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1933

NEW 7-TUBE DIAMOND

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Twelfth Year *581st Consecutive Issue*

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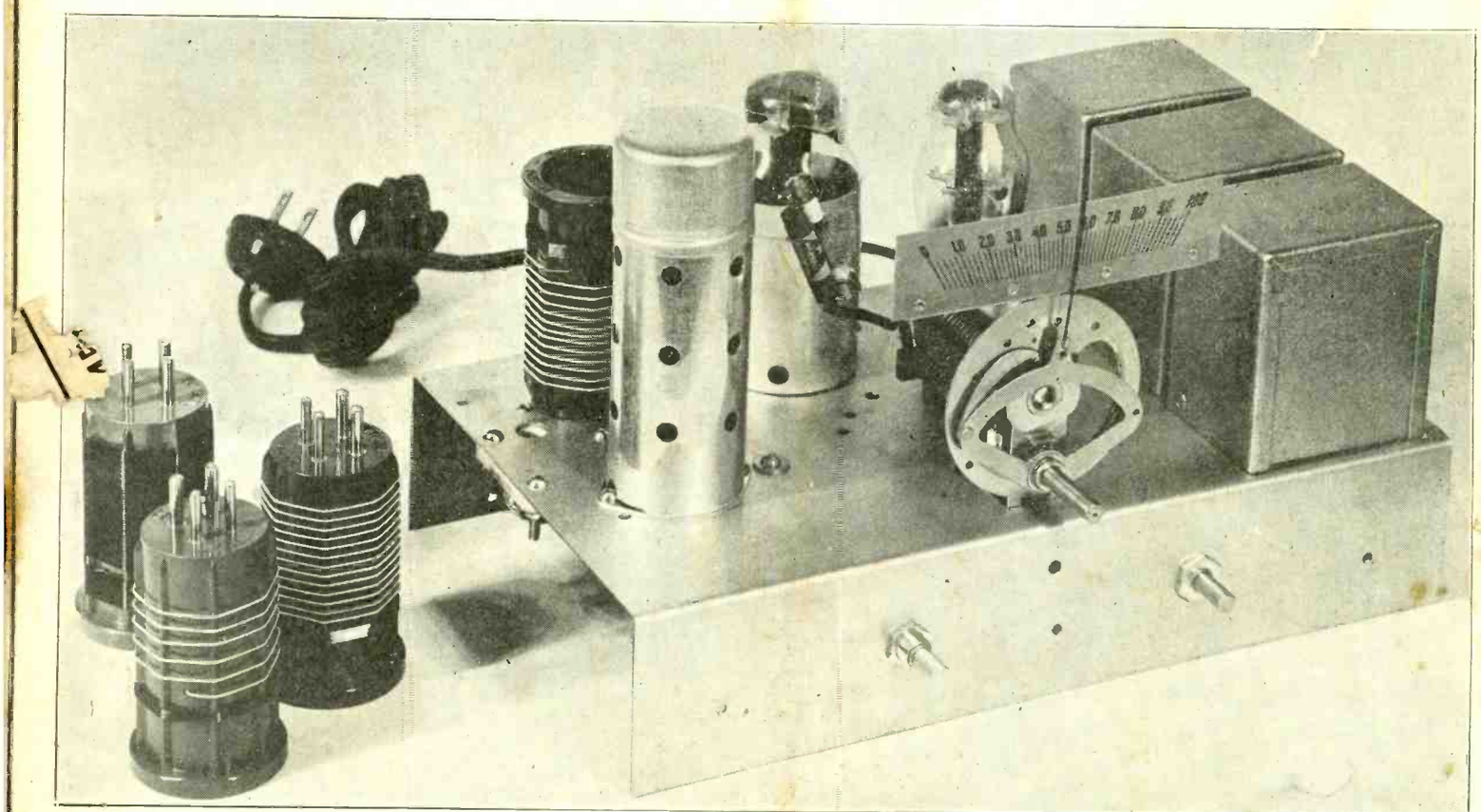
AN A-C and D-C SHORT-WAVE SET



A three-tube a-c and d-c short-wave set. The rectifier is floated on the line for d-c. Three B filter chokes are used.

FILTER CHOKE AND CONDENSER MEASUREMENTS

TUBE CAPACITY TUNES NEW I-F COILS

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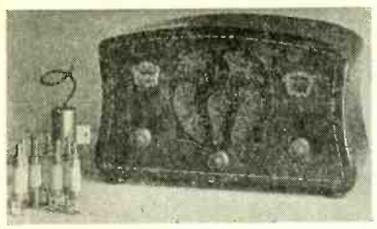

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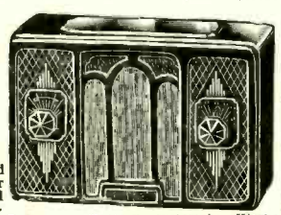

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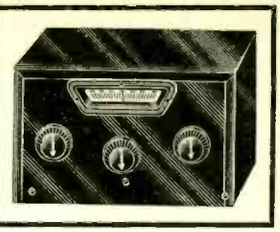

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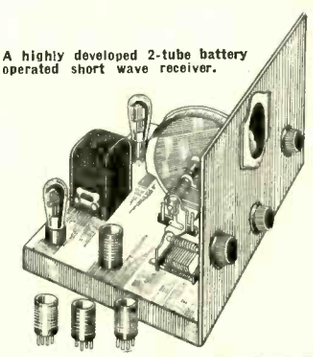

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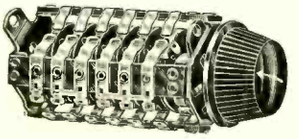
DUAL-RANGE SWITCHES



Wiping contact switches that improve with use and have an exceedingly low contact resistance enhance performance in the police-television-amateur bands without disturbing the line-up of the broadcast band.

The switches are sturdy, compact, smooth and dependable. The frame is insulated from the switch connections, so the switch may be used to slide condenser stator from one extreme of coil to a tap on the coil, or to short out part of the coil without changing condenser stator connection. The mounting hole is to be 5/16 inch diameter, with 8/32 hole ½ inch away, to engage a small flange that prevents slippage. Two extra holes on a fixed bracket permit additional anchorage to front and possibly rear flaps of chassis.

Type A is for governing three tuned circuits (triple pole, double throw) and besides there is a single pole single throw extra section for shorting and padding condenser or antenna series condenser. Entire switch encompassed by 2-inch diameter. Length, 5 inches; shaft, ¼ inch, 1" long. Used in 9-Tube Diamond. Cat. EBS-A at $1.49.

Type B is for governing four tuned circuits and substituting one padding condenser for another (five pole, double throw). The switch is 9 inches long. Used in the 12-Tube Diamond. Cat. EBS-B at $2.49.

We selected these switches because we deem them the best ones made, in the stated price range, and because they make excellent and definite contact and afford long service. The illustration reveals the general type of construction.

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

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2A7 Pentagrid and 2A3 Output in New 7-TUBE SUPER DIAMOND

By Herman Bernard

DUE to the high conversion conductance, 475 micromhos, of the 2A7 combination triode oscillator and pentode modulator, the quantity of sound output from a receiver using it and the 2A3 is about the same as that from the otherwise same receiver using the 58 as autodyne and the 2A5 as output. The 2A5 has a mu factor of 220, whereas the 2A3 has a mu factor of 4.2, so on this basis the 2A7 shows up about fifty times better sensitivity.

The object of a power tube with high amplification is to attain desired sensitivity. That is, not much need be put in, yet much will be taken out. In general, the power output need not be considered, since it is about the same for the pentode output tubes and the only low-mu tubes that are used much, the 245 and the 2A3.

Two Tubes Compared

Moreover, if one has a sensitive tuner, followed by a stage of driver audio, there is no object in using an output tube of high mu factor, because the very fact of the high mu requires that the operating point be at a low value of negative bias compared to the plate voltage. To attain a high mu the plate resistance must be large, and if the tube is overbiased generously, there will be distortion due to the uneven or unequal voltage peaks, and if it is overbiased very considerably the amplification will be cut off. This is usually referred to as plate current cut-off, because the plate current is so very low that, on most meters one may have around, it would be hardly possible to read it. But, of course, the plate current never does not actually cut off. So long as there is voltage across a resistor there is current through it.

The 2A3 may be compared to the 2A5 as follows:

Tube	*Plate Volts*	*Grid Bias*	*Plate Resistance*	*Volt. Amp. Factor*	*Power Output*
2A3	250	45	765	4.2	3.5
2A5	250	16.5	100,000	220	3.0

More Power Output

A tuner with a stage of audio, such as shown, will give abundant input to the power tube, and the bias voltage of 16.5 volts, for the 2A5, would be greatly exceeded in many instances, unless the sensitivity were reduced by resort to the volume control.

Further to increase the permissible grid swing in the power tube circuit, the plate voltage and negative bias may be raised, and with a single output tube the power capability becomes 5 watts. The plate current is 40 milliamperes under these conditions. This is not a case of overbiasing, because the plate voltage has been raised.

When the 2A3 official information was released (February 4th issue, p. 5), the maximum voltage for the single-sided circuit was given as 250 volts, but for push-pull 300 volts, the bias heightened from 42 volts for a-c on filament, 250 plate volts (single-sided), to 62 for a-c on filament, 300 plate volts (push-pull). In the push-pull instance the plate current per plate was 40 ma. whereas in the other instance 60 ma. This push-pull circuit is good for 15 watts, and is used in the Twelve-Tube Super Diamond.

Better Tone

If a single-sided output is used, the 300 volts may be applied, or more, with the bias heightened accordingly. The plate current should be held down to 40 ma. to avoid excesses at the large swings expected from a receiver backed up with a relatively large capability output circuit. So with 1,550 ohms in the biasing circuit (consisting of two 775-ohm resistors in series), and with 288 applied plate volts, we have 62 volts negative bias.

The tone quality obtainable from the 2A3 is superior to that from the pentode group of tubes, and incidentally one should remember that the output power ratings for the respective tubes refer to 7 per cent. total harmonic distortion for pentodes and only 5 per cent. for the triodes.

In the extra gain from the 2A7 and the extension of the power output capability there is of course a direct relationship, since ahead of the power tube voltage alone is being built up, and the type of output tube should be gaited to the amount of its input voltage. Not only should an average value of input voltage be considered, but the sudden peaks should be accommodated. Thus the maximum allowable signal voltage that may be put into the 2A3 may be 1 volt less than the bias, or 61 volts, which is a fairly large voltage, and average operation would be at considerably less than half that.

Screen Voltage Measurements

The circuit was built and rebuilt with the idea of preserving as much as possible an utter simplicity of circuit formation, so the two 58 r-f tubes and the pentode of the 2A7 have a common biasing resistor, 500 ohms, which affords a negative bias of 5 volts, since a total of 10 milliamperes flows in the three tubes. This is very

(Continued on next page)

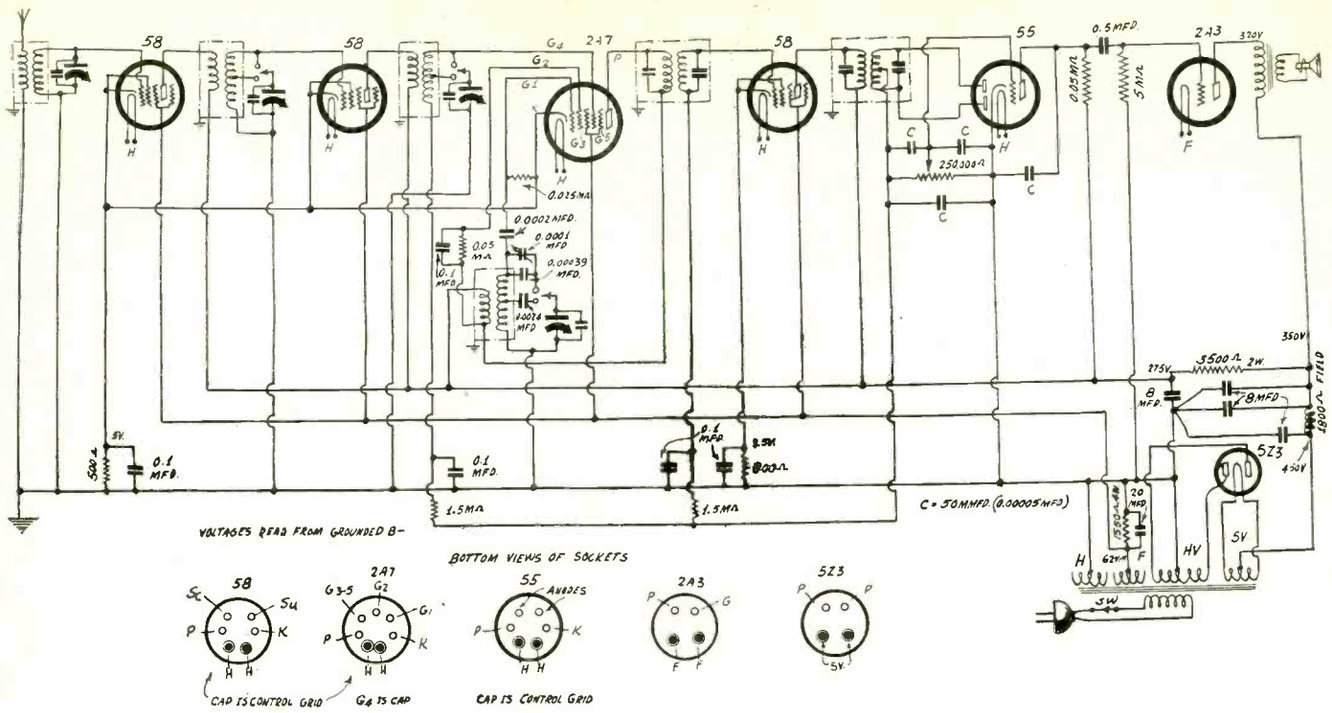
WINDING DATA FOR 1-INCH DIAMETER

Tuning Condensers, 410 mmfd. Intermediate Frequency, 465 kc.

Coil	Secondary	Primary
RF	230 mch., 130 turns No. 32 enamel wire; tap, 22d turn from ground end.	12 turns wound over secondary, 0.02 insulation. Any convenient wire size.
Ocs.	124 mch. 87 turns of No. 32 enamel wire; tap, 20 turns from ground end.	30 turns wound below secondary. 1/16-inch separation. Any convenient wire size.

All turns data take into account the inductance drop due to the shield, hence effective inductances are given for aluminum shields $2\frac{1}{16}$" outside diameter, $2\frac{1}{2}$" high.

A 15-turn tickler is also on the oscillator coil in commercial coils for use with 56, 55 and other similar oscilator tubes. The 30-turn winding is for the 2A7 and 6A7.



Voltages read to grounded chassis are given on the circuit diagram of the new 7-tube Super Diamond. A four-gang condenser and the new 2A7 pentagrid tube are used, with 2A3 output for best quality.

(*Continued from preceding page*)

small current, but it is due to the low screen voltage. The common screen supply is 62 volts, the same voltage as is used for power tube bias.

The oscillator triode of the 2A7 does not have the full B voltage applied, for a resistor of 50,000 ohms reduces it by around 130 volts.

The 2A7, it has been said, works exceptionally well, but it should be stated that it will do so only when the voltages are correct for the constants used. The screen voltage referred to as of 62 volts really amounts to 57 volts, for the correct points between which to read this are cathode and screen, the other 5 volts being for grid bias, for the pentode modulator, although the oscillator is operated at a static value of zero bias voltage.

In view of the newness of the tube, the semi-critical aspects of some of the voltages, and the unusual connections, it is advisable to go into detail concerning this tube and its connections.

The 2A7 has a heater and an independent cathode. It is called a pentagrid tube because there are five grids. Now the word "grid" begins to have a wider significance. It even includes a plate. Grid No. 1, which adjoins cathode on the socket, is the control grid of the oscillator triode. Grid No. 2 is the "plate" of the oscillator triode and in the tube structure adjoins Grid No. 1. Grids No. 3 and 5 are tied together inside the tube and constitute the screen of the pentode. Grid No. 4 is the overhead cap and is the control grid of the modulator pentode. The element referred to as plate is the plate of the pentode.

Special Circuit

The primary of the first intermediate transformer, as well as the feedback winding of the oscillator, is in this plate circuit. For a part of the total voltage drop across these plate circuit inductances the two plates are in parallel.

The tube functions as follows:

The radio frequency carrier is put into the control grid circuit as usual, and the return of the grid winding is made to the automatic volume control circuit. Because the pentode or modulator unit of the combination tube is of the remote cut-off or super control type, meaning that plate current decreases gradually with increases in negative grid bias voltage, distortion is avoided though a.v.c. is included. Moreover, as with variable mu tubes in general, cross modulation is avoided.

So the signal carrier voltage is put into Grid No. 4, which is surrounded by combined Grids Nos. 3 and 5, constituting screen and suppressor, to screen this control grid and the oscillator control grid from the plate of the tube, reduce the grid-plate capacity, and constitute the tube a pentode.

The other elements are Grid No. 1, oscillator control, and Grid No. 2, effectively the oscillator "plate."

Electron Coupling

The common circuit in the tube therefore is the cathode, and it is in this leg that the electrons of both circuits unite in loose coupling. Due to the communion of electron flow the coupling is called electron coupling, also emission coupling.

Excellent frequency stability obtains. The coupling is not due to external inductance, capacity or resistance, but to the intermingling of the electrons, hence is substantially non-reactive. Besides the condition of coupling of the oscillator is equivalent to that of no load.

The a-c plate resistance normally is 300,000 ohms, which is very high, and therefore the modulator operation is on a par with that of a tube of high internal resistance with a load of relatively low resistance. Thus frequency or phase shift due to the impedance characteristics of the load is small, looking at the entire circuit. The a-c impedance of the load may be 100,000 ohms under exceptionally good conditions, whereas the plate impedance itself may be 300,000. Here, however, due to low screen voltage and somewhat heightened bias (5 volts compared to usual 3 volts plus a.v.c.), the modulator plate impedance is considerably greater, hence the stability be still better.

The oscillator is of the grid leak type. The leak is 0.025 meg. (25,000 ohms) and is connected from Grid No. 1 to cathode. For higher screen voltages the leak value should be higher.

Grid Leak Action

With grid returned to cathode there is no bias at no oscillation. However, as soon as there is oscillation there is a considerable voltage on the grid and this causes grid current to flow. Since it flows through a resistor there is a voltage drop. Therefore Grid No. 1 is a rectifier, besides being the oscillator control grid. The rectified or grid current is such that the grid is negative in respect to the cathode by the amount of voltage drop in the grid leak.

Let us assume that 10 microamperes of grid current flow. Then the voltage drop in the resistor would be 0.00001 x 25,000, or 2.5 volts. The oscillation voltage changes a bit with frequency, because frequency stability can not be considered absolutely complete. The bias will increase as the oscillation increases and decrease as the oscillation decreases. Hence a check on overloading likewise is present.

The reason why the voltage is thus poled, or the grid negative, from a d-c aspect, is that the rectifier will rectify only when the anode is positive, because electrons can flow only from cathode to a positive element. The anode in this sense is the control grid of the oscillator, Grid No. 1.

However, if the effective value of the grid voltage were negative in respect to the cathode, for the above reason there would be no grid current. The factor that creates grid current is the amplitude of the oscillation. The check on an excessive amount of oscillation, or altogether too high an amplitude, is the current through the grid leak. The usual grid condenser is included in the circuit, connected from grid to grid terminal of the oscillator secondary coil.

Oscillation Hedged In

In a circuit in which compactness is not of the greatest importance, but rather performance is, it is well to have a sepa-

LIST OF PARTS

Coils

Three shielded radio frequency transformers, as detailed in coil data table. Antenna coil may be tapped as are others, but that tap is not used.
One shielded oscillator coil, as detailed in coil data table.
Two shielded 465 kc intermediate transformers.
One power transformer: primary, 115 volts a-c, 60 c.; secondaries, H, 6 amps., 2.5 volts, c.t.; F, 3 amps, 2.5 v., c.t.; HV, 450-0-450, 60 ma. d.c., c.t.; 5 v., 2 amps., c.t.
One dynamic speaker, 8, 10.5 or 12-inch diameter cone; 1,800-ohm field; output transformer built in; equipped with cable and plug. Output transformer may be 4,000 ohms, or type used for 47, 59 and 2A5 tubes may be used.

Condensers

One four-gang 0.00041 mfd. condenser with trimmers built in.
One 0.0002 mfd. mica grid condenser.
One 0.00039 mfd. mica padding condenser (accurate to 5 per cent.)
One 56-90 mmfd. adjustable padding condenser (or 20-100 mmfd. equalizer).
One 0.0024 mfd. mica fixed padding condenser (accurate to 5 per cent.).
Four 50 mmfd. (0.00005 mfd.) mica fixed condensers.
Four 0.1 mfd. bypass condensers.
Two cans, two 8 mfd. electrolytic condensers in each can; total, four 8 mfd.
One 20 mfd. electrolytic condenser, in single smaller can.
One 0.5 mfd. stopping condenser.

Resistors

One 500-ohm, 1-watt pigtail resistor.
One 800-ohm, 1-watt pigtail resistor.
Two 775-ohm 2-watt resistors in series, to constitute 1,550 ohm, 4-watt.
One 3,500-ohm, 2-watt pigtail resistor.
One 0.025 meg. (25,000-ohm) 1-watt pigtail resistor.
Two 0.05 meg. (50,000-ohm) 1-watt pigtail resistors.
Two 1.5 meg. 1-watt pigtail resistors.
One 5.0 meg. 1-watt pigtail resistor.
One 250,000-ohm potentiometer.

Other Requirements

One antenna-ground post assembly.
One chassis, 13¾ x 9⅝ x 3 inches (see April 22d issue, page 6).
Eight sockets: four six-spring, one small seven-spring, two UX and one UY. The UY socket is for speaker plug, although only three connections actually need be used: plate and two ends of the field coil.
Six tube shields and six bases.
One vernier dial with pilot lamp and escutcheon.
One short-wave switch (four pole, double throw).
Three knobs.

rate oscillator transformer and a separate modulator transformer. If each is well shielded from the other there should be no stray coupling between them, and the 2A7 lends itself admirably to a highly localized physical circuit in which the danger of stray oscillation fields thus is kept at a minimum. This is especially so because the coupling medium is in the tube itself. And the coupling is of the type that makes for the best quality.

The tube is called a pentagrid converter. Here the word converter is used in the general sense of changing one frequency to another, and has nothing to do with special devices known as short-wave converters, which term describes a means of bringing in signals of carrier frequencies different from those to which the set itself responds.

There are two general types of circuits recommended for the pentagrid converter tube, and the one shown is recommended as having somewhat better frequency stability than the other.

The biasing resistors are in ohms, 500, 800 and 1,550. The 500-ohm resistor will be found highly suitable if the shortwave switch is not included. A tap on the coils permits reception from 70 to 200 meters by throwing a switch. However, this switch requires a little extra wiring, and feedback may result in the broadcast band, and would require that the bias on the oscillating tube be heightened. This should be done in a manner not to increase the bias on the pentagrid tube. The method suggested is to determine the oscillating r-f tube or tubes by putting wetted finger to the control grid and recognizing the plop as an oscillation sign, and then putting a resistor from cathode of that tube to the common bias line. This resistor need not necessarily be by-passed. Around 800 ohms should be tried.

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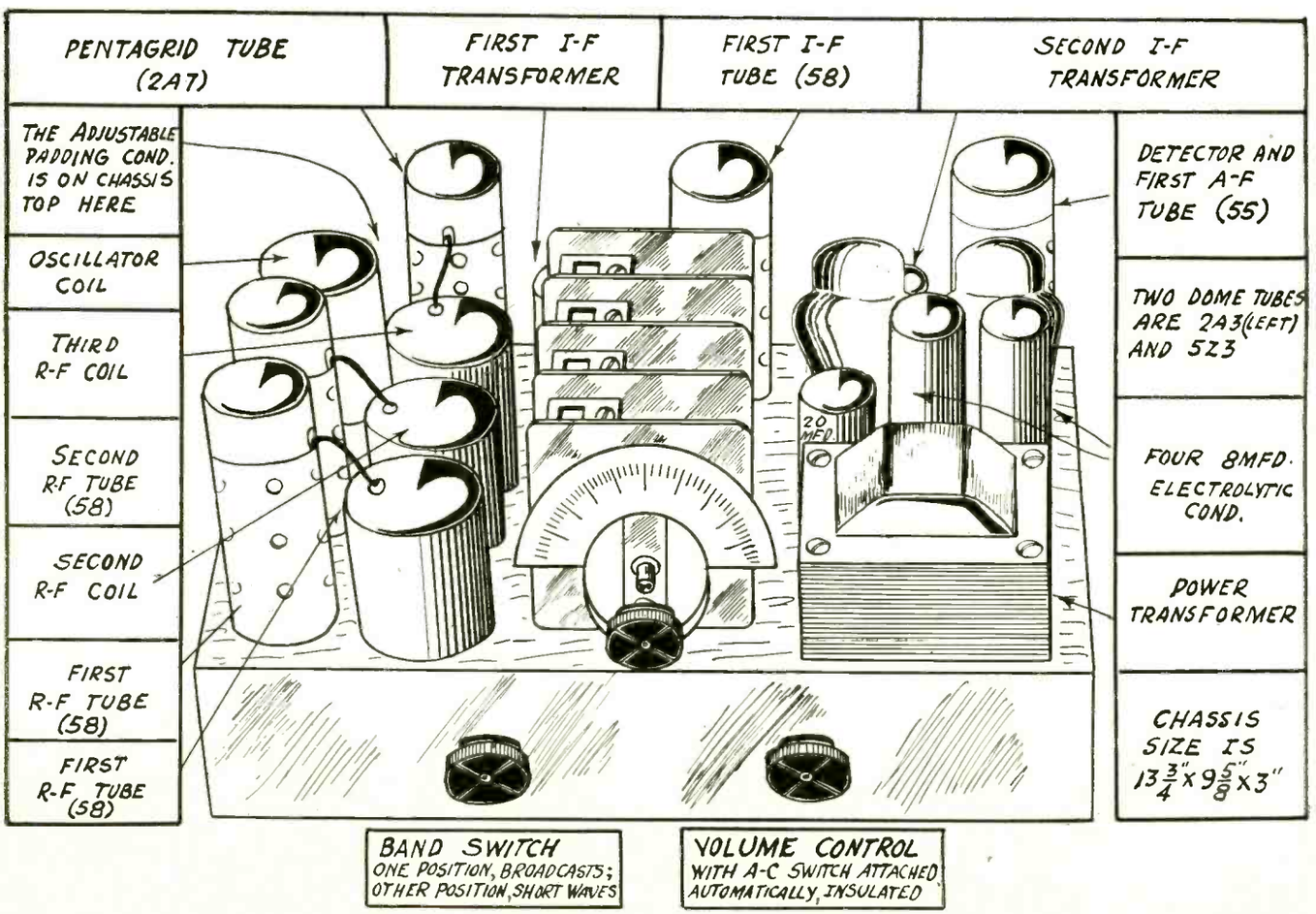

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The intermediate amplifier did not oscillate, except that at 530 kc there may be oscillation due to the combined reasons of the high intermediate frequency, 465 kc, and the padding. As the set is tuned at or near this low-frequency end, 530 kc or 540 kc, a plop may be heard. If it is at 530 kc no attention need be paid to it, as there is no station on that channel. If it is on 540 kc it might interfere with CKOK, a Canadian station.

Mispadding is the main reason. The receiver should be padded at 600 kc, whereupon the plop would not be present, although the response at 540 kc would not be as keen as when the low frequency padding is done at 570 kc or thereabouts. At the high frequency end the r-f and oscillator should be lined up at 1,450 kc.

The receiver covers the frequency range of 1,600 to 530 kc, exceeding the broadcast band by a total of 510 kc. It thus gets some police calls without the short-wave switch being used at all.

The field coil of the speaker is given as 1,800 ohms, just to ascribe a definite value, and the voltage maeasurements were made with a field coil of such resistance in use, but any field of higher resistance, up to even 2,500 ohms, may be used without making any change in the circuit. Lower voltages will be read and no particular performance difference noted. However, the speaker should have an output transformer with an impedance of no less than 2,500 ohms, and due to the high negative bias, speakers intended for the 47, 59 and 2A5 may be used, although the maximum undistorted power output is obtained in this circuit when the transformer impedance is 4,000 ohms. This is due to the increase in plate impedance over more usual specifications, i.e., higher negative bias, at the same current.

The volume control is the one shown frequently in circuits described in these columns, and the condensers from moving arm of potentiometer to extremes of the total resistance, and from one side of the total resistance to ground, may be omitted if there is no oscillation at the intermediate level when they are out. Sometimes there is enough capacity in the tube and wiring to enable stability without them, and it is advisable to leave them out if possible.

Trouble-Shooting

After the circuit has been built, and though it does produce fairly good results, there may be a raspiness of tone, or a stuttering effect on some or most stations.

The usual cause of the raspiness is incorrect bias on the 2A7, and it may be advisable to attack this by using some different value of resistor in series with the oscillator plate (shown as 50,000 ohms, Grid. No. 2). If anything, high values should be tried. This is better than altering the 500-ohm biasing resistor, as only the 2A7 tube is directly affected, whereas the other biasing resistor affects three tubes directly.

The stuttering effect is simply due to mispadding, particularly at the low frequency end. It is highly advisable that the series padding condenser for the broadcast band—a variable across a 0.00039 mfd. fixed condenser—be adjusted at 600 kc, or if a station is at 610 or 590 kc, use that, in the absence of an oscillator. Do not pad the circuit for any lower frequency, if you can avoid it, because elsewhere the padding would be somewhat off, and the stuttering effect produced.

The 600 kc position would be at about 84 on a 0-100 dial that increases numerically with increase in capacity.

The high frequency adjustment is made at 1,450 kc, which comes in at about 7 on the dial, but if there is a station of 1,500 or 1,400, that may be used, in the absence of an oscillator. If you have the oscillator of course abide by both 1,450 kc and 600 kc.

High Frequency Adjustment

To make the adjustments the r-f level has to be correct, that is, trimming condensers adjusted. However, it is quite practical to have the oscillator off at the high frequency end (since you won't know just where to set its trimmer) and then adjust the two r-f and modulator input trimmers for maximum response and then ascertain if a still greater maximum is obtainable under a new condition, i.e., with oscillator trimmer readjusted. The method to pursue is to "rock" the oscillator, i.e., changing the adjustment of its trimmer while the dial is turned back and forth over a small part of the dial. One setting of the oscillator will yield much greater response than any other, and this is the one to select.

There should be no squeals due to the receiver itself, although of course any squeals that are on the air will be brought in, as on any other receiver.

Use a Long Aerial

Though the receiver has been built a few times, not one squeal has been heard, provided the r-f and i-f levels were not oscillating. The biasing resistors are of such value as to be consistent with absence of such oscillation. However, if there is a piercing squeal at around 1,000 kc, it is almost a sure sign that the radio frequency level is oscillating, and the order of likelihood of oscillation is: second r-f tube, first r-f tube. Both those tubes may be oscillating, and if so, put an extra resistor of a few hundred ohms from cathode of offending tube to the common biasing line, not necessarily by-passed.

The circuit will stand a long aerial, and if utmost pep at low wavelengths, without any sacrifice of volume at high frequencies, are desired, the aerial should have a substantial effective height. In general this simply means an outdoor aerial of any regular sort, with no special stress on actual length, but those living in the country, far from broadcasting stations, should have an aerial well above surrounding trees, and at least 100 foot long on the horizontal plane, with leadin whatever is necessary.

Tubes Life-Tested

Representative quantities of tubes, selected at random from production, are life-tested. Characteristic checks made frequently during the life test reveal how well the tubes are standing up under actual operating conditions. In this way it is possible to determine the serviceability of each type. By controlling manufacturing processes in accordance with the results of these tests, each tube leaving the factory is particularly fitted for operation under the conditions for which it was designed.

The improvements in tube design and construction which have been made in the past enable the radio set engineer to achieve better set prformance. The improvements which will be made in the future will make possible even greater advances in receiver design. Consequently, it is helpful to the radio set engineer to be conversant with the latest design featurs of all radio tube types, since these features provide better performance capabilities which can be readily capitalized by the set engineer.

WELLS REVEALS SECRET

Carveth Wells, explorer and author heard over an NBC network, slipped for a moment into his old role of debunking big game when he confided that the "octupus" which started such a hair-raising fight with a diver in a film recently shown on Broadway, was in reality fashioned from rubber tubing, split rubber balls, and a large rubber bag, and was worked by an air pump.

Few Tubes Consistent with Good Results

By R. M. Klein

General Manager, Fada Radio Corp.

There was a time when a man was judged by the number of tubes in his radio set. Not so today.

In 1923 the four-tube set was the ultimate. The first neutrodyne was a four-tube affair. Then came 5-tube sets that became the standard, then 6, 7, 8 and then the 10 and 12-tube models. Because the public became multi-tube conscious unscrupulous dealers took advantage of the situation. This even extended to some unscrupulous manufacturers. There were sets with ten tubes where three of the tubes could be removed and the reception was just as good. In such cases it was plainly catering to a tube complex that had been built up in the minds of the public.

Performance Counts

In fact, up until comparatively recently the public was buying on the basis of the number of tubes. But even several years ago we were pointing out that it is not a question of how many tubes but a question of what the tube can do and of course, of proper design and engineering of a receiver.

This question of tubes got to be quite a joke in no-name circles. There were gyp stores in New York, Chicago, and other big communities where for some multi-tube jobs the selling of bulbs was often accompanied by the banter of the clerk: "20 cents extra if they light!"

Reserve Power

Naturally during all this ten-year period radio engineering was improving, sending stations were being bettered and every phase of radio made better. What's happened in regard to tubes? Well, for one thing, the cycle has run back to the 4 and 5-tube set; at least this is true in the case of some of the most popular models of the day, notably miniature sets.

The finest of the miniature models, while having only five tubes, is in reality a 7-tube receiver. In such a set, two of the five tubes have two complete sets of elements and replace four tubes in receivers not built according to these advanced plans. The result to the listener is a degree of sensitivity, selectivity and tone quality that can be found only in earlier seven-tube superheterodyne receivers of good manufacture.

The same thing applies to the new receivers today that used to be applicable to the best of the multi-tube sets, in regard to reserve power, the same argument that is applied to the ownership of a high-powered automobile. The fact that the reserve power is there makes possible better performance in every division.

So today—while the tube cycle has run back in numbers to the time covered by eight to ten years, it is quite a different story as to what a 5-tube set yields today.

IT'S NEARLY HOPELESS

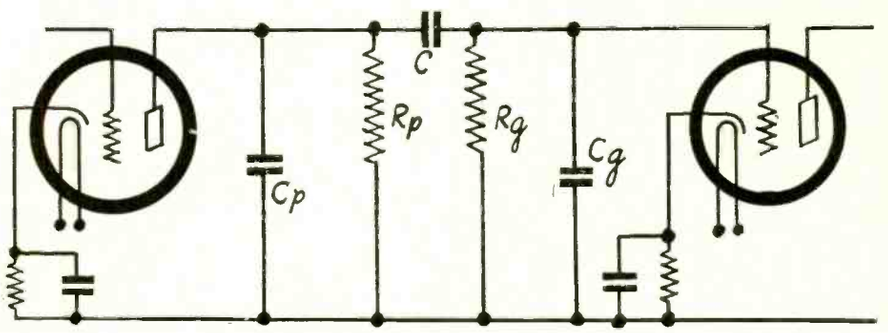
Real Fidelity in Audio Amplification of Wide Band of Frequencies Does Not Exist—Filters the Only Solution

By J. E. Anderson

IT IS generally thought that a resistance-coupled amplifier is distortionless insofar as frequency discrimination is concerned. This is far from the fact, and the reason is that there are capacities involved as well as resistances.

In Fig. 1 is a typical resistance-coupled circuit. The capacities involved are Cp, the plate to cathode capacity of the tube and any by-pass capacity that may be connected there for the purpose of shunting radio-frequency currents to ground; C, the plate-to-grid coupling capacity, and Cg, the grid to cathode capacity of the second tube.

It is generally thought that the shunt capacities are so small that they do not count and that the series capacity C is so large that there can be only a negligible voltage drop across it. The assumption is justified only if we limit the frequency of transmission between about 100 cycles and 5,000 cycles.



This is a typical resistance-capacity coupler which discriminates against both the highs and the lows. It acts as a tuned circuit.

A Tuned Circuit

When the signal frequency is high C offers little obstruction and it can be disregarded. But Cp and Cg, though small, will appreciably cut down the voltage transfer. Even when the frequency is as low as 10,000 cycles the reduction is serious.

When the frequency is low, the shunt capacities Cp and Cg do not cut down the voltage transfer, but the series capacity C does. The reduction begins to be appreciable, for ordinary values of C and Rg, at about 100 cycles. At 50 cycles the reduction is quite large, and at 25 cycles very little signal voltage gets to the grid of the second tube.

The effect of the series and shunt capacities is to produce a broadly tuned circuit. The series and shunt reactances cancel each other when $w^2=(R_p+r_p)/r_pR_pR_g(C_pC_g+CC_p+CC_g)$, in which w is 6.28 times the frequency and the various condensers and resistances are as indicated in Fig. 1.

The maximum amplification occurs very close to the frequency thus determined, but not exactly. For practical purposes we may regard the expression as giving the frequency at which the gain is greatest.

Let us assign typical values to the various parameters in the formula to see about where the greatest gain will occur. R_p is usually 250,000 ohms, R_g, 500,000 ohms, C_p about 250 mmfd., the effective value of C_g about 100 mmfd., and C about 0.01 mfd. The value of C_g depends on what follows the second tube and also on what that tube is. It may be larger than the value given, and it may be smaller. The value of r_p depends on the tube preceding the coupler, and we may assume a value of 100,000 ohms as an average value. Putting these values in the formula and solving for the frequency of "resonance," we obtain 450 cycles.

Gain at Other Frequencies

Below this "resonance" frequency the amplification falls, slowly at first and then more rapidly. Above the frequency the amplification also falls in about the same manner. If the curve is plotted with amplification against the logarithms of the frequency, that is, on an octave basis, it is very nearly symmetrical about the frequency of maximum gain. Thus at 10,000 cycles the gain would be the same as at 20.25 cycles. At 5,000 cycles it would be the same as at 40.5 cycles. Again, it would be the same at 2,025 and 100 cycles.

The amplification of a resistance-capacity amplifier, therefore, is far from uniform.

It might be argued that in a circuit in which the series condenser is omitted, as is the case of the Loftin-White circuit, the amplification would be uniform. Such is not the case, for the shunt capacities are still present to cut down the gain at the high frequencies. This coupler amounts to a low pass filter. The low frequencies do come through without relative loss, but the high frequencies are discriminated against even more than in the example given. The reason for this is that the resistances involved are usually much larger, and for that reason the effects of the shunt capacities are much greater. This is true in any case where a condenser is connected across a resistance, that is, the higher the resistance the greater will be the discrimination of high frequencies due to a given capacity.

Television Amplifiers

In a television amplifier it is essential that the amplification be uniform from about 20 cycles per second to about 50,000 cycles. It is clear from the preceding that an ordinary resistance-capacity coupler cannot be used, for the discrimination would be excessive at both extremes. Indeed, there would be little amplification at 20 cycles and hardly any at all at 50,000 cycles.

The problem of obtaining a high amplification at 20 cycles is not nearly so difficult as that of obtaining high amplification at 50,000 cycles. All that is necessary is to make the series capacity large. We assumed in the example that the series capacity was only 0.01 mfd. There is no reason why it should not be 10 mfd., or infinite as in the case of the Loftin-White circuit.

To obtain a high gain at the higher frequencies the first essential is to reduce the shunt capacities to the lowest possible values. But there is a limit to this, because they cannot be reduced beyond the self capacities of the two tubes.

The only improvement that can be effected in this direction is to reduce the shunt resistances so that the tube capacities will have relatively little effect. But in order to make any appreciable improvement above 20,000 cycles, it is necessary to use plate and grid resistances as low as 500 ohms, in place of the usual 250,000 and 500,000 ohms.

Reduction of Gain

But as the resistances are reduced the gain is also reduced, and rapidly. Hence it becomes essential to use more stages of amplification. This in turn introduces more shunt capacities, and more discrimination for the discrimination in the individual stages is cumulative. There is a limit, then, even in reducing the coupling resistances.

There is still another point in this connection. As the coupling resistances are reduced, it is essential to increase the series capacity, unless the amplifier is of the Loftin-White type. A condenser of 5 mfd. might be all right for the low notes when the grid leak is 0.5 megohm but it will not do if the grid leak is 500 ohms. A series capacity of 100 mfd. would be nearer what is required.

One way of reducing the plate capacity is to use low mu tubes, for they nearly always have lower plate-to-cathode capacity than high mu tubes, and especially than pentodes and screen grid tubes. But using tubes with low gain makes it necessary to use more stages, and again the capacities are multiplied and the discrimination increased.

Elimination of Audio

The ideal arrangement would seem to be a circuit in which there is no audio frequency amplification at all, and there is no doubt that that is the case. The radio frequency gain would then be increased sufficiently to make it possible to get enough audio out of the detector to operate the neon tube or the Kerr cell.

This, however, is not the complete solution of the discrimination problem. It is really only the beginning. There is plenty of discrimination in the radio frequency amplifier due to tuning. This is in direction proportion to the selectivity of the

(*Continued on next page*)

TUBES ARE BETTER

Greater Mechanical Strength Achieved, Higher Performance in Small Space

WHILE the primary purpose of "Application Notes" is the presentation of engineering data, it is felt by RCA Radiotron Co. and E. T. Cunningham, Inc., that recent innovations in tube design and construction merit the attention of the set engineer. All improvements in tube quality and uniformity should be of interest to the radio set engineer since they make possible the design of better receivers.

Improvements in radio tube design and construction are not necessarily limited to the forward steps represented by the introduction of new tube types. Existing tube types can be made better by careful study of their inherent weaknesses and the adoption of new manufacturing technique designed to overcome these faults.

The RCA Radiotron Company and E. T. Cunningham, Inc., are constantly experimenting to determine how the quality and uniformity of their product can be improved. The past year has marked the introduction of many improvements in the design and construction of Cunningham Radio Tubes and RCA Radiotrons. Some of these improvements are readily apparent, while others of equal importance are not so obvious.

Dome Bulb Construction

The introduction of the dome-bulb type of construction has made possible the greater uniformity of tubes. This dome-bulb construction has been incorporated in most of the newer types. Older types are being adapted to this form of construction as rapidly as development and manufacturing activities permit.

A mica support at the top of the electrode assembly fits into the dome of the bulb, bracing the tube's structure against mechanical displacement. Furthermore, the greater strength of the electrode assembly secured by the dome support has made it possible to simplify the construction of the tube, thus eliminating many welds and parts, and reducing the chances of error during assembly.

The resulting increase in uniformity of tube characteristics is a decided benefit to the set engineer, since it permits him to design receivers with closer tolerances and consequently better performance. The greater strength and rigidity of the dome bulb, preventing mechanical injury to the electrodes during shipment is assurance that the tubes used by the consumer will meet the exacting requirements of the set engineer.

Many new tubes are considerably smaller than preceding types. In some cases this reduction in size has been made possible by the use of better glass and by structural improvements in the tubes themselves. Since more efficient dissipation of heat reduces the limiting effects of grid emission and stem electrolysis, higher outputs are obtainable with these small-sized tubes.

The smaller size bulbs permit a saving in chassis space, a reduction in shipping weight, and the use of less packing materials.

New types of cathodes (such as the multifilamentary cathode employed in the 2A3) have opened new possibilities in tube design. Because of the large surface area of these cathodes, improvements in mutual conductance, lower plate resistance, and greater power are possible. Consequently, improved receiver performance is possible while the cost of circuit apparatus is lower.

Developments in new and small-sized cathodes have been incorporated in heater type tubes introduced during the past year. The better emission characteristics of the new cathodes have permitted the design of more powerful output tubes, since more plate current is made available for a given size of cathode. Because of a decrease in the amount of heat required to produce a given amount of emission, the new cathodes are economical of heater-power consumption.

Reduced Electrode Size

Smaller size cathodes are desirable because they allow the size of the whole electrode structure of the tube to be reduced. Economies in heater power consumption permit savings in circuit wiring and power transformer costs.

A careful study of heater-cathode-design problems has produced a new form of heater which has helped to decrease hum levels. Employing a reversed helical winding which is baked in a ceramic, the new heaters greatly reduce the electromagnetic field responsible for a large part of the hum in heater-cathode tubes. A reduction in heater (cathode) hum means that the overall hum may be sufficiently reduced so that less plate supply filtering will prove satisfactory.

Grid emission, which is always a troublesome problem in radio tube design and manufacture, has been greatly reduced by the application of new manufacturing methods.

The use of copper side rods, heat radiators, new grid materials, and grid wire which has been carbonized has aided in the control of grid emission. Certain older types of tubes, such as the 24-A, have been redesigned to use copper side rods for the grid. Copper is a better conductor of heat than materials formerly used for side rods. The superior conduction characteristic of copper enables it to carry off and dissipate more heat, resulting in a cooler grid.

Four Grid Emitters

Newer types of tubes, such as the 43, 48, 2A5 and 42, which employ cathodes requiring a large amount of heat, are subject to grid-emission troubles due to the proximity of the control grid to the cathode. To overcome this difficulty, heat radiators are mounted on the top of the grid side rods to help dissipate the heat which causes grid emission.

In addition, the use of new materials for the grid wires themselves has produced a cooler grid. As one example, the 59 employs for the grids adjacent to the cathode wire that has been carbonized. The carbonized metal reduces secondary emission and radiates heat so as to maintain the grid at a temperature low enough to prevent excessive primary emission.

The practical effect of reduced grid emission is that the tube dissipation can be increased. Higher internal dissipation means higher output from the tube and better performance from the radio set.

Another practical benefit to the set engineer resulting from a reduction in grid emission is the feasibility of operating tubes such as the 2A5 with resistance coupling, since the use of moderate values of resistance in the grid circuit of these tubes will not cause a loss of bias due to grid emission. Unless grid emission in certain output tubes is held to a low value, their use is limited to transformer-coupled circuits.

Rigorous Tests

A more stringent and exacting series of tests has been initiated for each tube type. Every tube is subjected to these tests. Each tube must conform to the standards of quality and uniformity established for that type.

Noisy tubes are frequently the source of trouble in receivers after they have been put in use by the customer. While this trouble has often been blamed upon man-made static, in many cases the tubes themselves were the cause. To guard against noisy operation in preliminary amplifier and detector applications, every tube of the types so employed receives a noise test in high-sensitivity receiving circuits in addition to numerous other electrical tests. In this way those tubes which might cause trouble are entirely eliminated.

Straight Characteristic Audio Filters

(*Continued from preceding page*)

circuit. The requirement in broadcast reception is that the receiver be able to separate two powerful stations separated by only 10,000 cycles. Obviously, such a receiver cannot be used for television reception, which must pass a band of 50,000 cycles either side of the carrier frequency. The broadcast set must be at least 20 times as selective as the television set should be.

There are various methods of making a set broad. One is to make each circuit broad. Another is to stagger the tuned circuits so that the band passed by the combined selector has the necessary width. Still another way is to use band pass filters. Of course, this is, in effect, a method of staggering tuned circuits. If filters are used the peaks can be placed as far apart as 50,000 cycles without any difficulty. But when that is done, what happens in between the peaks? Comparatively little comes through. Hence this is a way of emphasizing the high frequencies in the sidebands against the low frequencies. But filters can be constructed that have a practically straight characteristic from one extreme to the other. This is a problem of band pass filter design.

With the values given in the above example for the resistance-capacity coupler, the amplification at "resonance" is about 25, assuming that the amplification factor of the first tube is 40. At 10 cycles per second, and therefore at 20,250 cycles, the amplification is down to 9. Expressed in decibels this is equal to 8.876 db. That is serious frequency discrimination.

NATURAL CAPACITY TUNING

Intermediate Coils Without Extra Condensers Across Them

FREQUENCY stability in a superheterodyne has to do largely with the oscillator and the intermediate amplifier. In the oscillator the tube and circuit have to be such as to afford good stability, and if padding is used, then the padding condenser has to stay put. For ordinary purposes the spring-type, compression-adjusted condensers are satisfactory for padding, but for greater maintenance of setting air-dielectric condensers should be used.

However, if the capacity is high, and air-dielectric requires a large unit, then a fixed capacity may be used, with a small air-dielectric condenser across it. The fixed capacity may be mica, of the moulded type, as thus moisture is kept out, as the changes due to temperature are not serious.

With the compression type there may be 6 pounds of pressure on the spring, and this may tell in time on the threaded bolt, so that the capacity will change. Moreover, if the mica dielectric generally used in the compression type is loose, it too may shift a bit, contributing to the frequency alteration.

Non-Hygroscopic Form

In the intermediate amplifier air-dielectric condensers may be used for frequency stability, and besides the coil and form should be wax-impregnated, or otherwise treated, to reduce moisture effects. It might be preferable to have a form that is virtually impervious to moisture, that is, non-hygroscopic. Several materials of this type are on the market.

Another way would be to wind large inductance coils and depend on the natural capacity for resonance. This capacity would consist of the tube element capacity, the capacity of the coil and also the capacity of the shield and wiring affecting the stage concerned.

I thought of doing this in connection with both plate and grid circuits and tried out the idea with a transformer consisting of two honeycomb coils of 30 millihenries unshielded inductance. When the two coils were put into a shield, and separated by 1.5 inches, of course the inductance dropped, due to the shield, as it did due to the effect of the mutual inductance.

Two equal coils were used because the capacity of a single circuit (input and output) would not be so greatly different. Though the plate capacity would run a few micro-microfarads greater than the grid capacity, the extra capacities were large in comparison, so the net result was a capacity in each circuit not far different from the capacity in the other.

Frequencies Obtained

The resonance point was around 250 kc. Or perhaps it would be more accurate to state that there were resonance points centering about a frequency somewhat close to 250 kc. Four points were noted. Three of them were successively 2 kc apart and the fourth was the highest frequency and was 4 kc removed from its neighboring peak. It may be assumed therefore that the plate circuit had one peak, the grid circuit another, the pair as a unit another, but where the fourth peak came from is a mystery. The effect of course was that of a band-pass filter, and it was a fairly wide one, say, 10 kc out of 250 kc, which would be equivalent to 20 kc in the tuner of a broadcast superheterodyne at the low frequency end of the tuning and 60 kc at the high frequency end of the tuner.

The first stage tube was a 58, biased as usual, about 3 volts negative, with 250 volts on the plate.

Then another stage was inserted, but the frequency of response was much different, so much different in fact that little came through, although there was oscillation now in the only i-f tube used, as the second one was the second detector. Such oscillation, despite a considerable difference in frequency in the second detector, was to be expected, as with coils of such high inductance the coupling was too close, primary to secondary, and one transformer to another. While about 1.5 inches represents a fair physical separation of primary and secondary for frequencies of the region concerned, that applies only to the orthodox coil system, consisting of a moderate inductance and a moderate capacity, whereas here the inductance greatly exceeds the capacity.

Lower Frequency

The difference in frequency in the second stage is due also in part to the fact that the tube had a high negative bias, some 15 volts, and thus the plate impedance was higher. Consequently the shunt capacities due to tube elements, wiring, etc., was more effective, and the frequency was considerable lower, estimated at 150 kc.

However, the fact was proved that the system does work to the extent of enabling use of the inherent capacities, with large inductance, instead of the more usual method, and of course such capacities are fixed in a real sense, and the frequency stability, or freedom from shift, in the intermediate level, would be high. The detail left undone is to select just the right inductance value for the observed capacity in each circuit, and render the coupling loose enough. It is believed that a separation of a few inches between primary and secondary, and several inches between transformers will be necessary.

Taking a single stage, the response is large, much larger than with the standard systems. This can be realized quite readily as the effect of the high impedance in the plate circuit.

First Time for Dual Treatment

The selection of such a natural-capacity-tuned coil in the plate circuit has been made before, but this is the first time it is suggested that both the plate and grid circuits be treated the same way.

The actual accommodation of the inductance to the capacity can be worked out by any one who sees fit to set up a superheterodyne, with oscillator separately tuned, not ganged, and who will use coils as intermediate coupler direct to second detector and again to intermediate amplifier to note the frequencies of response. Starting with the higher frequency circuit, let that be the determinant, and reduce turns from the coils in the lower frequency circuit until resonance prevails. The attenuation of 10 db with one coil indicates attenuation of 20 db with two coils, that is, selectivity will improve to a practical value and gain will be enormous.

—Herman Bernard.

Men of the Moment

Jack Benny often has difficulty in convincing people that Jack Benny is his real name. But the facts are that he was born Jack Benny in Chicago, February 14, 1894, and attended Waukegan High School, Waukegan, Ill.

Benny got his first taste of the show business in vaudeville in a musical act. Later he made the Shubert revues on Broadway and then broke into the pictures with Metro Goldwyn Mayer. His first picture was "Hollywood Review." He made his mark with Earl Carroll's Vanities for two seasons and is today relatively a newcomer to radio, though very popular.

Bill Hay, who has been putting Amos 'n' Andy on the air now for several years, arrived late for the program recently for the first time in many moons. Held in another studio by a previous program until the last minute, Bill dashed into the Amos 'n' Andy program with the wrong continuity.

Ordering the organist to continue playing until he returned, Bill made a wild dash for his office where the necessary continuity was cached. When he finally returned the organist had been playing for four minutes. Amos 'n' Andy managed to squeeze through by running over the scheduled time only one minute.

Polarity Often Important Even with A-C Outlets

Polarity plays an important part in determining how you shall plug in your radio set to the wall outlet, points out the service department of Fada Radio and Electric Corporation, but it is not necessary to understand the technicality of polarity. All that it is necessary to remember is to reverse the plug if you run into difficulty.

There is a difference, as all technicians know, in the case of a-c and d-c power lines. In direct current there is only one way in which the plug can be inserted to furnish the current for reception, for the polarity "runs" in only one direction. This fact is generally known to set owners or they discover it.

But it is not as generally known that in alternating current that by a simple reversal of the plug one often may improve reception considerably. The polarity "runs" both ways in a-c, but better one way than the other. If you feel that your set isn't doing justice in an a-c neighborhood, try reversing the plug in the wall outlet.

Filter Capacity Measurement; Also Choke Coil Inductance

By J. E. Anderson

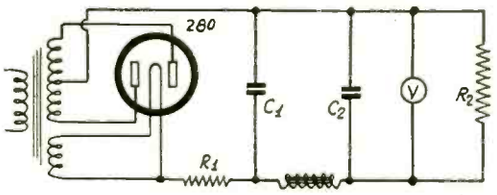


FIG. 1
A B supply circuit like this can be arranged to measure capacities by calibrating C1 against the output voltage V.

IT IS well known that the voltage output of a rectifier varies with the capacity that is put across the circuit next to the rectifier. When there is no condenser, that is, when there is choke input to the filter, the voltage is considerably lower than when a condenser is used. Also, the larger the condenser the higher the output voltage.

Use of Rectifier

These facts make it possible to use the rectifier as a means of measuring condenser capacities. The effectiveness of this method depends on the regulation of the rectifier and on the current drawn. The poorer the regulation the greater will be the variation in the output voltage. In a B supply the regulation should be as good as possible. In a device intended for capacity measurement, on the other hand, the regulation should be poor. The simplest way, perhaps, of making the regulation poor in an otherwise good rectifier and filter system is to put in a resistance R1, Fig. 1. The voltage varies because of resistance and therefore if we want greater variation we increase the resistance. A high resistance field coil will do likewise.

Calibration Necessary

If this method is to be used for the measurement of capacities, it is necessary to calibrate the circuit with known capacities. The voltmeter is put across the voltage divider, which in this case need only be a fixed resistance R2. If there already is a resistance and if it is tapped, it is all right. However, the load should be constant so that nothing should be connected across the voltage divider except the voltmeter.

Needs Constant Line Voltage

The method fails if the line voltage does not remain constant, for the line voltage not only determines the maximum voltage possible, and hence any fraction of it, but it also determines to a large extent the regulation of the device, for this depends on the filament temperature. Therefore it is important that the line voltage is the same when condensers are measured as it was when the circuit was calibrated.

The calibration consists of measuring the output voltage for various known capacities in the position C1. First a reading should be taken when there is no condenser across the rectifier line in this position. Then it should be measured with various capacities across the line. The data thus obtained, that is, output voltages and condenser capacities, should be entered on a graph in which the abscissas are voltages and the ordinates are capacities.

After this curve has been plotted the capacity of any other condenser, within the range of the calibration, may be measured by obtaining the voltage and reading off the corresponding capacity on the curve.

Condenser Set Needed

To apply this method it is necessary to have a set of condensers, ranging from about 1 to 10 mfd., the capacities of which are known. A set of four, each condenser having the following capacities, will be sufficient: 1, 2, 4 and 4 mfd. By suitably combining these in parallel values from 1 to 11 can be obtained in steps of 1. Of course, these "standards" need not be exceedingly accurate for the method of measurement is not one of extreme accuracy. Neither is high accuracy needed in condensers of this capacity.

Measuring Larger Condensers

The limit of the calibration is not the limit of the size of condensers that can be measured because it is always possible to connect a known condenser in series with an unknown. The known and the unknown when in series will form a condenser of smaller capacity that can be measured. When the capacity of the combination is known, the unknown can be computed. If the capacity of the known is C and that of the combination C1, the capacity of the large unknown is CC1/(C1—C).

It is also possible to measure condensers smaller than the smallest used in the calibration. This can be done directly, for the first reading on the calibration was for zero capacity, and there can be no capacity smaller than that. Incidentally, the method is more accurate for small condensers than for large, because the regulation curve varies more rapidly near zero capacity than it does for large capacities.

When the curve is plotted as suggested above, that is, voltage along the abscissas and the capacity along the ordinates, it will appear as the curve in Fig. 2. When the capacity is zero the voltage is least, and when the capacity is maximum the voltage is maximum. The rate at which the curve rises will depend on the value of the resistance R1 and R2 in Fig. 1.

Measurement of Large Inductance

The measurement of inductances of large value is a problem that usually requires a bridge and inductances standards. The problem is especially difficult if the inductance is to be measured when direct current flows through the coil as well as alternating current.

One way of measuring inductance without a bridge is to measure the current through it when a known alternating voltage is applied across it. This voltage might be the 110 volts of the a-c line. If the current is measured with a thermo-ammeter the inductance can be found by Ohm's law and a little computation. What is obtained directly is the impedance of the coil. Suppose we connect a voltage V across the coil and that the ammeter reads I amperes. Then the impedance Z of the coil is V/I. To apply this method it is only necessary to choose the sensitivity of the a-c ammeter so that the current is within range of it.

Impedance and Inductance

Knowing the impedance of the coil to a 60-cycle frequency is not quite the same as knowing the inductance. However, if the resistance of the coil is negligible the impedance is simply 6.28FL, in which F is the frequency of the current and L is the inductance in henries. Therefore we may write $L = 0.00265\,E/I$. Here the voltage may have any value. If the line voltage is 115 volts, which is about the average, the formula becomes $L = 0.305/I$ henries.

If we know approximately what the inductance is we can select the meter beforehand with the assurance that the current will be within its range. Thus if the inductance is 30 henries, the current will be about 0.0102 ampere, i. e., 10.2 milliam-

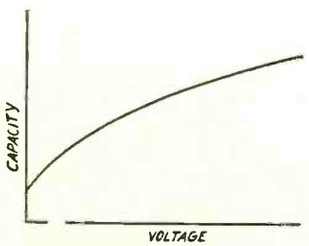


FIG. 2
The calibration curve of the capacity meter in Fig. 1 will look like this.

peres. One of the 115-milliampere thermoammeters would work all right.

Effect of Resistance

When the resistance of the coil is not negligible, the impedance obtained by the above method is the effective value, which is the square root of the sum of the squares of the resistance and the reactance. That is, $Z=(R^2+L^2w^2)^{1/2}$, in which R is the resistance in ohms, L the inductance in henries, and w is the frequency multiplied by 6.28.

R is the resistance to alternating current. This differs slightly from the d-c resistance. However, the d-c resistance may be used in the formula without introducing much error. Therefore it is possible to get a fairly close value for the inductance even when the resistance is not negligible. The d-c resistance may be measured with an ohmmeter, using a battery as a voltage source, and when that is known the inductance is easily computed.

Obtaining "Standard" Condensers

With the aid of a little ingenuity and a few pieces of equipment it is possible to build up or to select condensers that have given capacities. Let us first assume that an oscillator tunable to some frequency between 20,000 and 50,000 cycles. Next let us assume that sufficient parts for building another oscillator are available, an oscillator that will cover about the same range as the calibrated oscillator. A coil of known inductance is needed, and one can be obtained that is sufficiently accurate without the outlay of more than a few cents. Use this coil as the tuned coil in the auxiliary oscillator and another coil of the same value, or approximately the same, as tickler. The circuit may be hooked up as in Fig. 3, in which L is the known inductance and C is the capacity that is to be adjusted. L1 is the tickler.

Suppose, for example, that the coil L has an inductance of 3 millihenries. If C has a value of 0.02 mfd., the circuit will oscillate at 20,550 cycles. If, therefore, the calibrated oscillator is set at this frequency and the auxiliary oscillator is adjusted to zero beat with it, the capacity required across L will be 0.02 mfd. If several nominally 0.02 mfd. condensers are available they can be put across L and the one that gives the lowest beat is the nearest to 0.02 mfd.

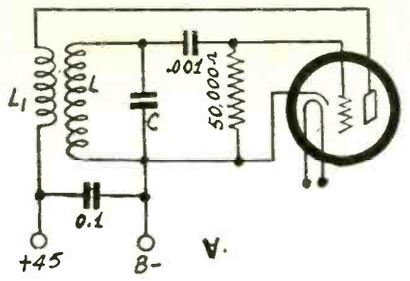


FIG. 3

The circuit of an auxiliary oscillator that can be used for determining C if L is known.

The capacity can also be computed from the known inductance and the frequency. Whatever the capacity of C may be, if it is within range of the calibrated oscillator, zero beat can be obtained, and the frequency can be determined. The capacity of C can be computed, for $C=\frac{1}{4\pi^2 LF^2}$.

Adjusting the Condenser

If the capacity is not just right, it can be made so by adding small condensers in parallel with it.

Larger values of capacity can be built up by connecting small condensers in parallel. The various condensers are first measured by the method suggested above. The sum of the capacities will then be the capacity of the combination when all are in parallel. It is easy to build up a condenser of 0.1 mfd. in this manner. It is not likely that the sum of a given number of small condensers will be just 0.1 mfd., but a small adjustable condenser can always be used finally to make the number come out even.

In many cases it is not necessary that the capacity of a condenser be of a given unitary value. All that is required is that the capacity be known, whatever it may be. It is just as easy to work with a condenser 0.091, for example, as one of 0.1 mfd., just so it is known that the value is 0.091 mfd.

A large condenser can also be measured by the series method. Suppose that a small condenser has been measured with the oscillator as suggested above and that a condenser ten times this value is to be measured. It can be connected in series with the known value and the frequency of the auxiliary oscillator measured with the calibrated oscillation. When the frequency is known the capacity of the series combination can be obtained, and from that the capacity of a large unknown.

Numerical Example

Let us suppose that the known condenser is 0.02 mfd. and the coil in the auxiliary oscillator is 3 millihenries. Next let us suppose that the frequency is 25,000 cycles when the large unknown condenser is in series with the 0.02 mfd. condenser. Then we know that the capacity of the series combination is 0.0135 mfd. When one condenser of 0.02 mfd. is connected in series with another and the combination makes a capacity of 0.0135 mfd., the unknown condenser must have a capacity of 0.0418 mfd.

Had the frequency of the oscillator been less than 25,000 cycles, the capacity of the unknown would have been larger. It is clear that if accurate results are to be obtained when the series condenser is large it is necessary to measure the frequencies very accurately.

Growth of High Power in Mexico Held Menace to Stations Here

Washington.

The growth of high-powered radio stations on the Mexican border has become a distinct liability as to American broadcasting, although such stations are not inherently evil, according to a report on the radio market in Mexico issued by the Bureau of Foreign and Domestic Commerce, Department of Commerce.

The report is based upon information transmitted by Assistant Trade Commissioner Edward D. McLaughlin at Mexico City and consular officers throughout the country.

High-Powered Stations Increase

The section of the report dealing with border stations and regulation of broadcasting in Mexico follows:

A most important phase of present Mexican radio is the growth of high-powered border stations. These stations, erected with at least a partial view to coverage in the United States, but operating under real or supposed advantages to be gained under Mexican jurisdiction, are not inherently evil, but through unexpected developments of the past few years, they have become a distinct liability as to American broadcasting. The admission of Mexico to a share of the available frequencies, and consultation in developing cooperative regulation as between that Government and the United States, Canada, and other interested North American governments, is the expected result of a conference to be held this year.

Results Problematical

What methods will be adopted by such conference of course can not be forecast; hence what effect it may have on the future of broadcasting in any of the countries involved is yet obscure, as only one aim is apparent—the provision for improved facilities for Mexico, naturally with as little loss to the other countries involved as may be arranged.

This one purpose, however, indicates a most certain improvement in Mexican broadcasting, reduced interference caused by the American and Canadian stations on channels near those used by Mexican stations, and a basis for a larger market for receiving sets and equipment.

The value of broadcasting licenses should also be increased, with a competition which can be used to encourage better programs.

The Mexican System

The regulation of Mexican broadcasting falls under the jurisdiction of the Secretaria de Communicaciones. Broadcasting licenses are issued at a fixed rate, the fee to be cancellable if the station is placed for certain periods at the disposal of the Government for educational broadcasts. Mexican citizens and corporations alone are permitted to broadcast. The registration of receiving sets is required by law, though unenforced to the extent of having become practically a dead letter.

No Business, Lawyer Turns Hermit, But Takes Set

Boston, Mass.

The captain of one of the Canadian National Steamships arriving here from the British West Indies brings back a story of a Granada lawyer, feeling that the next six months would bring no business, laid in a stock of literature, some simple food, put his radio into good condition and has retired to bed with the intention of getting up only to take exercise, to feed himself and to bathe.

A THOUGHT FOR THE WEEK

WHERE are those five-minute sponsored programs we have heard so much about? We understand quite a number are on the way and that chain stations will be offering these spasmodic bits before June has come around. The idea is interesting and seems to indicate that the business heads of radio are willing to admit that a third of a loaf of business is better than an empty cupboard.

POWERTONE SHORT

By Frank Grimes a

UNIVERSAL receivers are rapidly gaining popularity. Now the universal principle has been applied to short-wave receivers, and successfully, too. We are showing herewith the Powertone universal short-wave receiver. This circuit employs only three tubes, a 78 as regenerative detector, a 43 as power tube, and a 25Z5 as rectifier for the power supply.

As in all universal sets, the heaters of the tubes are connected in series, which in this case can be done without complications because all the tubes required the same heater current, namely, 0.3 ampere. The 78 requires a terminal voltage of 6.3 volts and each of the other tubes a voltage of 25. Therefore the total voltage is 56.3 volts. If the line voltage is 115 volts, which is a fair average, there is an excess voltage of 58.7 volts, which must be dropped in a ballast resistor. If the current is to be 0.3 ampere, it would require a ballast resistor of 196 ohms to drop the excess. A resistor of 200 ohms is specified and used, for this is the nearest commercial value.

The wattage dissipation in this ballast resistor will be 17.6 watts. The resistor specified and used is capable of a dissipation of 20 watts without undue heating, and therefore there is ample margin.

The B Supply

The 25Z5 is used as rectifier when the circuit is used on an alternating current line, and it is left floating when the circuit is used on a direct current line. While its use is essential when the supply is alternating it is not a dead weight when the supply is direct, because the tube helps to filter out the noise on line.

In a regenerative receiver thorough filtering is required if the hum is to be kept out of the signal. This is particularly the case when the circuit is used to receive short wave signals and also when the heaters are operated on alternating current. It is for this reason that three high-inductance choke coils are used in the positive lead of the B supply circuit. These chokes are particularly effective because the total current through them is extremely low, as there is no saturation effect in the cores.

But these chokes alone are not sufficient. Very large by-pass condensers are also used. Next to the rectifier tube is a 16 mmfd. electrolytic condenser. Another of 8 mfd. is connected between the junction of the second and third chokes and ground, and finally one 16 mfd. is put across the output of the filter. There there is a total by-pass capacity of 40 mfd. That and the thorough choking are enough to remove every trace of hum even when the regeneration is pushed to the ultimate limit.

Coils Used

The heart of any short-wave receiver is really the tuning system. The coils used must be efficient. The tuning condenser must be easily turned, and it must not be too large. The regeneration must be smooth and must not be subject to body capacity. All these requirements are met satisfactorily in the Powertone short-wave circuit.

There are four large plug-in type coils to cover the entire short-wave band. They are known as Octoform coils because there are eight equi-spaced ribs on which the wire is wound. Thus the wires are practically wound on air, for it touches the form at only eight points for each turn. Moreover, the turns are spaced so that capacity between adjacent turns is practically nil. This form of winding makes the most efficient coil practicable.

The forms are of different color to identify the wave band. The largest coil is red, the next brown, the next blue, and the smallest green.

Turns

Each coil has two windings, the tuned and the tickler. The largest coil contains 51 turns of No. 24 enameled wire for the tuned circuit and 19 turns of the same wire for the tickler. There is a separation of ⅛ inch between these two windings. The next largest coil contains 26 turns of No. 24 turns of double silk covered wire for the tuned winding and 13 turns of No. 24 enameled wire for the tickler. Between these two windings is also a separation of ⅛ inch.

The third coil in point of size contains 13 turns of No. 24 double silk covered wire for the tuned circuit and 8 turns of No. 24 enameled wire for the tickler. The separation between adjacent turns of the tuned winding is about ⅛ inch and the separation between the tickler and the tuned winding is about ¼ inch.

The smallest coil contains only 5 turns of No. 24 double silk covered wire for the tuned winding and the same number of No. 24 enameled wire for the tickler. The spacing of turns in the tuned winding is 3/16 inch and the spacing between windings is about ¼ inch.

Each form is provided with a flange at the upper end to provide an easy grip to facilitate changing of coils and this flange is sufficiently far removed from the turns that there is no danger of disturbing the windings. This is important in that it insures constancy of calibration. Moreover, the tickler is nearer the flange so that if there should be any displacement of turns it will be those of the tickler and the calibration will not change.

Variable Condensers

The tuning condenser is a 19-plate Hammarlund midget having a rated maximum capacity of 140 mmfd. The tickler condenser is of the same size and type.

The tuning condenser is controlled by a slow-motion mechanism. A large dial is attached to this mechanism and a long, moving pointer indicates the setting.

The regeneration control is a simple knob, but the condenser turns so easily that there is no difficulty in precise adjustment of the volume. Besides, the rotor of the regeneration condenser is grounded, as will be noticed by the diagram of the circuit. Therefore there is no body capacity to make adjustment difficult. This feature is of utmost importance in any short-wave regenerative receiver, for if the regeneration cannot be controlled easily and positively maximum results are impossible.

Parallel Feed

The plate of the regenerative tube is parallel fed. The tickler is connected in series with the control condenser between the plate and ground. The plate voltage is supplied through a 250,000-ohm plate coupling resistor and a radio frequency choke. The purpose of the choke is to prevent radio frequency current from escaping through the stray capacity in the resistance-capacity coupler and the grid-to-cathode capacity of the power tube. It serves this purpose primarily at the very highest frequencies, but, of course, it is there for the lower frequencies as well.

It will be noticed that a grid leak of 3 megohms is used in the detector circuit and that it is shunted by a condenser of 0.0001 mfd. This combination has been found to give exceptionally high sensitivity for the 78 tube when operated in the manner of this circuit. The suppresser grid is connected

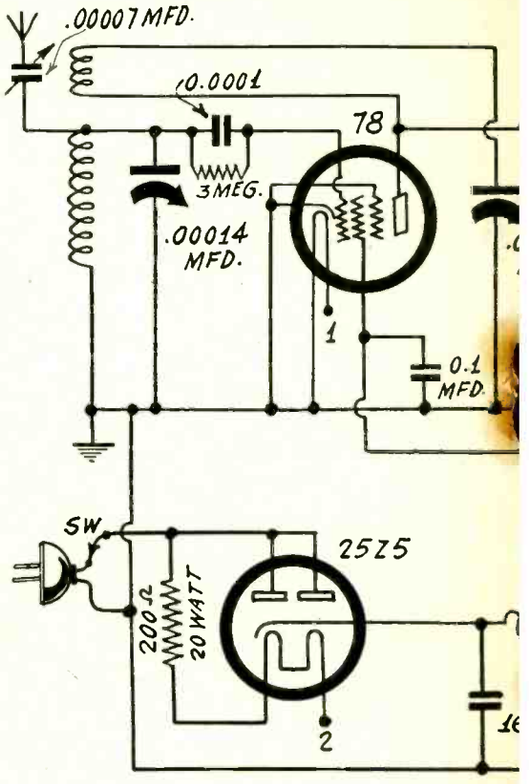


FIG
The circuit diagram of the Powe

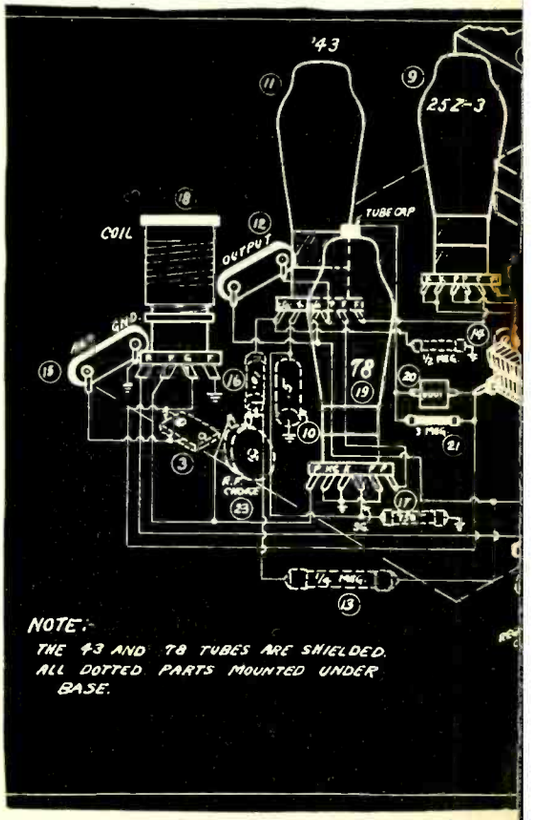
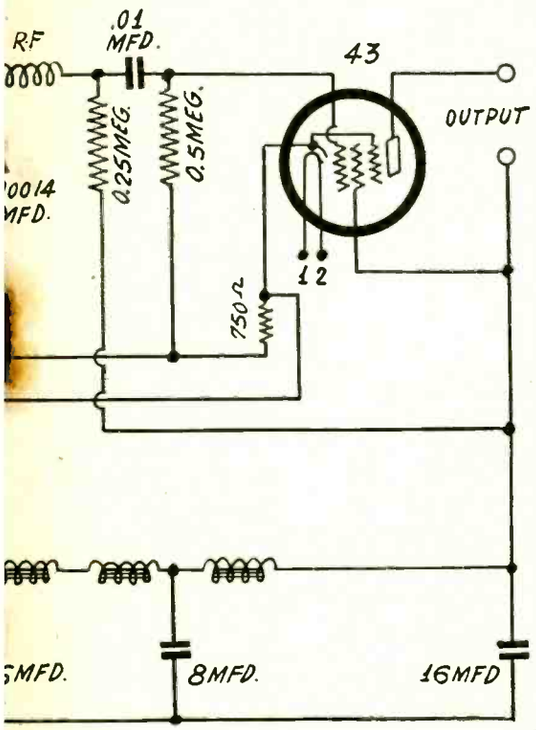


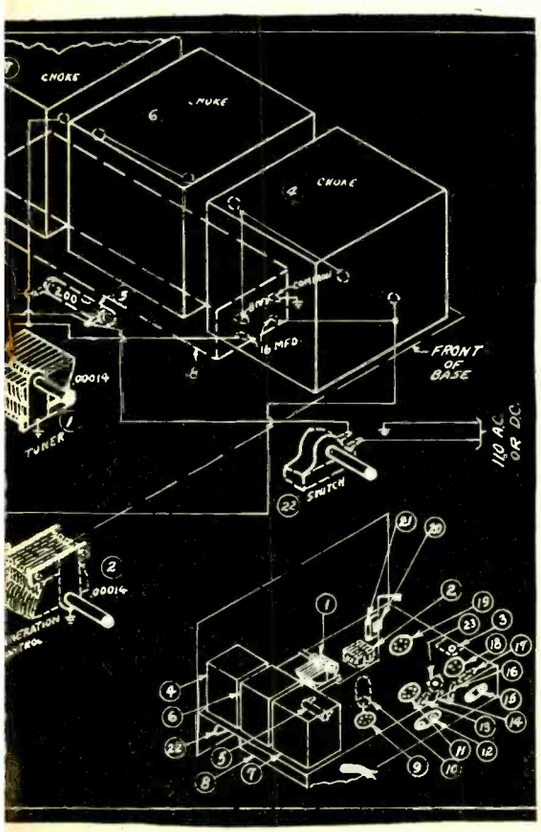
FIG
The pictorial diagram of the Powertone

T WAVE UNIVERSAL

nd Herman Cosman



. 1
tone universal short-wave receiver.



. 2
three-tube universal short-wave receiver.

LIST OF PARTS

Coils

One set of four two-winding short-wave plug-in coils
One 10-millihenry radio frequency choke coil
Three high-inductance filter chokes (about 30 henries each)

Condensers

Two 140 mmfd. variable condensers (Hammarlund)
One 70 mmfd. adjustable condenser (Hammarlund)
One 0.0001 mfd. grid condenser
One 0.01 mfd. stopping condenser
One 0.1 mfd. by-pass condenser
Three electrolytic condensers, two 16 mfd. and one 8 mfd., in one unit

Resistors

One 3-megohm grid leak
One 250,000-ohm coupling resistor
One 0.5-megohm grid leak
One 750-ohm bias resistor (one watt)
One 200-ohm, 20-watt ballast resistor

Other Requirements

Three six-contact sockets
One four-contact socket
One grid clip
Two pairs of binding posts
One line switch
One slow motion dial
Three knobs
One Powertone metal chassis
One six-foot chord with plug
Two tube shields, large for 43 and one small for 43.

to the cathode, which is also ground. In view of the fact that the resistance in the plate circuit of the tube is very high, a comparatively low screen voltage is required on the tube to make it function most efficiently. The simplest way of getting the required positive voltage for the screen is to connect the screen to the cathode of the power tube. This makes the effective screen voltage approximately 15 volts positive, which is a good value for this tube when operated in this manner.

Antenna Coupler

The tuned coil is put in the antenna circuit. However, to remove the uncertainties of the antenna constants, or inconstants, a small adjustable condenser having a maximum capacity of 70 mmfd. is put between the antenna lead and the tuned circuit. In practice, a smaller value than this will give best results, in general. To provide easy accessibility of this condenser it is mounted on the subpanel so that it can be reached from the top with a screwdriver. It is not necessary to make continual adjustments of this condenser, but only one each time the antenna is changed. The adjustment should be made on a signal tuned in with one of the medium size coils, preferably the second smallest coil. The condenser is not at all critical, however, just so it is smaller than 70 mmfd.

This condenser serves another purpose. It acts as a safeguard against short circuits in case the antenna should touch any grounded object. In this connection it is well to point out that the receiver should not be grounded actually, as this would not be safe in all instances. It is not at all necessary to ground the circuit because it is grounded well enough through the power line. If, however, an external ground is desired, it can be made perfectly safe by connecting a small condenser between the chassis and the ground.

The Power Stage

The 43 is a splendid power tube for a universal circuit. It will easily operate a dynamic loudspeaker if it gets adequate signal voltage. On strong signals it will in this circuit because of the fact that the first tube is regenerative. But it can also be used with a headset, and this is how most short-wave signals are received.

The 750-ohm bias resistor in the cathode lead of the 43 slightly overbiases the tube, but that is all right for the excess bias is slight.

The full plate voltage available is applied to the plate and the screen of the power tube. This voltage is about 100 volts after allowance has been made for the bias and the drop in the filter chokes.

Wiring of Heaters

One side of the heater of the 78 is connected to the chassis. One side of the power line is also connected to the chassis, the negative in the case of d-c. Hence we may say that the heater circuit begins with the 78. The other heater terminal of this tube, marked (1), is run to the correspondingly marked terminal of the 43. Terminal (2) picks up the heater of the 25Z5, and thence the circuit continues to the 200-ohm ballast resistor, which in turn goes to the "hot" side of the line. This does not mean that it goes to the ungrounded side of the d-c line, for in most instances the positive is grounded. In this case the chassis is really the "hot" side.

Layout of Circuit

The layout of the circuit can be seen from the photograph on the front cover. The three filter chokes are lined up in a row on the right end, looking from the front of the set. The tuning condenser and the dial are in the center. The coil is at the left rear end of the chassis. In front of the coil is the 78 tube and to the right of the coil the 43 power tube. The rectifier is the unshielded tube between the power tube and the rear filter choke.

The grid leak and the grid condenser are put directly in the lead from the stator of the tuning condenser to the cap of the 78 tube.

The adjustable antenna condenser is at the extreme left of the chassis by the side of the coil. Only the screw is visible from the top of the chassis.

Regeneration Control

Of the two controls on the bottom row of the panel, the right is the regeneration control and the right is the line switch.

All other parts are mounted underneath the chassis. The 40 mfd. electrolytic condensers are contained in a single block. The 200-ohm ballast resistor mounted between the line switch and the 25Z5 heater lug with stiff wires so that it is held in the air clear of all other parts. This is important because it is the only part of the circuit that gets really hot. Since it is entirely free from other parts there is plenty of ventilation to keep it reasonably cool and it cannot damage anything else by heat radiation or conduction.

At the rear of the set are four binding posts, two for the output and two for the antenna and ground. As cautioned above the ground post should not be connected to an external ground unless a condenser is put in the lead. A mica condenser of 0.001 mfd. is suitable or a paper condenser of 0.1 or 0.25 mfd. is just as good.

HOW TO USE 2A6

Control of Volume and of Overloading, So Best Tone Quality is Obtained

By Brunsten Brunn

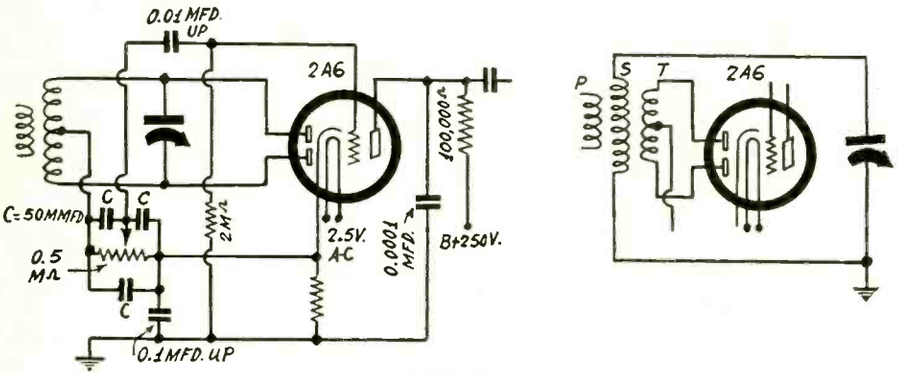


FIG. 1
A circuit showing the use of the 2A6 as a detector and amplifier

THE 2A6 is the 2.5-volt counterpart of the 75. In other words, it is a duplex diode triode with a high amplification factor in the triode section. As far as circuit connections are concerned, they are exactly the same as those for the 55 or tthe 85. The only difference pertains to the bias on the triode element. Since the triode has a high mu, a low bias is necessary. It follows that the signal amplitude that can be applied to the grid is much lower than that which may be applied to the 55. But this does not mean that a high output voltage cannot be obtained from it. It is possible to get even a higher voltage output from it than from either the 55 or the 85, and that for a greatly reduced input voltage. Therefore the tube will make a set considerably more sensitive compared with the same set using the 55.

Certain complications arise when a high mu tube is used. When any tube is operated near zero bias, which a high mu tube will necessarily be, grid current will flow, not only during positive voltage peaks, but nearly all the time. While the total current may be very low, it is sufficient to cause blocking on strong signals when the grid leak resistance is too high.

Fixed Bias

The tube can be operated either with diode bias or with a fixed bias. The connections when fixed bias is used are illustrated in Fig. 1. A fixed bias resistor of about 5,000 ohms is put between the cathode and ground and a condenser of 0.01 mfd. is connected between the signal source, that is, the diode load resistance, and the grid. A grid leak of 2 megohms is then connected between the grid and ground. This resistance should be regarded as the highest practical value, for if it is increased beyond that point, distortion due to blocking of the grid current may result.

A fixed bias is no insurance against overloading of the tube, for it is easy to have such a strong signal that the amplitude greatly exceeds the bias. To prevent this the grid stopping condenser is connected to a slider on the half megohm load resistance. Naturally, this will take the form of a potentiometer.

The fixed bias resistor should be shunted by a large condenser. In Fig. 1 the capacity indicated is only 0.1 mfd. While this is effective because the bias resistance has a high value, it would be better to use a much higher value of capacity. The amplification on the low notes on the triode circuit will be much higher.

Diode Bias

When diode bias is used, the cathode resistance is omitted and so are the 0.01 mfd. stopping condenser and the grid leak. That is, the grid of the tube is connected directly to the slider on the potentiometer. Now the bias on the grid of the triode should always be high enough, for it is always in proportion to the carrier voltage. Since the modulation is never 100 per cent., the signal voltage amplitude will always be less than the bias.

This, however, does not prevent overloading of the tube, for if the strength of the signal is greater than the cut-off voltage of the triode no clear signals are possible. It is conceivable that the bias would be such that the triode would act toward the audio frequencies as a grid bias detector. Any signal subjected to this double rectification would be distorted beyond recognition. Similar results have been obtained by connecting the output of a phonograph pick-up unit to the two grids of a push-pull amplifier with the grids in parallel.

It is always possible by means of the potentiometer to apply just the right bias and signal because only the drop between the cathode and the slider is effective on the grid.

Advantages of High Mu

The high amplification factor of the tube is not without advantages aside from the high voltage gain. When the bias resistance is included in the diode circuit, which is necessary in certain instances, the signal must first overcome the voltage drop in that resistance before any detection can occur. When this amounts to 20 volts, as in the case of the 55, this places a severe handicap on the sensitivity of the radio frequency circuit. In a high mu tube the drop in the bias resistor will not amount to more than a few volts. This is quite negligible in cases where there are several intermediate and radio frequency stages ahead of the diode circuit.

By-passing of the radio frequency signal is even more important in a high-gain tube than in one like the 55. Therefore there should be a condenser across the load resistance in the plate circuit of the triode. In Fig. 1 this is indicated as 0.0001 mfd. There is no reason why this condenser should not be used, and why it should not be of this size because in most instances it is necessary to put a condenser of even larger value across the line to eliminate high frequency noises.

Additional R-F Filtering

There should also be r-f filtering across the diode load resistance. In Fig. 1 are three such condensers, one across the entire potentiometer and one across each end from the slider. They are specified at 50 mmfd. each, but their values are subject to considerable variation. If it is necessary to use a condenser of large value elsewhere to cut out some of the high frequency noise, they might as well be made larger and thus save the anti-noise condenser, which might possibly be connected across the primary of the loud-speaker input transformer. Condensers as large as 250 mmfd. are used in the position C to good effect. Theoretically these condensers should be entirely too large for good quality, but it is a fact that the high notes are not only unnecessary but they are often undesirable for broadcast reception. It seems that most people prefer the unnatural quality resulting when the high frequencies have been removed from the signal. Just why this is so is difficult to say, but it may be that the low notes are more soothing to the nerves.

Listeners Demand Restores Goldberg Skit to KPO

San Francisco.

The Goldbergs are back in the West! The East Side household whose life day by day has become such an engrossing story to a nation of radio listeners are heard once more by westerners, at 8:00 p. m. They are heard over the NBC station, KPO.

More than a month ago the Goldberg program was cancelled in the West by its sponsors. The immediate result amazed the most experienced members of the BC staff, for more than 3,000 telephone calls were tabulated in the San Francisco headquarters the first night the program was off. Those calls formed only a percentage of the number of inquiries which got through. Telephone exchanges in San Francisco, Seattle and elsewhere were swamped by calls to the NBC stations in these cities.

BERNARDINE FLYNN WEDS

Bernardine Flynn, character actress known to radio listeners as Sade in Vic and Sade and Aunt Hessie in the Northwestern Chronicle, was married recently to Dr. C. C. Doherty, of Chicago. Miss Flynn is a daughter of George C. Flynn of Madison, Wis. She was born in Madison and was graduated from the University of Wisconsin. After playing in several Broadway productions, Miss Flynn turned to radio and joined the dramatic staff at the NBC Chicago studios three years ago. Dr. Doherty is on the staff at Passavant hospital in Chicago and a member of the faculty at Northwestern University medical school.

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.

Intermediate Amplifier

WILL you kindly publish a diagram of an intermediate frequency amplifier using two 58 tubes and a 55 for detector and a. v. c.? I should also like to have the circuit of an oscillator that can be used as a heterodyne generator in code reception. I need only the intermediate amplifier but if you have a complete receiver that would be all right, for I could use only the part that I need.—R. N. H., New Rochelle, N. Y.

You will find such a circuit on this page. The intermediate frequency transformers are tuned only in the primaries, but if you want to use doubly tuned transformers, there is no other change in the diagram than a condenser across each secondary. Of course, there would be a difference in the design of the coils, for close coupling is required when the primaries alone are tuned and very loose coupling when both windings are tuned. The oscillator for heterodyning I. C. W. appears in a box at the right of the main diagram. The transformer in this oscillator should be exactly like the other intermediate frequency transformers. If you use doubly tuned transformers for the amplifier, you may also use the same type for the oscillator, but it is preferable to tune only one winding in the oscillator, and that might as well be the plate winding. You should not follow up the 55 with an audio transformer unless you use at least 20,000 ohms in the plate circuit. The resistance shown is 50,000 ohms, which is all right for resistance coupling. A transformer may be connected to the output terminals by lowering the plate coupling resistance to about 20,000 ohms and by increasing the condenser in series with the output from 0.01 to 1 mfd. or more.

* * *

What Set to Build

IF YOU have a superheterodyne that is suitable for d-c operation, will you kindly publish it? I wish a set that has good quality, is fairly selective, and that does not cost a great deal. I would prefer a set with push-pull in the output stage, but it is not really necessary.—W. B. L., New York, N. Y.

We described such a receiver in the May 6, 1933, isue. Maybe that will fit your requirements. It uses six tubes, is a super, has push-pull output, a.v.c., and some other features.

* * *

Full-Wave Bias Detection

IS IT possible to arrange a circuit so that a grid bias detector rectifies the full wave? If so, what should the connections be?—B. R. V., Denver, Colo.

Hook up a circuit with two equal rectifier tubes. Put the radio frequency signal on the grids in push-pull fashion and connect the plates in parallel. Bias the two tubes just as if there were a single bias detector tube.

* * *

Padding of Oscillators

IN THE November 12th, 1932, issue you have an article on padding of oscillators to make them track with the radio frequency tuner. In that article you show a tracking curve for a case when the oscillator inductance is too large. What will the curve look like when the oscillator inductance is too small?—S. H., Atlanta, Ga.

Look at the tracking curve referred to upside down and imagine that the frequencies run in the opposite direction. The tracking will be good on the low frequencies and very bad on the high.

* * *

Revamping Old Speaker

HOW CAN an old loudspeaker be restored to usefulness? It is one of those that have a dry rectifier for supplying the field current, and apparently it is the rectifier that has given out.—W. E. T., Troy, N. Y.

If you are sure that the rectifier is at fault, the proper course is to get a new one, exactly of the same type as was used in the first place. If you have a storage battery, you might disconnect the connections between the field winding and the rectifier and subtitute the battery. That would be a test whether or not the rectifier is at fault because the battery should actuate the field. Of course, it depends on the voltages. If the output voltage of the rectifier is much higher than the voltage of the battery it will not work out. If you have an ohmmeter, or any other means of measuring resistance, determine the resistance of the field winding after you have disconnected the rectifier. If the resistance is around 4 ohms, or even six ohms, the battery should work all right. If the trouble is more serious, you can send the speaker to someone who specializes in repairing speakers. But it may be that you will save money by getting a new speaker. You know you can get very good speakers for a few dollars.

* * *

Use of Kerr Cell

THE Kerr cell is coming into use for television reception and you have mentioned it a number of times. It is my understanding that it will respond almost instantaneously. It has not been made clear, however, what the capacity of the cell itself will do to the signal. Is it not a fact that if the cell has a certain capacity that the necessary voltage will not develop across the cell at the very high frequencies? If so, what can be done to overcome this difficulty and how can the drop in response be measured?—F. G. W., Chicago, Ill.

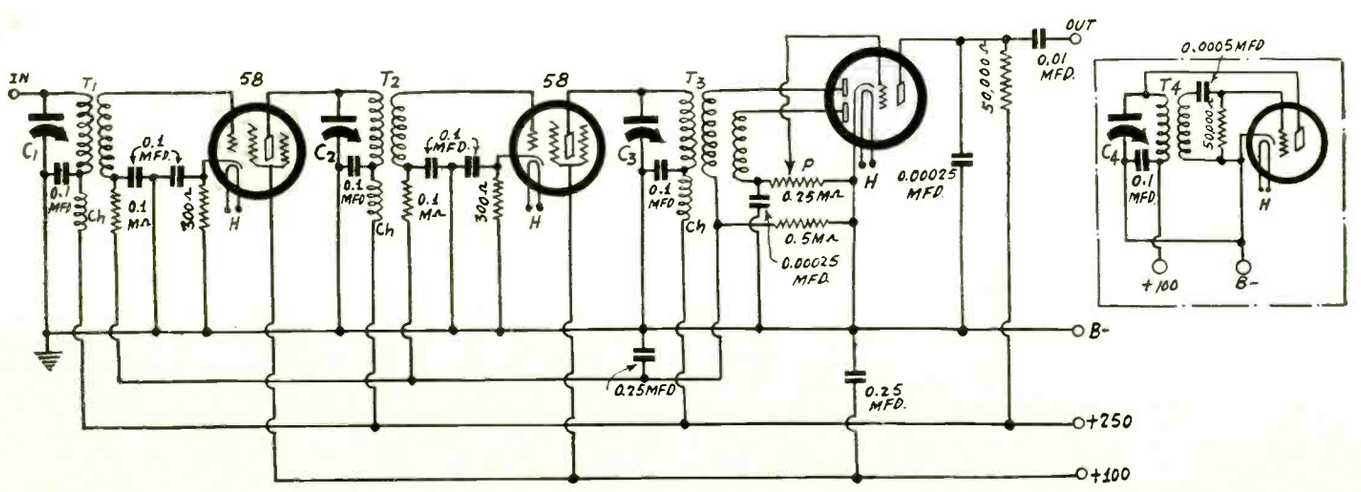
The response is said to be practically instantaneous, but if there is a considerable capacity, and there usually is, there is no doubt that it will cut down the response on the high frequencies. As far as the writer knows the effect has not been measured, but it could easily be done. Provide an oscillator that will generate frequencies up to about 50,000 cycles. Apply a known voltage in the cell circuit, that is, a voltage of some high frequency. This can be done with the aid of a universal meter or with any a-c milliammeter. The light from the cell should be made to fall on a photoelectric cell of known characteristics. By measuring the current in the photoelectric cell circuit, the response of the Kerr cell can be measured. If this is done for many different high frequencies, as well as for low, a response curve can be obtained. If the Kerr cell is fed by a high quality transformer, the measurement of the input could be done in the primary of this transformer. The result would be a curve showing the combined distortion of the cell and the transformer. The curve of the transformer can be taken separately and therefore, indirectly, the curve for the cell alone can be obtained.

* * *

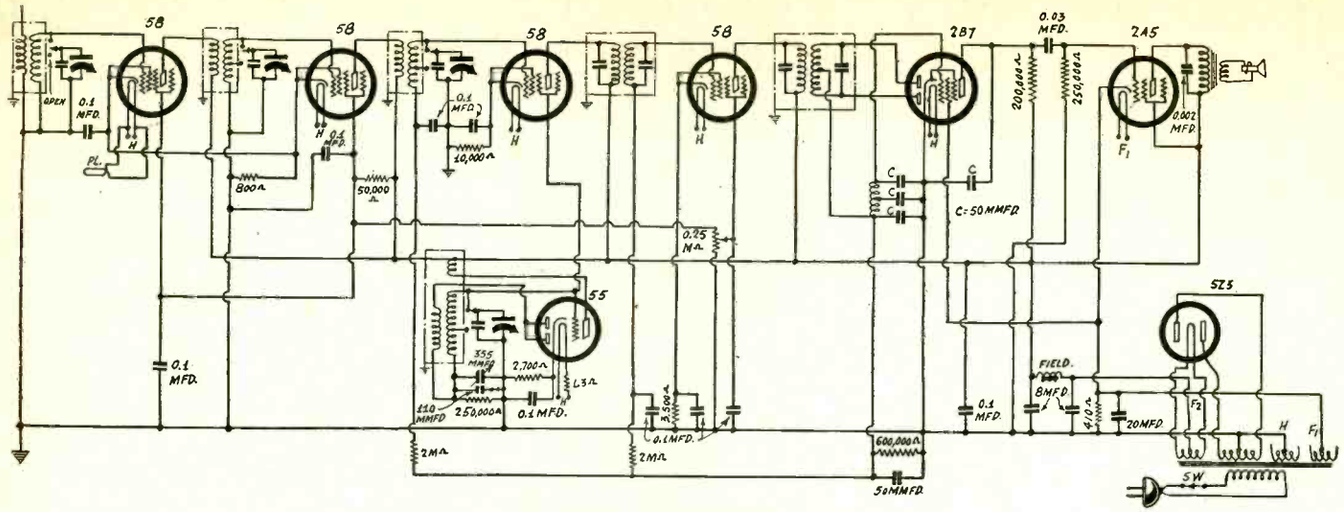
A Calibrated Oscillator

WILL you kindly recommend the circuit for a calibrated oscillator that is to cover

(*Continued on next page*)



An intermediate frequency amplifier circuit that can be used for the reception of I. C. W. provided a suitable mixer circuit put in front of it.



An eight-tube super of large output

(*Continued from preceding page*)
a wide range of frequencies. I wish one that can be frequency stabilized and which will remain stabilized for all settings of the variable condenser. I want to use a switch for changing the frequency range.—S. T., Bronx, N. Y.

Perhaps the best oscillator for this purpose is the symmetrical Colpitts. It requires three coils for each frequency band, and two equal condensers in series. The switch should be four-pole and should have as many points as you want frequency ranges. The tuning condenser may be a 350 mmfd. gang of two equal sections. These condensers will be in series as far as the oscillation frequency is concerned, yet the common rotor may be grounded. The inductance should be figured on the basis that the capacity is 175 mmfd. The coil between the stators of the two condensers should be full size, and the two other coils half the size of this.

* * *

Effect of Moisture

IN WHAT way does moisture affect the sensitivity of a radio receiver and why is it necessary to prevent moisture from getting into a set in hot climates? —W. E. W., Harrisburg, Pa.

When moisture gets into the coil forms and insulation, the losses increase and therefore the selectivity becomes less. It also changes the capacity of condensers and self capacity of coils and therefore changes the tuning. Moreover, moisture causes corrosion of copper wires and this will cause failure of a set after a time. These effects are greater in hot countries, not only because of the heat but because of the greater moisture in places where the heat is intense. Coils to be used in moist places should be wound on non-hygroscopic material and the insulation should also be non-hygroscopic. When the receiver is to be used under especially severe conditions, the coils and condenser should be sealed if that is possible. This may not be practical for variable condensers, but is certainly is for coils and small fixed condensers.

* * *

Transposed Leadins

IF YOU have published an article on the subject of transposed leadins for short-wave reception will you kindly refer to the issue? I have all the issues for several years back.—W. R. T., Toledo, Ohio.

A discussion of this subject appeared in the Dec. 3, 1932, issue. It is not an article on that subject, but is in connection with a short wave receiver. It explains the idea, however.

* * *

Intensity of Oscillation

IT WAS my understanding that the closer the coupling between the tickler and the tuned grid coil in an oscillator the more intense would the oscillation be. I have measured the oscillating current with different degrees of coupling and I find that the reverse is true. Do you think that I have made a mistake in the measurement or that my original idea on the subject was wrong?—R. H. J., Milwaukee, Wis.

The trouble must have been with your original idea. The oscillating current is greatest when the circuit just barely oscillates. If you had measured the grid voltage or the plate voltage swing, you might have found that the opposite held true.

* * *

A Vocal Letter

I WISH to send records of my own and my childrens' voices to my parents abroad. I have been wondering if it would not be possible to make phonograph records and then send these records. What do you think of the idea? Has it ever been done?—W. L. B., New Haven, Conn.

It is practical. It has been done and is being done. You can now record on thin sheets of celluloid that can be rolled up and mailed. Records can be made that play continuously for 5 minutes or more.

* * *

Required Selectivity

WILL the selectivity of a t-r-f receiver using two r-f tuners be selective enough to separate the strong local station, or will it be necessary to add another tuner to it—E. W. H., Chicago, Ill.

Very few sets of this type are selective enough, especially if they are made so that they have much sensitivity. At least one more tuner should be used. In most cases only a superheterodyne will be selective enough to eliminate interference from strong distant stations. We base our opinion on the situation in New York, and it is undoubtedly the same in Chicago.

* * *

A "C" Supply

WHICH makes a better C supply, a small rectifier operating from the 110 volt line or one that employs a vacuum oscillator and a small rectifier? What are the advantages and disadvantages of both?—O. W. A., Topeka, Kans.

As far as the voltage is concerned it makes no difference which type is used. The rectifier operating from the line has the advantage that it is simpler. But it has the disadvantage that larger filter chokes and condensers are needed to remove the hum. Whichever circuit is used, the tube should be at least as fast as the fastest tube that is to be biased with it. For example, if the tubes to be biased are filamentary triodes like the 2A3, it will not do to use a heater type tube for rectifier or for oscillator because before the bias voltage appears the power tubes will be unbiased and they will draw a very large current. If the oscillator or rectifier is of the filamentary type, there is no danger because it will heat up and begin to function just as quickly as any of the tubes to be biased. If all the tubes in the receiver and amplifier are of the cathode type it is all right to use a similar tube for the oscillator or rectifier. For example, it would be all right to use a 55 tube both for oscillation and for rectification.

* * *

8-Tube Super

KINDLY print a diagram of an 8-tube a-c superheterodyne having automatic volume control and full-wave detection with the 2B7.—A. S. G., Fresno, Calif. (The diagram is printed herewith.)

* * *

Individual Bias of Power Tubes

IN SOME commercial receivers I have noticed that the power tubes in the push-pull stage are biased by individual resistors. What is the advantage of doing this? When it is done, should there be a by-pass condenser across each or may the by-passing be dispensed with as in the ordinary push-pull stage when the two tubes are biased by the same resistor?—E. G. B., Washington, D. C.

It is of very doubtful advantage to use separate bias resistors for the power tubes. The only reason for doing it would be to compensate for differences in the tubes. Certainly, if two resistors are used they should be by-passed with large condensers because, as far as the feedback is concerned, no advantage accrues from the push-pull. Each tube is a single sided amplifier. When the same bias resistor for the two tubes, the push-pull effect extends to the bias and the by-pass condenser is not really necessary.

* * *

Voltage Output of Rectifier

WHICH gives better regulation of the voltage, choke input to the filter or condenser input? Which gives the higher voltage?—F. C. E., Fresno, Calif.

The regulation is better when a choke it put next to the rectifier, but the output voltage is much higher when a condenser is put across the line next to the rectifier tube. For example, for equal input to the 5Z3, 500 volts per plate, the voltage at 120 milliamperes is 550 volts when a 4 mfd. condenser is next the rectifier and it is only 395 volts when the condenser is omitted, the same choke coil of 20 henries being used in both cases. With condenser input the voltage at 240 milliamperes is 480 volts. Thus between 120 and 240 milliamperes there is a voltage drop

OPERATING CONDITIONS FOR THE 2A6 AS A RESISTANCE-COUPLED A-F AMPLIFIER

Grid Resistor Megohms	*Bias Volts*	*Self-Biasing Resistor Ohms*	*Plate Load Megohms*	*Plate Current Ma.*	*Peak Out.* Volts*	*Volt. Amplif.*
		Plate Supply Volts = 100				
0.25	-1.05	10,500	0.25	0.10	11-16	30
0.25	-1.05	15,400	0.50	0.07	10-14	29
0.50	-1.10	11,550	0.25	0.09	15-19	36
0.50	-1.05	15,000	0.50	0.07	14-19	37
		Plate Supply Volts = 135				
0.25	-1.05	6,200	0.25	0.17	17-23	42
0.25	-1.10	9,150	0.50	0.12	17-21	38
0.50	-1.05	5,850	0.25	0.18	20-30	50
0.50	-1.10	10,000	0.50	0.11	18-27	48
		Plate Supply Volts = 180				
0.25	-1.25	4,900	0.25	0.25	26-33	48
0.25	-1.20	7,100	0.50	0.17	24-30	46
0.50	-1.30	5,450	0.25	0.24	32-40	56
0.50	-1.30	9,000	0.50	0.14	30-38	55
		Plate Supply Volts = 250				
0.25	-1.30	3,170	0.25	0.41	33-38	51
0.25	-1.30	5,200	0.50	0.25	28-35	48
0.50	-1.35	3,380	0.25	0.40	36-46	59
0.50	-1.35	5,600	0.50	0.24	35-44	58

** The first figure gives the maximum undistorted output voltage obtainable, and the second figure gives the maximum voltage obtainable with some distortion.*

The 2A6 is a duplex-diode triode with the triode section of the high-mu type. This tube is identical with the 75 except that the heater voltage is 2.5 volts for the 2A6.

In Application Note No. 4, data were given for the 75 as a resistance-coupled audio-frequency amplifier. These data are repeated, since they also apply to the 2A6. Additional data for the 2A6 and the 75 with 250 volts plate supply are included above.

Official Data on 53 to be Printed Next Week

The RCA Radiotron Company, Inc., and E. T. Cunningham, Inc., have announced to radio equipment manufacturers a new tube, the 53.

It is described as a Class B twin amplifier tube combining in one bulb two triodes designed for Class B operation. It is intended primarily for use in the output stage of a-c operated receivers where it is capable of providing power output of 10 watts. Besides this application, the 53 may also be employed as the driver tube for the Class B output stage. As such, it is capable of providing adequate power with high gain and low distortion.

Other types recently made available include the following: 75, 2A6 and 6A4.

The 75 is a duplex-diode high-mu triode intended for performing the simultaneous functions of automatic volume-control, detection, and amplification in radio equipment, especially that of the mobile type employing a 6-volt heater supply.

The 2A6 is similar to the 75 but is designed for operation with a 2.5-volt heater supply.

The 6A4 is a power amplifier pentode (identified also as type LA) for use in the power output stage of automobile radio receivers and in other receivers employing a 6-volt storage-battery filament supply.

[*The official data on the 53 will be published next week, issue of May 20th.* —EDITOR.]

of 70 volts. This is a drop of about 14 per cent. compared with the mean. With choke input voltages at 120 and 240 milliamperes are, respectively, 395 and 365 volts, a change of only 30 volts. This is nearly 8 per cent. of the mean. The improvement in the regulation is not sufficient to offset the large difference in output voltages.

* * *

I-F Transformers with Air Condensers

WHAT are the advantages of doubly tuned intermediate frequency transformers with air dielectric condenser in place of compression type, mica insulated, condensers?—F. W. R., Flushing, N. Y.

They are considerably more selective for one thing. This, in turn, makes them much more effective, for the voltage that will appear across the second tuned circuit, for a given input to the transformer, is proportional to the selectivity factor. Perhaps a greater advantage is that they are more constant. The capacity of the condensers remains constant. Hence the tuning of the superheterodyne of which they form a part will remain constant. In other words, the padding adjustment will not be upset. These two reasons alone are sufficient to justify their use in a first class receiver.

* * *

Tubes for D-C Receiver

WHAT output tube or tubes would you recommend for a receiver that is to be operated in a d-c or a universal receiver? —W. H. C., New York, N. Y.

If the receiver is built with the automobile heater tubes, the most suitable output tube is the 43, because this has a 25-volt filament and draws the same current as the r-f and i-f tube. If the receiver is to be universal the 25Z5 rectifier should also be used. This, too, takes 25 volts and 0.3 ampere.

* * *

Reducing Hiss

ALL the sensitive receivers I have seen during the last year have generated a very strong hiss. Can you suggest a way of eliminating this unpleasant noise? What is the cause of it?—W. R. C., New York, N. Y.

Most of the hiss is said to be due to the so-called Johnson effect—voltages generated by thermal agitation of resistors. According to this view, most of the hiss originates in the grid circuit of the first audio amplifier. It is only said to originate here because the noise that does begin here is amplified by the succeeding tubes. The noise originating in the later tubes is not amplified sufficiently to cause any trouble. In order to reduce the "Johnson effect" the grid leak in the first a-f amplifier should be low in resistance value, and it should be of such wattage that it will be cool. Possibly the best way to avoid it is to use a transformer for coupling, or a choke coil of high inductance and very low d-c resistance.

Irregular emission of electrons from the cathode is also a prolific source of disturbing noises. This is the so-called "shot effect." This becomes serious as soon as the amplification becomes high.

Julia Sanderson's Parents Watch Her At the Studio

Mr. and Mrs. Albert Sackett, parents of Julia Sanderson, watched their daughter for the first time on the air Tuesday night during the Blackstone Plantation program, although they have heard her and their son-in-law, Frank Crumit, over networks for years.

RADIO WORLD

The First and Only National Radio Weekly

Eleventh Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager; J. B. Anderson, technical editor; J. Murray Barron, advertising manager.

PRINTING PROGRAMS

THE newspaper publishers, in annual convention in New York City, favored in principle the charging of advertising rates for printing radio programs. This attitude has been taken before, never found quite satisfactory, working out to newspaper owners' satisfaction in some small areas, but in other areas in a manner not consistent with frank admission. That is, in large areas where it has been tried it has been silently abandoned. It seems that the publishers have to pay some regard to their readers, and their readers like to turn to the radio program page to ascertain what's on the air.

The publisher may reply to the reader that since the sponsor of the program did not see fit to have the program printed at any cost to him that the complaint should be lodged with the sponsor. It is true that the publisher is not running a charitable institution, and that neither station nor sponsor rightly can feel any right to have the programs printed in the newspapers. As for sponsors and stations, they have simply fallen heir to a little riches (though at the moment they have not noticed it). The gravamen of the situation is the relationship between the newspaper and its reader. Does the newspaper want to lose the complaining reader?

If each newspaper elected which course it would pursue—as it does, despite the expression of "sense" of a convention—then disgruntled readers may quit one paper for another. If all newspapers refused to print programs for which they were not paid, and disgruntled readers would have no newspaper to turn to, maybe for a while the dissaffection would so cut into general newspaper circulation that the programs would go right back.

This right-about-face took place before on numerous occasions, and probably it would take place again. First, the newspapers themselves, valuing the circulation effect of printing the programs, have accustomed their readers to the convenience of a program department. Second, the minimum of publicity attaches to the programs as generally printed in newspapers, anyway, sponsors' names being omitted, though performers' name are included. Third, this is no time to run the risk of curtailed circulation. Fourth, reduced circulation would reduce advertising revenue, anyway, compared to which the gain from paid program advertisements would be slight. Fifth, and most important, radio programs are news, though tabulated in a six-point column somewhere in the "buried" pages.

The resolution favoring the printing of programs only as paid advertisements followed the adoption of a resolution by the Associated Press limiting the broadcasting of its news to thirty words locally (no networks) and then only with credit to the A. P. and the member paper sponsoring the broadcast. One can understand the restriction, as the news is dearly gathered, constitutes property right, and detailed broadcasting thereof might injure the sale of the very newspapers that are A. P. members. But it is hard to make sense out of the policy of programs as paid advertisements, though some form of censorship already exists, called editorial discretion. In the larger cities the small stations get absolutely no mention, or little mention, and not only are their programs omitted, but not a word of reference to the stations' existence appears for years and years. Evidently not enough readers are offended at this to cause any change of policy by the newspapers, but it is quite different with the general conversion of the program department to a branch of classified advertising.

WHITE HOUSE SETS

DURING somewhat more prosperous days there was a movement in the radio industry to encourage families to have two sets in the home, on a par with the automobile manufacturers' desire that each family should have two cars. There would be the fine, big car (or set), and then the knockabout one. However, just now both industries are elated to sell one unit to a family.

It should not be surmised, however, that there are few families that have two sets. Indeed, the popularity of the so-called universal receiver is due partly to its becoming the second set.

In the White House, considering the home part of that structure, including offices, as compared to the public part of it where visitors are admitted during certain hours, there are three sets. It is plain that President Roosevelt has a great use and admiration for radio. When the dramatic moment came for him to inform the nation of the banking situation, when all the banks in the country were closed, he chose the radio as the medium through which to deliver that message. And, by the way, he delivered it so well that he left radio indebted to him.

In the President's own study there is a radio receiver. The study is the Oval Room on the second floor. Mrs. Roosevelt has a set in the sitting room, while the third receiver is in the office of one of President Roosevelt's secretaries.

It will be recalled that the President's Secretary of Labor, Frances Perkins, before leaving New York City to be sworn in, said in a mass interview: "I hate telephones, automobiles, airplanes, and anything that makes noise. That includes the radio. No, I do not possess one."

So at least on this point there is discord in the official family, but it is expected that force of circumstances, plus her keen desire to keep abreast of things, will compel the Secretary of Labor to install a receiver in her home. At least, some enterprising Washington dealer ought to get after this lively prospect.

CHILD HORROR

ORGANIZATIONS interested in child welfare, including parents' groups, have become concerned over the rabid mysteries that are intended for juvenile ears, and yet are as gory and disgusting as can be imagined. They do not want their own or others' children to listen to such stuff, and one might expect that the sponsors of the programs would share these sentiments. Imagine a serial mystery for children in which one scene had to do with a child killing another and stuffing the body in a closet! That episode followed soon after the actual commission of such a crime in the outskirts of New York City, and perhaps the script writer may plead verisimilitude, but he can not plead common sense or decency in selection of topic and event. In fact, he could not have picked out anything worse.

A sponsor must feel ill at ease, to say the least, if the result of his large expenditure of money is antagonization of multitudes of listeners and their parents and guardians. A little something may be said in favor of much dubious material that goes over the air, but nothing can be said in favor of the gruesome appeal to children that offends every sensible impulse.

Parents complain that the thrillers are so terrifying that they cause children to awake from their night's sleep with a start, and to scream piercingly. There are enough natural conditions to cause a child's sleep to be disturbed without the psychological turmoil introduced as the result of listening to such broadcast thrillers.

The objectors are not local but are well scattered throughout the entire listening area—the whole United States—and if the public sentiment thus aroused is not sufficiently and permanently effective, some action by the Federal Radio Commission against stations whose operation is not wholly consistent with public interest, convenience and necessity, may be of some help. Much of the horror has been eradicated as the result of protests, but enough of the terrifying is still left in current juvenile scripts to justify careful vigilance. If radio can do no better than scare and torment children it is better that they be forced to forego listening to it.

GETS DAILY LETTER

John S. Young, announcer, has received a daily fan letter from Boston, signed "Your Bay State Listener," for the past five years.

In Radio World Ten Years Ago

C. H. Stoup authored an article headed "How to Construct and Tune a One-bulb Regenerative Set for Long-distance Work."

H. Parsons was responsible for an article entitled "A Flexible and Selective 3-Tube Reflex Circuit."

William L. Ettinger, Superintendent of Schools of New York City, signed his name to an interesting article headed "Valuable Advantages of Instruction by Radio in Public Schools."

Laurence M. Cockaday was even then a busy figure in radio. Russell P. May. R.E., wrote about Mr. Cockaday's New Four Circuit Receiver.

Crystal D. Detector (we honestly suspect it was an assumed name) descanted on the appearance of women in radio and grew quite excited over what it meant to the development of the science.

WEAF had just made some new installations in its studios in the Telephone and Telegraph Building at 195 Broadway, New York City, and Edgar H. Felix told RADIO WORLD readers all about them.

C. White, consulting engineer, waxed enthusiastic over the merits of a new single-circuit regenerative tuner.

Station WGY, Schenectady, N. Y., was represented by a series of photographs of its increased facilities, and Robert L. Dougherty told about them.

The Department of Commerce had just issued licenses to ten new Class "A" stations. All were in different states, running from KFHI, Wichita, Kan., to KFGM, Abilene, Texas.

Radio Telephony (so-called then) had started on its way in Chile and a contributor gave some details.

M. B. Sleeper had just written a book entitled "Radio Hook-Ups."

The Milwaukee Radio Amateurs Club had just held a convention in Milwaukee and the American Radio Relay League was very proud of the success of the affair.

And so to press—with the knowledge that radio, still young, was at least twenty-five years younger ten years ago—or something like that!

STATION SPARKS

By Alice Remsen

JIM

(For Don Carney's "Dog Chats"), Mondays, 8:30 P.M. WJZ E. D. S. T.

He was only a dog with a stump of a tail,
That seemed to wag all day.
With a never-ending appetite,
And always ready to play;
With so many friends along our street,
Who all made a fuss over him.
There was something wrong with anyone
That wasn't liked by Jim.

Jim was my pal, and he understood
Whenever my heart would sag.
He'd put his paw right on my knee,
And give his stub tail a wag;
As much as to say: "I'm here, old pal,
Don't worry, I'll see you through."
He was almost human at times like that,
And he certainly was true blue.

And now he's gone; no more I'll see
Him waiting for me each night,
Tearing along at breakneck speed,
Barking his great delight.
Gee! but I miss his friendship,
And life's looking pretty grim,
Since that stub of a tail stopped wagging,
And I lost my old dog, Jim.

A. R.

* * *

If you are fond of dogs, don't fail to listen to those fine dog chats. Don Carney has a fund of wonderful dog stories and he knows how to tell them. He also gives you good advice about your dog. If you don't own a dog already, you'll want to own one after listening to Don Carney.

* * *

The Radio Rialto

MAYBE I'M RIGHT

The radio business looks as though it's picking up around New York, judging from the auditions which are scheduled at advertising agencies. I have given five during the last three weeks, and three of them are really excellent prospects for Fall. Isn't that jolly good news? . . . See where the Gulf Refining Company at last made up its mind about going on the air. By the time this reaches print it will already have made its bow to the air audience, with Will Rogers as the main attraction. Of course, I knew the Gulf Refining people were air-minded, as they had been considering a mighty fine program arranged by friends of mine. This particular program was on the air for a few months and created a tremendous amount of interest among business executives and laymen, and in my humble opinion would have made a far more appropriate program for the Gulf Refining Company than its present layout, although I do not wish to decry the work of Mr. Will Rogers. It is very hard to convince clients that a good sustaining program which has proven its worth will sometimes please listeners much more than a big name. . . .

BREWERIES KEEP QUIET

Up to now the big breweries have not fallen for an ether build-up, with the single exception of Pabst's, which after all, is an old program and only had to do a continuity switch. Probably the Fall will see a change, at least Dame Rumor hath it so. . . . Ben Alley has a commercial on WEAF, the Orbach program, Tuesdays and Thursdays, 7:30 p.m, Local only. Ben has changed his style of singing; quite a radical transition, from an honest-to-goodness tenor to a crooner. . . . Helen Nugent is still warbling at the Paramount Grill at this writing. . . . Ran into John Fogarty yesterday on Broadway. This Irish lad has everything; he's good-looking, has a swell disposition, a charming smile and a great voice. Why he hasn't been sold commercially is a mystery to me. If you like good singing, tune in on this boy each Monday, Wednesday and Friday at 12:15 p.m. and Saturday evening at 11:15, WJZ and network. . . . Harry Frankel is spending the summer in Richmond, Indiana, his home town, and broadcasting once a week from WKRC, Cincinnati, over the Columbia network. Harry, as you probably know, is Singin' Sam, the Barbasol Man. . . .

THAT BLESSED EVENT

Mae Questel, the original Betty Boop, is expecting the stork to arrive at any minute; her place on the air is being taken by a young lady with the biggest blue eyes I ever saw; don't know her name, but she sure sounds like Mae, when she does the "Betty" stuff . . . When you hear the boyish voice paging Philip Morris on the Band of Famous Brands program, over an NBC-WEAF network each Monday, at 8:45 p.m. and each Wednesday and Saturday at 9:00 p.m., please don't think it is that of an actor, because it's not—it is the voice of a real pageboy, little Johnny, and he gets paid well for paging a man he never finds; his cry of "Paging Philip Morris" is the opening and closing signature of the program; rather a novel idea, what? . . . The National Vaudeville Artists have just finished their annual drive; it seems to me that here is a worthy cause which should be helped by the radio moguls. Why don't they broadcast an appeal to the public of the nation, calling their attention to the fact that the vaudeville artists, who have always contributed their talents to other worthy causes, are now in need of aid themselves? For some reason best known to themselves, a certain clique is trying to put the N.V.A. away in mothballs, but, in spite of all the propaganda against it, the dear old organization seems to come back each year a little better than ever.... Glen Gray has sent out an intriguing announcement of the opening of the Glen Island Casino, in New Rochelle, N. Y., where his Casa Loma Orchestra will play during the summer. The water looks alluring, as pictured in his folder, and if his music is half as good as the picture looks, it's quite likely I'll be there, if we get any hot weather. . . . The Octavus Roy Cohen program, "The Townsend Murder Mystery," finishes on May 13th, and a new production will open May 15th, with Everett Marshall and Al Mitchell's band; this series is sponsored by the Westinghouse Electric and Manufacturing Company; three times weekly, Mondays, Wednesdays and Saturdays, at 7:15 p.m. over WJZ, with a re-broadcast for the Coast at 11:15 p.m. . . .

RUDY VALLEE STILL AT IT

You've got to give Rudy Vallee credit for giving the air-public a good variety entertainment; this week I heard dance music and crooning, comedy and drama, musical comedy and opera; jolly good, I'll say! . . . The Radio Guild summer season has been inaugurated, and will continue for the next few months under the able direction of Vernon Radcliffe. . . . Louis Sobol, well-known Broadway columnist and air-news-caster, eloped with his present wife fourteen years ago; the date was April 27th. . . . Too bad that as soon as Myrtle Vail recovered from her auto accident the Wrigley program went off the air; however, it will probably return in the Fall. . . . Burns and Allen are back from Hollywood. . . . Al Jolson will return to the air via WABC in a couple of Saturdays, and what is more, Al will turn Hawaiian on us, singing with one of those hula-hula bands. Haven't heard yet whether he intends to wear a grass skirt. . . . And so, George Hicks, NBC announcer, who recently became a proud papa, admits that he is a bookworm. When he's not announcing, or warming the baby's bottle, George has his nose in a book; among his favorite authors are Sherwood Anderson, Turgenev, and Ernest Hemingway. He told me once he liked my stuff, poems and all. . . . You may not know that Welcome Lewis was born in Hollywood and that her first public appearance was made at the age of twelve at Grauman's Million Dollar Theatre in Los Angeles, and that's not so very long ago, either. . . . Irene Taylor is touring New England with Mal Hallett's band. . . . Lee Wiley, the songstress, is posing for McClelland Barclay. . . . My old pal Artie Collins, is playing at the Hotel La Salle, Chicago, with his orchestra. Sara Lee is still with the outfit. . . . And now I think it's time to do a biography of a rather remarkable person. . . . I mean Frank Black, Music Director, of the National Broadcasting Company.

* * *

Biographical Brevities

About Frank Black

Born in Philadelphia, the City of Brotherly Love, of Quaker stock, Frank Black was destined by his parents to a solid business future in the dairy profession, but fate willed otherwise. The chief musical director of the National Broadcasting Company did not have many opportunities for musical expression during his formative years; all his inclinations in that direction were sternly repressed. But in spite of his Quaker upbringing, he managed to study piano, and after he left Haverford College, a Quaker institution near Philadelphia, where he studied chemistry, Frank took up his studies with Joseffy.

At the age of sixteen he had conducted his first orchestra, and there was born the germ of his ambition, to be a great conductor. For twenty-three years he carried on and finally arrived. He came to New York from his home in Philadelphia to study the piano seriously with the great maestro, Rafael Joseffy; he became the master's favorite pupil and remained with him until his death in 1915. Then Frank took the job of conducting a musical comedy orchestra at a New York theatre. This was the beginning of his new career and it was also the beginning of a new style of popular music which Frank Black developed to its present high point—the blending of voices and instruments, so that one may take the place of the other without noticeable difference in the tonal effect produced. After a period of seasoning as assistant director under Erno Rapee at a Philadelphia picture palace, he was editing Rhythmodic Classics for a music publishing firm. Here he met the Revellers for the first time, and together they perfected orchestral harmonizing.

I first met Frank Black in 1927 and had a short period of work with him on the Palm-Olive program. I realized then what a dynamic personality this man had. He is full of a tremendous energy and has a marvelous capacity for creative work. During a normal week he conducts orchestras on a half-dozen big programs, each requiring from two to four hours of

(Continued on next page)

PERSONALITIES

Phillips H. Lord has found that "13" has been his lucky omen. He was born on the 13th of July. There are 13 letters in his name and there are 13 members in his Seth Parker company and Lord always signs important contracts on the 13th.

* * *

The current Old Gold program, featuring Fred Waring's Pennsylvanians Orchestra, which just concluded its original contract has renewed its broadcasts with the WABC-Columbia network for another thirteen weeks. This weekly feature is presented over a nationwide network of fifty-eight stations.

* * *

Sigmund Spaeth can't help being a tune detective. His father, Adolph Spaeth, was a German Lutheran minister and composer of hymn tunes. His mother, Harriet Reynolds Krauth, was editor of the Church Book, and also was musically gifted. Spaeth's sister, Carola, is a pianist and his brother, J. Duncan Spaeth, a professor of English at Princeton University, has musical and dramatic talents. Sigmund Spaeth is also a sports authority. He has been radio commentator at intersectional football games, he announced the Walker-Greb fight, and he has described the international tennis matches at Forest Hills, L. I.

* * *

Forty-five weeks a year on the air for eight years, and with an average of six half-hour shows in each of these weeks, Charlie Hamp now concludes he is just rounding out his 1,080th hour of broadcasting.

Long cited as the highest salaried non-network star on the airlanes, Charlie's one-man radio show on WBBM, the Red Star "Happyeast" program daily except Sunday, at 10:15 a.m., is now bringing him approximately two dollars for every hour of experience he has piled up.

Another interesting sidelight on Hamp is that he never uses a line of continuity. All of his conversation with the listeners is adlib. He never has a sheet of music before him at the piano, and he never repeats a program.

* * *

"Mitzi Green in Happy Landings" is the title of the newest attraction to be broadcast over WBBM on a two-a-week schedule. Little Mitzi, darling of the movie-going public, will be heard in this series of semi-dramatic transcription programs every Wednesday and Friday from 6 to 6:15 p.m. The series is sponsored by Ward Baking Company.

* * *

Harry Reser, NBC banjoist, whose correspondence course in banjo playing is popular throughout the world, says a statistical survey of his "school" shows that prisoners, sailors and boys in love are his biggest groups of pupils. He also has several Chinese, and a man in New Zealand enrolled in his remote control plunking classes.

* * *

Welcome Lewis, contralto, pulled a fast one on her accompanying orchestra the other night during rehearsal. Welcome insisted the violinist was not playing his notes correctly.

"You can have the fiddle if you can do better," the fiddler insisted.

Welcome picked up the violin and showed him how. She then confessed to the bandsmen that she played violin in vaudeville and in several orchestra pits, and has studied the instrument since childhood.

* * *

Will Cuppy and Jeanne Owen are lightning quick on that "Just Relax" program over NBC networks because they're on their feet at the microphones during their fifteen-minute "sparring match." And although their slogan is "Just Relax" the humorists never sit down for a moment. They step to and from the microphone between each sally.

* * *

Jeannie Lang, baby-voiced singer, and Annette Hanshaw, blues singer, when not singing over NBC networks see a lot of each other over luncheon tables and at movies. The other night Jeannie Lang suffered a sudden attack of laryngitis. Tom Howard, comedian of the Musical Grocery Store program, was at the studio, so were Harry Salter and his orchestra.

Suddenly Annette Hanshaw appeared, out-of-breath and explained what had happened to Jeannie. She had Jeannie's music with her and offered to go on. A five-minute rehearsal followed and the blonde singer went on with the show.

* * *

Jack Benny, comedian, heard on the Chevrolet program, estimates that he receives about 150 scripts a week from listeners, who think he ought to use them, because "friends tell me it's a riot." Benny so far, has returned about 150 manuscripts a week.

* * *

Leon Belasco speaks seven languages, was born in Russia, has lived in China, Japan, the United States and Europe, and conducted orchestras in Hollywood and aboard the S. S. Leviathan. . . . "Skippy," the cartoon kid brought to life via CBS, has something new to boast about . . . his boss and creator, Percy Crosby, has been commissioned a reserve major in the U. S. Marine Corps. . . . Mary McCoy, pretty blonde soprano heard in the new "Evening in Paris" series, is about the only artist in the world who ever paid admission to sing at the Metropolitan Opera House. . . . She forgot her season pass. She substituted for a stricken singer. . . . Agnes Moorehead, featured in a dim-wit dramatic role of the same series, is known as radio's "Dr. Jekyll and Mrs. Hyde" . . . she has played more than a score of roles ranging from old men to cockney maids. . . . "Snooney" of "Snooney and Her Dog," in the CBS Five Star Theatre, received a gangling blood-hound pup tagged "Snooney" from an appreciative fan. When she inquired what the pup might grow up to be, Dr. Seuss, the cartoonist, contributed a caricature resembling an airedale horse.

* * *

The old assumption that broadcasting is ruinous to box office receipts has received a decided set-back from Toscanini's current Beethoven Cycle with the New York Philharmonic-Symphony Orchestra. Scheduled purposely for the five Sunday afternoons, the regular broadcasting period for the concerts over WABC and a coast-to-coast Columbia network, the Beethoven programs have set a new high in attendance for the entire season.

"The signal success of the Philharmonic's current Beethoven Cycle stands as incontrovertible evidence that the music-loving public refuses to accept any substitute for performances 'in the flesh,'" says Arthur Judson, manager of the orchestra. "During the trying days of the past few years when the depression has affected the box office receipts of the concert hall, as it has of every other enterprise, the tendency has been to lay the blame on radio as the detracting influence.

"Yet all of our Beethoven programs have been broadcast over a nationwide Columbia network, and we have been forced to hang out the S.R.O. signs on the Sundays of the Cycle's duration. While the radio serves an invaluable purpose in bringing the art of Toscanini and the Philharmonic-Symphony Orchestra to the millions throughout the country who could never otherwise be privileged to enjoy it, the attendance at the current performances proves that broadcasting can not replace the concert hall. Radio is an adjunct to the concert field; it is a mistake to consider it in any sense a competitor."

* * *

Al Bernard, minstrel, has collected songs for fifteen years. He has one of the largest song libraries of any radio artist, using a huge room in his West 50th Street apartment to store the music.

* * *

Tom Howard, comedian, lives in Red Bank, N. J., but there's no front yard to his home that faces the Shrewsbury River. The result is that frequently when Tom sees a boat he likes, it comes chugging to the front door. There now are six boats anchored there.

* * *

Frank Crumit and Julia Sanderson, NBC duo, rehearse their broadcast numbers while motoring. They drive down from Springfield, Mass., each Tuesday for their program and sing their duets during the entire 150-mile drive.

* * *

Jane Pickens, NBC star, once sang as "Miss Incognito" over WSB, Atlanta, when she went home to Georgia during a vacation from Curtis Institute of Philadelphia, where she received her vocal training.

* * *

Bottle, the butler for Phil Baker, the Armour Jester, heard over a network every Friday at 6:30 p.m., PST, participated in the first broadcast at sea from the Leviathan. The stunt, staged in 1931, was an RKO "Theater of the Air" feature which attracted world-wide attention. Bottle in real life is Harry McNaughton, veteran of more than twenty years on the American stage. He had appeared as (unpaid) guest artist on many radio bills before he landed his present real-money job with his old friend, Phil Baker.

* * *

WHAT YOUR NBC ARTIST LIKES TO DO WHEN HE GETS TIME. . . . JIMMY MELTON cooks. . . . JEAN SARGENT plays poker. . . . PHILLIPS LORD sails a boat. . . . KELVIN KEECH drives his car. . . . PIC MALONE AND PAT PADGETT hunt and fish. . . . LOWELL THOMAS rides a horse. . . . B. A. ROLFE yachts. . . . EDDIE CANTOR goes to California. . . . ROBERT SIMMONS stays in the country. . . . FRANK PARKER plays polo. . . . FORD BOND eats. . . . JACK PEARL tells yarns. . . . RICHARD GORDON carpenters. . . . SIGMUND SPAETH goes to Europe. . . . FRANK MUNN rides a police boat. . . . ANDY SANNELLA visits his farm in Indiana and works his "ham" set. . . . WALTER DAMROSCH landscape gardens. . . . CARVETH WELLS writes a book.

Station Sparks

(Continued from preceding page)

rehearsing; he selects the music and builds these programs, makes special arrangements of a dozen or more songs and instrumental numbers, rehearses the Revelers and accompanies them on the piano, interviews scores of musicians, supervises a dozen other broadcasts, hears many auditions, holds dozens of conferences with NBC program board officials, and occasionally eats and sleeps.

He has been married for several years. Is very good-natured and has a quick wit. Has thick black gray-streaked hair. Black eyes, snapping with energy. High cheek bones. Is 39 years old.

RMA Convention Set for June 6 in Chicago

Plans for the Ninth Annual Radio Manufacturers Association Convention June 6th at the Stevens Hotel, Chicago; projects for stabilization of the industry and for events to stimulate radio interest and promote sales next fall, were approved by the Board of Directors at a special meeting at Chicago. President Fred D. Williams presided. There were meetings also of receiving set, parts and other industry groups.

President Williams and the executive Committee were authorized to proceed with plans for an outstanding radio event next fall which will promote interests of broadcasters, jobbers and dealers as well as manufacturers. It is planned to make announcement of details of the fall event at the convention in Chicago.

RMA Votes Non-Support of Garden Radio Show

RMA members are being advised that the Association's Board of Directors has carefully considered the proposed electrical and radio public show scheduled in September at Madison Square Garden, and has voted unanimously against sponsoring or supporting the Madison Square Garden show.

While RMA members are left free to make their own decision regarding exhibition in the Madison Square Garden show, members are being advised of the adverse opinion of the RMA Board.

NEW STORES PROSPER

Although opened only a few weeks ago, The Cut-Rate Radio Stores at 79½ Cortlandt Street, N. Y. City, are fast pushing to the front as one of the most progressive stores in the district. They are now fully equipped to instal various types of automobile radio receivers and are one of a few who make a specialty of moderate-priced receivers of this type.

TRADIOGRAMS

By J. Murray Barron

During the past few months considerable ac-dc receivers have been shipped to foreign countries. For those familiar with the conditions and ways of the folk from other lands there is some excellent business waiting. In six specific cases the manufacturers since the first of the year made good contact and in two instances made numerous other shipments as repeat orders. The prices are necessarily low, but the risk is nil, as the transactions are for cash. Naturally if the business is done as a strictly mail order one, better prices may be obtained, yet the short cuts are often preferable.

* * *

The Powertone line of short-wave receivers is now in production on a basis to fill all orders in the next few weeks. The ac-dc Universal Short-Wave Receiver with Hammarlund parts is the latest addition to the line and is a three-tube job, using 43, 78 and 25Z5 tubes. Under favorable conditions loudspeaker reception may be expected. The receiver uses the latest Octo-form short-wave coils and covers from 15-200 meters. Additional coils to cover higher wavelengths may be had. All nationally-known parts are used. These receivers are being merchandised exclusively by Try-Mo Radio Co., 85 Cortlandt Street, N. Y. City. They may be had in kit form or wired.

* * *

To those who are interested in a small ac-dc, especially the four-tube model, it is well to know that Postal Radio Corp., 135 Liberty Street, N. Y. City, announces that it will continue to merchandise this receiver, fitted for battery operation, 6-volt and Delco systems, notwithstanding that new models have been added. That the market is still very large for the smaller model on account of its extreme compactness is very evident from the sales from all sections of the country.

U. S. Licensing of S-W Auto Sets is Opposed

Formal protest was made to the Merchant Marine, Radio and Fisheries Committee of the U. S. House of Representatives by Radio Manufacturers Association, Inc., against a bill by Representative Ludlow, of Indiana, (D.), proposing restriction on short-wave sets in automobiles. The bill proposes to require licensing by United States Attorneys throughout the country of short-wave sets used in automobiles.

The RMA has not opposed similar legislation for licensing of short-wave sets by state police authorities, but is objecting to the plan of the Ludlow bill. The bill also is opposed by the Federal Radio Commission and other radio interests.

MARCH TAX $149,859.66

Internal Revenue Bureau collections during March of the Federal five per cent. excise taxes on radio and phonograph records amounted to $149,859.66, according to an official statement. The March tax collections on mechanical refrigerators were $125,340.70.

Literature Wanted

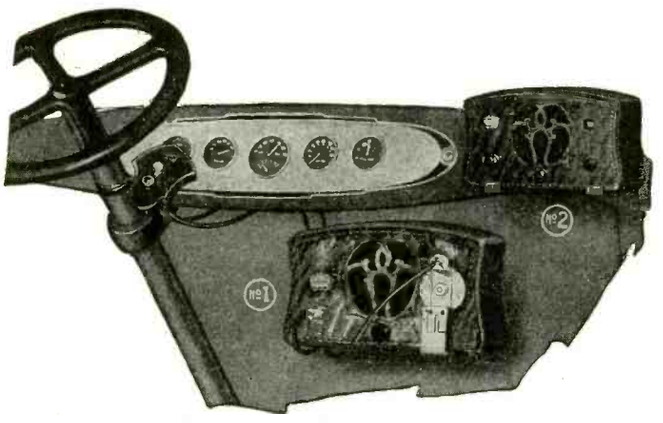
Readers desiring radio literature from manufacturers and jobbers should send a request for publication of their name and address. Address Literature Editor, RADIO WORLD, 145 West 45th Street, New York, N. Y.

Willard Thiel, Valders, Wisc.
Nelson Keller, Bo No. 72, Hahnville, La.
M. Curry, Curry's Radio Service, 1400 Laurel Ave., Knoxville, Tenn.
D. W. Schunight, 2312 Rosenew Drive, Box 224D, R.R. No. 9, W. Toledo, Ohio.
J. P. Ritchey, City Organizer, 509 West King Street, Lancaster, Penna.
F. W. Larson, 2215 Lenox Ave., Detroit, Mich.
Norman H. Speight, 83 Cavell Avenue, Toronto, Ont., Can.
E. F. McNutt, 18 Pasadena Avenue, Youngstown, Ohio.
B. C. Halley, 811 19th Street, Denver, Colo.
John Tipton, 1715 E. 13th Ave., Denver, Colo.
Kemper N. Venis, 308 E. 7th Street, Bloomington, Ind.
L. B. Vernon, 211½ Orange Ave., Fort Pierce, Fla.
Wm. H. Scott, Jr., 105 N. 7th Street, Bangor, Penna.
A. N. Duckworth, 1 Summer Court, Westboro, Mass.

CORPORATION REPORTS

Arcturus Radio Tube Company. Report for the three months ending March 31, a net profit after expenses, depreciation and other charges, $1,207, compared with a net loss of $124,000 for the same quarter of 1932. The company has liquidated all notes and paid all obligations other than current bills, as stated at the annual stockholders' meeting. Emanuel Diebitch was elected a director to succeed William De L. R. Anderson.

Car Radio, With and Without Remote Control



The mounting of a receiver has been much simplified, together with the simplification of the receiver itself. The photograph herewith shows two methods of mounting the Postal 5-tube universal superheterodyne in the car. Fig. 1 illustrates the mounting on the dash board whereas Fig. 2 shows the mounting on the instrument panel. The set has been been designed especially for easy mounting. In each case two mounting brackets are necessary, but these are made to fit the set exactly. There are only two small holes to drill in either case. It does not require an engineer to do the mounting, for anyone who can drill a hole and who can mount a bracket can do the job. Once the set has been mounted and connected, it only takes five seconds to disconnect it for use elsewhere.

The circuit can be arranged to work on 110 volts. a.c. or d.c., on 220 volts, a.c. and d.c., on 32 volts, and on batteries. Hence it is truly universal. When the set is used in an automobile the car storage battery is used on the heaters, and the plates are supplied either by a battery or a B battery eliminator, whichever is available. The set can also be used on a motorboat.

FIRST TENANT HAS OFFICE IN RCA BUILDING

The first tenants in New York's newest skyscraper—the 70-story RCA Building in Rockefeller Center—have moved into the towering structure. The field offices of Todd, Robertson, Hodd Engineering Corporation and Todd & Brown, Inc., builders and managers for the entire Development, have just been transferred from the old brownstone house at 20 West 49th Street, New York City, to the second floor of the RCA Building.

Offices in the building previously had been restricted to rough wooden construction shanties on the mezzanine floor level and various workmen's commissary shacks. Desks, chairs, typewriters, steel filing cabinets and a telephone switchboard have now transformed the gleaming, freshly-plastered space along the 49th Street side of the second floor into an active business office.

Scaffolding Removed

During the remainder of April work will be pushed forward vigorously to prepare the RCA Building for other tenants.

At present more than a thousand mechanics and workmen are finishing up the interior. Other hundreds are engaged on the British Empire Building and La Maison Francaise, which occupy the Fifth Avenue front of the block, and on three elements of Rockefeller Plaza—the new private street cutting north and south across the central block, the Sunken Plaza directly east of the street, and the wide Promenade leading from Fifth Avenue into the Plaza.

Already the Sixth Avenue entrance to the RCA Building is assuming its finished appearance. The scaffolding has been removed in the loggia that is ornamented by Barry Faulkner's huge enamel mosaic, and its brilliantly colored design attracts hundreds of passersby daily.

New Sidewalks

Preparations are being made to lay new sidewalks on the 49th and 50th Street sides of the RCA Building and on the 50th Street side and the Fifth Avenue front of the British Empire Building.

Activity Increases

The Rockefeller Center rental organization announces that rental activity has been increased during the past few weeks. The daily quota of visitors to the Renting and Information Office at 620 Fifth Avenue continues high, ample evidence of the wide interest that is aroused at the prospect of the approaching completion of the central block of the project.

AUTHOR CONSULTS PLAYER

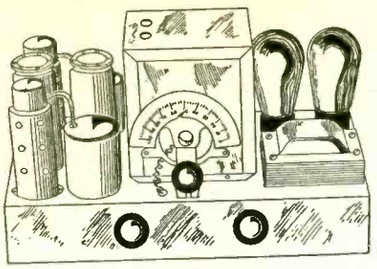
When in doubt as to the wisdom of putting an incident in the Vic and Sade skit, Paul Rhymer, NBC continuity writer who originated and writes the show, asks Bernardine Flynn as the final authority. Bernardine plays the part of Sade in the program. If he wants a youngster's opinion, he asks Billy Idelson who plays the part of Rush. Billy is very frank and does not worry about hurting people's feelings. Art Van Harvey (Vic) often suggests plots about which Rhymer builds episodes for the show.

MORE RADIO TAXES KILLED

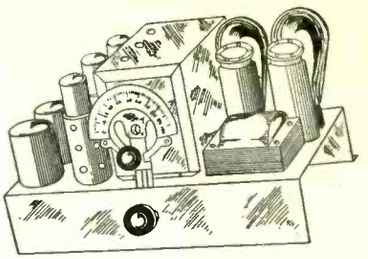
Following defeat of a bill in the Connecticut Legislature proposing a special 10 per cent. "luxury tax" on radio, Radio Manufacturers Association, Inc., is advised that a similar bill in the Missouri Legislature providing for a 2 per cent. special tax on radio has been killed and also that a similar "luxury tax" bill in the California Legislature has been stopped with prospects that it will die in committee.

LOOK AT YOUR WRAPPER

You will see by the date thereon when your subscription for Radio World expires. If the subscription is about to run out, please send us renewal so that you will not miss any copies. Subscription Department, RADIO WORLD, 145 West 45th St., N. Y. City.



BLUEPRINTS, COILS and CHASSIS FOR THE DIAMOND OF THE AIR



FOUR-TUBE DIAMOND

Extremely fine performance, including fetching tone quality, marks the Four-Tube A-C 1933 Diamond of the Air, blueprint of which is now available (half-scale). Many have been surprised that so much can be accomplished on a t-r-f set that costs so little to build. The circuit uses a two-gang 0.00035 mfd. condenser. Special coils are required. The chassis is metal, 13.75 x 6.75 x 2.5 inches.

Send $3.00 for six months subscription (26 issues) and get the blueprint, two official shielded coils and the drilled metal chassis free. Order PRE-D-4-COMB.

FIVE-TUBE DIAMOND

The Five-Tube A-C 1933 Diamond of the Air provides greater sensitivity than the four-tube model, also somewhat more selectivity, as a three-gang condenser is used. An infallible method of permanently suppressing oscillation is introduced, so that besides having a sensitive and selective set one will have a stable receiver. The tone is most excellent. Send $4.00 for 34 weeks subscription (34 issues) and get the blueprint, three shielded coils and drilled metal chassis free. Chassis is 13.75 x 9 x 3 inches. Order Cat. PRE-D-5-COMB.

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.

0-10,000-Ohm Resistance Meter

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.

We do not pay postage on resistance meter. Average postage 17c.

RADIO WORLD and RADIO NEWS } $7.00

Get both of these mazagines for one year for $7.00, although the regular subscription price of RADIO WORLD alone is $6.00 a year and that of "Radio News" alone is $2.50 a year. Instead of paying $8.50 you pay $7 and you get 52 issues of RADIO WORLD (one a week) and 12 issues of "Radio News" (one a month). "Radio News" recently bought "Citizens Radio Call Book," and "Technical Review" and consolidated them with "Radio News." This offer at this combination price applies only to United States and possessions. Send $7.00 and order Cat. PRE-RWRN.

To Canadian and other Foreign subscribers the combination price offer is at $8.50 for these two magazines. Order Cat. PRE-FOR-RWRN.

RIDER'S MANUAL

The standby of the service man is John F. Rider's "Perpetual Trouble Shooter's Manual," of which Vols. 1 and 2 have been published.

Vol. 1 consists of 2,000 diagrams of commercial receivers, power amplifiers, converters, etc. Total pages, 1200.

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.

To get Vol. 1 free, send $9.00 for 1½-year subscription (78 weeks) and order Cat. PRE-RM-1.

To get Vol. 2 free, send $9.00 for 1½-year subscription (78 weeks) and order Cat. PRE-RM-2.

PHONOGRAPH MOTOR

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 serviceable iron that works on a-c (any frequency) and d-c, 105-120 volts. Sent free on receipt of $1.50 for three-months subscription (13 issues). Order Cat. PRE-SOLIN.

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

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.

SHIELDS FOR 57, 58 TUBES Aluminium shields of the type specified by the tube manufacturers for sensitive circuits, so that the shield top fits snugly about the tube dome, are obtainable, six free on receipt of $1.00 for 8 weeks trial subscription. Order Cat. PRE-TUBSH.

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

(WE PAY POSTAGE ON ALL PRODUCTS LISTED ON THIS PAGE, EXCEPT OHMMETER).

NEW MODEL SHIELDED TEST OSCILLATOR!

AN improved modulated test oscillator, fundamental frequencies, 50 to 150 kc, enabling lining up of intermediate frequency amplifiers, r-f and oscillator circuits, is now ready. It is shielded in a metal box 9½" wide x 6¾" deep x 4½" high, with beautiful Japanese finish. The test oscillator is obtainable in two models, one for a-c operation, the other for battery operation. The same cabinet is used for both.

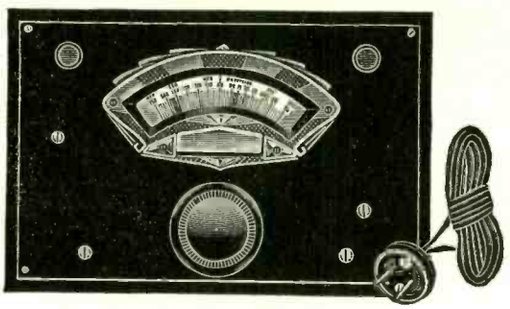
The a-c model not only is shielded but has the line blocked, that is, radio frequencies generated by the oscillator cannot be communicated to the tested set by way of the a-c line. This is a necessary counterpart to shielding, and a special circuit had to be devised to solve the problem.

The modulation in the a-c model is the a-c line frequency, 60 cycles, effected by using the line voltage on the plate of the tube. Besides a fuse there is a very high resistance between the shield cabinet and the a-c, a double preventive of line-shorting and application of a-c line voltage to the user.

The oscillator is equipped with an output post. No ground connection need be used, as the circuit is sufficiently grounded through the power transformer capacity to prevent body capacity effects in tuning.

The frequencies are more accurately read than normal use requires, being never more than 2% off, and usually not more than 1% off, many readings being right on the dot (no discernible difference). The frequency stability is of a high order from 100 to 50 kc, and somewhat less from 100 to 150 kc. Zero beats are guaranteed at all frequencies.

The oscillator was designed by Herman Bernard and is manufactured under the supervision of graduates of the Massachusetts Institute of Technology.



The test oscillator has a frequency-calibrated dial, 150 to 50 kc, with 1 kc separation between 50 and 80 kc and 2 kc separation between 80 and 150 kc. Intermediate frequencies are imprinted on the upper tier. Broadcast frequencies are obtainable on tenth harmonics (500 to 1,500 kc).

GUARANTY RADIO GOODS CO.
143 West 45th Street, New York, N. Y.

THE a-c model is completely self-operated and requires a 56 tube. The battery model requires external 22.5-volt small B battery and 1.5-volt dry cell, besides a 230 tube. The use of 1.5 volts instead of 2 volts on the filament increases the plate impedance and the operating stability.

The battery model is modulated by a high-pitched note. Zero beats are not obtainable with the battery model.

A-C MODEL, Cat. SHO-AC, less 56 tube..$7.68
56 tube 76c extra.

BATTERY MODEL, Cat. SHO-B, less 230 tube, less batteries $7.08
230 tube 98c extra.

Directions for Use

Remove the four screws and the slip cover, insert the 56 tube in its socket, restore the cover and screws, connect the a-c attachment plug to the wall socket, and the a-c test oscillator is ready for service.

For testing some particular set, follow the directions given by the designer or manufacturer. In the absence of such directions, use the following method.

Mentally affix a cipher to the registered frequencies on the lower tier (so 50 is read as 500, and 150 as 1,500), and set the dial for any desired broadcast frequency. Connect a wire from output post of test oscillator to antenna post of set. Leave aerial on for zero beats, off otherwise. At resonance the hum will be heard. Off resonance it will not be heard. For testing intermediate frequencies, connect the wire to plate of the first detector socket. The first detector tube may be left in place and bared wire pushed into the plate spring. The intermediates then are tuned for strongest hum response. If an output meter is used, tune for greatest needle deflection.

The battery model is connected to voltage sources as marked on oscillator outleads and is used the same way.

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

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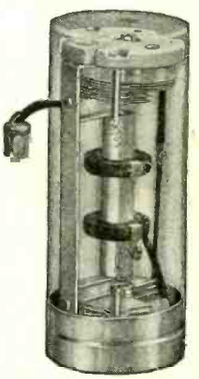
NEW $2.65 INTERMEDIATES



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

Highest grade intermediate transformers, 465 kc or 175 kc, with or without secondary center tap, just released by Hammarlund, use air-core condensers for tuning.

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

The use of these air variables practically eliminates the variations in gain and selectivity inherent in intermediate transformers in which the coils are tuned by means of adjustable condensers of the compression type using mica as dielectric. The transformers are pre-tuned to the desired frequency. List price, $4.50; net, $2.65 each.

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PADDING CONDENSERS

Either capacity, 50c

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

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

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

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

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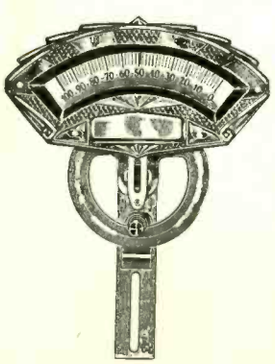
Matched Combination of Dial, Condenser, Coil



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

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

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

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

Cat. DJADF — Frequency calibrated **94c**

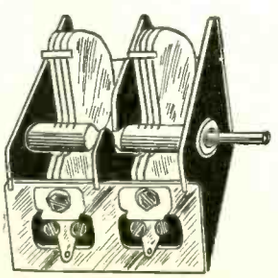
Cat. RFCH — (TH) — Honeycomb coil of 20 millihenries inductance. Two extreme lugs for total winding. Center lug is tap..... **45c**

Cat. TRF-250—Radio frequency transformer 2⅛-inch diameter shield; primary and tapped secondary. Tap may be used for oscillation in cathode leg of beater tube **45c**

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

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

Short-Wave Condenser



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

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115 DIAGRAMS FREE

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

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

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

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