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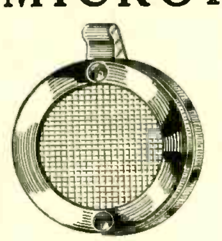

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TWELFTH YEAR

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THE 53 AS A MIXER

Identic Bias Circuit and One for Differing Biases

By Frederick C. Austrian

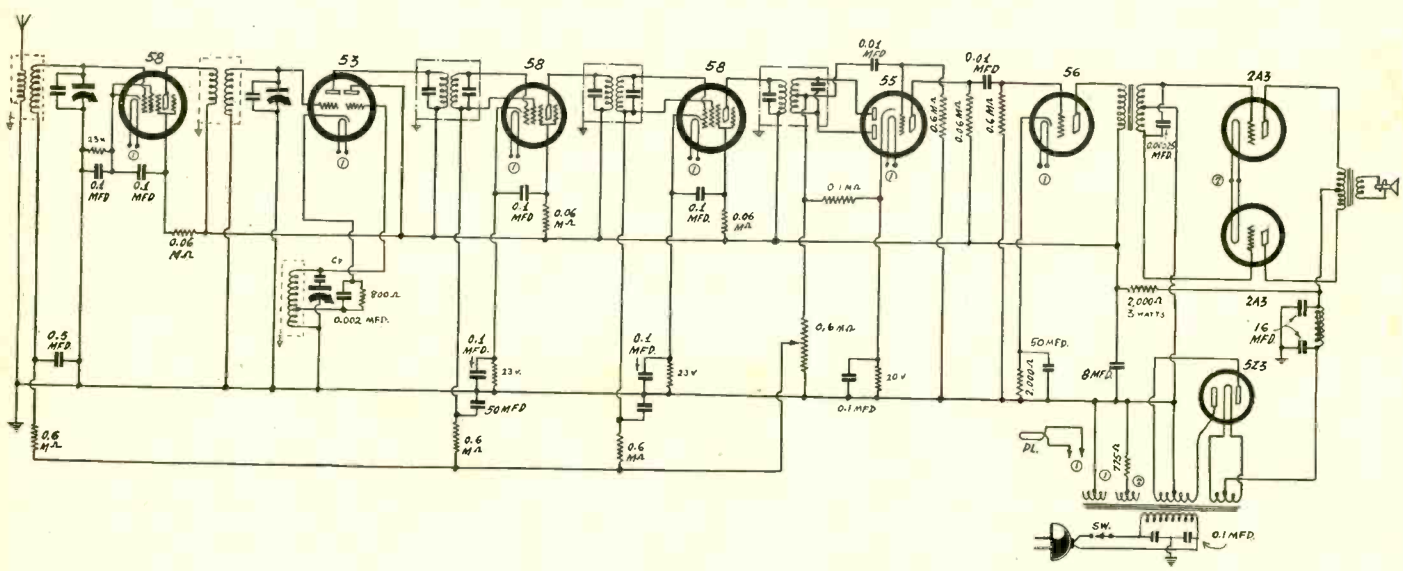


FIG. 1

The 53 is used as mixer in this circuit with the same bias voltage on both sections. An unusual type of manual volume control circuit is shown. The amount of a.v.c. depends rather on the setting of this control than on the carrier intensity, although, of course, the carrier amplitude has something to do with the amount of a.v.c.

THE simplest way to use the 53 as the mixer in a superheterodyne is that shown in Fig. 1. A single tapped winding constitutes the oscillator inductance and the coupling coil. The oscillator tuned circuit comprises the entire winding. The part of the winding between tap and ground serves the double function of feedback for the oscillator and coupling between modulator and oscillator. Both these tubes are in the one envelope in the case of the 53, and there is not enough coupling between the two units to produce signals in the broadcast band, so the external coupling is required.

The location of the tap is not critical, and coils that have so-called police-band taps may be used, except of course that the oscillator inductance is less than that of the two radio-frequency transformers above it. For 0.00035 mfd. the carrier frequency coils should have 250 microhenry secondaries, whereas for the oscillator the inductance and the padding condenser Cp depend on the intermediate frequency. For 175 kc the inductance may be 190 mch and Cp adjustable between 800 and 1,300 mmfd, whereas for 465 kc the inductance would be 126 mch and the padding capacity 350-450 mmfd.

Primaries of Coils

For the antenna coil the primary should be small, for the interstage coil rather large. For the primaries wound over secondaries, the antenna winding may be 20 turns and the other 35 to 40 turns. For No. 32 enamel wire on 1 inch diameter the winding data may be 130 turns for the large secondaries, 100 turns and 76 turns for the respective oscillator windings, tap about one-quarter the number of turns from the ground end.

The same bias is used for modulation and oscillation, but the value of biasing resistor may be raised beyond 800 ohms, as that is given only because the tube will oscillate infallibly. The detecting bias for this tube, other voltages standard, is 7.5 volts, and the amplification bias is 3 volts, but the conversion accomplished in a tube, while akin to detection, is not always best achieved with the detecting bias, so some medium bias may be used.

The circuit also has automatic volume control with a manual control not often

(*Continued on next page*)

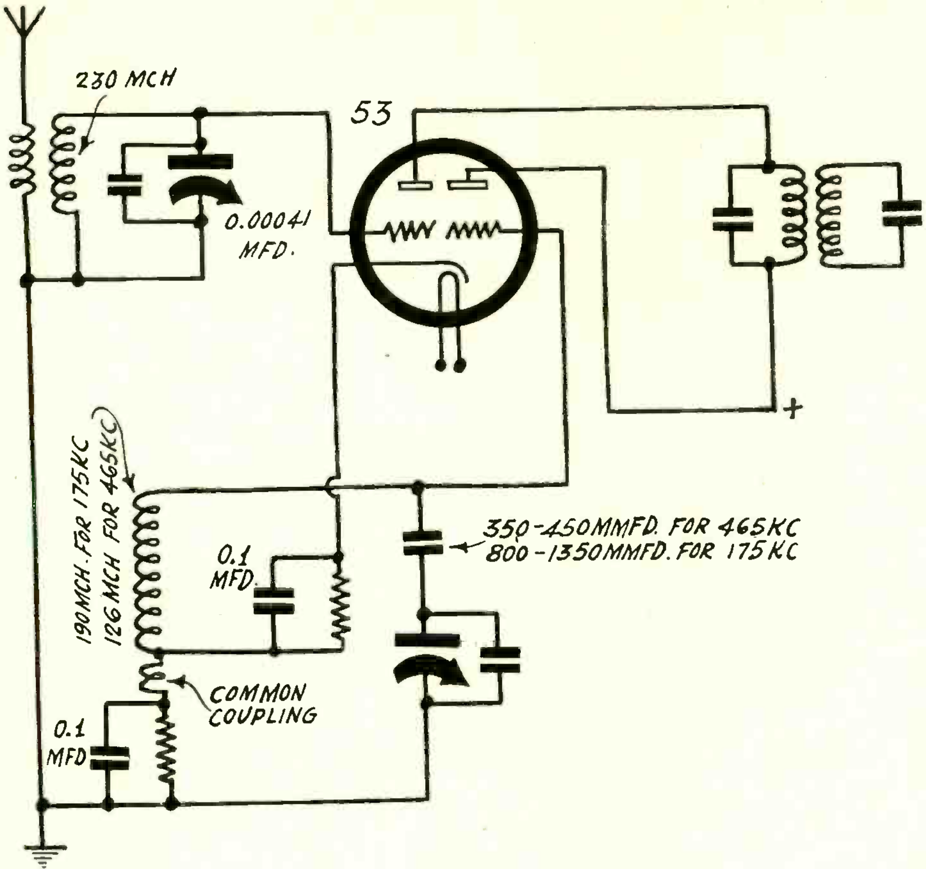


FIG. 2

In this circuit the two sections of the 53 are independently biased, and the voltages may be arranged to be 4.5 volts between ground and the cathode side of the lower resistor, and 3 volts between the upper end of the lower resistor and the cathode of the tube.

(*Continued from preceding page*)
shown. The controlled tubes have a voltage drop of 23 volts between cathode and ground at no signal, and the diode of the 55 has a voltage drop of 20 volts. Therefore the effective bias on the controlled tubes is the difference, or 3 volts, at no signal. If only a 3-volt drop took place in the cathode resistors of the controlled tubes, the grids at no signal would be 17 volts positive.

Slight Time Delay

The return of the controlled grids is made to the arm of a high resistance potentiometer, and 0.6 meg. is given as a minimum value. That is, the potentiometer should be of large resistance compared to the diode load resistor, as there is a voltage loss in proportion to this relationship. Thus, with the values on the diagram the automatic volume control is delayed one-sixth and the no-signal bias is really 2.5 volts instead of 3. Some time delay is tolerable in a highly-sensitive circuit.

As the arm of the volume control is slid upward, in respect to the diagram, more of the diode-rectified voltage is utilized, but the 55 bias overcomes this and though the rectified voltage is negative in respect to the cathode, the cathode is positive in respect to ground. So the bias is decreased and sensitivity increased as the arm is slid upward. The automatic volume control effect is reduced. That is, this is a form of manual control of a. v. c. dependent on the position of the control more than on the amplitude of the carrier.

No values are given for the resistors to develop the 23 and 20 volts, but these may be selected on the basis of no signal input, and will vary according to tube condition, voltage of line and power transformer, and even filter capacities used. The resistor to develop the 20 volts will be much larger than the ones for the 23 volts, and it may be expected that values of around 5,000 and 40,000 ohms may have to be selected.

If different biases are desired they may be obtained as shown in Fig. 2, where the grid of the modulator is returned to ground, thus introducing as bias the full voltage developed across the two resistors in the cathode leg, whereas the oscillator's grid is returned to a voltage 3 volts below cathode, if the sum of the two voltages is 7.5 volts. Thus, the drops in the two resistors would be: upper, 3 volts, lower, 4.5 volts.

The inductance for 0.00041 mfd. tuning at the signal level would be 230 microhenries, otherwise the coil data are the same for this circuit as for the previous one.

New Transformer Firm Enters Precision Field

I. A. Mitchell, chief design engineer and vice-president, S. L. Baraf, technical and sales director, and L. Goldstone, production manager, have organized the United Transformer Corp., with plant and offices at 264 Canal Street, N. Y. City. They were formerly with Kenyon Transformer Co.

The plant of the United Transformer Corp. is equipped with modern precision machinery and accurate tools and testing equipment for the manufacture of quality audio, filter and plate transformers, as well as voltage regulators for broadcast, television, public address, laboratory and industrial applications.

The engineers specialize in the design of audio transformers having a linear characteristic from 20 to 20,000 cycles. Special schematic circuits are available on Class A and Class B power amplifiers having power outputs from 5 to 200 watts.

Skinny Primaries Aid Wide Frequency Range, 539 to 1,780 Kilocycles

In any circuit where not much may be put into the detector without overload, the volume control should be ahead of the detector. In the circuit shown on page 5 the screen voltage on the 57 and 58 tubes was around 110 volts when the plate voltage applied was 250 volts. Due to the large drop in the plate load resistor in the 57 circuit, the effective screen voltage is higher than the effective plate voltage. This brings up again the question whether the effective or the applied voltages should be considered. From tests made with this receiver it is apparent that the applied voltages govern. Both sensitivity and tone were improved when the circuit was built as shown, instead of a high extra series resistor put between the 58 screen and the 57 screen.

Another interesting fact about the circuit was that, with 12-turn primaries wound over secondaries of 250 microhenries inductance (130 turns of No. 32 enamel wire on 1-inch diameter tubing in 2-inch diameter aluminum shield), the tuning was from 539 kc to 1,780 kc, quite a range. This was due largely to the small primaries, for they introduce a smaller distributed capacity, for the tuning condenser was of the usual commercial type, and did not achieve such a wide range when coils with larger primaries were used.

The speaker field may be 1,800 ohms to 2,500 ohms, the only difference being that the B voltage will be lower with the higher resistance. The field used had a resistance of 1,800 ohms, and the speaker itself was a dynamic with output transformer for self-biased 2A3 (2,500 ohms).

Six-Fold Increase in Tax Yield Laid to Upturn in Trade

Marked improvement in summer sales of radio compared to last year is shown by a Treasury Department report just issued. Internal Revenue collections during July, 1933, of the 5 per cent. excise tax on radio products and phonograph records amounted to $191,074.94, according to the official statement just released in Washington. This compares with excise tax collections of $32,848.50 from June 20th to July 31st, 1932, during the initial operation of the excise tax law.

July, 1933, tax collections on mechanical refrigerators were reported at $893,008.57 against only $27,611.65 in July, 1932.

A THOUGHT FOR THE WEEK

GEORGE M. COHAN has made good on the air; of that there isn't the slightest doubt. The wonder is that he had not displayed his entertaining qualities as a microphone showman years before. Those who handle the mail for the N. B. C. are amazed at the number of phone calls, wires and letters sent Mr. Cohan by his old and new friends. Here is a sample letter from an editor who had covered many of Mr. Cohan's play openings in former years:

"My dear George Cohan:

"Your last Sunday night air programme was splendid. All your old friends were hoping that you were still the George M. Cohan they had known so many years—and you did not disappoint us. You are still the master showman, and we are all proud of you.

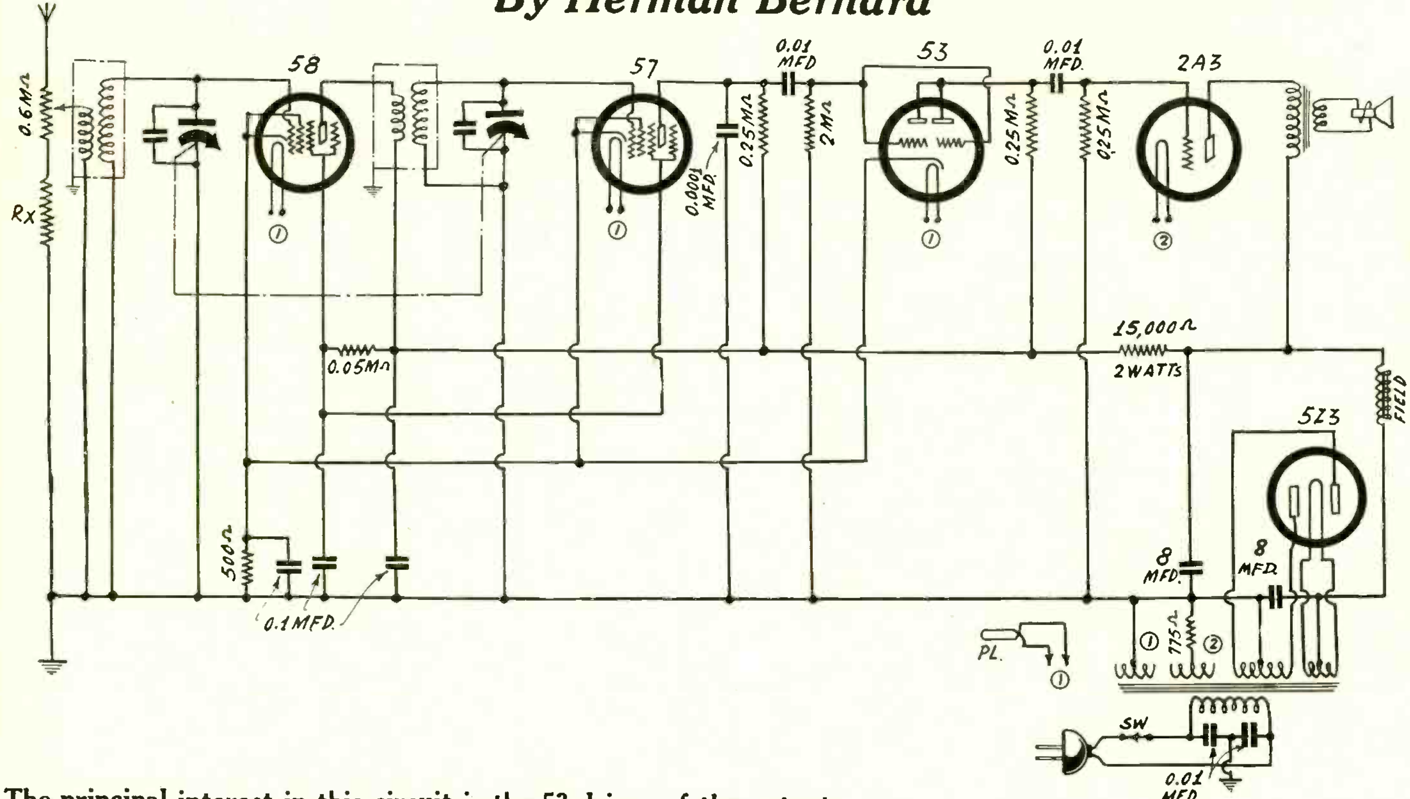
"Great good luck to you in your coming air appearances. Long may you wave!

"Sincerely yours,

("Signed) ...."

A 53 AUDIO DRIVER

By Herman Bernard



The principal interest in this circuit is the 53 driver of the output.

THE sensitivity of an audio amplifier is limited by the common impedances. When the amplification is pressed beyond the critical point there is an audio oscillation due to back coupling through these impedances. The gain in practical audio amplifiers therefore is nearly always under 1,000. This is particularly true if there is a series B choke of high resistance, as where the speaker field is used as the choke.

It naturally follows that though tubes of higher sensitivity may be developed, their use is always accompanied by certain safeguards against oscillation, and these safeguards amount substantially to limitation of the quantity of amplification or gain. So the circuit difference between a pentode output tube and a triode output tube would be principally the absence or presence of a driver. There should be less distortion with the triode.

Conditions develop in the use of new tubes that one learns only by experience. The static characteristics on which tube data are so largely based, and which form the groundwork of the preliminary information imparted concerning new tubes, do not go far enough.

No Results at First

Some experiments were conducted with the 53 tube for various uses, and so far the best results have been obtained simply by tying together two grids and separately tying together two plates, to form a relatively high mu-factor triode. The mu may be around 15 and the plate resistance high enough to support a resistive load.

Audio oscillation, or motorboating, prevailed when the tube was used with recommended constants. So the bias was made lower, the plate load resistor orthodox, and one of the audio grid leaks sharply lowered. Actually the one ahead of the 53 was 0.25 meg., with 2 meg. in the power tube circuit, but it is known from experience that the same result is effected by transposition, and so it is suggested the lower value grid leak be in the output tube circuit, to minimize the effect of any possible grid current there.

The circuit illustrated did not produce any results when the common cathode biasing resistor ahead of the power tube was 1,200 ohms and the resultant bias was 3 volts. Therefore the 500-ohm value was selected. But meanwhile there had been several minutes of perplexity, as there was nothing the matter with the circuit—except that it did not work. All tubes, voltages and currents checked O.K., etc., the usual story.

Audio Regeneration Helps

The circuit as a whole lends itself to all uses associated with weak signals, including, of course, short waves, in which instance, however, the detector tube would be made regenerative. In the broadcast range four local New York City stations load up the output tube and one overloads it, assuming volume control at position of maximum response. Since the detector tube has to be included in any consideration of an audio chain, very little need be put into the detector to get a great deal out of the power tube. And, of course, the 2A3 will handle quite a signal, around 40 volts rms.

It is plain there would not be enough gain if one depended on the tubes' mu-factor alone. The amplification due to the tubes and coupling media is never as much as the tubes' mu-factor, as there is no transformation ratio to step up the voltage. The gain would be less than that attributed to the mu-factor due to the tube's plate resistance being only a part of the total resistance in the plate circuit.

However, resistance coupling is nearly always accompanied by audio regeneration. This is not a predictable quantity, either, and so the extent of the effect has to be derived from experience. From the fact that one of the audio grid leaks is as low as 0.25 meg. it may be assumed that the feedback was intense, but even with such a low value there is enough feedback to cancel the need of a large bypass condenser across the power tube's biasing resistor.

Small Primaries

This regenerative effect upsets all calculations as to time constants in the audio circuits, required amounts of bypass capacities and some other considerations, and it is well to encounter considerable such feedback, for resistance-coupled audio would be quite insensitive without it.

The total circuit shown is indeed a simple one for reception of local stations, with good quality, the otherwise deficient selectivity being made up by using coils with small primaries.

The regenerative effect of the small primaries works in opposite directions in the two coils, as it increases the regenerative r-f effects as to the antenna coupler's primary, but reduces them as to the interstage coil's primary. Thus a situation otherwise perplexing is explained, in that the general assumption is that skinny primaries make for stability, no consideration being given to the effect of reduced antenna resistance when the primary in that circuit is small.

The circuit was so constructed that there was a little r-f feedback at the high frequencies and a little at the low frequencies, both correctible by slightly reducing the volume control below the position for maximum response.

More Stations This Way

This double situation proved that there was stray capacity back-coupling (high r-f oscillation) as well as stray inductive back-coupling (low r-f oscillation). With a little more filtering, for instance a bypassed r-f choke in the 58 plate lead, this feedback could be eliminated, but it is desirable to some to have a little assistance of this sort, as more stations are received.

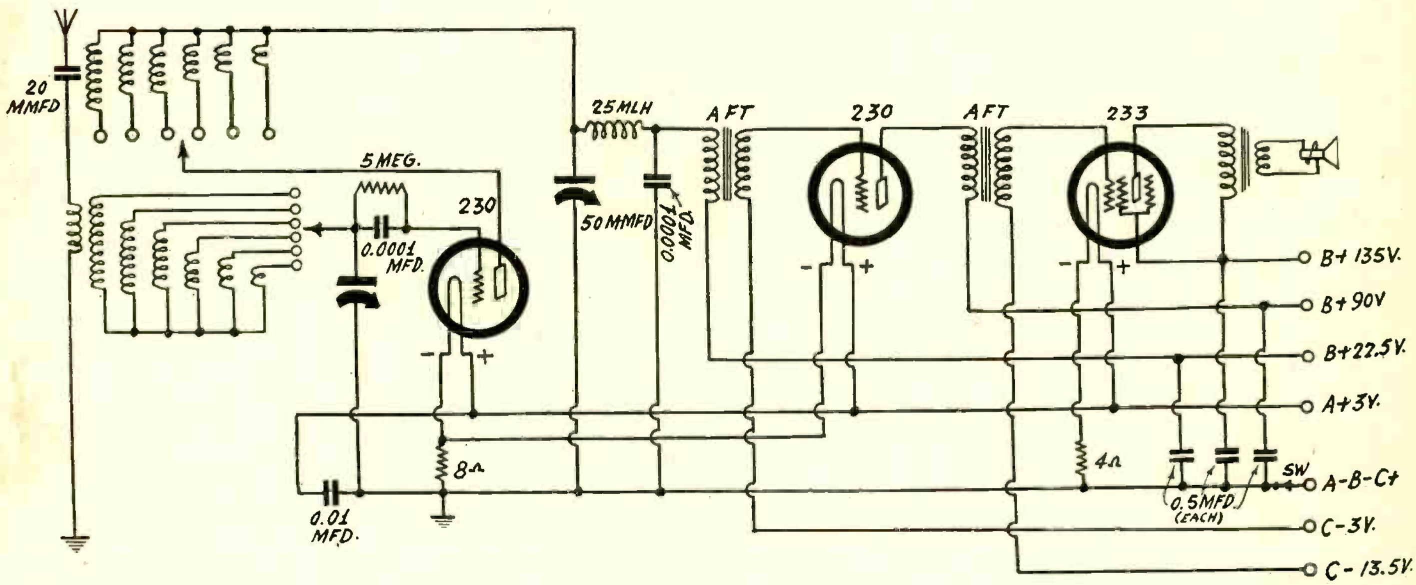
The volume control was a high-resistance potentiometer. This type usually has a taper so abrupt that the loudest local is made inaudible in this circuit when the control is turned only a few degrees. Therefore a series resistor is inserted, Rx, to bring up the response at the lowest-resistance setting of the potentiometer. The value of this resistor should be determined experimentally, but is not critical. For 600,000 ohms in the potentiometer it may be around 100,000 ohms.

Another point is that the inclusion of a substantial resistor in the Rx position renders the operation at the low-volume settings of the volume control free from any consequent reduction in selectivity.

PHONES OR SPEAKER

Served by These Short-Wave Sets

By Herman Bernard



A three-tube short-wave battery-operated set, using 2-volt tubes, and drawing little B current, around 22 milliamperes. A switch is used for band changing.

THE popular two-tube and three-tube short-wave battery sets, one for earphone, the other for speaker reception, are shown herewith as switch-operated. If the tuning condenser is small enough, say, 80 mmfd., then six coils will cover the short-wave band, and the spreadout will be pretty good, in fact, much better than that which results from the four-coil-larger-capacity system.

The antenna series capacity is made small purposely, so that regeneration will be present throughout the tuning scale, a purpose aided by a high value of leak, and so that the antenna may be switched through this condenser to the various coils. This would require simply connecting the ground side of the series condenser to the stator side of the grid leak, and omitting the primary, which is shown as a symbol in case anybody wants to use a primary. If such a primary is used it really should be repeated for each tuned coil, which is a job.

Good Switch Needed

It is all right to have to provide a tickler common to two coils, thus three ticklers, but many would prefer a separate tickler for each tuned secondary, because of the greater flexibility of adjustment to correspond to the 50 mmfd. feedback condenser.

The only rub is the switch, and the only good switch to come to the author's attention was one used in expensive set analyzers and made by a manufacturer of precision instruments. This has low capacity, also positive contacts at all points, infallibly and most agreeably, and, being of the wiping contact type, improves with use. Unless one goes in for a good switch he had much better adhere to plug-in coils.

A 2-to-1 tuning ratio would prevail, as outlined last week (issue of September 2d), and that is not at all bad.

The winding data for the coils, 80 mmfd. maximum capacity for tuning, form diameter 0.75 inch, are as follow:

Coil No.	Frequency Range Mgc.	Inductance	No. Turns	Winding Space
1	1.5 to 3	140.8	111; 32 en.	1"
2	3 to 6	35.2	58.2; 28 en.	1"
3	6 to 12	8.8	33.75; 18 en.	¾"
4	12 to 24	2.2	11.5; 18 en.	½"
5	24 to 48	0.56	4.8; 18 en.	¼"
6	48 to 96	0.14	2.2; 18 en.	⅛"

70-Mu Power Tube

The ratio of the audio transformers is not critical, as at least 3-to-1 would be used, though it is not especially good for the speaker set to go much beyond 5-to-1, as the quality then begins to decline. The speaker set uses a pentode output tube, the 233, which has a power output of 0.7 watt, which is enough for such a set. And besides the power output should not be confused with the sensitivity. The tube has a voltage amplification factor of 70.

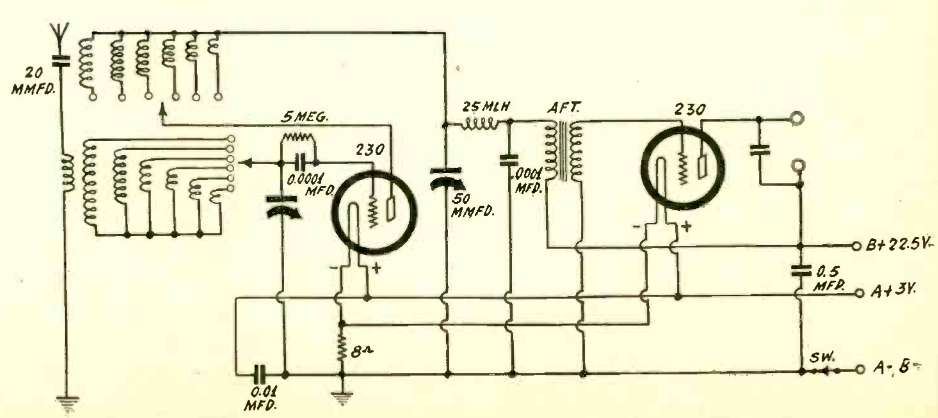
The speaker may be a dynamic, but if so would naturally be used with a storage battery, for field excitation, whereupon the resistors in the filament legs would be 32 ohms and 16 ohms, respectively, and the one in the earphone set 32 ohms.

However, for dry-cell operation a magnetic speaker may be used, and may be connected directly in the plate circuit, without filtered output or coupling transformer, provided its impedance is high enough (7,000 ohms), otherwise an output transformer would be used.

Transformer Selection

In selecting the transformer, the impedance ratio is that of 7,000 ohms to the actual impedance of your speaker. Most magnetic speakers have an impedance around 4,000 ohms, so the ratio would be 7,000 to 4,000 ohms, primary to secondary.

The earphone set has phones directly in the audio amplifier tube plate circuit, with any small condenser across the phones, 0.0001 mfd. to 0.001 mfd. If there is body capacity effect in handling the phones, put a 25-millihenry r-f choke coil in series with the plate lead to one phone connection.



The two-tube equivalent for earphone use.

CONSTANT OUTPUT

Tube Would Be Its Own A-V-C Supply

By W. J. Mellish

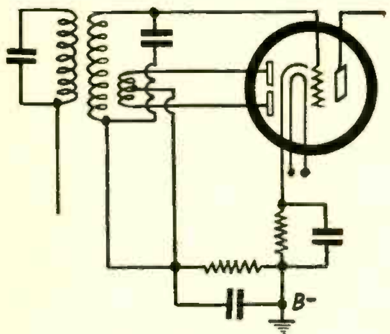


FIG. 1

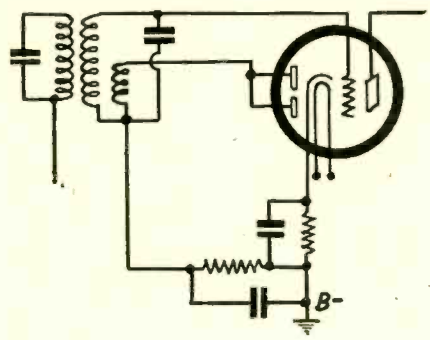


FIG. 2

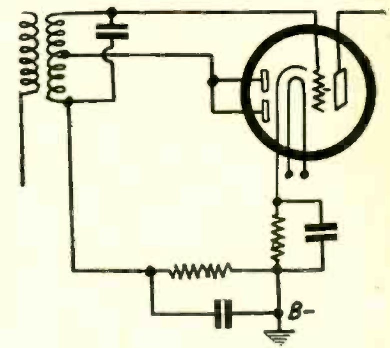


FIG. 3

SOME day there will be a constant-output tube. That is, the tube will be an amplifier and have in the envelope a rectifier that controls the amplifier, so that the output level remains the same despite carrier amplitude rise or fall. This is built-in automatic volume control. An approximation of this result mav be obtained with the present 55, which is one diode-and-amplifier tube that has a sufficiently extended cutoff to permit the method to work over large swings. There is no remote cutoff amplifier with diode.

Fig. 1 shows an intermediate transformer, coupled with which is an extra winding, which is center-tapped, to permit full-wave rectification in the diode. The extra winding feeds the load resistor, and the grid return of the amplifier is connected to the ungrounded end of this resistor. A small bias is supplied to the amplifier by the cathode-leg resistor, to prevent zero bias at no signal, or at zero radio-frequency voltage during any alternation. Fig. 2 shows the same condition, except that the rectifier is half-wave, hence the voltage across the load resistor (the augmentative bias voltage) is twice as great as in the previous example, other factors being equal.

Fig. 3 shows the use of a transformer with a center tap, or tap located off-center, but nearer to the return than to the grid, for half-wave rectification. If the tap is at center the voltage taken off may be too great, provided the tube is one of a chain at the same frequency.

The action in all instances is as follows: The carrier voltage is developed across the primary of a transformer and due to the inductive coupling is present, perhaps in amplified form, in the secondary.

Instead of grounding the secondary directly, which under these circumstances can not be done, a resistor is interposed. It is the same resistor that is the load on the rectifier. The extra coupling coil is in series with this resistor.

When the anode is positive in respect to the cathode, being made so by the signal, current flows through the rectifier. Thus in the half-wave rectifier, during the negative cycle there is no contribution of auxiliary bias by the device.

In the full-wave system there is always rectification, because one anode at a time is always positive, though at that same instant another anode is negative.

Hence the bias varies with the carrier. It also varies somewhat with the audio frequency, since the audio frequency is an amplitude modulation of the carrier.

The rectifier itself may be linear. Such a tube as the 55 may provide linearity, say, between 5 and 15 volts. If the cathode biasing resistor is such as to make the starting bias 5 volts, then the rectifier has to overcome 5 volts before rectification takes place.

Cities Will Have Vision Transmitters in Relay System, Says Hollis Baird

By Hollis Baird

Chief Engineer, Shortwave and Television Laboratory

Chain television is going to be one of the first requirements of commercial television, but the links in that chain need a wholly new method of interconnection, a method which challenges the skill of the engineer and fires the imagination of the man in the street who wants to know the "how" of things.

Tall buildings, high hills and great towers will be at a premium for television. Ultra-short waves will be used to get the space (or width) in the ether necessary for sending the fine details that will make up the home pictures of the future. As ultra-short waves have more the characteristics of light, they can easily penetrate darkness and fog, but solid objects rapidly weaken them. Thus, the visual horizon, from a given point, promises to be the range limit of an ultra-short wave station.

The television broadcaster will have a range for his main station, depending on how high he can get the transmitting antenna into the air; the higher its location, the broader the horizon and thus the greater distance the signal will travel satisfactorily. When radio became good entertainment it had to expand its field to meet the public demand. So will television. Present chain radio broadcasting is sent over telephone wires, but the voice requirements are only one four-hundredth of television requirements and no present telephone circuits, nor any that appear in the offing, will be able to carry the television signals.

A relay system is the solution. At the farthest visible point on the horizon from the main transmitter a receiving station will pick up the television signals and relay them to another similar station. This point-to-point transmitting is called "directional" and the action is repeated until the required distance is covered. When the signal reaches the city desired, it will be put out on a non-directional antenna and the program will then cover a circle some 30 miles in radius.

As an instance, a 200-mile airline between two cities would require five 1,000-watt relay stations 30 miles apart. Sending ultra-short waves out on a narrow focused beam requires but little power. This same signal to be clearly heard over a radius of 30 miles necessitates a transmitter as powerful as that now used for city radio broadcasting stations. This means that every sizable city in the country will eventually have its own powerful television station interconnected by relay stations to various key television stations from which the programs will eminate.

At first thought, the erecting of a sufficient number of powerful stations and small relay stations to provide nation-wide reception appears to be a herculean task but, as in radio, public needs are invariably met when the demands become great enough. Research and invention have a kindly way of meeting such requirements when they arise.

These stations, dotting the countryside, transmitting television from point to point, create an exciting picture of the not-too-distant future when skilled artists will appear in our homes over chain television systems.

Complete Tube Characteristics

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE ■	RATING: FILAMENT OR HEATER VOLTS	FILAMENT OR HEATER AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUPPLY VOLTS	GRID VOLTS ■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
RCA-1A6	PENTAGRID CONVERTER ¤	SMALL 6-PIN	FIG. 26	4 17/32" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	67.5	CONVERTER	180	−3.0 min.	67.5	2.4	1.3	500000	Anode-Grid (#2) 135 Max. Volts, 2.3 Ma. Oscillator Grid (#1) Resistor, 50000 Ohms. Conversion Conductance, 300 Micromhos.				C-1A6
RCA-2A3	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 5/8" x 2 1/16"	FILAMENT	2.5	2.5	250	—	CLASS A AMPLIFIER PUSH-PULL AMPLIFIER	250 300 300	−45 −62 −62	— Self-bias Fixed-bias	—	60.0 40.0 40.0	800 Power Output is for 2 tubes at stated load, plate-to-plate	5250	4.2	2500 5000 3000	3.5 10.0 15.0	C-2A3
RCA-2A5	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.0	C-2A5
RCA-2A6	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250✖	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			C-2A6
RCA-2A7	PENTAGRID CONVERTER ¤	SMALL 7-PIN	FIG. 20	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	100	CONVERTER	250	−3.0	100	2.2	3.5	360000	Anode Grid (#2) 200 Max. Volts, 4.0 Ma. Oscillator Grid (#1) Resistor, 50000 Ohms. Conversion Conductance, 520 Micromhos.				C-2A7
RCA-2B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 17/32" x 1 9/16"	HEATER	2.5	0.8	250	125	PENTODE UNIT AS R-F AMPLIFIER PENTODE UNIT AS A-F AMPLIFIER	100 250 250✝	−3.0 −3.0 −4.5	100 125 50	1.7 2.3 —	5.8 9.0 0.65	300000 650000 —	950 1125 —	285 730 —	— —	— —	C-2B7
RCA-6A4 also LA	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	4 11/16" x 1 13/16"	FILAMENT	6.3	0.3	180	180	CLASS A AMPLIFIER	100 180	−6.5 −12.0	100 180	1.6 3.9	9.0 22.0	83250 45500	1200 2200	100 100	11000 8000	0.31 1.40	C-6A4 also LA
RCA-6A7	PENTAGRID CONVERTER ¤	SMALL 7-PIN	FIG. 20	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	100	CONVERTER	250	−3.0	100	2.2	3.5	360000	Anode Grid (#2) 200 Max. Volts, 4.0 Ma. Oscillator Grid (#1) Resistor, 50000 Ohms. Conversion Conductance, 520 Micromhos.				C-6A7
RCA-6B7	DUPLEX-DIODE PENTODE	SMALL 7-PIN	FIG. 21	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	125	PENTODE UNIT AS R-F AMPLIFIER PENTODE UNIT AS A-F AMPLIFIER	100 250 250✝	−3.0 −3.0 −4.5	100 125 50	1.7 2.3 —	5.8 9.0 0.65	300000 650000 —	950 1125 —	285 730 —	— —	— —	C-6B7

¤Grids #3 and #5 are screen. Grid #4 is signal-input control-grid

✝Applied through plate coupling resistor of 200000 ohms.
✖Applied through plate coupling resistor of 250000 ohms.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD OHMS	POWER OUTPUT WATTS	TYPE
RCA-6F7	TRIODE-PENTODE	SMALL 7-PIN	FIG. 27	4 17/32" x 1 9/16"	HEATER	6.3	0.3	100 250	— 100	TRIODE UNIT AS AMPLIFIER PENTODE UNIT AS AMPLIFIER PENTODE UNIT AS MIXER	100 250 250	−3.0 −3.0 −10.0	— 100 100	— 1.5 0.6	3.5 6.5 2.8	17800 850000 Oscillator peak volts = 7.0. Conversion conductance = 300 micromhos.	450 1100	8 900	— —	— —	C-6F7
UX-200-A	DETECTOR TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	45	—	GRID LEAK DETECTOR	45	Grid Return to (−) Filament			1.5	30000	666	20	—	—	CX-300-A
RCA-01-A	DETECTOR★ AMPLIFIER	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −9.0	—	—	2.5 3.0	11000 10000	725 800	8.0 8.0	—	—	C-01-A
RCA-10	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	5 5/8" x 2 3/16"	FILAMENT	7.5	1.25	425	—	CLASS A AMPLIFIER	350 425	−31.0 −39.0	—	—	16.0 18.0	5150 5000	1550 1600	8.0 8.0	11000 10200	0.9 1.6	C-10
WD-11 WX-12	DETECTOR★ AMPLIFIER TRIODE	WD 4-PIN MEDIUM 4-PIN	FIG. 12 FIG. 1	4 1/8" x 1 3/16" 4 11/16" x 1 3/16"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −10.5	—	—	2.5 3.0	15500 15000	425 440	6.6 6.6	—	—	C-11 CX-12
UX-112-A	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−4.5 −13.5	—	—	5.0 7.7	5400 4700	1575 1800	8.5 8.5	—	—	CX-112-A
RCA-19	TWIN AMPLIFIER	SMALL 6-PIN	FIG. 25	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.26	135	—	CLASS B AMPLIFIER	135 135	0 −3.0	—	—	Power output value is for one tube at stated load, plate-to-plate.				10000 10000	2.1 1.9	C-19
UX-120	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/8" x 1 3/16"	D-C FILAMENT	3.3	0.132	135	—	CLASS A AMPLIFIER	90 135	−16.5 −22.5	—	—	3.0 6.5	8000 6300	415 525	3.3 3.3	9600 6500	0.045 0.110	CX-220
RCA-22	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 17/32" x 1 13/16"	D-C FILAMENT	3.3	0.132	135	67.5	SCREEN GRID R-F AMPLIFIER	135 135	−1.5 −1.5	45 67.5	0.6* 1.3*	1.7 3.7	725000 325000	375 500	270 160	—	—	C-22
RCA-24-A	R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 17/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER BIAS DETECTOR	180 250 275●	−3.0 −3.0 −5.0 approx.	90 90 20 to 45	1.7* 1.7* —	4.0 4.0 Plate current to be adjusted to 0.1 milliampere with no signal.	400000 600000	1000 1050	400 630	—	—	C-24-A
RCA-26	AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	FILAMENT	1.5	1.05	180	—	CLASS A AMPLIFIER	90 180	−7.0 −14.5	—	—	2.9 6.2	8900 7300	935 1150	8.3 8.3	—	—	C-26
RCA-27	DETECTOR★ AMPLIFIER TRIODE	MEDIUM 5-PIN	FIG. 8	4 11/16" x 1 13/16"	HEATER	2.5	1.75	275	—	CLASS A AMPLIFIER BIAS DETECTOR	135 250 250	−9.0 −21.0 −30.0	— —	— —	4.5 5.2 Plate current to be adjusted to 0.2 milliampere with no signal.	9000 9250	1000 975	9.0 9.0	—	—	C-27
RCA-30	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.06	180	—	CLASS A AMPLIFIER	90 135 180	−4.5 −9.0 −13.5	—	—	2.5 3.0 3.1	11000 10300 10300	850 900 900	9.3 9.3 9.3	—	—	C-30

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode. ●Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor. *Maximum.

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD OHMS	POWER OUTPUT WATTS	TYPE
RCA-31	POWER AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4 1/4" x 1 9/16"	D-C FILAMENT	2.0	0.13	180	—	CLASS A AMPLIFIER	135 180	−22.5 −30.0	—	—	8.0 12.3	4100 3600	925 1050	3.8 3.8	7000 5700	0.185 0.375	C-31
RCA-32	R-F AMPLIFIER TETRODE	MEDIUM 4-PIN	FIG. 4	5 17/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER BIAS DETECTOR	135 180 180♥	−3.0 −3.0 −6.0 approx.	67.5 67.5 67.5	0.4* 0.4* —	1.7 1.7 Plate current to be adjusted to 0.2 milliampere with no signal.	950000 1200000	640 650	610 780	—	—	C-32
RCA-33	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 6	4 11/16" x 1 13/16"	D-C FILAMENT	2.0	0.26	135	135	CLASS A AMPLIFIER	135	−13.5	135	3.0	14.5	50000	1450	70	7000	0.7	C-33
RCA-34	SUPER-CONTROL R-F AMPLIFIER PENTODE	MEDIUM 4-PIN	FIG. 4A	5 17/32" x 1 13/16"	D-C FILAMENT	2.0	0.06	180	67.5	SCREEN GRID R-F AMPLIFIER	135 180	−3.0 min.	67.5 67.5	1.0 1.0	2.8 2.8	600000 1000000	600 620	360 620	—	—	C-34
RCA-35	SUPER-CONTROL R-F AMPLIFIER TETRODE	MEDIUM 5-PIN	FIG. 9	5 17/32" x 1 13/16"	HEATER	2.5	1.75	275	90	SCREEN GRID R-F AMPLIFIER	180 250	−3.0 min.	90 90	2.5* 2.5*	6.3 6.5	300000 400000	1020 1050	305 420	—	—	C-35
RCA-36	R-F AMPLIFIER TETRODE	SMALL 5-PIN	FIG. 5	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER BIAS DETECTOR	100 180 250 100● 250●	−1.5 −3.0 −3.0 −5.0 −8.0	55 90 90 55 90	— — 1.7* —	1.8 3.1 3.2 Plate current to be adjusted to 0.1 milliampere with no signal.	550000 500000 550000	850 1050 1080	470 525 595	—	—	C-36
RCA-37	DETECTOR★ AMPLIFIER TRIODE	SMALL 5-PIN	FIG. 8	4 1/4" x 1 9/16"	HEATER	6.3	0.3	250	—	CLASS A AMPLIFIER BIAS DETECTOR	90 180 250 90 250	−6.0 −13.5 −18.0 −10.0 −28.0	— —	— —	2.5 4.3 7.5 Plate current to be adjusted to 0.2 milliampere with no signal.	11500 10200 8400	800 900 1100	9.2 9.2 9.2	—	—	C-37
RCA-38	POWER AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	250	CLASS A AMPLIFIER	100 180 250	−9.0 −18.0 −25.0	100 180 250	1.2 2.4 3.8	7.0 14.0 22.0	140000 110000 100000	875 1050 1200	120 120 120	15000 11600 10000	0.27 1.00 2.50	C-38
RCA-39-44	SUPER-CONTROL R-F AMPLIFIER PENTODE	SMALL 5-PIN	FIG. 9A	4 17/32" x 1 9/16"	HEATER	6.3	0.3	250	90	SCREEN GRID R-F AMPLIFIER	90 180 250	−3.0 min.	90 90 90	1.6 1.4 1.4	5.6 5.8 5.8	375000 750000 1000000	960 1000 1050	360 750 1050	—	—	C-39-44
UX-240	VOLTAGE AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	4 11/16" x 1 13/16"	D-C FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	135✖ 180✖	−1.5 −3.0	—	—	0.2 0.2	150000 150000	200 200	30 30	—	—	CX-340
RCA-41	POWER AMPLIFIER PENTODE	SMALL 6-PIN	FIG. 15A	4 1/4" x 1 9/16"	HEATER	6.3	0.4	250	250	CLASS A AMPLIFIER	100 180 250	−7.0 −13.5 −18.0	100 180 250	1.6 3.0 5.5	9.0 18.5 32.0	103500 81000 68000	1450 1850 2200	150 150 150	12000 9000 7600	0.33 1.50 3.40	C-41
RCA-42	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	4 11/16" x 1 13/16"	HEATER	6.3	0.7	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.5	34.0	100000	2200	220	7000	3.00	C-42

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
■Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.
●Applied through plate coupling resistor of 250000 ohms or 500-henry choke shunted by 0.25 megohm resistor.
♥Applied through plate coupling resistor of 100000 ohms.
✖Applied through plate coupling resistor of 250000 ohms.
*Maximum.

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS

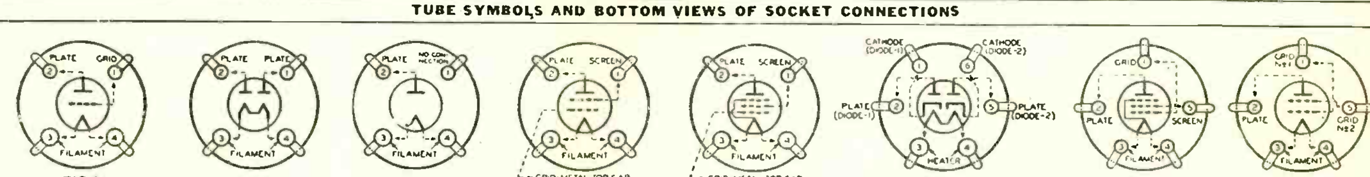


FIG.1 FIG.2 FIG.3 FIG.4 FIG.4A FIG.5 FIG.6 FIG.7

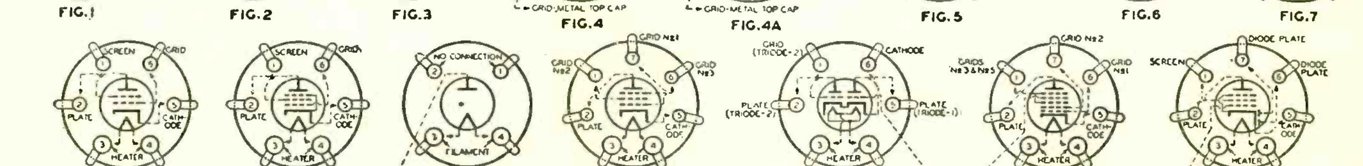


FIG.15 FIG.15A FIG.16 FIG.18 FIG.19 FIG.20 FIG.21

INDEX OF TYPES BY USE AND BY CATHODE VOLTAGE

CATHODE VOLTS	POWER AMPLIFIERS	VOLTAGE AMPLIFIERS Including Duplex-Diode Types	CONVERTERS IN SUPERHETERODYNES	DETECTORS	MIXER TUBES IN SUPERHETERODYNES	RECTIFIERS	CATHODE VOLTS
1.1	—	11, 12, 864	—	11, 12, 864	—	—	1.1
1.5	—	26	—	—	—	—	1.5
2.0	19, 31, 33, 49	30, 32, 34	1A6	30, 32	1A6, 34	—	2.0
2.5	2A3, 2A5, 45, 46, 47, 53, 59	2A6, 2B7, 24-A, 27, 35, 55, 56, 57, 58	2A7	2A6, 2B7, 24-A, 27, 55, 56, 57	2A7, 35, 58	82, 866 (C-366)	2.5
3.3	'20	22, '99	—	'99	—	—	3.3

Chart, with Socket Connections

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS MAXIMUM OVERALL LENGTH x DIAMETER	CATHODE TYPE■	RATING: FILAMENT OR HEATER VOLTS	RATING: FILAMENT OR HEATER AMPERES	RATING: PLATE MAX. VOLTS	RATING: SCREEN MAX. VOLTS	USE Values to right give operating conditions and characteristics for indicated typical use	PLATE SUP-PLY VOLTS	GRID VOLTS■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESIS-TANCE OHMS	MUTUAL CON-DUC-TANCE MICRO-MHOS	VOLT-AGE AMPLI-FICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUT-PUT WATTS	TYPE
RCA-43	POWER AMPLIFIER PENTODE	MEDIUM 6-PIN	FIG. 15A	$4\frac{11}{16}$" x $1\frac{13}{16}$"	HEATER	25.0	0.3	135	135	CLASS A AMPLIFIER	100 135	−15.0 −20.0	100 135	4.0 7.0	20.0 34.0	45000 35000	2000 2300	90 80	4500 4000	0.90 2.00	C-43
RCA-45	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	$4\frac{11}{16}$" x $1\frac{13}{16}$"	FILAMENT	2.5	1.5	275	—	CLASS A AMPLIFIER	180 250 275	−31.5 −50.0 −56.0	180 250 275	—	31.0 34.0 36.0	1650 1610 1700	2125 2175 2050	3.5 3.5 3.5	2700 3900 4600	0.82 1.60 2.00	C-45
RCA-46	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	$5\frac{5}{8}$" x $2\frac{1}{16}$"	FILAMENT	2.5	1.75	250	—	CLASS A AMPLIFIER □	250	−33.0	—	—	22.0	2380	2350	5.6	6400	1.25	C-46
								400	—	CLASS B AMPLIFIER ◊	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				5200 5800	16.0 20.0	
RCA-47	POWER AMPLIFIER PENTODE	MEDIUM 5-PIN	FIG. 8	$5\frac{5}{8}$" x $2\frac{1}{16}$"	FILAMENT	2.5	1.75	250	250	CLASS A AMPLIFIER	250	−16.5	250	6.0	31.0	60000	2500	150	7000	2.7	C-47
RCA-48	POWER AMPLIFIER TETRODE	MEDIUM 6-PIN	FIG. 15	$5\frac{5}{8}$" x $2\frac{1}{16}$"	D-C HEATER	30.0	0.4	125	100	CLASS A AMPLIFIER	95 125	−20.0 −22.5	95 100	9.0 9.0	47.0 50.0	10000 10000	2800 2800	28 28	2000 2000	1.6 2.5	C-48
RCA-49	DUAL-GRID POWER AMPLIFIER	MEDIUM 5-PIN	FIG. 7	$4\frac{11}{16}$" x $1\frac{13}{16}$"	D-C FILAMENT	2.0	0.120	135	—	CLASS A AMPLIFIER □	135	−20.0	—	—	5.7	4000	1125	4.5	11000	0.17	C-49
								180	—	CLASS B AMPLIFIER ◊	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				12000	3.5	
UX-250	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	$6\frac{1}{4}$" x $2\frac{11}{16}$"	FILAMENT	7.5	1.25	450	—	CLASS A AMPLIFIER	300 400 450	−54.0 −70.0 −84.0	—	—	35.0 55.0 55.0	2000 1800 1800	1900 2100 2100	3.8 3.8 3.8	4600 3670 4350	1.6 3.4 4.6	CX-350
RCA-53	TWIN-TRIODE AMPLIFIER	MEDIUM 7-PIN#	FIG. 24	$4\frac{11}{16}$" x $1\frac{13}{16}$"	HEATER	2.5	2.0	300	—	CLASS B AMPLIFIER	250 300	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				8000 10000	8.0 10.0	C-53
RCA-55	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	2.5	1.0	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	C-55
RCA-56	SUPER-TRIODE AMPLIFIER DETECTOR★	SMALL 5-PIN	FIG. 8	$4\frac{1}{4}$" x $1\frac{9}{16}$"	HEATER	2.5	1.0	250	—	CLASS A AMPLIFIER	250	−13.5	—	—	5.0	9500	1450	13.8	—	—	C-56
										BIAS DETECTOR	250	−20.0	—	—	Plate current to be adjusted to 0.2 milliampere with no signal.						
RCA-57	TRIPLE-GRID AMPLIFIER DETECTOR	SMALL 6-PIN	FIG. 11	$4\frac{15}{16}$" x $1\frac{9}{16}$"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0	100	0.5	2.0	exceeds 1.5 meg.	1225	exceeds 1500	—	—	C-57
										BIAS DETECTOR	250	−3.9	100	Cathode current 0.97 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**.				

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode. Requires different socket from small 7-pin. □Grid next to plate tied to plate. ◊Two grids tied together. **For grid of following tube.

TYPE	NAME	BASE	SOCKET CONNEC-TIONS	DIMENSIONS	CATHODE TYPE■	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	USE	PLATE SUPPLY VOLTS	GRID VOLTS■	SCREEN VOLTS	SCREEN MILLI-AMP.	PLATE MILLI-AMP.	A-C PLATE RESISTANCE OHMS	MUTUAL CONDUCTANCE MICROMHOS	VOLTAGE AMPLIFICATION FACTOR	LOAD FOR STATED POWER OUTPUT OHMS	POWER OUTPUT WATTS	TYPE
RCA-58	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	$4\frac{15}{16}$" x $1\frac{9}{16}$"	HEATER	2.5	1.0	250	100	SCREEN GRID R-F AMPLIFIER	250	−3.0 min.	100	2.0	8.2	800000	1600	1280	—	—	C-58
										MIXER IN SUPERHETERODYNE	250	−10.0	100	—	—	Oscillator peak volts = 7.0.					
RCA-59	TRIPLE-GRID POWER AMPLIFIER	MEDIUM 7-PIN#	FIG. 13	$5\frac{5}{8}$" x $2\frac{1}{16}$"	HEATER	2.5	2.0	250	—	AS TRIODE ¶ CLASS A AMPLIFIER	250	−28.0	—	—	26.0	2400	2600	6.0	5000	1.25	C-59
								250	250	AS PENTODE ** CLASS A AMPLIFIER	250	−18.0	250	9.0	35.0	40000	2500	100	6000	3.00	
								400	—	AS TRIODE ● CLASS B AMPLIFIER	300 400	0 0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				4600 6000	15.0 20.0	
RCA-71-A	POWER AMPLIFIER TRIODE	MEDIUM 4-PIN	FIG. 1	$4\frac{11}{16}$" x $1\frac{13}{16}$"	FILAMENT	5.0	0.25	180	—	CLASS A AMPLIFIER	90 180	−19.0 −43.0	—	—	10.0 20.0	2170 1750	1400 1700	3.0 3.0	3000 4800	0.125 0.790	C-71-A
RCA-75	DUPLEX-DIODE HIGH-MU TRIODE	SMALL 6-PIN	FIG. 13	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	250✖	−1.35	—	—	0.4	—	—	Gain per stage = 50-60			C-75
RCA-77	TRIPLE-GRID AMPLIFIER DETECTOR	SMALL 6-PIN	FIG. 11	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.3	250.	100	SCREEN GRID R-F AMPLIFIER	100 250	−1.5 −3.0	60 100	0.4 0.6	1.7 2.3	650000 1500000	1100 1250	715 1500	—	—	C-77
										BIAS DETECTOR	250	−1.95	50	Cathode current 0.65 ma.		—	Plate coupling resistor 250000 ohms. Grid coupling resistor 250000 ohms**.				
RCA-78	TRIPLE-GRID SUPER-CONTROL AMPLIFIER	SMALL 6-PIN	FIG. 11	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.3	250	125	SCREEN GRID R-F AMPLIFIER	90 180 250 250	−3.0 min.	90 75 100 125	1.5 1.0 2.0 3.0	5.4 4.0 7.0 10.5	315000 1000000 800000 600000	1275 1100 1450 1650	400 1100 1160 990	—	—	C-78
RCA-79	TWIN-TRIODE AMPLIFIER	SMALL 6-PIN	FIG. 19	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.6	250	—	CLASS B AMPLIFIER	180 250	0 0	—	—	Power output value is for one tube at stated load, plate-to-plate.				7000 14000	5.5 8.0	C-79
RCA-85	DUPLEX-DIODE TRIODE	SMALL 6-PIN	FIG. 13	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.3	250	—	TRIODE UNIT AS CLASS A AMPLIFIER	135 180 250	−10.5 −13.5 −20.0	—	—	3.7 6.0 8.0	11000 8500 7500	750 975 1100	8.3 8.3 8.3	25000 20000 20000	0.075 0.160 0.350	C-85
RCA-89	TRIPLE-GRID POWER AMPLIFIER	SMALL 6-PIN	FIG. 14	$4\frac{17}{32}$" x $1\frac{9}{16}$"	HEATER	6.3	0.4	250	250	AS TRIODE ¶ CLASS A AMPLIFIER	160 180 250	−20.0 −22.5 −31.0	—	—	17.0 20.0 32.0	3300 3000 2600	1425 1550 1800	4.7 4.7 4.7	7000 6500 5500	0.300 0.400 0.900	C-89
										AS PENTODE ** CLASS A AMPLIFIER	100 180 250	−10.0 −18.0 −25.0	100 180 250	1.6 3.0 5.5	9.5 20.0 32.0	104000 80000 70000	1200 1550 1800	125 125 125	10700 8000 6750	0.33 1.50 3.40	
										AS TRIODE ● CLASS B AMPLIFIER	180	0	—	—	Power output values are for 2 tubes at indicated plate-to-plate load.				13600 9400	2.50 3.50	
UV-199 UX-199	DETECTOR★ AMPLIFIER TRIODE	SMALL 4-NUB SMALL 4-PIN	FIG. 10 FIG. 1	$3\frac{1}{2}$" x $1\frac{1}{16}$" $4\frac{1}{8}$" x $1\frac{3}{16}$"	D-C FILAMENT	3.3	0.063	90	—	CLASS A AMPLIFIER	90	−4.5	—	—	2.5	15500	425	6.6	—	—	C-299 CX-299
RCA-864	AMPLIFIER TRIODE	SMALL 4-PIN	FIG. 1	4" x $1\frac{3}{16}$"	D-C FILAMENT	1.1	0.25	135	—	CLASS A AMPLIFIER	90 135	−4.5 −9.0	—	—	2.9 3.5	13500 12700	610 645	8.2 8.2	—	—	C-864

★For Grid-leak Detection—plate volts 45, grid return to + filament or to cathode.
■Either A. C. or D. C. may be used on filament or heater, except as specifically noted. For use of D. C. on A-C filament types, decrease stated grid volts by ½ (approx.) of filament voltage.
#Requires different socket from small 7-pin.
**Grid #1 is control grid. Grid #2 is screen. Grid #3 tied to cathode.
¶Grid #1 is control grid. Grids #2 and #3 tied to plate. ✖Applied through plate coupling resistor of 250000 ohms.
●Grids #1 and #2 connected together. Grid #3 tied to plate. **For grid of following tube.

RECTIFIERS

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	CATHODE TYPE	FIL. VOLTS	FIL. AMPERES	PLATE MAX. VOLTS	SCREEN MAX. VOLTS	RATINGS	TYPE
RCA-5Z3	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	$5\frac{5}{8}$" x $2\frac{1}{16}$"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 250 Milliamperes	C-5Z3
RCA-12Z3	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	$4\frac{1}{4}$" x $1\frac{9}{16}$"	HEATER	12.6	0.3	—	—	Maximum A-C Voltage per Plate 250 Volts, RMS Maximum D-C Output Current 60 Milliamperes	C-12Z3
RCA-25Z5	RECTIFIER-DOUBLER	SMALL 6-PIN	FIG. 5	$4\frac{1}{4}$" x $1\frac{9}{16}$"	HEATER	25.0	0.3	—	—	Maximum A-C Voltage per Plate 125 Volts, RMS Maximum D-C Output Current 100 Milliamperes	C-25Z5
RCA-1-v°	HALF-WAVE RECTIFIER	SMALL 4-PIN	FIG. 22	$4\frac{1}{4}$" x $1\frac{9}{16}$"	HEATER	6.3	0.3	—	—	Maximum A-C Voltage per Plate 350 Volts, RMS Maximum D-C Output Current 50 Milliamperes	C-1v°
RCA-80	FULL-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 2	$4\frac{11}{16}$" x $1\frac{13}{16}$"	FILAMENT	5.0	2.0	—	—	A-C Voltage per Plate (Volts RMS) 350 400 550 D-C Output Current (Maximum MA.) 125 110 135 The 550 volt rating applies to filter circuits having an input choke of at least 20 henries.	C-80
UX-281	HALF-WAVE RECTIFIER	MEDIUM 4-PIN	FIG. 3	$6\frac{1}{4}$" x $2\frac{7}{16}$"	FILAMENT	7.5	1.25	—	—	Maximum A-C Plate Voltage 700 Volts, RMS Maximum D-C Output Current 85 Milliamperes	CX-381
RCA-82	FULL-WAVE▶ RECTIFIER	MEDIUM 4-PIN	FIG. 2	$4\frac{11}{16}$" x $1\frac{13}{16}$"	FILAMENT	2.5	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 125 Milliamperes Maximum Peak Inverse Voltage 1400 Volts Maximum Peak Plate Current 400 Milliamperes	C-82
RCA-83	FULL-WAVE▶ RECTIFIER	MEDIUM 4-PIN	FIG. 2	$5\frac{5}{8}$" x $2\frac{1}{16}$"	FILAMENT	5.0	3.0	—	—	Maximum A-C Voltage per Plate 500 Volts, RMS Maximum D-C Output Current 250 Milliamperes Maximum Peak Inverse Voltage 1400 Volts Maximum Peak Plate Current 800 Milliamperes	C-83
RCA-84 also 6Z4	FULL-WAVE RECTIFIER	SMALL 5-PIN	FIG. 23	$4\frac{1}{4}$" x $1\frac{9}{16}$"	HEATER	6.3	0.5	—	—	Maximum A-C Voltage per Plate 225 Volts, RMS Maximum D-C Output Current 50 Milliamperes	C-84 also 6Z4
RCA-866	HALF-WAVE▶ RECTIFIER	MEDIUM 4-PIN	FIG. 16	$6\frac{3}{4}$" x $2\frac{7}{16}$"	FILAMENT	2.5	5.0	—	—	Maximum Peak Inverse Voltage 7500 Volts Maximum Peak Plate Current 0.6 Ampere	C-866 (CX-366)

▶Mercury Vapor Type. ° Interchangeable with type 1.

PHOTOTUBES

TYPE	NAME	BASE	SOCKET CONNECTIONS	DIMENSIONS	RATINGS	TYPE
RCA-868	PHOTOTUBE	SMALL 4-PIN	FIG. 28	$4\frac{1}{8}$" x $1\frac{9}{16}$"	Max. Anode Supply Voltage, 90 Volts. Max. Anode Current, 20 Microamperes. Static Sensitivity, 55 Microamperes per Lumen. Dynamic Sensitivity, 50 and 48 Microamperes per Lumen at 1000 and 5000 Cycles per second, respectively.	C-868

TUBE SYMBOLS AND BOTTOM VIEWS OF SOCKET CONNECTIONS

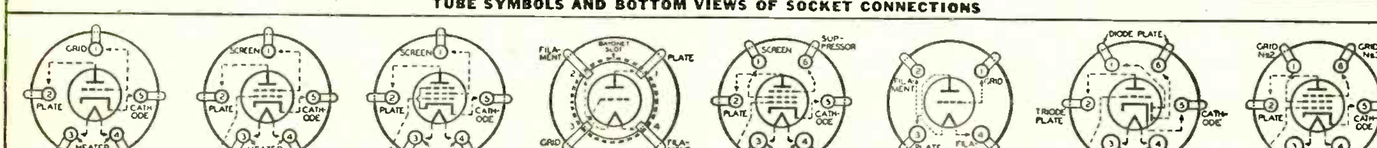


FIG.8 FIG.9 FIG.9A FIG.10 FIG.11 FIG.12 FIG.13 FIG.14

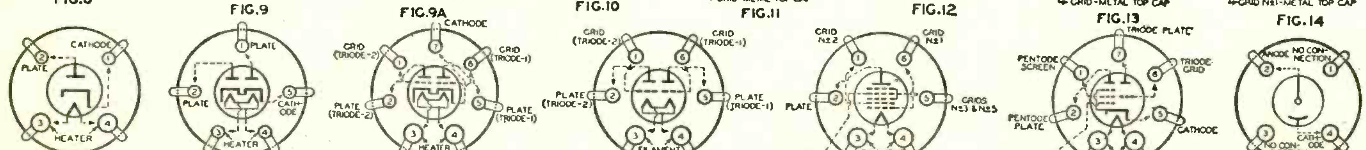


FIG.22 FIG.23 FIG.24 FIG.25 FIG.26 FIG.27 FIG.28

INDEX OF TYPES BY USE AND BY CATHODE VOLTAGE

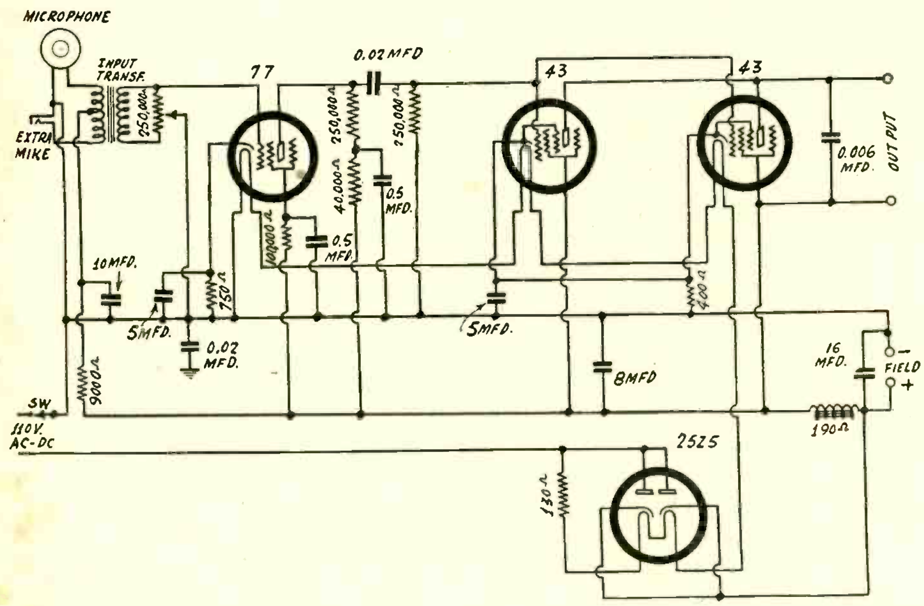
CATHODE VOLTS	POWER AMPLIFIERS	VOLTAGE AMPLIFIERS Including Duplex-Diode Types	CONVERTERS IN SUPERHETERODYNES	DETECTORS	MIXER TUBES IN SUPERHETERODYNES	RECTIFIERS	CATHODE VOLTS
5.0	112-A, 71-A	01-A, '40, 112-A	—	00-A, 01-A, '40, 112-A	—	5Z3, 80, 83	5.0
6.3	6A4, 38, 41, 42, 79, 89	6B7, 6F7, 36, 37, 39-44, 75, 77, 78, 85	6A7, 6F7	6B7, 6F7, 36, 37, 75, 77, 85	6A7, 6F7, 39-44, 78	1-v, 84	6.3
7.5	10, '50	—	—	—	—	'81	7.5
12.6	—	—	—	—	—	12Z3	12.6
25.0	43	—	—	—	—	25Z5	25.0
30.0	48	—	—	—	—	—	30.0

THE COMMUNICATOR

Improved by Slight Changes

By Robert G. Herzog, E.E.

Engineering Department, Thor Radio Co.



The constants have been changed in the Communicator to make the performance even better than before. The above diagram incorporates the changes, which are mentioned in the text. The 77 is a 6-pin tube, with overhead grid. Suppressor is tied to cathode for this circuit and the two are treated as one element.

LIST OF PARTS

Microphone input transformer.
250,000 ohm potentiometer with switch chassis.
Four sockets.
Dual 8 and 16 mfd. 175-volt electrolytic.
10 mfd. 25-volt electrolytic.
Three 5 mfd. 50-volt electrolytics.
Two .5 mfd. 100-volt electrolytics.
Two .02 foil condensers 200-volt.
.006 foil condenser 150-volt.
190-ohm B choke.
400-ohm 5-watt resistor.
9,000-ohm 1 watt.
750-ohm ½-watt.
40,000-ohm ½-watt.
250-000-ohm ½-watt.
250,000-ohm ½-watt.
100,000-ohm ½-watt.
Two pup jacks.
Cordohm.
Screen grid cap.
Cabinet.

ON a chassis only 4x4x4/3 inches, contained in a cabinet of 5x5½x9 inches over all, the Communicator, a four-tube amplifier with microphone input, was built by many, following the diagram published in the July 15th issue. Excellent success was reported by constructors, and they will be surprised to learn that results can be improved by introducing some changes derived from experience in the laboratory.

Before stating the changes it is well to give an idea of the Communicator to those not familiar with what it is. A 77 tube is used as first-stage audio amplifier, feeding two 43 tubes in parallel. The circuit has a 25Z5 rectifier, so may be used on alternating or direct current. Its purpose is to constitute an inter-office phone system and store window demonstrator. You speak into the microphone and you are heard clearly at a great distance. That is, your voice is given unusual carrying power, and the output that can be handled is approximately 2 watts, which is ample.

Changes Stated

The device is not only small in size but the parts cost little, and one may build it simply, or may obtain a factory-constructed model.

The screen voltage on the 77 has been decreased by using a series resistor of 100,000 ohms instead of 75,000 ohms, consistent with the now accepted practice of lowering the screen voltage in audio amplifiers and detectors for better clarity. Blocking is thereby avoided. Also, the negative bias on the output tubes is increased by using 400 ohms instead of 300 ohms as the biasing resistor. The gain in the 77 tube is ample to supply the modulation voltage to load up the output tubes.

There were a 100,000-ohm resistor and a condenser, used for hum-bucking, in the model previously described, but with direct grounding of the grid return of the output tubes this filter circuit is not needed. Moreover, the omission makes room for larger filter capacities for the biasing resistors, 5 mfd. being used instead of 2 mfd.

A heater resistor of 130 ohms may be omitted from the chassis by using a Cordohm, which is a cable with the proper resistance built into it.

Specialized Circuits

It is recommended that the circuit be built as shown, but as a hint to those who desire some specialized use it may be stated that the fundamental circuit lends itself to these individualized purposes. For instance, the circuit could be arranged for battery operation only, using the 12A5's instead of the 43's, or, for additional power, 48's may be substituted for 43's in the circuit as shown. For operation on direct current only (110-volt line) the 25Z5 may be omitted, and for operation on alternating current only the voltage doubler circuit may be used. This doubler circuit will be found in expositions of the use of the 25Z5 which, it is assumed, the reader has handy. The tube's uses were described in the February 4th issue of RADIO WORLD.

In all these instances few changes are necessary. Any desiring particularized uses along the lines indicated, or in other directions, and not feeling quite up to the problem of introducing them, may address questions to the author, care of RADIO WORLD.

Dual Opportunity

The Communicator should be regarded also as an opportunity for extra sales by service men and others, no less than as a means of personal use. Visitors to the store with which the author is connected have been struck by the Communicator's performance, especially in the light of the extremely compact size. Many hours of figuring and experimenting had to be spent before the desired result was compactly and efficiently achieved.

Generator Power Supply Useful on Sound Trucks

ROBERT G. HERZOG, E.E.

In equipping a sound truck it is often advantageous to obtain power supply from a separate storage battery. This ordinarily gives rise to the inconvenience of recharging this battery periodically. A spare battery is often necessitated to avoid interruption.

These inconveniences may easily be eliminated by mounting an additional generator and cutout in a convenient location at the front end of the motor. The generator should be so mounted that it may be driven by the fan belt, the length of which may be suitably increased. Such generators can be purchased from second hand dealers at low cost. Brackets are also obtainable for almost any make automobile.

Martini on Air Weekly in Full-Hour Program

Nino Martini, Columbia's tenor who was recently engaged by the Metropolitan Opera Company for lyric roles during the season of 1933-34, has just been signed for a new series of one-hour programs to be heard over a nationwide WABC-Columbia network every Sunday, beginning October 1st. These broadcasts, forming a new edition of the "Bath Club" Review Series, will be sponsored by the Corn Products Refining Company in the interests of Linit, and will be heard over a chain of more than fifty stations.

Radio University

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

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

Inductance

WILL YOU PLEASE give me a general idea of how inductance changes? I refer to radio-frequency solenoids.—P. O'L.

The inductance varies as the square of the number of turns, except for small changes in number of turns, when it varies directly according to the number of turns. The relationship of frequency and inductance is that the frequency is approximately proportionate to the inductance. The relationship of inductance for various bands, same variable tuning capacity, is that the inductance should be decreased for higher frequency bands by the reciprocal of the capacity ratio. If the capacity ratio is 3-to-1 the inductance for the next band is one-third of that for the present band.

* * *

Inductance is Length

WHAT IS inductance as a quantity? How does it differ from frequency as a quantity? Can one unit be capacity, inductance and resistance?—K. R.

Inductance is a unit of length. Frequency is a unit of time. In fact, frequency is the reciprocal of time. One unit is bound to be a combination of inductance, capacity and resistance. Whatever term predominates gives it its full classification. So, the same element may be an inductance at one frequency, a capacity at another and a resistance at another. At zero frequency a coil of 200 microhenries would be a resistance. At broadcast frequencies it would be an inductance. At ultra frequencies it might be a condenser. Whether the current or the voltage leads determines the classification as between capacity and inductance, whereas if the unit is overwhelmingly d-c resistance it is a resistor.

* * *

Matching Pickup

AS I HAVE a transformer that, I think, was intended originally for bell-ringing, I wonder if I might use it as a matching transformer? Its primary is 2 ohms, its secondary 25 ohms. I would want to work into a vacuum tube.—J. H.

No, this transformer can not be used. A 25-ohm impedance in the grid circuit of a vacuum tube at audio frequencies is practically a short circuit. Is it possible what you have given are the d-c resistances? One should really know the impedances instead. Matching transformers can be bought for less than a dollar these days and we suggest you get one of the proper value.

* * *

Regenerative Effect

IS IT POSSIBLE to estimate the effect of regeneration? I have been told that it increases the signal 1,000 times or so, but this seems to me an incredible figure for such a simple procedure.—K. Y. L.

The effect of regeneration varies greatly, especially as the variation is steep indeed just a bit to either side of critical value. However, measurements have been made, and has been found that in extreme instances the gain ascribable to the regenerating tube is 15,000, or around 4,000 times the gain without regeneration. The extreme instances may be accomplished by fine tuning of the receiver and just-right setting of the regeneration control. The gain, but not so much the selectivity, depends on the goodness of the coil and condenser. The coil should have low r-f resistance and the circuit losses throughout should be low. The ratio of inductance to capacity should be as high as practical.

* * *

The 57 as a Detector

WILL YOU PLEASE give me data on the operation of the 57 as a detector? I have read that the plate current should be adjusted to 0.1 milliampere.—K. L.

There are several methods of procedure, and adjustment of the plate current is one way. However, the tube is most sensitive at a lower bias than the 6 volts normally suggested, values between 3 and 4.5 volts being preferable. If not much is to be put into the tube the negative bias may be 3 volts, screen voltage 100 volts and plate voltage (with 0.25 meg. load) 250 volts. It is the most sensitive tube commonly used, since the gaseous 200-A has been virtually discarded as too noisy, and besides is a battery type, which should impair its popularity today, anyhow. It is interesting to note that wherever a 57 is used (except as oscillator) the 58 may be substituted with no circuit changes, although the sensitivity will not be as good.

* * *

Pickup Connections

DOES IT MAKE much difference how a phonograph pickup is connected in circuit? I have seen some circuits with pickup in the cathode leg, others with pickup in the grid circuit (across a resistor load already there), again in series with a radio-frequency coil feeding a detector, and have even seen it in the plate circuit. Which is best and what's the difference?—J. E. C.

Phonograph pickups of different types are made for different circuit connections. For instance, as a broad classification, there are low-impedance pickups and high-impedance pickups. The low-impedance ones usually require a matching transformer, so that they may be fed to the high impedance grid or plate circuit for best transfer of energy. With mismatched impedances there is too much loss. The matching transformer would have a primary equaling the impedance of the pickup, and a secondary of high impedance, matching but not necessarily equaling that of the grid or plate circuit. The plate circuit type really looks into a succeeding grid circuit, so may be regarded from the grid circuit viewpoint. The high impedance pickup may be put directly in the grid circuit, as across a leak or an audio transformer secondary, usually a switch serving to cut the pickup in or out. The pickup with high impedance may not be expected to have a sufficiently high impedance, but where cost or space is an item it dispenses with the transformer without serious loss. The grid circuit impedance is very large, and practical values exceed 200,000 ohms, so even a high impedance pickup could stand a matching transformer, as with transformers (no current) it is easy to achieve impedance values around 2,000,000 ohms, if necessary. Some grid circuits have as large an impedance as that and a transformer with such a secondary would work into such grid to advantage. Connection of the pickup in the cathode circuit is a makeshift simplification, as no gain is derived from the tube in whose cathode it is connected, since it is the same as a plate circuit connection, the cathode-to-ground circuit being principally in the plate circuit.

* * *

Different R-F Coils

DIFFERENT TYPES of antenna coils are shown from time to time, interstage coils likewise. I would like to know if the type that has an r-f choke as the primary load, with a few turns over the secondary used as a coupling capacity, is all right? What is the difference in performance?—R. B. M.

The various types of coils all serve their good purposes. Designers concoct or select such coils as meet the requirements of their

(*Continued on next page*)

(*Continued from preceding page*)

receivers. In general, the standard transformer will be found preferable, that is, primary wound over or adjacent to secondary. The special type with choke primary, and the turn or so over the secondary for capacity coupling effect, one end of this small winding open, is intended to bolster up the gain at the low radio frequencies. This it does well, but at the expense of gain at the higher frequencies, and also of selectivity. Where the circuit gains and selectivities permit, the special coils may be introduced to effect a leveling of the r-f amplification, otherwise the gain would be greater at the higher frequencies. In most receivers this rising characteristic is not atoned for, as the conservation of selectivity at the higher frequencies meets the sentiments of most designers.

* * *

Code on T-R-F Set

I HAVE a tuned radio frequency set, and yet I get some code where there should be none, in the middle or so of the broadcast band. If it were a super I could expect it, as I have been told about that, without understanding it, but in a t-r-f set I feel there is a mystery.—J. R. W.

Some few transmissions of code in the broadcast band are licensed and you may be receiving one of them. Another possibility is that some one sending code on a higher or lower frequency than the extremes of the broadcast band may have an extra receiver going that has a broadcast-band oscillator in it, and, unknown to him, the oscillator is being modulated by his dots and dashes. Another possibility is harmonics of low frquency code stations, due to impure wave form of transmitting carrier. The last-named is quite likely. The pickup of code in supers would be due to second or other harmonics of the oscillator beating with fundamentals (code carriers) that get by the radio-frequency tuner. Sometimes the code is at or near the intermediate frequency itself, and the little that gets by at the original frequency is amplified greatly in the i-f channel. The remedy for this would be to put a circuit across the primary of the antenna coil, resonating this circuit at the intermediate frequency, to trap out this direct interference.

Improvements Made in 38, 41, 42, 89 and 2A5 Allow Higher Grid Leak

Recently completed life tests have indicated that tube types 38, 41, 42, 89 and 2A5 will give satisfactory operation with a resistance of 1 meg. in series with the grid, and with 250 plate volts, provided the heater voltage does not rise more than 10 per cent. above the rated value under any conditions of operation.

This increase in the maximum permissible value of resistance in series with the grid of the 38, 41, 42, 89 and 2A5 is of particular interest to the set designer, since it makes possible the obtaining of higher amplification from the preceding tube, together with lower distortion and higher voltage output. This is especially true when the preceding tube is a pentode, a high-mu triode, or a diode, since each of these requires a load of 100,000 ohms or greater.

Heretofore it has not been possible to use high values of grid circuit resistance with the smaller output tubes having close spacing of their elements and comparatively large power output capabilities. Recent improvements in the design of the 38, 41, 42, 89 and 2A5 tubes have made it possible to use the grid resistance of 1 meg.

Stopping I-F Oscillation

AS A CUSTOM-SET builder my principal trouble is stopping intermediate amplifiers from oscillating, particularly two-stage amplifiers (three coils).—C. W. F.

Since the cathode circuit is common to grid, plate and screen circuits, as well as to suppressors, a high degree of filtration of the cathode helps a great deal. It is far more effective than merely using choke-condenser filters in individual plate leads. Use shielded wire on overhead grids and ground the sheath. In the absence of such wire, turn any fine wire back on itself for the length of the grid lead, and then wind over the grid lead from the grid end toward the coil, grounding the two fine wire terminals at the coil shield. A lug under the head of a machine screw will make a good soldering place. Then try large capacity across each individual biasing resistor, or, if there is a common resistor, a still larger capacity across that. A minimum value for each stage would be 0.5 mfd., and usually 1 mfd. is much more effective. If the foregoing reduces the oscillation greatly (as it will) but does not cure it completely (as it may not), determine which tube is oscillating, and filter each element (screen and plate, for instance) with a high inductance r-f choke and 0.1 mfd. condenser, as and if necessary, ground the suppressor of the tube. The general scheme of grounding all i-f suppressors may be resorted to if all other methods, including the foregoing, do not produce complete stabilization, but the selectivity is reduced a bit that way.

* * *

Form-Fitting Shields

RECENTLY I OBTAINED some of those form-fitting tube shields. I use shielded wires on control grid connections of screen grid tubes, and I find that there is oscillation with shielded wire grounded to chassis—L. W.

If oscillation is present when chassis-grounded shielded wire is used, ground the shielded wire to the tube shield instead, as with that type of shield the shield is connected to cathode through a flexible phospher bronze strip. The difference in r-f potential between cathode and chassis is sometimes enough to produce oscillation.

* * *

Push-Pull Resistance Audio

HAS PUSH-PULL resistance-coupled audio been reduced to practice yet, to the extent that it may be safely used and is easily duplicated in production? What methods are suggested?—J. W. C.

There has been considerable trouble with push-pull resistance-coupled audio in the past, but some advance has been made recently, using ideas that have been generally known for several years. A method that works well has been reduced to repeatable practice in our laboratories and will be disclosed next week, in a double-push-pull circuit, a pair of 58's (or a 53 used as two tubes) driving 2A3's. Other methods are under investigation and in following weeks it is expected some especially novel data will be presented, all within the classification of excellent performance.

* * *

53 Phase-Inverter

HOW DOES THE 53 work as a phase-inverter tube for push-pull resistance audio?—M. C.

Attempts we have made to get good results with this tube used in the manner you state have not been encouraging, and until a practical circuit is worked out we would not suggest that you use this type of phase inversion, unless your object is purely experimentation.

* * *

Transformer Out of 57

CAN A TRANSFORMER be used effectively with primary in the plate circuit of the 57 or 58, and if not, what do you suggest, as I have the transformer and the tube?—I. F.

No, the primary of the transformer is a part short circuit to the very high plate impedance. To use the part and tube you have, connect the plate and the screen together, put a resistive load on the plate circuit, around 50,000 ohms, and use a stopping condenser between plate of tube and plate terminal of primary. Connect return of primary to cathode. Primary inductance has to be very high.

Peck's New Television Light Source Increases Illumination 3,000 Times

6-Volt Auto Headlight Bulb Modulated by Secret Inexpensive Element

William Hoyt Peck, one of the nation's leading optical experts, who has been experimenting in the television field for the past several years, has perfected a method of using a 6-volt automobile headlight bulb as the source of illumination in casting a television image covering a screen 20 by 24 inches.

Mr. Peck, president of the Peck Television Corporation, New York City, has evolved a radically new type of reflector system which not only utilizes 83.33% of the light emitted by the bulb, but enables that light to be concentrated to a point no larger than the crater of a neon tube. This is the first time in the history of optics that such a feat has been accomplished.

3,000 Times as Much Light

In practical application, as tested with Weston photometric apparatus, the Peck reflector system gives slightly more than 3,000 times as much light as the best neon crater tube available. This means that bigger, brighter images can be had from a bulb costing only 10c and of nearly indefinite life.

Modulation is accomplished by means of a separate element, which Mr. Peck is unwilling to disclose at present. He did state, however, that his light modulator is not a tube, is unaffected by temperature or humidity, will never need replacement, contains no liquid, will operate on approximately 1/40 the power produced by an ordinary amplifier, and can be produced for less than $3 each in lots of 5,000.

This new apparatus has been designed by Mr. Peck for use in conjunction with his particular type of scanning disc, though it can be adapted to any mechanical system.

Transmitter Nearly Ready

The Peck disc, described in RADIO WORLD nearly a year ago, has been proven to transmit four times as much light as any other form of lens wheel, and sixty times as much as a pinhole disc. It consists of a six-inch wheel with a row of sixty reflecting lenses arranged in a circle on the face of the wheel near the periphery, instead of the usual spiral. Scanning is accomplished by tilting the lenses, each lens being angularly displaced from its next preceding lens by 25 minutes for sixty line scanning.

The system can be used equally well for 60, 120, 180 or 240 line scanning.

The same lens system as is used in the receiver can be employed for transmission, the only change necessary being the replacement of the light source with a photo-electric cell. This will enable stations to use direct pick-up, requiring no more light than is used for motion picture photography. Mr. Peck is now completing a transmitter of this type, and expects to give public demonstrations soon.

NEW BOARD OF WMCA HEADED BY AL SMITH

WMCA, New York City, 570 kc, full time, has been bought by the Federal Broadcasting Corporation, a new organization with wealthy young men behind it. Alfred E. Smith, former Governor of the State of New York, has been elected chairman of the board of directors.

While the admitted aim of the undertaking is to establish a chain, as its very name might imply, that accomplishment is regarded as being not imminent, because of the vast amount of preparatory work necessary. However, feelers are being sent out and, with Mr. Smith's name behind the enterprise, as well as the fortunes of the Ryans, Morrises and Whitneys, it is expected that the goal will be realized.

Offices and studios are at 1,697 Broadway, New York City, where the first meeting of the board, with Smith presiding, was held the other day.

Associates Listed

Among those actively associated with the enterprise are Clendenin J. Ryan, Jr., John Hay Whitney, Allan A. Ryan, Jr., A. Newbold Morris, John T. Adams, Howard G. Cushing, Maj. T. O. Freeman, Walter S. Mack, Jr., and Bethuel M. Webster, formerly counsel to the Federal Radio Commission.

A statement by Mr. Smith on the acceptance of the chairmanship follows:

"I believe that I can be of service to the public of New York through the medium of this station, which reflects the life, pulse and tempo of New York. The enthusiasm of the industrious young Americans who are members of the board leads me to believe that the station will serve its listening audience with programs of entertainment and education of the highest degree.

"The potentialities of radio and its intimate association with the home have raised it to institutional proportions with an opportunity for unlimited service to the public."

Would Be Fifth Network

Donald Flamm, the colorful Broadway figure who led the station's activities for the past several years, has returned to the theatrical field as a producer. He was the chief executive, to which position Mr. Adams succeeds.

In the new network it is intended to include only "first-class transmitters." If the venture materializes there will be five networks. The fundamental three are two of the National Broadcasting Company and one of the Columbia Broadcasting System. The fourth is the Amalgamated Broadcasting System, of which Ed Wynn is the head, and in which it is reported he has invested $250,000. This system is all set to go, and has important financial backing, as well as an existing station grouping. Edsel Ford and a large New York City bank are said to be interested. The opening date is to be announced soon.

Wynn is in Hollywood to make a moving picture. One script he discarded as inadequate and then he set out to find a new one, finally writing much of it himself.

Fernald Directs Sales of Kenyon Transformers

Paul R. Fernald, formerly one of the outstanding custom set builders, and later a successful sales executive, has been appointed director of sales by Kenyon Transformer Co., Inc., 122 Cypress Avenue, New York City.

Kenyon offers a complete line of power, audio and matching transformers, both of the commercial and precision types.

TERMS SOUGHT IN CLASSIFYING SHORT WAVES

There is as yet no general agreement on the classification of frequencies higher than the highest broadcast carrier, so committees of the Institute of Radio Engineers and Radio Manufacturers' Association, Inc., are attempting to reach a satisfactory basis of nomenclature. The American Standards Association also is interested.

One of the proposals under consideration is as follows:

200 to 10 meters—short waves.

10 meters to 1 meter—meter waves.

99.99 to 10 centimeters—decimeter waves.

9.99 centimeters to 1 centimeter—centimeter waves.

9.99 millimeters to 1 millimeter—millimeter waves.

At present the general reference to short waves is taken to include all waves below 200 meters, with the exception that below 10 meters the phrases ultra waves, quasi-optical waves and micro-waves are used. Some start the short-wave classification at 80 meters, calling the waves between 80 and 200 meters intermediate short waves.

The growth in the use of the lower waves, particularly below 10 meters, necessitates greater clarity of definition, and any agreement reached by the committees is expected to be acceptable to the science at large. Previous experience with standardization of terms indicates this. However, formal adoption usually does not take place until the memberships have had an opportunity to express opinions on the tentative proposals.

Station Sparks

By Alice Remsen

TALENT RIGHT AT OUR ELBOWS

The powers that be in radio are worrying over the lack of new talent. The chains have sent out frantic appeals to its affiliated stations for likely prospects. There's plenty of talent right in their own backyards if they'd only use commonsense. F'rinstance—from vaudeville they could gather Harland Dixon, Billy Glason, and Hal Neiman, all clever *ad lib* comedians. Then there is Sidney Teneyck, who drifted over to WCAU, Philadelphia, because he was not appreciated in New York, and Sidney was a lad with a brand-new style of humor. Then there is Maria Cardinale, who has been appearing on NBC morning programs, a soprano with a distinctive style of her own, which is rare in that type of voice, and plenty of ability. The Giersdorf Sisters are another good bet; they have looks, class and talent, and are real troupers. Ivy Scott, on the NBC regular staff, is a soprano who is also a good comedienne; plenty of experience and always does a good job; deserves a build-up. Then there also is little Jean Sothern, former picture star; this lass is chock-full of talent which could be used to good advantage if handed properly. Plenty more, too, with tricks and styles which sound a little different.

THE LISTENERS ARE THE JURY

After all, radio is for the listener only, and the listener judges only by what he hears; he doesn't care whether the singer is blonde, brunette or red-headed, fat or thin, old or young, just so long as the voice pleases; but the powers that be in radio don't figure that way; their first thought is: how much revenue can we derive from this person? Will he or she make a good appearance for vaudeville, pictures or what have you? And therein lies most of the trouble; of course, there are plenty of other angles, too; personal pull and politics play a great part in the radio game; radio executives have their favorites, which after all is just being human, but I do think that a little more real attention paid to talent already available would go a long way toward alleviating the so-called talent depression.

THE GROWTH OF ROMANCE

August 24th was the date on which Florence Golden and Don Becker, of WLW, were married, at St. Anthony's Church, in Forest Hills, Kentucky; I watched this romance grow; it was a very beautiful thing; these two young folks were head over heels in love with each other; there's nothing finer in the world; here's jolly good luck, Don and Florence! May you spend many happy years together. . . . The big noise of the week in radio around New York is the new broadcasting company which has been formed by a group of business men; they call themselves the Federal Radio Corporation, and have taken over WMCA, which they will operate on a big-time basis, linking up a chain in the near future; the young members of old New York families—such as the Thomas Fortune Ryans and the John Hay Whitneys—are at the head of the scheme; they are wise enough to place the managership of the new company into the hands of a real showman, Jack Adams, who knows his business and will no doubt make a success of it. . . . Rumor has it that Alex Gray will return to the air; he'll be welcome. . . . From the same source comes the news that Vera Van, petite blonde songstress, will replace Gertrude Niesen on that Thursday night Mark Warnow program over WABC. . . . Ex-Lax had an audition at Columbia last week; no less than nineteen female warblers and several bands were heard; Isham Jones and a well-known contralto made the grade for the final audition, but have not been signed up to the present writing. . . . They say that Alice Fay was pretty well cut up in that auto accident with Rudy Vallee; Miss Fay is still in the hospital as this is being written; Rudy was heard as usual on the Fleischmann program, but did not sound quite so blithe; give him credit for doing anything at all after a car turned turtle with him. . . .

SOME PRORAM CHANGES

Swift and Company's show will be on CBS instead of NBC, starting September 29th; Olson and Johnson will be starred; reason for the change given out as not enough outlets in territory required by Swift. . . . Another new program starts over NBC-WJZ network on September 7th, sponsored by the Borden Milk Company in the interests of Eagle Brand canned milk; Marcella Shields, Walter Scanlon and a piano duo will be featured, with a cooking talk by Jane Ellison. . . . Brad Brown and Al Lewellyn were in, but are out again, for the Household Finance Corporation on WOR; Macey and Smalley have taken over the program. . . . October 8th will find Angelo Patri back on the air again, via WABC for the Cream of Wheat Corporation; this time Mr. Patri will have a band and a comedy skit as added attractions and the bill will be for a half-hour, Sundays at 10:00 p.m., EST; it's a thirteen week contract. . . . Frank Novak, who rejoices in the distinction of being a one-man band, playing almost every instrument used in a dance orchestra, is doing a great deal of field work in the social end of radiodom; he has organized a bridge club at NBC and expects to arrange elimination games this winter in order to find a foursome to compete with other clubs; Frank opens on a three-a-week series for the Jello Company very shortly; the program will be called "The Wizard of Oz," and will contain original music written by Frank; a rather tall order, but he can do it; he is also putting out an illustrated child's book, as a give-away advertising tieup; a very clever lad, Frank. . . . Darrell Woodyard, formerly basso with the Cities Service Cavaliers, has been signed up with The Rondoliers; Darrell, by the way, is a fine-looking chap, happily married and the proud father of a two-year-old boy. . . . John Fogarty, that sweet-voiced Irish tenor, is playing some dates booked for him by Fanchon & Marco. . . . Mabel Jackson, well-known radio soprano, is combining business with pleasure, and is whiling away these hot days singing at the Hollywood Inn at Far Rockaway. . . . Harry Duke and his Georgians are doing some good work over WTNJ, Trenton, N. J., and WPEN, Philadelphia. . . .

DELPHINE MARCH DOING WELL

Delphine March did a grand job in the light opera "Olivette," recently, singing the title role over WABC; her lovely contrato voice is also heard to great advantage during that station's "Cathedral Hour." . . . The new series of "Evening in Paris" programs will open on September 11th with Agnes Moorehead in humorous episodes and Nat Shilkret's Orchestra; a fifteen minute program, Mondays, 9:15 p.m., EDST, on WABC and seventeen other stations. . . . Frederic William Wile starts his eleventh year on the air when he resumes his series of weekly talks over WABC on Saturday, September 16th, at 7:00 p.m. EDST. . . . Gertrude Niesen will be the featured soloist on the Johnny Green programs over WABC, Sunday nights at 8:30 p.m., EDST; Miss Niesen has a low contralto voice which comes over the air excellently. . . . Vera Van is another contralto on WABC who deserves mention, and, though it is not generally known, it was Tom Neeley, erstwhile of NBC's program department, who discovered Miss Van, when she first arrived from California. . . . Alexis Sanderson, WHOM program director, and also possessor of a fine voice, came back from his week-end vacation feeling a trifle out of sorts; too much home cooking, says Alex. . . . If you feel like warbling into a microphone just to prove that you can sing as well as this, that or the other crooner, take a trip up to the WHOM studios, Hotel President, on West 48th St., New York, some bright Saturday afternoon at 2:15 p.m. and you'll be given a chance, for WHOM is holding public auditions at that hour. . . . Harry Richman and Milton Berle have joined Fred Waring's Pennsylvanians, and may now be heard with that great musical aggregation each Wednesday, at 10:00 p.m. EDST, over WABC and network on the Old Gold program; of course, Richman sings and exchanges comedy banter back and forth with Berle. . . . The surprise of the week is the news that Barbara Maurel, CBS contralto, and Phil Whitten, of Station WINS, were secretly married to each other last March. . . . And now I think it's time to call it a day and trudge the highway to West 45th Street and the editorial sanctum.

WLW's 500 KW IN USE SOON

The gigantic undertaking of WLW, Cincinnati, in establishing a transmitter with an output of 500,000 watts, is slowly progressing, as careful tests are made of each new item of advance. It is expected the enormous power output will be ready for use in February or March, and the experiment then made as to whether such great power will constitute the station one of national coverage, that is, "a one-station network."

The field of such high-power transmission is virtually unexplored in this country, although there has been abundant experience in regard to 50,000 watts, compared for instance with 5,000 watts. The 50,000-watt stations are clear-channel occupants, while the 5,000-watt stations are regional.

Not all the higher-power experiments have been consistent with expectations although in general the service area has been increased and the quality as well. Listeners therefore await with especial interest the introduction of enormous power at WLW, an undertaking laden with expense, but one that promises rich returns if it works out satisfactorily. The station is owned by the Crosley Radio Corp.

MORE ECONOMICAL TUBES

Sometimes tubes usually used for automotive sets or for d-c are found in a-c sets, supplied by a power transformer. The main reason for this is economy of power consumption. The tubes, if run at 6.3 volts, 0.3 ampere, dissipate 1.89 watts in the heater, whereas the regular a-c type tubes, 2.5 volts at 1 ampere, dissipate 2.5 watts. Thus there is an economy of about 25 per cent.

A SUMMARY OF PROVISIONS IN INDUSTRY CODE

By HERMAN BERNARD

Inclusion of the radio industry under the Code of Fair Competition for the Electrical Manufacturing Industry, instead of under the separate Code offered by Radio Manufacturers Association, Inc., was an entirely salutary step, viewed from the public interest, because the RMA proposed Code was too stiff and discriminatory. It sought to legislate all the evils out of the radio industry, as such evils are considered to exist by the large set manufacturers, and was entirely too detailed and peremptory for a basic code. The general tenor of both Codes is about the same, being consistent with the National Recovery Act and the President's Re-Employment Agreement or so-called blanket Code.

Functionally radio must be classified under the electrical grouping anyway, and the Electrical Industry Code provides for subdivision for branches of that industry, where special problems may be solved as circumstances require, and even some provisions included later that are in contradiction of the present Code. Another point in favor of the action taken is that the Electrical Industry Code already had the approval of President Roosevelt, and thus long hearings and much delay were avoided.

Hours and Pay

Hours and pay provisions are practically the same in both Codes, safeguard of labor rights is the same, and the National Electrical Manufacturers Association becomes the official body to administer the Code. It is well equipped to do this work. It is older and on a more solid foundation than is the RMA.

The minimum age limit of employees under the Code is 16 years, the minimum pay for processing employees (factory help) is 40c an hour, except that if the pay on July 15th, 1929, was less, it may be that, but in no instance less than 32c per hour. The same rates apply no matter what the geographical location of the factory, except that other provisions may be made for special groups or branches of the industry later.

For salaried employees the minimum is $15 per week.

The exceptions to this pay scale are that office boys and girls and beginners and learners may be paid 80 per cent. of the basic rate, or not less than 25.6c per hour, and not less than $12 per week, and that commission salespeople are not subject to any pay minimum.

As to hours, these are 36 hours per week maximum for processing employees (factory help), all others 40 hours a week, exceptions being rush seasons and emergencies, but employers are required to report to the administrative agency when they exceed the maximum hours, and limitations are placed on such excesses.

Employers Must Report

Employers are required to report their costs, dollar volume of sales, quantity of sales, stock on hand, etc., so that the administrative agency will have complete and authentic information on which to base any revision of industry practices that experience may prove necessary.

As to prices, the general limitation is that the seller must not dispose of a product at less than its cost to him, exceptions being that close-outs or surpluses may be offered at such prices as will move them, provided permission is first obtained to do this, and also sales are permitted at less than cost if necessary to meet competition of equivalent products, if such authorization is contained in branch Codes for particular sections of the electrical industry, to be considered by the administrative body later on.

Prices and discounts are not fixed, but provisions looking toward the possible necessity of fixing them, to correct price evils, are included.

Manufacturing and distributing are to be classified as to present practices, so that if list prices and discount sheets prevail, or net prices, these may be continued in force. Employers are required to file their list prices and discounts, or net prices, if such are used, and to abide by them, not giving any customers more favorable terms of price, discount and payment than any other customers. Machinery for alterations of list prices is set up, so the employer has a free rein where he follows the custom of the branch of the industry under which he is classifiable.

However, should no custom prevail in any branch as to either list price and discount, or net price, the administration may institute either custom, and the employers would be required to file schedules under it and not sell at a greater discount or at a lower net price than scheduled by him.

TRADIOGRAMS

By J. Murray Barron

An unusual offering to the public of New York City and also the mail order buyers is the Pilot radio receiver sold by Thor's Bargain Basement, a 7-tube superheterodyne with tubes, cabinet and dynamic speaker, complete, ready for operation. These are the last of this model. There is also the K 136 short and long-wave receiver kit with cabinet, very popular with the home constructors.

* * *

West Side Y. M. C. A. Schools announced that the courses conducted at the Twenty-third Street Branch have been consolidated at 5 West 63rd Street, N. Y. City. L. A. Emerson, the director, will send full information.

* * *

An interesting and serviceable advertising novelty that should prove useful to the "ham" or short-wave enthusiast is being distributed free by Postal Radio Corp., 135 Liberty Street, N. Y. City. It is called Slide Commercial Calculator and acts as a slide rule.

* * *

It is well known that buyers in large department stores like to get window space for their merchandise and those who get the choice display room or frequent displays are considered fortunate. It should not be difficult for anyone to understand this for, after all, window space is naturally limited, and offerings displayed therein reflect the standards of the organization, so merchandise should be of the latest, something that is popular or in demand, appreciated, in other words, a good buy. With this thought in mind short-wave kits, converters and complete receivers must be gaining rapidly in popularity, for no less than five prominent retail radio stores in lower New York City have extensive window displays with a wide choice of short-wave outfits, ranging from a few dollars to $175. Even those in the lower-price range have testimonials as to their efficiency, and such a performance a few years ago would be considered impossible. Short-wave receivers and broadcasting have indeed made wonderful progress during the past two years, and with a like record in the near future it should be a comparatively easy task, with a good receiver, to bring in short-wave stations from all points of the globe.

* * *

Notwithstanding the great progress made in the radio industry and the highly developed receivers put out by the dozens of manufacturers, we find great numbers still using battery radio receivers. That this is fact can be testified to by one organization in New York City that sells considerable B battery eliminators by mail. While some are for use in connection with auto receivers, many are for farms that have 32-volt systems.

* * *

Looking over numerous radio organizations, both retail and mail order, we see a great desire to co-operate with the NRA. We should ever be on guard against what during the World War we termed the slacker. He is always with us. Today, while perhaps it is a little too early to judge entirely, as adjustments in radio Codes will be made, there are many who display the Blue Eagle but to whom it means nothing, for they have done nothing more than to paste the insignia on the window.

BERMAN 6 FT., 6 IN., 365 LBS.

Herbie Berman, bass fiddler of the Merry Madcaps, Norm Cloutier's dance orchestra which is heard over an NBC-WEAF network on Tuesday and Saturday afternoons from WTIC in Hartford, Conn. He stands six feet, six and a half inches and weighs 365 pounds. He has a tuba made especially large to conform to his dimensions.

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.*

Max Stein, 314 Madison Street, New York City.
John A. Smoot, 1454 Spring Road, N.W., Washington, D. C.
Ralph Williams, Box No. 27-G, Van, Texas.
N. H. Crouse, 1140 W. 37th Place, Los Angeles, Calif.
Craig Goodwin. New Hartford, Conn.
J. J. Black, 1773 Marks Ave., Akron, Ohio.
P. L. Antonich, 620 East Park Ave., Anaconda, Mont.
R. J. Stier. Fountain Square Hotel, Vine Street, bet. 4th & 5th, Cincinnati, Ohio.
C. H. Weant, 4306 Springwood Ave., Baltimore, Md.
Geo. A. Hadsell, Manager, The Radio Laboratory, Galion, Ohio.
Ralph B. Brehm, 92 Nutt Ave., Uniontown, Pa.
George I. Viall, Jr., 5 North Water St., Rochester, N. Y.
Hugo Menzel, Rte. 3, Box 804, San Jose, Calif.
Walter N. Brown, Jr., 15 Pembroke St., Garrett Park, Md.
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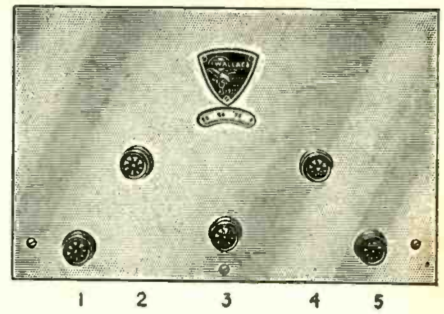
CORPORATION REPORTS

Sparks-Withington Company, report net loss for the year ended June 30, 1933, after depreciation, taxes and other charges, $285,137. Last year the net loss was $1,930,514. For six months ended June 30, 1933, net loss after above charges, $84,141; for the same period in 1932, $1,437,857.

Weston Electrical Instrument Corporation, for quarter ended June 30, 1933, net loss after taxes and charges, $31,888, compared with net loss of $47.298 in preceding quarter. Net loss for six months ended June 30, $79,186, after depreciation, taxes and other charges, compared with net loss of $99,454 for the first six months of 1932.

POWERTONE
WALLACE
Short Wave Receiver



Control No. 1—"On" and "Off" Switch.
Control No. 2—Band Spread Switch.
Control No. 3—Tuning Dial.
Control No. 4—Antenna Tuning Condenser.
Control No. 5—Regeneration Control.

Made By Powertone Electric Co. Exclusively

DESIGNED by Don C. Wallace, W6AM-W6ZZA, internationally known short wave expert and amateur. Under competitive tests he was able, when using this receiver, to hear more D.X. stations, and many which were entirely inaudible on any other. As a result he was awarded the "Hoover Cup" for premier short wave design and performance. The receiver is finely built of precision parts throughout. Proper circuit design and layout is the result of much painstaking labor. Each part has a definitely set purpose—and functions at peak efficiency at all times. Band spread tuning of the important amateur bands, 160, 80, 40, 20 meters, is controlled by means of a single panel switch.

The receiver, while fundamentally simple has been refined to the last degree. It produces an extremely high ratio of signal to noise. A control is provided for each important circuit, resulting in peak efficiency under all conditions. Heavily cadmium plated sub-base with black crackle metal front panel.

CIRCUIT:—

Ultra low-loss design to produce peak efficiency from aerial to headphones. A special system is used, which tunes the aerial circuit to the exact frequency of the sending station. Thus none of the energy is wasted, and at the same time considerable additional selectivity is obtained.

Special flat-wound silvered ribbon inductances are employed throughout, producing the highest possible circuit efficiency. A unique panel controlled inductance switching system suits the receiver to amateur "band spread" tuning or short wave listener requirements at will. Thus this receiver answers all short wave requirements.

Employs two 230 tubes. Requires two volts D. C. for filament operation, 45—90 volts of "B" battery.

FEATURES:—

*Band Spread and Continuous Tuning.
*Ultra Low-Loss Silver Ribbon Coils.
*A Control for Each Circuit.
*Tuned High Efficiency Antenna System.
*HAMMARLUND Dual Section Isolantite Tuning Condenser.
*Precision HAMMARLUND Tuning Dial.
*HAMMARLUND Regeneration Control.
*Highest Quality Audio Transformer.
*Precision HAMMARLUND R. F. Choke.
*Ultra Low-Loss HAMMARLUND Isolantite Sockets.
*Beautiful Black Crackle - Finished Panel.
*Rigid Steel Chassis.
*Equally Suited to Amateur or Short Wave Listener Uses.
*Precise Layout—The Result of Many Experiments.
*Zero Body Capacity.
*15 to 200 Meter Tuning Range.

No. 1 Coil:— 20- 32 Meters
No. 2 Coil:— 40- 60 Meters
No. 3 Coil:— 75-150 Meters
No. 4 Coil:—150-200 Meters

Price of complete kit of parts, including drilled panel and base, a choice of any one of the four plug-in coils and clear constructional blue print **$14.70**

Completely wired and tested .... **$3.23** extra

Each extra coil **$1.18**

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TWELFTH YEAR

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Practical Push-Pull Resistance Couplers

DIODE DETECTION, WITH BOTH THE REACTIVE AND NON-REACTIVE LINKS—THEORY OF DIRECT-COUPLED SYMMETRICAL CIRCUITS

By Herman Bernard

PUSH-PULL resistance-coupled audio is one of the several topics in radio concerning which theoretical aspects have been treated over a period of years, with some reduction to practice, but without the production of any circuit regarded as standard, or, indeed, any circuit which is used much at all. There are practically no receivers with such a circuit. Yet, like television, ultra-wave DX and other topics in the same hopeful class, the push-pull resistance coupler is bound to arrive at a commercially practical stage. Besides, it gives experimenters meanwhile an opportunity to pursue a hobby that offers interesting possibilities.

Push-pull resistance-coupled audio, as considered in this text, relates to the development of the push-pull circuit without the introduction of an input transformer. It is familiar practice to have a push-pull input transformer working out of a normal detector and have the succeeding stages push-pull resistance-coupled, but such a circuit is not considered within the true category because the use of resistance coupling should be exclusive.

Omission of Stopping Condensers

Besides the foregoing considerations, one might bear in mind that true push-pull resistance coupling may be developed in leak-condenser coupling hookups, which are reactive, or in circuits that omit the stopping condensers, and are called non-reactive. The term non-reactive means, in effect, equality of amplification for all audio frequencies, which is true when a load is a pure resistance.

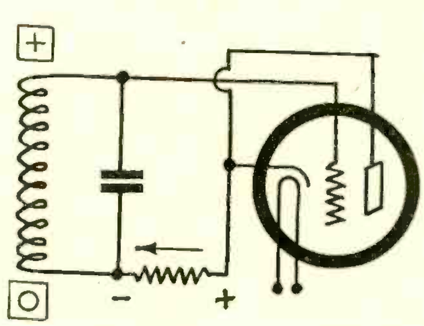


FIG. 1
The 56 used as a diode will stand 40 volts rms input. Diagram shows anode positive to a-c (sign in square), while direction of d-c current flow and d-c polarities of load resistor are designated.

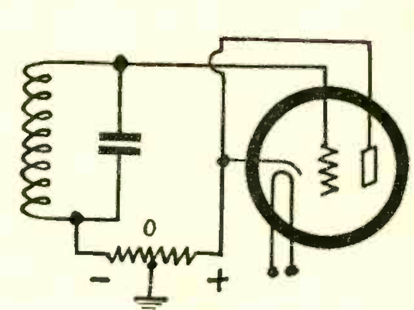


FIG. 2
The direct current through the load resistor is pulsating, so if the center of the resistor is taken as the reference point, at any instant the extremes have equal but opposite signs.

In actual practice true non-reaction is hardly possible, as effects are to be expected from unavoidable capacities, including even the elemental capacities of tubes used, capacity between wire connectors and capacity to metal chassis. These capacities, though small in quantity, are large in effect because of shunting of high tube or load impedances by small condensers. Nevertheless a circuit will be considered non-reactive if it omits the stopping condensers.

To realize the problem of push-pull resistance coupling we must understand the rectification fundamental. A typical rectifier is shown in Fig. 1, consisting of a 56 tube used as diode, plate tied to cathode, this combination constituting the operating cathode, while the element that otherwise would be grid is the operating anode. The object of the rectifier is to

(*Continued on next page*)

These Four Circuits Work All Right

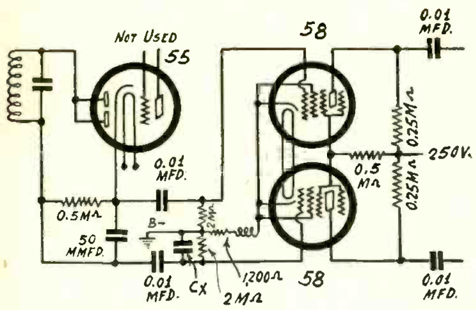


FIG. 3
This is a practical push-pull resistance-coupled circuit, using stopping condensers and grid leaks. The center of the load resistor may be grounded, if desired, but it is not strictly necessary, due to the subsequent leaks as parallel resistors with grounded center, the effect on the signal division being reflected back. Stopping condensers and grid leaks are used. This is a reactive circuit, that is, frequency affects the amount of gain somewhat. The 58's will drive 2A3 output tubes.

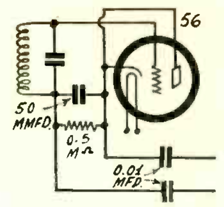


FIG. 4
The 56 used as a diode, with plate tied to cathode to constitute the operating cathode, and otherwise grid is anode.

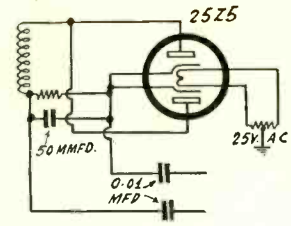


FIG. 5
The 25Z5 used as a half-wave rectifier. This tube requires a 25-volt feed to the heater. The 50 mmfd. condenser across the load resistor may not be necessary here or in Figs. 3 and 4.

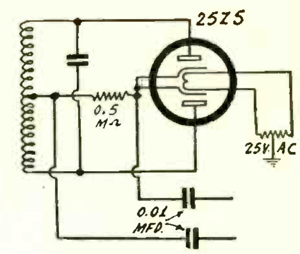


FIG. 6
Here full-wave detection, using the 25Z5, is illustrated, the circuit after the stopping condensers again being as in Fig. 3. By the full-wave method only half the voltage is achieved as by the half-wave rectifier.

(*Continued from preceding page*)
produce a direct-current output from an alternating-current input. The alternating current in this instance is radio frequency and in this sense all frequencies from the highest used in carrier radiation, to 20 kc, may be considered as radio frequencies.

Rectification Requisites

The alternating voltage in the primary of the transformer develops a voltage across the secondary. We are interested only in voltage except in power output tubes. Since it is alternating, no point along the secondary ever remains at any given voltage, but there is a fluctuation, measured in multiple cycles per second. During each cycle the voltage rises twice to maximum and falls twice to zero. The two maxima, however, are oppositely polarized during any cycle. Zero naturally is the same for both, being an identical quantity. Therefore the upper end of the coil will be negative maximum and positive maximum once each cycle.

The following are requisites for rectification: (1), an alternating-voltage input; (2), a positive anode; (3), a device capable of rectification; (4), a continuous direct-current path. Besides there must be a load to render practical the utilization of the rectification.

We have the a.c. The positive anode occurs once in each cycle, so we have that. The tube will rectify. A continuous current path is provided because the tube impedance is low, sufficient direct current can flow through it, and there is no discontinuity in any part of the external circuit. A load resistor is provided.

Half-wave Type

The rectifier in Fig. 1 is of the half-wave type, because rectification takes place only when the anode is positive, and it is positive only during half the wave period. On the diagram the alternating current signs are in squares, and the anode is shown as positive, bottom end of coil as zero, both a-c values.

The positive a-c sign does not represent a constant value of voltage, but during the alternation when the anode is positive it is so by the effective quantity of a-c voltage. This is obtained by taking the square root of the sum of the squares of the positive voltages during the alternation and is the familiar root-meant-square voltage (rms.).

Now that we have accomplished rectification we have to consider the flow of the new current, which is direct current. There may be residual fluctuation in the d-c, but a condenser will remove it. Although a-c flows in two directions, d-c flows in only one direction. That is, d-c does not reverse itself.

Direction of Flow

The direction of current flow in an external circuit of a rectifier is from cathode to anode and takes place only when the a-c is at a positive value on the anode. The signs ascribed to this direction are inherited from the earlier and erroneous theory of electricity, but because embedded in the recorded science, are still retained. We say therefore that in the external circuit the current flows from plus to minus. Inside the rectifier it flows from minus to plus, for that is in reality the same direction.

Take a clock as example, turn the hour hand through 360 degrees, starting at 9. The rotation is from left to right, until 3 is reached, when the direction is from right to left, and yet there has been only one actual direction, that of clockwise. The wheels of an automobile are always turning in the same direction at the same time, though by applying some other test, as left-and-right based on an arbitrary zero line, the same anomaly exists as in the case of direction of current flow in a rectifier and its external circuit.

Action During Positive Cycle

Taking the two extreme instances in the rectifier, when anode is positive and when it is negative, we know that rectification takes place only when the a-c voltage on the anode is positive, whereupon d-c flows in a known direction, but what happens when the anode is negative? Since no rectification takes place, nothing happens. The circuit is dead on the negative a-c alternation, just as if the rectifier tube were removed from its socket during each negative excursion of the carrier.

Broadly, there are two frequencies to consider, the radio-frequency carrier and the modulation of that carrier by the signal, hence the object of the form of rectification used on the carrier, called detection, is to eliminate the carrier and leave only the modulation or signal. When signal is referred to, audio frequencies are meant. When carrier is referred to, radio frequencies are meant. The fact that the modulation is impressed on the carrier need not prove confusing, since the effect is to change the frequency or amplitude of the carrier, which is a radio frequency, even though the rate of change may be at an audio frequency. At least the carrier, modulated or not, is inaudible. The detected component of a modulated carrier is audible to a suitable load.

Signs of the Circuits

The two signs for alternating current and the two for direct current in Fig. 1 have no intrinsic relationship whatever. For instance, the zero point for a-c at a given instant when there is rectification is the same point as negative of the rectifier. The secondary is a short circuit to d-c, therefore the point marked positive for radio frequencies (denoted by sign in square) is negative for audio frequencies, being the same for d-c at one end of the coil as at the other. The d-c signs are not circumscribed. They denote the polarities during rectification. The arrow shows the direction of d-c flow.

How far have we progressed toward push-pull resistance coupling? We have reduced a carrier to direct current and have a permanent d-c positive sign at one end of the load resistor and a permanent negative sign at the other end of the load resistor, for all purposes during full-wave or half-wave rectification, and permanent zero signs during non-rectification.

An Author's Contention

We have considered direct current, but not in its true light as existing in the circuit for detection of broadcasts. It is true that the current is unidirectional, but it is also true that direct current may be continuous or discontinuous. We found discontinuity during the alternation when

Two of These Are Duds and Two Ace-High

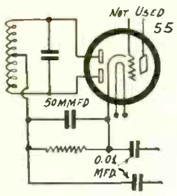


FIG. 7
Full-wave detection, using the 55. The triode elements can not be used, as there is no suitable method of making the B voltage effective without unbalancing the circuit.

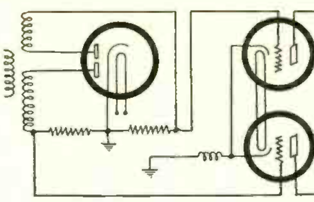


FIG. 8
Considering the omission of stopping condensers as constituting non-reactive coupling, a circuit like this might represent a first attempt. Either the driven tubes have simultaneously negative grids or alternately negative grids, neither instance representing symmetry.

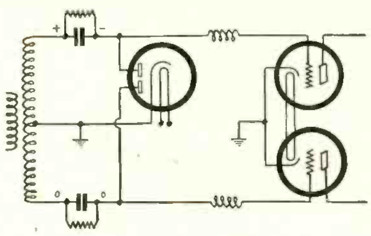


FIG. 9
The danger in non-reactive coupling is that one grid may be driven positive. When the upper diode is conducting the upper driven grid is negative, but the lower driven grid has zero bias, because grid is returned to grounded cathode through a non-current-carrying circuit.

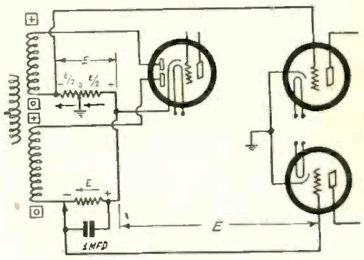


FIG. 10
A true push-pull resistance-coupled circuit. The d-c voltage across the load resistor (upper diode) is divided, center of the resistor grounded, and when negative signal cycles are applied to the upper driven grid positive ones, with bias suitably bucked, are applied to the lower driven grid.

the anode was negative. Likewise, though continuous, it may be steady, or unsteady. If it is unsteady it is called pulsating, and this is the type of direct current existing in detector outputs. The pulses are equivalent to amplitude changes in the steady state of d-c, and these changes are patterned by the original audio frequencies as put into the microphone at the station.

It is the author's contention that in a vacuum tube with only a resistive load in the plate circuit, or output circuit, there is never any alternating current but that there is pulsating direct current, and any presence of alternating current would be due only to a coil in the plate circuit, where reincarnation of a-c is effected by the electro-magnetism.

Whenever we have an a-c voltage or a pulsating d-c voltage across a load we may select the center of the load as the datum or reference point and then the push-pull effect is introduced if we take off the output from the extremes, for the voltages at any instant at these extremes will be equal in quantity but directly opposite in sign. Thus, in Fig. 2 the center point may be taken as zero. The left-hand branch would change from zero to negative maximum and then the right-hand branch from zero to maximum positive. It may be argued that the mid-point is not zero, but half of the maximum, but zero is an arbitrary point, and the termination of the impedance into which the whole works decides the zero point.

A Practical Circuit

So far we have the possibility of a push-pull input, using no transformer but simply a resistor. Now we shall introduce the method in a practical circuit, Fig. 3, and observe precautions that experience has taught.

The load resistor is 0.5 meg. and across it is a small condenser, 50 mmfd. This condenser is not always necessary, as there is usually sufficient inherent capacity to bypass the residual ripple. Two stopping condensers are used, 0.01 mfd. each, or larger, one connected from the coil side of the 0.5 meg. resistor to grid of the succeeding stage, the other connected from cathode of the diode to grid of the succeeding stage. Two grid leaks are used, 2 meg. or higher resistance, from respective grids to grounded B minus. It is therefore not necessary directly to ground the center of the diode load resistor, for since the grid leaks are in parallel with that load, grounding the center or common point in the leak circuit will suffice. A biasing resistor of 1,200 ohms will do for the two 58's, an r-f choke of 10 mlh. or higher inductance being used to help kill off r-f oscillation that otherwise might be present. If there is still oscillation, additional similar chokes would have to be used between each grid and its grid leak. The output is to be connected to the resistance-loaded grid circuits of push-pull power tubes.

Why the Stopping Condensers

The reason for including the stopping condensers is that the direct connection of one of the grids (upper in Fig. 3) would result in a positive grid. That is, the change would be by from zero bias to positive bias. A way of overcoming this would be to introduce an additional rectifier to buck out the positive bias, as was suggested by J. E. Anderson in the January 21st issue, 1933.

Instead of the 55 the 56 may be used as diode for the Fig. 3 circuit, as shown in Fig. 4, or the 25Z5 as in Fig. 5. These are half-wave rectifiers. For full-wave rectification the circuits are shown in Fig. 6 for the 25Z5 and Fig. 7 for the 55, of which the triode is rendered useless because of unbalance if B voltage is applied. Following the rectifiers there would be the same sort of circuit as in Fig. 3, and of course in addition the power stage would be included, biased as usual.

In connection with all of the foregoing circuits it will be found that the capacity to ground is unequal in the two legs, as represented by the leaks, or, if the load resistor of the diode is grounded at center, by one leg of that load. In general the capacity to ground on the cathode side is larger, and on the other side is compensated for by the additional capacity Cx, in Fig. 3.

Cx for All Circuits

Cx should be included in all circuits. It should be put on the side that results in appreciable increase in signal intensity. While the capacity value is not extremely critical, for fine adjustment it would be necessary to measure the capacity across each leg, and make up for the deficiency in the one leg. This measurement may be made with any oscillator having a known inductance and generating a known frequency. The tuning condenser capacity can be obtained by computation for this frequency, and the capacity for the new frequency likewise obtained when one and the other legs of the push-pull circuit are used in parallel with the tuning condenser. When the two differences are obtained the smaller is substracted from the larger, and the final difference is introduced across the smaller to equalize the capacity. All computation may be avoided by consulting "The Inductance Authority," a recent book by Edward M. Shiepe.

So far we have used stopping condensers and considered only half-wave rectifiers. Now let us see what can be accomplished if the condensers are omitted.

A Faulty Circuit

Fig. 8 shows the omission of the stopping condensers, but this is the same situation previously discussed as impossible, because of the positive bias on one of the grids. In direct non-reactive coupling the bias on the succeeding tube may be only that arising from the d-c flow in the carrier-rectified circuit, this being known as diode biasing. Obviously positive biasing of the grid is out of the question.

In Fig. 7 when the lower anode is positive to r.f. the left-hand resistor carries d-c, positive at cathode, negative at the other end of the resistor, so negative may be connected to grid of a following tube. If the upper anode is positive to r.f. at the same time, then the grid of the other tube may be connected to negative side of the second load resistor, to right. However, both grids are negative at the same instant, so the circuit is not push-pull. Let us reverse one of the coils. When one anode is positive the other is negative, so when one diode is conducting the other is not conducting, and the upper grid is positive. The circuit won't work.

(Continued on next page)

(*Continued from preceding page*)

What is required is that one grid be swung negative at one instant and the other grid be swung equally positive at the same time, but that the bias should not run positive.

Another Try

The more or less arbitrary designation of polarities makes it difficult sometimes to comprehend the aim, but if it is remembered that the requirements consist of making one tube at a time handle the load, without grid of either going positive, the fulfillment can be better gauged.

Using a conventional center-tapped secondary, the non-reactive method may be considered with the load resistors in the negative leg, Fig. 9. Center is connected to cathode and grounded. Also cathodes of the succeeding pair of tubes are grounded. Some question may arise as to where the positive voltage is. The answer is that the cathode is the positive and that the anode ends of the resistors are alternately zero and negative, so the grids of the pair of tubes after the rectifier, if tied to respective anodes, share the work alternately and equally during each cycle. To prevent the detection being communicated to the pair of tubes at right in Fig. 9 large radio-frequency chokes are used, 25 mlh, or greater inductance, and to enable the anodes to be polarized by r.f. large enough bypass condensers have to be used across the individual load resistors.

Not So Hot

A somewhat greater departure from non-reaction results because the condensers across the load resistors have to be large enough not to attenuate the input to the anodes, and the larger they are the more the circuit departs from non-reaction. Also the chokes have to be large enough to prevent any considerable amount of r.f. getting into the first audio tubes. The associated circuit and tubes have to be shielded and even the grid leads to overhead caps of the 58's shielded and shield sheath grounded. Otherwise there will be r.f. oscillation. To avoid excessive attenuation due to the resistance loads the resistors have to be considerably smaller than usual.

In this circuit full-wave rectification is used. One diode-to-cathode circuit rectifies at a time. The object is to avoid a positive grid. Let us see if this is accomplished. When the upper diode is conducting the resistor is negative at anode and positive toward cathode. Grid is connected to negative. All right so far. During the time the upper diode is rectifying the lower one is idling. The grid of the companion succeeding tube is connected to the plate of the lower diode.

If the lower section of the diode is not conducting, then any voltage arising will be in accordance with the upper diode, for this is when the positive-grid danger arises for the lower tube. Tracing the lower tube's d-c circuit, grid is connected to one diode anode through a choke and returns to ground through the lower half of the secondary. Since the grid voltage is that between cathode and grid, and since cathode is grounded and grid goes through a no-current circuit to ground, grid is grounded, and there is zero bias, but no positive grid. But there is no symmetry, no push-pull.

More Likely Circuit

To achieve push-pull it is necessary that when one grid is negative in respect to the signal the other is positive. We have avoided a positively-biased grid but we have not provided opposite signs at the grids at any instant, as no positive signal region is provided.

In Fig. 10 is shown a circuit that subscribes to the requirements. It is a half-wave diode detector, across which is developed the d-c voltage E when the upper anode is positive to radio frequencies. The center of this resistor is grounded, and as the cathodes of the succeeding pair of tubes are grounded, half the voltage across E is put into the upper driven tube. However, since half-wave detection develops twice the voltage of full-wave, by taking off half from the half-wave type we still have the same amount of signal voltage for the driven stage as if all the voltage from a full-wave circuit were used.

The midpoint may be taken as zero, so when the upper anode is conducting there is a condition across the resistor which develops opposite signs at the extremes. The left-hand end is put into the grid of the upper tube following, and being always negative, the tube is diode-biased exclusively, in the familiar manner, and the bias is equal to the signal voltage.

The Stumbling Block

The lower driven tube is the stumbling block. If its grid were returned to positive of the load resistor in the upper rectifying circuit, when the upper grid is negative the lower one is positive to an equal amount, considering the signal only. But considering also the d-c bias effect of the voltage, when the upper grid is $-E/2$ the lower grid is $+E/2$, whereas there should be a bucking bias introduced in the lower driven tube to keep its grid away from possibility of positive bias.

If we use the lower diode of the 55 as additional rectifier, operating in phase with the other, we can introduce a varying bucking bias that is proportional to the diode-bias above, and we have only to find out what that bucking bias should be and how to insure it. The total voltage in the upper rectifier is E, the input to the upper driven tube is $-E/2$, the unchecked condition of the lower driven grid is $+E/2$, which is a difference of E between grids, and therefore the bucking bias should be equal to E also, so that the biases on the two driven tubes will be the same at any instant.

Bias Adjusted

There is the signal to consider. There may be a little radio frequency in the load resistor of the upper rectifier, which a condenser will remove, as stated, and shown in Fig. 1, etc. In the bucking-bias circuit we do not desire any signal whatsoever, therefore put a large condenser across the load resistor in that circuit, 1 mfd. Thus a bucking bias is present that is always twice the value of the positive bias that otherwise would result from the signal alone. So the static operating condition of the lower driven tube is $-E+E/2$, or $-E/2$, and that is exactly the static operating condition of the upper driven tube. Thus as the positive cycle of the signal is applied to the grid of the lower driven tube the 1 mfd. condenser bypasses the signal to the grid, and the condition of equal but opposite voltages is achieved and "equal and equal" bias safeguarded.

An adjustment is necessary, and the bucking resistor is therefore made variable.

The transformer is predominantly used in push-pull audio circuits because no adjustment is necessary, the gain is generally greater and the servicing is easier. Such inclusion is more expensive as to parts but less expensive as to testing and adjustment, so that from a broad cost viewpoint the two may be considered about equal.

Servicing is very important, and the inclusion of the transformer simplifies this greatly. Few service men would have the equipment necessary to balance a resistance-coupled push-pull circuit, and possibly not many of them would be equipped with the technical knowledge, not that deep knowledge is required, but that there have been little data available to them. Hence the current articles, as well as previous papers in these columns, will prove of considerable assistance to those desiring to familiarize themselves both theoretically and empirically with this interesting circuit.

Other Circuits

The realm of push-pull resistance coupling is very large, and other circuits than those discussed this week may be used to advantage. Nothing has been written up this week about the phase-shifting tube, but the possibilities in that direction are inviting, rather, however, from the viewpoint of the reactive coupler.

One idea is to use the triode of the 55 or other such tube as the phase shifter, then have push-pull drivers and push-pull output. The 53, being two equal tubes in one envelope, may be used so that one of the tubes is a phase-shifter. Some experiments made with this tube in this manner have not proved successful enough. However, all the circuits shown this week, including those that are fallacious, have been tried out. Those stated as working do work and those stated as not working, while producing a signal, create considerable distortion, and are not even theoretically acceptable.

The increase in the amount of amplification ahead of the audio channel, which has been going on steadily for several years, makes for the reduction in the amount of audio amplification, so that there are many circuits that have the detector feeding directly into the power tube.

Can Drive Triode Output

Generally this consists of a screen grid detector driving a pentode output tube, in smaller sets, but there is no reason why, with higher r-f and i-f gain in larger sets, the detector can not be made to swing the output tube or tubes, provided that the detector will stand the 50 or 60 volts necessary to load up the output.

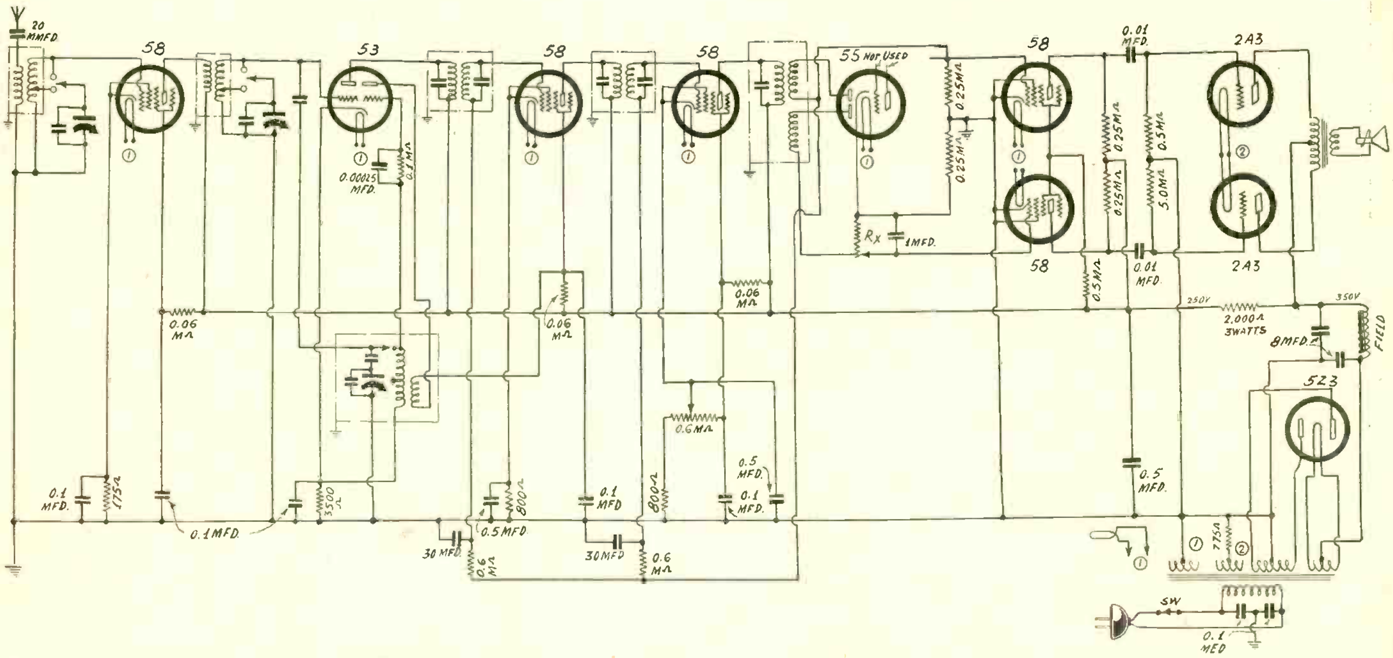
While the diodes of the duplex-diode-triode tubes will not fulfill this requirement, the rectifiers used for B supplies of course will. There are two considerations: the capacity of the tube elements should not be high, and also, for hum reasons, the rectifier should be of the indirectly-heated cathode type. Therefore diagrams show the 25Z5 used in this way.

Heater Rectifiers

There is also a 6.3-volt half-wave rectifier heater type tube, the 1-v, and a 12.5-volt half-wave heater type rectifier, 12Z3, concerning which some data will be found on page 11. Any one of these may be used. At present they are the only heater type rectifiers. The 1-v and the 12Z3 may be used only for half-wave rectification, the 25Z5 for either half-wave or full-wave.

A 10-TUBE SUPER

With True Push-Pull Resistance-Coupled Audio



One of the anodes of the 55 is used as the separate rectifier to supply a bucking bias to the lower driven 58, the grid of which otherwise would run positive. The grid and plate of the 55 triode are not used because the cathode has to be "left in the air" to support the push-pull circuit.

THE true push-pull resistance-coupled audio amplifier described in the foregoing pages is included in the complete receiver design shown above. Except for the 53 mixer tube, the circuit ahead of the detector is conventional.

The reason for the small series condenser in the aerial circuit is to improve selectivity ahead of the modulator. Only a three-gang condenser is used, therefore, as one section tunes the oscillator and another the modulator, the remaining one is for the t-r-f stage. One such stage without loose coupling between antenna and tuned winding would result in some squeals. These are absent when the selectivity ahead of the modulator is raised high enough, and loose coupling is one of the easiest and most effective ways of doing this, even though the input is reduced somewhat. If larger input, consistent with some squeals, is more satisfactory, the condenser may be made larger.

The 53 as a mixer has not been used much, but works well, when the operating conditions are right. It is critical, in that it will not work at all unless the voltages are right. Thus it resembles the 2B7 tube to this extent. It is advisable to have a low plate voltage, and this may be obtained from the screen of the first intermediate tube.

Tests of Biasing Resistor

The oscillator grid leak, shown as 0.1 meg., and the biasing resistor, marked 3,500 ohms, are critical. Since oscillator grid is returned to cathode, the oscillator bias depends on grid current through the leak. Hence both the leak value and the bias affect the operation, and in actual practice 3,100 ohms proved excellent, but various resistors around that value, say, 3,000 to 3,500 ohms coding, had to be tested before one was found of exactly the desired value.

The two intermediate tubes are subject to automatic volume control, and the filter circuits are shown with very large electrolytic condensers across the resistors (30 mfd. across 0.6 meg.). The reason for specifying the large capacity is that sometimes its inclusion boosts volume considerably. In other instances it does not, and if it doesn't, use 0.1 mfd. or somewhat higher capacity, but it is well first to try the very high electrolytic capacities, which come in small containers, about as long as your finger and twice its diameter. There is greater volume if the electrolytics in this circuit are connected in the a.v.c. filter with positive to a chassis and negative to the resistor.

There should be no trouble in the tuner, as it is familiar and besides follows authenticated lines. Neither should there be any trouble in the succeeding part of the receiver if directions are followed.

Fixing Up One Coil

Perhaps it is just as well to build the audio circuit as shown and try it out. To accomplish the construction with parts normally obtainable it is necessary to get a center-tapped intermediate coil, remove the interconnection of the two wires that create the center, so that you have two separate coils, both fed from the same primary, and also to remove the tuning condenser that was across the center-tapped secondary. This condenser removal consists merely of unsoldering the connections, or one of the connections, if the condenser is used as a surpporting bracket for the coil, as is true in some assemblies. Now you have a coil with the required three windings and the secondaries are connected with beginning of one coil to anode, beginning of other to anode, and ends to loads. Select your own "beginning."

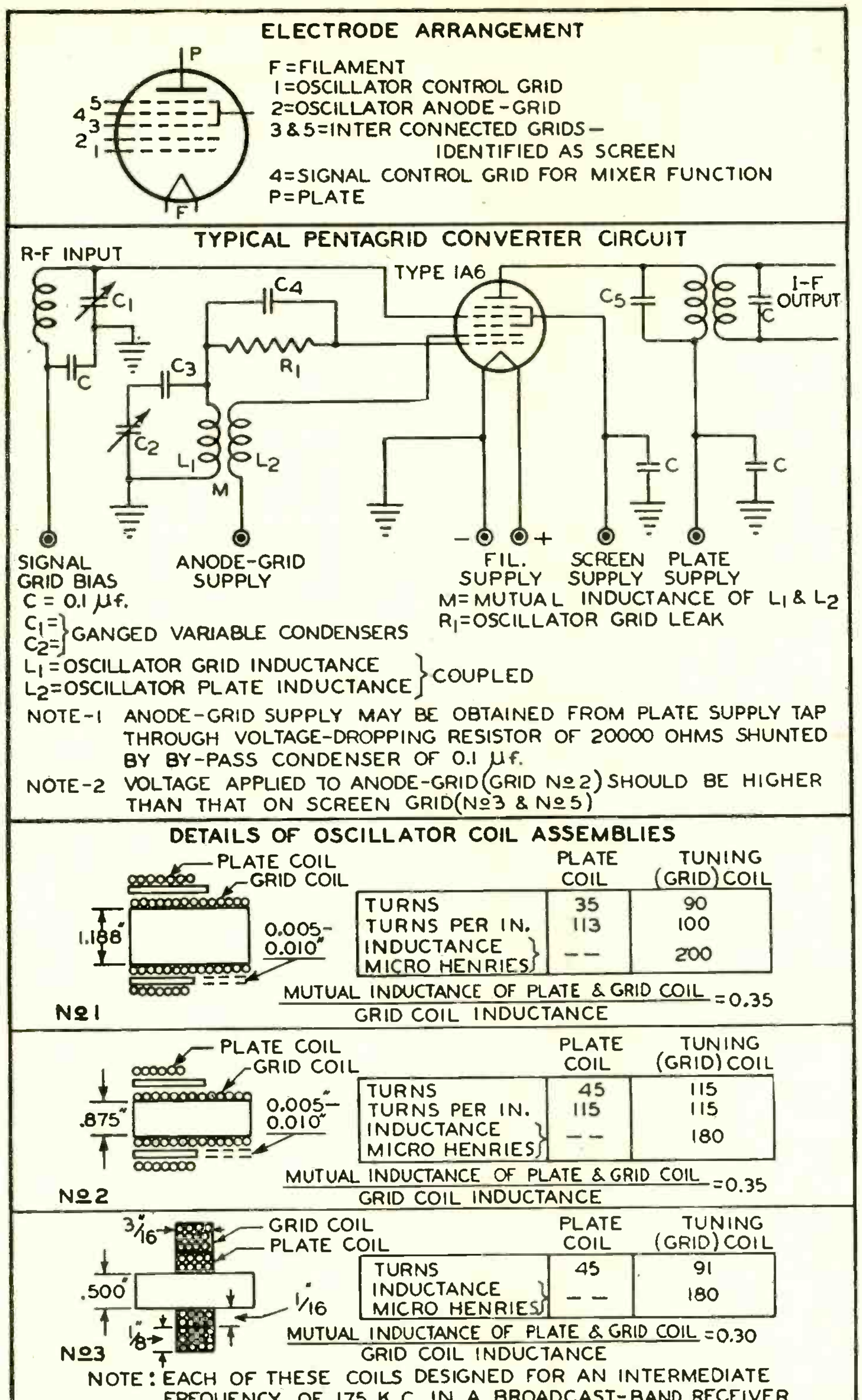
Unfortunately, the ratio is not favorable, as the input to each diode is only half of what it could be if each separate secondary had twice the number of turns it now has, that is, each had the same number as the primary. This is not a serious drawback, however, for trial of the circuit, but merely results in somewhat less quantity of sound than one might expect without knowing a cause of this reduction.

It would be advisable to have the winding serving the lower diode somewhat more closely coupled to the primary than is the other secondary, if this is practical in the coil assembly, because the voltage will tend to lag in the lower branch, where it is preferable to have it higher so that it may be adjusted to equal the other.

The audio resistors used should be measured and equal values included. This applies particularly to the 0.25 meg. and 5.0 meg. values. Then the resistor Rx, which may be 0.5 meg., is adjusted until the same plate current flows through each 0.25 meg. in the 58 circuit, when a steady-modulated oscillation is put into the antenna. This means that broadcasting stations may not be used for the test but a single-tone-modulated test oscillator should be.

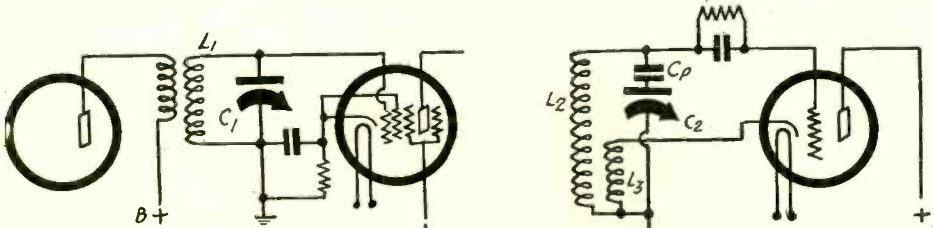
Hot Resistor Test

In the absence of instruments or knowledge about devising testing methods additional to what has been suggested, one may simply feel the 0.25 meg, resistors in the 58 plate circuits. The one in the upper branch can't be troublesome, so judge by it. Feel the other one. If it is perceptibly hotter there is grid current in the plate circuit of the lower 58, so use more of Rx, or, if fixed values are being used, include a higher resistance for Rx.



A typical circuit for the 1A6, with notation of socket connections. Details are given for oscillator coil assemblies.

Cathode Feedback in Oscillator



A modulator circuit, as at left, may be coupled with a local oscillator in a superheterodyne where the feedback winding in the oscillator is through the cathode circuit (right).

HOW T

Pentagrid Co

THE type 1A6 tube is a pentagrid converter designed primarily for use as a combined oscillator and mixer in battery-operated superheterodyne receivers. The 1A6 possesses many operating advantages over the oscillator-mixer combinations hitherto employed for battery-operated superheterodynes. Among these advantages are: Economy in A current drain, greater operating stability, higher and more uniform translation gain, volume-control effectiveness comparable with that of a super-control amplifier in an i-f stage, reduction or elimination of the intercoupling effect between the signal and the oscillator circuit, almost entire elimination of radiation from the local oscillator, simplicity of oscillator circuit adjustment, and economy in chassis space requirements.

Resembling the 2A7 and 6A7 in both function and operation, the 1A6 is subject to the same general operating requirements as those applying to other pentagrid converters. The circuit shows a desirable arrangement for the 1A6. An explanation of the various circuit elements is included.

Coupling Between Units

The design of a superheterodyne receiver employing the 1A6 is conventional. There are no unusual features which must be taken into consideration. The r-f input circuit, the i-f transformers, and the gang-tuning condensers are designed in the usual manner. No data are given in this note on the design of these parts, since they will vary greatly with the intermediate frequency used and the frequency band to be covered by the receiver.

In designing oscillator coils for the 1A6, the coupling between oscillator grid-coil and oscillator anode-coil should be slightly greater than that commonly used with triode oscillators. Tests have shown that for the 1A6 the ratio of M/L (the mutual inductance M between the oscillator anode-coil and the oscillator grid-tuning-coil to the inductance L of the oscillator grid-tuning-coil) should be approximately 0.35.

Higher values of coupling than that obtained with the above ratio may cause difficulty in tracking the oscillator frequency with the signal frequency, while lower values of coupling will result in reduced translation gain.

The diagrams show details for the construction of three oscillator coils designed to give good results with the 1A6. There are no unusual features involved in the design or construction of these coils. Two methods of construction are shown to enable the designer to choose the coil form better suited to his space requirements. Each of the three coils shown has an M/L ratio which will give satisfactory operation of the 1A6. The coils shown are suitable for use with an intermediate frequency of 175 kc in a broadcast-band receiver. The use of other intermediate frequencies will necessitate changes in the inductance of the coils. Usually coils which are suitable for the 2A7 or 6A7 will be found to be satisfactory for the 1A6.

The curve sheet shows the conversion transconductance of the 1A6 versus signal-control-grid volts. This curve was taken with 180 volts on the plate of the

O USE THE 1A6

nverter Tube for Battery Sets

1A6. With 135 volts on the plate, the conversion transconductance usually will be about 90% of the value shown. The volume-control capabilities of the tube are clearly indicated by the curve.

Translation Gain Formula

The translation gain obtainable with the 1A6 is:

$$\frac{aS_cZr_p}{Z + r_p}$$

Where
a = Voltage ratio of the i-f transfomer
S_c = Conversion transconductance
Z = Effective impedance of the i-f transformer across the input terminals
r_p = Plate resistance of the 1A6.

With transformers ordinarily used, the translation gain of the 1A6 approaches 40. With special high-impedance transformers, a gain of approximately 60 can be readily obtained.

TYPICAL OPERATING CONDITIONS

Plate supply voltage	135	180	Volts
Oscillator grid leak (R_1)	50,000	50,000	Ohms
Oscillator grid condenser	200	200	mmfd.
Oscillator anode-grid supply voltage	135	180*	Volts
Screen supply voltage	67.5	67.5	Volts
Signal control-grid bias voltage	-3	-3	Volts
Oscillator control-grid current	0.2	0.2	Milliamperes
Oscillator anode-grid current	2.3	2.3	Milliamperes
Screen current	2.5	2.4	Milliamperes
Plate current	1.2	1.3	Milliamperes
Total cathode current	6.2	6.2	Milliamperes
Oscillator coil M/L ratio	0.35	0.35	
†Conversion transconductance at -3 volts on grid †4	275	300	Micromhos
†Conversion transconductance at -22.5 volts on grid †4	4	4	Micromhos
Plate resistance	0.4	0.5	Megohm

**The oscillator anode-grid voltage must not exceed 135 volts. If the oscillator anode grid is supplied from a plate-voltage source of more than 135 volts, a voltage-dropping resistor must be used. With 180 volts plate supply, a 20,000-ohm voltage-dropping in series with the oscillator anode-grid will reduce the voltage to a permissible value.*

†Conversion Transconductance is defined as the ratio of the intermediate-frequency component of the mixer output current to the radio-frequency signal voltage applied to grid †4. In determining the performance of a frequency-converter stage, S_c is used in the same way as g_m (mutual conductance) is used in a single-frequency amplifier computations.

Latitude Permitted

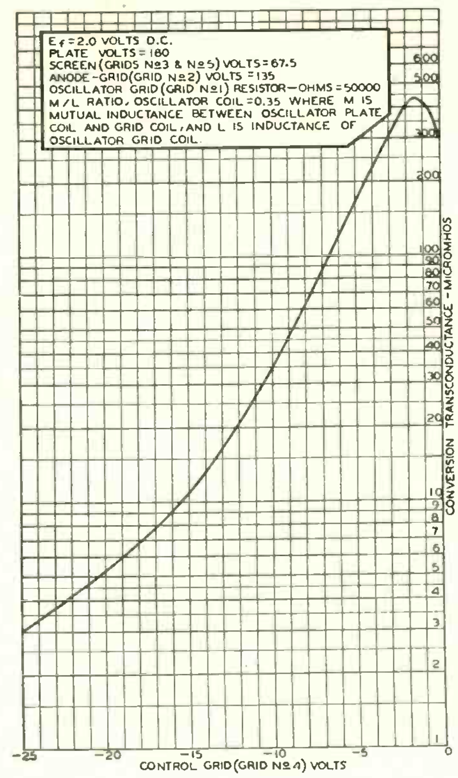
The tabulation gives typical operating conditions for the 1A6, but these conditions do not necessarily provide the best results obtainable. The voltages, resistors and coils may be varied within fairly wide limits to fit the conditions of a particular application, provided that maximum ratings are not exceeded.

In general, decreasing the voltage E_{c3} and E_{c5} from 67.5 volts will decrease the gain. The screen voltage must, however, never exceed 67.5 volts under any conditions of operation. The optimum value of screen voltage is dependent on other electrode voltages and on circuit constants. All currents will increase with increasing screen voltage. A reduction in the oscillator grid-leak resistance R_1 increases the gain and, at the same time, the currents.

An increase in the M/L ratio of the oscillator coil operates in the same way.

The total cathode current in the 1A6 should never exceed 9 milliamperes. Varying operating conditions to raise the cathode current above the 6.2 milliamperes shown for typical operating conditions usually will not increase the gain appreciably. Consequently, more satisfactory operation of the 1A6 is obtained with approximately 6 milliamperes cathode current, since higher values tend to shorten the life of the tube.

The typical operating conditions for the 1A6 set forth in this note have given satisfactory results in our laboratory. In designing circuits for the 1A6, it must be remembered that a large number of variable factors is to be taken into consideration, say RCA Radiotron Co. and E. T. Cunningham, Inc. The tubes are quite flexible in their voltage requirements, so that reasonable care in the selection of the supply voltages and circuit constants will insure better operation than provided by combined oscillator-mixer circuits using tube types not especially designed for this dual function.



Operation characteristics of the 1A6. The control grid voltages are plotted against conversion transconductance in micromhos.

Right or Wrong?

QUESTIONS

1. Which gives the greater sensitivity, the 56 tube or the 53 as driver of output, transformer coupling between?
2. If a transformer has a skinny primary will the frequency coverage be greater or less than if the primary were large?
3. In a resistance-coupled audio amplifier, is it desirable that there should be a-f regeneration, or should the feedback filtration be made so complete as to eliminate all such regeneration?
4. What are the power output of the 33 and its amplification factor at standard operating voltages? What sort of a tube is it? Is it necessary to filter the output on account of the large plate current?
5. Is there a tube now available that affords a constant output? What is the requirement of a constant-output tube and what would be its advantages?
6. Is there a 1.1-volt amplifier triode, and if so, state its characteristics?
7. Can a B supply be utilized for sound trucks without B batteries?
8. Does a neon tube in television utilize a large percentage of the available light?
9. Is there a standard classification of short waves?
10. What improvements have been made in the 38, 41, 42, 89 and 2A5 and to what purpose?

ANSWERS

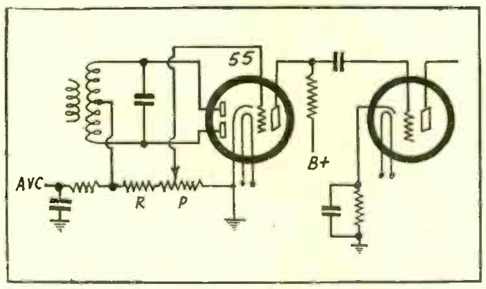
1. The 53 gives greater sensitivity. Its two plates may be tied together and its two grids tied together, to constitute a single operating tube, and the amplification factor will be around 16 instead of around 8 for the 56.
2. The frequency coverage, or ratio, will be greater in the case of skinny primaries than with large primaries, because the capacity between primary and secondary is less. This capacity appears as a lumped capacity across the coil terminals of the tuned secondary and therefore tends to reduce the frequency ratio.
3. It is imperative that there be regeneration to insure sensitivity. However, the amount of regeneration must not exceed a certain level, otherwise motorboating results. The feedback filtration therefore should not be so complete as to remove all possibility of audio regeneration. It would be impractical, anyway, to achieve such approach to perfection of filtration at audio frequencies.
4. The power output of the 33 is 0.7 watt and the amplification factor is 70. The tube is a battery-operated output pentode (power tube), of the 2-volt series. The plate current being small, there is no need of an output filter for the purpose of protecting a speaker winding.
5. There is no constant-output tube. The requirement of such a tube is that its amplifier should have automatic volume control applied in the same envelope, perhaps through special geometry of the single tube. The advantage would be the isolation of a. v. c. to each stage thus self-controlled.
6. Yes, the 864, a 1.1-volt filament type tube, 0.25 ampere filament current, 135 plate volts, 9 volts negative bias. It is a Class A amplifier triode.
7. Yes, an auxiliary generator can be hooked up to the fan belt and made to supply the plate voltage.
8. No, only a small amount of the available light can be utilized in usual practice, with the television neon tube.
9. There is no standard classification for short waves, but engineering committees are holding meetings with the idea of formulating a proposed standard.
10. These five tubes have been improved so that the grid emission is reduced considerably, thus permitting the use of higher values of grid leaks.

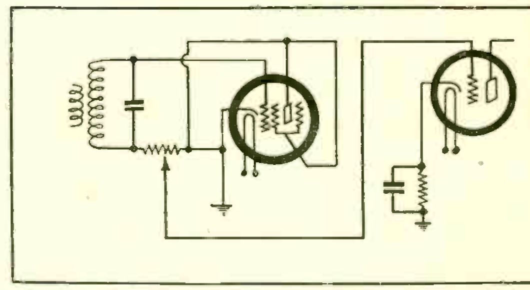
STABILIZATION OF I. F.

Method That Is Fool-Proof and Even Enables Three-Stage Amplifier

By Roger Beale Conant

At left R is a limiting resistor to prevent putting into the diode-biased triode all the rectified voltage. P is the manual volume control. A grid leak is needed in the next tube. In the drawing at right a 56 as diode works into an audio amplifier.





OSCILLATION in the intermediate amplifier is a common trouble these days, with two-stage high-gain amplifiers, and therefore some pains were taken to achieve a reliable cure that applies generally.

In brief, the cure consists of choke-condenser filtration of each plate circuit in the intermediate amplifier, and including the modulator plate, besides cathode choke-condenser filtration in the first intermediate amplifier, with a choke between the detector and the feed to the first audio, a small bypass condenser on the detector side but none on the audio side, and 1 mfd. for cathode bypass. This method was applied to three viciously oscillatory circuits and quieted them all.

Shielding Necessary, Too

Besides the foregoing, the usual shielding of coils and tubes, using standard tube shields, is necessary. Control grid leads to overhead caps should be shielded and shields grounded. Shielded wire suffices.

It was found that a common screen supply could be used for all tubes served, including r-f and mixer tubes, as well as i-f tubes, without introducing any trouble.

The bypass capacity in the cathode and screen legs had to be 1 mfd., and therefore some expense is incurred, but it is worth while, since the sensitivity is lifted to a high level, with a gain of more than 200 per stage using doubly-tuned coils, and no gain sacrificed to attain stability.

Although it was found preferable to filter the plate circuits as explained, tests showed that most of the trouble was in the cathode branches, which can be understood readily, since the cathode is common not only to the plate, screen and suppressor circuits, but is common to part of the grid circuit as well. That is why the cathode capacities are 1 mfd. for bypassing, and as an extra precaution the stage that has the greatest tendency to oscillate, the first i-f, has a choke in the cathode leg as well.

Three Stages Practical

Using the same fundamental parts, without the precautions outlined being taken to the fullest, the gain in the intermediate amplifier had to be held down considerably to insure stability, and yet when the remedies were introduced the gain could be as high as the circuit, constants and standard voltages permit, and the bias had to be no more negative than standard. It was even possible to use three stages of i.f. (four coils) without oscillation trouble. Anyone who has experimented with three-stage intermediate amplifiers must know that the stabilization problem is not very simple unless the reasons for the trouble are known and the remedies specifically applied to overcome the known sources of instability.

The full voltages were used on plates and screens, in fact, instead of the usual 250 volts and 100 volts, the values were 270 and 120 volts, respectively, just to make the solution a bit more difficult, and to safeguard freedom from oscillation when the method is reproduced in actual 250-volt and 100-volt practice.

The intermediate amplifier, therefore, can be completely stabilized, and it is not necessary to use large condensers, or even very large chokes, in the separate plate legs. The choke coils used were small honeycombs of 800 turns, inductance 10 millihenries, and the capacities recommended are 0.002 mfd. Larger may be used without any disadvantage, smaller ones may be used, but not so small that the frequency of the choking circuit is higher than that of the intermediate amplifier.

100 kc Maximum

The choking frequency should be considerably lower, as the necessity is to create a low-pass filter. If the capacity is as low as 0.00025 mfd., and the choke is 10 mlh., then the natural period is 100 kc, which is low enough for any of the popular intermediate frequencies, that is, for 175 kc or higher. The highest intermediate frequency used in this class is 520 kc, but even that is not so generally encountered, and is rather special to home-constructors of particular types of kit-sets.

It is obvious that the coupling in the screen circuits is not large, as a condenser gets rid of any tendency to back-couple, provided it is large enough, and 1 mfd. is sufficient. Just why any large capacity should be necessary for relatively high frequencies (and the intermediate frequencies are high compared to such a capacity) is not clear, but it is certain enough that the large capacity did the trick, when aided by the other devices.

Special Cases

The use of standard bias of course is consistent with full amplification. The difference between 800 ohms and 300 ohms as biasing resistors means a difference of almost 60 per cent. in the amplification, which is certainly important. Then, too, the second detector may be used in half-wave fashion, if desired, as this affords twice the voltage that is obtainable from full-wave detectors.

Some incidental aids are necessary, and if a diode detector is used with direct coupling to the triode, as in a 55, a 10 mlh. or higher inductance choke should be connected between the grid of the tube and the terminal of the coil from which pick-off is taken, and a small condenser put from pickoff point to ground, but none across the other end. Sometimes, in extreme instances, the value of this capacity has to be made consistent with stability, and while 50 mmfd. usually will prove sufficient, in some instances the value had to be doubled. This assumes a load resistor of around 0.5 meg. In the actual instance 0.6 meg. were used, because a meter was handy that had 2,000 ohms per volt resistance, and 300-volt scale, so the voltmeter setup could be used as a current meter directly, because of 600,000 ohms series resistance, and indeed as voltmeter, too, directly disclosing the amount of the rectified voltage.

It was found that with a long aerial the loudest local station developed 70 volts at the diode output, which is palpably too much, especially since any diode-biased audio amplifier, as the triode of the 55, stops doing business soon after 30 volts, and all one hears then is a lot of hash. It wouldn't improve the situation one bit if stopping condenser and leak were used, as the distortion would be just as bad, due to action of the tube on the positive portion of its characteristic.

58 as Diode-Biased Tube

The 55, 2B7, 2A6 and other tubes having diode elements are not the most satisfactory as diode-biased when one has a very sensitive set, uses a long aerial and lives near strong stations, because of the high voltage occasionally put into the first audio amplifier. Of course a volume control ahead of the first a-f tube would provide a check, but a tube with an extremely remote cutoff would be preferable, and therefore a 58 could be used separately as the diode-biased tube, and the 55 triode not used at all, or, if used, devoted to i-f amplification, as the third intermediate amplifier, if three stages are to be used. Even at 50 volts negative bias the mutual conductance of the 58 is something, whereas with the other tubes in the same general amplifier class, it is nothing.

It is advisable with all the diode-biased tubes to have a small starting bias, that is, some bias even if there is no signal. Otherwise there will be grid current at

(*Continued on next page*)

1-V OR 12Z3 AS RECTIFIER?

Which One Would You Choose and On What Basis?

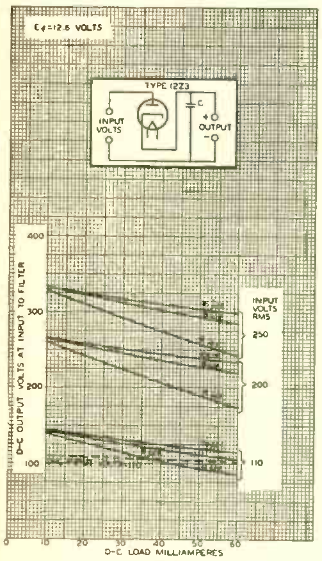


FIG. 1

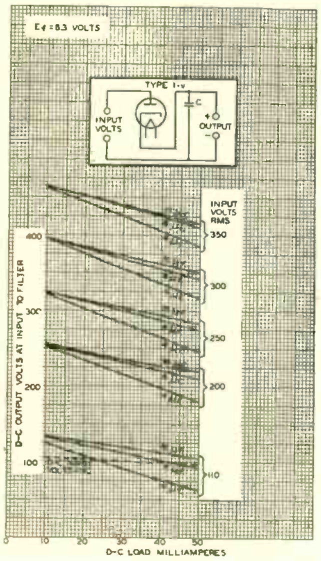


FIG. 2

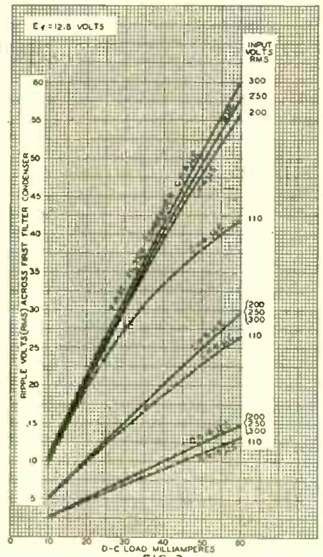


FIG. 3

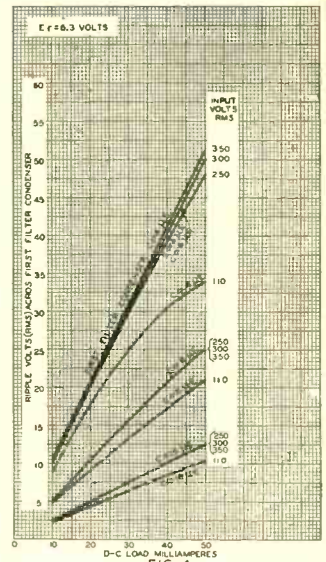


FIG. 4

THE type 1-v and type 12Z3 tubes are half-wave vacuum-type rectifiers having heater voltages of 6.3 and 12.6 volts respectively and heater currents of 0.3 ampere each.

A tabulation of their rated characteristics follows:

	1-v	12Z3	
Heater Voltage	6.3	12.6	volts
Heater Current	0.3	0.3	ampere
Maximum A-C Plate Voltage (RMS)	350	250	volts
Maximum D-C Output Current	50	60	ma.

These two rectifiers may be used in transformerless universal receivers having series heaters, for which application, the 12Z3 is perhaps the more useful since it has the greater voltage drop across the heater. The 1-v because of its 6.3-volt heater may be used in automobile receivers or in a-c operated receivers employing the 6.3-volt tubes. In general, in making a selection between these two rectifiers, the choice will be determined by the most suitable heater voltage, say RCA Radiotron Company, Inc., and E. T. Cunningham, Inc.

Figs. 1 and 2 showing regulation characteristics of the 12Z3 and 1-v indicate that the 12Z3 has slightly better regulation than the 1-v. The 1-v will supply at 350 volts rms input approximately 400 volts d.c. at 50 milliamperes, and the 12Z3 will supply at 250 volts rms input approximately 300 volts d.c. at 60 milliamperes.

Figs. 3 and 4 show the ripple, or rms voltage developed across the first filter condenser. This is observed to be practically the same for both tubes. From these curves it is apparent that doubling the first filter capacity will halve the ripple voltage developed across the condenser, and that to secure the ripple voltage for any load only one point need be known since these curves are approximately straight lines passing through the origin.

High Gain from I-F Channel

(*Continued from preceding page*)
small signal input or at no signal. The reason for grid current despite a small bias due to signal is that the heater type tubes of the medium amplifier class draw grid current at bias values less than 0.8 volt, so it is well to have 1-volt bias. If the no-signal plate current in the triode of the 55 is 2 ma, for instance, then 500 ohms will afford this single volt, and a bypass condenser across the resistor frees it from a degenerative effect on the circuit.

Time Delay

When the small self-bias is introduced the diode load resistor is returned to grounded B minus, as this is necessary to make the bias effective, for if return were to cathode the drop in the 500 ohms would not be utilized in the grid circuit. With a potential difference of 1 volt between cathode and ground and load resistor returned to ground, the tube naturally will not rectify until the signal is more than 1 volt, that is, until the anode has a positive radio-frequency value of input, measured from B minus.

This situation creates time delay, which means that the detector does not detect until the bias voltage is overcome by the signal, but the moment is is thus overcome, the bias resistor becomes less and less effective, since the plate current is being cut down.

Some Sacrifice of DX

Nevertheless, though strong signals are hardly affected by the 500 ohms at all, weak ones, below 1 volt, are wiped out, so some distant stations may be sacrificed, but they would not be of the type worth hearing, as less than 1 volt input, with no time delay, results in grid current, hence severe low-note attenuation, or raspiness.

Amplification of different frequencies being relative, the cure for the reduction of low-note intensity on weak signals is to have a volume control that is also a tone control, to cut down the high audio frequency response. This may be accomplished very readily by using a variable condenser across the load resistor. While the volume is not reduced as greatly as with other methods, the low notes continue to be heard well at very small total volume of sound. Some of the more expensive sets have volume controls that also are tone controls working in this direction. The suggested location of the condenser control is such as to reduce the input to the first audio tube, in line with protecting that tube from danger of overload and hence saturation.

With a minimum of 1 volt required at the detector, if there are two stages of i.f. at 200 gain per stage there is a gain of 40,000 between the modulator output and the detector input. With an r-f stage and good conversion conductance in the mixer (say, 200) there would be a gain of at least 2,000, or now a total of 80,000,000. Remember that audio amplification has not been included, and that has as well to do with sensitivity as has r-f or i-f amplification.

It can be seen, therefore, that large values of voltage can be fed to an output tube, or a pair of output tubes. Since we have found that a three-stage channel can be stabilized, with overall gain of sufficient value to load up a power tube, it is practical to use a diode rectifier and have the power tube direct-coupled by the diode-bias method. This comes within the suggestion of using the triode of the diode tube as last i-f amplifier, but the power tube, due to large plate current, would have to be independently biased, although not necessarily to the full amount usually recommended. The signal would take care of the extra bias.

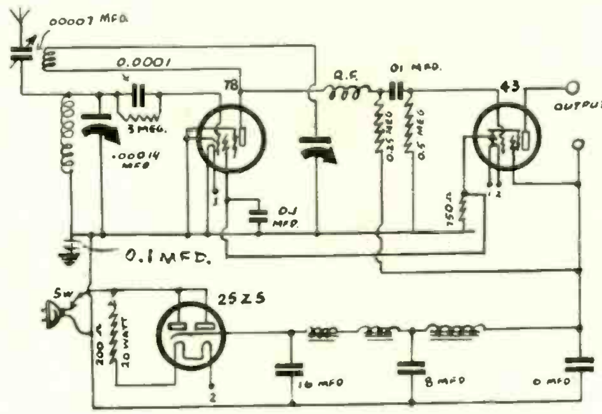
Radio University

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

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

A Universal

CONCERNING the circuit printed on page 5 of the September 2nd issue, will you please let me know if it is correct to ground cathode of the 78 tube? Also please explain the heater circuit continuity. What are some of the advantages of using the 43 as an output tube? What is the actual voltage applied to the plate and the screen of the output tube, if not the full line voltage?—O. R. W.



A universal short-wave circuit for earphone use. This has 78 cathode grounded as any grid leak detector may be.

One side of the heater of the 78 is connected to the chassis. One side of the power line is also connected to the chassis, the negative in the case of d-c. Hence we may say that the heater circuit begins with the 78. The other heater terminal of this tube, marked (1), is run to the correspondingly marked terminal of the 43.

Terminal (2) picks up the heater of the 25Z5, and thence the circuit continues to the 200-ohm ballast resistor, which in turn goes to the "hot" side of the line. This does not mean that it goes to the ungrounded side of the d-c line, for in most instances the positive is grounded. In this case the chassis is really the "hot" side.

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

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

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

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

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

* * *

Diode Biasing

DOES NOT bias become zero at times on diode-biased tubes? Will sets be better though no new tubes come out?—A. S.

Where the tube is diode-biased it is well to remember that twice during each cycle there is no bias due to the signal, and this no-bias condition occurs much less frequently at audio than at radio frequencies, a point in its favor, whereas the static condition is that of no bias contributed either way by any signal, and only the self-bias would apply, so the static or self-bias should be within the capabilities of the tube.

In general, as the tubes that came out within the last year or so are used more and more, and effects noted, improvements result, so that even without any new tubes being imminent, it is still a fact that the circuits for the coming season are better than their predecessors.

* * *

Honeycomb Coils for T.R.F.

CAN NOT HONEYCOMB coils be used for tuned radio frequency amplification, especially as they are so compact, and a small shield is possible? For compact sets, such as used for automobiles, I don't see why this idea has not been taken up. Is the usual solenoid superior? What about the shape factor, whereby the diameter of all commercial broadcast solenoid coils is around half (or less) the axial length of the winding? I thought this developed a high r-f resistance. What is the effect of using Litz wire?—K. L. M.

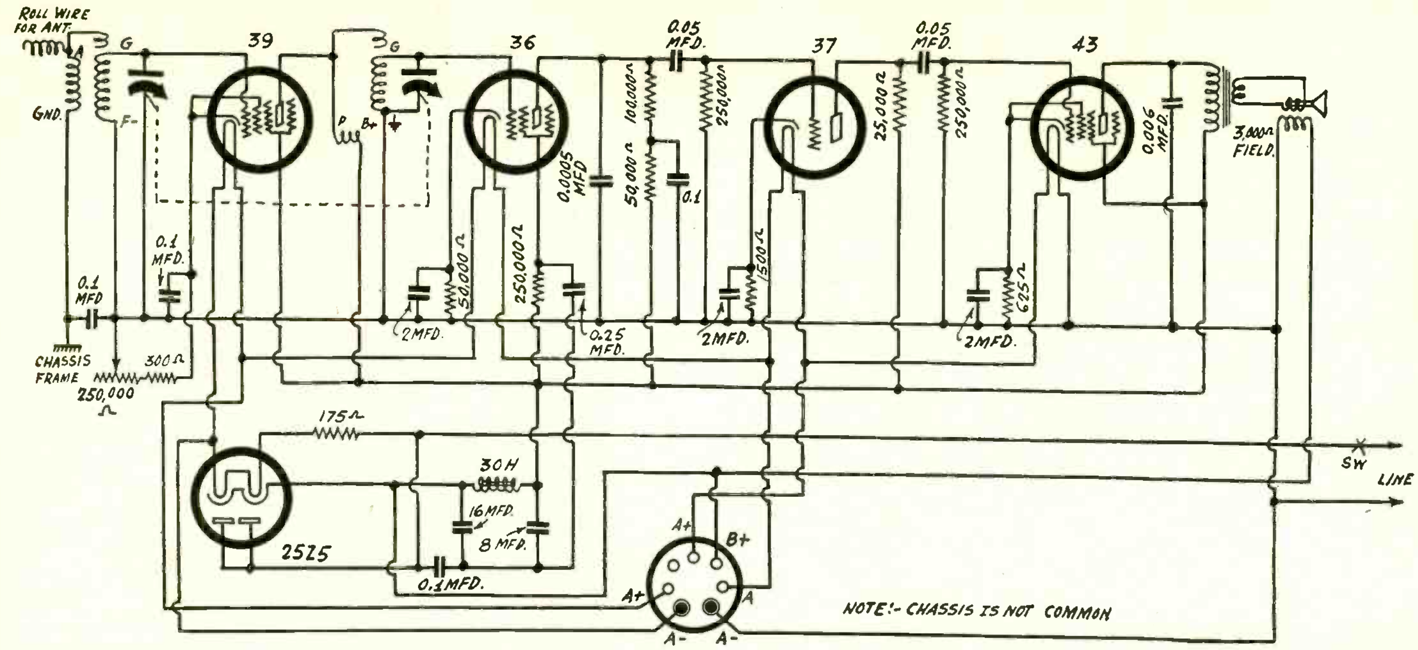
Honeycomb coils can be used, and there is one coil manufacturer producing them, but not in shielded form. They work well. The solenoid is in some respects superior. For compact sets, where much is sacrificed anyway, it is entirely feasible to use honeycomb coils for tuning circuits, and because of the little antenna pickup it would be practical to wind with Litz wire. This type of wire is better at the lower radio frequencies, hence winding a coil with such wire results in a more nearly even amplification. However, in car sets there is much to overcome, as the short aerial is particularly good for higher frequencies, but weak on lower radio frequencies. Thus equality of amplification would not result, without additional means of insuring it, but the effect would be in the right direction, anyway. The shape factor of coils as used commercially for broadcasts is out of proportion, but quite a latitude is permissible, as the performance change is small within a large factor change. However, there is no doubt that if the shape factor were somewhat better the coils would be somewhat better, also. Practical requirements dictate the factor—a small diameter and the necessity therefore of using a fine wire so as not to extend the axial length of the winding overmuch. The "ideal" coil has a diameter 2.47 times the winding space.

* * *

Marconi's Ultra Waves

MARCONI REPORTS that ultra waves travel father than others are willing to admit, some 170 miles, or beyond the horizon quite some. Is it a fact, or is it not, that the penetration of these waves is limited to the horizon? What is the extent of Marconi's contribution?—J. E. C.

Nobody doubts that Marconi's ultra



A five-tube universal receiver, using the 25Z5 as rectifier when a-c service is desired, and floating that tube on the line when d.c. is used. A precaution that should be taken is to observe polarity of connection to the outlet, so mark outlet and set plug, and warn the family to plug in the right way.

waves, around 45 centimeters, were received over distances of 160 and 170 miles in his experiments last year and this year, but how he has accomplished it is not definitely known to the science, for he has kept the details secret. It is agreed that ultra waves behave somewhat like light waves, and that is why they are called quasi-optical waves. The general impression has been that their radiation is limited to the horizon distance. This distance is not a fixed quantity but depends on the altitude of the point of radiation. Thus from a high tower the distance to the horizon would be greater than from the ground to the horizon, just as the hypothenuse of a right-angled triangle is always longer than the base. The curvature of the earth is regarded as the deterrent to any considerable distance penetration of ultra waves, but the similarity with light-wave propagation brings up the phenomenon of light "turning a corner," as it were. Einstein in his relativity theory pointed out the effect of magnetism and gravitation on light transmission, and the same condition may cause the ultra waves to go considerably beyond the technical horizon.

* * *

Transformerless A-C Set

IS IT PRACTICAL to have a good a-c set, using no transformer, but car type tubes, and heater rectifier? What output tubes would you suggest?—K. C. B.

Yes, it is entirely practical, for it simply amounts to building a universal type set and not using the d-c option. The rectifier may be the 25Z5, the amplifiers the 78's, with a triode detector push-pull-transformer coupled to a pair of 48 tubes. All heaters, including rectifier, would be in series.

* * *

Five-Tube Universal

PLEASE SHOW a design for a five-tube universal receiver, using the 25Z5 rectifier, with limiting resistor value noted (heater circuit).—O. H.

The circuit diagram is printed herewith and shows choke primaries not inductively related to tuned secondaries, but capacity coupled to the secondaries by the self-capacity of a very small winding (usually one, two or three turns over secondary). Thus one terminal of the small winding goes to plate or antenna, other terminal being left open, so to speak, although due to the condenser effect there exists a closed circuit in reality. The value of the limiting resistor is noted, as requested, and other values are values constants of other parts are given.

* * *

I-F Selectivity

IT HAS BEEN STATED that the doubly-tuned intermediate transformers are more selective than the singly-tuned-circuit intermediate transformers, but I can't understand why this should be, since it has been my experience (consistent with the theory I have studied) that an inevitable band-pass effect or double-hump exists, with the doubly-tuned circuit, and therefore the selectivity should be less. Which is right?—K. R. W.

Either one may be more selective than the other, depending on factors not disclosed. For instance, assume a singly-tuned transformer, untuned winding in the plate grid circuit, tuned winding in the grid circuit. If the coupling is loose the selectivity will be a certain amount, and may be greater than the selectivity of the doubly-tuned transformer of equal or even looser coupling. However, gain is another consideration, and to keep this high the singly-tuned type uses tight coupling, while the other invariably uses rather loose coupling, and besides affords excellent gain due to both circuits being tuned. When the peaking is accomplished both circuits of the double type transformer are tuned as near as may be to the same frequency, and while the result is not a single frequency, but a narrow band, the attenuation 10 kc off resonance for stated input may be better than in the instance of the singly-tuned transformer. The theory you suggest is of course correct, but the effect of the two types in respect to selectivity depends very much on the degree of coupling.

Station Sparks

By Alice Remsen

AUDITIONS AND CONTRACTS

Auditions and still more auditions for Fall programs! No less than nineteen contralto warblers competed for the Ex-Lax contract. Three made the grade for final auditions—two Columbia artists and one freelance. As might be expected, one of the Columbia staff won out and so you will hear the voice of Gertrude Neissen, combined with the music of Isham Jones' Orchestra and the comedy of Lulu McConnell, when the chocolate laxative reaches the air. . . . At the pre-showing of the Metro-Goldwyn-Mayer film, "Broadway to Hollywood," a great many radio stars were seen. Paul Whiteman was among them; first time I had seen him since the shrinkage; and has he shrunk? Well, rather! He looks great! Ted Husing was popping around all over the place, and so was Nick Kenny, the poetically inclined radio editor of the New York *Daily Mirror*; and music publishers? yes; they were there in droves. The film tells the story of a vaudeville family, from the 1880's to the present day; very true to life. Alice Brady and Frank Morgan give marvelous performances. The National Variety Artists, Inc. attended in a body; marched from the N. V. A. Club to the Capitol Theatre, with flags, torches and a drum corps. Lot of fun; eyes were wet before the end of film. . . . Understand that Rocco Vocco, for many years with the Feist Music, Inc., has left that firm to go with Bobby Crawford and the De Sylva, Brown & Henderson firm; wish him lots of luck! . . . Jack Pearl will retain the role of Baron Munchausen this season; same sponsor, but the show will be for one half hour only, Saturdays 9:00 p. m., WEAF; opening program, October 7th. . . .

* * *

WHAT THEY'RE DOING—AND WHERE!

American Oil Company (Amco) is the next new show to be auditioned. Style of program not yet decided upon; probably name band and singer, with comedy skit here and there; it will be heard over the Columbia air-waves. . . . J. C. Nugent, the playwright-actor-manager, has a thirty-nine week contract with Dill's Mixture, over NBC, starting some time in October. . . . It is quite likely that you will hear the voice of Patricola, erstwhile vaudeville headliner, on an NBC sustaining series very shortly; her audition was favorable. . . . Peter Dixon has caused considerable talk, and made many literary gents look to their laurels in the field of radio, since his "Children of Israel" skit on Al Jolson's broadcast the other evening, came over the air so well. You did one sweet job Peter! Congrats! . . . Did you hear Roy Atwell on WEAF last Friday evening at 9:00. He's as funny as ever. . . . Myrt and Marge are unlucky again. Myrt is in a hospital in Los Angeles after being seriously hurt in an accident; Marge is stranded in the Andes, where she went in search of local color for their skits during the coming season; snowbound, of all things. . . . To those of my readers who have been inquiring as to the whereabouts of Frank Knight, erstwhile Columbia announcer; he has been signed up by WMCA; which reminds me that Al Smith, our own beloved ex-governor of New York, is interested in the management of that station; and the new chain is materialising; within a week or so, WMCA expects to have eleven stations hooked up, reaching as far West as Michigan. . . . Virginia Rae, who was the Olive Palmer on the old Palm-Olive Hour, is scheduled to sing at one of the concerts to be held during September in the Madison Square Garden, New York. . . . Welcome Lewis is still playing in vaudeville. . . . Jack Arthur made such a hit during his engagement at the old Roxy Theatre, New York recently that a route is being laid out for him immediately at a big figure and Jack will make more money this season than ever before. . . .

* * *

ANOTHER NEW CHAIN

Another new local station tie-up has been announced; the Biow Advertising Agency and a noted watch manufacturer have united to establish a local chain, with WODA and WAAM as the nucleus of the hook-up. . . . And now it comes out that Conrad Thibault, the baritone, has so much radio work he is forced to turn down a few programs; he's a lucky man; there are plenty of excellent artists starving to death these daays. . . . Muriel Pollock is back from her European trip. . . . Great Moments of History goes into the discard on October 8th and a new show steps into its place, with Ozzie Nelson's Orchestra, singer Harriet Hilliard and comic, Joe Penner. . . . One of my favorite songwriters, Allie Wrubel, has a new song with the Berlin firm which will be heard plenty over the air-waves in the next few weeks; it is titled "And So Goodbye"; think it's a hit. . . . Arthur Pryor, Jr. will be a busy man early in October, when the famous program, "March of Time," goes back on the air; Pryor directs this series, and what a job it is; ten hours a day from Tuesday afternoon, to Friday evening he devotes to its preparation, but the result justifies the time spent and the hard work necessary for its production, for without a doubt it is one of the finest programs ever sent out over the air. . . .A new three-a-week series for housewives made its debut on September 11th, with Mrs. Mary Ellis Ames, widely known economics authority, in charge; each Monday, Wednesday and Friday, 11:30 a. m. EDST; WABC and network; under the title of "Kitchen Close-ups," with Mrs. Ames giving appetizing recipes, authentic tips on kitchen savings and short cuts in the day's routine about the home. . . .

* * *

SOME BIG BOYS AND GIRLS

Harriet Lee is back again on WABC, singing with the Happy Bakers program each Monday, Wednesday and Friday; associated with Harriet on the bill are the trio known as Men About Town, although their title in this particular production is Happy Wonder Bakers; they are Phil Duey, Frank Luther and Jack Parker; Joe Green's orchestra supplies the music. . . . The Church of the Air has entered its third year of broadcasting; each Sunday through the Fall and Winter a nation-wide network will carry two half-hour periods devoted to services conducted by outstanding leaders of the Protestant, Catholic and Jewish faiths, morning services at 10:00 o'clock and afternoon services at 1:00, EDST . . . Singin' Sam (Harry Frankel) is back from his Indiana home; with the other Hoosier member of the Barbasol program, Edwin C. Hill, Sam is warbling over WABC twice weekly, Mr. Hill talking three times weekly and Sam singing the Barbasol theme at each broadcast. . . . Kenneth Roberts, the CBS announcer, motored to Cincinnati for his vacation and spent some time there with his old friend, Paul Stewart, who is working at WLW, announcing, writing, acting and master-of-ceremony-ing . . . Swift & Company will open their new Fall series some time in October; the program will emanate from Chicago, and Olsen and Johnson, those two clever comics, will be starred; band and supporting cast not decided upon at this writing. . . . Those popular and dramatic episodes in the life of "Marie, the Little French Princess," will continue over a Coast-to-Coast network this Fall;Tuesdays, Wednesdays, Thursdays and Fridays, 1:00 p. m. EDST; this program is sponsored by Louis Philippe, Inc., and features Ruth Yorke as the Princess, and James Meighan, nephew of Tom Meighan, as the young American hero. . . .

* * *

AND STILL THEY COME

The "Bill and Ginger" program has a contract renewal. Very glad to hear it; these young folk are clever, and the script is fine, written by my old friend from WOR days, Arthur Q. Bryan. . . . Goldy and Dusty are still holding their own on WABC each morning at 9:15. .. . That unique person, known as The Voice of Experience, is back on the air-waves, giving advice to poor human sadly in need of that very useful commodity; he has an evening program now, coast to coast, which started on Tuesday, September 12th, from 8:30 to 8:45 p. m., EDST. . . . Walter Preston is singing just as well as ever; you can hear him in the new NBC Sunday night show, "Light Opera Nights"; this show will bring back memories to you of that fine old show of Philco, when Jessica Dragonette first started to sing over the air; the same theme song, "Memories," will be used; Harold Sanford will conduct, and Henry Neeley, the old stager, will be the musical master of ceremonies. . . . Betty Washington is doing some good work with her combination vocal and instrumental trio over WOR; each Wednesday, 10:15 a. m.; the three girls are Betty Washington, Myrna Westcott and Willa Renard, known as the Rainbow Trio; under the management of Vincent Sorey . . . Jerry Macey and Ed Smalle, with Roger Bower, have lots of fun during their Household Finance program over WOR each Wednesday at 9:15 p. m.; they dig up the funniest old numbers and put them on with all the trimmings. . . . Sidney Ten Eyck has been retained permanently by WOR and so his engagement with WCAU, Philadelphia has been indefinitely postponed; Sid is looking marvelous, and has developed into a regular Broadway Beau Brummel . . . Must run along now. See you here next week.

A THOUGHT FOR THE WEEK

THAT N. R. A. CODE is a great thing for radio, as it is for all other fields of American activities. We're just wondering what effect it will have on the efficiency of some of those sets that don't seem to be willing to do their share in entertaining the family or giving complete satisfaction to the technician. Can a set listen as well as make a noise?

TRADIOGRAMS

By J. Murray Barron

The Fansteel Products Co., Inc., of North Chicago, Ill., announces the appointment of Carl G. Howard as sales manager of the battery charger division. Mr. Howard was an early operator of an amateur radio station, from which he branched into the broadcasting and sales activities.

* * *

That the popularity of set construction is widespread was conclusively proved from a survey recently made in connection with the mail order business. A completely wired receiver was offered at a very low price, with little off for the parts to wire the kit yourself, yet the requests for diagrams and parts was so large in proportion that it left no doubt as to whether kits could be sold. In fact, to one who would specialize in kits the competition would be far less than in attempting to sell a wired receiver. With a few good numbers in the kit line, with a reasonable price and proper publicity, a substantial business could be created. The field is so large that the surface isn't even scratched.

* * *

After the lean years of both storekeeper and the public, now to see the decided change surely makes a fellow feel like living. It's like recovering from a bad illness, or the passing of a terrible storm, with the sun bright after it has been hidden for days. With the aid of the NRA, progress has actually been made and so many of us know dozens who have returned to work, besides other who have had incomes increased and hours shortened, that we just must believe times are on the uptrend.

* * *

RCA Radiotron Co., Inc., manufacturer of radio tubes, has signed the blanket NRA code.

Literature Wanted

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

Harry E. Coy, County Assessor's Office, Omaha, Nebr.
Bertram F. Start (Radio Service Engineer), 110 Northumberland Park, Tottenham N. 17, London, England.
Pope Radio Service, James L. Pope, 1963 East 82nd St., Cleveland, Ohio.
H. S. Miller, Box 235, Spindale, N. C.
W. H. Crafts, 3050 West Euclid, Detroit, Mich.
C. B. Dickey, 1718 Monroe, Toledo, Ohio.
G. Pasquale, Wellsville S. W. League, 100 Main St., Wellsville, N. Y.
Aubrey E. Fales, 12 Marvin Ave., Shelby, Ohio.
Oval L. Robinson, 306 Tippett Ave., Morehead, Ky.
Harry Boerstler, 2619 Park Ave., Cincinnati, Ohio.
Joseph Ingentoff, 336 Locust Ave., Port Chester, N. Y.
M. H. Ryder, 257 So. Palm Drive, Beverly Hills, Calif.
Fred J. Haskell, 532 Ash St., Waukegan, Ill.
Gustav Harms, 1318 Addison Street, Chicago, Ill.
A. E. Philbrick, Roxbury, Conn.
C. M. Findley, 133 E. State St., Kennett Square, Penna.
C. A. Kemnitz, Eldorado, Wisc.
Frs. Coupal, Brebeuf Co., Terrebonne, P. Q., Canada.
G. B. Martin, 3328 Palmer St., Chicago, Ill.
John Meehan, 219 Genesee St., Utica, N. Y.
N. M. Dahlberg, General Merchant, Valemount, B. C., Canada.
Boris Tolmachoff, "Plum Cottage," Vance Ave., Lavallette, N. J.
Jack Litwin, 576 James St., N., Hamilton, Ont., Canada.
D. W. Rosenzweig, 124 Sterling Ave., Lafayette, Louisiana.
A. N. Horne, care Empire Pipe Line Co., Bartlesville, Okla.
E. L. Horne, General Radio Repairs, Batesburg, S. C.
W. M. Horton, Lock Box 462, Douglas, Wyoming.

MAGNET WIRE TABLE

The magnet wire table herewith is useful for determining axial length of coil windings, or, if the length and wire size are known, the number of turns, and indirectly the inductance.

Another useful purpose is determination of the approximate amount of wire for current shunts across meters. Moving the decimal point three places to the left, under continuous current ohms per 1,000 feet, gives the resistance per foot. For instance, No. 40 wire has a c-c resistance of a little more than 1 ohm per foot. From the known meter resistance and sensitivity, the required shunt may be calculated, the approximate length of wire obtained from the table. For low resistance shunts do not use the finer wires.

Turns Per Inch

B. & S. Gauge	cc. Ohms per 1,000 Feet	Single Silk	Double Silk	Single Cotton	Double Cotton	Enameled	Enameled SS	Enameled DS	Enameled SC	Enameled DC
14	2.525			15.6	13.6	15.2			14.1	13.3
15	3.184	16.9	16.3	16.1	15.1	17.0			15.6	14.8
16	4.016	18.9	18.2	17.9	16.7	19.1	18.4	17.7	17.4	16.3
17	5.064	21.2	20.3	19.9	18.2	21.5	20.5	19.7	19.3	17.9
18	6.385	23.6	22.6	22.1	20.2	23.9	22.8	21.8	21.4	19.7
19	8.051	26.3	25.1	24.4	22.2	26.8	25.4	24.2	23.6	21.5
20	10.15	29.4	27.8	27.0	24.3	30.1	28.4	26.9	26.1	23.6
21	12.80	32.7	30.8	29.8	26.7	33.7	31.6	29.8	28.9	25.9
22	16.14	36.6	34.2	33.0	29.2	37.7	35.0	32.8	31.7	28.1
23	20.36	40.6	37.7	36.2	31.6	42.3	39.0	36.4	34.9	30.6
24	25.67	45.2	41.6	39.8	34.4	47.1	43.1	39.8	38.1	33.1
25	32.37	50.2	45.8	43.6	37.2	52.9	47.8	43.8	42.8	35.8
26	40.81	55.8	50.5	47.8	40.1	59.1	52.9	48.0	45.7	38.6
27	51.47	61.7	55.5	52.0	43.1	66.2	58.4	52.9	49.7	41.4
28	64.90	68.4	60.9	56.8	46.2	74.1	64.5	57.8	54.0	44.4
29	81.83	75.1	67.1	61.3	49.2	83.3	71.4	64.1	58.8	47.6
30	103.20	83.1	73.2	66.5	52.5	92.2	77.8	69.2	63.0	50.3
31	130.10	91.5	79.3	71.9	55.8	103.4	85.6	75.3	68.1	53.5
32	164.10	100.5	86.5	77.2	58.9	115.6	93.8	81.6	73.2	56.6
33	206.90	110.1	93.6	82.8	62.1	129.3	102.7	88.2	78.5	59.7
34	260.90	120.4	101.0	88.4	65.3	144.9	112.3	95.2	84.0	62.8
35	329.00	131.4	108.5	94.3	68.4	162.3	122.5	102.4	89.6	65.9
36	418.80	142.8	116.2	100.0	71.4	181.8	133.3	109.8	95.2	68.9
37	523.10	155.0	124.2	105.8	74.3	202.4	144.1	117.1	100.6	71.7
38	659.60	167.7	132.2	111.6	77.1	227.7	156.4	125.1	106.4	74.6
39	831.80	180.5	140.2	117.2	79.8	252.5	167.7	132.2	111.6	77.1
40	1,049.00	194.5	148.3	122.8	82.3	280.1	179.5	139.4	116.6	79.5

CORPORATE ACTIVITIES

CORPORATION REPORTS

B. F. Keith Corporation and subsidiary companies—Net loss for quarter ended June 30, 1933, $187,127, against a net profit of $43,101 for the quarter ended March 31, 1933. The net loss for the six months ended June 30 was $144,025, compared with a net income of $233,424 for the corresponding period of 1932.

BANKRUPTCY PROCEEDINGS

Assignments

Lyman Radio Mfg. Co., Inc., address, 142 Liberty St., New York City, assigned to Fred S. Hare, of 15 Vanderbilt Ave., New York City.

Musique Radio Mfg. Co., Inc., 142 Liberty Street, New York City, also assigned to Fred S. Hare, 15 Vanderbilt Ave., New York City.

Petitions Filed—Against

Plaza Music Co., Inc., radio and music store, of 10 West 20th St., New York City, petition filed by Electric Motive Mfg. Co., for $624; by William Brand & Co., for $32; and by Concourse Condenser Co., for $389.