RADIO WORLD

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The First and Only National Radio Weekly

Twelfth Year *579th Consecutive Issue*

TWO NEW TUBES

2A6 is a High Mu 55

6A4 is Auto Power Valve

How to Use the New

"TWIN B" TUBES

APRIL 29
1933

ALL-WAVE D-C SUPER

Nine Tubes, with 48 P-P Output

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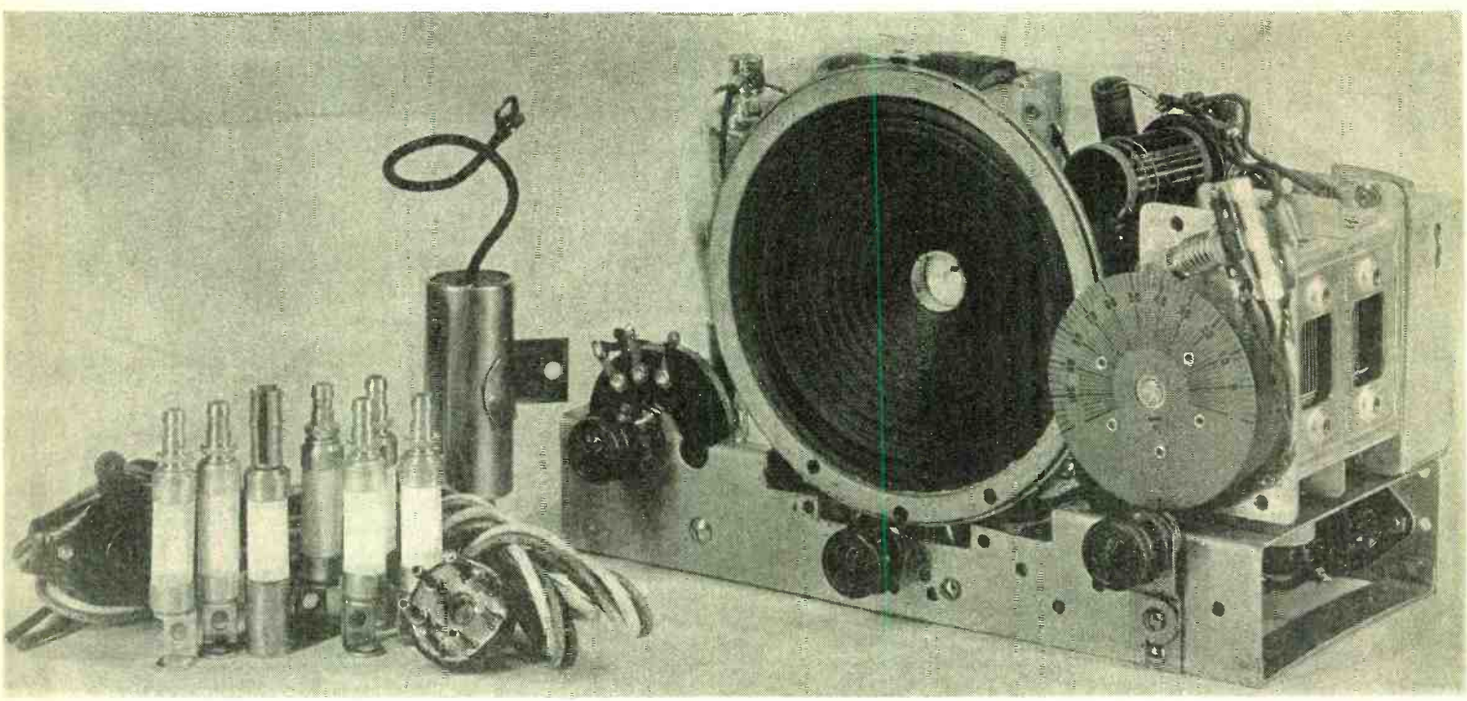
Per Copy

5-TUBE A-C and D-C SUPER for HOME OR CAR



This five-tube universal superheterodyne can be used in car or home for it works on d-c and a-c lines and on batteries. See pages 8 and 9.

COILS AND PADDING FOR SUPERS

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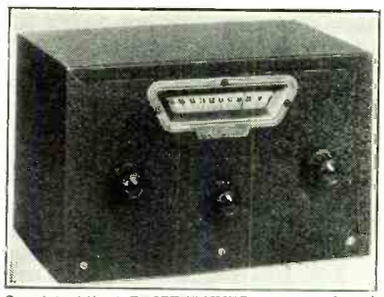

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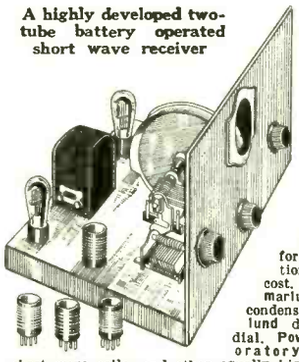

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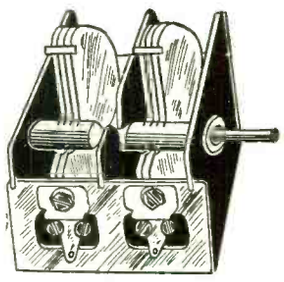

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THE 2A6 AND THE 6A4

High Mu 55 is First, Pentode Output Tube is Other

TWO more tubes are to be announced officially within a short time, and meanwhile some preliminary unofficial information concerning them can be given and it will be found to match closely the data that will be officially released.

One of the new tubes will be like the 55, except that the amplifier unit will be a high mu triode, instead of a relatively low mu triode. It will be for 2.5-volt heater operation. The designation will be the 2A6.

The other new tube will be the 6A4, a power amplifier pentode for automobile and d-c line use, particularly valuable for universal a-c and d-c receivers.

2A6 Bias 2 Volts

The duo-diode triode with the high amplification factor for 2.5-volt a-c heater operation will draw 0.8 ampere heater current and is for operation as a class A amplifier tube at 250 plate volts, with grid bias of only 2 volts, mu of 100, mutual conductance of 1,100 micromhos; plate current, 0.8 milliampere. The plate load resistor should be 100,000 ohms.

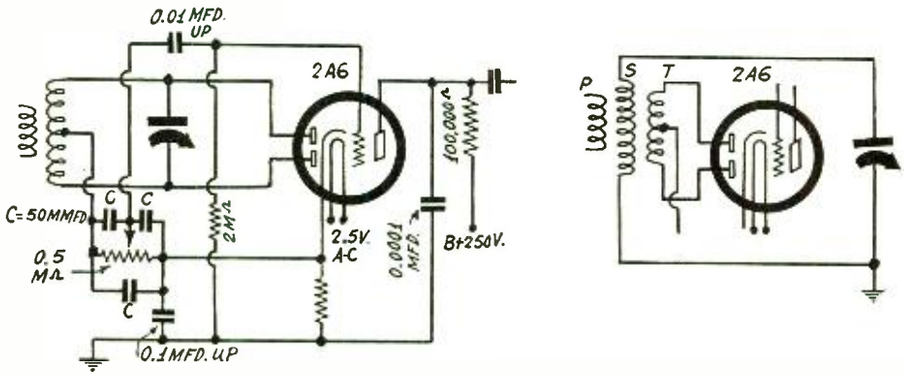
The tube has the same general physical construction as the 55, with a six-pin base and with an overhead grid for the amplifier.

The 2A6 completes the trilogy of tubes of the duo-diode type, with different amplification factors and operating conditions to serve various purposes. For instance, the 55, mu 8.3, will remain preferable where there is to be transformer coupling, as to feed a push-pull output or driver stage; the 2A6 will permit a gain of more than 10 times as much, comparing resistance coupling used with the 55 with resistance coupling used with the 2A6; while the new the 2B7, recently announced, will permit a still higher gain with resistance coupling (mu as audio amplifier not listed in the tube charts). The 2B7 is an extra-high mu tube, and is a pentode, but for its proper operation in a resistance-coupled amplifier the conditions are more critical and exacting than in the case of the 55 and the 2A6.

Apportionment of Purposes

Particularly where a diode-biased amplifier is used, when the amplifier grid is connected to the load resistance of the diode detector unit, if there is considerable sensitivity ahead of the diode, the amplifier of the 55 will sustain the higher voltage better than either of the two other tubes before the amplification cuts off due to the bias becoming too high, for the signal voltage alone is the bias on the tube. Thus the selection of the tube to occupy this position will depend largely on the gain ahead of the diode, and the greater the gain, the lower the mu of the amplifier tube to be used. That is, higher gains would cause the 55 to be favored, lower gains the 2A6, and still lower gains the 2B7.

For high-powered sets, therefore, the 55 would still be the most satisfactory, and the reason for the new tubes, the 2A6 to be announced and the 2B7 recently announced, is to compensate for low values of gain in the r-f and i-f amplifiers.



The 2A6 as plate-current-biased amplifier, with volume controlled at the full-wave detector load resistor. This is suitable for supers. At right is a coupling method for t-r-f, P and S being primary and secondary, and T a 200-turn center-tapped honeycomb to fit inside the coil form.

The 6A4

The 6A4 will have a five-pin base, with 6.3-volt heater at 0.3 ampere. Various plate voltages may be used, but the 100-v. value probably will predominate, therefore the data are given for this condition. The grid bias will be 6.4 volts for 100 volts on the plate, the plate current will be 9 milliamperes then, the screen current 1.6 milliamperes; the plate resistance, 83,250 ohms; required load resistance, 11,000 ohms; amplification factor, 100; mutual conductance, 1,200 micromhos; power output at 9 per cent. total harmonic distortion, 0.31 watt.

It will be recommended that the feed to the tube on the signal line be by transformer or impedance coupling, due to the resultant low d-c resistance, for at signal values of input greater than the negative bias, there would be grid current, and the effect of such current in most circuits where the grid load resistance is high is to make the tube lose bias at such signal strengths. However, if a resistor is used as grid load of the new power tube, it should not have a value in excess of 0.5 meg.

The power output is not large, of course. In the automotive and d-c line series of tubes the power output values compare as follows under equivalent operating conditions (100 volts):

38 tube, 2 watts; negative bias, 9 volts.
41 tube, 0.5 watt; negative bias, 8 volts.
89 tube, 2 watts; negative bias, 15 volts.

The other power tube in the series is the 42, but the plate voltage recommended is 250 volts, at 16.5 volts bias, output 3 watts.

Plate Current Important

However, depending on the use to which

(*Continued on next page*)

THE 79 AS CLASS B

Driver, Voltage and Transformer Specifications

TABLE 1 - CLASS B COMBINATIONS

Driver Stage						Transformer		Output Stage, 1-79, Grid Volts=0					
Arrangement	Tube Type	Used As	Plate Volts *	Grid Volts *	Input Signal Volts RMS	Voltage Ratio Pri./ 1/2 Sec.	Peak Power % Eff.	Plate Volts	Plate to Plate Load Ohms	Av. Ma. per plate** No Sig.	Sig.	Output Watts	Total Distortion %
1	89	triode	160.0	-20.0	14.2	2.14	75	180	10000	3.5	20.5	5.11	7.8
2	85	triode	167.5	-12.5	8.8	2.66	70	180	14000	3.5	15.0	3.72	8.0
3	85	triode	204.0	-16.0	11.3	2.66	70	220	14000	4.5	20.0	6.20	10.8
4	37	triode	185.5	-14.5	10.3	2.66	70	200	14000	4.0	17.0	4.76	10.6
5	41	pentode	167.5	-12.5	8.75	4.28	#	180	7000	3.5	25.0	5.24	11.0
6	41	pentode	167.5	-12.5	8.75	3.30	#	180	8000	3.5	27.3	6.96	16.0

Primary of transformer (approx. 70% eff.) shunted by a resistor of 15000 ohms.
* Sum of voltages for plate and grid is the same as the plate voltage for the 79.
** The value of d-c plate current with full output.

TABLE 2 - CLASS B COMBINATIONS WITH SPECIFIED TRANSFORMERS

Driver Stage								Transformer	Output Stage, 1-79, Grid Volts=0		
Arrangement	Tube Type	Used As	Plate Volts	Grid Volts	Screen Volts	Screen Ma.	Plate Ma.	Identification	Plate Volts	Plate-to-Plate Load - Ohms	Av. Ma. per Plate No Sig.
1	89	triode	160.0	-20.0	-	-	17.0	S-45-A	180	10000	3.5
2	89	pentode	163.0	-17.0	163.0	2.5	17.0	S-74°	180	7000	3.5
3	85	triode	185.5	-14.5	-	-	6.0	S-75	200	12000	4.0
4	37	triode	185.5	-14.5	-	-	4.0	S-75	200	12000	4.5
5	41	pentode	167.5	-12.5	167.5	3.0	17.0	S-74°	180	8800	3.5

° Primary of S-74 input transformer shunted by a resistor of 15000-20000 ohms.

Two tables relating to the new 79 tube. Table 1 gives a number of possible combinations of driver stage, and 79 in Class B output. Table 2 shows the operating conditions for several combinations of driver stage and a 79 in Class B with specified transformers.

THE following was released by E. T. Cunningham, Inc., and RCA Radiotron Company, Inc.:

APPLICATION NOTE ON THE TYPE 79 TUBE

With the introduction of the type 79 tube, a new stimulus has been given to the use of Class B output amplifiers in automobile receivers. The 79 is a Class B Twin amplifier, combining two high-mu triodes in one bulb.

The construction of the 79 offers special advantages in automobile receiver design where space requirements are at a premium. The 79 thus replaces with one tube the two formerly required for a Class B output stage. A more compact design for the receiver is, therefore, possible.

The 79 offers further advantages of sufficient importance to be considered in the selection of an output system. The use of the 79 requires only one socket for the Class B stage, so that the circuit wiring is reduced. Furthermore, the 79 requires only 0.6 ampere heater current, thus giving low A battery drain for a Class "B" output stage.

No Power Output Sacrifice

The 79, combining two tubes in one, has not required any sacrifice in power output. This is important because it has become increasingly desirable that the automobile radio set be capable of delivering adequate power output.

The trend toward higher driving speeds has raised the noise level within the automobile. Tires, engine, and windage contribute to a high noise level. In addition, the absorption of sound waves by the occupants of the car, the upholstery, and the lining are factors which must be considered in the design of an automibile-radio receiver. It is obvious that, with speakers of moderate efficiency, high power output with good quality is essential for a satisfactory receiver.

The power output from the 79 will depend principally upon the plate supply voltage available and the type of the tube used in the driver stage. Various types of tubes which are feasible as drivers include the 37, 41, 85 and 89. Because of the special requirements of Class B operation, it is important that the voltage regulation of the power supply be fairly good.

Table 1 gives a number of possible combinations of driver stage and a 79 in a Class B output stage. The combinations, as given, call for the same plate supply voltage for both the driver and the output stage. Variations in sensitivity, in total harmonic distortion, in maximum power output available, and in plate current requirements due the different combinations are clearly illustrated in Table 1.

The current per plate of the 79 varies greatly with the signal impressed on the grid. Table 1 shows the value of current per plate of the 79 with no signal on the grid, and also with a signal of sufficient amplitude to give full output from the 79. The values of current per plate with signal correspond to the maximum power output values which are normally of short duration. The filter condenser in the d-c plate voltage supply system assists in supplying the momentary peaks of plate current. The average audio output required for usual broadcast reception is considerably less than that required for maximum volume. It follows that the d-c current requirements, per plate, on the average, are also lower than the values shown in Table 1 under average milliamperes, with signal.

The Various Methods

Arrangement 1, with 180 volts on the plates of the 79, gives good power output and a relatively low amount of distortion, but requires a large input signal to the 89. The plate current for the 89 under these conditions is high, being approximately 17 ma. (The plate current for the driver tube is shown in Table 2).

Arrangement 2, with 180 volts on the plates of the 79 and an 85 as driver, gives a low power output and low distortion, but requires only a small input signal to the driver. The plate current requirements of both the driver and the output stage are very moderate.

Arrangement 3, similar to arrangement 2 except for higher plate voltages on the driver and the 79, gives high power output; but the distortion and required signal voltage are large. The plate current requirements are moderate.

Arrangement 4, with the 37 as a driver, gives a relatively low power output and requires a relatively large input signal. However the plate current requirements

Comparison of 6.3-volt Output Tubes

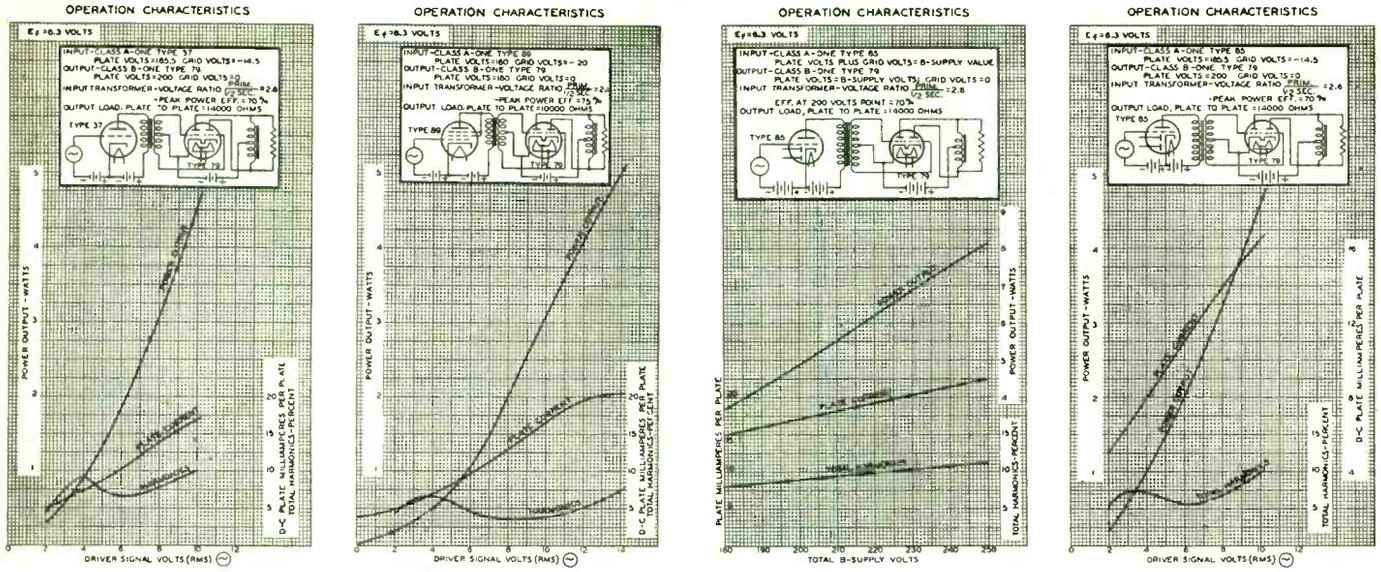
(Continued from preceding page)

a power tube is put, the plate current has to be considered. For battery operation the 42's high voltage would not be suitable, moreover the 42 is a screen grid tube, the plate current is 34 ma, the screen current 6.5 ma, a total of 40.5 ma in one tube alone, which rather restricts the use to d-c line operation, where the current dosn't matter much.

The 38, at 100 plate and screen volts, draws 7 ma and 2 ma respectively, or 9 all told, which is much more economical, although the output is pretty high, at 2 watts. The new 6A4 draws 10.6 ma plate and screen currents.

For the 41, at 100 volts, the plate current is 9 ma, the screen current 1.6 ma, total also 10.6, the output one-quarter that of the 38, or 0.5 watt, but nearly twice that of the new 6A4. The 89 has no screen, the plate current is 13 ma.

For some of these tubes the standard minimum plate voltage recommendation is greater than 100 volts, e.g., 41 is 125 volts; 42 is 250 volts; 89 is 160 volts. The 6A4 therefore falls more nicely into the 100-volt class for economical operation and justifies its existence as a pentode where the plate voltage is thus limited, as in a-c and d-c universal sets, for which it makes a suitable output tube, although there is a special a-c and d-c type output tube for 25-volt heater, the 43. The plate voltage for this may be 95 volts, bias 15 volts, screen volts 95, plate current being 20 ma and screen current 4. The power output is 0.9 watt. For limited purposes low wattage is all-sufficient.



Characteristics of the 79 with 37 driver (left), 89 driver (second from left) and two instances of 85 driver.

of this combination are the lowest of any shown.

Arrangement 5, with the 41 as a driver, gives a fairly high power output with moderate signal voltage input, but requires high plate current.

Arrangement 6, similar to Arrangement 5 with the exception of the plate load resistor for the 79, gives very high power output with moderate signal input. However, the distortion is very high; the plate current drain for this combination is also the highest for any combination considered.

A study of these combinations will reveal certain advantages for each. Where low plate current drain is the prime consideration, arrangements 1 and 4 will give perhaps the best results. Where power output is the governing factor, arrangements 3 and 5 are of interest. Where maximum sensitivity is required, arrangements 2, 5 and 6 merit attention. In making a selection of any combination of driver and output stage, the engineer must be careful to give full consideration to all the requirements of the application. From the arrangements shown, a judicious choice will yield a combination best suited to any particular requirement.

Interstage Transformer Designs

The combinations of Table 1 were obtained from laboratory interstage-transformers adjusted to the general requirements for services in an automobile receiver. Since these data were obtained, transformers specially adapted to the needs of this class of service have been designed, constructed, and tested. The design constants of three different transformers, identified by our numbers, S-45-A, S-74, and S-75, are included in this note. The power output and distortion obtained with these transformers will approximate the values shown in Table 1.

Table 2 shows the operating conditions for several combinations of driver stage and one 79 in a Class B output stage with transformers S-45-A, S-74, and S-75.

Arrangement 1 of Table 2 is similar to Arrangement 1 of Table 1.

Arrangement 2 employs an 89 operated as a pentode in the driver stage. An output of 7.0 watts, with 16.5 per cent total harmonic distortion, is obtained with this arrangement.

Arrangement 3, with a plate voltage supply of 200 volts, uses an 85 as a driver. The power output obtainable with this arrangement is approximately 4.6 watts.

Arrangement 4 is similar to Arrangement 4 of Table 1 with the exception that the load resistance in this case is 12,000 ohms. It was found that this value of load resistance gives better results with the transformer S-75 than does the 14,000 ohm plate-to-plate load shown in Table 1.

Arrangement 5 employs a type 41 pentode as the driver. The optimum load resistance is found to be 8,800 ohms when transformer S-74 is used. A power output of approximately 6.0 watts with 15.0 per cent total harmonic distortion is obtained with this combination.

Operation Characteristics

On attached sheets are shown curves of power output, plate current requirements and total harmonic distortion for the 79 versus the input-signal voltage to the driver. The conditions for each set of curves are noted at the top of the curves.

Also shown are curves of power output, plate current, and distortion versus plate supply volts for a typical combination using the 85 as a driver. The effect of increasing the plate voltage for the driver tube and the 79 are clearly indicated by these curves. Since the power output obtainable with a type 85 driver approximates that obtainable with a 37 driver, these curves may be used to estimate the performance of an arrangement employing the 37 as a driver. (This particular curve shows power outputs for the 79 as high as 8.0 watts. It should be remembered that these are peak values. The 79 is not recommended for continuous operation at such high values of power output.)

TRANSFORMER S-45a*

Core: Material-Grade Audio B Gauge No. 26, Allegheny Steel Company or equivalent.
Punching—EI-625
Window—15/16" x 5/16"
Tongue—5/8"
Stack—¾"
Joint—Butt
Net Section—2.72 sq. cm.
Mean length mag. circuit—11.1 cm.
Weight—0.41 lb.
Winding: Traverse and Margin 1/16" + 25/32" + 1/16"
Form (inside dimensions)—21/32" x 25/32" x length 29/32"
Primary: Turns—2,500 No. 39 enameled
Location—over insulated secondary
Turns per layer—180
Layers—14
Insulation between layers—0.001" paper
Insulation over winding—0.012" paper
Mean length of turn—4.37"
Resistance at 25° C.—824 ohms
Secondary: Turns—2340 No. 37. enameled, tap at 1170 turns.
Location—next to core
Turns per layer—140
Layers—17
Insulation between layers—0.001" paper
Insulation under winding—0.045" paper
Insulation over winding—0.015" paper
Mean length of turn—3.60"
Resistance at 25° C—392 ohms
Inductance of primary at 10 volts 60 cycles and 17 ma. d.c. is 11 henries.

Our design identification number.

TRANSFORMER S-74*

Core: Material-Grade Audio B Gauge No. 26, Allegheny Steel Company or equivalent
Punching—EI-625
Window—15/16" x 5/16"
Tongue—5/8"
Stack—¾"
Joint—0.002" paper per leg
Net Section—2.72 sq. cm.
Mean length mag. circuit—11.1 cm.
Weight—0.41 lb.
Winding: Traverse and Margin 1/16" + 25/32" + 1/16"
Form (inside dimension) 21/32" x 25/32" x length 29/32"
Primary: Turns—4,500 No. 40 enameled
Location—over insulated secondary
Turns per layer—200
Layers—23
Insulation between layers—0.001" paper
Insulation over winding—0.012" paper
Mean length of turn—4.37"
Resistance at 25° C.—1,850 ohms
Secondary: Turns—2,650 No. 39 enameled, tap at 1,325 turns
Location—next to core
Turns per layer—180
Layers—15
Insulation between layers—0.001" paper
Insulation under winding—0.045" paper
Insulation over winding—0.015" paper
Mean length of turn—3.6"
Resistance at 25° C.—695 ohms total
Inductance of primary at 10 volts 60 cycles and 17 ma d.c. is 30 henries.

Our design identification number.

TRANSFORMER S-75*

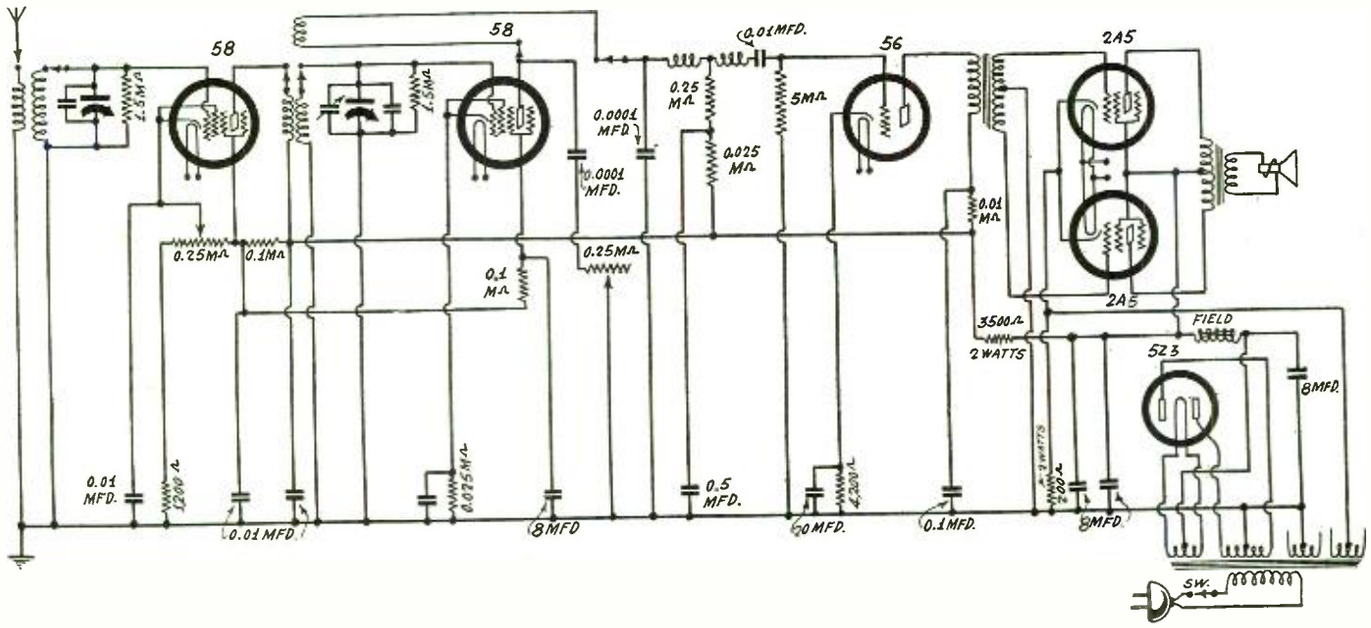
Core: Material—Grade Audio B Gauge No. 26, Allegheny Steel Company or equivalent
Punching—EI-625
Window—15/16" x 5/16"
Tongue—5/8"
Stack—¾"
Joint—Butt
Net Section—2.72 sq. cm.
Mean length mag. circuit—11.1 cm.
Weight—0.41 lbs.

(*Continued on next page*)

WINDING MIXER COIL

Directions for 1" Diameter, No. 32 Enamel, for 175 kc and 465 kc Supers

By Herman Bernard



In a t-r-f set the secondary inductances should be the same.

THE winding of coils for the radio frequency and oscillator sections of a superheterodyne for broadcast coverage sometimes proves confusing, for when an expected result turns out quite disappointing, one may wonder whether padding can be well accomplished at all.

A few rules are all that are needed, and if these are followed the results should be excellent.

The first step is to determine the radio-frequency tuning. This may be done by using the t-r-f section in the usual manner, then resorting to an untuned stage to the detector. This would be the second detector in a superheterodyne, but since we are dealing with an intrinsically t-r-f set, it is now the only detector.

For the usual type of coupling, the oscillator coil may be put into temporary service as the untuned coupler, with primary or erstwhile feedback winding in the plate circuit of the final r-f tube, secondary feeding the detector, no condenser across secondary.

Full-Wave Detection, Also

If the detector is to be full-wave, then we may put two high resistors across the secondary, extremes of winding to diode plates, center of the resistors (juncture) to one side of the rectifier load resistor. This is a good method of duplicating the full-wave result.

Now we may line up the r-f level at some high frequency, say, 1,450 kc, by adjusting the trimmers, and note the dial setting, marking it on the dial if desired, and then select, say, 1,000 kc and also 600 kc, or 590 or 610 kc, for the low-frequency point. It is well besides to mark where the extreme low frequency, 540 kc, comes in, just to be sure it is receivable at radio frequencies.

If we are winding our own coils, all we need do is put on enough secondary turns to reach 540 kc, and verify that 1,500 kc is receivable. We do not even need to know the inductance, but just as an aid, the following information will come in handy for the low-frequency (540 kc) requirement:

Max. Cap.	*Inductance*	*Turns of No. 32 Enamel on 1 inch*
350 mmfd.	250 mch	125
375 mmfd.	230 mch	118
410 mmfd.	220 mch	112
500 mmfd.	175 mch	98

The wire is very fine, of course, but as the form is only about 1.75 inches axial length, and the wire winds 112 turns to the inch, for the larger inductance coils

Class B Transformers

(*Continued from preceding page*)

Winding: Traverse and margin 1/16" + 25/" + 1/16"
Form (inside dimensions)—21/32" x 25/32" x length 29/32"
Primary: Turns—3,600 No. 39 enameled
Location—over insulated secondary
Turns per layer—180
Layers—20
Insulation between layers—0.001" paper
Insulation over winding—0.012" paper
Mean length of turn—4.37"
Resistance at 25° C.—1,142 ohms
Secondary: Turns—2,820 No. 38 enameled, tap at 1,410 turns
Location—next to core
Turns per layer—157
Layers—18
Insulation between layers—0.001" paper
Insulation under winding—0.045" paper
Insulation over winding—0.015" paper
Mean length of turn—3.6"
Resistance at 25° C.—570 ohms total
Inductance of the primary at 10 volts 60 cycles and 5 ma d.c. is 26 henries

APPLICATION NOTE ON HIGHER VOLTAGE RATINGS FOR THE 36, 37, 38, 39-44, AND 89

Due to the increased application of the 36, 37, 38, 39-44, and 89 in sets employing a.c. for the heater supply, we have considered it advisable to increase the maximum plate voltage rating on these types to 250 volts.

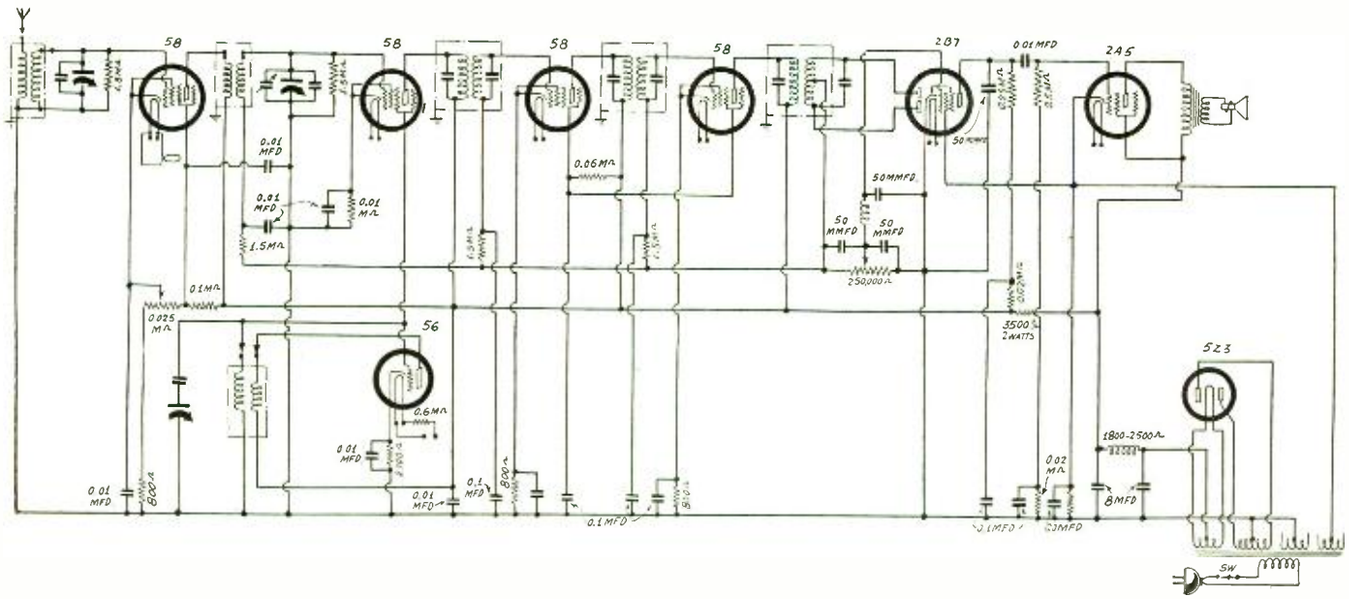
To determine the possibility, and advisability, of operating these types at 250 plate volts, life tests were made on a sufficiently large quantity to insure accurate results. From the findings of our tests we can safely recommend our 36, 37, 38, 39-44, and 89 for operation at 250 volts on the plate, with either an a-c or d-c heater supply.

At this increased plate voltage which is available in a-c receivers and in auto sets employing high-voltage B eliminators, these tubes will give greater gain in the case of the amplifiers, and will deliver more power to the loudspeaker in the case of the output tubes.

Listed below are the conditions for operation of these types with 250 volts on the plate.

Tube Type	*Plate Volts*	*Control Grid Volts*	*Screen Volts*
36	250	— 3	90
37	250	—18	...
38	250	—25	250
39-44	250	— 3	90
89 (Pentode	250	—25	250
89 (Class B)	250	0	...

**Our design identification number.*



For a super the oscillator inductance should be less than the r-f inductance.

there isn't much excess room, and especially not if a primary is to be wound alongside of, instead of over, the secondary. Indeed, this may be one reason why primaries are commonly wound on top of secondaries, with insulating fabric between.

Effect of Shield

The number of turns given applies to unshielded coils, but if a shield is used the inductance drops, and in general, for inductances around 150 mch it may be expected to drop 5.5 per cent. and for the higher inductances, around 6 per cent. An average of 6 per cent. may be figured, and thus the inductance in microhenries of the unshielded coils would become 265 (130 turns), 243.8 (122 turns), 233.2 (118 turns), and 185.5 (100 turns.)

Tight winding is assumed. The inductance values and numbers of turns are fairly accurate, not meticulously so, however, since the objective is to tune in the lowest frequency somewhere close to the end of the dial, and this should be accomplished. The only other requirement is that 1,500 kc be reached at the other end, and if the tuning condenser minimum is not too high, and the coil and wiring capacities not too high, the 1,500 kc attainment will be considerably exceeded. Thus, with the maximum effective inductance, some 250 mch, the 1,500 kc frequency will be exactly struck if that minimum capacity is 45 mfd. This is a pretty large minimum, since condensers these days have about 20 mmfd. and the rest of the factors should not contribute much more than 10 mmfd. extra.

If the minimum is 25 mmfd. the extreme frequency would be 2,000 kc, but since there are trimmers to adjust, and one of them depends on another to an extent, so at 1,450 kc the alignment should be best, a minimum of 40 mmfd. may be assumed, and a frequency of 1,560 kc.

Padding Capacity

For the selection of the oscillator, if the intermediate frequency is low the padding condenser's effect on the parallel tuned circuit at the high frequency end may be neglected. If the frequency is higher, say, 400 to 470 kc, then the padding condenser will have a little effect. So for 175 kc ignore the padding condenser, and the inductance may be derived from a consideration of the minimum capacity at 40 mmfd. The frequency is to be 1,550 plus 175 kc, let us say; therefore, with 40 mmfd., we are to tune to 1,725 kc. Therefore the inductance would be 200 microhenries, or 108 turns of No. 32 enamel wire, or, counting shield effect, by adding 6 per cent., 210.8 mch, approximately, or 111 turns.

The effective inductance being considered, the padding capacity may be obtained by knowledge of the maximum tuning condenser capacity and the frequency.

Account has not been taken of the effect of the trimming capacity on the maximum, nor the added effect of circuit wiring capacity, tube and coil capacities, etc., thereon, but the percentage of addition is not large. For instance, out of 350 mmfd. the extra amount may be 10 mmfd. and it might be about the same for all the capacities stated. It may be ignored, not actually, but as a matter requiring any theoretical consideration.

The Formula

So take the maximum capacity as 350 mmfd. The inductance is now known, 200 mch, and as the padding is to be for nearly the maximum of the condenser, let us assume maximum. The frequency is to be 540 plus 175 or 715 kc. The knowns are 715 kc, 350 mmfd., 200 mch. The capacity required is 275 mmfd. to attain the 715 kc with 200 mch, and the series capacity or padding condenser may be computed:

$$Cp = \frac{C1 \times C2}{C1 - C2}$$

in which C1 is the larger known capacity, 350; C2 is the effective capacity, which is smaller; Cp is the unknown series or padding condenser.

$$Cp = \frac{96{,}250}{75} = 1{,}283 \text{ mmfd.}$$

Practical Method

Since an adjustable padding condenser would be used, the variation may be 850-1,350 mmfd., which is a standard value, and was used in the a-c Diamond Supers that had 175 kc intermediate transformers.

Taking up the problem of the oscillator coil practically, the trimmer may be set half way, and a coil of larger inductance subjected to turns removal until the highest frequency comes in where it should. This would require an oscillator or wave meter for purposes of establishing the high frequency position.

The circuit finally would be built and padded at 600 kc or close thereto. It is not so greatly important that just 1.450 kc be used for the high frequency adjustment as it is that the low frequency adjustment be at 600 kc.

Take then the case of 465 kc intermediate frequency. The r-f coils would be the same, of course, for the capacities used, since here there is no change in frequency from the foregoing conditions. However, the low and high frequency r-f extremes, 540 kc and 1,550 kc, would be represented on the oscillator by 1,005 kc and 2,015 kc.

For a minimum of 40 mmfd. the inductance for 2,015 kc would have to be 150 mch, obtainable by winding 84 turns of No. 32 enamel wire on 1 inch diameter, or, accounting for the shield, 89 turns. The capacity required to generate 1,005 kc with 150 mch is 152.5 mmfd., and the series capacity required for 350 mmfd. is about 265 mmfd.

Oscillator Minimum Capacities

There would be no trouble if the oscillator minimum capacities were nearly alike in all instances, but oscillators may develop unexpectedly large minimum capacities, and besides if the oscillator does not tune high enough the assumption is that the inductance is too high, whereas it is probably too low.

This does not sound right, but it is right, because to attain a lineup the oscillator trimmer will be turned down quite a bit, requiring that the r-f trimmers be jammed virtually all the way home. Thus besides other reasons the oscillator minimum capacity is entirely too high, because the inductance was too high and to get the r-f to match at some high frequency, say, 1,450 kc, some more capacity had to be used at r-f than suitable conditions would warrant. Besides, 1,500 kc is missed out. If it is found that the oscillator can not be matched at the high frequency without jamming down the oscillator trimmer, remove a few turns, say, 3, from the oscillator winding.

50 mmfd. Minimum

For general practice the oscillator inductance is recommended at 124 mch for 465 kc, 85 turns of No. 32 enamel, or 129.5 mch, allowing for shield, equalling 87 turns, and the minimum capacity assumed for 2,015 mfd. of 50 mmfd., the extra capacity beyond what is expected being contributed by the trimmers, and thus enabling a balance of r-f and oscillator trimmers, without jamming any of them. The effective capacity in the tuned circuit for 1,005 kc would be about 200 mmfd. and the series capacity 390.5 mmfd. The

(*Continued on next page*)

A FIVE-TUBE SUPER

By Thos. W. Crossley

Consultant, Postal Radio Corporation

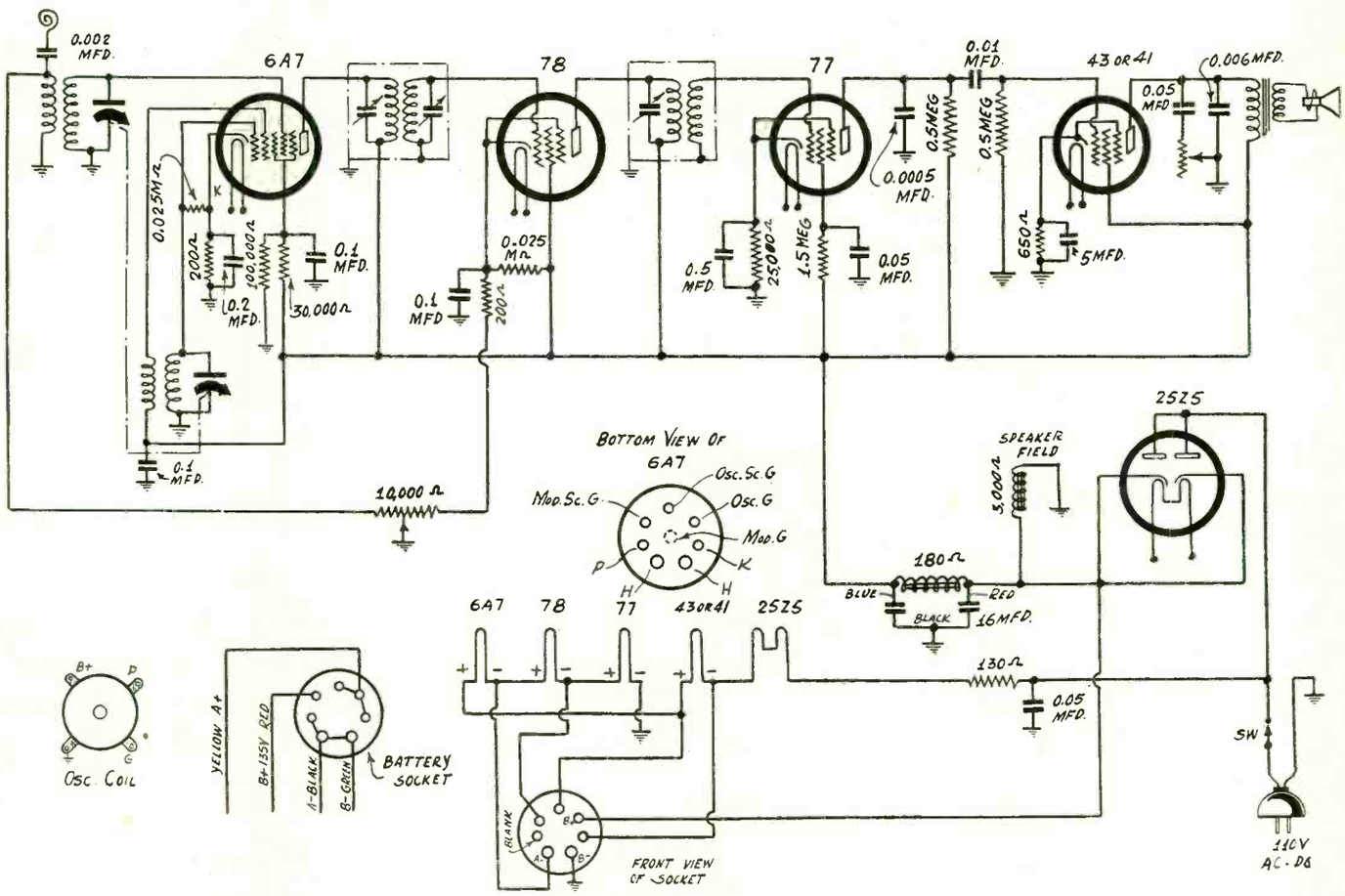


FIG. 1

The circuit of the Postal five-tube universal a-c and d-c superheterodyne, which can be used on either a-c or d-c lines without change, and on a six-volt battery with slight change.

THIS five-tube receiver does more in the way of bringing in distant stations than many ten-tube supers did a couple of years ago. It is a real DX set, and one reason for its high sensitivity is obviously the use of the new tubes from beginning to end. While the circuit has only five tubes in physical appearance, it really has six tubes functionally, because the first, the 6A7, is really two tubes in one.

First of all, the 6A7 is an oscillator. We say first because the oscillator elements are closest to the cathode. As such, it is of the tuned grid type. The control grid is the grid next to the cathode and the anode for the oscillator is the next. The full plate voltage available is applied to this element. In the grid circuit is a 0.0002 mfd. stopping condenser and a grid leak of 25,000 ohms. This combination insures freedom from blocking and interruption of operation at any part of the tuning range. It will be noted that the grid leak is returned to the cathode and not to ground.

The Mixer

The outer elements of the tube are used primarily for the r-f signal. The high potential side of the tuned circuit is connected to the control grid, which is the cap of the tube, and the plate is connected to the first i-f transformer. The screen, of course, goes to a high voltage, a separate voltage divider of 30,000 ohms and 100,000 ohms being used to insure correct screen bias.

When the two sets of elements in the 6A7 are taken together they form a highly efficient mixer in which the inner set can be regarded as a complex cathode with emission variable according to the oscillation. The result is a signal of the intermediate frequency which is selected and amplified by the two i-f transformers and the 78 tube.

The tracking in this circuit is a special feature. Note that the r-f circuit is tuned with a condenser with maximum capacity of 366 mmfd. and that the oscillator is tuned with a condenser of maximum capacity of 180 mmfd. The two sections are ganged and they have been designed specially for tracking at 456 kc. The inductance of the oscillator, of course, has been designed to match the condenser and the intermediate frequency, and the design has been made specially for this combination.

The Intermediate

The first intermediate transformer is doubly tuned. The condenser across each winding is 140 mmfd. Therefore, there is a high L-C ratio, which insures high gain in the circuit.

The second intermediate transformer is tuned only in the primary winding, but the coupling between the two windings is suitably close so that a high gain is insured in this circuit also. As in the previous transformer, the tuning capacity is 140 mmfd. and there is the same high ratio of inductance to capacity.

The first intermediate coupler is really a band pass filter which has two frequencies at which the gain is maximum, but they are close together. The second transformer has only one frequency of maximum amplification. When the tuning is done properly the three peaks will combine so as to make a single peak,

MIXER COILS

(Continued from preceding page)

values of 124 mch for the inductance, 390 mmfd. for the series condenser, with 410 mmfd. for the tuning condenser, are the ones for the Push-pull 12-Tube Diamond and also for the 8-Tube a-c receiver that has the same sensitivity without, of course, so great a power output (3 watts compared to 15 watts).

For the r-f coils, however the inductance recommended was 230 mch, to be absolutely certain of reaching 540 kc, and enabling also reaching 2,015 kc without trimming capacity, and about 1,575 kc with r-f trimming capacity.

The No. 32 enamel wire can not be obtained at all stores and supply houses, but inquiries directed to the Trade Editor will elicit suitable information.

broad-topped in the vicinity of the intermediate carrier but sharp at either side. This combination insures optimum quality with highest practical selectivity. In other words, the circuit is not sharp in respect to the essential side frequencies but is very sharp in respect to interfering frequencies. That is an approach to the ideal.

Image Suppression

One might suppose that the single r-f tuner would be unable to suppress image frequencies. But this is not the case because of the high value of the intermediate frequency. Any signal that would cause image interference is 912 kc removed from the desired frequency. Therefore, a single r-f tuner is quite able to suppress the interfering carrier. A tuner that could not do that would not be a tuner at all. The reason for the choice of such a high intermediate frequency is to make the use of a single r-f tuner practical.

The advantage of using tuned plate load in the 78, and also on the 6A7, comes from the fact that these tubes have very high internal resistances. The tuned plate impedance offers the highest load to the tube and thus insures maximum output. The effective resistance of the tuned circuit in the plate of the 78 is L-RC, in which L is the inductance of the winding, R the resistance in the coil, and C the capacity of the condenser. On the assumption that the capacity is 140 mmfd. and the resistance of the coil is 20 ohms, the value of the load resistance is 310,000 ohms. It may even be higher than that.

For detector a 77 is used, and it is of the grid biased type. It has a bias resistor of 25,000 ohms, which is shunted by a condenser of 5 mfd. This large condenser across such a high resistance insures thorough filtering and eliminates reverse feedback on even the lowest audio notes.

The load resistance on the 77 is 0.5 megohm, a value high enough to insure a high voltage transfer from the detector to the power tube. If the 77, or any other screen grid tube, is to be operated without distortion as a detector, or voltage amplifier, it must have a suitably low screen voltage. In this circuit the voltage is dropped by means of a 1.5 megohm resistor between the screen and the highest voltage. The resistor is shunted to ground, by a condenser of 0.05 mfd. to maintain the screen at a steady potential. A 0.0005 mfd. condenser is connected between the plate and ground to by-pass intermediate frequency currents that get to this point.

The Power Stage

For d-c and a-c operation the power tube should be a 43, for that has a 25-volt filament. The 41 should be used when the circuit is operated from a six-volt storage battery.

The signal is supplied to the power tube through a 0.1 mfd. condenser, and a grid leak of 0.5 megohm is employed. The time constant of this combination is so high that low notes will not be depressed in volume.

The power tube is biased by means of a 650-ohm resistor in the cathode lead and this resistor is shunted by a 5 mfd. condenser. There can be little reverse feedback through this combination.

A tone control is connected across the output of the power tube. This consists of a 0.05 mfd. condenser in series with a variable resistor of about 0.5 megohm. A somewhat lower value can be used. There is in addition to the tone control a 0.006 mfd. condenser across the output to eliminate high frequency noise present in all sensitive receivers but which is not essential to the signal. The tone control can be used as an adjustable means for doing the same thing in almost any degree desired by the operator.

The loudspeaker, which properly belongs to the power tube, derives its field power from the rectifier, the 25Z5. The field is connected in parallel with the supply to the tubes so that there is no additional voltage drop, except that due to resistance in the tube as a result of increased current. Of course, the speaker is of the dynamic type and suitably matched to the tube.

As mentioned, the rectifier for the B supply is a 25Z5 tube. Its two plates are connected together, and so are its cathodes, and therefore the rectifier is of the half wave type. It is in the circuit whether the supply is a.c. or d.c., and the same filter is used in both cases.

The filter consists of two 16 mfd. electrolytic condensers across the line and a 180-ohm choke coil. Of course, one of the condensers is connected across each side of the choke. What remains of the line voltage after the rectifier and the filter is applied directly to the plates of all the tubes, but it is dropped for some of the screens. The screens of the power tube and the 78 get the full voltage.

The Heater Circuit

The heater circuit is shown dissociated from the signal circuit for the sake of clarity. The heater circuit starts at the power switch, which is the positive side of the circuit in case of d.c., and picks up a 130-ohm ballast resistor and a 0.05 condenser. The resistor in turn is connected to the heater of the rectifier tube. The other tubes are all connected in the series, when the special plug is not in the socket attached to the heater circuit. There is a total voltage drop of 68.9 volts in the heater filaments. The difference between this and the line voltage is dropped in the ballast.

The special socket associated with the heater circuit has been explained before, but it will do no harm to repeat. By tracing out the connections as they will be after the plug, according to the wiring scheme inserted, has been inserted, it is seen that the filaments of the four tubes are in parallel and all connected across the A plus and A minus terminals attached to the cable. The plug is used only when the receiver is to be operated on batteries. While the socket is mounted and wired on all sets, the plug is only supplied as special equipment.

The 43 is a 25-volt tube and may for that reason be connected advantageously in series in a universal set, but it will not work when the circuit is to be operated on a storage battery. Therefore it becomes necessary to substitute a 6.3 volt tube when the circuit is operated with the plug in the socket. The 41 is such a power tube. This tube takes a filament current of 0.4 ampere, which is all right when the heaters are in parallel.

The rectifier tube is thrown out of the circuit when the plug is inserted, and this, too, is as it should be, because it is not needed when batteries are used for powering the circuit.

Connections of Coils

If the plug is obtained for operating the set on batteries, as in an automobile, care should be taken that the 41 is not left in the circuit when the set is later used on 115 volts, for all the filaments are then in danger of burn-out, or at least serious damage, because the ballast resistor will be deficient by about 75 ohms. The series circuit has been designed for a 43 power tube, not a 41. The parallel circuit has been designed for a 41, not for a 43. If the 43 is left in the circuit when it is converted to parallel connection, there is no danger, and the fact that nothing happens is a reminder that the tube must be changed.

The connections of the oscillator coil are shown in an insert drawing. The terminal marked "P" is connected to the anode of the oscillator, that is, to grid No. 2. The terminal marked "G" goes to grid No. 1. The ground terminal, of course, is connected to the chassis, and "B" is connected to the high voltage line.

The connections of the radio frequency coil are no different from what they would be if an ordinary mixer tube were used. The antenna terminal, which may be marked "P" goes to the antenna condenser and the "G" terminal goes to the cap of the tube. The other two terminals go to the chassis.

The actual connections of the two coils to the various tubes elements are shown by an insert drawing of the socket and by appropriate markings on the tube diagram.

The volume control is that which has been found to be especially effective in circuits not equipped with automatic control, and in circuits with automatic volume control but without a noise suppressor. The cathode of the 78 intermediate frequency amplifier is not connected to ground but to a 10,000-ohm potentiometer, the other end of which is connected to the antenna. The slider is connected to the chassis.

The 0.002 mfd. condenser in the antenna lead is there for protection of the circuit against possible shorting of the line. Without it, an accidental ground of the antenna would cause a dead short of the line in some instances.

An external ground on the set is not needed because the circuit is adequately grounded through the line. If an external ground connection is used, there should be a condenser between the ground wire and the receiver chassis. This condenser may be of the same size as the one in the antenna lead. The probability is strong that no difference will be noted if an external ground is used.

A-C and D-C Short-Wave Set Due from Powerstone

For the past few months the engineers of the Powertone Electric Company have been busily engaged in the design of a short-wave receiver that operates on a.c. and d.c. and answers all requirements of the short-wave listener and amateur.

Particular attention was paid to efficiency in all circuits. A proper layout of the apparatus and selection of those tubes best suited to the operating voltages available insure extremely sensitive operation from either power source.

After exhaustive tests in which the receiver produced consistent long-distance reception, it was accepted as one of the Powertone line. In the laboratory test European broadcast short-wave signals were consistently received.

A receiver of this type must not be confused with the many popular priced outfits that appear from time to time, as it is a product of a long established house, in fact one of the first in the field and bears the reputation of the whole organization.

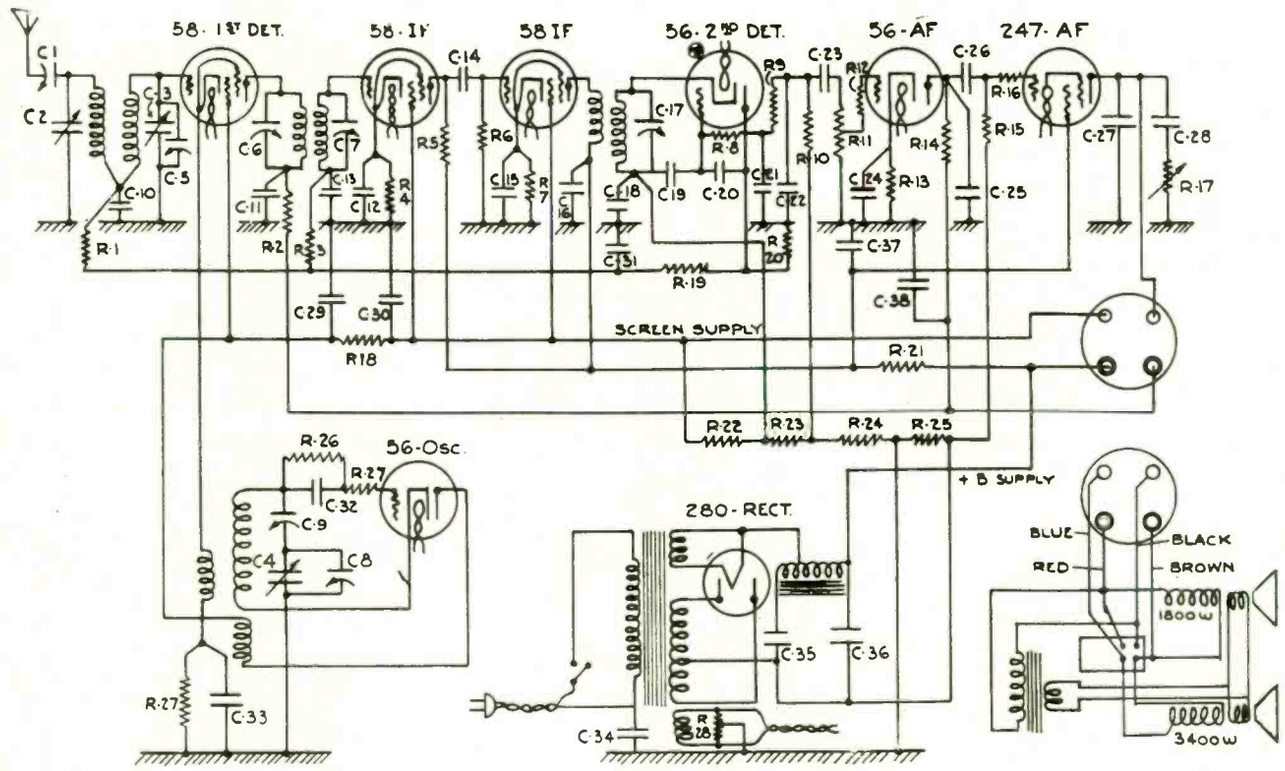
Radio Station Is Held Not a Public Utility

Salem, Ore.

The term "public utilities corporation," when used in an act or a city ordinance but not therein defined does not include radio broadcasting stations, according to an opinion by the Attorney General, I. H. Van Winkle.

He was asked by a member of the Legislature whether the term would cover railroads, telegraph lines and radio stations when used in an act or a city ordinance imposing a gross license tax. The Attorney General held that the term would cover railroads and telegraph lines but not radio stations, and added that "especially is it clear that radio stations are not included in an ordinance attempting to impose a gross license tax against same."

BOSCH 242 AND 243

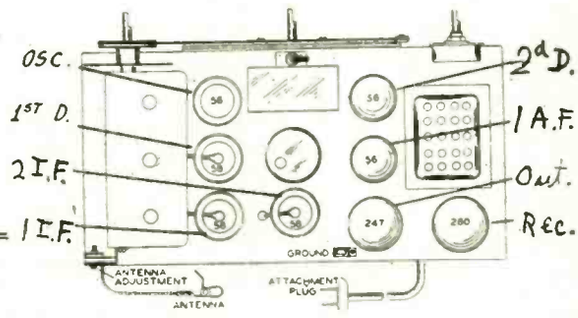


SCHEMATIC DIAGRAM OF MODEL 242 RECEIVER

C1 - Antenna Trimmer
C2 - Tuning
C3 - Tuning
C4 - Osc. Tuning
C5 - Alignment
C6 - IF Alignment
C7 - IF Alignment
C8 - Osc. Alignment
C9 - Osc. End Cond.
C10 - .05 mfd. 2 ply
C11 - .05 mfd. 2 ply
C12 - .05 mfd. 2 ply
C13 - .05 mfd. 2 ply
C14 - 1100 mmf.
C15 - .05 mfd. 2 ply
C16 - .05 mfd. 3 ply
C17 - IF Alignment
C18 - .05 mfd. 2 ply
C19 - .0001 mfd.
C20 - .05 mfd. 2 ply
C21 - .0001 mfd.
C22 - .0001 mfd.
C23 - .05 mfd. 2 ply
C24 - 25 mfd.
C25 - .01 mfd. 3 ply
C26 - 1100 mmf.
C27 - .002 mfd. 4 ply
C28 - .05 mfd. 3 ply
C29 - .05 mfd. 2 ply
C30 - .05 mfd. 2 ply
C31 - .05 mfd. 2 ply
C32 - .0001 mfd.
C33 - .05 mfd. 2 ply
C34 - .01 mfd. 4 ply
C35 - 4 mfd. (60
C35 - 8 mfd. (25
C36 - 8 mfd.
C37 - 4 mfd.
R1 - 10,000 ohms
R2 - 1000 ohms
R3 - 10,000 ohms
R4 - 600 ohms
R5 - 25,000 ohms
R6 - 100,000 ohms
R7 - 600 ohms
R8 - 15,000 ohms
R9 - 15,000 ohms
R10 - 500,000 ohms
R11 - 500,000 ohms
R12 - 100,000 ohms
R13 - 5000 ohms
R14 - 75,000 ohms
R15 - 500,000 ohms
R16 - 100,000 ohms
R17 - 500,000 ohms
R18 - 1000 ohms
R19 - 500,000 ohms
R20 - 1 megohm
R21 - 1500 ohms
R22 - 2500
R23 - 150
R24 - 1400
R25 - 250
R26 - 100,000 ohms
R27 - 5000 ohms

Stage	Tube	Fil.	Plate	Screen	Cathode
1st Det.	58	2.4	200	90	7 - 10
1st IF	58	2.4	115	95	4
2nd IF.	58	2.4	115	95	3.4
2nd Det.	56	2.4	0	-	38
Osc.	56	2.4	95	-	2 - 4
Output	247	2.4	260	265	20
Rect.	280	4.8	-	-	-

Note: These values are readings of a high resistance voltmeter to ground, with the exception of filament voltages. Cathode voltages are given instead of grid voltages, inasmuch as the grid is at ground potential.

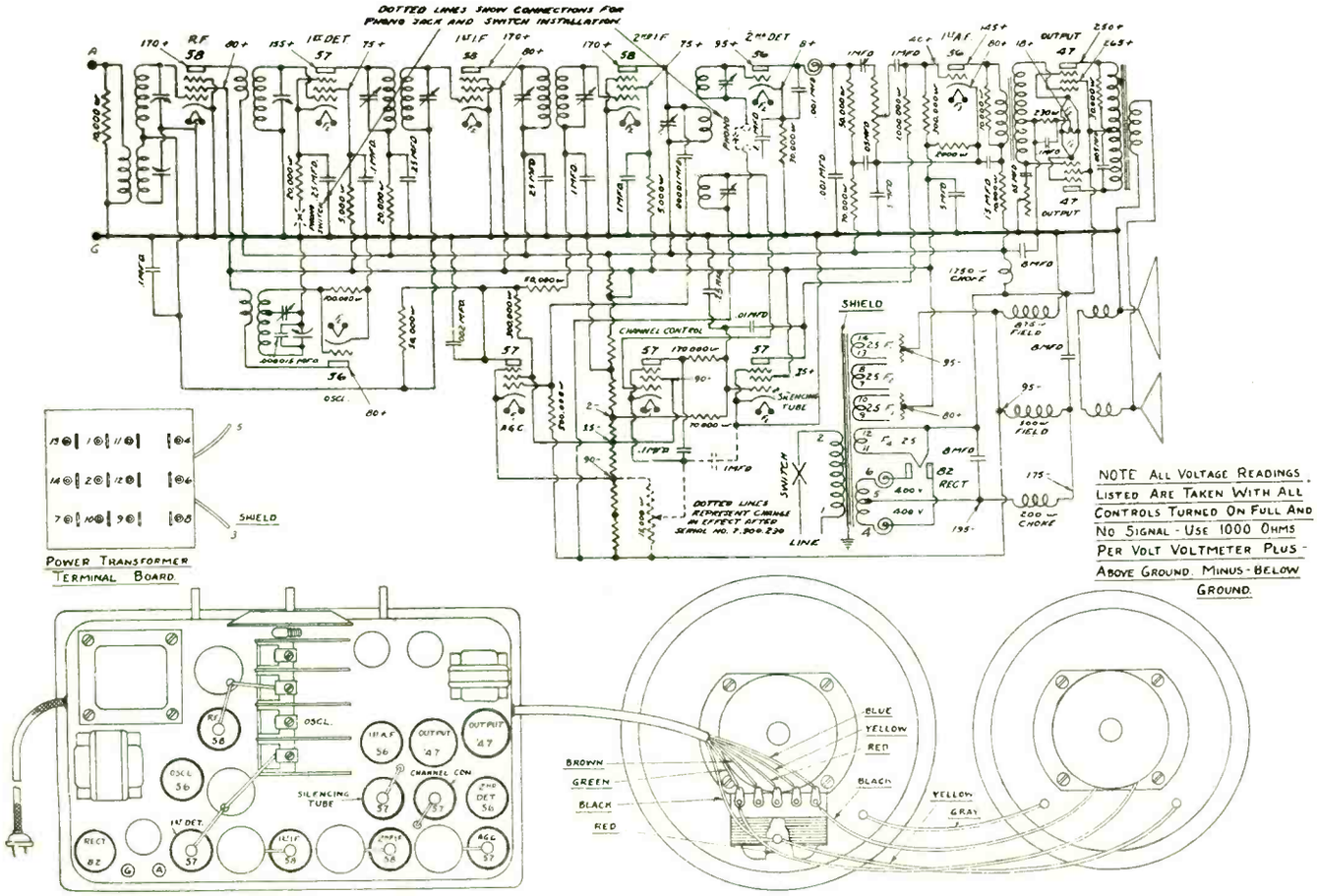


The Bosch 242 and 243, using this circuit in different cabinets, is an eight-tube superheterodyne. The chassis layout, with tubes and some parts identified, is at lower right.

THE question of image suppression in this circuit has been solved by using a band pass filter in front of the first stage. This permits the use of three tuned circuits although there is only one radio frequency amplifier. The two tuned circuits between the antenna and the first tube are coupled with a 0.05 mfd. condenser, C-10, connected between the junction of the two tuned inductances and ground. A condenser of that value, for the inductances ordinarily used in broadcast tuners, would admit a band approximately 10 kc wide. That is, there would be 10 kc separation between the two peaks of amplification. The hollow between the two peaks virtually disappears so that the band-pass effect is obtained. The condenser serves another purpose. It will be noticed that a resistor R1 is connected to the junction of the coils and that this resistor goes to the automatic volume control voltage. Therefore the condenser also serves as a by-pass. This arrangement is particularly attractive because it adds the needed selectivity without adding a tube not needed for amplification. The effectiveness of the condenser as a band pass coupler decreases as the frequency increases, and that is just as it ought to be.

Quality is served by use of band-pass filter tuning.

LYRIC MODEL SA-130



The circuit and layout diagrams of the Lyric Model SA-130, a thirteen-tube commercial receiver that is far removed from the midget class. The circuit incorporates all the latest innovations.

THIRTEEN tubes can be counted in this receiver. Thirteen tubes should make any receiver supersensitive. Especially is that the case when all the tubes are of the supersensitive type. Even when two of the tubes are disposed of in one stage, as in the push-pull output stage in this instance, there should be enough amplification for all reasonable requirements.

There are several unusual features in this circuit. Note particularly the first coupler. The secondary appears to be made of two coils in series, with two variable condensers, also in series, connected across the coils. Closer inspection, however, shows that there are two tuned circuits with extremely loose coupling between them. The common impedance between the two circuits is the reactance of a 0.1 mfd. condenser, which appears as a by-pass. The first tuner, therefore, should be very selective.

Oscillator-Modulator Coupling

Another unusual feature is that there is no explicit coupling between the oscillator and the first detector. Apparently, stray coupling is depended on. That is another point in favor of selectivity, but stray coupling can be controlled more or less when a given amount of it is required.

In the oscillator there is no separate stopping condenser in the grid circuit, but none is required because the series padding condenser has been connected so that it serves the purpose. Or rather, the padding and tuning condensers together block the grid.

There are two intermediate frequency amplifiers in the circuit and three doubly tuned i-f tuners.

A 56 tube is used for second detector and it is used as a grid biased transrectifier.

The audio amplifier is obviously designed for full reproduction of low and high notes, and for great output in addition. The output stage contains two 47 tubes in push-pull, and two speakers are connected to the tubes. Tone correction is employed. There is a series resistor-condenser circuit in shunt with the primary of the push-pull output transformer to remove undesired high-frequency noises. There is also a means for balancing the primary. A 0.5 mfd. condenser is connected in series with a variable resistance between one of the push-pull input grids and ground. This circuit permits equalization of the inputs to the two tubes, especially at the high frequencies where differences are likely to occur due to stray capacities. Again, there is a resistance across the primary of the push-pull input transformer. This, too, aids in smoothing out the amplification.

A.V.C. and N.S.C.

A separate 57 is used for automatic volume control. The signal input to this tube is taken from the plate of the second i-f amplifier. The two i-f amplifier tubes and the r-f amplifier are controlled automatically by this a.v.c. tube.

Two other 57 tubes are used for noise control. One of them is called the silencing tube and the other the channel control. These tubes together act as a squelcher by controlling the operating bias on the 56 audio tube immediately preceding the push-pull stage.

The circuit is arranged so that it can be used with a phono pick-up. A closed circuit is wired into the grid return lead of the 56 biased detector. When the phono pick-up is plugged into this the output of the pick-up is impressed on the 56 and the entire audio amplifier is effective. At the same time that the phono pick-up is inserted at this point, the cathode lead of the first detector is opened to cut off any radio signals that might be coming through.

The layout of the receiver is indicated by the insert drawing at the lower left corner of the circuit sheet. A notable feature of the layout is that the audio part is as far as possible from the power supply. Thus there can be no inductive coupling between the power transformer and the audio input transformer. Electric coupling is effectively prevented by grounded shields around the transformers, coils and tubes. The output push-pull transformer is mounted on one of the speakers so that also is removed from the power supply.

A 9-TUBE, ALL-WAVE D-C

Push-Pull 48 Output Tubes in Receiver

By R. J.

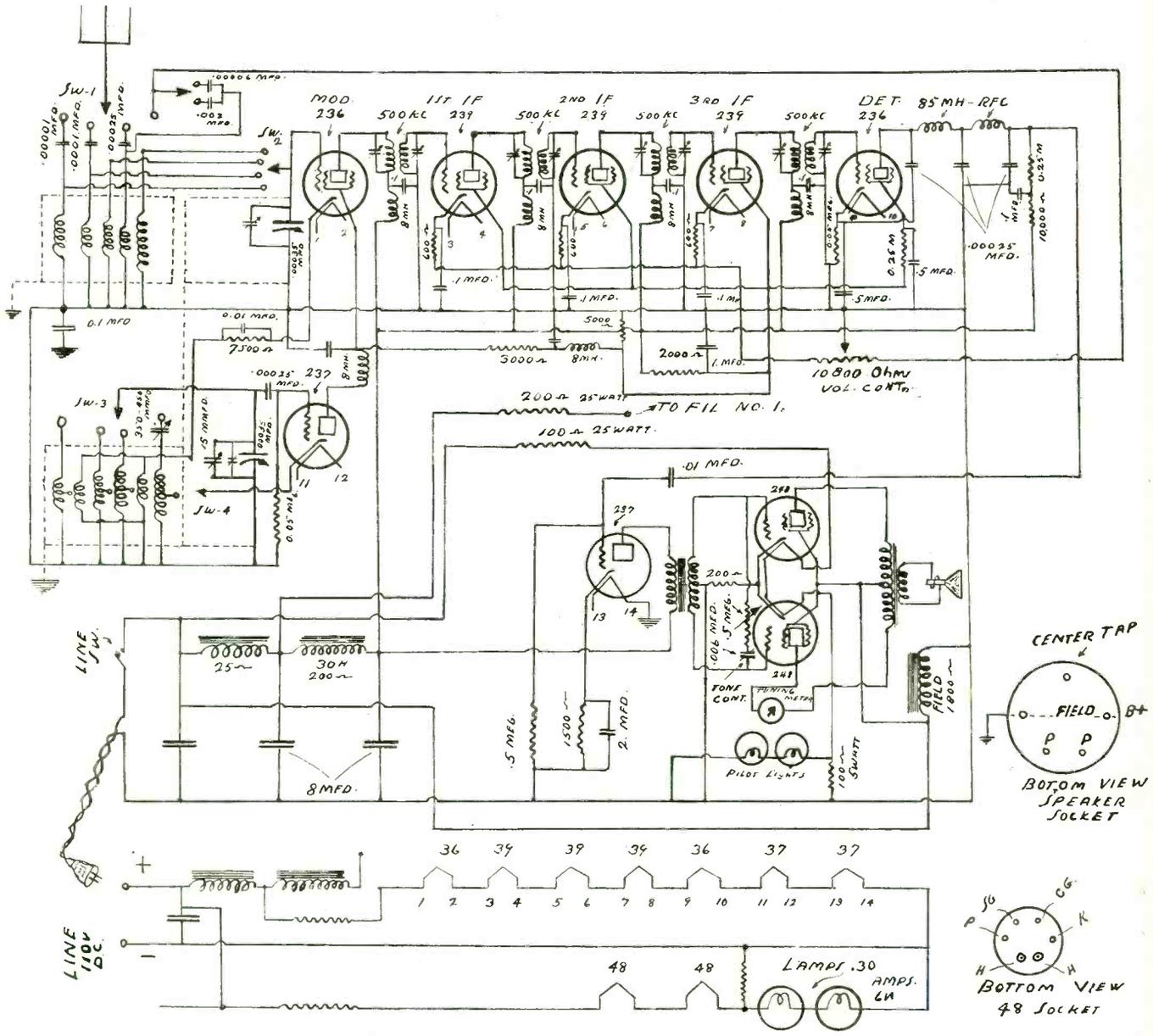


FIG. 1

The circuit diagram of Mr. Casanova's superheterodyne receiver. It is an all-wave receiver.

THE DX hunter living in districts supplied with d-c power lines has been denied the thrill of listening to foreign short-wave stations because good performance was deemed as an impossibility with a receiver operated with d-c line power.

Short waves are the most prolific producers of thrills in radio at this time, because they are readily brought in from remote places. Yet for those who possess up-to-date short-wave receivers these signals are not strangers, but such receivers are available for virtually only a-c and battery operation.

The diagrammed receiver promises to give many radio enthusiasts, residents of d-c districts, the thrills of DX reception. This is a nine-tube all-wave d-c, superheterodyne that brings stations from 500 to around 25,000 kc., covering everything in radio that has any public interest at this time. The nine tubes are: one 237 oscillator, two 236 detectors, three 239 intermediate frequency amplifiers, one 237 first audio stage and two 48 output power tubes in push-pull.

With the advent of these new tubes, with special characteristic for d-c, it became possible to design an all-wave receiver that could meet the same high standard of performance of the a-c operated type.

The circuit here described, if properly constructed, will perform well and afford sensitivity, selectivity and quality. The author has received European stations with such results that until the stations were identified he was in doubt whether they were foreign or local. It is capable of delivering a high output without distortion, thanks to the new type of output tubes.

When I tackled the job of designing this receiver I was specially interested to cover the whole short-wave band, but as adding the broadcast band too didn't add much to the construction, I decided to include that band.

For this receiver a switching system is used, and it has proved to be on a par with plug-in coils, with convenient changing from one band to another. I recommend that a good switch be used if the

SUPER WITH BAND SWITCH

That Brings In Foreign Stations Well

Casanova

LIST OF PARTS

Coils

Four modulator windings on one form, with the primary between first and second winding.
Four oscillator windings on another form, with two pick-up windings, one between first and second winding and the other between third and fourth windings.
Four shielded intermediate frequency transformers picked at 500 kc.
Eight r-f chokes, two 85 mlh. and six 8 mlh.
One filter choke, 25 ohms d-c resistance
One 30-henry B supply choke coil, d-c resistance about 200 ohms
One dynamic speaker, 1,800-ohm field (field or any resistance up to 2,500 with output transformer match for P.P. 48).

Condensers

One two-gang straight frequency line tuning condenser with trimmers
One 150 mmfd. manual trimming condenser
One 0.00025 mfd. grid condenser with clips
Four 0.00025 mfd. fixed condensers
One 0.001 mfd. fixed condenser
One 0.00006 mfd. mica fixed condenser
One 0.0001 mfd. mica fixed condenser
One padding condenser on isolantite base, 350-450 mmfd.
One 0.01 mfd. fixed condenser
Four shielded blocks, each block containing three 0.1 mfd. fixed condensers
Three 8 mfd. electrolytic condensers
One 2.0 mfd. by-pass condenser
One 1.0 mfd. by-pass condenser
Two 0.5 mfd. by-pass condensers
One 0.006 mfd. fixed condenser

Resistor

One 7,500-ohm pigtail resistor.
One 0.015 meg. (1,500 ohms) pigtail resistor
Three 600-ohm bias resistor
Two 0.05 meg. (50,000) pigtail resistor
Two 0.25 meg. (250,000) pigtail resistor
One 0.01 meg. (10,000) pigtail resistor
One 0.003 meg. (3,000) pigtail resistor
One 0.005 meg. (5,000) pigtail resistor
One 0.5 meg. (500,000) pigtail resistor
One 200-ohm 5-watt resistor
One 200-ohm 25-watt resistor
One 100-ohm 25-watt resistor
One 100-ohm 5-watt resistor
One 10,000-ohm potentiometer
One 250,000-ohm tone control
One 2,000-ohm pigtail resistor

Other Requirements

One chassis 18 inches by 10 inches front to back, 3¼ inches elevation
One National drum on dial
One antenna-ground binding post assembly
Ten sockets, two six-pin type and eight UY, the extra UY for speaker plug
Five tube shields
One four-deck four-position switch (four pole—four throw)
Two six-volt pilot lights
One tuning meter

best results are expected. This switch is marked in the diagram—sw. 1, sw. 2, sw. 3, and sw. 4, and is a four-deck four-position model.

As all the heaters, if connected in series, including the pilot lights, would require 116.1 volts, it was not advisable to connect all of them in one series, so a series-parallel system was chosen.

The seven tubes requiring 0.3 ampere were connected in one series with a resistor of 200 ohms after the first choke, which has a d-c resistance of 25 ohms, making 225 ohms, just right for the seven tubes. The drop in this resistor is 65.9 volts, assuming the line to be 110 volts, but it would never be the case, because most of the d-c lines are higher than that. A little allowance was made to compensate for this, but in any instance these tubes will stand from 6 to 7.5 volts.

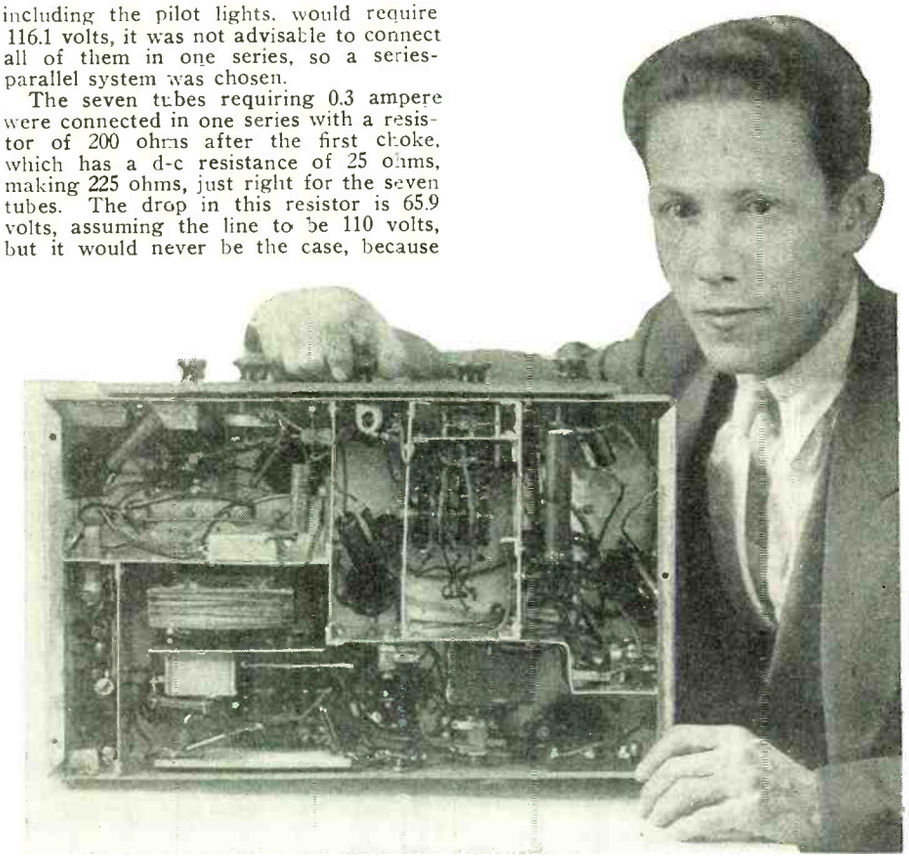


FIG. 2
Mr. Casanova demonstrating the wiring and the layout of the parts under the subpanel of his receiver.

The other parts of the heater circuit are the two 248 and the two pilot lights (one for the dial and the other for the tuning meter). Each of the 48's takes 30 volts and each of the pilot lights 6 volts, so 72 volts are needed. In this case a simple series circuit will not do, for the 48 tubes require 0.4 ampere, whereas the pilot lights require only 0.3 ampere. Therefore, we must put a shunt across the pilot lights and adjust it so that it will take the extra 0.1 ampere. This resistor is given as 100 ohms and its dissipation is only 1.2 volts (5 volts marked for safety). This shunt resistor is connected between the chassis and the second 48 in the series. This resistor was marked 100 ohms instead of 120, that is the right value, in order to prolong the life of the pilot lights.

The intermediate frequency transformers used are a commercial type peaked at 500 kc. This is a rather high intermediate for an all-wave set, but it ought to be that high so that some benefit will be derived from modulator tuning at the higher frequencies.

The modulator for the broadcast band tunes from almost 500 to beyond 1,500 kc. and in order to cover this band of frequencies with 500 kc. intermediate, the oscillator has to tune from 1,000 to 2,000 kc. The two tuning condensers (.00035 mfd.) are ganged, therefore the oscillator will have to be padded. A commercial type of padding condenser 350-450 mmfd. will serve the purpose because the inductance on the oscillator was computed on that basis. In the lowest short-wave band no padding is required if the coil data are followed.

The tuning range of the modulator for this band is from 1,500 to 4,285 kc., while the oscillator has to tune to frequencies 500 kc. higher or 2,000 to 4,785 kc. The padding for this band was accomplished by using a small inductance without reducing the effective capacity of the tuning condenser. Of course if some discrepancies occur between modulator and oscillator it would be that the oscillator frequency was too high instead of too low and this can easily be corrected with the parallel condenser across the oscillator main tuning capacitance.

This small manual trimmer condenser across the oscillator main tuning capaci-

(*Continued on next page*)

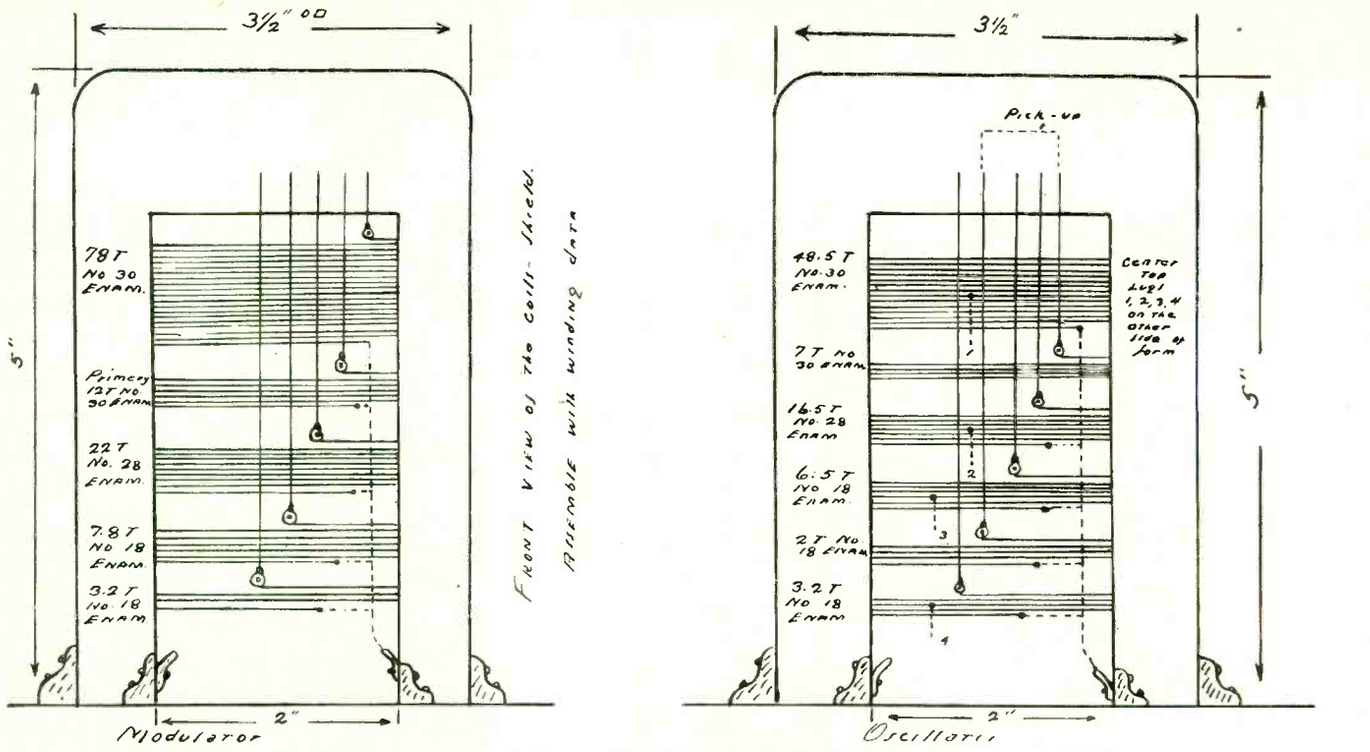


FIG. 3

View illustrating the design of the coils used in Mr. Casanova's receiver.

(*Continued from preceding page*)

tance has not much effect on the broadcast band or the second band, in fact, it is not used at all in those bands. The valuable effect of this condenser starts to be noticed on the third coil, being of vital importance on the smallest one. On these higher frequencies this parallel condenser may be used as the tuning capacity and the main tuning condenser set for approximately the desired frequency, obtaining in this way much better tuning characteristic than if the larger condenser were used.

It will be noticed if you examine the wiring diagram that a common primary is used for the first and second coil on the modulator form. It is placed between the broadcast and the next coil, improving greatly the selectivity, than if the signals were fed directly to the grid of the modulator on those bands. For the other short-wave bands it was unnecessary to use any primary, so the signal goes directly to grid and modulator coil.

Another special arrangement is the wto pick-up windings on the oscillator coils, each pick-up winding being common to two coils.

It will be noticed from the coil winding data that the inductance for the two smallest coils modulator and oscillator are the same. This is satisfactory in this band of frequencies, because the difference between them is only 500 kc. (the intermediate frequency), it being a small percentage of either. At the highest frequencies the difference would be 500 kc. out of 25,000 kc or possibly more, but it is compensated because as higher frequencies are tuned in on that coil, the oscillator runs to too high a frequency, outpacing the modulator. Here the manual trimmer comes into play, taking up these small discrepancies.

Volume Control

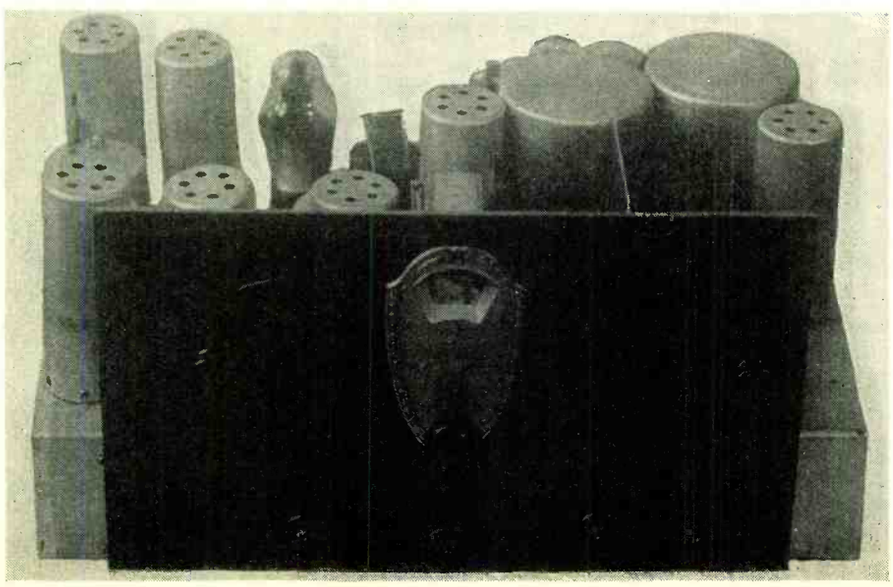
On the broadcast band the volume is controlled by a combination signal and bias and a local distant switch had to be used in order to cut down entirely some strong local signals on that band. For the other bands the volume is controlled only by increasing the bias of the three intermediate frequency amplifiers. As will be noticed, one of the condensers for the local distant switch is of a very small capacity, but it was necessary to use such small value in order to cut down some strong local signals.

The best way is to wire the first coil (broadcast band) and get it working satisfactorily there before proceeding to the higher frequencies. Once you get the receiver working, tune in a station around 1,450 kc. and adjust the trimmer condensers on the modulator and oscillator, then take a lower frequency tuning in a station not higher than 600 kc. and adjust the padding condenser. Once these condensers were adjusted for the broadcast band there is no need to touch them any more. It is of vital importance, for the sake of good tracking, that the manual trimmer condenser be at its minimum capacity when padding for this frequency.

By no means is the B supply poorly filtered, for in short-waves particularly there must be excellent filtration. The B supply for all the plates is passed through the two filter chokes, except the power tubes that gets the plate voltage directly from the line, it being only filtered by the first 8 mfd. condenser. This is all right, because that's a push-pull stage and besides is the last one. The speaker field may have any ohmage from 1,800 to 2,500 ohms and is connected across the line.

In the demodulator plate circuit there are two r-f chokes effecting the filtration and have to be of considerable inductance so two commercial types of 85 mlh. each were used, the distributed capacity being very small, only a few micromicrofarads.

Now, the first filter choke in the B supply has 25 ohms d-c resistance and the filament current for the 0.3 amp. tubes is passed through this choke. Of course the d-c resistance of this choke can be increased or decreased, but any change would have to be compensated in the filament resistor for those tubes. This choke was made from the laminations of a power transformer and one pound of No. 24 d.c.c. wire. The other filter choke used is a commercial one rated at 40 mils., 30 henries and 200 ohms d-c resistance.



ORGANIZING THE AERIAL

By Arthur H. Lynch

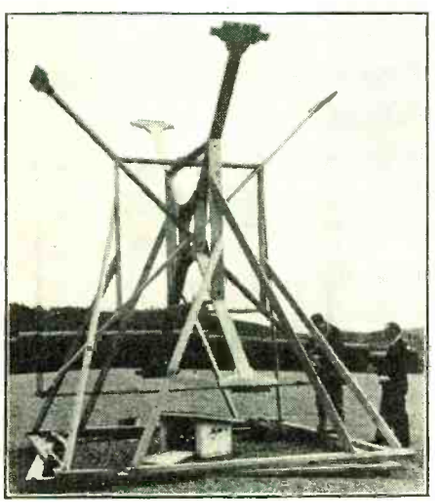
WHILE the modern receiver has a signal sensitivity measured in a fraction of a microvolt per meter, little engineering effort has been expended to make this performance useful through the development of an equally modern receiving antenna. An automobile can travel 272 miles an hour, but this fact contributes little to the facilities of actual transportation. Similarly the capability of a receiver to respond to an infinitesimal field is of no practical significance when the ordinary antenna system picks up noise interference of a magnitude greater than the weaker signals.

Consideration of the factors involved indicates that the antenna problem should be attacked from three angles. The design of an aerial which will provide adequate pick-up, the conservation of energy through the use of efficient insulating materials, and the elimination of noise pick-up by that portion of the aerial system which passes through an interference area.

The first problem is most readily solved by a long, horizontal stretch of wire strung clear of all shielding obstacles, or, where reception of a specific frequency may be desirable, an antenna favorable to that frequency, such as a doublet of the correct dimensions. Where physical conditions make it convenient, it may be desirable to take full advantage of directional effects.

Insulation Problem

The problem of efficient insulation begins at the far ends of the aerial and ends at the receiver proper. While the voltages induced are necessarily small, thus lessening the actual magnitude of losses, the effect of such losses may be relatively great. The following considerations are involved in an aerial system which can be depended upon for consistently excellent reception over a period of years: Stranded, enameled wire of high tensile strength but light weight should be employed. All insulating material should be absolutely non-hydroscopic and, particularly in the case short-wave reception, should introduce a minimum of capacitative effects. The new, ceramic insulating material called Lynchite combines practically perfect electrical characteristics with mechanical strength.



© United Air Lines

This apparatus resembles a clothes-dryer, but in reality it is one of aviation's potent weapons against unfavorable weather. It isthe directional antenna for a new airport localizer beam which has just been successfully tested by United Air Lines to bring pilots flying above clouds down directly over airports. By "shooting" radio signals directly at the pilot, a virtual path is laid from the airport to the plane, which the pilot can follow down the field.

Broadcast engineers of the Westinghouse Electric and Manufacturing Company are shown holding their new blimp at Saxonburg, Pa., before it rises to carry the new experimental 500-foot half-wave antenna. Experiments have started which may greatly increase broadcast transmitting efficiency for greater distance in radiation and for reduction of fading.

Interference Fields

Noise interference fields are usually confined close to their sources—electrical wiring and machinery, passing automobiles, etc. Their average altitude is generally much less than that of the antenna proper, and the pick-up of these disturbances is effected for the greater part by the down-lead. Obviously, elimination of any pick-up by the leadin—both signal and noise—will result in vastly improved signal to noise ratio and usable sensitivity.

The use of a transmission line leadin is the most effective method of achieving this desired result. A shielded transmission line offers the most simple installation, and with properly designed impedance matching couplers at the antenna and receiver ends, provides suitable noise reduction characteristics for regular broadcast reception. For short waves, however, the impedance characteristics of the shielded line are such that appreciable noise pickup and rather severe losses occur in the shielded lead itself and the noises are transferred to the receiver. For short waves the open transmission line, with transposed or crossed leads every fifteen inches or so, provides a highly effective solution to the noise problem. This system is also excellent for noise reduction with all-wave receivers.

TONE CONTROL

If the total by-passing is excessive, due to the condenser in tone controls, not only will the hiss and the carrier heterodyne be suppressed, but also the higher and essential audio frequencies. The effect of connecting a given condenser can be tested easily. As soon as the condenser is connected there is an immediate lowering of the "tone" of the set. Quotation marks are used here because there can be no actual lowering of tones, but only relative suppression of the highs and the lows as they are. That is, a middle C tone will remain middle C regardless of the size of the condenser, but the condenser can be made so large that the tone is not heard. Moreover, the timbre of the music is changed by the condenser. Since the timbre of a musical note depends on the relative values of the fundamental tone and its overtones, it is clear that if the overtones are suppressed more than the fundamental, the timbre will change.

The music from different instruments of the same type is recognized by the timbre. It is quite conceivable that by means of a filter, of which the by-pass condenser is a very simple example, it is possible so to change the timbre of the music that it seems to be coming from another instrument. The oboe is said to have the purest tone, that is, the tone containing the least overtones. It is possible that the music from other similar instruments could be changed so that all would sound like the oboe. The opposite change is not possible by the same type of filter, but it could be done, provided that the harmonics were present in the first instance.

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Resistance of Condensers

ABOUT HOW MUCH resistance is there in a condenser that is used for radio frequency by-passing? Is it enough to cause any appreciable feedback? How can it be measured?—W. T. B., Lancaster, Pa.

The resistance of a condenser depends on the frequency, the capacity, the construction, and on the insulating material between the electrodes. A condenser measuring 0.001 mfd. was put on a bridge and its resistance measured at 1,000 cycles per second. It was found to have a resistance of about 1,000 ohms. The same condenser measured at radio frequency had so low resistance that it could not be measured. The measurement of resistance at radio frequency is quite difficult because it is so low that it is negligible in comparison with other resistors that must be used. The method often used is to construct a condenser that has as low a resistance as possible and then compare its resistance with the resistance of the condenser to be measured. The result is a difference, so the actual resistance is more than that obtained. It is quite safe to assume that a radio frequency by-pass condenser has negligible resistance. This does not hold for electrolytic condensers when they are used for radio frequencies.

* * *

Choking Ignition Noise

A CHOKE COIL in the lead from the battery to the induction coil is supposed to prevent ignition noises from reaching the radio receiver. Will you please tell me where this lead may be found? What kind of choke is required and is it necessary to use a condenser? Where should the condenser be placed?—W. E. M., Jersey City, N. J.

Ask your auto mechanic where the lead is in your particular car. It is the low tension wire. The condenser should be placed between the live side and the chassis on the ignition side of the choke. You need a coil wound with heavy wire because the current is heavy. Fine wire will burn out. The inductance is not so important but one millihenry should be large enough.

* * *

Function of Suppresser

IN NEARLY all the modern screen grid and pentode tubes there is an element called the suppresser. What does it suppress and why does it have to suppress it?—W. R. H., New York, N. Y.

When there is a screen near the plate and that screen is at a potential comparable with that of the plate, electrons attain a very high velocity by the time they reach the plate. They bombard the plate violently. The energy they contain is sufficient to release a large number of electrons from the plate, and these are attracted back to the screen. The result is, in some instances, depending on the relative values of the effective plate and screen voltages, more electrons leave the plate and go over to the screen than those that go in the desired direction. The plate current may reverse direction. Under such conditions the tube cannot function properly. The purpose of the suppresser is to prevent the released electrons from reaching the screen, or rather from leaving the plate. The suppresser is either maintained at zero or negative voltage. When the secondary emission, as it is called, is prevented by the suppresser, the irregularities in the grid voltage, plate current characteristic are prevented and the tube functions even when the screen voltage becomes equal to the effective plate voltage. Indeed, the screen voltage may become larger than the effective plate voltage without any deleterious effects.

* * *

Increase of Sensitivity

WHY IS IT that a receiver increases in sensitivity toward the high frequency end of the tuner? Formerly it used to be that the higher the frequency the lower the amplification. What has happened to reverse this?—F. W. W., Minneapolis, Minn.

It is still true that the amplification on the high frequencies is not so good as on the low frequencies. But there are many factors which must be taken into account. First, the coupling due to mutual inductance between two windings of a transformer is directly proportional to the frequency. This makes the sensitivity greater on the high frequencies than on the low, other things being equal. Then there is the L/C ratio. In a tuner controlled by a condenser, as usual, the L/C ratio increases as the frequency increases. The voltage developed across the tuned circuit increases as this ratio increases. If there is a high frequency tuner and a low frequency tuner in which the L/C ratio is the same, and also if the mutual inductance in the two cases is proportional to the frequency, then the high frequency tuner will be less efficient. Or rather, the amplification in the circuit will be less at the higher frequency.

* * *

Construction of Oscillators

WILL you kindly publish the circuit of an audio frequency oscillator that can be used for modulating a radio frequency oscillator. It should be as simple as possible. I have for the purpose an output transformer which I wish to use, if that can be done. I would also like to have a radio frequency oscillator, but I think I can draw a suitable circuit myself. How can the oscillators be coupled so that the r-f will be modulated?—W. B. J., Kansas City, Mo.

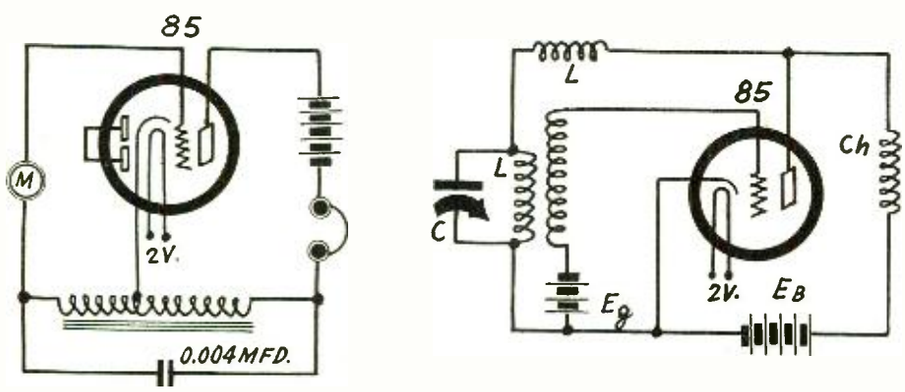
A simple audio frequency Hartley is shown herewith. If the output transformer you have is push-pull, use only the primary winding. If it is a plain transformer you can tune either winding or both, depending on the frequency you want. If the transformer is push-pull with a low voltage secondary, as would be the case if the transformer is intended for a dynamic speaker, use the small winding for impressing the a-f on the r-f oscillator. You can connect this winding in series with the plate voltage or in the cathode lead of the r-f oscillator. The r-f oscillator shown on the diagram is faulty in that a stopping condenser has been omitted. Put this condenser in place of the lone L coil, for this coil is not needed except for stabilization.

* * *

Computing Amplification

IN ESTIMATING the amplification in a resistance coupled circuit, should the grid leak and the stopping condenser be taken into account as well as the plate resistance? If so, how may this be done? I can easily figure the amplification with the plate coupling resistor alone but the grid leak has me stopped.—T. H. J., Youngstown, Ohio.

If the stopping condenser is as large as it ought to be, it can be neglected entirely for the voltage drop across it will be negligible. That leaves the plate coupling resistance and the grid leak in parallel. Therefore, to compute the amplification it is only necessary to find what the resistancce of the plate coupling resistance and the grid leak is when the two are in parallel, and then to use this in the same formula as is used when the plate resistance alone is taken into account. Suppose, for example, that the plate coupling resistance is 250,000 ohms and that the grid leak is 500,000 ohms. The resistance of the two in parallel is 167,000 ohms. If the mu of the tube is 10 and the internal plate resistance is 20,000 ohms, the amplification is nearly 9. It is not likely, however, that the internal plate resistance is so low as 20,000 ohms under these conditions, so that amplification will be less than that computed. This is especially the case when the tube is self biased with a high resistance, for then only a part of



At left is a Hartley audio frequency oscillator which can be used for modulating the output of a radio frequency oscillator.

the output voltage is available for the next tube.

* * *

Image Reception

IF THE intermediate frequency of a superheterodyne is 465 kc, what two frequencies can come through the intermediate amplifier if there is insufficient selectivity in the radio frequency level?—G.R.P., Rye, N. Y.

In any case the two frequencies are F + f and F — f, in which F is the oscillator frequency and f is the intermediate frequency. Thus if f is 465 kc, the two frequencies are F + 465 and F — 465. If the oscillator is set at 1,000 kc, the two radio frequencies are 1,465 and 535 kc. Which of these is the stronger depends on which one is tuned by the radio frequency tuner. In most present-day superheterodynes, the higher oscillator setting is used, and therefore the r-f would be tuned to 535 kc. The two signal frequencies that may be received at any setting are always separated from each other by twice the intermediate frequency. This helps in determining what station interferes with a desired frequency. Suppose, for example, that the intermediate frequency is 175 kc and that interference occurs on a signal frequency of 660 kc. The intermediate frequency would be 1,010 kc.

* * *

Controlling the Regeneration

WHICH is the best way of controlling the regeneration in a short-wave receiver? I have seen circuits in which the control is by means of a variable condenser, others in which it was by means of a rheostat or potentiometer across the tickler coil, and still others in which the control was in the screen voltage lead. And in still others it has been in the cathode lead and a combination of cathode and screen.—W. C. B., Binghamton, N. Y.

There is very little difference just so the control does control. Some controls are smoother than others, but that is not so much a matter of the type of control as the range of the control in relation to the tickler. A condenser is always smooth in the sense that it is continuous and not jerky. But some resistance controls are also smooth in this sense. A resistance or potentiometer control has the advantage of the condenser in that it is smaller and requires less space in the circuit.

* * *

Two Speakers

IS IT a fact that better tone can be obtained with two separate speakers than with a single one, or is that idea just propaganda of speaker manufacturers? Personally I have tried two speakers but I don't notice any marked difference, and that difference is unfavorable to two speakers.—R. E. N., Chicago, Ill.

The theory of two speakers is sound. There is no question about the possibility of getting better tone quality with two speakers than with a single speaker. But by simply connecting two speakers to the set worse results are likely to be obtained. In the first place, the two speakers must be different, one suited to the high frequencies and the other to the low. In the second place, the speakers must be coupled to the output correctly. The load on the single tube or single push-pull stage must not become too low or too high. One speaker must not be connected so that it will short-circuit the other, nor must one be so connected that it will choke the other. In the third place, it is doubtful that two different speakers can be connected correctly to the same stage without the use of elaborate filters. Perhaps the best way is to have two output stages, one for the low-note speaker and another for the high-note speaker. The signal division can be done in the grid circuit without much difficulty, or with no difficulty at all. The output stage designed for the low notes should be capable of high power output for it will be called on to handle the large amplitudes of the low notes. The output tube for the high notes could be smaller for it will not be called on to handle very high signal voltages, assuming that the signal division is made so that the low frequencies do not reach the grid of the high-frequency amplifier.

* * *

Television Receiver

WHAT can be done to broaden a television receiver so that it will bring in the wide sidebands without much attenuation? I wish to build a television superheterodyne but don't want it so selective as a broadcast receiver usually is.—T. Y., Boston, Mass.

First, you should use a high intermediate frequency so that a wide band is possible. Obviously, you cannot get a 100,000 band if the i-f is only 100 kc. Perhaps the best intermediate frequency would be one that is just below the lowest television frequency that you wish to receive. Perhaps 1,510 kc would be all right, or one slightly higher to get away from the broadcast band. Next, you must not make each tuned circuit too selective. If the i-f coils are doubly tuned you can stagger them. By detuning sufficiently you can bring about two peaks quite far apart. This, of course, would make the reception of low notes difficult. But this can be taken care of by having one tuned circuit that has a single peak and by placing this peak midway between the peaks of the doubly tuned transformers. The broadness should be carried on to the r-f tuner. Close coupling between the primaries and secondaries will help. A long antenna will also be helpful. If you have amplification to spare, you can broaden each tuner by connecting a resistance across the tuning condenser. The lower this resistance the broader will the tuner be. About 50,000 ohms may be tried as a starter.

* * *

Advantage of Double Push-Pull

IS THERE any advantage in using double push-pull audio amplification over a single push-pull stage? That is, is the quality improved? Can more volume be obtained with double push-pull than with only one push-pull stage?—F. R. M., Atlantic City, N. J.

If an intermediate audio stage is necessary, push-pull in that stage is desirable, just as it is desirable to have push-pull in the output stage. The quality will be considerably improved, provided, of course, that the transformers used are good. There will be no increase in the output of the receiver, for that is limited by the output tubes, which remain the same whether the intermediate audio stage is push-pull or single-sided. There will be a slight increase in the sensitivity, perhaps, but that depends on the transformer ratio.

* * *

Filtering D-C Receivers

IS IT necessary to put by-pass condensers on both sides of the filter choke in a receiver that is operated exclusively on a d-c line? If so, what is the function of the condenser across the line?—A. B., New York, N. Y.

It is not at all necessary to put a condenser across the line. If the condenser must be disposed of in some manner the best place to put it is across the line on set side, that is, add it to the condenser on that side, because the larger the capacity of this condenser the better the circuit will work. Of course, there is a practical limit.

* * *

Function of Tubes

IN YOUR April 15th issue you have a new automobile receiver circuit in which the 6B7 is used in a unique way. Which is the detector in this circuit? My guess is that it is the 75 or 37. But you call that an audio amplifier.—A. W. L., Bridgeport, Conn.

The duplex diode in the 6B7 is the detector. The pentode of this tube is a radio frequency amplifier. The 75 or the 37, whichever is used, is an audio amplifier and nothing else. We cannot have two audio detectors in a circuit. Some have tried that and found that it does not work, just as the theory says it should not.

A THOUGHT FOR THE WEEK

GEORGE ENGLES is a big figure in radio, as he has been in the amusement field for a good many years. As managerial head of the NBC Artists Service, he has continued his contacts with many of the stars whom he formerly represented in the concert world. Recently Mr. Engles was reminded that he had been director of the NBC Artists Bureau for five years. This reminder came in the form of an invitation to go to the home of Walter Damrosch in New York City. On arriving there, Mr. Engles found his friends on hand to welcome him. Among these were Mr. Damrosch, the master of ceremonies; Efrem Zimbalist, Alma Gluck, Sophie Braslau, Giovanni Martinelli, Mario Chamlee and Ignace Paderewski. There were cables and telegrams of congratulations from such noted artists as Fritz Kreisler, Mischa Levitzki, Rachmaninoff and Mme. Schumann-Heink. It was a great occasion for everybody concerned—indicating that Mr. Engles had not only been successful as a representative of famous artists but that he also had won their loyalty and friendship in splendid fashion.

RADIO WORLD

Title Reg. U. S. Pat. Off.

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.

EXPORTS NEEDED

VIRTUALLY without exception, those radio corporations making public their financial reports show a loss for 1932 and, where reports have been made for the first quarter of the present year, the fact of continuing losses is confirmed. For the most part these losses are individually inevitable, in that the companies suffering them are able to show a profit if given half a break by conditions.

Part of the trouble is due to the net reduction of the export market. Given their exports of a few years back, these same companies could show a profit today. But the principal foreign countries that were large buyers of radio sets and equipment have debased their currencies, erected stiff tariff walls and "quotas," accumulated vast exportable surpluses of their own products in different lines, and have ceased to get loans in the United States. All these factors tend to reduce our exports to the principal countries to which we hope to make exports, hence a net shrinkage of more than 40 per cent. in 1932 as compared to 1931, or from $22,635,154 to $13,312,136, a decrease of about $9,323,000.

We have our own tariffs to protect our own industries and products, and can not complain if other countries follow a like course, but the general activities of other countries has resulted in a combined assault on the position of the United States both as to its gold holdings and as to its export trade, so that debased foreign currencies, and import "quotas" that leave the United States as other than the most favored nation, help to weaken our own exports in which the radio industry is so vitally concerned.

The effect of our own tariff is to raise the price of the foreign-made competitive product, but when foreign currencies are debased to an extent that often more than equals the tariff, the effect is to nullify the tariff. For instance, Japan's currency is so debased as to enable that country to counteract a 60 per cent. tariff.

Formerly great export activity was unhealthily stimulated by American loans to foreign governments and foreign corporations. Our own money thus was used abroad not so much to pay us for our exports as to establish a credit against exports, and our increased loans increased trade.

One need not dwell on the export-import figure for world business in 1928, of $68,000,000,000, and compare it with the 1932 figure of $26,000,000,000, but 1932 shows a decrease of 35 per cent. under 1931, whereas the radio exports from the United States, comparing the same two successive years, decreased nearly 42 per cent. This is felt keenly, because radio sets and accessories are virtually 100 per cent. American products, that is, free from foreign-made materials or foreign labor.

The position of the United States in world commerce has not been consistent with that of most nations, in that though a creditor nation we were not willing to accept goods in payment, but demanded gold, and therefore sought the most favored customers, nations with sufficient gold holdings, and thus indirectly tapped all the gold.

Therefore the radio industry, one that holds world leadership both from engineering and commercial viewpoints, and normally can lay down a better set in a foreign country at a lower cost than that of domestic production in that country, has a concern in the state of the American currency, the protection of the American gold supply, export-import bartering, inter-governmental debt settlement and non-discriminatory tariffs. The recent move to inflate our own currency is actuated by the desire of exporters to enable foreign countries to buy here, for the reduced values of foreign currencies are the equivalent of increased prices of what we have to sell.

The radio industry, like other industries, is looking for governmental aid in the solution of the problem, and might be expected to lend willing co-operation to plans that under more favorable conditions might not even be considered. While our first desire is to protect ourselves, we do not expect foreign countries to buy from us when we do not buy from them, though we do expect that currencies, tariffs, "quotas" and diplomatic relations be established so as to lift us out of the disadvantageous position into which we have been forced by the actions of other countries. Our own return to prosperity depends somewhat on getting a better break in the world markets than raids on our gold supply have given us, and that we be not allotted too great a share of the world's disfavors.

Daylight Saving Time on Chain Begins April 30

Beginning Sunday, April 30th, the National Broadcasting Company will operate its schedule on Daylight Saving Time.

In general the program listings will remain unchanged. For example, a program now scheduled at 8 p.m., Eastern Standard Time, will be heard April 30th and thereafter at 8 p.m., Eastern Daylight Saving Time. The Daylight Saving schedule will continue in operation until Sunday, September 24th.

The chief exception to the change is the National Farm and Home Hour, which will appear on the summer listings as one hour later than usual.

The switch to Daylight Saving Time will be made at 2 a.m., April 30th.

SKETCH LIMITS HELD HURTFUL

Feeling that the duration of dramatic sketches to units of fifteen minutes is arbitrary and inconsistent with the actual requirements, resulting in "padding" or sacrificial curtailment, WINS, New York City, is presenting sketches of four to 24 minutes' duration.

"The radio drama will aproach the merit of the theatre only when its scripts are written under conditions approaching those of the theatre," James D. Mugford, dramatic director of WINS, said.

"A play for Broadway doesn't have to fit into specific time limits. Witness 'Mourning Becomes Electra,' and the host of short farces, like 'Springtime Comes for Henry.' Writing for fifteen-minute periods—or multiples of 15-minute periods—means that radio dramas are either padded episodes or condensed dramas. Only once in a great while a plot will exactly fit into the radio mold.

"Radio drama will become an important contribution to American culture when the time-room is provided for its growth."

The presentations of the Cosmopolitan Players at WINS are an illustration of possibility of adapting a varied program to the requirements of radio drama. The sketches presented, usually two on each broadcast, are permitted to run their normal length. Music and guest speakers fill in the remaining time.

Will Rogers Returns to Air as Commentator

Will Rogers returns to the air beginning Sunday at 9:00 p.m., E. D. S. T.

Rogers will be the main attraction of a half-hour weekly program to be sponsored by the Gulf Refining Company over an extensive NBC-WJZ network in the East and South. He will be supported by an orchestra and will discuss current events.

HO-HUM!

Although hundreds of documents and thousands of envelopes are handled in the NBC mail department, it remained for Sherlock Holmes of the air—Richard Gordon, in real life—to find a dollar bill lost by Alfred Cook, of the mail department.

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.

John Savik, 106 Fifth St., Lackawanna, N. Y.
Robert J. Tucker, 3722 Wallace St., Philadelphia, Pa.
A. W. Bonnefil, Les Cayes, Haiti, W. I.
Perry J. Sherman, P. A. Engineering, No. 1112 Mesquite St., Corpus Christi, Texas.
Merle Barker, Rice, Kans.
R. G. Jones, Apt. 1, 3181 Maplewood Ave., Montreal, Canada.
John P. Grist, 91 Gloucester St., Ottawa, Ont., Canada.
A. H. McMullen, 1223 West 5th St., North Platte, Nebr.
C. J. Hill, 142 Grove St., Rutland, Vt.
Edw. B. Johnson, 154 Wardwell Ave., West New Brighton, N. Y.
Jean Karakan, Rua Duilio 101 (Agua Branca), S. Paulo, Brazil.
W. E. Nicholson, 41 East Clay St., Waterbury, Conn.
Mr. J. C. Hill, 318 Magnolia St., Jacksonville, Fla.
Samuel T. Edge, 305 N. St. Asaph St., Alexandria, Va.

SHORT WAVE CLUB

Bud Anderson, 1001 East 19th St., Minneapolis, Minn.

STATION SPARKS

By Alice Remsen

THE CODE OF A LEGIONNAIRE

(For "Tales of the Foreign Legion")

WABC, Thursdays, 10:00 P.M.

Silver sand in the glaring sun,
Hard blue sky overhead.
Heat as fierce as an oven's breath,
Water, scarce as a bed.

Bayonets gleaming thin and sharp,
Used when the rush begins;
A Legionnaire doesn't hesitate,
Nor wait to pray for his sins.

Russians and Poles and Serbs and Croats,
English, Germans and Dutch;
White and black men belong there, too—
Race doesn't count for much.

Hard-bitten, hard-fighting, strong-armed men—
With everything left behind,
No one asks what their past has been—
Nobody seems to mind.

Proud of the Legion, loyal to death,
Reckless and devil-may-care;
"DIE WITH A SMILE, BUT GET YOUR MAN FIRST!"
Is the code of a Legionnaire.

—A. R.

* * *

IF YOU ARE FOND OF EXCITEMENT, thrills, war-time atmosphere and fighting men, listen in to those stirring Tales of the Foreign Legion. They are intensely dramatic and very well acted. Your time will not be wasted. Listen in! You'll like them. WABC and network.

* * *

The Radio Rialto

Some New Ones on CBS

New York is just as bad as Cincinnati, so far as rain goes, but we must expect it in April if we want any May flowers. It's simply pouring today; cold as the deuce, too—glad I don't have to go out—so I'll sit in my sun parlor, minus the sun, and tap out these lines to you, dear readers. Well, your girl friend is glad to be home again, although to say I miss those many friends I made out in the Middle West is putting it mildly. Roamed around the old rialto yesterday and gleaned a few news items. . . . Over at Columbia several new programs have already made their debut; among them is "The Friendly Philosopher," starring Pedro de Cordoba, noted actor, and Will Osborne and his orchestra; every Monday, Wednesday and Friday at 10:45 a.m., E.S.T., with a repeat broadcast for Western stations at 11:45 a.m., E.S.T. This series is sponsored by the Corn Products Refining Company. . . Bourjois has changed its set-up from a mystery drama to a musical show; they now use Nat Shilkret's orchestra, Frank Parker and Mary McCoy. Agnes Moorhead will be retained from the dramatic production to supply a comedy note to the program. Each program will be in the form of a miniature musical comedy woven around the "boy and girl" situation. Mondays, as usual, at 9:30 p.m. . . . New sustaining features include a series of popular song recitals by two well-known stars of radio and concert—Ethel Hayden, soprano, and Arthur Lang, baritone; every Monday at 3:30 p.m. E.S.T. . . . A new series of light opera programs, directed by Channon Collinge, will be heard from 8:00 to 8:30 p.m., E.S.T., on Wednesdays. Radio versions of Gilbert & Sullivan works and the light operas of Suppe, Herbert, Planquette and others will be presented by Columbia soloists, symphony orchestra and chorus. . . . Grand opera will not be forgotten during the summer, either, at the Columbia Studios, for Howard Barlow is directing a series of presentations every Monday from 9:00 to 9:30 p.m. to be known as Grand Opera Miniatures, with a cast which includes Mary Eastman, soprano; Barbara Maurel, contralto; Theo Karle, tenor; and Evan Evans, baritone. Verdi's beautiful "La Traviata" was chosen for the premier presentation on April 17th. . . . The Trans-Pacific programs broadcast direct from the beach at Waikiki early Sunday mornings were so successful that it was decided to continue them as a regular feature, and so, if you are up at 12:30 to 1:00 a.m. next Sunday morning tune in on the Columbia network and hear a program by Joseph Kamakau and his serenaders, in typically Hawaiian folk-melodies and hula-hula music, with occasional waltz and foxtrot versions of native tunes, Station KGMB, Honolulu, transmits them to us. . . .

Ranny Weeks at NBC

Over at NBC Ranny Weeks, from Boston, is the latest recruit to the baritone ranks. Ranny is known as New England's smartest troubador and has gained a considerable reputation among the smart clubs and ballrooms of Boston and popular Massachusetts and Connecticut roadhouses. At any rate, Ranny Weeks is now to be heard over an NBC-WEAF network as the featured artist on the Band of Famous Brands series, sponsored by the makers of Philip Morris cigarettes, each Monday at 8:45 p.m. and each Wednesday and Saturday at 9:00 p.m. . . . For the first time in five years Rubinoff is taking his band on tour. Now the dance lovers who have thrilled to his marvelous music each Sunday night will have a chance to see him in person, but Rubinoff will make his dates so that he can return to New York for the Sunday night Chase & Sanborn broadcasts just the same. . . . Rudy Wiedoft has joined B. A. Rolfe's band . . . Did you all hear the one and only G.B.S. over WJZ-NBC networks? He's a windy old boy; when he once starts to talk no one knows when he's going to stop, but at least he says something worth while, and judging from the laughter and applause, the large audience at the Metropolitan Opera House liked him. There was a great deal of well-meant advice mixed in with good-natured joshing at the hundred per cent American, but Mr. Shaw wouldn't be himself if he made a speech without criticism of his brother earth-dwellers. The man's a marvel and can speak for hours on end without notes and on almost any conceivable subject; if that's what a vegetable diet does for a person—well, I never did care much for meat myself! . . . NBC is building up Jimmy Melton, Frances Langford and John Fogarty; the latter sure does deserve a build-up; he's worked hard for it and I hope it succeeds in making him an ace air-attraction. . . .

Those Pickens Girls

One of my correspondents would like to know something of the Pickens Sisters. . . . Well, all I can say right now is that the girls are real sisters from Georgia, and each of these Georgia peaches is as sweet as she sounds. Jane is the one I know best and she's simply swell. . . . As Paul Whiteman and Jack Pearl are taking to the road together, Pearl's sponsor is deciding to use Paul and his orchestra for the Thursday broadcasts, which will continue during the tour, emanating from wherever the boys are playing; much easier than hiring different bands in each city. . . . Howard Petrie is the latest NBC announcer to succumb to the lure of matrimony; he married Alice Wood, NBC hostess, at the Little Church Around the Corner, on April 21st. Jolly good luck to you both, Howard and Alice. . . . The trend of thought around the advertising agencies here in New York is very optimistic. It's quite likely that the summer will see a good many new air programs. Plans are even now being made for the Fall. The radio stations themselves have dropped the axe quite indiscriminately, claiming that new voices are needed; therefore, auditions are in full swing, but—and here lies the rub! Talent is being invited to broadcast, on the off-chance of clicking—without adequate compensation and in many cases with no compensation at all other than the satisfaction of being heard via the ether, which may or may not mean a thing; to my mind this is a backward step for radio itself; here and there an artist might be discovered in this manner, but the usual run of talent willing to work for nothing is extremely poor and only lets the station exploiting it down in the estimation of its listeners. But I suppose that this situation, like everything else, will work itself out. . . . Now that Lent is over business will pick up; everything points that way. . . . President Roosevelt's reforestation idea will put a good many men to work at healthy open air occupation; this will not only put money into circulation, but will circulate a little hope and faith into human beings sorely in need of those two qualities. . . . Time for a cup of tea, so, until next week—so long!

* * *

Biographical Brevities

About Phil Baker

That irresistible jester, Phil Baker, was born in New York and, when a mere lad, overcome by the desire to see something of the world, he ran away from home, got as far as Boston, was pretty hungry when he arrived, and jumped at the chance to appear in an amateur night show at the old Bowdoin Square Theatre in the city of beans and culture, thereby earning 50 cents. The story of his stage career after that night covers a period of twenty years and during that time this runaway boy has developed into one of the highest paid artists in his chosen profession.

Returning to his New York home from Boston, Phil eventually became secretary to Carl Laemmle, in the old IMP film company. Mary and Lottie Pickford and King Baggot were the company's stars at that time. Bored by a secretary's chores, young Phil spent all his leisure moments at a movie house around the corner from his home. He almost lived there, sitting down front and watching the nimble fingers of the girl pianist. One hot night the girl was taken ill and had to leave. The picture was continuing without music when Phil, without invitation, slipped down to the piano and began to play. He knew about three tunes, but he could make the proper hullabaloo for the Indians going on the warpath, or the trains rushing through the night; he knew a little sneaky music and there was always "Hearts and Flowers" for love scenes. The manager gave him a regular job and he was really started on his career.

His first stage venture was in vaudeville, accompanying a violinist on the piano. Later the team was formed of Bernie and Baker—and what a team, Phil and the Old Maestro! By that time Phil was playing an accordion. When the

(*Continued on next page*)

PERSONALITIES

Tom Howard, of NBC's "Musical Grocery Store," says he took a piece of cheese to the movies the other night, because Mickey Mouse was playing there, and he wanted to get his autograph.

* * *

Bess Johnson, comely young dramatic actress, daughter of a historic West Virginia family, didn't have to overcome the family's objection to the stage, as her mother did. Her mother played with Lillian Russell and other celebrities of that time when the stage was frowned on by many self-respecting persons. So when her daughter evidenced a desire for the footlights, Mrs. Johnson coached and sponsored Bess to eventual stardom.

* * *

In 1900 or thereabouts, it was "Aw, hire a hall!"

That pat squelch lasted probably twenty years or more.

About 1920 we began to hear "Aw, take the air."

Now radio has finally given us the up-to-the-minute phrase we need to replace those old standbys.

It's that "get off the air" which the mysterious and pestiferous Beetle, the "ghost stooge," hurls at Phil Baker, the Armour Jester over NBC networks on Friday nights.

It's so apt that the gagsters of the air are wondering now why no one ever thought of it before.

* * *

The continuation of a standing rule applying to Amos 'n' Andy broadcasts is brought home to friends of Correll and Gosden almost every day. Ernest Truex, famous theatrical star and friend of long standing, is no exception to the rule, so he had to wait outside their studio recently when he accompanied them to NBC for a broadcast.

"They're about the only showmen I know who play to an empty house by preference," he remarked.

Since his departure with the traveling Barn Dance unit, the Arkansas Woodchopper, a favorite with listeners of WLS, Chicago, has been besieged with requests for his return to the regular studio programs. Because he was eager to meet the demand, Arkie determined while at Goshen to drive to Chicago after the night show to put in an appearance on the Dinnerbell program the following day, and planning to leave immediately in order to be back in Goshen in time for the evening theatrical performance. While he was traveling at 70 miles an hour, the steering apparatus of his car became suddenly useless. But fortunately the car remained on the highway until the singer was able to bring it to a stop. By immediately changing to a train, Arkie was still able to make his appearance on the noon program.

* * *

The RCA Building at Radio City, N. Y. City, is nearing completion.

In the Great Hall, Diego Rivera, Mexican artist, is at work on his fresco. Walls of the elevator banks along the main corridor where the murals of Jose Maria Sert, Spanish muralist, and Frank Brangwyn of England will be installed are in readiness for the canvases. The murals are being completed in studios in Europe and are expected soon to be on their way to New York.

The sculptured panels by Gaston Lachaise, which decorate the western facade of the RCA Building, are already finished. Barry Faulkner's huge mosaic, in the Sixth Avenue loggia, is in place and within a week the last of the scaffolding will have been removed.

Work is progressing satisfactorily on the panels by Leo Friedlander which are now being carved in limestone over the 49th and 50th Street entrances to the building. Lee Lawrie's design for the decorative treatment of the main entrance is fast being transferred into finished sculpture, and this week workmen began the first steps in the installation of the huge cast glass window screen, also designed by Mr. Lawrie, which will be placed in the loggia facing the Sunken Plaza.

* * *

Lowell Thomas receives letters each month from a man who claims he is the nearest white man to the North Pole. His writer, who catches each Thomas broadcast by short wave, lives in Elsmereland, north of Baffin Land, in the Arctic. He is a representative of the Northwest Royal Mounted Police. The territory is inhabited by eskimos.

* * *

Don Bestor, now leading his orchestra over networks from the Hotel Lexington in New York, has discovered a fellow farmer in his band. He is Howard Workman, his bass player, who, as a 4-H Club member, once won a blue ribbon for raising a prize hog in Indiana.

Station Sparks

(*Continued from preceding page*)

team split each became a star in his own right.

During the war Phil joined the Navy; this broadened the lad out in more ways than one; he was scared to speak a line before that; but the Navy worked wonders. Can the lad talk? I've heard so! His experience in vaudeville and musical shows has given him a marvelous background from which to develop a radio personality.

Phil Baker's present vehicle, one of the biggest radio shows on the air, has proven his versatility. He is not only a master of ceremonies, but a capable actor, musician and comedian; and a producer and radio star of the first water. If you don't believe me, tune in on the Armour program each Friday night over a coast-to-coast network via NBC-WJZ, 9:30 p.m. E.S.T.

Regenerative Intermediate Channel Boosts Short-Wave Results

A modified version of the single signal superheterodyne, which utilizes only five tubes and represents a considerable constructional and operational economy is described by James J. Lamb of the American Radio Relay League laboratory staff.

The performance of the simplified version compares favorably with that of the more elaborate model, and is greatly superior to that of any ordinary type of short-wave superheterodyne, with adequate sensitivity to get down to the very low background level and selectivity which can be run up to the order of 1 kilocycle, in broadcast terminology. The five tubes are used as oscillator, mixer, i-f amplifier, power detector and audio beat frequency oscillator. Thus two tubes are oscillators, the remaining three doing the actual work.

Instead of the piezoelectric quartz filter circuit with controllable selectivity, which was the principal factor in making the original receiver the most selective design for c.w. telegraph reception yet achieved, a regenerative or "negative resistance" intermediate frequency amplifier is used in the new super. With this amplifier just on the verge of oscillation, selectivity and sensitivity characteristics approaching the original are achieved, entirely adequate in eliminating the "audio frequency image" which is the bane of ordinary heterodyne radiotelegraph reception.

The adoption of the single-signal type of reception in radiotelegraph work is rapidly becoming universal. The Army, the Navy and the Coast Guard have become interested in this new type of reception for application to their needs. Various commercial communications companies are making use of the principle, which results in performance never before considered by them technically or economically feasible. All over the world, in South America, in New Zealand and Australia, in China, and of course in many European countries, the superheterodyne is being built and used.

It has practically revolutionized the design of commercial high frequency receivers, in modern models of which are to be found almost without exception the features of the original super—stabilized electron coupled oscillators, high sensitivity and selectivity never before achiev-

President Fred D. Williams, of Radio Manufacturers' Association, Inc., has called a special meeting of the Association's Board of Directors on Tuesday, April 25, at the Stevens Hotel, Chicago, to consider a comprehensive plan for initiating merchandising and sales activities next fall in which all radio interests would participate.

A program for the ninth annual RMA convention at Chicago June 5th and 6th also will be presented for approval of the Board.

FRENCH LET UP

Following protests of the RMA to the State Department and to the American Chamber of Commerce at Paris, the French Government has withheld its proposed new restrictions which were to be effective on radio imports. Press dispatches from Paris stating that France had dropped, at least temporarily, the new import restrictions proposed through a tax on import quota certificates, have been confirmed. The proposed new tariff restrictions are held at least in abeyance indefinitely and, according to press reports, may be permanently abandoned. The French Government proposed to impose virtually a prohibitive tax on import license certificates under the quota plan and was also reported to be contemplating a reduction of prevailing import quotas.

STATE RADIO TAX BEATEN

The proposed "luxury" tax on radio of ten per cent, provided in a bill introduced in the Connecticut Legislature, has been defeated. Radio interests in Connecticut, under the leadership of R. J. Mailhouse, chairman of the RMA State Legislative Committee, rallied in opposition to the bill. Similar tax bills in Missouri and California legislatures are being vigorously opposed by radio interests.

EXPORTS DROP 42% DESPITE SOME INCREASE

Washington.

Radio exports declined nearly 42 per cent. in 1932, compared to 1931, according to figures supplied by the Department of Commerce:

1931	$22,635,154
1932	13,312,136
Decrease	$ 9,323,018

The drop is almost 42 per cent. It was due to reduced exports to principal countries, for there was an export gain as to other countries.

Countries	Increase	Decrease
46	$871,969	
57		$10,194,987
103		$ 9,323,018

Increased shipments of sets and equipment were noted to Belgium, Irish Free State. The Netherlands, Norway, Yugoslavia, Panama, Haiti, Bolivia, Colombia, Paraguay, China, Hong Kong, East Indies, Kwaugtung, Palestine, Turkey, Australia and Morocco.

Canada Buys $3,000,000 Less

Increased sales to these countries is indicative of the activity of radio manufacturers in developing markets in the smaller countries.

Shipments to Canada during 1932 declined nearly $3,000,000, compared with 1931, due in great part to the newly enforced regulation concerning the percentage of locally made parts that must be included in a Canadian-made set.

Local manufacturing activity plus higher duties curtailed our trade with Italy. The quota system in France accounted for the lessened trade with that country. Shipments to Spain remained at about the same, approximating $1,000,000 each year. Increased broadcasting activity in China is reflected in larger sales in that market, increasing from $206,405 in 1931 to $359,788 in 1932.

British purchases of American radio equipment dropped from $2,641,065 in 1931 to $716,669 in 1932, and from all countries from £2,204,081 to £955,813. The pound is at about $3.46 at current exchange.

The adverse effect of prices due to the exchange on silver is the principal reason for this decreased trade, though efforts of British manufacturers and patent holders to retain the market for local manufactures have aided this reduction.

Argentina Leads

The increases represented by the 46 improved markets totaled a net change of $871,969, the declines in other countries amounting to $10,194,987, in which Canada participated to the extent of $2,983,345, for the first time in the history of the radio industry dropping from first place among customers for United States radio goods to second, being supplanted by Argentina.

The United Kingdom's purchases declined by $1,924,396; Switzerland, $481,259; France, $295,462; Germany, $105,181; Italy, $689,873; and Japan, $99,201—a total loss of $6,578,717 in countries with appreciable domestic radio industries, and each undertaking exceptional programs for increased use of domestic-made equipment.

TRADIOGRAMS

By J. Murray Barron

Try-Mo Radio Corp., 85 Cortlandt Street, N. Y. City, reports a continued demand for short-wave kits and sets. The 2-volt battery receivers are selling well, especially the Beginner's Twin and the Rocket. In the near future a complete array of short-wave kits and wired receivers of all types, both battery and ac-dc, will be catalogued, which list will be sent by the corporation upon request.

* * *

Thor's Radio Bargain Basement, 167 Greenwich Street, N. Y. City, is now featuring its new Milrad 7-Tube ac-dc receiver. This set uses 43 push-pull, 25Z5, 36 and 37 tubes. It is housed in a full-sized table model cabinet of attractive design and beautifully finished, with 8-inch Rola dynamic speaker and is sold at a popular price.

* * *

Alan Radio Corp., 83 Cortlandt Street, N. Y. City, announces a full line of public address systems for the serviceman who wants to take advantage of a popular-priced line of efficient units. This line also includes a small and effective unit for the automobile.

* * *

Postal Radio Corp., 135 Liberty Street, N. Y. City, is now in production on its new 5-tube ac-dc superheterodyne receiver. It is a very sensitive receiver with an extraordinary pickup and performs exceptionally well on DX. It also picks up some of the police channels. It will operate with small self-contained aerial and requires no outside aerial or ground connection. It is equipped with the latest tubes and dynamic speaker and has built-in socket for use on batteries or B eliminators. The same receiver is used for the automobile and the home or camp. There are essentials such as remote control, eliminators etc., that can be had if set is for the automobile.

* * *

Servicemen and others selling radio merchandise in their community, especially the smaller places, should get after the public address systems and the small ac-dc business. To-day, with the varied low-priced lines, with the assurance of correct information, there should be very little difficulty in supplying anything in radio in one's community.

* * *

El Rey Radio Mfg. Co., 8406 South Broadway, Los Angeles, Cal., announces the curtailment of production on its regular line of radio receivers to take care of the all-year-round demand for auto sets, due to the favorable climatic and road conditions of that territory. The model covers from 180 to 600 meters and has option of battery or electric operation. Installation depots for this type of set report that servicemen find it a twelve-month business. There is a new display board that will be sent to established El Rey dealers.

* * *

Ohmite Mfg. Co., 636 North Albany Ave., Chicago, Ill., reports great interest and increased sales in their Dividohm, a practical replacement voltage divider. These resistors are wound over an Isolantite tube which supports the wire and resists the pressure of the contact button, thus freeing the winding from any strain. They are handy and can be carried in tool kit without fear of breakage if ordinary care is taken.

PETITION IN BANKRUPTCY
Filed Against

Duovac Radio Tube Corp., 360 Furman St., Brooklyn, N. Y., manufacturers of electric, radio and transmission tubes, by Admak Mfg. Co., Inc., $731.36; Corrugated Quench Gap Co., $170; Driver-Harris Co., 239.51; Engineering Co. of Newark, N. J., Inc., $3,909.11; Granger Mfg. Co., $729.44; Newark Radio Laboratories, $598.91. Julius Zeitz, 501 Fulton St., Brooklyn, appointed receiver in bond of $10,000, by Judge Moscowitz.

NEW COMBINED AERIAL STOPS MOST FADING

A new type of radio receiving antenna which permits the simultaneous reception of vertically and horizontally polarized radio waves and practically eliminates fading has resulted from recent radio facsimile tests conducted on the SS. President Harding by RCA engineers during the round trips of that vessel between the United States and Europe.

The announcement was made by C. J. Pannill, executive vice-president of the Radiomarine Corporation of America, with which company the U. S. Lines have been actively cooperating in the development of equipment for radio facsimile reception of weather maps on ships at sea by permitting many special installations on its vessels.

Simple Design

"When the President Harding sailed," said Mr. Pannill, "she was equipped with the new type antenna which makes possible the advantages of diversity radio reception without widely separated antennas. The new design is simplicity itself, and was developed to avoid interference with guys, rigging and other aerial gear of a steamship. It is showing so much promise in performance that I should not be at all surprised if this method of antenna construction should ultimately be employed in other than marine service.

"The new antenna combines the virtues of the 'doublet' and the 'zeppelin' antennas in a single design. The horizontal 'doublet' section of the antenna intercepts radio waves of horizontal polarization and the 'zeppelin' part picks up waves of vertical polarization.

Separate Receivers

"Each section of the new antenna is connected to a separate radio receiver and the amplified results of the two are combined in a common output, which operates the facsimile reproducer. Fading generally results fro ma change in the plane of polarization of a radio wave, caused by varying conditions in the natural medium of transmission. The new antenna, with its associated r eceiving equipment, is designed to intercept signals impinging on any plane and will therefore operate under all conditions of reception.

"The new antenna makes possible an increasingly dependable and rapid service in this new field of marine radio facsimile transmission."

9-Year-Old Boy Youngest Amateur

Hartford, Conn.

The latest claimant for the title of youngest Federally-licensed radio amateur in the United States is Russell Stedinger, 2816 Delaware St., Oakland, Cal., who has been issued the call signal W6HRZ by the Federal Radio Commission.

According to the American Radio Relay League, Russell is just nine years old. He is an enthusiastic amateur, and has already communicated with voice as far as Hawthorne, Nevada, with his low-powered amateur transmitter which operated in the amateur 2000 kc. band.

'HAMS' LAUDED FOR 'QUAKE AID

Commendation for the emergency work performed by radio amateur stations in Southern California during the recent earthquake was expressed in a letter from Harold A. Lafount, acting chairman of the Federal Radio Commission, to the American Radio Relay League. K. B. Warner, secretary of the League, was requested to express to its members the Commission's appreciation of the prompt and efficient action taken by amateur licensees in bringing aid to the stricken area.

Amateur work during the California earthquake reached as high a degree of effectiveness as in any previous emergency of the more than thirty major disasters in this country in which amateurs have operated. Ordinarily called upon to bridge a total gap in all communications when a major disaster occurs, amateur work during the recent earthquake stepped into the front rank of communication along with the wire services on a basis of the sheer merit of the work performed.

The first general announcement of the tragedy was broadcast by an amateur station shortly after the initial heavy tremblors, and throughout the week-end and the following week dozens of amateur stations in the earthquake area communicated among themselves and with hundreds in other sections of the country relaying many thousands of official and personal messages. Service of this nature is, as was stated by Mr. Lafount, of the highest order of importance.

Inductance Values for Lowest Band in Short Waves

In all-wave tuning, assuming the same capacities, except padding, the first short-wave band would require the following:

Capacity	*R-F Inducance*	*Osc. Inductance* 175 kc	465 kc
350 mmfd.	33 mch	30 mch	25 mch
375 mmfd.	30 mch	28 mch	23 mch
410 mmfd.	27 mch	24.6 mch	20 mch
500 mmfd.	23.5 mch	21.5 mch	18 mch

The padding condenser for 175 kc would be 5,770 mmfd. and for 465 kc would be 875 mmfd.

The coils inductance values for the rest of the bands may be worked out along the same lines, that is, a certain minimum capacity, and thereafter the inductances may be the same, or, for the second band, nearly the same and for the other bands actually the same, because the percentage of frequency difference is very small.

Only in the first or lowest frequency short-wave band need a padding condenser be used, but even here the inductance could be apportioned so that the condenser would not be needed for 175 kc, but for much higher intermediate frequencies it would be, because the percentage of frequency difference is greater.

Of course it is not desirable to use the same capacity throughout, that is, 350 mmfd. and the like constitute too much when the third, fourth and possibly fifth short-wave bands are to be covered, hence it is usual to reduce the capacity of the tuning condenser, which may be done with series condensers, but then the inductance has to be selected on the basis of the actual capacity, not on the basis of the original capacity of the tuning condenser without regard to the sharp reduction effectuated by the series capacity.

TROUBLE SHOOTER'S MANUAL, Nos. I and II

Having assembled 2,000 diagrams of commercial receivers, power amplifiers, converters, etc., in 1,200 pages of Volume No. 1 of his Perpetual Trouble Shooter's Manual, John F. Rider, noted radio engineer, has prepared Volume No. 2 on an even more detailed scale, covering all the latest receivers. Volume No. 2 does not duplicate diagrams in Volume No. 1, but contains only new, additional diagrams, and a new all-inclusive information on the circuits covered.

Volume No. 2—Perpetual Trouble Shooter's Manual, by John F. Rider, Shipping weight 8 lbs. Order Cat. RM-VT @.....$5.00
Volume No. 1 (8 lbs.). Order Cat. RM-VO @ $5.00

We pay postage in United States on receipt of purchase price with order. Canadian, Mexican and other foreign remittances must be in funds payable in New York.

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

12-TUBE DIAMOND blueprint in preparation, ready about May 8th; full scale; price, 50c.
ANDERSON - BERNARD 8-tube blueprint in preparation, ready about May 8th, 70c.
RADIO WORLD, 145 W. 45th St., N. Y. City

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ENVELOPES, $1.39 per thousand; we pay postage; samples for stamp. Young Printing Company, Fairfield, Penna.

URUGUAY STAMPS—100 different stamps, $1.00. 200 different stamps, $3.50. Stamps will be shipped direct from Uruguay. Heriberto Meyer, care Radio World, 145 West 45th St., New York City.

SELL ELECTRIC NEONLIKE WINDOW DISPLAY SIGNS. Complete, 98c. Particulars. Slogans 8 in. x 14 in. Box 63, Rugby Sta., Brooklyn, N. Y.

BARGAINS IN FINEST PARTS! — Highest grade, new parts, few of each on hand. National dial, flat type, modernistic escutcheon, type G, clockwise, $2.19; Pilot drum dial No. 1285 @ $1.89; a-c toggle switch, 19c; triple pole, four-throw Beat switch, insulated shaft, $1.62; double pole, four throw, $1.08. Direct Radio Co., 145 West 45th St., N. Y. City

"HOW TO WRITE FOR RADIO"—By Katherine Seymour, Assistant Continuity Editor of the National Broadcasting Company, and J. T. W. Martin, radio writer of the staff of Batten, Barton, Durstine and Osborn—the first authoritative book of its kind, by authors who know their business. The chapter headings are: Opportunities for the Radio Writer; Early History of Radio Writing; "Straight" Continuity; Dramatic Radio Writing; Radio Adaptations; Production (of Musical and Dramatic Programs); Sound-Effects the "Props" of Radio; Radio Advertising Writing; Properties of the Air. Price $3.00. Book Dept., Radio World, 145 W. 45th St., N. Y. City

"THE CHEVROLET SIX CAR AND TRUCK" (Construction—Operation—Repair) by Victor W. Pagé, author of "Modern Gasoline Automobile," "Ford Model A Car and AA Truck," etc., etc. 450 pages, price $2.00. Radio World, 145 W. 45th St., N. Y. City.

ANDERSON'S AUTO SET

Designed by J. E. ANDERSON

FOREIGN RECEPTION ON 6-INCH AERIAL

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

The complete parts, including set chassis and set shield, battery box, remote control, battery cable, all condensers, resistors and coils, speaker with shielded cable; and a kit of RCA tubes (two 239, two 236, two 237, one 89, and one 85) are supplied less aerial. Cat. 898-K @.....$34.60

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

DIRECT RADIO CO.
143 West 45th St. N. Y. City

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

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

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SHORT-WAVE COILS and FORMS

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

Two-winding coils, UX base. Cat. SWA (four coils) $1.20
Three-winding coils, 6-pin base (tickler interwound with part of secondary) Cat. SWB @ $1.40

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

SCREEN GRID COIL CO., 145 W. 45th Street, New York City

CHARACTERISTICS CHART

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

NEW RADIO AMATEUR'S HANDBOOK, 180,000 words, 207 illustrations, 218 pages (10th edition, issued 1933). Price, $1.00 per copy. Radio World, 145 West 45th Street, New York, N. Y.

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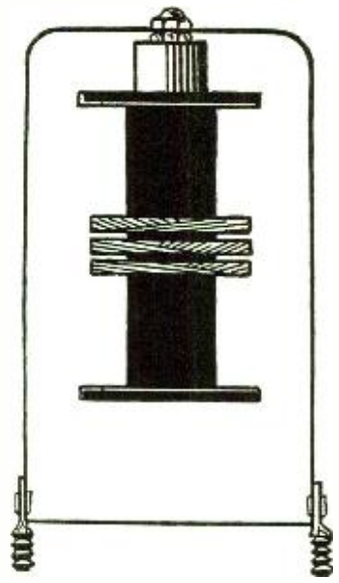
Subscription Dept., RADIO WORLD, 145 W. 45th St., N. Y. C.

Semi-Tuned Coupler



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

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

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

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

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

Short-Wave Plug-in Type

Cat. SWB—Four plug-in coils, 6-pin base; primary, secondary, fixed tickler.....$1.40
Cat. SZ—Six-spring wafer socket for use as coil receptacle for six-pin coils.....11c
Cat. SWA—Four plug-in coils, UX base, primary and secondary; primary may be used for feedback if condenser connects aerial to grid..$1.20
Cat. SX—Four-spring (UX) wafer socket for use as coil receptacle for four-pin coils.....10c

CONDENSERS

Cat. DJA-14—Single 0.00014 mfd. condenser with compensator built-in. ¼-inch shaft. Supplied with bushing to take ⅜-inch dial hub..98c
Cat. DJA-25—Single 0.00025 mfd. feedback condenser. Useful where 0.0002 or 0.00025 mfd. is specified $1.02
Cat. DJA-14-D—Double (two-gang) 0.00014 mfd. condenser with compensators built in, ¼-inch shaft. Supplied with bushing to take ⅜-inch dial hub $1.90

SPECIALS

Two coils for 4-tube Diamond. Cat. DP...$ .90
Three coils for 5-tube Diamond. Cat. DT..$1.35
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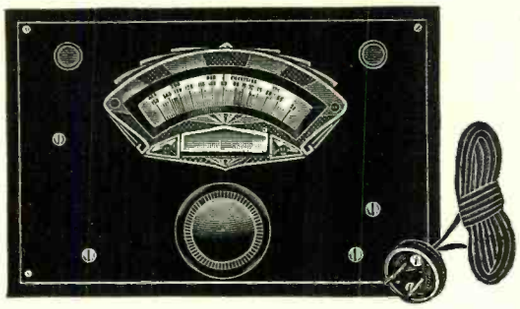
Two r-f coils and separate oscillator coil for Anderson's Auto Super. Cat. AUSU.....$1.45
Two r-f coils and separate oscillator for 175 kc. supers. Cat. 175-SU.....$1.45

Screen Grid Coil Co.

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

Choice of Shielded Test Oscillators



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

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

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

Average Accuracy 1% or Better

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

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

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

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

Get One of These Test Oscillators *Free!*

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

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

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

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

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

SHIELDED OSCILLATORS, $1 EXTRA

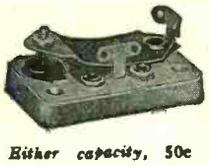
DIRECTIONS FOR USE

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

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

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

PADDING CONDENSERS



Either capacity, 50c

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

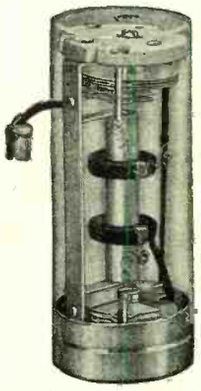
0.0005 HAMMARLUND S. F. L. at 98c.

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

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

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

NEW $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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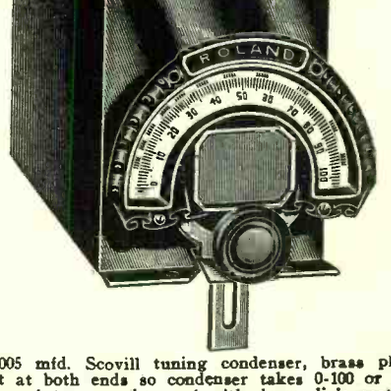

0.0005 mfd. Scovill tuning condenser, brass plates, shaft at both ends so condenser takes 0-100 or 100-0 dials and two can be used with drum dial; sectional shields built in, trimmers affixed; total enclosed in additional shield as illustrated. Access to trimmers with screwdriver. Side holes for bringing out leads to caps of screen grid tubes. Cat. SCSHC @....$1.98

Same as above, with ghost type dial (travelling light). Cat. SCSHC-DL @.....$2.25

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

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

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