Company, was born and educated in New York City. He is a newcomer to radio, but was a pioneer in the recording business. Has made more than 10,000 discs in the seventeen years he has been recording. During that time has used eight different names in directing orchestras. Carl Fenton is the only one that stuck. This name was coined for him in 1920 when the Carl Fenton Orchestra was formed for recording purposes. Has conducted for every large recording concern. Worked exclusively for Brunswick from 1920 to 1928. Was musical director for Gennett from 1928 to 1930. Although he had never been heard over the air until the Cremo programs, he has played on records with many radio stars, among them Scrappy Lambert, Dick Robertson, Irving Kaufman, Alice Remsen, Sam Lanin, Paul Specht, Frank Luther and Arthur Fields.

Has played the violin since he was seven. At the age of fourteen was giving recitals. Began his professional career playing in theatres; then played under Joseph C. Smith, whose Plaza Hotel Dance Orchestra was one of the first to make records and was the outstanding dance organization of the day. That was in 1917. Now Joseph C. Smith is playing the violin in the Cremo Orchestra under the direction of Fenton. (Just one of Carl's characteristics—he never forgets his friends.)

The popularity of the Carl Fenton Orchestra records led to many requests to play at proms and social functions. In this way Carl made many valuable contacts through directing his orchestra for dances at Princeton, Yale, Dartmouth, U. of Penn., Rutgers, Penn State, Illinois, Indiana, Lehigh, Lafayette and others. He also made two nationwide tours with his orchestra.

Carl plays an excellent game of bridge, auction; has not yet tackled contract, but plans to do so between Cremo shows. Always breaks a hundred on the golf links. Leans toward blue and brown suits and brown shoes. Is married and has two children, girl and boy, both of whom are musically inclined and quite talented. His wife, as Flo Whitehill, was a vaudeville headliner for years, by herself and also as Ted Claire's partner. Carl has no superstitions. Possesses a very valuable library of music. Never misses a prizefight if he

(Continued on next page)

BIG INCREASE AS AMATEURS 'EAT UP' PHONE

Washington.

Intensified interest by American amateurs in radio transmitting is disclosed in the annual report of W. D. Terrell, director of the Commerce Department's radio division. During the last fiscal year, the report shows, the number of licensed amateur radio stations rose to 22,739, an increase of nearly 4,000 as compared with the preceding year.

It is apparent from this figure, it is pointed out, that amateurs are by far the largest users of transmitting radio stations in the United States.

Accompanying the increase in amateur stations was a noticeable increase in the number of inquiries received in the division from amateurs. The growing use of radio telephone by amateurs, it is believed, accounts for this unusual interest.

Cooperative Work Continues

Notwithstanding the expansion in amateur radio transmitting, the report states that few violations of assigned frequencies were detected. It seems evident, Director Terrell declares, that the amateurs realize that their future success and public good-will depend upon the operation of their stations in an orderly manner, having due regard for other users, including the broadcast listeners.

While no major emergency occurred in the United States to enable the amateurs to participate in the relief work for which they have been noted in recent years, greater cooperation was afforded to more than a dozen expeditions sailing from this country, and increased activity is reported in connection with the Naval Radio Reserve and the Army Amateur Radio System.

Citing the comprehensive activities of his division in the field of radio regulation, Mr. Terrell points out that during the fiscal period reviewed in his report, 19,458 inspections of all classes were made which was a substantial increase over the 1930 period. This figure included 11,433 ship installations, it is explained. As a result of improved apparatus the number of defects in radios of vessels showed an appreciable decline.

During the fiscal year 1931, the report shows, the Radio Division examined 11,850 applicants for operator's licenses as compared with 9,356 in the preceding fiscal period. Of the 1931 applications, 5,776 were for commercial licenses and 6,073 for amateur licenses. The total number of licenses issued in the fiscal year reviewed was 20,703, of which 5,506 were commercial and 11,541 amateur. These latter figures include renewal licenses which are issued without reexamination.

Service Areas Determined

The Radio Division has in operation six fully equipped radio test cars, the report reveals. With these cars it has been possible to make a large number of field strength surveys to determine the service areas of broadcast stations, and ascertain whether or not they render good broadcast service to radio listeners in their respective areas. It would not be possible today, the report states, to perform the field work required in connection with the monitoring of low-power radio stations without these test cars.

Describing the operations of the fixed monitoring broadcasting stations conducted by the division at various points throughout the country, the report points out that although these stations maintain waches of less than eight hours out of the twenty-four during working days, they reported more than 76,000 frequency measurements during the last fiscal year, as compared with 45,700 for the previous year.

A constantly increasing improvement in frequency control has been noted since the monitoring work of the division was undertaken, the report declares.

167 Foreign Stations Measured

The large frequency monitoring station at Grand Island, Nebraska, was placed in operation during the last fiscal year. During the brief time this station has been functioning, highly accurate frequency measurements have been made daily on radio stations in the United States and foreign countries.

Since last February, when it began to function this station has made a total of 3,029 measurements.

At the end of the fiscal year, 167 different radio stations located in foreign countries had been measured, a total of 789 measurements having been made on these stations. It is interesting to note, the report says, that a very large number of these foreign stations failed to maintain their assigned operating frequencies, and in many cases were observed to be causing interference with radio telephone and telegraph stations operating in the United States.

In addition to the foreign stations measured, 2,240 measurements were made at Grand Island on 650 individual radio telephone and telegraph stations in the United States.

Referring to the use of radio in aviation, Director Terrell's report declares that developments along this line during the past year have been most encouraging. At the end of the fiscal year there were 303 planes equipped with radio as compared with 215 in the 1930 period.

STATION SPARKS

(*Continued from preceding page*)

can help it. Smokes as many as eighteen or twenty cigars a day. Never inhales. Never smokes cigarettes. Is of medium height and weight. Black hair, liberally sprinkled with grey. Merry brown eyes. Fine sense of humor. Never lets a friend down. His creed is "live and let live." Is very patient. Optimistic. Knows his business and minds it. His two greatest ambitions are not for himself; one is for his wife to get a break on the air and the other is for his children to receive the best possible musical training. In short, Carl Fenton is a good man to know and deserves all the fine things that can possibly come to him.

* * *

SUNDRY SUGGESTIONS FOR WEEK COMMENCING NOVEMBER 29

Sun., Nov. 29; New York Philharmonic.......WABC—3:15 15
Sun., Nov. 29; Footlight Echoes..WOR—10:30 p.m.
Mon., Nov. 30; Soconyland Sketches.......WEAF—8:00 p.m.
Mon., Nov. 30; Mildred Bailey & King's Jesters.......WJZ—midnight
Tues., Dec. 1; Singin' Sam.......WABC—8:15 p.m.
Tues., Dec. 1; Raising Junior.......WJZ—6:00 p.m.
Wed., Dec. 2; Alice Joy..........WEAF—7:30 p.m.
Wed., Dec. 2; Crime Club........WABC—9:30 p.m.
Thurs., Dec. 3; Sherlock Holmes.......WEAF—9:30 p.m.
Thurs., Dec. 3; Basil Rusdael, Weaver of Dreams.......WOR—10:15 p.m.
Fri., Dec. 4; Rosario Bourdon Orchestra.......WEAF—8:00 p.m.
Fri., Dec. 4; Waves of Melody, Tom Brown.......WJZ—10:45 p.m.
Sat., Dec. 5; Little Symphony Orchestra.......WOR—8:00 p.m.
Sat., Dec. 5; Nocturne with Ann Leaf.......WABC—11:45 p.m.

(If you should like to know something of your favorite radio artists or announcers, drop a card to the conductor of this page. Address her Miss Alice Remsen, care RADIO WORLD, *145 West 45th Street, New York N. Y.).*

DEMONSTRATES TONE FIDELITY TO ENGINEERS

Bad sending apparatus, bad radio receivers or even improper acoustic conditions in the room in which one listens to a radio receiver may cut out part of the full sound range, Edwin K. Cohan, technical director of the Columbia Broadcasting System, explained in a talk before the New York Electrical Society, and spoil the quality of the best music or speech. Some such alterations and defects were illustrated by talking motion pictures showing the differences between perfect and imperfect reproduction. One of these, made by scientists of the Bell Telephone Laboratories, illustrated how echoes caused by too reverberent a living room may spoil the quality of radio reception in the home, even if both the broadcasting and the reception are perfect.

Broadcast Demonstration

An actual broadcast by the Mills Brothers Quartet made from the stage of the Society's auditorium showed how modern ampliers let radio artists sing or speak in extremely low voices, most of the broadcast being inaudible to persons in the auditorium although it was being heard by millions of radio listeners in all parts of the country. Mr. Cohan also demonstrated the new "one-man broadcasting station," which can be carried on an announcer's back as he follows the players on a golf course or the participants in a public ceremony, carrying the speech from this small portable transmitter to a pick-up station somewhere nearby, by which the impulses then are amplified and sent over the lines.

Applies "If" to Receivers

"Present engineering developments along the transmission lines are sufficiently perfected," Mr. Cohan said, "to reproduce all the sounds within audible range without distortion or loss of any essentials. If the average radio receiver were capable of reproducing the music that is in the ether just outside the door, the fidelity of reproduction would be much greater than at present."

The perfection of the telephone lines and other equipment now used for high frequency broadcasting also was demonstrated by Mr. Cohan by sending a program originating from the Columbia Studios to the Auditorium over a mile of wire, and then feeding the same program from New York to Chicago and back to the Auditorium over 2,000 miles of wire, which caused virtually no difference in the quality of the reproduction.

Ads Interrupting Program Criticized

The Better Broadcasting Contest sponsored by the Hygrade Sylvania Corporation disclosed that small proportion of the answers criticised the advertising feature of sponsored programs. The strongest and most often repeated objection was to advertising talk inserted in the midst of the program.

THE MONITOR RECEIVER

The instalment covering the 15-2000 meter set will be published next week, although originally intended for the present issue.

FOOTBALL REAL ON AIR, DUE TO FOCUSED 'MIKE'

This year, for the first time, the great football games have been borne to distant fans with all the colorful sound detail of the actual contest. This has been accomplished through development by engineers of the National Broadcasting Company of the parabolic reflector microphone.

The "human ear" of radio enables the engineers to focus the microphone on any desired spot. The parabola is placed in some commanding position, such as the roof of the press box, and "aimed" at the center of interest, whether it is one of the cheering sections, college bands marching down the field, or the teams in scrimmage.

"How "Mike" Is Manipulated

During actual play the parabolic "mike" is tuned low so that its pick-up will not interfere with the announcer's description of the game, but merely provide for his voice a background of occasional roars from the stands or student singing. Between halves and during time out, the "ear" is tuned up again, and the colorful noises characteristic of a football crowd again are sent clearly over the air.

The former method of obtaining crowd noises, cheering, and the playing of the bands was to string half a dozen or more regular microphones at strategic points about the field, and cut in one or another as desired. This was not nearly as satisfactory in results, nor so flexible in operation.

The new instrument developed by the NBC engineers consists of a regular microphone and a sound reflector which looks something like an old fashioned wooden chopping bowl.

Sound Is Rebounded

The microphone has its back to the noise source, so to speak, and faces toward the concave side of the reflector. Thus the noise hits the concavity, and rebounds, concentrated, into the microphone. The reflection principle is the same as in a searchlight, but the action is reversed. The light is reflected outward; the sound is concentrated inward.

Another advantage of the parabolic microphone's directional feature is reduction of interference from sounds outside the desired area.

With the standard microphone, noises from all directions affect the sensitive diaphragm, especially in outdoor broadcasting, since control of incidental sounds is impossible. But with the parabola, protection is afforded against noise outside the focus.

Engineers of the National Broadcasting Company have been working for years to perfect the new device so that it is flexible enough for practical use. The principle, so far as known, was first employed during the war, when parabolic sound reflectors were used to locate enemy planes at night, through the hum of the motors.

Fibre Reflector

The radio reflector is made of a compressed fibre material so it can be moved about readily. When placed high above a football stadium it is anchored against the wind.

It is probable that before long NBC will use parabolic "mikes" on all large spectacle broadcasts.

Lafount Amazed by Art's Progress

Washington

Harold J. Lafount, Federal Radio Commissioner, said less than half the time on the air is used commercially, so the rest is open to educators. He added:

"Commercialism has developed radio into an amazing degree of perfection within an incrediably short space of time. It would be foolish for education to refuse or disregard the inheritance which is now at hand, and which can be enlarged and developed almost without limit, through further investigation and experiment, in a mutually helpful way. The air is not sold out. More than twice as much time remains unsold as is used by advertisers. This time is at the educators' command. The commercial broadcaster has always been generous in his offers of time and facilities. Some times these offers have been laughed at."

RADIO IS FOUND NOT TO AFFECT THE WEATHER

A serious check-up on complaints that radio causes temperature and moisture changes, and thus affects the weather, has been made by W. J. Humphreys, chief of the Division of Meteorological Physics of th Weather Bureau. In "The Monthly Weather Review," he states that radio does not cause floods, droughts, heat or cold, and not only does not affect the weather but rather is itself affected thereby.

In an editorial in the subject of Mr. Humphreys' findings "The New York Times" says:

"Mr. Humphreys painstakingly explains that there is no evidence that the activity of a broadcasting station has any effect whatsoever upon the temperature of nearby water or direction of the wind; that wireless waves do not produce condensation nuclei, such as fine particles of dust or sea salt, and that broadcasting has no effect upon the temperature of the nearby air. Thus the broadcasting station is found not to be responsible for excessive rainfall and floods. By the same token it is clear that broadcasting is not responsible for droughts. The radio may be affected by the weather, Mr. Humphreys concludes, but the weather is not affected by the radio. This conclusion is supported by theory, experiment and observation."

C. W. Horn, general engineer of the National Broadcasting Company, said:

"The most exhaustive research has failed to show that radio can be accused justly of influencing weather conditions. The shoe is on the other foot, for radio is a sufferer from the weather.

"Drought-stricken areas of the country have to be checked as to broadcasting activity, which was found to be the same as in other sections suffering from floods at the same time. But despite the most conclusive tests, radio still remains in many minds guilty of doing things to the weather."

Letters complaing of radio's effect on the weather are privately regarded as from "cranks," so the scientific stud and report came as a surprise, because of dignifying the allegations, even while denying their tenability.

AIR IN EUROPE IS IN A PLIGHT, BOARD IS TOLD

Washington

A report, requested by Commissioner Harold J. Lafount, was made by Dr. Willis E. Everette, California radio engineer, on the radio conditions in Europe, based on a clinical study that lasted six months. The following is a summarization:

The industry as a whole throughout Europe is in a state of confusion. There is evidence on every hand of a lack of systematic control. Stations are operating haphazardly, with no regard for each other or the listening public.

The situation is reminiscent of the tangled confusion of radio in this country before the organization of the Federal Radio Commission in 1927. At that time, 734 broadcasting stations were operating in the United States. There was no regulatory control board, and as a result the stations did about as they pleased. It was only natural that disorganization and interfence between stations resulted from such a state of affairs.

Ruthless Broadcasting

In Europe today the situation is just as bad, or possibly worse, than it was in this country before the Commission was organized. Stations are broadcasting simultaneously with little regard for other stations. The majority of these stations have tremendous power. In his survey Dr. Everette found that the average power of the major stations was about 53,000 watts. Many stations broadcast with power of more than 100 kilowatts.

Because of poorly arranged programs and poor announcing, much time is wasted. Most European stations lose one hour in dead silence in every seven days' broadcasting. Inefficient methods of arranging programs cause lapses of time between different parts of a broadcast. An average of from 1 to 10 minutes of silence elapses between different sections of the same program.

Tick Tock, All's Well

Many stations keep a clock close to the microphone during these intermissions between program sections, in order that listeners may be sure their sets are working or the broadcasting station has not shut down. The "tick-tock" informs listeners that the station's power is still on, and that their sets are still functioning.

Methods of announcing are not efficient. In many cases a period varying from one-half to one hour elapses between station announcements. The announcers seem to mumble their words, using poor enunciation, making it almost impossible to understand them.

Receiving sets in Europe are not so far advanced as in this country. The cabinet type set has not yet been manufactured by foreign companies, and as a result American radio sets get wide sale abroad, the doctor reported, according to "The United States Daily."

Because of the tremendous power of stations operating without systematic organization, the inefficiency of arrangement of programs and announcements, and the low quality of receiving sets, radio reception in Europe is far beneath that in the United States.

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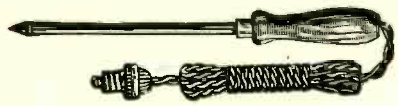

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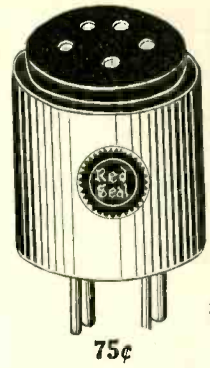

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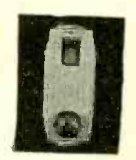

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