RADIO WORLD

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The First and Only National Radio Weekly

608th Consecutive Issue *Twelfth Year*

Stabilization of T-R-F Sets for Best Quality

Calibrating a Low-Frequency Test Oscillator

MODEL 7-TUBE T-R-F SET WITH LATEST TRIMMINGS

(See Page 8)

NOV. 18th
1933

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Per Copy

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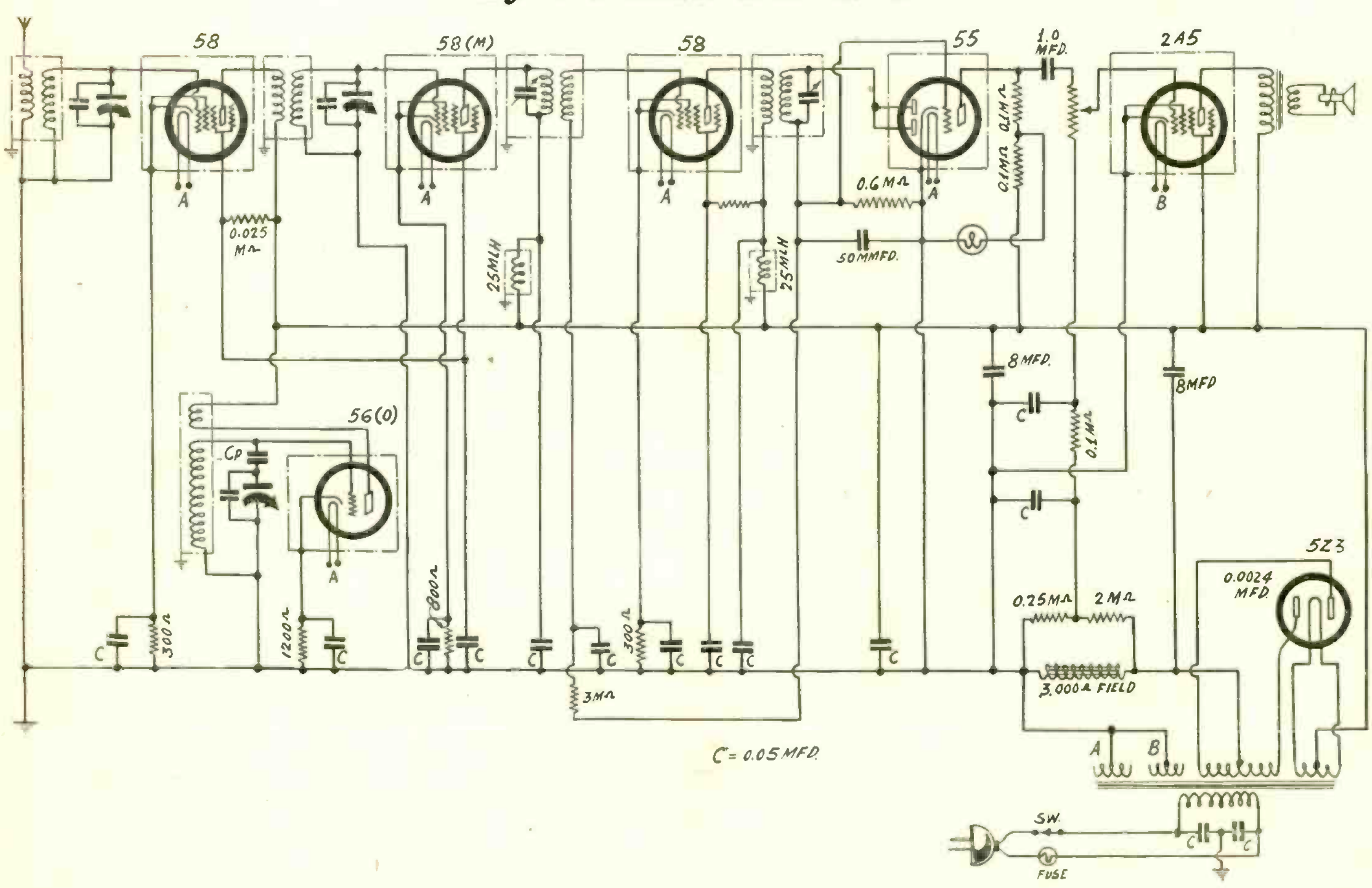
TWO ADVANCED SUPERS

7-TUBE AND 9-TUBE MODELS, WITH A. V. C. AND RESONANCE-INDICATING PILOT LAMP

By Herman Bernard



HONEYCOMB coils for radio-frequency and local oscillator tuning have been developed recently to an excellent efficiency, and enable the construction of a more compact receiver without any sacrifice of performance, compared to the coils more generally used in 2 1/16-inch outside diameter shields. The diameter of the shields for the honeycomb coils is 1⅜ inches, and the height is about 1.5 inches.

These coils were used in two laboratory-model receivers, one having seven tubes, the other nine tubes. The diagrams are shown in Figs. 1 and 2.

A detail of the receivers is that the oscillator tube is a separate 56, so that the degree of coupling may be regulated. With the pentagrid converter tubes the coupling has to be what it is, and since the apparent selectivity is increased by looser coupling, there may be sufficient coupling between the 56 oscillator (O) and the 58 modulator (M) without any external provisions, provided the two coils or tubes, or both, are near enough to each other, so no special manner of coupling is illustrated.

However, if extra coupling is required, or desired, it may be accomplished by putting two insulated pieces of wire tightly inside a metal tubing 2 inches long, anchoring one end of one wire to one grid (M) and the other end of the other wire at the other grid (O), but without any conductive coupling. Ground the shield-tubing. The two pieces of wire act as the plates of a tiny condenser,

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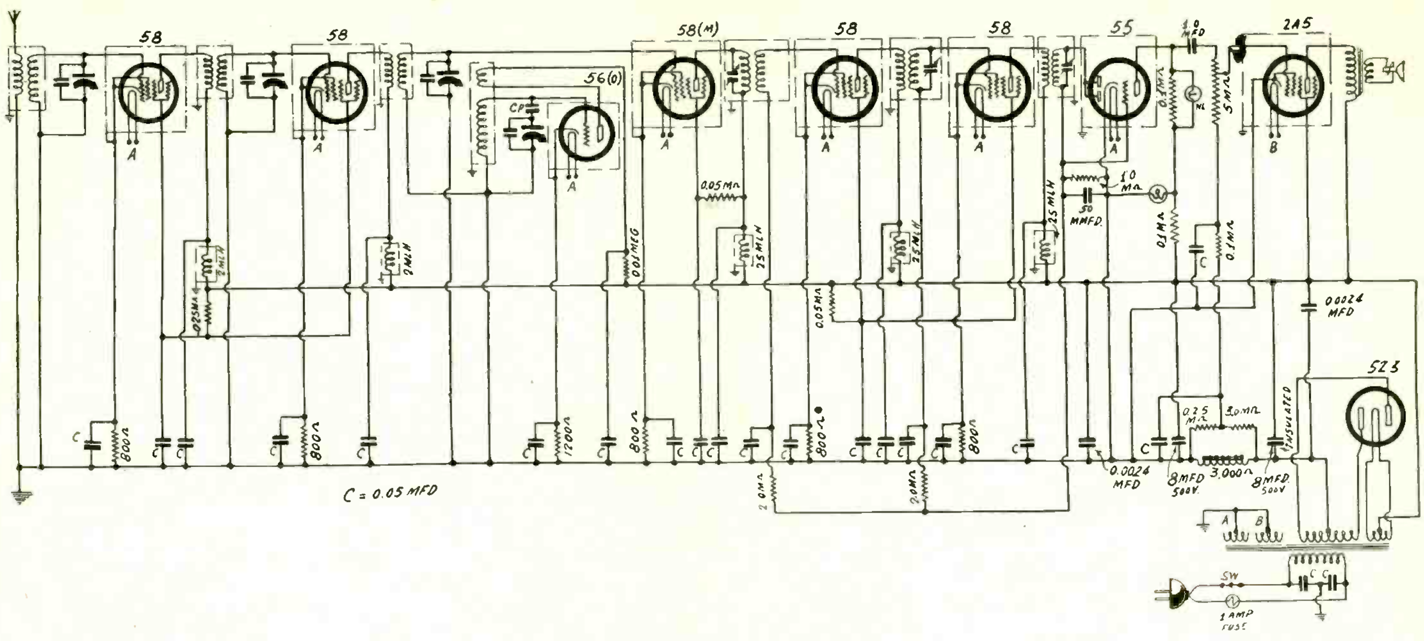


FIG. 2

The nine-tube model requires more r-f, i-f and other filtration, for it has two stages of r-f and two of i-f. In both circuits the B line voltage to ground should be about 250 volts.

(Continued from preceding page)

and if coupling is to be reduced, the length of one wire may be shortened.

The difference between the two receivers is that the smaller one uses a three-gang condenser and one intermediate amplifier stage, while the other uses a four-gang condenser, and two i-f stages. The extra gang takes care of another stage of t.r.f. The extra stages impose extra filtration, which is included. The smaller receiver is ample for ordinary use. The larger one is for those who want very special results in the way of distance. The quality of reproduction from the two models is the same.

The pilot lamp use is a novelty. It is a candelabra type neon lamp that also serves as resonance indicator. The lamp has a resistance built in, and thus is suitable for 110 volts. However, more than 110 volts will be dropped across the load resistor in the plate circuit of the 55, so half the available voltage is used to feed the lamp, and the other end of the lamp is grounded. While the lamp is constantly lighted by d.c., it also is sensitive to a.c., therefore the rectified carrier, or pulsating d.c., which is referred to in common parlance as a.c., when rising causes the lamp to light more brightly.

Lamp Is a Real Service

The plate circuit modulates downward, and if the lamp were put across the plate load resistor alone, or across a part of that resistor, at resonance the light would be dimmest. A canvass proved that the opposite method was preferred, and is easily attained simply by grounding one side of the lamp. A sensitive voltmeter may be used for measuring the drop in the lower 0.1 meg. resistor in the plate circuit, at no signal, to be sure the drop does not exceed 110 volts, and if it does, a smaller resistor would have to be used in the lower leg. The drop decreases (hence voltage at lamp increases) with signal.

The resistance of the lamp does not remain constant, but the proportion of change due to a.c. is not so great as to cause the lamp to be a drag on the circuit. Stated in terms of indication, this means weak signals do not make an appreciable illumination change. Strong signals do. As it is hardest to judge resonance for locals, due to the intensity, and automatic volume control which tends to make off-resonance volume pronounced, the lamp is really serviceable.

The bias for the output tube is obtained from part of the voltage drop in the negative-leg B choke.

The 2A5 Bias Method

There are two high-resistance units in series, connected as a total in parallel with the choke, so that the d-c resistance of the choke is not of such great importance. The actual resistance values are cited for a field of 3,000 ohms d-c resistance, but if smaller resistance fields are used, either the smaller resistor may be increased or the larger one may be decreasd, until the plate current in the 2A7 tube reads 34 milliamperes on a signal of considerable intensity. This is contrary to the usual method of determination, which requires that such adjustments be at no signal, and the reason is that the output tube modulates downward.

When a signal is introduced (compared to no signal at first), the plate current in the output tube goes down, and if the signal is very strong that current declines considerably, until it may be around 20 milliamperes. So if the adjustment were made on a non-signal basis, for a strong signal the operation of the tube would be far toward the negative, or in the region of rectification distortion. So if the adjustment to 34 milliamperes is made on the basis of a considerable signal, which may be a station, then there is a safeguard against operation on the distorting portion of the characteristic.

Wider Voltage Swing

Likewise by the present method the actual voltage swing is extended, since the tendency of the signal to drive the grid positive always is overcome by the effect of increased general plate current (from all tubes) causing the voltage to rise in the choke. If the bias always is greater than the signal there will be no grid current, the grid load resistance may be very high (to support low notes) and the power output therefore would seem to be considerably greater than the usual 3 watts. That phase, however, has to be explored some more, and curves run, to determine how much the power output is increased. Certainly it is a satisfactory method of getting the bias, and permits of hum filtration with small capacity to augment the filtration in the B filter proper by the choke and the two 8 mfd. condensers.

The usual precaution for negative-leg choke circuits must be observed, that the condenser next to the rectifier (between 5-volt filament center and B minus) must have its negative side insulated from ground, for B minus is not grounded. This condition is met if condensers with two output lead wire leads for each 8 mfd. are used, and indeed the two 8 mfd. capacities may be electrolytics in the same can.

A peculiarity of this system is that the positive sides of both 8 mfd. condensers are connected together.

465 kc Used

The r-f and i-f biasing resistors, 800 ohms in the larger set, are 300 ohms in the smaller. The higher resistance increases the bias and the selectivity, permissible where there is amplification to spare, and especially as the only purpose of the extra stage is increased selectivity. The modulator in the larger set has a higher bias than the one in the smaller set, to take care of the extra voltage due to the added r-f stage.

A mica-dielectric condenser is put next to the rectifier, besides the 8 mfd., so that if the impedance of the electrolytic is high to radio frequencies, there will be no squealing and no hum-modulation. Likewise, a similar condenser is across the other 8 mfd. a condenser for radio-frequency reasons.

The intermediate frequency intended to be used is 465 kc, the oscillator padding condenser is adjustable, 350-450 mmfd., and the r-f and oscillator inductances are proportioned to the gang condenser and pad. The capacities used were 0.0004 mfd., the r-f inductance 230 microhenries, and the oscillator inductance 126 microhenries. Secondaries alone are considered. The coils, being honeycombs, can not well be wound at home. However, any desiring to wind solenoids, for shielded purposes, on 1-inch diameter tubing, may put on 127 turns of No. 32 enamel wire for the r-f secondaries, primaries over secondaries, insulating fabric between, primaries having 25 turns. The oscillator would consist of 87 turns of No. 32 enamel wire, 30-turn tickler wound over secondary, insulating fabric between. The size wire used on primaries and tickler is not critical.

Small R-F Transformers

Besides small r-f and oscillator coils of the honeycomb type, also small intermediate transformers have appeared, shields only 1⅛ inches in diameter. These coils have a single tuned circuit, and therefore the diagrams

(Continued on next page)

The Pentagrid Tubes in Multi-Range Sets

COIL DATA

FREQUENCY BAND Megacycles		0.15 to 0.40	0.55 to 1.5		1.5 to 4.0	4.0 to 10	10 to 25
ASSEMBLY NO.		1	1	2	2	3	3
R-F COIL	Turns	442	121	147	36.8	10.4	4.2
L_1	Wire	#36 sse	#30 sse	#32 enam	#30 enam	#30 enam	#20 enam
OSC.GRID COIL	Turns	194	83	91	33.4	9.1	4.0 *
L_2	Wire	#36 sse	#30 sse	#32 enam	#30 enam	#30 enam	#20 enam
OSC.PLATE COIL	Turns	90	45	30	12	12	6
L_3	Wire	#36 sse	#30 sse	#32 enam	#30 enam	#36 enam	#36 enam

* This coil is not suitable for use with the 1A6 unless a type 30 tube is used in parallel.

COIL ASSEMBLIES

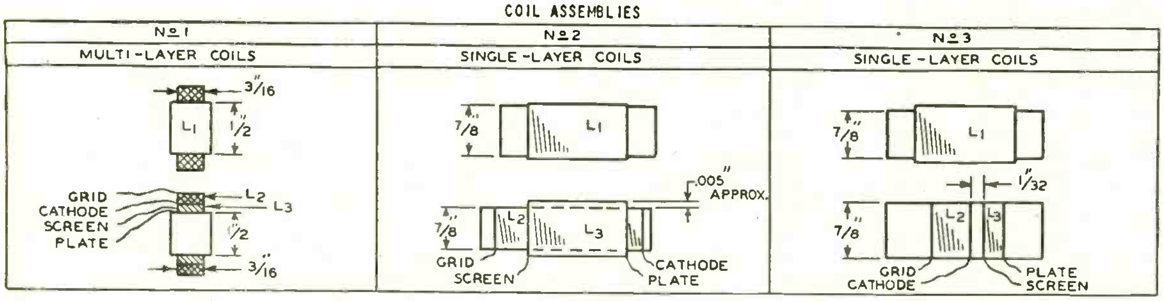


FIG. 1

Coil design for 150-400 kc., 550 to 1,500 kc., 1,500 to 4,000 kc., 4,000 to 10,000 kc., and 10,000 to 25,000 kc. The frequencies are designated in the table in megacycles. To convert to kilocycles move the decimal point three places to the right. The coil assemblies for honeycombs on ½-inch diameter dowels and solenoids on ⅞-inch diameter tubings are shown in the lower drawing.

THE pentagrid converter tubes 2A7, 6A7 and 1A6, frequently used as combination mixer (first detector) and oscillator in broadcast receivers, have application in short wave, or multi-range receivers.

This application note is devoted to a discussion of the conditions under which the pentagrid converter may be used in multi-range receivers, of the proper circuit conditions for best operation, and of the specifications and constants for the inductances and capacitances suitable for various frequency bands.

The 2A7, 6A7 and 1A6 are suitable for operation in any frequency band in which they can be made to oscillate. All of the advantages which these tubes have for applications at broadcast frequencies are retained at the higher frequencies. The fundamental circuits for the higher frequencies are found to be almost identical with those used for the broadcast band. Also, operating voltages are the same as those recommended for broadcast frequencies, say RCA Radiotron Co., Inc., and E. T. Cunningham, Inc.

In a multi-range receiver, it is generally desirable to use the same tuning condenser for each frequency band, a convenient ca-

(*Continued on next page*)

Two Advanced A-C Superheterodynes

(*Continued from preceding page*)

show inclusion of such a type. It is generally preferable, where there is only one tuned circuit, to put it in the grid circuit, except perhaps in the instance of the modulator output, where the capacity across the tuned winding is helpful in upholding a high plate circuit impedance to the intermediate frequency, but a low one to higher frequencies, so that types of interference are bypassed.

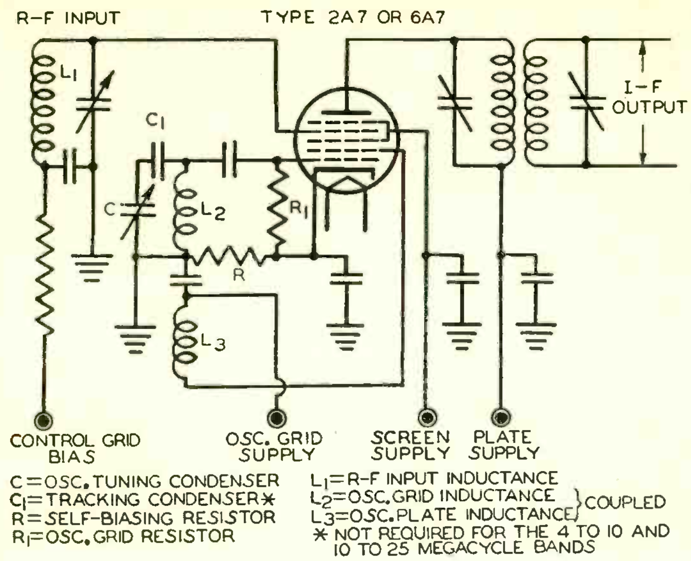
The volume control, located in the grid circuit of the output tube, is well positioned from the viewpoint of overload, as the last tube will overload the first, but sometimes there will be hum when the control is turned to low volume levels. This would require that the 0.1 meg. in series with the grid leak proper be increased considerably, to the order of megohms, or that the capacity from juncture of the two resistors to ground be increased, and such a capacity increase would have to be considerable. Sometimes a combination of both remedies is necessary.

If the circuit chokes up on loudest locals, reduce the detector load resistor until the choking disappears even from the loudest local. The reduction need not be below 250,000 ohms.

The output tube is shown as shielded, although it is not necessary to have a shield all around it. The circuits were built with tuning condenser at center, with disc dial, the tubes starting from right front, going to right rear, then to the left behind the condenser for intermediates, and then coming forward along the left-hand side of the condenser to detector and power tubes. Thus the 2A5 was close to the first r-f tuning condenser, and a stray field connected them, causing squealing, until a grounded metal strap was placed between one side of the tube and the companion side of the condenser frame.

The power transformer was placed unusually, at rear, on the upright wall of the chassis. A cutout was made for inserting the transformer, from the inside out, and the cover plate was then attached at the outside of the rear wall of the chassis, the nuts holding the plate also fastening tightly the four screws through the laminations, at the corners. The rectifier tube was put at left rear and the two 8 mfd. in one case at right rear.

The total current drain may not be much under 100 milliamperes for the larger set, 65 milliamperes for the smaller.



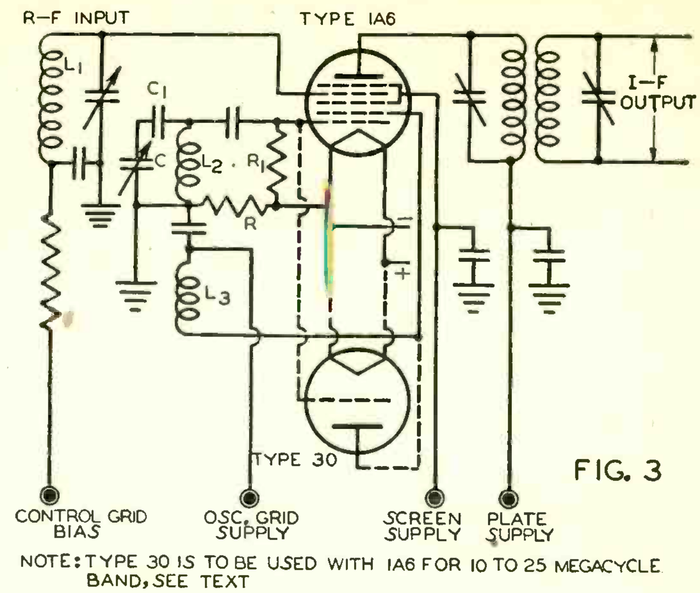


FIG. 2
The circuit in which all coils as described in Fig. 1 will operate, using the 6A7 or 2A7 pentagrid converter tube. It is a standard circuit. The tracking condenser C_1 is not required for 4 to 10 mc. and 10 to 25 mc.

FIG. 3
The 1A6 may not produce results in the 10 to 25 mc. band unless a triode (30) is put in parallel. This method also extends the frequency range for the 2A7 (56 in parallel) and 6A7 (37 in parallel), above 25 mgc.

(Continued from preceding page)
pacity range being approximately 40 to 350 mmfd.

In a multi-range receiver typical frequency bands are:

550 to 1,500 kilocycles, 1.5 to 4 megacycles, 4 to 10 megacycles, 10 to 25 megacycles. A low frequency band of 150 to 400 kilocycles (kc) is sometimes included.

An intermediate frequency of approximately 450 kc is suitable for use with all of these bands. The 2A7 and 6A7 will operate satisfactorily in all of the bands to provide gain comparable with that obtained at broadcast frequencies. The 1A6 may be used in all except the 10 to 25 megacycles (mc) band. Although the 1A6 can be made to oscillate at frequencies higher than 25 mc, it is difficult to cover the 10 to 25 mc band. To cover this and higher frequency bands, the 1A6 can be used in combination with a triode in a circuit to be described.

The table below gives for the frequency ranges considered the approximate values of inductances for r-f and oscillator coils and of series condensers. The constants assumed are:

R-f tuning condenser 40 to 350 mmfd.
Intermediate frequency 450 kc.

The minimum capacity assumed will be somewhat higher for the high-frequency ranges, due to the close coupling between circuits necessary at high frequencies.

Frequency Band Megacycles	.15 to .40	.55 to 1.5	1.5 to 4.0	4 to 10	10 to 25
R-f coil inductance (L_1) in mh......	3248	241.6	32.5	4.43	.709
Oscillator grid coil inductance (L_2) in mh............	699	131.2	25.0	3.60	.648
Tracking condenser (C_3) in mmfd....	120	385	1000	*	*
Additional minimum capacity required in oscillator circuit in mmfd.	22	9.5	4.3	11.3	4.2
Ratio of oscillator grid coil inductance to r-f inductance	.21	.54	.77	.81	.92

*Not required for the 4 to 10 and 10 to 25 megacycle bands.

Short-Wave Coil Requirements

The design of the high-frequency oscillator coils requires care. The principal requirements are:

1. Low resistance in the grid coil.
2. High mutual inductance between grid and plate coils.
3. Low capacitance between grid and plate coils.
4. Low self-inductance in plate coil.

Since these requirements are to some extent contradictory, compromises are indicated. Other considerations such as restrictions on overall dimensions and wire size should be taken into account.

Coil Design Details

The details of coil design are illustrated in Fig. 1. Grid and plate coils are made short in comparison with their diameters to facilitate proper coupling. The plate coil is wound at the end of the grid coil rather than inside of it in order to keep their intercapacitance at a low value. The inductance of the plate coil is about twice that of the grid coil for the 10 to 25 mc coil. Increasing plate turns beyond the number given will increase the amplitude of oscillation at the low-frequency end of the range, but will also limit the high-frequency end to a value considerably less than 25 mc.

All except the 10 to 25 mc coil may be used with the 1A6, although it may be desirable to increase the plate turns on the 4- to 10 mc. coil for use with this tube. All coils will operate with the 6A7 and 2A7 in the circuit of Fig. 2.

It is possible to use the 1A6 in the 10 to 25 mc band and the 2A7 and 6A7 at still higher frequencies by connecting a triode in parallel with the oscillator portion of the pentagrid converter, as shown in Fig. 3. This combination may be used in any variation of this circuit without change in connections or voltages. The function of an extra tube is to increase the voltage available for excitation of the oscillator circuit. This is necessary at high frequencies because of the very unfavorable L/C ratios and consequent low impedances obtained with tuned circuits operating at these frequencies.

Tube Combinations

Combinations suitable for use in this circuit are:

Pentagrid Converter	Triode
2A7	56
6A7	37
1A6	30

When these converter-triode combinations are used, it is not necessary to disconnect the triode for low-frequency operation. However, with this combination, it will probably be found desirable to reduce the number of turns in the low-frequency oscillator plate coils in order to keep the voltage developed across the grid coils at the value best suited for operation of the converter.

Station Operators Ask $40 Minimum in Code

Washington

Radio operators and technicians working in broadcast stations at a hearing on the Broadcasters' Code were represented by Thomas R. McClean of the International Brotherhood of Electrical Workers. He objected to certain features of the tentative code submitted by the National Association of Broadcasters. Mr. McClean stood for a forty-hour week and a $40 salary minimum, with provisions for overtime pay.

He also produced data concerning the actual cost of operation for stations of medium power and said a station of this type employing ten operators, on the air sixteen hours per day and operating seven days per week, could, by advancing the hourly unit price of their facilities by ninety cents, pay each operator $10 more per week.

"The average advertiser, undoubtedly an NRA member himself, will not object to this additional insignificant amount," he said.

Practically 80 per cent of all employed radio operators and engineers in the United States have signed up as members of the International Brotherbood of Electrical Workers, said he.

Mr. McClean is making his headquarters at 1200 15th street, N.W. Washington, D. C.

The Ray-O-Television Mfg. Corp., 4701 Thirty-fourth street, Long Island City, N. Y., has as chief engineer Ivan Bloch, formerly chief engineer of the General Television Manufacturing Corp. and instructor at the Polytechnic Institute of Brooklyn. A. C. Matthews is assistant chief engineer in charge of radio and electronics. Dr. P. C. Goldmark, formerly head of the Television laboratories of Pye Radio, Ltd., Cambridge, England, is lending assistance with his patents.

OSCILLATOR CALIBRATION

Low-Frequency Testing Device that Affords Harmonics for Rest

By A. C. Lang

OFTEN when one desires to build a test oscillator to cover more than one tuning range, hence requiring more than one coil, the inductance of the first coil, as well as that of the second, presents a problem.

Assume that a honeycomb coil is used as starter, the small type, on 3/8-inch diameter dowel. The frequency ratio of tuning may be ascertained, by beating with broadcasting stations, even though the fundamental frequencies are not known. The ratio may be derived from the broadcasting stations, by getting the low-frequency position on the test oscillator to give response in the receiver which is similarly tuned. Then as the receiver dial is turned bit by bit to the high-frequency end, so is the test oscillator dial. Therefore the frequency ratio of the test oscillator may be figured out by dividing the low broadcasting frequency extreme into the high-frequency extreme so far as the oscillator goes. The answer is in terms of the oscillator.

Turns Off as an Aid

If a choke coil of 800 to 1,000 turns is used, while maximum capacity in the test oscillator may not correspond to a virtually extreme low frequency in the set, if the test oscillator dial is at 80, say, turns are removed from the coil until the beat results at maximum capacity. There need be no particular concern about the fundamental frequency in this operation, as it will be lower than the lowest intermediate frequency now popularly used.

A good estimate of what the low frequency of the oscillator actually is may now be obtained. Since the receiver frequencies must be known, either because the frequencies of stations tuned in and beaten against are known, or because the receiver is frequency-calibrated with accuracy, if the lowest oscillator frequency beats with a station then the test oscillator's low frequency is a sub-multiple of the receiver's low frequency. It is easier to do the examples than to get a good idea from the words, therefore:

$$\text{LFTO} = \frac{\text{LFR}}{2 \text{ or } 3 \text{ or } 4 \text{ etc.}}$$

where LFTO=low frequency of test oscillator, and LFR=low frequency of receiver.

Absolute Value

Now, since we know the frequency spread on the receiver, which may be 1,000 kc (the difference between 540 and 1,540 kc, let us say), if we leave the test oscillator fixed at the low-frequency extreme and tune the receiver, we get a series of beats or at least responses in the untouched receiver, and that series is related to the fundamental low frequency of the test oscillator by harmonics. With a little estimating we can get sufficient data to ascertain in absolute value the lowest frequency to which the test oscillator tunes.

We know the receiver covers 1,000 kc. We can count the responses due to turning the oscillator dial from one end to the other. If we find that there are ten responses, and they just cover the test oscillator dial scale, we know there are ten instances of harmonics, and as they are related to the fundamental by the 1,000 kc span, therefore the test oscillator's low frequency setting equals 1,000 kc divided by the number of responses, or, in this case, the low frequency is 100 kc.

"Fractional Response"

If the frequency range of the test oscillator is exactly 3-to-1 there would be no need of estimating, and since we have no particular frequency in mind for the low end, except one that gives us opportunity to line up commercial intermediates at other settings, and the coil turns are sufficient for that, we can adjust the inductance and also the trimmer on the condenser. Then with 0.00035 mfd. to 0.0005 mfd., whatever our tuning condenser is within this range, we can just match the response with the receiver at the low-frequency end, turn the oscillator dial, and adjust the trimmer so that there is a beat at the minimum capacity setting of the oscillator tuning condenser itself.

If we don't do this we must estimate, giving a fraction, say, 7 full responses and what seems to be a difference equalling "half a response." The difference preferably should be at the low-frequency end of the oscillator, as it is easier to estimate there, because the absolute frequency differences are smaller. However, dividing by a fraction is not difficult Suppose there were 7.5 responses, and the span was 1,000 kc, then the low-frequency setting would be 10,000/75 or 133.3 kc.

The inductance is not known or even worried about.

Frequency Difference

After we have obtained the approximate low-frequency this way, and it will be close enough even for measurement purposes if the number of responses and the frequency span of the set are accurately determined, we can calibrate against broadcasting stations, and run a curve. We know that our span for the test oscillator will be the difference between the low-frequency setting and three times that setting, or, if the low is 100 kc, then the high is 300 kc (assuming 3-to-1), a difference of 200 kc.

We can not feel certain of inductance, as we would have to estimate the capacity, the frequency being accurate, let us say. But we do not care about the inductance. We may derive some comfort from the fact that the inductance for the next higher span of frequencies must be the original inductance divided by the capacity ratio, or

$$\text{L new} = \frac{\text{L old}}{9}$$

So if we have an original inductance estimated at 1,800 mh, the next smaller inductance would be 1,800/9 or 200 mh.

But, as stated, we do not need to know any inductances. All we need to do is to adjust a coil to yield the desired frequency. If we have another coil just like the first one and remove half the turns we will not have taken off too much wire, so will take off more turns until we get a response or beat with the test oscillator condenser at minimum, where it was during experiments with the other coil, to yield a response on the same dial spot on the receiver as before. We now have a lower harmonic of our test oscillator beating with the station frequency, because the fundamental frequency is higher in the test oscillator. It may be the frequency four times that of the fundamental at the first high-frequency setting of the first coil, or three times that frequency.

Rechecking

Therefore how can we check? Exactly the same way we did before. Assume a high-frequency response that jibes. Question: What is the frequency? Turn to the low-frequency extreme of the test oscillator, turn the receiver dial, count the responses, estimate fractions if need be. Fewer responses, of course. Say we had 10 responses before. How many responses do we want now? Well, if we had 100 kc at the low end of the test oscillator before, we want 330 kc now, or three times as high a frequency. So we expect 1,000/330, or 3.3 responses. We must get three, we don't want four, and if we do get three we have a pretty good checkup. Since we have one response or beat as guide, we know that if we made the mistake of selecting inductance that now yields the second harmonic of the original low frequency (100 kc), we have 200 kc, and would get from the receiver five responses.

Well, if we get five and want only 3.3. we can take off turns until we get about four responses, knowing we are in the right direction, then more turns until we arrive at 3.3 responses, or, since we now know our approximate frequency region, until we get a beat at one end of the test oscillator dial with the low frequency end of the set, get another beat somewhere near the middle of the test oscillator dial, set unmolested, and the third response before the oscillator condenser plates are at minimum. We can calibrate the new LC circuit as we did the other one, or use the original calibration, multiplying the frequencies by 3 when we read them.

The succeeding coils are treated in the same manner.

Ultra Waves Sent from Altitudes in Tests

A study of ultra-high frequency radio waves transmitted at intervals of 500 feet from ground level to a height of nearly four miles above Boston, began recently with a daily broadcast on a wave length of 5 meters from the weather research airplane of the Massachusetts Institute of Technology.

These broadcasts, transmitted by voice, will continue for two weeks more. The research plane in its daily flights to gather meteorological data leaves the East Boston Airport at 7:30 a. m. EST, and flies for two hours. The primary object of the radio wave study is to learn more about the behavior of very short waves transmitted from known altitudes up to 20,000 feet.

The investigation is considered by the American Radio Relay League to be the most important of its kind ever attempted, and all amateur radio operators in this country and Canada have been notified to listen for the broadcasts and report reception conditions.

T. R. F. MODERNIZED

A.V.C. and N.S.C. Included in Up-to-Second Design

By J. E. Anderson

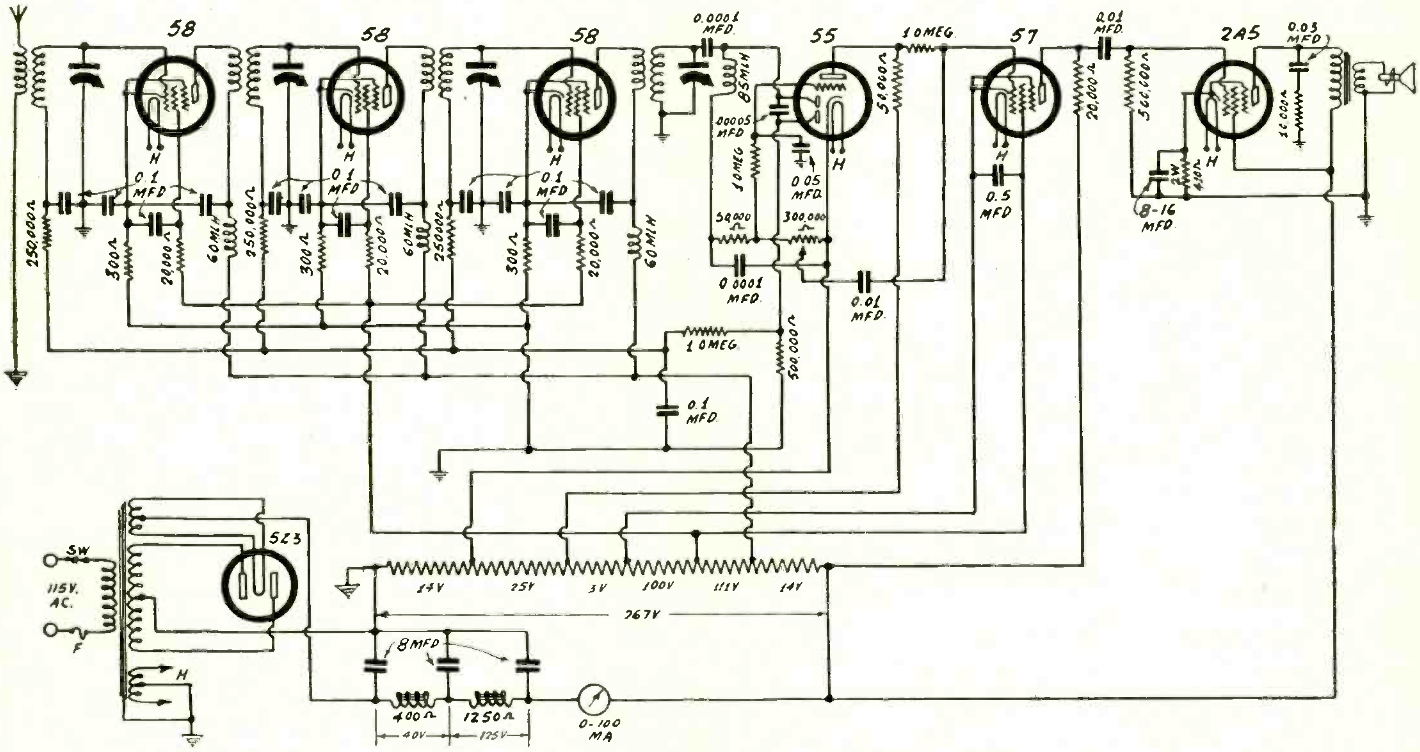


FIG. 1

A seven-tube tuned radio frequency with four tuned circuits, delayed automatic volume control and inter-channel noise suppression control. It is capable of an undistorted output of 3 watts.

HERE IS a seven-tube tuned radio frequency receiver with all the trimmings such as delayed automatic volume control and interchannel noise suppressor. In these days when nearly all radio receivers are of the superheterodyne type we do not often see a tuned radio frequency receiver that is carefully designed, but here is one, and we owe it to the RCA Radiotron-Cunningham tube manual. The radio frequency amplifier has no less than three 58 tubes and for tuned circuits, and for that reason it has a high sensitivity. Moreover, it is not subject to the heterodynes that infest some superheterodyne receivers.

In every case where it is possible, by-passing is done to the cathode of each tube and there is a filter resistor or filter choke in every supply lead. Each of the three radio frequency stages has four 0.1 mfd. by-pass condensers, three of which go to the cathode. Thus for the three stages we need twelve of these condensers. The condenser in each stage that is not connected to the cathode is connected between the grid return and ground. Its purpose is to prevent feedback at radio frequency from the automatic volume control.

Supply Lead Filtering

In each of the three screen leads of the 58s is a 20,000-ohm filter resistor, and in each of the plate leads of these tubes is a filter choke of 60 millihenries or more inductance. These resistors and chokes together with the 0.1 mfd. condensers form excellent filters to prevent undesired interaction among the stages.

In the cathode lead of each of these tubes is a bias resistor of 300 ohms, which fixes the minimum bias on the tube and hence the highest sensitivity of the circuit.

There is also a filter resistor of 250,000 ohms in each of the grid return leads, and this resistor taken in conjunction with the 0.1 mfd. condenser from the coil to ground is effective in preventing radio frequency feedback from the automatic bias device.

The Detector

The detector is the diode of the 55 tube. The input circuit is arranged so that the tuning condenser of the last tuned circuit can be grounded, and hence so that a four gang condenser can be employed for tuning. In the lead between the high potential side of the tuned circuit and the anode is a 0.0001 mfd. condenser. Then between the anode and the load resistance is a high quality radio frequency choke of 85 millihenries. This choke does not appreciably change the tuning characteristic of the tuned circuit and does insure that a signal voltage is impressed on the diode rectifier.

The load resistance is composed of two parts, first a fixed resistance of 500,000 ohms and then a potentiometer of 300,000 ohms, which is the manual volume control. One side of this is connected directly to the cathode of the tube so that the bias on the triode does not impose a handicap on the diode detector. A condenser of 0.0001 mfd. is put across the total load resistance to remove the carrier component of the detected signal.

The Second Anode

The second anode of the 55 is utilized for automatic bias and the input voltage to this rectifier is practically the same as that to the signal detector. A condenser of 50 mmfd. is connected between the two anodes to provide a voltage for the a.v.c. rectifier. A 500,000-ohm load resistance is connected between the second anode and ground, and from the negative end of this, that is, from the anode end, is connected a one-megohm resistor which goes to the common grid return of the automatically controlled tubes. The purpose of this resistor is to filter the grid bias as well as to help prevent the audio signal from being short-circuited. A filter condenser of 0.1 mfd. is connected between the common grid return and ground as additional insurance against feedback. Since the second load resistance is grounded, the voltage developed in it will add to the fixed bias on the three controlled tubes.

The 55 Triode

The 55 triode is utilized as a d-c amplifier and is used as the interchannel noise suppression control. The control grid is connected, through a one-megohm resistor, to the junction of the two load resistors on the first diode rectifier. Thus it receives a bias equal to the drop in the potentiometer. To insure that the grid only gets d-c a condenser of 0.05 mfd. is connected between the grid and ground.

It is clear that the bias on the triode is directly proportional to the intensity of the carrier voltage since it is a portion of the total drop in the load resistance. When the signal is very strong, as it will be when a station is being received, the bias on the grid is high and the plate current in the triode is low and may be entirely cut off. Then there will be only a small voltage drop,

LIST OF PARTS

Coils

Four shielded radio frequency transformers designed for 350 mmfd. condensers and the broadcast band of frequencies.
Three 60-millihenry choke coils.
One 85-millihenry choke coil.
One 400-ohm, 30-henry filter choke, measured at 100 milliamperes.
One power transformer with 115-volt primary, one centertapped secondary with 400 volts, r.m.s., on each side, one centertapped 5-volt winding, and one 2.5-volt centertapped winding.
One dynamic loudspeaker with input transformer of 7,000 ohms and a 1,250-ohm field winding.

Condensers

One gang of four 350 mmfd. tuning condensers with trimmers.
Thirteen 0.1 mfd. by-pass condensers.
One 50 mmfd. condenser.
Two 100 mmfd. condensers.
One 8 to 16 mfd. electrolytic, low voltage condenser.
One 0.03 mfd. condenser.
Three 8 mfd. electrolytic, 500-volt by-pass condensers.
One 0.05 mfd. condenser.
Two 0.01 mfd. condensers.
One 0.5 mfd. condenser.

Resistors

Three 250,000-ohm resistors.
Three 300-ohm bias resistors.
Four 20,000-ohm resistors.
Three one-megohm resistors.
One 300,000-ohm volume control potentiometer.
Three 500-,000-ohm resistors.
One 50,000-ohm resistor.
One 410-ohm, 2-watt resistor.
One 10,000 to 20,000-ohm resistor, fixed value.
One voltage divider with five taps and total resistance of about 12,730 ohms.

Other Requirements

Five grid clips.
Six six-contact sockets.
One four-contact socket.
One line switch (may be attached to potentiometer).
One one-ampere line fuse.
One seven-tube chassis.
One vernier dial with pilot light.
Five tube shields.

or none at all, in the 50,000-ohm load resistance on the triode. The bias on the grid of the succeeding tube, a 57, will be that determined by the fixed bias on this tube. It will be in a condition to amplify whatever signal that is impressed on its grid.

Now suppose that the signal is weak or entirely missing. There will be a low drop, or no drop at all, in the potentiometer. The plate current of the triode will be high. Hence the drop in the 55 triode load resistance will be high. Now this drop is added to the bias on the 57 grid. It will be so high that the plate current in the 57 will be cut off and that tube cannot amplify. Thus when there is a strong signal to be amplified, the 57 is in proper adjustment for amplification, but when there is no signal, only noise, to be amplified, the 57 is a complete block, and the noise will not get through.

Signal on 57

The audio signal impressed on the 57 is derived from the potentiometer in the load circuit of the first diode. The slider is connected, through a 0.01 mfd. condenser, to the grid of the 57. The one megohm resistor between the control grid of the 57 and the plate of the 55 serves to prevent the audio signal from shorting through the load resistance of the 55.

The output of the 57 is delivered to the grid of a 2A5 power pentode through a condenser of 0.01 mfd. and a grid leak of 500,000 ohms. A load resistance of 20,000 ohms is used in the plate circuit of the 57.

The pentode is biased by a 210-ohm, 2-watt resistor in its cathode lead, and this resistor is shunted by a condenser of 8 to 16 mfd. It should be of the low voltage electrolytic type. It should be remarked that the larger value is preferable because the pentode has a high gain and if the bias resistor is not thoroughly by-passed there will be considerable reverse feedback at the low frequencies.

The output of the pentode is delivered to a dynamic loudspeaker through a transformer with a primary impedance of 7,000 ohms. Across the primary is a fixed tone corrector consisting of a condenser of 0.03 mfd. and a resistor of 10,000 to 20,000 ohms, the two being connected in series between the plate and ground.

As is customary with power pentodes, the screen and the plate voltages are the same, and the highest available in the circuit.

Voltages on 55

By tracing out the leads from the 55 triode, we note that the cathode is connected to a point 14 volts above ground and that the plate return is connected to a point 25 volts higher. Thus the effective voltage in the plate circuit of the 55 triode is only 25 volts. That is sufficient for the purpose the triode is used. It is further noticed that the cathode of the 57 is connected to a point three voltages higher than the plate return of the 55 triode. Hence the minimum bias on the 57 is 3 volts, and that is the voltage on the tube when it is in adjustment for amplification of the audio signal.

The 14-volt drop in the voltage divider next to ground is the delay voltage on the automatic volume control. The signal voltage must exceed this voltage before the automatic volume control takes hold. This makes the set more sensitive on weak signals. This would not be the case if the delay voltage were a handicap on the signal detector rectifier. When the delay voltage is in the detector rectifier, detection will not begin until the delay voltage has been exceeded, and this would make the circuit less sensitive.

The Tuners

The circuit is tuned by a gang of four equal condensers of the usual type, say four 350-mmfd. condensers. Each of these should be equipped with a trimmer condenser so that all may be lined up to the same frequency at the high frequency end of the tuner.

Four equal radio frequency transformers are also used, and, of course, the secondaries, which are tuned, should have such inductance that the broadcast band will be covered.

It is necessary, of course, that the coils be shielded and that the shields be grounded, for otherwise it will not be possible to stabilize the circuit. Moreover, the tubes should be surrounded by grounded metal covers and the grids should be protected from each other and also from the plates. Grounded sleeves should not be used around the grid leads because they will add too much to the capacity, but metal plates may be placed between adjacent grids. Sometimes these precautions are not necessary, but they are to be kept in mind in case oscillation should result.

The B Supply

A 5Z3 rectifier tube is used in the B supply. The power transformer employed has four windings, three of which are centertapped. The positive lead is taken off the centertap on the five-volt winding and the ground from the center of the high voltage winding. The 2.5-volt filament winding is also ground, as is the core and frame of the transformer. In the primary windings, which is wound for a line voltage of 115 volts, contains a one-ampere fuse and a line switch.

The r.m.s. voltage across each half of the high voltage winding is 400 volts. This will yield a rectified voltage before the input to the filter of 432 volts when the total current drawn is 100 milliamperes.

The first condenser across the line has a capacity of 8 mfd., and it should be an electrolytic condenser of 500 volt rating. Then there follows a filter choke of 400 ohms and 30 henries, measured at 100 milliamperes. The voltage drop in this coil will be 40 volts when the full current is drawn. After this choke there is another condenser of 8 mfd. of the same type and rating as the first. A speaker field of 1,250 ohms serves as the second choke, and in this there will be a voltage drop of 125 volts. A third 8 mfd. condenser similar to the other two completes the filter.

A net voltage of 268 volts is available on the receiver side of the filter, and this voltage is applied to the screen and plate of the power tube. Since the bias on this tube is 16.5 volts, the net voltage on the plate and screen is 251.5 volts.

The high voltage is also applied to the plate return of the 57 amplifier, but since the cathode of that tube is connected to a point 42 volts above ground, the effective voltage in the plate circuit of the 57 is 209.5 volts. The screen voltage of this tube is 100 volts.

Voltages on Amplifiers

The plate returns of the three 58 radio frequency amplifiers are connected to a point 253 volts above ground, and therefore the effective plate voltage is 250 volts, since the bias takes the extra 3 volts. The screens of these tubes get 139 volts.

The resistance values in the voltage divider can be estimated from the plate and screen currents in the various tubes, and the fact that the total current drawn is 100 milliamperes. Thus starting with the bottom section we have: 610 ohms; 1,200 ohms; 130 ohms; 5,900 ohms; 4,650 ohms; and 240 ohms. Three watt resistors will do for all, for that is greater than the power expended in the 111-volt section, where both the current and the voltage is highest.

These resistance values are approximate only and they are given as a guide in making adjustments. The voltage adjustments should be made with the aid of a high resistance voltmeter and they should be those specified in the drawing.

NBC Mobile Sender In Car Uses 150 Watts

NBC's new mobile transmitter, mounted in a specially built automobile, was heard over the air for the first time during the ceremonies marking the opening of the National Broadcasting Company's Radio City headquarters.

The car, twenty-two feet long, was built by General Motors to specifications. It is capable of sixty-five miles an hour and is sturdy enough to stand all existing road conditions. It is streamlined and aluminum painted.

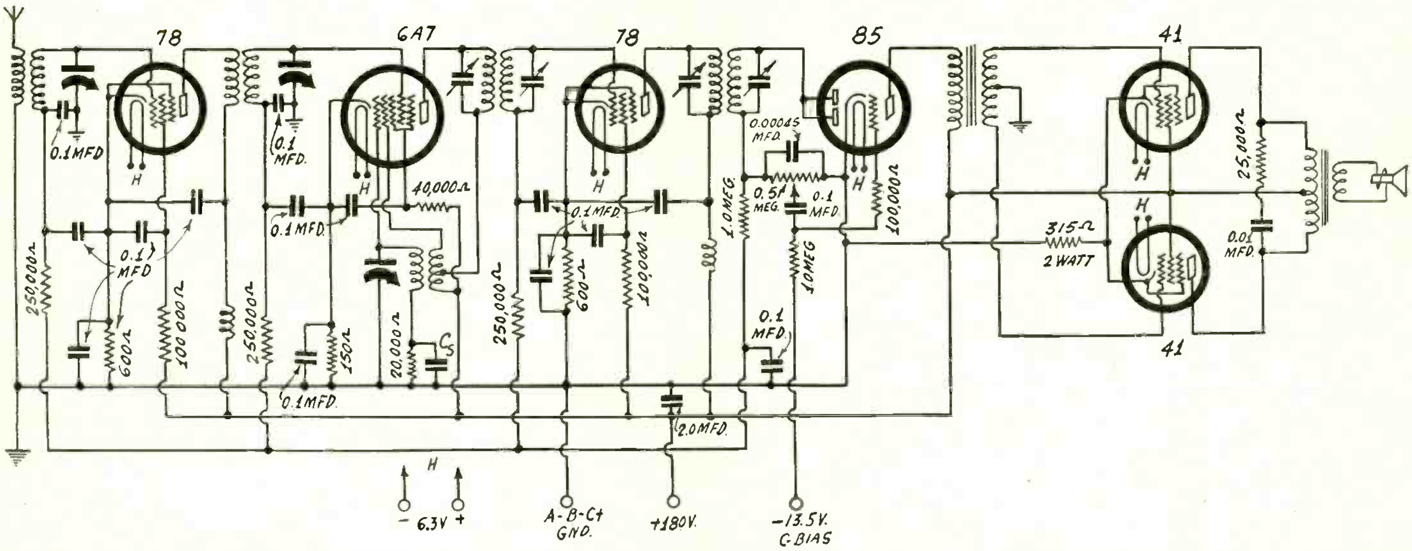
The short-wave transmitter housed in the car, says George Milno, NBC eastern division engineer, will have a power of 150 watts, three times the strength of the NBC's old mobile transmitter, and a range of up to 100 miles. This will make it possible for the NBC to originate special broadcasts at practically any point in the United States, since there are few places not within 100 miles of a wire line where a pick-up could be made for the networks.

The car has a trap-door over the announcer's seat, next to the driver, so that when desirable the announcer may stand, with his head above the top level of the car, to witness and describe what is going on. On the dashboard, in front of the announcer, is a desk which may be used for a microphone or a portable typewriter.

MODEL AUTO SET

6-Tube Receiver, Push-Pull 41 Output

By Brunsten Brunn



A six-tube automobile superheterodyne with manual and automatic volume controls and push-pull output. High sensitivity is assured by the use of a 6A7 mixer oscillator tube.

HERE is a six-tube superheterodyne the design of which is found in the RCA Radiotron-Cunningham tube manual. It is suitable for an automobile receiver because it utilizes 6.3-volt tubes and is equipped with both automatic and manual volume controls. It may also, of course, be used in a home receiver where a 6.3-volt filament source can be provided, either a.c. or d.c. The plates and screens may be supplied voltages from a battery, a rectifier B supply, or a motor-generator.

As all the receivers which we have taken from the same source, this one is characterized by thorough filtering in the various stages, and wherever a by-pass condenser is used, the fact that the cathode of a tube is the source of the electrons has been recognized. That is, by-pass is done to the cathode rather than to ground. This method of by-passing is the most logical and the most effective in producing independence of each tube from the others as far as stray coupling is concerned.

By-pass Condensers

Let us examine the by-passing for each tube in turn, beginning with the first. We note four different by-pass condensers, one from the grid return to the cathode, another from the ground to the cathode, still another from the screen to the cathode, and still another from the plate return to the cathode. Each condenser has a value of 0.1 mfd.

Going over to the 6A7 tube we note three by-pass condensers, each of 0.1 mfd. capacity. One goes from the grid return to the cathode, another from the screen return to the cathode, and still another from ground to the cathode. On the 78 intermediate frequency amplifier we find four of these 0.1 mfd. condensers, and they are disposed exactly as in the case of the first tube.

On the detector tube, the 85, we have only one by-pass condenser, and that is connected across the load resistance of the diode. It has a value of 0.00045 mfd. and it goes to the cathode, as does the load resistance. On the power stage there is no by-pass condenser because the amplifier is of the push-pull type.

Let us now return to the first and second tubes. It will be noticed that there is a by-pass condenser C of 0.1 mfd. from each coil to ground. This is our contribution to the circuit. In the original circuit the condenser was not grounded but was connected only to the coil. This was undoubtedly an oversight because the circuit will not work unless each condenser section is grounded if we use the ordinary three gang tuning condenser with common rotor.

Other Condensers

There is also a condenser Cs across the oscillator grid leak, which has a value of 20,000 ohms. This condenser is the oscillator padding condenser. If the intermediate frequency is 175 kc, which is the value suggested in the original specifications, the padding condenser should have a range of about 700 to 1,000 mmfd. Of course, it should be adjustable.

Another 0.1 mfd. condenser is associated with the automatic volume control, being connected between ground and the common grid return leads of the three controlled tubes. Another condenser of 0.1 mfd. is connected in the lead from the slider of the manual volume control potentiometer. This serves as a stopping condenser in the audio amplifier and makes it possible to have a fixed grid bias on the triode of the 85 tube.

Another condenser, one of 0.01 mfd., is connected in series with a 25,000-ohm resistor across the primary of the push-pull output transformer. The condenser and the resistor form a tone control by partly shunting out the high frequency audio notes from the transformer.

Bias Resistors

The minimum bias for each of the 78 tubes is obtained from a 600-ohm resistor in the cathode lead, each yielding a bias of 3 volts.

In the cathode lead of the 6A7 mixer-oscillator is a resistor of 150 ohms, which yields a fixed bias of approximately 1.5 volts. The power tubes are biased by a 315-ohm resistor of 2 watts rating. This yields a bias of 13.5 volts.

The grid leak of 20,000 ohms across the padding condenser affects the bias on the oscillator section of the 6A7, increasing it when the oscillation makes the grid positive during the peaks of the voltage swing.

Since a transformer is used in the plate circuit of the 85 triode, a fixed bias is essential on this tube. It is obtained by means of a battery and its value is 13.5 volts. In case the circuit is powered by a rectifier B supply it is possible to insert a resistor in the negative lead of the rectifier and making its value such as to give the proper bias. The grid return then would be connected to the most negative point and the rectifier would be grounded at the positive end of the bias resistor. The reason self bias is not used on the triode is that this could not be done without putting a voltage handicap of 13.5

(*Continued on next page*)

LIST OF PARTS

Coils

Two shielded radio frequency transformers for 350 mmfd. condensers.
One oscillator coil for 350 mmfd. condenser and 175 kc I. F., with tapped primary.
Two shielded, doubly tuned, 175 kc intermediate frequency transformers.
One push-pull input transformer.
One dynamic loudspeaker, with push-pull output transformer and 6-volt field.
One 85 millihenry choke coil.
One 85 to 125 millihenry choke coil.

Condensers

One gang of three 350 mmfd. condensers with trimmers.
Twelve 0.1 mfd. by-pass condensers.
One 0.00045 mfd. condenser.
One 0.01 mfd. condenser.
One 700-1,000 mmfd. padding condenser.
One 2 mfd. by-pass condenser.

Resistors

Two 600-ohm bias resistors.
One 150-ohm bias resistor.
One 315-ohm, 2-watt bias resistor.
One 20,000-ohm resistor.
One 25,000-ohm resistor.
One 40,000-ohm resistor.
Three 100,000-ohm resistors.
Three 250,000-ohm resistors.
Two one-megohm resistors.
One half-megohm potentiometer.
Other requirements:
Four grid clips.
Five six-contact sockets.
One seven-contact socket.
One remote control (if set is built for automobile use).
One six-tube chassis.

LINING UP T-R-F AND SUPERS; PADDING THE OSCILLATOR

The following is an excerpt from the instruction sheet furnished with the Bernard Test Oscillator that works on a.c., d.c. and batteries and is constantly modulated. The data herewith concern lining up the intermediate channel and r-f section, as well as padding the oscillator on a superheterodyne.

If a commercial receiver is being peaked and the manufacturer has issued instructions as to the particular method to be applied, use that method, as the oscillator is applicable to any method. In the absence of manufacturer's instructions proceed as follows:

Intermediate Frequencies: Connect the output wire of the Bernard oscillator to the plate of the tube ahead of the second detector. Turn on the set and the oscillator and adjust the oscillator dial to the desired frequency. Tune the transformer feeding the second detector. Now put the output wire to the plate of the preceding tube. Tune the succeeding intermediate transformer. If there are only two transformers you are now at modulator plate. If there are three or four transformers, work backwards to the modulator plate. Retune all transformers for loudest response, or greatest needle deflection, if an output meter is used. If doubly-tuned transformers are being peaked, first carefully tune the grid circuit, then carefully tune the plate circuit, but do not retune the grid after the plate has been tuned. Due to body capacity effects in the intermediate transformers, it is often necessary, and in all instances, highly advisable, even when using insulated screwdrivers, to remove the driver after the condenser has been turned just a bit, and note the response. Bit by bit the change in setting is made until resonance is sharp. Maximum response can be missed by a tenth of a degree in sensitive circuits. Plate circuits are the more subject to body capacity.

T-R-F Sets and Supers

If the output from the Bernard oscillator is too strong, which it may be if the receiver is very sensitive, instead of connecting the output wire directly to the output post, put to the post a 1-inch piece of insulated wire, end bared, and twist the output wire around the insulation for a few turns. This reduces the coupling markedly at the intermediate level.

Broadcast Frequencies—For tuned radio frequency sets, the output wire from the oscillator may be connected to the antenna post and the ground wire to the ground post, the oscillator dial turned to read the desired frequency, or, if an unknown frequency is to be determined, the set's dial is placed at the unknown frequency and the oscillator dial turned until the modulation is heard, when the oscillator dial will read the unknown frequency. For superheterodynes the loose-coupling method described at the end of the preceding paragraph is usually preferable for the broadcast level.

Gang Condenser

For broadcast superheterodynes, since the intermediate amplifier has been peaked, if the tuner has a gang condenser the r-f level must be peaked and the oscillator padded or tracked. By *padding* is meant the adjustment of a series condenser; by *tracking* the adjustment of the parallel trimmer only, for sets using a specially-cut oscillator tracking section of the gang.

For padding, two tie-down points are selected, say, 1,450 kc and 600 kc. If the receiver is not very sensitive, the output of the Bernard oscillator may be connected directly to antenna post, replacing aerial, and other lead from the test oscillator to set's ground post, with ground wire not removed from the post. For sensitive receivers use the loose-coupling method previously described.

Turn on the set and the test oscillator. Adjust the test oscillator to read 600 kc and turn the set's dial to that point near the maximum capacity setting where the modulation from the oscillator is heard best. Open the parallel trimmer on the gang's oscillator condenser all the way and leave it thus. Adjust the series padding condenser bit by bit until response is loudest. Tentatively set the trimmers on the r-f sections of the gang for maximum response.

"Rocking" the Dial

Adjust the test oscillator to 1,450 kc and turn the set's dial to near the minimum capacity setting until the modulation is heard best. Slightly readjust the r-f trimmers now to determine if response can be increased. Now make ever so slight an adjustment of the set's oscillator condenser parallel trimmer, "rocking" the dial a few degrees to right and left, to ascertain if response increases, and if it does, leave the oscillator trimmer at the new maximum-response setting, otherwise restore it to its former setting.

Now adjust the test oscillator to 600 kc again, turn the set dial to the position near maximum capacity for loudest response, and slightly readjust the series padding condenser in a test for improved response. Leave it at the maximum-response setting, whether this is a new setting or the old one. That completes the adjustments.

Never readjust any trimmers at 600 kc after they have been set for 1,450 kc. If other frequencies than 600 kc and 1,450 kc are recommended by the set manufacturer for padding follow the manufacturer's advice.

The other example, that of a tracking section, requires only the adjustment of parallel trimmers on the gang, at one frequency. This should be done for maximum response at the geometric mean of the broadcast band, 900 kc.

In any instance, where the set's oscillator condenser is not ganged, only ganged r-f sections need be adjusted once, at 1,450 kc.

The Bernard Test Oscillator has frequency-calibrated dial and takes care of frequencies from 135 to 1,500 kc.

365 Van Loads Take 42 Hours to Move NBC to Radio City

Radio City's population went up 800 when the staff of the National Broadcasting Company moved into its new headquarters. Those who left their desks at 711 Fifth Avenue found them on the next work day in Radio City.

The huge development again had its population boosted, this time by thousands, when actual broadcasting got under way in Radio City's studios. The Radio City inaugural program was heard over combined coast-to-coast NBC-WEAF-WJZ networks.

There was great prior activity in the new studio block as rehearsals and auditions were in progress. These served as a means of testing the new equipment, which operated perfectly the first time it was put into use.

While the rehearsals were going on, men were still busy laying carpets in the corridors of the studio building and putting the finishing touches on decorations and furnishings.

The removal of some 20,000 articles from 711 Fifth Avenue to 30 Rockefeller Plaza, the official address of the new headquarters, was accomplished without a hitch. It required forty-two hours to move the 365 van loads.

The NBC private branch telephone exchange was changed to Circle 7-8300.

Heaters Floated in Auto Set

(*Continued from preceding page*)

on the diode rectifier. Thus the signal would have to have a peak of this value before the tube would begin to detect. Such a handicap is too much for an automobile receiver. Indeed, it is too much for any type of receiver.

In the grid return leads of each of the automatically controlled tubes is a resistor of 250,000 ohms, which is used for filtering. In the common lead of these grid returns and connected to the negative end of the load resistance of the diode is a one-megohm resistor, which serves not only as a filter but also to prevent short circuit of the audio signal through automatic bias filter. The grid leak of the triode is also one megohm. There is another resistor of 100,000 ohms in the lead to the grid.

A resistor of 100,000 ohms is put in the screen lead of each of 78 amplifiers. These serve to drop the voltage, since they are connected to the same supply voltage as the plates. In the screen lead of the 6A7 is a resistor of 40,000 ohms for the same purpose.

In the plate return lead of the first 78 is a radio frequency choke coil, which may have a value of 85 millihenries. There is a similar coil in the plate return of the intermediate frequency amplifier. This might have a higher value, say 125 millihenries.

A condenser of 2 mfd. is put across the high voltage supply as a general by-pass. This should be of the paper dielectric type, since it will function mainly at radio and intermediate frequencies. If the B supply is such that additional filtering is required, that should be a part of the voltage supply.

There are two equal radio frequency transformers wound to fit tuning condensers of 350 mmfd. And there is one oscillator coil, wound to fit a 350 mmfd condenser and an intermediate frequency of 175 kc. In the intermediate we have two doubly tuned transformers, each winding tuned to 175 kc.

Following in the triode is a push-pull input transformer and following the push-pull tubes is a push-pull output transformer. This may be a part of the dynamic loudspeaker. The speaker should be designed for two tubes in push-pull, each with an output impedance of 9,000 ohms. The field should be designed for 6.3 volts so that it may be connected to the storage battery.

The heaters are all floating so that the circuit may be operated on either a-c or d-c on the filaments. When d-c is used the negative of the battery should be grounded, when that is possible. Otherwise the positive may be grounded. The maximum plate voltage is 180 volts. No other voltage divider than that included in the circuit is needed.

The power output of this receiver is about 3 watts, for each tube is rated at 1.5 watts when the applied plate and screen voltage is 180 volts.

This is all-sufficient for the purposes intended.

STABILIZATION IN ASSURANCE

By Robert G. H

Chief Engineer, Th

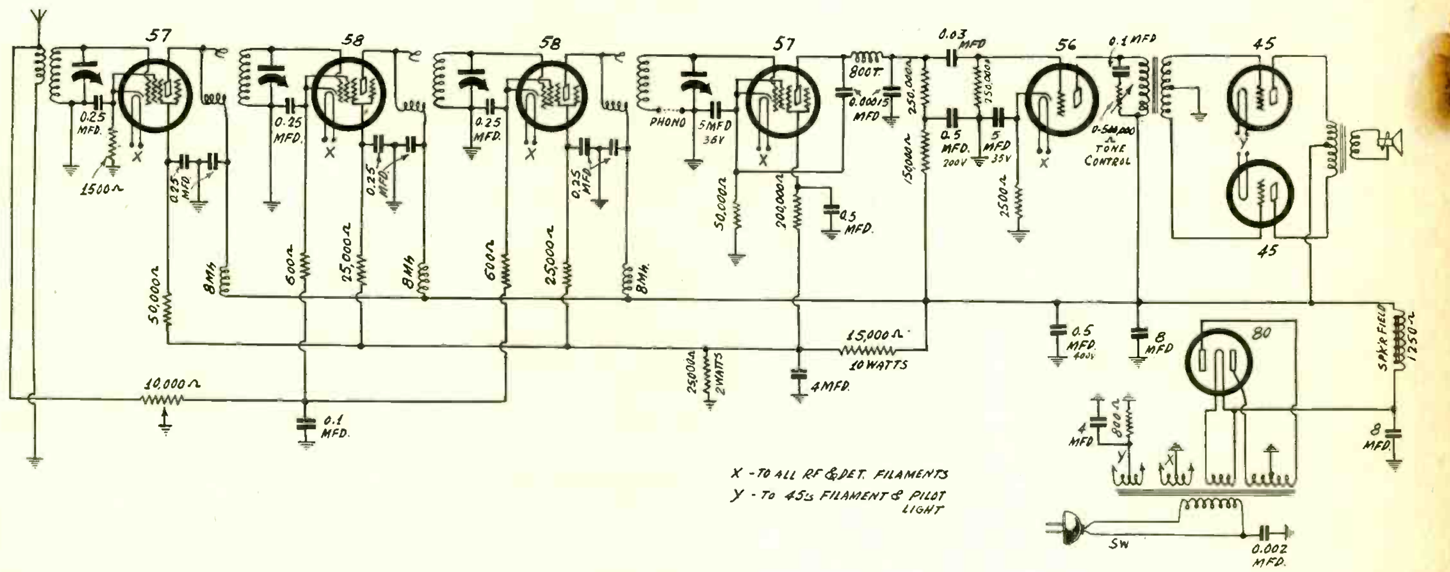


FIG. 1

An eight-tube tuned radio frequency set designed for quality reproduction. There are three stages of t-r-f, a 57 detector, a 56 driver, and 45 push-pull output.

THE CIRCUIT in Fig. 1 is an improvement of the circuit that was published in the September 30th issue. The values of a few parts have been changed slightly and other minor parts have been added. These changes have improved the stability of the radio frequency amplifier. The circuit remains remarkably sensitive and selective. The high quality of the output also has been improved. As an example of the selectivity of which it is capable, many fans in New York area have been able with it to tune in WLW, Cincinnati, Ohio, through the strong local signals of WOR. These two stations are separated by only 10 kc, and WOR is one of the strong stations in the metropolitan area. Hence this separation is a feat of no mean order.

The resistor mounting block shown in Fig. 2 is a convenient method of mounting all the resistors and is employed in all the better class factory-built receivers. It facilitates wiring and makes a much neater job. Besides the various resistors there are also three by-pass condensers mounting on the block.

Making of Strips

The strips can be made at home by those who have the time and material. The strip should consist of a piece of bakelite two inches wide and from seven to eight inches long. The thickness need not be more than 3/32 inch but may be greater. A hole is drilled in each corner for mounting the strip. Then for mounting the resistors and condensers two rows of ten holes each, one row on each side of the strip. In each row there should be a separation of about ½ inch between the holes and the distance between two corresponding, or opposite, holes in the two rows should be the same as the distance between the pig-tail resistors that are to be mounted. In most resistors the distance is 1.5 inches.

The condensers and resistors should be mounted on the strip and should be wired according to Fig. 2 before the strip is mounted in the set. This will greatly simplify the wiring after the strip has been mounted.

Mounting the Parts

In mounting the parts on the chassis it is common procedure to mount the tube sockets first. They are so mounted that the heaters face the rear of the chassis. The three r-f and the detector tubes are shielded and the shield bases should be mounted with the tube sockets. The r-f chokes may be mounted next, two on the chassis and two on brackets, using the same screw that mounts the coils, which can next be fastened to the chassis.

Grid leaks should be soldered to the lugs provided at the bottom of the tuning condenser before it is mounted on the chassis.

The push-pull input transformer is mounted between the two electrolytics and the tuning condenser, as near the tube sockets as possible, allowing room for the tubes themselves. The electrolytics finish the mounting on the top of the chassis. The volume control and tone control fit in slots in the front of the chassis. The antenna and phonograph twin post assemblies go in the rear.

The heaters are wired first, the plate and screen leads next. Little wiring is necessary, since the resistor assembly is wired already.

To align the receiver, connect the aerial and ground plug. Turn on the set and rotate the tuning condensers until some signal is heard. Leave the condensers at such a setting to bring in the signal as clearly as possible. Adjust the trimmers on the top of the tuning condensers with a screw driver until the signal becomes loudest. Always reduce the volume till it is barely audible so that any change may be more readily detected. For a final adjustment

"I'm Only an Amateur," Marcon

It was the last day of Senatore Guglielmo Marconi's visit to the Chicago World's Fair, to which he had come from far-off Italy to be signally honored as the Father of Radio. the long round of dinners, broadcasts and receptions was over. The time was 11 p. m., and everyone in the party was tired. Everyone, too, was hoping that the next event would be the journey back to the hotel. But they had not reckoned with Mr. Marconi.

"I hear that there is an amateur station in the fair," said he. "I want to go and see it."

Some one suggested that all the buildings had closed an hour before, but that did not still the great inventor's insistence. So his big car, with the Italian and American colors flying, turned in the narrow street before the Federal building, and started slowly down the avenue toward the Travel and Transport building.

The building was not closed. Of all those

A T-R-F SET FOR OF QUALITY

erzog, B. S., E. E.

or Radio Company

LIST OF PARTS

Coils

One shielded antenna coil.
Three shielded radio frequency coils.
One push-pull input transformer.
One power transformer.
Three 8-millihenry choke coils.
One 800-turn choke coil.

Condensers

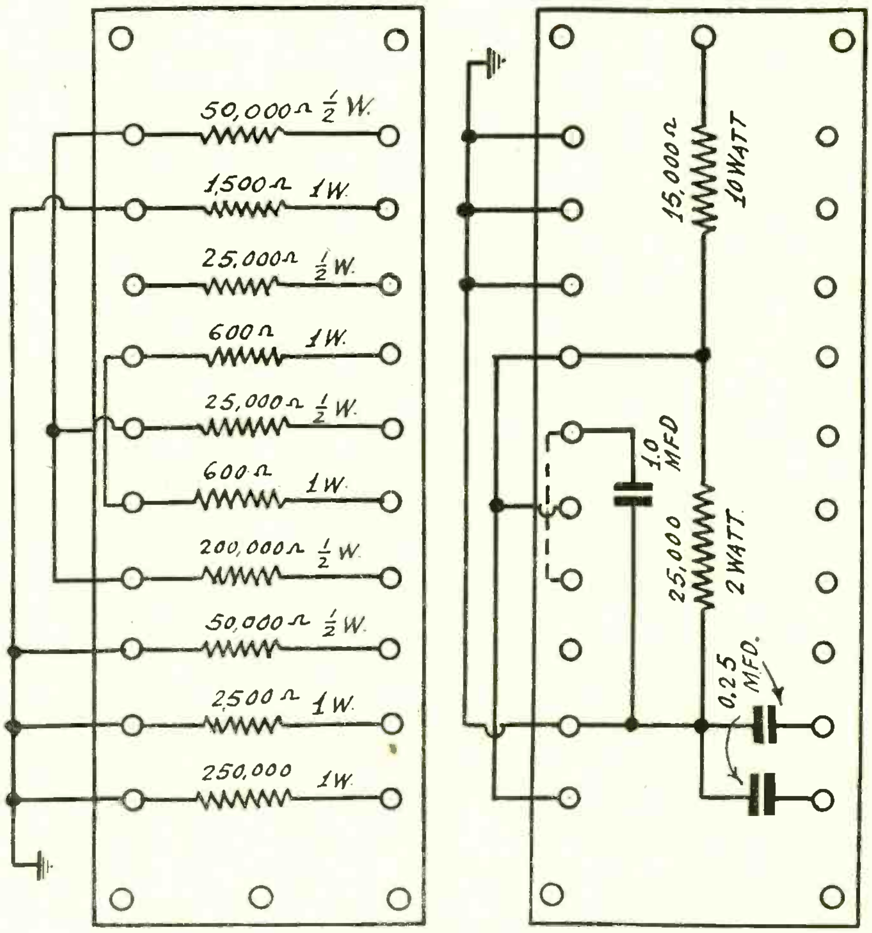
One 4-gang condenser, 0.00035 mfd.
Two 8 mfd. electrolytics, 500-volt rating.
One dual 5 mfd., 35-volt electrolytic condenser.
Three 0.25 mfd. condensers.
Two 0.1 mfd. condensers.
One 0.03 mfd. condenser.
One 0.5 mfd., 200-volt, condenser.
One 0.5 mfd., 400-volt condenser.
Two 0.00015 mfd. condensers.
One by-pass block.
Dual 4 mfd., 175-volt.
One 0.002 mfd. condenser.

Resistors

One 10,000-ohm volume control.
One 500,000-ohm tone control and switch.
One 15,000-ohm, 10-watt resistor.
One 25,000-ohm, 2 watt resistor.
Two 600-ohm, one-watt resistors.
One 1,500-ohm, one-watt resistor.
One 2,500-ohm, one-watt resistor.
One 800-ohm, 5-watt resistor.
One 150,000-ohm, ½-watt resistor.
Two 25000-ohm, ½-watt resistors.
One 200,000-ohm, ½-watt resistor.
Two 50,000-ohm, ½-watt resistors.
Two 250,000-ohm, ½-watt resistors.

Other Requirements

One resistor mounting block.
One 1,250-ohm dynamic speaker with output transformer for 45's.
One full-vision dial.
Three knobs.
Nine sockets.
One drilled chassis.
Four tube shields.
Four screen-grid caps.
Antenna-ground posts.
Phono posts.
A-c cord and plug.
Hardware.
Hook-up wire.



a station about 1,500 kc should be selected and the process repeated.

All plate leads should be shielded and the shields should be connected to the chassis. This is essential if stability is to be obtained.

The reason some of the changes have been made in the circuit is that some builders of the set have had difficulty with oscillation notwithstanding the fact that thorough filtering has been used to eliminate feedback. The bias resistors for the 58s have been increased to 600 ohms and the bias by-pass condenser for the first 58 has been increased to 0.25 mfd. as means of stabilization. An additional 0.1 mfd. condenser has also been put across the volume control to render this noiseless.

Low Note Response

The response on the low notes is excellent and for that reason some have encountered hum. This tendency to hum has been reduced, without at the same time reducing the low note response, by increasing the filter resistor in the plate circuit of the 57 to 150,000 ohms, or even to 250,000 ohms when necessary. If this does not remedy the hum in some instances, the 56 plate circuit may be treated in the same manner, that is, by putting a resistance of 10,000 ohms in series with the plate and then putting a condenser of 0.5 mfd. from the plate end of this resistor and the cathode, or ground, whichever gives less hum. This resistor would go between the B plus terminal, of the transformer and B plus, and the condenser would go from the transformer to ground. The tone control consisting of a condenser and variable resistance in series, should be left across the transformer primary.

The circuit is very dependable.

ni Admits at Ham Station at Fair

on the grounds, perhaps, it alone remained open, with a welcome waiting up on the second floor for any wandering amateur who might chance to stray by. The Marconi party, which included G. H. Clark, in charge of the RCA radio museum at the Fair, were the only guests in the building. Up the blue-green-red-yellow escalator they rode, turned here and there on the floor above, and finally arrived at the amateur radio exhibit of the American Radio Relay League.

The two operators on duty did not seem to know their distinguished visitor, but he at once introduced himself. He inspected the equipment carefully, especially one of the transmitters, and said concerning the latter: "That is a very fine piece of workmanship.' The proud builder deprecated his efforts, saying, "But it was built by only an amateur."

"Ah," said the illustrious Senatore, "But I am only an amateur myself."

Radio University

A QUESTION and Answer Department. Only questions from Radio University members are answered. Such membership is obtained by sending subscription order direct to RADIO WORLD for one year (52 issues) at $6 without any other premium.

RADIO WORLD, 145 WEST 45th STREET, NEW YORK, N. Y.

Belt Position on Pulley

I SEE YOU answered a question about a drill press the other week. I have a question for you about such a press. The motor is an excellent one (G. E.), rated at 1,750 r.p.m. When I put the belt on the pulleys the right way the speed builds up slowly, but in fact never does quite reach 1,750 r.p.m. When I put the belt on the wrong way, the speed becomes 1,750 almost instantly, and stays that way. How do you figure that out?—K. L. C.

The confusion arises from misunderstanding as to which is the right way and which the wrong way to put on the belt. You will notice that the belt has a smooth side and a rough side. You assumed that the rough side was to be toward the pulleys, the smooth surface on the outside, so that the belt would get a better "bite" on the pulleys. However, the smooth side should go toward the pulleys. This is what you mistakenly call the "wrong" way. It is the right way because of the convection on the smooth side of the belt corresponding to a similar one on the pulley, so that there is in effect a driving track, with no slippage.

* * *

Meritorious Chap Waxes Curious

NOT BEING FAMILIAR with radio, and having obtained an all-wave set in a merit test, I would like to know if my present aerial is satisfactory? I live on the ground floor of a four-story building. My lead-in is about 85 feet perpendicular. The horizontal portion of the antenna is 100 feet.—T. H. O'M.

If the upright wire does not pick up interference, the aerial should prove satisfactory. However, most of the disturbing noises classified as man-made static consist of electrical disturbances near the ground, and if noisy reception is present on short waves, you will have to kill off the pickup from the vertical line. This may be done by running two wires, one from usual pick-up point on the aerial, other from a ground on the roof, and transpose these wires frequently on the way down, connecting the aerial take-off wire to antenna post of the receiver, and the other wire to ground post of the set, which post should be grounded additionally. Transposition blocks, consisting of insulators that enable ready separation and transposition of the wires, are on the market. Twisted pair wire, of the a-c cable type, also is satisfactory, but not the parallel pair type. It is possible that for short waves the set will work better with a shorter effective aerial, so arrange perhaps to use the whole horizontal aerial at maximum for broadcast-band frequencies, and when going to short waves, insert between the antenna post and the lead-in a condenser of 0.0001 mfd. or smaller capacity. Remember that without transportation the lead-in may pick up as much as, or more than, the horizontal portion, so is part of the aerial.

* * *

Wants Short Waves

SHOULD I BE ABLE to receive many foreign stations on short waves? I am ready to buy a good short-wave set if I can have any authentic assurances that results will be really good.—P. K. E.

There are several excellent short-wave receivers on the market, all nationally-advertised, and if you select one of them you would get results consistent with your location. If you are unfamiliar with short waves you will not know the peculiarities, if any, of your location in respect to such reception. Why not arrange with some one who has a small short-wave set, and have him try it out at your place for several days and nights, as occasion permits, to determine whether your location is all right for short waves? Most locations are, of course. Sometimes there is an off-period for short-wave reception, due to the moon and other causes, and for a few days and nights there's practically nothing doing, so don't let one of these possible experiences mislead you. Any one who lends you the set, and you might offer to pay him for the service, will be able to give you a rough comparison between results on his own location and in yours, and if your location seems as good or better, and he will tell you what he brought in, you may expect to do as well or better in receiving foreign stations.

* * *

Interference with a Relative

ONE OF MY RELATIVES broadcasts from a station on 1,450 kc, but there is another station, in the mid-West, on the same frequency, and when both stations are on the air at the same time there is a sort of droning interference. I asked a friend of mine, who has some knowledge of radio, but does not profess to be an expert, whether it would be possible to get rid of this interference, and he said that if it came in on the carrier of the local station it couldn't be eradicated. However, he suggested I write to you about it.—L. E. D.

The interference is due to a beat between the two waves. When the carriers are sent out as carriers they are on a frequency of anywhere between 1,450,050 and 1,449,950 kc, as the law does not permit greater deviation than 50 cycles from assigned carrier frequency. The difference between the maxima is 100 cycles, but it is doubtful whether you get much audio amplification in your receiver at this frequency. However, if the interference you describe as a drone is around 100 cycles or less, or approximately like the hum produced by the 60-cycle a-c line.

While your friend is quite right that the removal can not be made from the carrier itself, the tone may be eliminated from the detector output or other audio amplifier, or speaker output, whether by a trap tuned to the general frequency of the interference, or, more simply, by greatly reducing the low-frequency amplification in the audio amplifier, as switching in a relatively low resistance across the audio line (25,000 ohms, say) only when the interference is to be eliminated. If what you call a drone is a relatively high audio frequency, though it came along on the carrier as modulation, nevertheless it may be eradicated from the audible response by cutting in a condenser across the audio line, say 0.05 mfd. These particular remedies are for application only when the trouble is present, as for general reception one would not want to avoid the possibility of keeping the tone true throughout.

* * *

Vacuum Tube Voltmeter

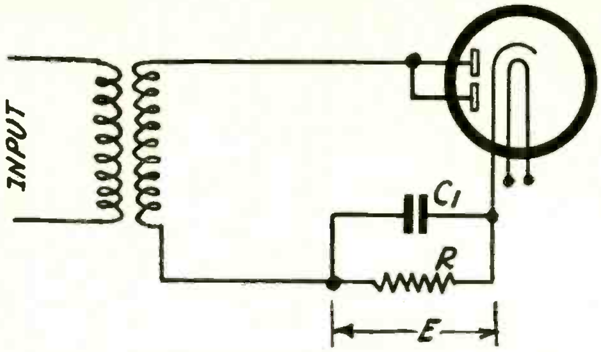
IF A VACUUM TUBE is hooked up for use as a peak voltmeter by the slideback method, can this also be used as a direct reading voltmeter for alternating voltages? What would have to be done in order to make it direct reading?—W. T.

Yes, it can. Since the circuit is hooked up for peak voltage measurement it has a current meter in the plate circuit. This is used for indicating no deflection on peak measurements. At the first adjustment the bias is made such that there is just zero plate current when no a-c is impressed. As the a-c is impressed current will begin to flow and this current is approximately proportional to the signal impressed. It is only necessary to calibrate the meter in terms of a-c voltage impressed. There should be a high resistance in series with the meter when the instrument is used as direct reading voltmeter. This is not desirable when it is used as a peak voltmeter. Therefore there should be a switch by which the resistance can be cut out. This resistance is also useful when the instrument is used for peak measurements as a protection and it should be shorted only when the bias has been increased so much that the current is near zero. Shorting the resistance at the final adjustment makes the peak voltmeter more sensitive. Incidentally, it is best to use a very sensitive milliammeter for both applications.

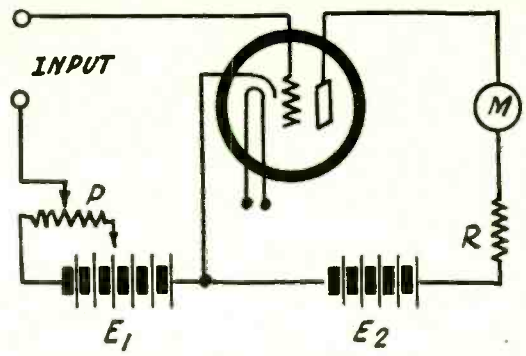
* * *

Accuracy of Oscillator

MY OSCILLATOR has a 200 mmfd. tuning condenser and is equipped with a dial that can be read accurately to one part in a



A diode rectifier circuit reduced to its simplest terms. It shows the signal source, the transformer, the load resistance, and the filter condenser.



This is the essential connection of a slide-back vacuum tube peak voltmeter. The peak is equal to the difference in the grid bias values.

thousand. The minimum capacity has been adjusted so that the coverage is two-to-one. That is, one coil goes from 500 to 1,000 kc, approximately, and another from 1,000 to 2,000 kc. From these data can you tell me how accurately the oscillator can be set to a predetermined frequency? So far I have been unable to set closer than about 5,000 cycles at any setting.—T. L.

We have to make many assumptions if we are to estimate the closeness of the setting. First let us assume that the capacity range is 200 mmfd. That will make the minimum capacity 66.7 mmfd. and the maximum 266.7 mmfd. Next let us assume that the capacity change is linear so that the smallest capacity change that can be read is 0.2667 mmfd. Now the frequency change dF due to a capacity change dC is given by $dF = FdC/2C$, in which F is the supposed frequency and C is the supposed capacity. Now if we take the 1,000-2,000 kc range, the highest F is 2,000 and the corresponding capacity is 266.7 mmfd. This gives $dF = 4,000$ cycles. The lowest frequency is 1,000 kc and the corresponding capacity is 266.7 mmfd. This gives $dF = 500$ cycles. Thus you can set the oscillator eight times more accurately at 1,000 kc than at 2,000 kc. The error is about what you found. Now we assumed that the capacity was straight line. Most condensers now made for tuning receivers have plates shaped so that the change in capacity is slower at the high frequency end. The effect of this is to make the setting error larger at the low frequency end and smaller at the high frequency end. That, of course, is desirable. It should also be noticed that a large minimum capacity will make the setting error smaller at the high frequency end. The setting error is, perhaps, not the greatest error. The capacity and the inductance change with temperature, and one day the setting error may be much greater than some other day, depending on the temperature. Moisture also affects the frequency, and therefore the setting error.

* * *

Low Frequency Reception

WILL YOU KINDLY publish a description of a radio receiver that will tune in stations in the band between 250 and 500 kc? Or if an existing receiver can be converted, please show how?—W. H. C.

If you have a superheterodyne with doubly tuned transformers and an intermediate frequency of 450 kc, approximately, remove the condensers in the tuned circuits and substitute therefor variable condensers of 350 mmfd. Since the primaries are connected to the high voltage and the condenser will be grounded on one side, it is essential that a large by-pass condenser, of at least 0.01 mfd. be used from the plate return of each to ground. The radio frequency circuit and the oscillator will not be needed in the set so these tubes should be removed. In case the mixer is a 2A7 or the like, just kill the oscillator and remove the grid clip. The antenna should be connected to this grid, using a leak to ground. This method of adaptation is the simplest and the low frequency receiver will be of the t-r-f. If there is only one intermediate frequency stage, the circuit will not be very sensitive. This lack of sensitivity may be compensated for by adding another stage, either in the low frequency level or in the audio level.

* * *

Detection Bias for 56

WHEN A 56 tube is used as a grid biased detector with a transformer in the plate circuit, what should the grid bias be, assuming an applied plate voltage of 250 volts, and if the tube is self-biased, what should be the bias resistor?—G. R.

When the 56 is used as a grid bias detector with 250 volts in the plate circuit, the bias should be 20 volts, according to tube specifications. Also, the bias should be adjusted to give a plate current of 0.2 milliamperes. Presumably, these two conditions are not inconsistent. Hence we can assume that when the grid bias is 20 volts the plate current is 0.2 milliamperes. If a resistor in the cathode lead is used to give the bias, it must be determined on the basis that the drop across it will be 20 volts when the current is 0.2 milliamperes. Thus a resistance of 100,000 ohms would be required. A resistance of this size would cause a considerable reverse feedback unless a condenser of large value were used. It is recommended that the condenser be not less than 8 mfd.

* * *

Diode Detections

PLEASE SHOW a simple diagram of the diode detector. In all receivers the diode rectifier is so involved with the rest of the circuit that it is difficult to trace just what belong to the rectifier and what does not.—T. R.

The figure shows the diode rectifier in its simples form. The two plates, or anodes, are tied together. Then the secondary of the input coil is connected between the anode and the load resistance R. Since the circuit is a unidirectional conductor an alternating voltage in the coil will result in a direct current through the circuit, including the resistance R. This current is pulsating and for that reason the condenser C1 is connected across the resistance. This condenser takes the pulses when they are higher than the average and discharges through the resistance when the pulses are less than the average. The current through the resistance is therefore very nearly free of fluctuations and we might say that only pure d-c flows through R. This current will set up a voltage E across the resistance which is the product of the mean current and the resistance. When the signal voltage impressed is modulated the average voltage varies at a rate depending on the frequency of the modulating frequency. Hence E is not a steady voltage when the input is modulating but varies according to an audio rate, and that variation is the detected signal.

* * *

Slide-back Peak Voltmeter

WILL YOU please explain how a peak voltmeter that utilizes a tube functions? I should like to measure peak voltages by this means if it is not too difficult.—B. W. E.

In the figure are shown the essential features of the peak voltmeter, except the voltmeter that is actually used to measure the voltages. The meter M should be a sensitive milliammeter or a microammeter. R might be a high variable resistance used for the sole purpose of protecting the meter M. A better idea is to put a variable resistance of rather low value across the meter in place of a series resistance. This shunt should be such that it can be opened easily and thus to get the highest possible sensitivity of the meter when it is safe to do so. E2 is any convenient voltage that will send a plate current through the circuit. E1 is a grid bias battery which can be varied in small steps. Its highest values should be equal to the highest peak that is to be measured. P is a potentiometer by which the grid bias can be varied in very small steps or continuously. The signal to be measured is connected to the terminals marked "input." The first thing to do is to adjust the bias on the tube until the plate current is just zero when the input terminals are shorted. Then the short is opened. The signal will now cause a plate current to flow. Change the bias until again the plate current is just zero. The difference between the two bias readings is equal to the peak value of the signal voltage. In order to have a convenient means of measuring the bias at the two settings a voltmeter should be connected across the bias, that is, from the cathode to the lower of the input terminals. Moreover, there should be a large condenser across the meter, say a capacity of one microfarad. The tube used should have a sharp cut-off and it may well be a high mu tube. A variable mu tube is not satisfactory.

* * *

Thermal Agitation Voltage

WHAT IS MEANT by thermal agitation voltage? Does this have anything to do with the noise in a receiver?—T. E.

The electrons in a conductor do not move smoothly in one direction, but first in one direction and then in the other, not in the manner of an alternating current, but at random. The result is if there were a certain voltage acting in the circuit it does give rise to noise. An expression for the mean square of the agitation voltage has been derived on the supposition of random movement and it agrees fairly well with experiment.

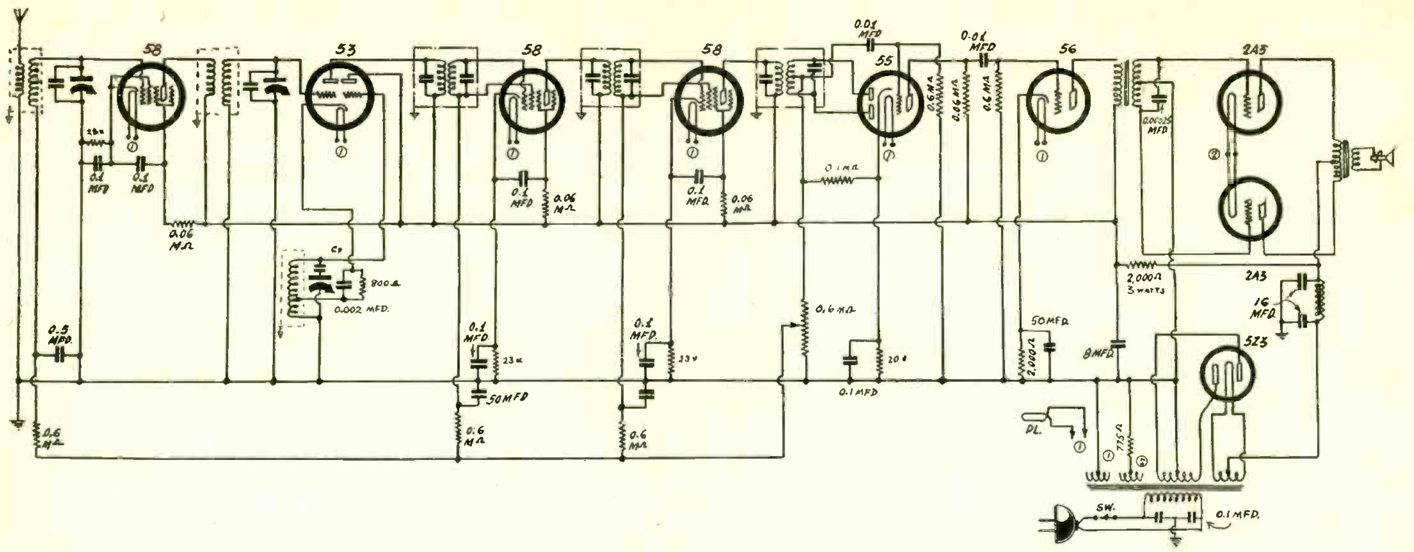
* * *

Change of Current with Signal

DOES THE AVERAGE plate current in a vacuum tube depend in any way on the signal or does it remain constant for all signal strengths? If it does depend on the signal, does it increase or decrease as the signal voltage increases?—A. G.

In a properly biased amplifier in which the d-c resistance of the grid circuit is negligible, the mean current increases because the currents corresponding to the positive half of each cycle are greater than those corresponding to the negative half. That is, an amplifier is in part a detector. If, however, there is a high resistance leak in the grid circuit as well as a stopping condenser, the reverse may be the case. For example, in

(Continued on next page)



The Hartley system of oscillation is used in this superheterodyne, where the 53 is the mixer. The cathode is led to a tap on the grid coil, and thus the plate and grid currents of one section are common through the tap, and feedback results. Also there is external coupling between the two sections due to the common cathode having an inductive load. The diagram illustrates the answer to J. T. H's. question on this page.

(Continued from preceding page)

a detector working on the leak and condenser principle, the plate current decreases as the signal increases.

* * *

The 53 as a Mixer

PLEASE SHOW the 53 tube as a mixer tube in a superheterodyne. Is additional coupling necessary, or is there enough in the tube between the two sections or units thereof?—J. T. W.

The diagram on this page shows the 53 as a mixer. There is usually enough coupling, consisting of that which is in the tube itself and the stray inductive and capacitive coupling due to proximity of connecting wires, coils, etc., and also incompleteness of shielding. The diagram shows one section of the 53 used as r-f input, the other as oscillator. External coupling is provided, however, by taking one-quarter the total number of turns from the ground end of the oscillator winding. The common cathode of the tube is led to a resistor, the other side of this resistor goes to the tap, while across the resistor is a bypass condenser. The tube will oscillate readily. The rest of the super circuit shown follows standard practice, there being a stage of t-r-f, a tuned input to the detector, a tuned oscillator, two intermediate amplifier stages, a full-wave 55 diode detector, three stages of audio (the last push-pull) and a rectifier. The first audio tube is the triode of the 55.

Pentagrid Tube

REGARDING the 2A7 and 6A7 tubes, please enumerate the grids etc. in respect to a circuit diagram, and clear me up on the method of connecting the return of the primary of the first i-f transformer through the oscillator plate winding.—H. T. D.

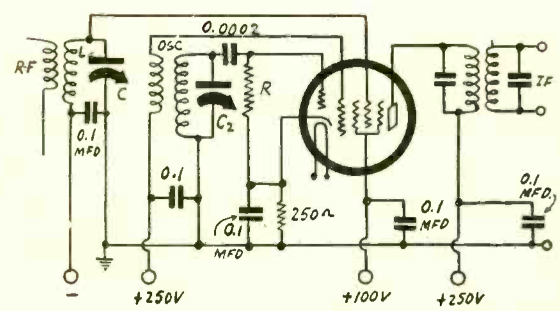
Look at the diagram at left on this page. The inverted U at bottom of the encircled elements represents the heater. To the left the hooked lead with the right-angle bend toward ground represents the cathode. The grid just above the cathode and the bend of the heater diagram is Grid No. 1 and is the oscillator control grid. To the right of this is Grid No. 2, to which a positive voltage is applied, and which may be called for convenience the equivalent of oscillator plate. Next to the right a straight line from the top has a zig-zag at bottom, and this is Grid No. 4, or r-f control grid. Surrounding this control grid (No. 4) and positioned between Grid No. 4 and the plate is the screen, which consists of two grids, interconnected in the tube, that is, the grid that encompasses the control grid (4) and the grid that separates the plate from 4. These two (screen) are Grids Nos. 3 and 5. The plate is the element represented by the parallelogram. Also, this complete diagram represents the more conventional method of hookup, R being 50,000 ohms or so. The method of leading the primary current of the first i-f transformer through the oscillator plate winding, with bypassed series resistor to reducing the screen voltage below any plate voltage, is shown at right.

* * *

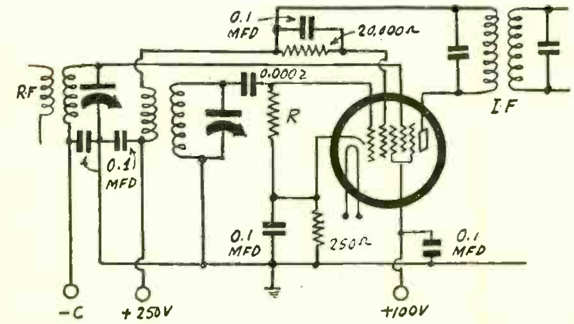
T-r-f Set Squeals

MY TUNED-RADIO-FREQUENCY set, using 58's, 57, 56 and 45's, with 80 rectifier, has a four-gang condenser, three stages of t-r-f and tuned detector input. However, there is considerable difficulty about oscillation, from 30 on the dial to 0, and sometimes also at other places. Please show remedial connections.—A. V. H.

Whether your r-f transformers are of the conventional type, primary and secondary, or have inductively isolated choke primaries, as in the diagram, with a turn or two used for capacity coupling, the tendency to oscillation can be reduced by increasing the biasing resistor in the first stage. The diagram on page 12 shows 1,500 ohms, the tube being a 57, but may be a 58 instead. Another method of approach is to increase or decrease the value of the bypass condenser across that biasing resistor. Usually decreasing it helps. For instance, the condenser may even be omitted from particularly unstable sets, or may be as small as 50 mmfd. If you use electrolytic condensers for B filtration, put a mica condenser of 0.006 mfd. or higher capacity between rectifier filament and ground or B minus (if B minus is not grounded) and a paper dielectric condenser of 0.5 mfd. in parallel



The 2A7 or 6A7 used in standard fashion. The 0.0002 mfd. condenser is the grid condenser, while R is the grid leak. Instead of 0.00025 mfd. it is permissible to use 0.00025 mfd. R should be around 50,000 ohms. The bias for the r-f control grid is supplied by the 250-ohm resistor. The bias for the oscillator results from grid current flow through the leak R. The identities of the various grids are pointed out in an answer.



Another way of using the B voltage supply, which is supposed to give somewhat better frequency stability than the method diagramed at left. Notice the post for 250 B volts. The return for the first i-f primary to this voltage is made through the plate winding of the oscillator. Since the screen voltage should be less than either plate voltage, the 20,000-ohm bypassed resistor takes care of this in a satisfactory manner.

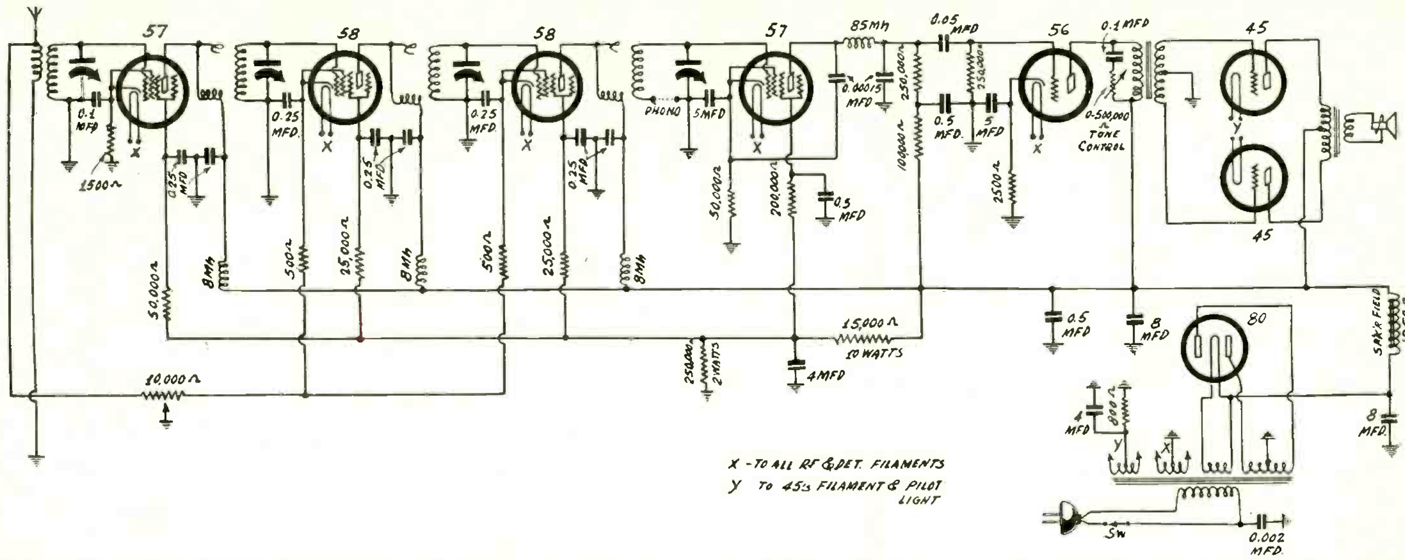
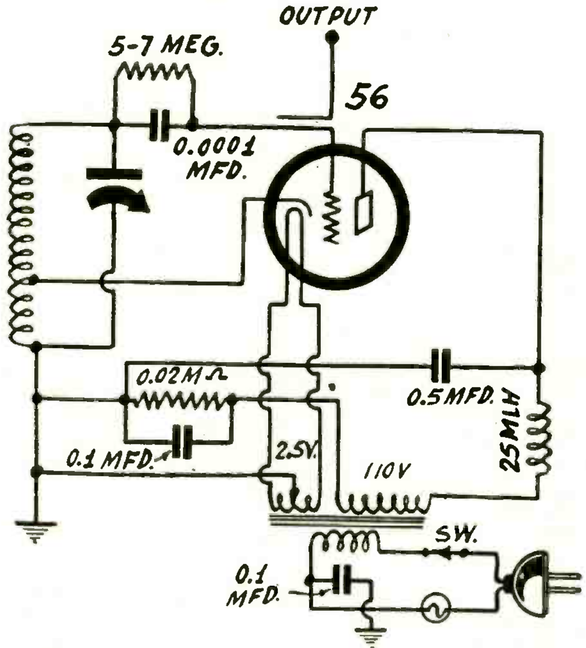


Diagram of an eight-tube tuned radio frequency receiver, to which reference may be had for prevention of oscillation. See improvement of this diagram, on page 12.



A simple test oscillator that, depending on the inductance of the tuned winding, may cover radio frequencies from the lowest to around 25 or 30 mc. A low-frequency oscillator may be used for general testing and lining up, including intermediate frequencies, while harmonics will serve for higher frequencies.

with the second electrolytic, as diagramed. With resistor-capacity filtration of the screen leads you should then have sufficient filtration and general bypassing to avoid any more oscillation trouble.

* * *

Test Oscillator

USING A 56 TUBE, what would be a suitable test oscillator, with a.c. on the plate?—W. O. G.

The diagram shows the circuit. If you desire to cover the broadcast band you may use an r-f coil intended for the capacity of tuning condenser you have, and calibrate against stations. If the coil is not tapped, use the primary as a tickler, by inserting it in series with the plate lead to the 25 mh choke. If no oscillation is present, reverse the tickler connections. For low frequencies r-f chokes may be used as tuning coils. One that is tapped somewhere near the center, inductance 25 mh, will go from 50 to 150 kc with 0.00035 mfd. A secondary of about 3,500 mh will tune from about 135 to 400 kc. Harmonics may be used for higher frequencies with such an oscillator, no matter how low the original frequency (fundamental) is. The output is sufficiently coupled by one of two parallel wires, one the grid lead (for a few inches) the other the extra wire close to it. The transformer, with 2.5 and 110-volt secondaries, is commercially obtainable.

* * *

Frequency Modulation

WHEN a broadcast wave is modulated by an audio signal of 5,000 cycles per second, does the carrier frequency vary by 5,000 cycles plus and minus the assigned frequency? If it does, how is this fact reconciled with the limitation that a station carrier must not deviate by more than 50 cycles plus or minus? If it does not, then how can the side band frequencies be 5,000 cycles plus and minus the carrier frequency?—W.B.L.

A good station now has crystal control of the frequency and it is arranged so that the modulation cannot in any way affect that frequency. A good station stays much closer to the assigned frequency than the limit set by federal regulation. Only the amplitude of the carrier varies at a rate 5,000 cycles per second. That is, the carrier amplitude rises and falls in value once in every 1/5,000th of a second. The theory of modulation is such that a wave modulated by 5,000 cycles is equivalent to three waves, one having the frequency of the carrier, one having the frequency of the carrier less 5,000 cycles, and the other carrier frequency plus 5,000 cycles. Sure, the station does send out the two side frequencies as well as the carrier. But it does not allow its frequency to vary.

* * *

Choking Up of Receiver

THE SIGNALS from my receiver are clear at times and at other times they are terribly distorted. The circuit seems to be choked up. What can account for this trouble?—S.B.

Presumably the trouble is one of grid bias on the detector or one of the audio tubes. Perhaps a grid is open. If there is a break in a grid leak this would account for the trouble. If the detector is diode biased it may be that the bias on strong signals is so great that the plate current in the triode is cut off. It is also possible that something happens to the plate voltage of one of the tubes. If a plate voltage falls greatly and the bias on that tube is not changed, the same conditions of choking would result.

* * *

Test for Grid Current

PLEASE EXPLAIN a quick method for determining whether or not grid current flows in a vacuum tube.—E.R.W.

If grid current is suspected it can be detected indirectly by its effect on the plate current. Put a milliammeter in the plate circuit and note the current. If there is a grid leak in the grid circuit, short it and again note the plate current. If there is grid current the plate current increases. If there was no grid leak insert one before noting the plate current the first time and then the same test can be applied.

* * *

Microwaves

WHAT ARE the shortest electromagnetic waves that have been generated and what were their wavelengths?—R.S.

The shortest radio waves ever generated were produced by Madam Glagowela-Arkadiewa of Poland in 1924 and ranged in lengths from 0.008 to 0.5 centimeters. These waves are so short that they enter into the region of heat waves.

* * *

Intermediate for Short Waves

WHAT INTERMEDIATE frequency would you recommend for a short-wave superheterodyne that is to tune down to the 20 meter region? Is it better to use 175 kc or frequency more nearly equal to the broadcast frequencies?—J.E.F.

Just what intermediate frequency is selected is not of great importance, but it may be better, all things considered, to use a frequency around 450 kc. This is not too high for the frequencies immediately above the broadcast band and it is not too low for those of the 20-meter region. If, however, the frequencies immediately above the broadcast band are not to be received, the intermediate may be as high as 1,500 kc. When a low intermediate frequency is used there is not so much difficulty to make the radio frequency tuner track with the oscillator. But then there is not so much radio frequency selection, either. The latest broadcast superheterodyne frequency, namely, 456 kc, is all right for a short-wave receiver, and it has the advantage that suitable intermediate frequency transformers can be obtained easily.

The Review

Questions and Answers Based on Articles Printed in Last Week's Issue

Questions

1. Can a large power tube be driven by a small tube, such as the 37, 56, 57 and 77? If so, what would be the general nature of the B voltage requirement? Why?

2. What sort of a tube is the 845, what B voltage does it require, and what should the negative bias be at a particular B voltage?

3. In a short-wave set, about what should be the value of an r-f choke coil to prevent radio frequencies from entering the audio channel? What is the main purpose of the choke?

4. Is the 53, in any manner of connection, a suitable driver for the 2A3? Give the reason for your answer.

5. What is a good way of connecting a potentiometer across the secondary of an audio transformer to constitute a volume control? Compare the difference between using a potentiometer in that way and using the same element as a rheostat where the secondary is directly grounded.

6. Can an audio choke coil provide a suitable load in the plate circuit of the 57? If so, what advantage does the choke have, compared to a resistor?

7. When a potentiometer is placed across a heater winding or filament winding of a transformer arm to B minus, why does one setting produce minimum hum, practically inappreciable, while other settings introduce much hum?

8. A grid leak of 1.0 meg. is used with a stopping condenser of 0.1 mfd. What is the time constant of the circuit and what is the low-frequency amplification point where the intensity is about as great as at, say, 100 cycles?

9. Why is a bypass condenser connected across a biasing resistor of a single tube, and why not across the biasing resistor of a pair of push-pull tubes, where the plate current of those two tubes exclusively provides the voltage drop through the resistor?

10. What may be the output from two 48 tubes worked in push-pull, where the plate voltage is limited by the 110-volt d-c line? Mention suitable tubes and type of coupling for a three-stage audio amplifier, including such output arrangement.

11. In a d-c set, using electrolytic condensers, why is it important to connect the plug to the convenience outlet in only one way?

12. How is a padding condenser usually connected in relation to the section of a gang condenser used for tuning the oscillator?

13. State the connections of the 56 used as a diode to drive 59's in push-pull, using resistance coupling and stopping condensers.

14. State two reasons for a stage of amplification in a quality test oscillator.

15. Taking a grid current oscillator of the usual type, with leak and condenser, state what effect capacity has on frequency stability.

16. Consider a neon lamp connected across the oscillator grid circuit. How may the glow be interpreted in terms of frequency stability and amplitude stability?

17. What is the advantage of an auxiliary oscillator that covers at least part of the broadcast band, in conjunction with a test oscillator of wide frequency coverage?

18. Using the 56 or any other tube as a peak voltmeter, what is the starting plate current requirement, how is the adjustment made when calibrating, must the a. c. be known, and what is the difference in procedure when calibrating for rms?

19. Considering the modulation as a single tone, and assuming that the peak value of a carrier can be read with and without modulation, what is the formula for effective percentage modulation?

20. State two remedies for dead spots in a short-wave receiver?

21. In a constant-gain transformer, is the input voltage always the same or is the coupling always the same?

22. Can twisted pair be used as leadin for transposition purposes? State connections.

23. In a universal set, is it necessary to use a rectifier tube?

24. How high voltages may be in the grid circuit of a normal test oscillator?

25. Can a circuit have a negative resistance? Why?

Answers

1. A large power tube can be driven by a small tube, if the B voltage applied to the small tube is high enough, say, around 500 volts, with suitably proportioned negative bias on the small tube. The high plate voltage is necessary because that voltage always should be higher than the voltage of the pulsating d. c. in the plate circuit, preferably about twice as large.

2. The 845 is a high-powered triode output tube, capable of more than 40 watts output in push-pull, negative bias 155 volts at 1,000 volts applied in the plate circuit.

3. An r-f choke coil to prevent radio frequencies from flowing from detector to audio channel should have an inductance of 10 millihenries or higher. The main purpose of a choke is to offer a low d-c path but a high impedance to the radio frequencies.

4. The 53 is not particularly suitable for driving a 2A3, whatever connection is used, because the output will not come near enough to the quantity permitted by the negative bias on the 2A3, which may be around 50 volts.

5. A good way of connecting a potentiometer across the secondary of an audio transformer is to put one extreme of the potentiometer to one extreme of the secondary, other extreme of the potentiometer to other extreme of the secondary, and connect the arm to ground through a bypassed high resistance. This is better than using the grounded rheostat method because a rheostat shorts the secondary proportionate to the volume reduction and thus introduces distortion of low notes particularly.

6. Yes, an audio choke can present a suitable load to the 57 plate circuit if of high enough inductance. An advantage of this method is that the effective plate voltage remains substantially unchanged, since the choke has a low d-c resistance, whereas by resistance coupling the effective plate voltage changes greatly due to the high d-c resistance path. Voltage gain may be practically uniform over the usual audio scale due to the constancy of effective plate voltage by the choke method.

7. The potentiometer across a filament winding permits ready means of finding the electrical center of the winding, where the hum voltage is absent or minimum.

8. The time constant is the product of the resistance in ohms and the capacity in farads, or 1,000,000 x 0.000,000,1 equals 0.1. The lowest frequency of uniform response is the reciprocal of the time constant, or 1/0.1, equals 10/1 or 10. Therefore, the response at 10 cycles would be as great as that at 100 cycles or other frequency sensibly related to the lower limit.

9. A bypass condenser is put across the biasing resistor to prevent negative feedback. In push-pull this condenser may be omitted because at any instant the signal current through the resistor is zero in a symmetrical circuit.

10. The output of two 48's in push-pull may be 4 watts. For three-stage audio, a first and a second 37 tube, transformer coupling, the last 37 feeding the push-pull tubes, would be suitable.

11. Because if electrolytic condensers are connected the wrong way large current flows through them, the capacity is practically shorted, and the ruin of the condenser for further use is likely because the plates of the condenser lose their formative voltage.

12. The padding condenser is connected in series with the gang section, between the stator of the gang and the "high" terminal of the tuned coil.

13. The 56 as a diode preferably should have plate tied to cathode, this combination serving as cathode, while the grid is the diode anode. The r-f input is between anode (grid) and one side of a load resistor, the other side of which resistor goes to cathode. Stopping condensers between both sides of the load resistor are connected to equal leaks in the grid circuits of the power tubes.

14. A stage of amplification in a test oscillator is useful because it increases the oscillation voltage without overtaxing the oscillator proper, and also because it puts a tube between the oscillator and the output, and thus renders the frequencies of the test oscillator virtually immune from change due to various loads introduced by the tested circuit.

15. High capacity in the tuned circuit improves frequency stability.

16. The glow, if steady, denotes amplitude stability. This does not necessarily mean frequency stability, but when there is frequency instability there is considerable shifting of amplitude, so a steady amplitude is an excellent frequency sign.

17. The auxiliary oscillator enables ready beats with broadcasting stations so these accurate carriers may be used as standards of reference.

18. When a tube is to be calibrated as a peak voltmeter the procedure is to reduce the plate current, by high negative bias, until it is so small that it practically can not be read on the sensitive d-c meter you will use as indicator in the plate circuit. The a. c. is applied, and then the bias is increased, preferably by batteries, until the plate current drops again to its nominal cutoff value. The difference in bias voltage equal the peak voltage of the a. c. For rms calibration an average operating point is selected for bias, with usual plate current, and the effect of the a. c. is noted in the plate circuit d. c. milliammeter. The a. c. input has to be known in rms values for the rms calibration, but not for the peak test, or, to obtain rms values approximately correct, rms values may be taken as 0.707 of the peak.

19. The formula for effective percentage modulation, or, since a single tone is concerned, also percentage modulation is

$$M\% = 100 \left(\frac{Em}{E} - 1\right)$$

where Em is the reading taken with modulation applied and E is the reading taken with modulation removed, both peak values.

20. Increase the value of the grid leak and use a small series condenser in the antenna circuit.

21. The coupling is always the same. The input amplitude may vary just as in any other system.

22. Yes. Since the twisted pair consists of insulated wire, at the roof one terminal of one wire is connected to aerial as usual, and other terminal of that same wire, at the set, to the antenna post. The other wire is grounded at the roof and connected at the set to the ground post, which post is grounded separately to a cold water pipe. This constitutes transposed lead-in or so-called noise-reducing antenna.

23. Yes.

24. The voltage usually changes considerably but may be around 85 volts or so over part of the tuning scale, particularly in the lower frequency region of tuning.

25. A circuit can have a negative resistance because the higher the current through it the lower the voltage drop, or because the voltage drop is constant though the current increases.

Station Sparks

By Alice Remsen

CALL IT WHAT YOU WILL!

Radio is becoming quite a racket. The majority of successful radio artists have a manager, publicity man, secretary, chauffeur and coach, and so everybody wishing to get into radio, even the smallest of sustaining artists, must have a manager; every potential radio star—from three years old and up, must be exploited by a publicity man, and mothers, eager to see their offspring in the money, pay out hard-earned cash for a line here and there—and pay out more so that their little darlings may learn to warble hi-de-ho's and wah-wah-wah's in the regular radio manner. Talent doesn't matter so much; in these days it's "Have you a manager?" and "Whom do you know?" So, dear readers, when you listen in to some painfully excruciating voice—don't blame the poor singer; blame the manager, who, after all, must make his own bread and butter, too; but it is a fact that to obtain even an audition is almost impossible unless the artist has someone to speak for him, and the manager is of no use to the artist unless he has good connections—meaning friends at the station or in the advertising agency; yes, it's getting to be quite a racket. A few years ago nobody paid much attention to radio, it was the poor relation of vaudeville and pictures—now it's playing the role of the rich uncle.

ONE COMEDIAN AND ONE SINGER

And speaking of uncles reminds me that Ed Wynn is back on the Texaco program talking about his uncle; heard his initial broadcast of this season and must say that he came back stronger than ever with some excellent comedy material. . . . John McCormack, the famous Irish tenor, who is now heard in an NBC song series from New York, has a lot of fun in the studio during his rehearsals; he imitates Russ Columbo, Phil Harris and other popular singers of the radio. "How'd you like to hear a little Columbo?" he asks, breaking out into a throaty bub-bub-a-bub-bub or a noisy vo-dodeedeedo! He even imitates the women singers of the air and throws the orchestra into hysterics with his grimaces and funny vocal gymnastics, but once the tenor has launched into his own program he is seriousness itself. A great fellow, McCormack! . . . The Maxwell House Showboat program players celebrated its first anniversary on the air recently; they held a party at the Hotel Montclair, New York, from which spot the program was broadcast; Bill Scotti, the Montclair maestro, played the host. . . . Ralph Kirbery, NBC baritone, flew to Cleveland immediately after his midnight program one night last week; he gave an audition there the next morning at nine o'clock and flew back again immediately. . . . A program worth while on WABC is "Harlem Serenade" each Thursday at 8:30 p. m., starring Aida Ward, the Hall Johnson choir and Claude Hopkins Orchestra. . . . Irving Kaufman has been rediscovered; it is this versatile radio veteran who plays the dual roles of "Lazy Dan, the Minstrel Man" and "Mr. Jim," Lazy Dan's boss, over the WABC-Columbia air-waves; Irving is a miracle man when it comes to singing and talking to himself in various voices. . . . The second series of "The Parade of the Champions" started on WABC, November 11th. George Gershwin, Helen Morgan, Harry Richman, Kate Smith and Morton Downey are the personalities selected to appear on the programs. Several orchestras will be heard—William Merrigan Daly's, Willard Robison's, Vincent Lopez's, Jacques Renard's and Jack Miller's. . . . It will be George Hall's music to which the Duponts and their guests will dance on December 1st. . . . Vivien Ruth, the new Happy Wonder Bakers soloist, was born in Passaic, New Jersey.

IRVING MILLS GETS WILL HUDSON

Irving Mills announces that he has just signed a contract giving him the exclusive services of Will Hudson, phenomenal writer and arranger of hot tunes; Will was on a pleasure trip to New York from his Detroit home when Cab Calloway whispered to Irving Mills about the unusual work of this writer. Irving Mills lost no time—a telephone call—an appointment— a hearing—and now the contract, which means that Will Hudson will be around New York contributing his music to radio for some time to come. . . . The gentle and dignified character of "Maria" in the Maxwell House Showboat program is played by Irene Hubbard, who is a cousin of the late Elbert Hubbard, the famous essayist; her mother was a Russian and her father an Englishman, a Cornishman, to be exact; Miss Hubbard lived in both England and Russia, but was schooled at Vassar; she made her debut on the stage with the famous Ben Greet Players, and has played many roles, from Portia to Tondelaya—which you might say is going some—and from Lady Macbeth to Sadie Thompson, than which nothing can be more dissimilar. . . . It's round-up time in Texas, not the cattle herding, branding, hot, dusty, tiresome work on the open ranges, but the herding of friends, relatives and scholars at the University of Texas for the awarding of diplomas, which ceremony will be broadcast over Station WSM, of Nashville, Tennessee. . . "The Romance of Helen Trent" is the title of a new serial, now heard five times weekly over a coast-to-coast WABC-Columbia network each Monday, Tuesday, Wednesday, Thursday and Friday, at 2:15 p.m. EST; originating in Chicago and sponsored by Edna Wallace Hopper, Inc.; the serial portrays the story of a thirty-five-year-old divorcee, Helen Trent, whose husband has deserted her for the love of a younger woman; Virginia Clark plays the role of Helen Trent; Karl Huebl, her divorced husband, Martin; Lester Tremaine portrays the role of her old admirer, Grant Douglas. . . . A new anthology of poems is on the market, titled "Poet's Gold," it is published by Macauley and contains selections compiled by David Ross, Columbia's poet-announcer; the poems will favor the recitationist rather than the individual reader —so if you yearn to recite poetry, purchase a copy of "Poet's Gold."

DALY WITH CBS

William Merrigan Daly is another former NBC artist to go Columbia; it is to Mr. Daly's facile fingers that Columbia has entrusted the baton which will direct the twenty-five-piece orchestra to be heard in the weekly broadcasts centered around Byrd Antarctic Expedition, every Saturday evening at 10:00 p. m., EST, beginning November 18th. . . . An ex-Army corporal is the most recent addition to the Columbia artists' staff; he is Arthur Herbert, a personable young man who sings tenor, and is adept at the piano, guitar, saxaphone and drums; he is heard on the "Metropolitan Parade" in the mornings, and "Manhattan Moods" on Wednesday afternoons. . . . And so Columbia has publicly announced a veto on the advertising of whisky, gin or other hard liquors; it will advertise both wine and beer —but no hard liquor, rather a queer quirk; but that means nothing; if you remember, it was only recently that patent medicines were allowed to share space in the sacred precincts of radio—and how they do advertise! . . . On the first test of the short wave connection between Columbia and KJTY, the station aboard the good ship Jacob Ruppert, of the Byrd Expedition, it was discovered that John N. Dyer, CBS engineer aboard the Ruppert, was seasick. . . . Norm Sherr, CBS Chicago pianist, once conducted a band of five pieces for the Emperor of Japan. . . . November 17th is the date on which Fred Waring's Pennsylvanians will play for the prom of the University of Pennsylvania. . . . Bing Crosby and Lennie Hayton were supposed to arrive in New York before this writing, but have not yet finished their picture assignment in Hollywood.

BIG NAMES AT WMCA

WMCA of New York is getting to be quite a station, a great many celebrities have been heard recently over their air-waves; the latest is Erno Rapee, director of the Roxy Orchestra, who was guest on the Mana-Zucca soiree; on the same program were John Kelvon and Gloria LeVey. Another celebrity to be heard on this up-and-coming station is Mary Lewis, the operatic star, who has been studying "mike" technique in order to give perfect radio programs; Harold Hansen, tenor, is heard with Miss Lewis each Monday night on WMCA. . . . Rather chilly at this moment—so here goes for a cup of nice hot tea and then the trek to New York.

NBC Restores Salaries That Were Cut 10%

The National Broadcasting Company restored a ten per cent. salary cut to its employees. All employees who were on the payroll as of April 1st, 1933, when the last salary reduction was made, received the salary increase.

A THOUGHT FOR THE WEEK

STEPHEN COLLINS FOSTER, who died almost forgotten some decades ago, has been brought back to life in a measure, by the recent NBC series of Foster programs by John Tasker Howard, musical critic and author. Of course, America's most beloved song writer has never quite been out of the public mind, for whenever "Swanee River" and other American folk-songs have been sung his name has come to the thoughts of many. Yet to the average person the name of Foster has not been so familiar as to make it eloquent of the man who spent so much of his life in the shadows of the Bowery. Mr. Howard has received so heavy a fan mail about his NBC series that he has decided to write a definitive book on Foster as a personality and the writer of so many of our moving native songs. Thomas Y. Crowell Company will publish the book early in January and at last we shall know the song writer and his struggles through the work of a sympathetic pen.

INDUSTRY ACTS TO KEEP LIVELY UPSWING GOING

Organized effort to continue in 1934 the increased volume of radio sales was planned for the industry by the Radio Manufacturers Association board of directors at a meeting in Chicago. President Fred D. Williams called the association's directors to consider plans especially designed to promote mid-winter radio selling and stimulate early spring business. Following up the marked increase in radio business this fall, the RMA plans several activities designed to keep up the radio sales curve after the holidays and through the spring months.

The annual RMA trade show was omitted in 1933, but there is agitation for its restoration in 1934.

The National Recovery plan and results of the Electrical Code also were considered. New radio and tax legislation in prospect when Congress reconvenes in January were other matters before the Association's governing body. Revision of the federal excise taxes, following prohibition repeal, are an immediate concern of the RMA Board, to make plans for future action on behalf of radio interests.

Code Working Well

Initial operation of the NRA code has been effected in the radio industry with a minimum of difficulty. Questionnaires and labor reports were distributed during October by the code supervisory agencies, Arthur T. Murray, code supervisor for receiving set manufacturers; E. T. Cunningham, B. G. Erskine and H. W. Harper, comprising the code agency for tube manufacturers, and Leslie F. Muter, the code supervisor for radio parts and accessory manufacturers. RMA members and also many non-members received and transmitted the various reports required under the code by National Electric Manufacturer Association, the general code authority.

For radio set manufacturers, the "open price" plan, providing for exchange and publication of set manufacturers' prices and discounts, was instituted on a broad scale.

Forms for October labor reports will be received by radio manufacturers in time for submission by November 20.

Wholesalers Heard From

Several codes in which radio manufacturers are interested were further considered by the NRA at Washington during October but none was developed sufficiently to be set for hearing. The proposed code of the Radio Wholesalers Association has been further revised in conference with the NRA and Benjamin Gross, chairman of the Wholesalers Code Committee, has also been in conference at Washington on the NRA problem of possibly developing a general code for wholesaling.

A revised code also has been submitted to the NRA by the Institute of Radio Service Men. Kenneth L. Hathaway, secretary of that association, is continuing negotiations with the Washington authorities.

Radio Taxes

The Internal Revenue Bureau reports collections during September, 1933, of the federal 5 per cent excise tax on radio and phonograph records amounting to $147,930.49 as compared with $165,710.65 in September, 1932.

The September collections on mechanical refrigerators were $394,596.53 as against $107,063.30 in the same month last year.

TRADIOGRAMS

By J. Murray Barron

Wholesale Radio Service Co., Inc., opened a branch at 219 Central Avenue, Newark, N. J. This store will carry a complete line of replacement parts of the leading manufacturers. There also will be special departments for short-wave and broadcast receivers and public-address systems. Mail orders will be filled from the New York City office at 100 Sixth Avenue.

* * *

That there is big activity in short-wave receivers has been demonstrated the past month at the Hammarlund Mfg. Co., 424 West Thirty-third Street, N. Y. City. Notwithstanding the additional help taken on under the NRA code, and the general increased activities at this time of the year, production was behind, but is now showing up better. All deliveries are promised for the holidays, but new orders should not be held off too long.

* * *

At a recent meeting of the New York Chapter of the Short-Wave Club, held at Fifteenth Street and First Avenue, N. Y. City, first lessons in code were given. The code machine was loaned by Blan the Radio Man.

* * *

All servicemen should be interested in the vest-pocket volume control guide issued free by Electrad Inc., 175 Varick St., N. Y. City.

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The 1934 dual-wave and all-wave sets, as well as exclusively short-wave receivers, are now being distributed by Fanning Radio Labs., 377 Eighty-seventh Street, Brooklyn, N. Y. There is a free illustrated booklet.

* * *

A display of the Moderne Midget, with chromium fittings, is being made at the 61 Cortlandt Street store of Walter H. Nussbaum. A very strong appeal is made by this type of set, judging by the public's response.

* * *

D. T. Siegel, general manager, Ohmite Manufacturing Co., 636 N. Albany Ave., Chicago, Ill., manufacturers of electrical resistance units and rheostats, announces that the company has appointed Sylvan Ginsbury, 86 Rue Du Pelican, Antwerp, Belgium, as its European sales representative. Mr. Ginsbury, who also has New York offices, will handle the products of both the radio and industrial divisions of the Ohmite Company. Ohmite has a new line of center-tapped low-wattage radio resistors, of the same construction as the Wirewatt resistors, with the exception of the center terminal lug.

CORPORATION ACTIVITIES

CORPORATION REPORTS

Electrical and Musical Industries. Ltd.—Total income for year ended Sept. 30, 1933: £82,648. Net profit for the year, after deduction of £79,738 for salaries, wages, depreciation and sundry fees, and £2,008 for directors' fees, £902, which, with £2,314 balance brought forward from preceding year, made a credit balance of £3,216. Directors stated inability to recommend payment of any dividend on the preference stock which has been unpaid since the July, 1932, and disbursement was omitted.

BANKRUPTCY PROCEEDINGS

Petitions Filed Against

Amalgamated Broadcasting System, Inc., 501 Madison Ave., New York City, by Handi-Man Co., Inc., for $800; Perry Ruling and Binding Co., Inc., for $500; Rite Printing Service, Inc., for $200.

Receivers Appointed

Amalgamated Broadcasting System, Inc., 501 Madison Ave., New York City. Judge Bondy appointed The Irving Trust Co. Assets, about $10,000; liabilities, about $50,000.

Bankruptcy Schedules

Emro Radio Products Corp., 145 Hudson St., New York City. Assets, $42,618, principal item being stock, $40,000; liabilities, $12,233.

ABS PETITIONED IN BANKRUPTCY

The Amalgamated Broadcasting System, Inc., was petitioned in bankruptcy by three creditors, and the Irving Trust Company was appointed receiver. The offices of ABS are at 501 Madison Avenue, New York City. This is the intended chain of which Ed Wynn, the comedian, was president and principal backer, but he withdrew a few weeks ago.

ABS intended to have chains of local stations and present programs of unusual merit. In and around the Middle Atlantic States the System had stations associated with it, and started its career a couple of months ago after many months of preparation.

Wynn, interviewed after he resigned from the presidency and from all connection with the corporation, said that he had bought stock and also loaned money, but refused to give figures.

"My stage role of 'The Perfect Fool' still applied," he explained.

The System had assembled a staff of artists and was seeking sponsors. Wynn said that one of the reasons why he withdrew was that no sponsors for programs had been signed up. There were eight announcers, as well as a complete office and mechanical staffs. The conduct of the station is now in the hands of the trust company and an announcement about further plans is expected. The assets and liabilities have not yet been disclosed.

McCLELLAND RESIGNS FROM NBC

George F. McClelland resigned as vice-president in charge of sales of the National Broadcasting Company. He said he intended to enter the radio broadcasting business in an independent capacity.

STORES DOING BETTER

Business picked up in the Cortlandt Street stores following the New York Municipal election, after a disappointing pre-election business.

Literature Wanted

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

Harry S. Lillie, Box 1048, Avalon, Catalina Island, Calif.
Robert Vaughan (W8KJZ), 69½ Dudley St., Akron, Ohio.
W. S. Gilford, P. O. Box 1011, Lake Providence, La.
Louis A. Thompson, 2930 West View St., Los Angeles, Calif.
Jos. Belick, 65 Front St., Coplay, Pa.
Ernest F. Davis, 806, Bellflower, Calif.
John F. Miller, 1020 Allen St., Allentown, Penna.
Paul A. Peterson, 1815 W. 39th Place, Los Angeles, Calif.
A. X. Kovlan, Nutter Fort, W. Va.
Donald Byron Morse, Middlesex Road, Moretown, Vermont.
John Bush, Jr., 246 Burgess Place, Passaic, N. J.
John S. Tamashiro, Waimea, Kavai, T. H.
Walter R. Fritz, 907 Journal Bldg., Portland, Ore.
Major R. R. Newman, Station Hospital, Fort Devens, Mass.
W. Allder, North American Distributors, 516 Howe St., Vancouver, B. C., Canada.
B. T. Himes, P. O. Box 1287, W. Palm Beach, Fla.
W. E. McGillivray, 201 Osberne St., Winnipeg, Canada.
A. Voris, 716 Main St., Daytona Beach Peninsula, Fla.
Ken. Williams, Ken's Radio Service Lab., 115 West 1st St., Reno, Nev.
R. D. Speers Co., 329 West 3rd St., Davenport, Iowa.
Paul Grass, 1085 Annette Ave., Montreal, P. Q., Canada.
W. D. Highfill, 38 Capitol Sq., S. W., Atlanta, Ga.
Earl Scoville, 1053 Court St., Medford, Ore.
R. H. Bauman, 205 Liberty St., Batesville, Ind.
D. T. Jenkins, 35 Palm Ave., Los Gatos, Calif.
E. Knittel, 3343 158th St., Flushing, N. Y. City.

STATIONS BY FREQUENCIES

United States, Canadian, Newfoundland, Cuban and Mexican Transmitters Listed

Corrected to November 8th, 1933

The stations listed herewith are in the order of frequencies, with equivalent wavelengths given. The call, location, owner, and power are stated. The location is that of the main studio, for United States stations. If the transmitter is located elsewhere it is indicated additionally, preceded by T. The power given is the licensed maximum. Some stations use maximum power in daytime only. These are identified by an asterisk after the power figure (*). Usually in such cases the night power is half the day power. CP means construction permit, license awaited.

—EDITOR.

(*Concluded from last week's issue, November 11th*)

1310 KILOCYCLES—228.9 METERS

WEBR—Buffalo, N. Y.; Howell Broadcasting Co. (Inc.); 250 W.*
WMBO—Auburn, N. Y.; WMBO, Inc.; 100 W.
WNBH—New Bedford, Mass.; T—Fairhaven, Mass.; Irving Vermilya, trading as New Bedford Broadcasting Co.; 100 W.
WOL—Washington, D. C.; American Broadcasting Co.; 100 W.
WGH—Newport News, Va.; Hampton Roads Broadcasting Corporation; 100 W.
WEXL—Royal Oak, Mich.; Royal Oak Broadcasting Co.; 50 W.
WFDF—Flint, Mich.; Frank D. Fallain; 100 W.
WBEO—Marquette, Mich.; Lake Superior Broadcasting Co.; 100 W.
WHAT—Philadelphia, Pa.; Independence Broadcasting Co.; 100 W.
WTEL—Philadelphia, Pa.; Foulkrod Radio Engineering Co.; 100 W.
WJAC—Johnstown, Pa.; Johnstown Automobile Co.; 100 W.
WFBG—Altoona, Pa.; William F. Gable Co.; 100 W.
WRAW—Reading, Pa.; Reading Broadcasting Co.; 100 W.
WGAL—Lancaster, Pa.; WGAL, Incorporated; 100 W.
WSAJ—Grove City, Pa.; Grove City College; 100 W.
WBRE—Wilkes-Barre, Pa.; Louis G. Baltimore; 100 W.
WKBC—Birmingham, Ala.; R. B. Broyles, trading as R. B. Broyles Furniture Co.; 100 W.
WTJS—Jackson, Tenn.; Sun Pub. Co.; 100 W.
WTRC—Elkhart, Ind.; Elkhart Daily Truth; 50 W.
WROL—Knoxville, Tenn.; Stuart Broadcasting Corporation; 100 W.
KRMD—Shreveport, La.; Radio Station KRMD, Inc.; 100 W.
WSJS—Winston-Salem, N. C.; Winston-Salem Journal Co.; 100 W.
KFPM—Greenville, Tex.; Dave Ablowich, trading as The New Furniture Co.; 15 W.
KTSM—El Paso, Tex.; Tri-State Bdcstg Co., Inc.; 100 W.
WDAH—El Paso, Tex.; Tri-State Bdcstg Co., Inc.; 100 W.
KFPL—Dublin, Tex.; C. C. Baxter; 100 W.
KFXR—Oklahoma City, Okla.; Exchange Avenue Baptist Church; 250 W.*
WCLS—Joliet, Ill.; WCLS (Inc.); 100 W.
WKBB—Joliet, Ill.; Sanders Brothers Radio Station; 100 W.
KFGQ—Boone, Iowa; Boone Biblical College; 100 W.
KGFW—Ravenna, Nebr.; Central Nebraska Broadcasting Corporation; 100 W.
WBOW—Terre Haute, Ind.; Banks of Wabash (Inc.); 100 W.
WLBC—Muncie, Ind.; Donald H. Burton; 50 W.
KGBX—St. Joseph, Mo.; KGBX (Inc.); 100 W.
KFBK—Sacramento, Calif.; James McClatchy Co.; 100 W.
KCRJ—Jerome, Ariz.; Charles C. Robinson; 100 W.
KGCX—Wolf Point, Mont.; First State Bank of Vida; 250 W.*
KGEZ—Kalispell, Mont.; Donald C. Treloar; 100 W.
KMED—Medford, Ore.; Mrs. W. J. Virgin; 100 W.
KXRO—Aberdeen, Wash.; KXRO (Inc.); 100 W.
KIT—Yakima, Wash.; Carl E. Haymond; 100 W.
KFYO—Lubbock, Tex.; Kirksey Bros.; 250 W.
WIAS—Iowa Bdcstg Co., Ottumwa, Ia.; 100 W.

1320 KILOCYCLES—227.1 METERS

WADC—Akron, Ga.; Allen T. Simmons; 1 KW.
WSMB—New Orleans, La.; Saenger Theatres (Inc.) and Maison Blanche Co.; 500 W.
KID—Idaho Falls, Idaho; KID Broadcasting Co.; 500 W.*
KGHF—Pueblo, Colo.; Curtis P. Ritchie and Joe E. Finch; 500 W.*
KGMB—Honolulu, Hawaii; Honolulu Broadcasting Co. (Ltd.); 250 W.

1330 KILOCYCLES—225.4 METERS

KMO—Tacoma, Wash.; KMO, Inc.; 250 W.
WDRC—Hartford, Conn.; T—Bloomfield, Conn.; WDRC (Inc.); 500 W.
WSAI—Cincinnati, O.; T—Mason, Ohio; Crosley Radio Corporation (lessee); 1 KW.*
WTAQ—Eau Claire, Wis.; T—Township of Washington, Wis.; Gillette Rubber Co.; 1 KW.
KSCJ—Sioux City, Iowa; Perkins Brothers Co.; 2½ KW.*
KGB—San Diego, Calif.; Don Lee, Inc.; 500 W.

1340 KILOCYCLES—223.7 METERS

WSPD—Toledo, Ohio; Toledo Broadcasting Co.; 1 KW.
WCOA—Pensacola, Fla.; Pensacola Bdcg. Co.; 500 W.
KFPY—Spokane, Wash.; Symons Broadcasting Co.; 1 KW.
KGDY—Huron, S. Dak.; Voice of S. Dak., 250 W. (CP).

1350 KILOCYCLES—222.1 METERS

WAWZ—Zarephath, N. J.; Pillar of Fire; 250 W.
WBNX—New York, N. Y.; Standard Cahill Co. (Inc.); 250 W.
KWK—St. Louis, Mo.; T—Kirkwood, Mo.; Greater St. Louis Broadcasting Corporation; 1 KW.
WEHC—Emory, Va.; Emory & Henry College; 500 W.
KIDO—Boise, Idaho; Boise Broadcasting Station; 1 KW.

1360 KILOCYCLES—220.4 METERS

WFBL—Syracuse, N. Y.; Onondaga Radio Broadcasting Corporation; 1 KW
WQBC—Vicksburg, Miss.; Delta Broadcasting Co. (Inc.); 500 W.
WCSC—Charleston, S. C.; South Carolina Broadcasting Co., Inc.; 500 W.
WGES—Chicago, Ill.; Oak Leaves Broadcasting Station (Inc.); 1 KW.*
KGER—Long Beach, Calif.; Consolidated Broadcasting Corp.; 1 KW.

1370 KILOCYCLES—218.7 METERS

WODM—St. Albans, Vt.; A. J. St. Antoine and E. J. Regan; 100 W.
WLEY—Lexington, Mass.; Carl S. Wheeler, trading as Lexington Air Stations; 250 W.*
WSVS—Buffalo, N. Y.; Elmer S. Pierce, principal, Seneca Vocational High School; 50 W.
WCBM—Baltimore, Md.; Baltimore Broadcasting Corporation; 250 W.*
WBTM—Danville, Va.; L. H., R. G. and A. S. Clarke, doing business as Clarke Electric Co.; 100 W.
WLVA—Lynchburg, Va.; Lynchburg Broadcasting Corporation; 100 W.
WHBD—Mount Orab, Ohio; F. P. Moler; 100 W.
WHDF—Calumet, Mich.; Upper Michigan Broadcasting Co.; 250 W.*
WJBK—Highland Park, Mich.; James F. Hopkins (Inc.); 100 W.
WIBM—Jackson, Mich.; WIBM (Inc.); 100 W.
WRAK—Williamsport, Pa.; Clarence R. Cummins; 100 W.
WHBQ—Memphis, Tenn.; Broadcasting Station WHBQ (Inc.); 100 W.
KCRC—Enid, Okla.; Enid Radiphone Co.; 250 W.*
WMBR—Tampa, Fla.; F. J. Reynolds; 100 W.
KMAC—San Antonio, Tex.; W. W. McAllister; 100 W.
KFJZ—Fort Worth, Tex.; Ralph S. Bishop; 100 W.
KONO—San Antonio, Tex.; Mission Broadcasting Co.; 100 W.
KGKL—San Angelo, Tex.; KGKL (Inc.), 100 W.
WGL—Fort Wayne, Ind.; Fred C. Zeig (Allen-Wayne Co.); 100 W.
KICA—Clovis, N.M., Southwest Broadcasting Co.; 100 W.
KFJM—Great Forks, N. Dak.; University of North Dakota; 100 W.
KWKC—Kansas City, Mo.; Wilson Duncan, trading as Wilson Duncan Broadcasting Co.; 100 W.
WRJN—Racine, Wis.; Racine Broadcasting Corporation; 100 W.
KGAR—Tucson, Ariz.; Tucson Motor Service; 250 W.*
KRE—Berkeley, Calif.; First Congregational Church of Berkeley; 100 W.
KOOS—Marshfield, Ore.; H. H. Hansetly (Inc.); 100 W.
KFBL—Everett, Wash.; Otto Leese and Robert Leese, doing business as Leese Bros.; 50 W.
KVL—Seattle, Wash.; KVL, Incorporated; 100 W.
KGFL—Raton, N. Mex.; KGFL, Inc.; 50 W.
KUJ—Walla Walla, Wash.; KUJ, Inc.; 100 W.
WRAM—Wilmington, N. C.; Wilmington Radio Asso.; 100 W.
WJTL—Tifton, Ga.; Oglethorpe University; 100 W.
WPFB—Hattiesburg, Miss.; Hattiesburg Bdcg. Corp.; 100 W.

1375 KILOCYCLES—218 METERS

CMGE—Cardenas, Cuba; Genaro Sebater; 30 W.

1380 KILOCYCLES—217.3 METERS

WSMK—Dayton, Ohio; Stanley M. Krohn, Jr.; 200 W.
WKBH—LaCrosse, Wis.; WKBH (Inc.); 1 KW.
KOH—Reno, Nev.; The Bee, Inc.; 500 W.
KQV—Pittsburgh, Pa.; KQV Broadcasting Co.; 500 W.
XETB—Torreon Coah., Mex.; Jose A. Berumen; 125 W.

1382 KILOCYCLES—217.25 METERS

CMJC—Camaguey, Cuba; Feliciano Isaac; 75 W.

1390 KILOCYCLES—215.7 METERS

WHK—Cleveland, Ohio; T—Seven Hills, Ohio; Radio Air Service Corporation; 1 KW.
KLRA—Little Rock, Ark.; Arkansas Broadcasting Co.; 1 KW.
KOY—Phoenix, Ariz.; Nielsen Radio & Sporting Goods Co.; 500 W.

1395 KILOCYCLES—215 METERS

CMCG—Havana, Cuba; Jose Justo Moran; 30 W.

1400 KILOCYCLES—214.2 METERS

WFOX—Brooklyn, N. Y.; Paramount Broadcasting Corporation; 500 W.
WLTH—Brooklyn, N. Y.; Voice of Brooklyn (Inc.); 500 W.
WBBC—Brooklyn, N. Y.; Brooklyn Broadcasting Corporation; 500 W.
KOCW—Chickasha, Okla.; J. T. Griffin; 500 W.
WKBF—Indianapolis, Ind.; T—Clermont, Ind.; Indianapolis Broadcasting (Inc.); 500 W.
WBAA—West Lafayette, Ind.; Purdue University; 1 KW.*
KLO—Ogden, Utah; Peery Building Co.; 500 W.

1410 KILOCYCLES—212.6 METERS

CMCH—Havana, Cuba; Hernani Torralbas; 20 W.
CMCM—Havana, Cuba; Martinez-Madicu; 15 W.
WRBX—Roanoke, Va.; Richmond Development Corporation; 250 W.
WBCM—Bay City, Mich.; T—Hampton Township, Mich.; James E. Davidson; 500 W.
KGRS—Amarillo, Tex.; E. B. Gish (Gish Radio Service); 1 KW.
WDAG—Amarillo, Tex.; National Radio and Broadcasting Corporation; 1 KW.
WODX—Mobile, Ala.; T—Springhill, Ala.; Mobile Broadcasting Corporation; 500 W.
WSFA—Montgomery, Ala.; Montgomery Broadcasting Co. (Inc.); 500 W.
KFLV—Rockford, Ill.; Rockford Broadcasters (Inc.); 500 W.
WHBL—Sheboygan, Wis.; Press Publishing Co.; 500 W.
WAAB—Boston, Mass.; Bay State Broadcasting Corp.; 500 W.
WHIS—Bluefield, W. Va.; Daily Telegraph; 250 W.

1420 KILOCYCLES—211.1 METERS

WTBO—Cumberland, Md.; Associated Broadcasting Corporation; 210 W.*
WILM—Wilmington, Del.; T—Edge Moor, Del.; Delaware Broadcasting Co. (Inc.); 100 W.
WMAS—Springfield, Mass.; Albert S. Moffat; 100 W.
WPAD—Paducah, Ky.; Paducah Broadcasting Co., Inc.; 100 W.
WJMS—Ironwood, Mich.; WJMS, Inc.; 100 W.

(*Continued on next page*)

(*Continued from preceding page*)

KWCR—Cedar Rapids Bdcg Co.; Cedar Rapids, Ia.; 250 W.*
WMBC—Detroit, Mich.; Michigan Broadcasting Co.; 210 W.*
WELL—Battle Creek, Mich.; Enquirer-News Co.; 50 W.
WJBO—New Orleans, La.; Valdemar Jensen; 100 W.
KGFF—Shawnee, Okla.; D. R. Wallace (owner KGFF Broadcasting Co.); 100 W.
KABC—San Antonio, Tex.; Alamo Broadcasting Co. (Inc.); 100 W.
WSPA—Spartanburg, S. C.; Virgil V. Evans, trading as The Voice of South Carolina; 250 W.*
KICK—Red Oak, Iowa; Red Oak Radio Corporation; 100 W.
WLBF—Kansas City, Kans.; The WLBF Broadcasting Co.; 100 W.
WMBH—Joplin, Mo.; Edwin Dudley Aber; 250 W.*
WEHS—Evanston, Ill.; WEHS (Inc.); 100 W.
WHFC—Cicero, Ill.; WHFC, Inc.; 100 W.
WKBI—Chicago, Ill.; WKBI, Inc.; 100 W.
KFIZ—Fond du Lac, Wis.; The Reporter Printing Co.; 100 W.
KFXY—Flagstaff, Ariz.; Albert H. Scherman; 100 W.
KGIX—Los Vegas, Nev.; Los Vegas Radio Corp.; 100 W.
KGIW—Trinidad, Colo.; Leonard E. Wilson; 100 W.
KGGC—San Francisco, Calif.; The Golden Gate Broadcasting Co; 100 W.
KXL—Portland, Ore.; KXL Broadcasters, Inc.; 100 W.
KBPS—Portland, Ore.; Benson Polytechnic School; 100 W.
KORE—Eugene, Ore.; Frank L. Hill and C. G. Phillips, doing business as Eugene Broadcast Station; 100 W.
WENC—Americus, Ga.; Americus Broadcasting Co.; 100 W.
WAGM—Presque Isle, Me.; Aroostock Broadcasting Corp.; 100 W.
WHDL—Tupper Lake, N. Y., Tupper Lake Bdcg. Co., Inc.; 100 W.

1430 KILOCYCLES—209.7 METERS

WHP—Harrisburg, Pa.; T—Lemoyne, Pa.; WHP (Inc.); 1 KW.*
WBAK—Harrisburg, Pa.; Pennsylvania State Police, Commonwealth of Pennsylvania; 1 KW.*
WCAH—Columbus, Ohio; Commercial Radio Service Co.; 500 W.
WNBR—Memphis, Tenn.; Memphis Broadcasting Co.; 500 W.
KGNF—North Platte, Nebr.; Great Plains Broadcasting Co.; 500 W.
KECA—Los Angeles, Calif.; Earle C. Anthony, Inc.; 1 KW.
WFEA—Manchester, N. H.; New Hampshire Broadcasting Co.; 500 W.
WHEC—Rochester, N. Y.; WHEC, Inc.; 500 W.
WOKO-WABO—Albany, N. Y.; T—Mount Beacon, N. Y.; WOKO (Inc.); 500 W.

1440 KILOCYCLES—208.2 METERS

WCBA—Allentown, Pa.; B. Bryan Musselman; 250 W.
WSAN—Allentown, Pa.; Allentown Call Publishing Co. (Inc.); 250 W.
WBIG—Greensboro, N. C.; North Carolina Broadcasting Co. (Inc.); 1 KW Daytime.
WTAD—Quincy, Ill.; Illinois Broadcasting Corporation; 500 W.
WMBD—Peoria Heights, Ill.; E. M. Kahler (owner Peoria Heights Radio Laboratory); 1 KW.*
KXYZ—Houston, Tex.; Harris County Broadcast Co.; 250 W.
KLS—Oakland, Calif.; E. N. and S. W. Warner, doing business as Warner Bros.; 250 W.
WTAD—Quincy, Ill.; Ill. Bdcg. Corp.; 500 W.
KDFN—Casper, Wyo.; Donald L. Hathaway; 500 W.
CMBL—Havana, Cuba; Julio C. Hidalgo; 20 W.

1450 KILOCYCLES—206.8 METERS

WSAR—Fall River, Mass.; Doughty & Welch Elec. Co., Inc.; 250 W.
WHOM—Jersey City, N. J.; New Jersey Broadcasting Corporation; 250 W.
WGAR—Cleveland, Ohio; WGAR Broadcasting Co.; 500 W.
WTFI—Athens, Ga.; Liberty Broadcasting Co.; 500 W.
KTBS—Shreveport, La.; Tri State Broadcasting System (Inc.); 1 KW.

1460 KILOCYCLES—205.4 METERS

WJSV—Alexandria, Va.; T—Mt. Vernon Hills, Va.; Old Dominion Broadcasting Co.; 10 KW.
KSTP—St. Paul, Minn.; T—Westcott, Minn.; National Battery Broadcasting Co.; 25 KW.

1470 KILOCYCLES—204.0 METERS

WLAC—Nashville, Tenn.; Life and Casualty Insurance Co.; 5 KW.
KGA—Spokane, Wash.; Northwest Broadcasting System (Inc.); 5 KW.

1480 KILOCYCLES—202.6 METERS

WKBW—Buffalo, N. Y.; T—Amherst, N. Y.; Buffalo Broadcasting Co.; 5 KW.

1490 KILOCYCLES—201.2 METERS

WCKY—Covington, Ky.; T—Crescent Springs, Ky.; L. B. Wilson (Inc.); 5 KW.

1500 KILOCYCLES—199.9 METERS

WFDV—Rome, Ga.; Rome Broadcasting Corp.; 100 W.
WNBF—Binghamton, N. Y.; Howitt-Wood Radio Co. (Inc.); 100 W.
WMBQ—Brooklyn, N. Y.; Paul J. Gollhofer; 100 W.
WWRL—Woodside, N. Y.; Long Island Broadcasting Corporation; 100 W.
WSYB—Rutland, Vt.; H. E. Seward, Jr., and Philip Weiss, doing business as Seward & Weiss Music Co.; 250 W.
WKBZ—Ludington, Mich.; Karl L. Ashbacker; 50 W.
WMPC—Lapeer, Mich.; First Methodist Protestant Church of Lapeer; 100 W.
WPEN—Philadelphia, Pa.; Wm. Penn Broadcasting Co.; 250 W*.
WWSW—Pittsburgh, Pa.; Walker & Downing Radio Corp.; 250 W Daytime.
WOPI—Bristol, Tenn.; Radiophone Broadcasting Station WOPI (Inc.) 100 W.
KNOW—Austin, Tex.; A. P. Miller; 100 W.
WRDW—Augusta, Ga.; Musicove (Inc.); 100 W.
KGKB—Tyler, Tex.; East Texas Bldg. Co.; 100 W.
KGKY—Scottsbluff, Nebr.; Hillard Co. (Inc.); 100 W.
WKBV—Connersville, Ind.; William O. Knox, trading as Knox Battery & Electric Co.; 150 W*.
KGFK—Moorehead, Minn.; Red River Broadcasting Co. (Inc.); 50 W.
KPJM—Prescott, Ariz.; Scott and Sturm; 100 W.
KXO—El Centro, Calif.; E. R. Irey and F. M. Bowles; 100 W.
KDB—Santa Barbara, Calif.; Santa Barbara Broadcasters, Ltd.; 100 W.
KREG—Santa Ana, Calif.; The Voice of the Orange Empire, Inc., Ltd.; 100 W.
KPQ—Wenatchee, Wash.; Wescoast Broadcasting Co.; 50 W.

A Joke for the Week

A news commentator appearing at a busy station happened to glance at the bulletin board where hung a mimeographed copy of the day's program. He noticed near the end the following: "Newspaper Ann, 11 p.m." When he went into the publicity department he asked the director:

"Who is Newspaper Ann?"

"I never heard of her," was the reply.

"Well, she's broadcasting from this station, and as the publicity director you ought to know. I was wondering who she was, because I know nearly all the newspaper women in town."

"I'll find out," said the publicity man, and telephoned to the chief announcer for the information. But the chief announcer knew her not, either, though he said he would try to find out, if the publicity man would hold the wire.

While waiting, the publicity director burst into laughter.

"What a dumb-bell I am!" he exclaimed. "Newspaper Ann! Well, well! At 11 o'clock every night we announce the identities of all the newspapers that print our programs. We call this notice 'Newspaper Announcements.' 'Ann' stands for 'announcements'!"

Harry H. Steinle, former general sales manager of the CeCo Manufacturing Co. and later vice-president and general sales manager of the Triad Manufacturing Co., has resigned the latter connection to direct the sales of the Lynch Manufacturing Co. Mr. Lynch has been active with his own company again for the past year.

RADIO WORLD and "RADIO NEWS"

BOTH FOR ONE YEAR **$7.00** Canadian and Foreign $1.50 extra

You can obtain the two leading radio technical magazines that cater to experimenters, service men and students, the first and only national radio weekly and the leading monthly for one year each, at a saving of $1.50. The regular mail subscription rate for Radio World for one year, a new and fascinating copy each week for 52 weeks, is $6.00. Send in $1.00 extra, get "Radio News" also for a year—a new issue each month for twelve months. Total 64 issues for $7.00.

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Great for getting right down into your set!

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ANDERSON'S AUTO SET

Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

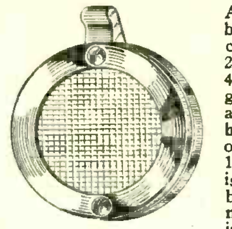
This new auto set is the most sensitive car receiver we have ever come across. Mexican and Canadian stations were tuned in from New York City on a 6-inch aerial. The circuit, an 8-tube superheterodyne, with automatic volume control.

The complete parts, including set chassis and set shield, battery box, remote control, battery cable, all condensers, resistors and coils, speaker with shielded cable; and a kit of RCA tubes (two 239, two 236, two 237, one 89, and one 85) are supplied less aerial. Cat. 898-K ●........$34.66

Wired model, licensed by RCA, with complete equipment, less aerial, but including RCA tubes. Cat. 898-W $37.40

Hennessy Radio Pubs. Corp.
143 West 45th St. N. Y. City

LAPEL MICROPHONE

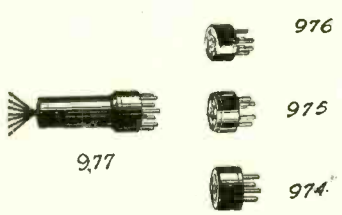


A single-button carbon-granule lapel microphone, impedance 200 ohms, requiring 4.5-volt excitation, of good frequency characteristics, and both handy and inconspicuous. Outside diameter, 1⅝ inches. The case is chromium-plated brass. The excitation may be provided by introducing the microphone in a cathode circuit carrying around 20 to 25 milliamperes, or a 4.5-volt C biasing battery may be used. Net price, $2.95.

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

"HANDBOOK OF REFRIGERATING ENGINEERING," by Woolrich—Of great use to everybody dealing in refrigerators. $4. Book Dept., Radio World, 145 W. 45th St., N. Y. City.

Analyzer Plug and Adapters



For constructing a set analyzer, an analyzer plug, to go into a receiver socket, is necessary. We offer the exclusive seven-pin analyzer plug, plain long handle as illustrated, and three adapters that enable putting the plug connections into UX, UY and six-pin receiver sockets. The plug has 5-foot 7-lead cable. All four parts sent free on receipt of $6.00 for one-year's subscription (52 issues). Order Cat. PRE-ANPLAD.

RIDER'S MANUAL

The standby of the service man is John F. Rider's "Perpetual Trouble Shooter's Manual."

Vol. 2 contains additional diagrams on the same basis as above, but in Vol. 2 there is no duplication of any of the diagrams printed in Vol. 1.

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Allen-Hough synchronous phonograph motor, 78 revolutions per minute; takes up to 12-inch records. Works from a-c line, 50-60 cycles, 105-120 volts. Equipped with felt-covered turntable. To start the motor give it a slight impetus. Fits into 3-inch depth, hence handy for compact installations. Given free with 34-weeks subscription at $4.00. Order Cat. PRE-PHOMO.

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A 0-10,000-ohm ohmmeter and continuity tester. A rheostat is built in for correct zero resistance adjustment. The unit contains a three-cell flashlight battery. Supplied with two 5-foot-long wire leads with tip plugs. Case is 4-inch diameter baked enamel. Sent you for an order for one year's subscription for RADIO WORLD (52 weeks) at the regular rate of $6. Order Cat. PRE-500.

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R-F CHOKE COILS

These coils have 50, 100, 200, 400 and 800 turns, diameter 1 inch, and are suitable for detector plate filtering, screen filtering, grid and plate loads, etc. The 50 is for short waves, 100 for television band, 200 for broadcast band, 400 for high intermediate frequencies (450 to 300) and 800 for lower intermediate frequencies. Any four, or four of a kind, or combinations not exceeding total of four, sent free on receipt of $1.00 for 8 weeks trial subscription. Order Cat. PRE-4-CH and state chokes desired, by quantity and number of turns.

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"The Superheterodyne," by J. E. Anderson and Herman Bernard. A treatise on the theory and practice of the outstanding circuit of the day. Special problems of superheterodynes treated authoritatively.

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0-10 Amperes D.C.	No. 338
0-25 Milliamperes D.C.	No. 325
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0-100 Milliamperes D.C.	No. 390
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HANDY PACKAGE OF PARTS

One grid condenser of 0.00025 mfd., with clips; one 5-to-7 meg. fixed grid leak; one knob with ¼-inch shaft; one a-c cable and plug. All sent on receipt of $1.00 for 8-weeks trial subscription. Order Cat. PRE-HANPKG.

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

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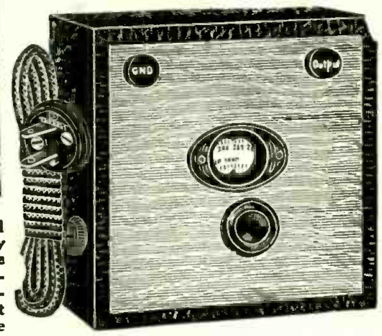
A *NEW* TEST OSCILLATOR

That Works A.C., D.C., or Batteries!

SHOWN ONE-THIRD ACTUAL SIZE



Over-All Size Is Only 5x5x3"! Dial Reads Frequencies Directly!

A NEW TEST oscillator, Model 30, has been produced by Herman Bernard, so that all the requirements for lining up broadcast receivers, both tuned radio frequency and superheterodyne types, will be fully and accurately met. This device may be connected to 90-120-v a.c., any commercial frequency, without regard to polarity of the plug, and will function perfectly. It may be used also on 90-120-volt d.c. line, but plug polarity must be observed. One of the plug prongs has a red spot, denoting the side to be connected to positive of the line. If you don't know the d.c. line polarity, you may connect either way, without danger. The oscillator will work on d.c. only when the connection is made the right way. Moreover, 90 volts of B battery may be used instead of either of the foregoing, simply by connecting two wires between the plug at the batteries, observing polarity. No separate filament excitation is required. The oscillator is modulated with a strong, low note under all circumstances. It uses a 30 tube.

THE dial of the Bernard Model 30 Test Oscillator is directly calibrated in kilocycles, so there is no awkward necessity of consulting a chart. The fundamental frequencies are 135 to 380 kc, so that nearly all commercial intermediate frequencies as used in present-day superheterodynes are read on the fundamental. The points for other intermediate frequencies, e.g., 400, 450, 456 and 465 kc, are registered on the dial also, two harmonics, with which the user need not concern himself, being the basis of these registrations. Besides, the broadcast band is taken care of by the fourth harmonic and the dial is calibrated for that band, also.

The divisions on the dial for the fundamental band, 135 to 380 kc, are 1 kc apart from 135 to 140 kc, 2 kc apart for 140 to 180 kc and 5 kc apart for 180 to 380 kc. For the broadcast band, 10 kc apart from 550 to 800 kc, 20 kc apart from 800 to 1,500 kc.

The test oscillator may be used also for short waves, by resorting to higher harmonics.

Send $12 for 2-year subscription for RADIO WORLD and order Cat. BO-30 sent free, with tube (prepaid in United States and Canada).

Another model, BO-30-S, same as above, except frequencies are ten times as high, hence instrument is for short-wave work only, is available on same basis.

540-4,500 kc Tuning Units

The Tuning Units consist of a four-gang 0.00046 mfd. condenser, with trimmers on it, 3/8-inch diameter shaft, 1 1/8 inches long, mounting spades, condenser closing to the left; and a set of four shielded coils. The condenser is the same for tuned radio frequency sets or superheterodynes, but for superheterodynes a series padding condenser is supplied also. For t-r-f sets the four coils are alike. For supers three coils are alike and there is a different coil for the oscillator, with a selection for 175 kc, 456 kc or 465 kc intermediate frequency.

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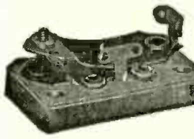

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