MODERN RADIO

EDITED BY ROBERT S. KRUSE

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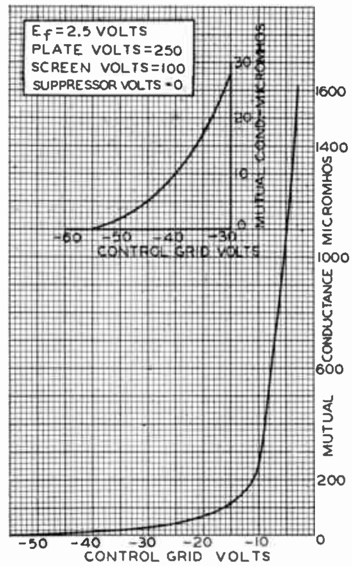
May Number 11 20 cents

Brand New Tubes Galore!

—'46—'56—'57—'58—'82

NATIONAL'S SHIELD FOR THE '57 AND '58



Control curve of R. C. A.'s type '58. Variable-mu action shown by almost straight high-mu and low-mu section. High amplification is provided by the steep section, while the long-long low-mu section prevents strong-signal overloading.

THE '57 AND '58 PENTODES

The r.f. pentode of the variety represented by the '57 and '58 is "something else again" from the audio-output type such as the '47. In a month with less new tubes we will have opportunity to explain—not now.

Briefly, the two new tubes are of the same general family, but the '58 is of the variable mu type. Both have "suppressor" grids between the screen and plate preventing damage from the rather common condition in which the screen momentarily is more positive than the plate.

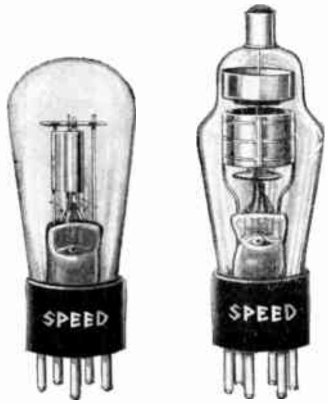
The construction suggests that the tube should be materially better than the '24 for 5 meter r.f. amplification—though it may be mentioned in passing that gains of about 3 to 5 per stage are possible with the '24 used carefully. As was prophesied in this paper (March) the trend away from super-regenerative reception has begun—and if the '57 and '58 are not as suitable as we think—there will be another tube. The '57 is a good bias detector, when worked with a one-quarter megohm coupling resist-

	Type '56	Type '57	Type '58
Filament Potential—Volts	2.5	2.5	2.5
Filament Current—Amperes	1.0	1.0	1.0
Plate Potential—Volts	250	250	250
Screen Potential—Volts	—	100	100
Control Grid Potential—Volts	—13.5	—3	—3
Plate Current—M. A.	5.0	2.0	8.2
Screen Current—M. A. (nominal)	—	1.0	3.0
Plate Impedance—Ohms	9500	1,500,000	800,000
Amplification Factor—	13.8	1500	1280
Mutual Conductance—Micromhos	1450	1225	1600
at-40 Volt Grid Bias—Micromhos	—	—	10
at-50 Volt Grid Bias—Micromhos	—	—	2
Base	Small 5 prong	Small 6 prong	Small 6 prong
Overall Height	4¼"	4⅞"	4⅞"
Kind of Tube	Improved '27	r.f. pentode	r.f. pentode variable mu.

ance, a grid voltage of minus 6 and everything else as in the table above.

THE IMPROVED '27—
i.e., THE '56

The '56 can be read off from the table and the curves. It is an improved '27,

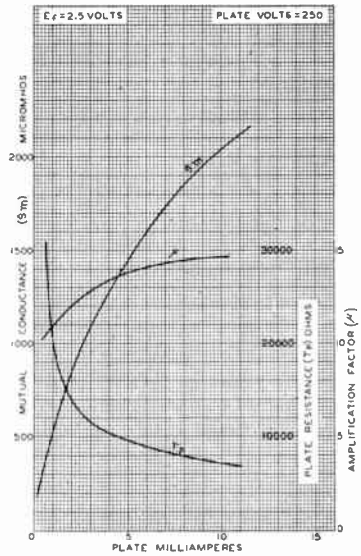


Speed's '56 and '58.

taking less current, using less space—and doing a better job. Why say more?

THE '82 RECTIFIER

The '82 rectifier was described in our April issue, page 21.



Curves on R. C. A.'s '56.

THE '46 "CLASS B" TUBE

This tube is discussed in the Class B story on page 12.

FEDERACION RADIO-TECNICA DE AMERICA-LATINA

From small beginnings four years ago the Federacion Radio-Tecnica de America-Latina has grown until its correspondence covers thirty-two countries at present. Its purposes as expressed by its organizer, Sr. Luis Lopez Romera, are to further radio experiment and study in all Spanish-speaking countries.

In additions to letters and bulletins the Federacion holds local meetings. In a recent meeting at Los Angeles 65 were present. The speaker was "Modern Radio's" Western Representative, Don C. Wallace.

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Editor
ROBERT S. KRUSE

Associate Editor
L. W. HATRY

Business and Advertising Manager
N. T. YOUNG
Tel. 5-2733

Contributing Editors—BOYD PHELPS, PERRY O. BRIGGS, R. R. BATCHER.

Advertising and Subscription Representative for California, Washington and Oregon, Don C. Wallace, 4212 Country Club Drive, Long Beach, California

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The Phelps "No-Loss" Antenna

An Antenna System Without Insulation

In March "Modern Radio" Mr. Boyd Phelps described his startling circuit for getting 500 watts (half a kilowatt) from a crystal oscillator, and suggested that a special antenna was helpful in doing this. Here is that antenna.

Briefly the antenna is a vertical quarter-wave affair, projecting up through a wheel-shaped counterpoise whose wires are also a quarter-wave long. The theoretical values seldom work out correctly in these things and in practice it was found that the antenna structure could be made 73 feet high overall whereupon the range of 75 to 85 meters could be covered by changing the counterpoise wire-lengths from 58 to 66 feet without materially affecting the "no loss" feature.

Now then—the first mast-section is a telephone pole, the second a squared timber and the third one a copper tube—clamped to the second section without insulation! It isn't necessary to worry about insulation because there is neither current nor voltage at that point—by theory and by test. Several feet above the wooden topmast a number of wires (2 shown) are taken out over cross-arms, thence down to another pair of cross-arms at the top of the mainmast and finally down to turnbuckles (no insulators) hitched to ringbolts in the mast. This wire cage surrounds the mast and (as Faraday proved long since) a reasonably complete cage keeps electric fields out. A considerable variety of tests have shown that the cage works as stated. Furthermore, it is quite o.k. to use the uninsulated turnbuckles for this is the nodal point of the system and for quite a distance in both directions there is nearly zero voltage to ground. From each ringbolt a counterpoise wire departs to a post and these, as well as the cage-wires are bonded to a ring which is seen to surround the mast below the eyebolts—further insuring that said bolts do not receive any potentials.

Of course one can't josh the electrons forever—when they arrive at the ends of the counterpoise wires some voltage does result as they bounce back, but there are many wires, they are but 7 feet off the earth, and therefore the capacity is large, the voltage low—and the loss small.

Tests with both scale models and a full-sized structure have shown this antenna to have the performance which one would expect of an extremely low-loss, although the structure is simple as compared to most recent antennas. The counterpoise shape can be varied, and feed is possible in a wide variety of ways, voltage-feed to the end of a counterpoise wire by means of a one-wire or "Zeppelin" feeder being one of the easiest of all.

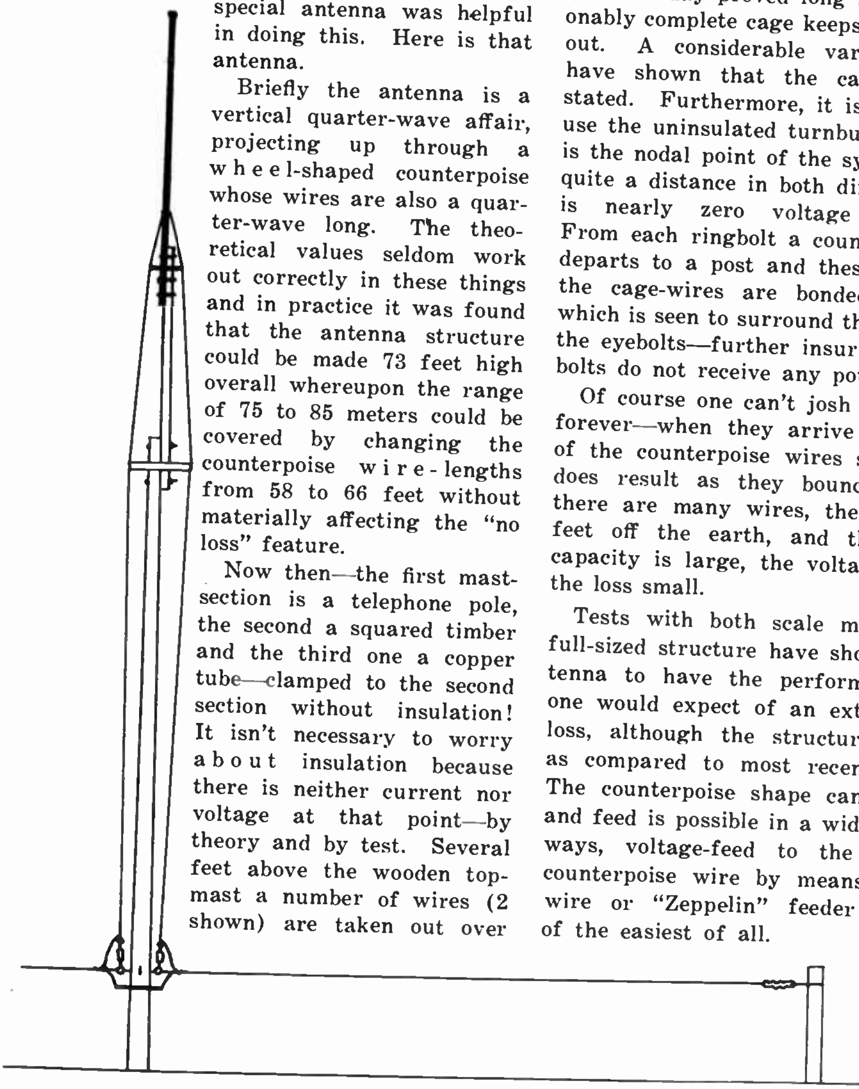
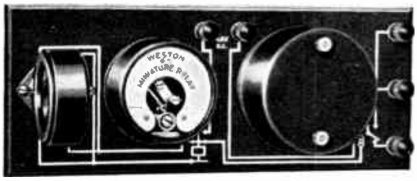


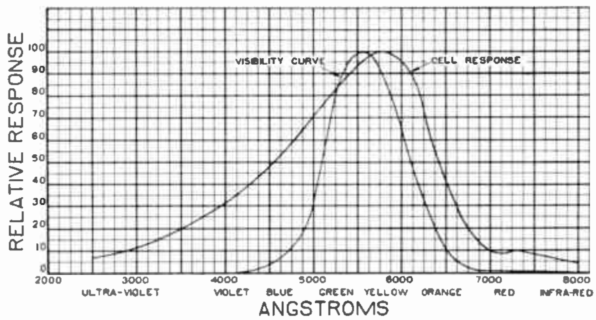
Photo-electric Experimental Apparatus



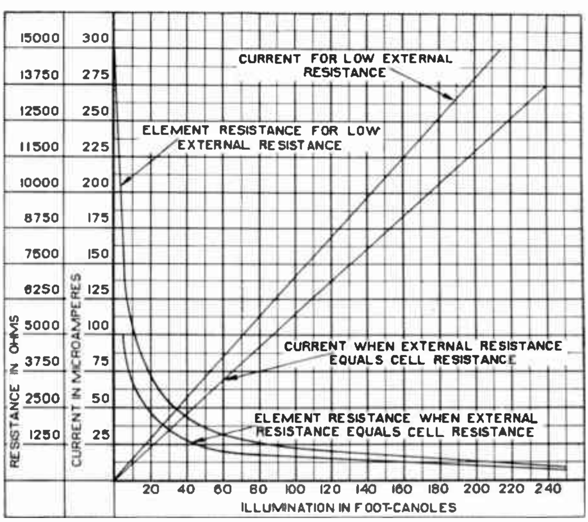
The experimenters' panel. At the left is the photronic cell which is merely plugged in and hence removable. The sensitive voltmeter-relay is at the center and the "power" relay at the right. The parts can be bought separately.

The well-known "Photronic Cell" of the Weston Electrical Instrument Corporation is now being supplied panel-mounted with two relays which permit the cell to control moderate powers around 100 watts. The cell itself controls a relay of the contact-making volt-meter type, which in turn controls a "power relay" whose contacts are designed for 1 ampere at ordinary lighting-circuit voltages. An experimenter's booklet has been prepared which shows a considerable number of light-control arrangements which will suggest ways of attacking the particular problem the experimenter has in mind—for of course no proper experimenter ever copies exactly what he finds in the book!

The frequency - against - sensitivity curve of the photronic cell appears herewith, and will be seen to have the same general shape as the eye sensitivity curve, but to extend further in both directions, especially into the longer infra-red territory. Thus the cell may be used for "invisible light" signalling and control experiments. Incidentally—one may manufacture either of these kinds of light rather easily. The ordinary sun-lamp is a source of considerable light in the ultra-violet region and almost anything which runs above a dull red provides more or less infra-red. For example, an ordinary Mazda lamp with a thin hard-rubber sheet for a filter provides a fairly decent "dark-light" source. Black paper serves in a pinch.



Sensitivity against frequency, as compared with the human eye.



The photronic cell as an illuminometer.

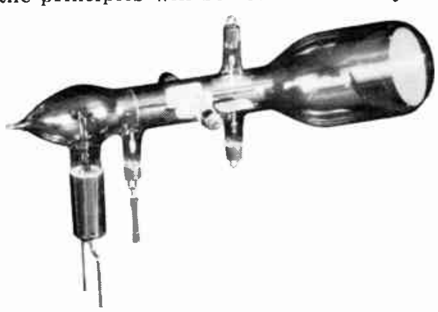
The Photronic Cell

How To Use Cathode Ray Tubes

By R. R. Batcher*

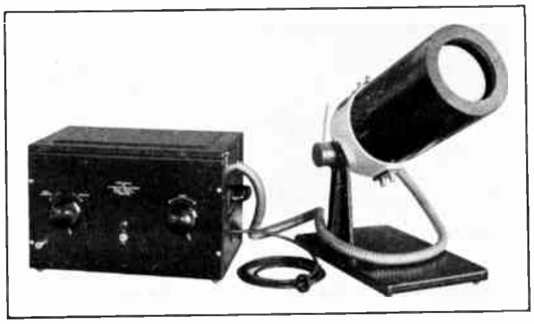
Although one of the oldest of all electronic tubes, the cathode ray tube has never received the attention it deserves. During the last few years improvements have made it more simple to operate and relatively cheap to use. The most attractive improvements have been those which have given the tube longer life, greater brilliance and easier focusing. It has long since demonstrated its usefulness in a great many applications, yet experimenters and engineers seem unaccountably slow to take advantage of its capability of delineating high-frequency currents, and to compare two factors, without necessarily bringing time into the problem. While it is true that the cathode-ray oscillograph has only one "vibrator", this vibrator has two degrees of freedom—that is, it can be moved in two directions which makes possible many unique and exceedingly useful tests—not to speak of such special work as television.

Before going into the practical uses the principles will be reviewed briefly.



A Cathode-Ray Tube.

The tube (see Fig. 1) must contain, (1) a source of electrons such as a heated filament, (2) an anode to attract the electrons and give them velocity along the tube. The electron jet (R in Fig. 1) is shot through a small hole in the anode at a speed sufficient to carry the electrons to the far end of the tube where they strike the screen. (3) means



General Radio

A portable cathode-ray oscilloscope with power supply. The potentiometer at the left controls the potential on the anode, to make the tube more brilliant (right) or more sensitive (left). The right-hand knob controls the focussing field.

for deflecting the jet so as to make it useful. This can be done by coils (magnetic field) outside the tube, or by condenser plates (static field) inside as in Fig. 1. Finally there is needed (4) the fluorescent screen which makes the gyrations of the jet visible. An additional requirement (5) is a means for focusing the electron beam into a fine jet. This may take many forms and had best be left for later discussion.

If the electron stream were composed of magnetic sand particles instead of electrons we would of course be able to bend the jet to the side by means of a magnet, so that it would strike at a different place on the screen. The static field of the earth's gravitation would also bend the stream downward. If we could change gravity we could move the point of impact up and down. In a quite similar manner the electrons in the jet can be bent aside by a magnetic field, or by a static field (electrostatic in this case). We cannot see the stream bend, as we could in the case of the sand-blast jet, until we make the electron-path visible in some manner. In the usual tubes the path is made visible by the glowing gas molecules which it strikes as it travels toward the screen—

* Consulting Engineer, 113-35 198th Street, St. Albans, L. I.

so that the jet is nicely outlined in blue or purple. To make the point of impact on the screen more apparent, certain chemicals are coated on the screen where the electron jet is likely to strike. These chemicals glow brilliantly where the jet strikes them—for the same reason, and in the same general way as the figures on a "radiolite" watch dial—but the effect is much more intense. A common type of such "fluorescent" material is Willemite, a kind of quartz sand containing zinc. This sand is found naturally in many places.

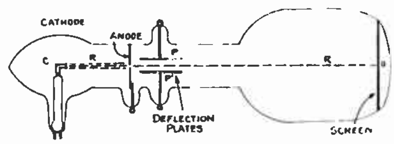


Fig. 1. Schematic sketch of a cathode-ray tube. A cathode-ray tube. The cathode is at the extreme left, then the flat plate or anode with its central opening, next the two pairs of deflection plates and finally the round screen.

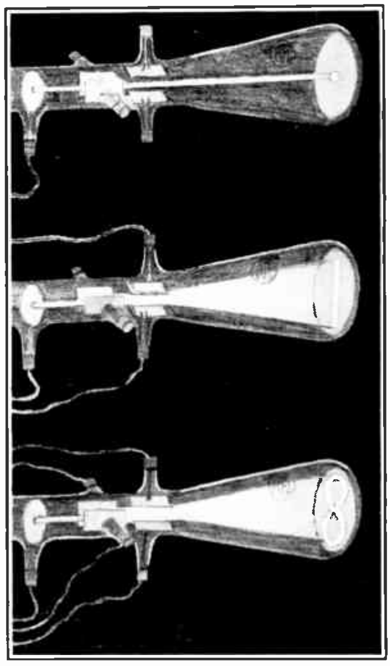
One very essential auxiliary piece of equipment is a power supply which furnishes filament and plate voltages for the tube in the usual way. The former is generally at a voltage below 2½, and sometimes is a. c.; the latter ranges from 200 to 3,000 volts depending on the screen-brilliancy desired, and must be d. c. The greater the anode potential used the less sensitive the tube is, since it is obviously harder to bend a ray of very high-speed electrons. At the same time the brilliance of the spot on the screen is dependent on the anode voltage and higher voltages are necessary when a bright spot is necessary—as when the spot is moving very fast or is to be photographed.

The value of a cathode ray tube depends upon its:

1. Sensitivity; an average tube requires a potential of about 45 volts to swing the spot across the screen. For many tests it is desirable to do this with less voltage, to eliminate the need for amplifiers.

2. Brilliance; for high frequency work the spot moves very rapidly over the screen. It is desirable to be able to discern the path even though the spot traverses it but once. For photographic records of the diagram this is an extremely important consideration. Brilliance is mainly due to the type of fluorescent salt used as screen coating and to the anode voltage, as mentioned above.

3. Accuracy; the movement of the spot should be directly proportional to the applied voltages to the deflection



Cathode-ray tubes in action.

At the top, filament lighted and anode voltage applied, with ray properly focussed and centered.

In the second tube a. c. has been connected to one pair of deflection plates and the ray is swinging up and down, the spot on the screen becoming a line.

In the third tube the timing wave has been connected to the other pair of deflection plates, swinging the ray sidewise. The "figure 8" on the screen shows that the ray is making two sidewise swings for each up-and-down swing, therefore the timing-wave has twice the frequency of the other wave. If the frequency had been the same the picture would be one of those in the first column of Fig. 2.

slates, at any portion of the screen, and for any frequency.

4. Life; the life of a tube depends (with most designs) on the active life of the cathode. In many cases the active coating on the cathode wears out before the filament has actually burned out. In modern tubes some considera-

tion is given to the problem of preventing violent bombardment of the filament from positive ions, which tends to destroy the activity of the oxide coatings.

5. Focusing; some simple means should be available to focus the ray to a small spot. In many tubes this can be done with an accurate adjustment of the filament current and anode potential. In other tubes an auxiliary electrode is provided for this purpose. In some tubes this takes the form of a coaxial cylinder inside of the tube, surrounding the filament. This cylinder is usually kept at a negative potential with respect to the filament. In other cases the electrode is a disc with a small central hole, interposed between the cathode and anode. This plate is kept at a potential positive (with respect to the cathode) but having a value considerably less than the anode potential. In either arrangement the actual potential must be closely adjusted to the required value. The focusing electrode, when available in tubes, is also useful for other purposes as well, such as in making frequency comparisons and for television.

In the ordinary vibrating-mirror oscilloscope or oscillograph, a time scale is produced by a synchronous motor driving a rotating mirror. (See Reinartz article, February "Modern Radio".) There is nothing in the cathode-ray tube which is capable of producing a time scale. For this reason many tests are made with the wave-to-be-investigated applied to one pair of deflection plates (see illustrations) while a "timing wave" of known wave-form is applied to the other pair of deflection plates. This requires a timing oscillator, of which several types are available. In any oscilloscope the effect of a timing device is to show on the same screen successive sections of the curve produced by the voltage (or voltages) being investigated.

Imagine that this curve is somehow marked or printed on a long transparent film—the length of course being due to TIME. If this long picture is to be gotten into the limited area of the oscilloscope screen several possible schemes occur to condense it. One method would be (A) to wrap the film around and around a glass cylinder, and then to look through the whole thing in that form. Another way (B) is to fold it up into a zig-zag by creasing at regular intervals —whereby every second section is reversed as to direction in the finished pile. A third scheme would be to (C) cut the

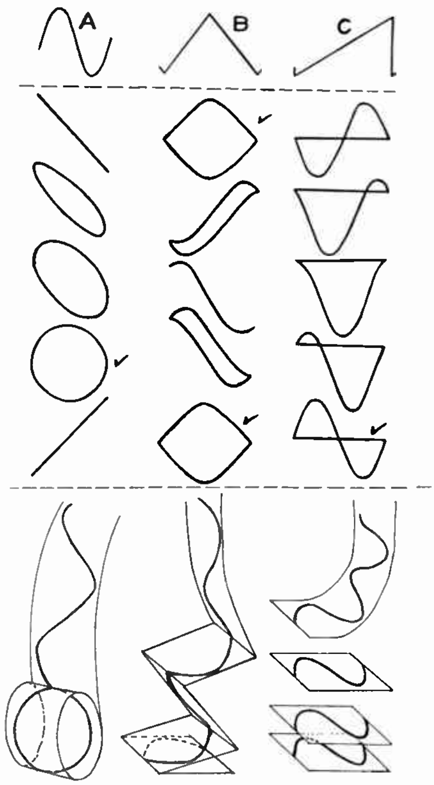


Fig. 2. Effect of different timing-waves. If sine-wave a. c. is connected to one pair of the tube's deflection plates the curves shown in each column can be produced by connecting to the other pair a timing wave of the same frequency, and of the shape shown above the dashed line.

A is a sine-wave and produced the "rolled up" effect (see text).

B is a saw-tooth wave and gives the zig-zag folding (see text).

C is a snap-back wave and produces the cut-and-pile effect, with the straight snap-back line added.

A and C are the most useful.

The mechanical equivalent of each folding method is shown at the bottom of the column. The folding is in each case producing the curve checked in the column above.

film into short sections and pile them all up. In any of these cases the resulting roll or stack would be rather meaningless unless we knew which method had been used.

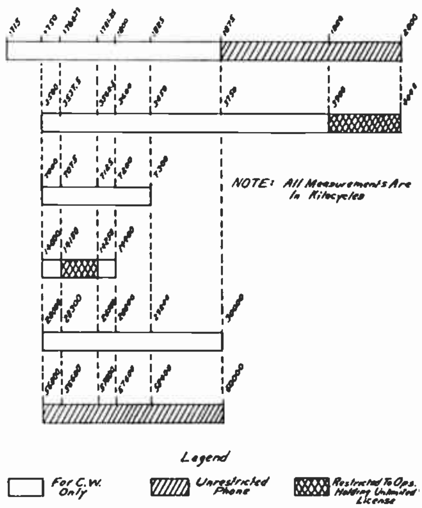
In the cathode-ray tube we do not have a long film, but we do have a crease which is ELECTRICALLY folded so as to get all parts on the screen. The folding is done automatically by the timing oscillator as already suggested. For example—suppose that sine-wave a.c. were connected to one pair of deflection plates and to the other pair there were connected a "timing wave" OF THE SAME FREQUENCY from an oscillator giving a sine-wave form (A in Fig. 2). The resulting diagram on the screen would take one of the forms shown in the first column, depending on the PHASE relation between the timing wave and the measured wave. That this is really equivalent to the "wrap around" method can be easily shown by drawing a sine-wave—or a number of them—on a film or piece of thin paper and wrapping this around a cylinder just one wavelength in circumference. When it is viewed from different angles (different phases) the forms shown in the first column of Fig. 2 will be seen. If the timing oscillator waveform is of the "Sawtooth" type shown in Fig. 2B, the effect is of zig-zag folding and the diagram on the screen takes one of the forms in the second column, according to phase. This also can be shown by tracing the long sine curve on a long film or thin paper and folding zig-zag in one-wave-length parts. The various forms will be seen on looking through the stack—depending on where in the wave (phase) the crease was made. The electrical equivalent of the crease-location is of course the phase of the timing wave with respect to the measured wave. Finally if the oscillator wave form is of the "Snap Back" type shown in Fig. 2C we will have the effect of "cut and pile" in pieces one wavelength long. The straight return-line of the snap-back is added, however.

Types (A) and (C) are usually used since it is extremely difficult to produce waveform 2B that is symmetrical (having equal slopes). Any sine-wave oscillator will give the A waveform while the C type can be produced by a modified glow lamp flasher oscillator, or with a mechanical voltage divider such as a rotating potentiometer and a source of direct current of suitable voltage.

While for some measurements this contracted or folded diagram is more difficult to analyze, the rules to apply are not difficult. This form of diagram is a distinct advantage in other tests, such as studies of phase displacements, etc., wherein direct measurements of points of intersection and of the maximum deflections are utilized.

In a future article several practical applications of the cathode-ray tube will be described.

WHAT'S HAPPENED TO THE PHONE BANDS



Courtesy Bliley Piezo-Electric Co.

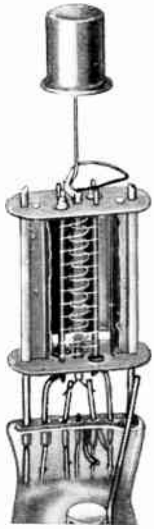
The 5-meter local band is open to all, the 150-160 band is open too—if you don't bother broadcast reception at 200 meters.

The 80 and 20 meter DX bands can't be used until you have a special license. See page 25 on passing that examination.

"I don't want to miss an issue of 'Modern Radio'."

C. H. Vincent,
Packard Proving Grounds,
Detroit, Mich.

The Wunderlich Detector Tube



Structure of the Wunderlich tube. Note the two interwoven grids. The top connection is to the cathode, because the grid system must be symmetrical, hence both grids come out through the base. The tube is also made in the 6-pin base with all connections at the bottom. Both 2½ and 6 volt heaters are available.

The Wunderlich tube comes from the Arcturus Radio Tube Co., which pioneered the commercial variable-mu screen-grid tetrode which is now universally used. If the Wunderlich tube solves an equal number of difficulties it will be a large contribution.

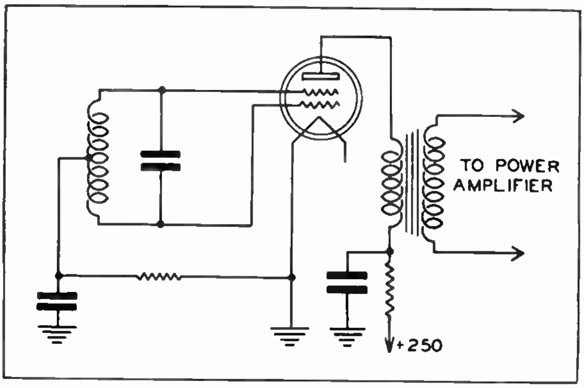
Briefly the Wunderlich tube is designed to act as a gridleak detector or detector of increased power capacity, and at the same time to provide a simpler source of automatic varying bias to be used in automatic volume control.

The action of the new tube is best understood if we first think of the ordinary '27 gridleak detector as a half-wave rectifier (grid circuit) followed by an audio amplifier in the same tube (grid-plate transfer). The rectifier is obviously a single-sided or half-wave affair, hence a good bit of the original r.f. gets through into the plate circuit. This tends to overload the plate circuit and is the main limitation on the power-capacity of the tube. Another limitation is the fact that such a detector has no bias at all until a signal arrives, hence the plate voltage must be kept low to avoid damage.

In the Wunderlich tube there are TWO grids which are co-cylindrical, in other words, the turns of one grid lie between those of the other grid. Either grid alone may be used to make an ordinary detector of the tube, but if both are connected as shown in the diagrams it will be seen that the input system provides a push-pull r.f. rectifier. As a result the r.f. reaching the plate circuit is greatly decreased and one cause of plate-circuit overload is largely removed. As a further aid in this direction the tube is operated on a high-voltage supply but the output audio-coupling is by means of a resistance or by means of a transformer in series with a resistance. Thus the plate current is limited when no signal is being received—the tube is

As used with transformer-coupled output. The secondary of the transformer will ordinarily be center-tapped and feed a push-pull pair. Note the voltage-adjusting resistor in series with the primary.

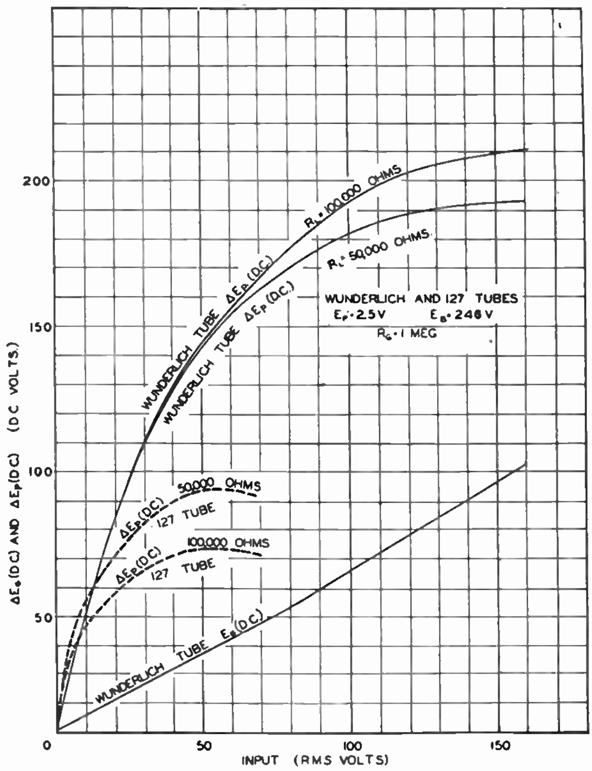
The grid-condenser, lower left, may have a capacity around .0001; the grid-leak, connected to it, a resistance of 250,000 to 1,500,000 ohms.



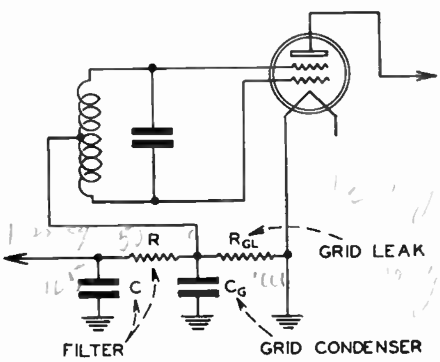
safe. When a carrier arrives a proportional bias is generated by the gridleak, the plate current drops and the plate voltage accordingly rises as needed to handle the carrier. As a result of these combined actions the tube can easily drive a pair of '45 tubes—and of course even more easily a pair of '47 tubes. The transformer is normal as the plate impedance of the Wunderlich tube is far below that of bias types.

The voltage across the gridleak is a mixture of audio and d.c. The d.c. part is proportional to the carrier. Thus, if the audio is filtered, out as shown in the diagrams, the d.c. part is useful for feeding back to preceding r.f. or i.f. tubes for automatic control of sensitivity—commonly called automatic volume control or A.V.C. This requires no separate tube as in most A.V.C. systems—nor does it require an extra audio stage as in those systems which use a diode detector and must make up for its lack of amplification by means of an extra audio stage. (See paper on Automatic Volume Control elsewhere in this issue.)

One seldom gets anything for nothing, hence one asks what the corresponding penalty is for these advantages. Fortunately it is not large. The input circuit must supply the two grids in pushpull, hence only half of its voltage is applied to each grid. Therefore the tube produces less audio than a '27 would if used as a gridleak detector—but is still materially above what would be obtained from a bias-type '27, and it has been done without the impedence-matching difficulty of the bias-type '24. In the superheterodyne type of receiver the center-tapped secondary feeding the detector offers no difficulty since it is as easy to insulate both sides of the tuning condenser as one side. If the detector follows a tuned r.f. stage it will be necessary to insulate the rotor or else to tune the primary of the transformer.



Overload curves showing that the Wunderlich tube begins with the '27 tube (gridleak) but continues above it.



Using the tube as an A.V.C. source. The d.c. voltage generated across the gridleak Rgl by the rectified carrier is filtered free of audio and stray r.f. by means of the filter resistor R and the condenser C. The lower left arrow indicates wiring feeding A.V.C. bias to tubes under control. The plate line (arrow upper right) goes to the audio coupler.

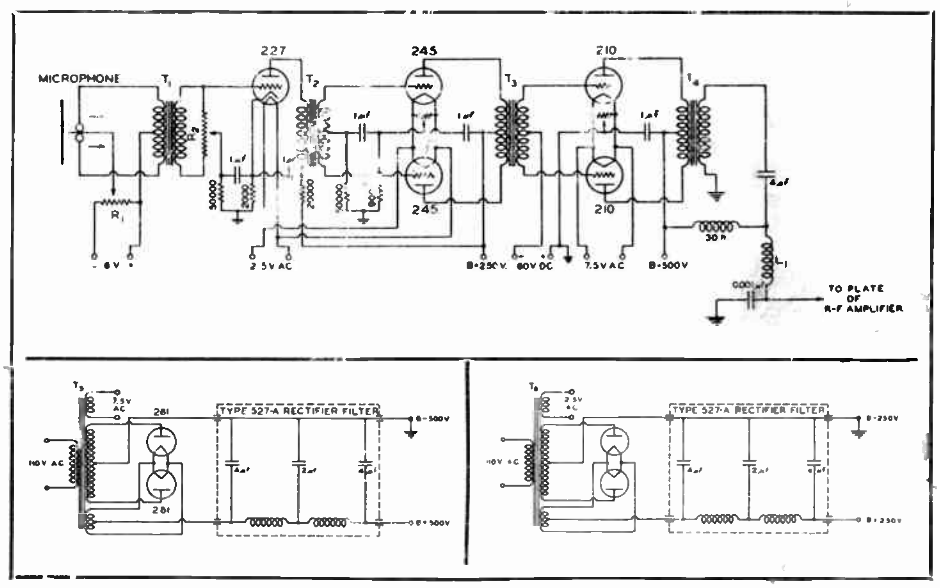
"Class B" Audio in Plain Terms

By Robert S. Kruse

First of all—a "Class B" audio stage is one in which the tubes are deliberately fed far too much audio grid-input so that they are very much overloaded, draw grid current and produce a fearsomely deformed output. Right up to the output transformer everything is just as bad as it can be—but in the output transformer the distortions of one tube cancel those of the other tube and from the secondary emerges nice high-grade audio in large quantity—maybe. In the next issue we will tell you what to do about it if the magic fails to work, and also will attempt to show why so many Class B amplifiers sound very good as long as there is lots of loud music—but sound pretty sick when spoken to softly.

In order to talk about something actual—that you are able to buy—we are taking the National and General Radio "Class B" transformers as examples. Refer first to the General Radio diagrams. You will notice that this is a speech amplifier beginning with a 2-button mike, hence a rig suitable for modulation or for working into public address horns—depending on the secondary of the output transformer T4. The front end of the system is orthodox in every way; having all the usual bias resistors, bypasses and filter resistors. The second stage does not use a single '27, but instead uses a pair of '45 tubes, because it takes power to drive the grids of the third (Class B) stage—for when a grid draws current we may be sure power is being wasted and the preceding stage has to furnish the power to be wasted. The transformer T3 must be special because of this grid current in the secondary. It must have a low secondary resistance—or else the grid current would produce a bias in exactly the same way as when we use a gridleak, and this bias would be opposing the input, causing reduced amplification. Build this transformer if you will, but the Answer Factory of this magazine will have no part in the proceedings.

The distorted output of the pair of '10 tubes is fed to the T4 transformer with prayer and while the third harmonics get through the result is surprisingly



good at ordinary levels if the bias and plate voltages stay put at the values indicated. That's a large "if". Observe that the C battery of the '10 stage must be of low resistance, and also that it will be operating with a reverse current, hence will gradually charge up to abnormal voltage and become noisy. This is not the fault of the Burgess Battery Company, but simply a bad habit of all distortion amplifiers. The plate supply must maintain its voltage reasonably well with changing loads for Class B audio draws no steady plate currents — instead the demand dives and swoops. A separate plate supply is essential. The 500 volt supply shown has been found satisfactory, providing the capaities are as shown and the choke coils do not have a total resistance any higher than 175 ohms. While '81 rectifiers are shown it is somewhat better to use the '66 variety. The filament winding feeding the rectifier need not be center-tapped, a connection at one end is o.k. The separate 250 volt supply is for the first two stages.

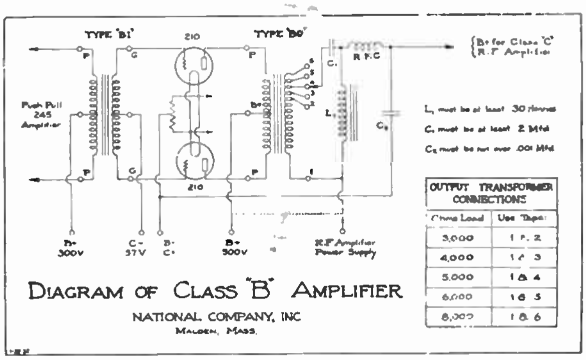
The rig as a whole is in this instance intended as a modulator and the output transformer is of General Radio's type 110—LEPPER

292B, designed to work into the plate circuit of an r.f. amplifier stage consisting of a '10 tube worked at 500 volts. The transformer constants are given below. Since T4 is not meant to carry d.c. in its secondary the output-coupling is provided through an audio choke, and audio condenser and an r.f. choke and condenser. Constants are given, L1 being the r.f. choke.

The transformer constants are as follows:

	292-A (input) T3	292B (output) T4
Voltage Ratio	1 to 1	1.7 to 1
Primary inductance at 60 cycles	70 hy	40 hy X 2
Primary resistance	620 ohms	230 ohms X 2
Secondary resistance	780 ohms	520 ohms
Max. d.c. primary volts	275	700

When it is necessary to work into some other sort of a load, such as a different tube or tubes, it is convenient to have an output transformer that is tapped. In the diagram of the National "Class B" amplifier such a transformer is shown. It is strongly recommended that one attempt to forget about the business of impedance-matching as this somewhat loses its significance when using a distortion-amplifier. It is better to think of the plain resistance of the



load. For instance if we are modulating a '10 tube which is running at 500 volts d.c. it is clear that our job is to supply to that tube half as many audio watts.. Since the resistance of the load is not always the same it is convenient to be able to change the output voltage of the amplifier so as to put the most power into the load. This can be done easily if the output transformer has a tapped secondary such as is shown in the National diagram herewith. This transformer has another design feature, C1 and L1 can be omitted, and the plate current of the '10 tube-to-be-modulated (that is the r.f. tube) can simply be fed through the transformer secondary. The wire is large enough to prevent any noticeable heating and the audio curve is changed only in that it cuts off at 100 cycles instead of 40 cycles—and one doesn't need that for speech! This—you will see—is the transformer "Modern Radio" has been so long preaching about. The connection of the dotted line MAY be used—but the separate plate supply is still to be preferred if one works the stage "Class B". Later we will have more to say on Class A stages worked in this way.

The main snag in this sort of an amplifier is of course the need for battery bias for the Class B stage. A re-

NATIONAL'S TRANSFORMERS AND CONSTANTS

	BI Input	BO Output
Voltage Ratio	1 to 1	1.66 to up to 1 to 1
Primary inductance	20 hy	20 hy
Primary resistance	150 ohms	115 ohms
Secondary resistance	200 ohms	90 to 160
Primary turns		2 x 1000
Secondary turns		1225, 1415, 15580, 1730 and 2000
Inter-winding insulation		4000 volts a.c.

sistance-drop bias of any sort does not answer very well as it varies with the wobbling plate current. To get around this nuisance there has been introduced the type '46 tube, which is an odd 2-grid affair that can be turned into a high-mu or low-mu tube by merely connecting its extra grid—but the accompanying diagram should make everything clear.

In the first position the tube is being used as a "Class A" or non-distorting amplifier. Its outer grid has been tied to the plate so as to produce a low-mu tube useful for such work. In the push-pull stage the two grids have been tied together, producing a tube of such a high mu that no bias whatever is required, the tube being nearly cut off without it. Thus it can be used "Class B" without the infernal nuisance of having to provide a separate and highly stable bias as is needed ordinarily in these stages.

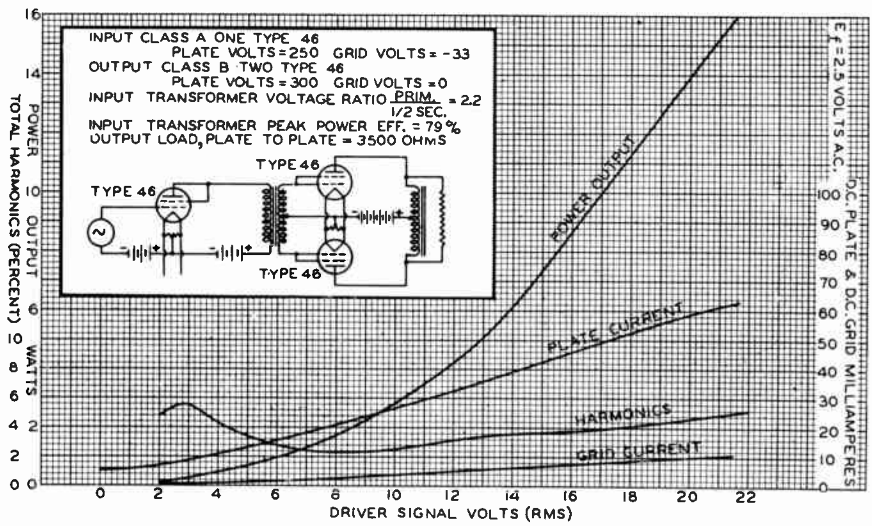
The tube has the usual 2½ volt, 1¾

ONE TYPE OF '56

ampere filament and 5 pin base. The constants are as follows:

	Class A	Class B
Plate voltage	250	400
Plate current	22 ma.	4 to 200
Grid bias	—33	0
Load resistance per tube	6400*	1300-1450
Mutual conductance	2350	meaningless
Amplification factor	5.6	meaningless
Power output in watts per tube	1.25	10

* Better make it twice this in the diagram shown below by courtesy of R. C. A.-Radiatron.



How to Install and Service Automatic Volume Control

Part 1—Basic Circuits and Installations

By L. W. Hatry, Associate Editor

This article is written from two viewpoints, that of finding troubles and that of adding automatic volume-control to an existing set. First we should understand basic circuits and functions.

Automatic volume-control is automatic sensitivity control. The sensitivity control is got, as most sensitivity control is got, by spoiling the efficiency of one or two of the r.f. or i.f. amplifying tubes, usually screen-grid type. When manual control is used the screen voltage or bias voltage of the r.f. amplifiers is varied by moving a slider on a resistance which supplies the voltage. With most automatic volume-controls of wide range and reliability, control is likewise got by varying the bias on some r.f. amplifiers but the bias is made and determined by the strength of signal and thus adjusts itself automatically. Thus if the antenna is receiving a fading signal the set automatically changes its sensitivity and the result is a steady loudspeaker output.

The machinery for an automatic volume control is seldom as complicated, in fact, as it looks to the inexperienced eye. For instance, we have in Fig. 1 the basic circuit of the automatic bias mechanism used by Philco. The tube is a 227 used as a two-element or half-wave rectifier. To the r.f. input terminals are attached a tuned-circuit or some other suitable source of r.f. signal voltage. Rectification of the r.f. produces a d.c. voltage drop across R, (the r.f. is by-passed by C). The d.c. voltage from R. to the chassis (indicated as ground) is supplied to the tubes being controlled, the connections giving polarity as shown. This automatic-bias varies with the r.f. signal. The normal bias for the tubes must be supplied as well, otherwise no signal means no bias—hence damaged r.f. and i.f. tubes. This normal bias may be got the usual way, that is with a cathode-to-chassis resistor, or better (as Philco gets it) from a resistor in the negative leg of the power supply, which resistor carries the plate current to all tubes except the power audio tubes. This keeps the normal bias essentially unchanged when the plate current of the

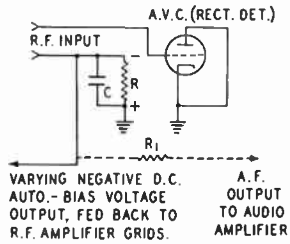


Fig. 1

automatically biased tubes (only two) is cut down by the automatic bias. The normal voltage got from the resistor (plate-current IR drop) suffers less than 20% reduction when large signals push the controlled tubes near to zero plate-current.

To make this clearer, in Fig. 2A is shown the essentially complete Philco a.v.c. circuit. The function of the 70,000 ohm R_3 resistor (between bias resistor R2 and Cathode) is to filter hum or possible a.f. feedback dropped across R2. C is an r.f. by-pass condenser 110 uufd. in capacity. R1 is an r.f. filter resistor keeping r.f. out of the audio system. The audio drop across RC is fed thru R to the grid of the following a.f. tube, which is an extra amplifier made necessary by the fact that the rectifier-detector does not amplify as an ordinary biased triode detector would. Because it performs a part of the work of the ordinary detector this extra audio stage is euphemistically called the "detector amplifier".

The rest of the Philco system would include additional filter resistors in the auto-bias line, their function (with by-passes) being to prevent audio or radio feedback to the r.f. tubes. Since the a.v.c. tube supplies a negative bias, the bias line feeds through the r.f. transformer secondaries to the GRIDS of controlled tubes, these tubes having their cathodes grounded. In a.v.c. systems giving a positive output (d.c.) the bias is, of course, fed to the CATHODES of the tubes to be controlled. This information should be checked against the diagram of any of the Philco a.v.c. receivers, 90, 95, 96, 111, 112 or 112x, to be found in a good service-manual such as Rider's Perpetual. The system is likely to give little trouble in either tubes or components: it is very easily applicable to an existing receiver.

are under the figure.

3. Now wire as in Fig. 2A and 2C but use .1 to .2 microfarad in the c.r. combination of the a.v.c. tube. If the tubes to be controlled are '35 or '51 tubes instead of the '24 type use twice to thrice the value of R.

R. C. A.-Stromberg Circuit

Let us now consider the other very widely applied system, that is used by R. C. A., Stromberg and others.

The basic circuit is shown in Fig. 3A. Fig. 3B shows a partial equivalent circuit. Notice the Rp and R are a potentiometer across the B supply. The B plus end of R is grounded to chassis. The a.v.c. tube is biased to no plate current and the r.f. rectified by the tube increases the plate current in the usual

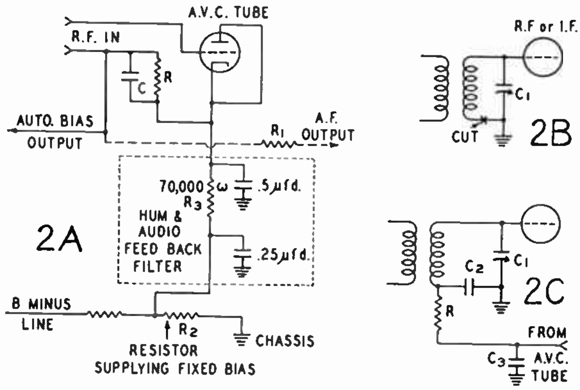


Fig. 2

A is the essentially complete Philco A.V.C. tube circuit.

B and C indicate the changes to be made in an r.f. amplifier grid circuit to apply the automatic control bias.

R of A is 200,000 ohms for 224's r.f. and C .00011 in Philco sets.

While it is quite possible to divert some existing tube to a.v.c. use, because of the danger of loss of gain, it's much safer to add a special a.v.c. tube and to leave the detector and audio system alone. Space for the tube can always be found on the chassis, even if the tube is in an odd attitude. The procedure is as follows, using Fig. 1 as a basis.

1. Install the socket of the a.v.c. tube and connect the grid terminal to the plate of r.f. or l.f. tube preceding the detector.

2. Break the grid returns of the r.f. or r.f. tubes which are to be controlled as in Fig. 2B and change to the circuit of Fig. 2C. Constants and precautions

rectifier-action manner. Thus the tube draws through R a current varying with the signal strength. As a result there is a voltage drop across R which also varies with the signal and is, therefore, suitable for use as an a.v.c. bias on the grids of an r.f. or i.f. amplifier.

In Fig. 3 I have shown the a.v.c. tube self-biasing with a cathode series resistor. This was done to simplify the diagram, it should not be regarded as an altogether satisfactory trick since it gives a.v.c. action of somewhat limited range. To obtain the full range a fixed bias should be supplied in some other manner.

The circuit of Fig. 3 as used or as applied to existing receivers is no small problem. Since R is grounded to chassis in common with the tubes to be controlled, it must start at the same negative potential as they, which means that we must move the cathode and grid of the a.v.c. tube still further negative in order that a B voltage be available in the plate circuit of the a.v.c. tube. See

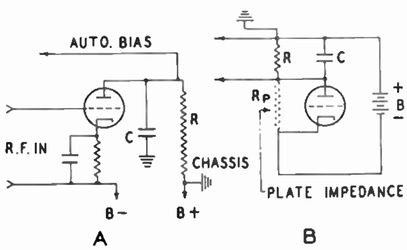


Fig. 3. R-200,000 ohms for 224's and C about .5 ufd.

Fig. 4 for the circuit as used in an R. C. A. receiver. Actually the a.v.c. tube gets its r.f. from an r.f.t. but here I indicate the r.f. drop as being across a grid-resistor for a reason that will be clear further along, and also for convenience and diagram simplicity.

Notice in Fig. 4 that the cathode of the a.v.c. tube is moved negative from chassis by the voltage drop through the filter choke L. Thus the drop across L is the B voltage for the a.v.c. tube. Although hum might be introduced because of the conditions at the center of the power-supply filter the resistors R and R3 act as filters aided by C. However, after getting B voltage on a.v.c. we must also bias its grid to no plate-current, or near that point, so we must go further negative for bias. Hence the grid "line" picks up the voltage-drop across the second filter choke (at high hum level) L1 through resistors R1, R4 and R5. R4 and R5, with two .1 by-passes, filter out the hum in the filter system, and their size is 1 megohm each. These resistors take no current since the grid is biased well, negative in relation to cathode. Of course, if the bias is too high or too low the a.v.c. action will be interfered with, this is subject to an adjustment by means of the resistance of L1 or else as will be described later. The main point now is to understand clearly how the additional voltages necessary for the a.v.c. tube are got at "below" chassis potential, and to realize without fail that such additional voltages must be supplied for the facts are as true of a battery set as an a.c. one, the only difference being the source of voltage.

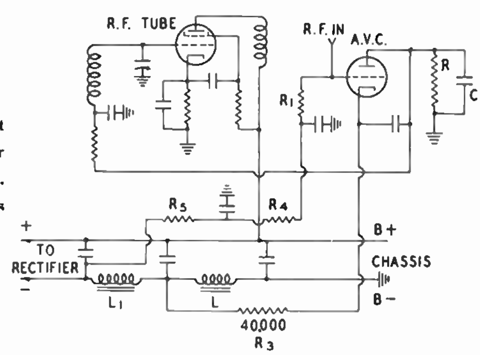


Fig. 4. A practical triode A.V.C. tube circuit showing wiring through to the r.f. tube under control. R is 200,000 ohms for 224 tubes. A.V.C. is a 227. The A.V.C. plate to cathode by-pass is a .01 ufd. mica condenser.

Part 2 will appear in June. Bias adjustment for the A.V.C. tube and tests for correst setting will be described. Also—A.V.C. time constants.

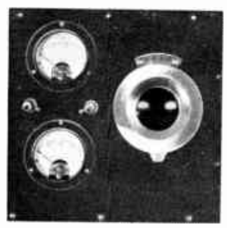
CLIVE B. MEREDITH

A Simple Modulation Indicator

By Italo A. Martino*

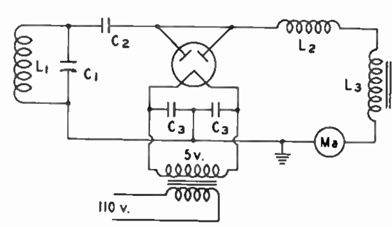
A very simple modulation indicator can be constructed in less than an hour from parts to be found kicking around the station—and it will keep the operator informed as to the modulation nearly as well as do the much more costly devices.

As the diagram shows, the indicator is nothing more than a rectifier whose r. f. input is from a tuned circuit coupled to the transmitter. The rectified output is fed through filter chokes to a d. c. milliammeter. While a 280 rectifier is shown, the arrangement will also work with other sorts of tubes such as the '99, '01A, '71, etc., provided the grid and plate are connected together at the socket terminals and a proper filament supply is used. As used by the writer at the present time all the material is mounted on a small board excepting the meter and the tuned pickup coil. The meter is mounted on the monitoring panel of the station so that it is visible at all times. The pickup coil is mounted near the antenna coil and the rectifier proper is mounted down below, out of the intense field surrounding the tuning inductances. The filament transformer is connected so that the device is turned on when the rest of the transmitter is started up. It works without any need for attention.



A dressed-up version, with a filament voltmeter, 110 volt switch for the filament transformer, and meter-protective switch for breaking the circuit between Ma. and L3.

When used as a modulation indicator only the pickup circuit is tuned "dead" to the carrier with no modulation in use and the pickup coil then moved to and from the antenna coil until the meter shows some convenient reading such as 35 Ma. on a 50 Ma. meter, retuning carefully after each movement of the coil. Care should be used; it is very easy to pick up too much power and burn out the meter. Now if a pure tone were fed through the audio system and into the modulator, the readings of all the transmitter tank circuits, the antenna circuit—and the modulation indicator—should rise, because the audio system is feeding additional power into the transmitter. If everything is right, if the tone is steady and really pure, and just strong enough to produce 100% modulation then the antenna power will be exactly 1½ times as great as before modulation, and the thermo-ammeter in the antenna will accordingly read just 1.22 times as much as before. The tuned pickup circuit of the modulation indicator will also have its current increased by 22% but since the meter is not a thermo-ammeter but an improvised rectifier-meter its reading will be slightly different. Actually no harm is done for one seldom has a perfectly pure tone to



The diagram of connections.
L1 and C1, A tuned pickup resonant to the station's carrier frequency.
C2 Stopping condenser, .006 mica.
C3 Filament bypasses .002 to .006 mica.
L2 r.f. choke suited to carrier frequency, 85 mhy. choke of good make o.k. at most frequencies.
L3 iron-core choke from plate-supply filter of a receiver.
Ma. d.c. meter, range 0-50 Ma. for tube shown. See text.
The circuit is deliberately left incomplete: if your transformer secondary has a center-tap, ground that; if it hasn't, provide one by means of a 50 ohm center-tapped resistor.

* Engineer WDRC, Bloomfield, Connecticut.

test with anyway. Therefore the practical thing to do is to establish by test where the modulator (or something else) overloads. Note what the modulation meter says at the time and use that as your "100% reading".

Notice that the pickup coil was placed near the antenna coil of the transmitter—not near the modulated amplifier. There is a good reason for this—a very good reason. One may be modulating nicely in the early part of the system and losing much of the modulation further on. When first adjusting a new transmitter it is not a bad idea to check every "tank" as well as the antenna, to make sure that the same percentage increase takes place in all the tuned circuits from the modulated tube on. At the same time check backward and make sure that the oscillators and buffers do not change—they shouldn't!

If the transmitter is working at very low power the modulation indicator of course should not use up much power; use a smaller rectifier tube and meter. You can then, if you wish, dress the indicator up in a nice little aluminum case so that you can "tote" it around to other transmitters, broadcast or amateur. The filament supply, whether battery or transformer, can be included easily. When you leave the station the owner will probably be going through his stock of parts, for he will not be satisfied without an indicator of his own after having once seen how useful this simple device really is. The writer's indicator has been in use for about one year at a broadcasting station which carries a very heavy schedule. It has been checked regularly against a General Radio Modulation Meter and has remained "on the job".

COMING ! !

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The Spatari Code

Premier Crystal Laboratories have printed a very useful new folder entitled "Instructions for Grinding and Finishing Quartz Blanks and Crystals". In this is included formulas for calculating required thickness for a particular frequency and wavelength. The folder may be had on request. Address your request to 72 Cortlandt Street, New York, N. Y.

FEATHERWEIGHT PHONES

Both the Dictograph Products Company, Inc., 220 West 42nd Street, New York, N. Y., and Trimm Radio Manufacturing Company, 1528 Armitage Avenue, Chicago, are offering extremely lightweight headsets made possible by the use of cobalt-alloy steel magnets. The phones are in every way normal except as to size. The weight per headset is about four ounces.

The Trimm phones are offered in a 2,000 ohm (d.c. resistance) type while the Dictograph headsets are available in a number of windings as listed, the "A. R." standing for "Aircraft Radio" from

the fact that the units were originally developed for mail-flying where they must be worn in a helmet for long periods.

Type	1,000 Cycle Impedence	d.c. Resistance
A. R. 10-9	3,500	720
A. R. 10-8	1,000	270
A. R. 10-7	750	200
A. R. 10-6	525	120

The low-impedence types are especially rugged. The sensitivity remains the same since an output transformer is used in any case and the ratio is simply adjusted to match the headset.

In one afternoon Yorkshire, Eng., reported sun, rain, hail, sleet, snow, thunder, lightning and a high wind. So the official forecaster was right.—"Richmond Times-Dispatch".

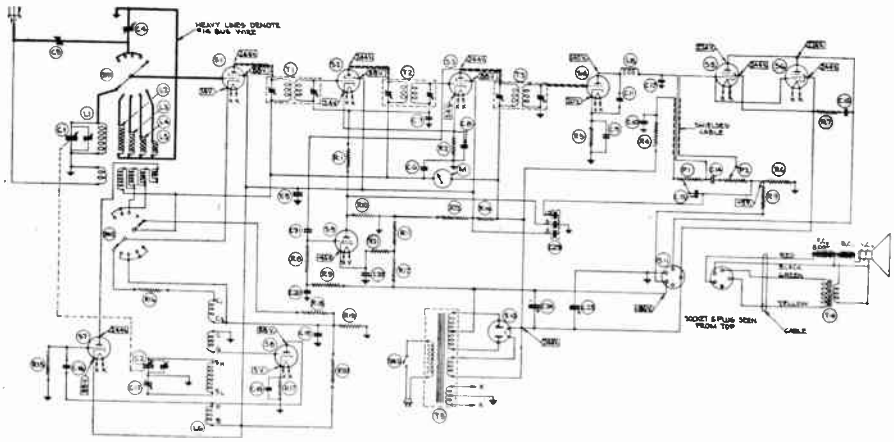
The S-M "Q" Receiver

The Silver-Marshall "Q" receiver attains multi-range tuning without the usual complexity by ignoring our pet taboos—and getting away with it!

Even in the broadcasting range the set is unorthodox. There is but one tuned circuit—and no r.f. amplification at all—before the first detector, yet the local-signal selectivity seems acceptable in the presence of two strong Hartford stations, one at 1330 kc. and the other at 1060 with 50 antenna kilowatts. No cross-modulation at all was noticed at a location about six miles from the 50 kw. station.

When one starts to switch ranges and study the diagram as to the circuit-changes which take place, the real surprise occurs. In the first place one notices that the oscillator is not switched at all—it calmly keeps on working at the same old frequencies. The secret is that the shortwave ranges have been chosen so that the harmonics of the oscillator land in the proper place. Since the oscillator itself (S8 in the diagram) produces only weak harmonics a distortion-amplifier (S7) is switched in on all short-wave ranges. Its grid being fed directly from the oscillator plate through C15, the tube is thoroughly overloaded and delivers an output rich in harmonics.

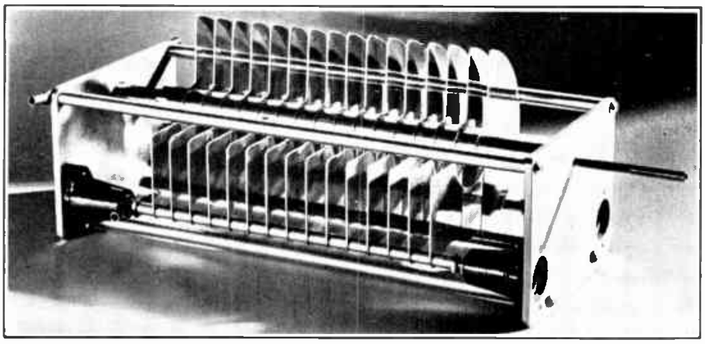
Switch SW2 then switches in the proper output coil to provide coupling to the appropriate coil (L2, L3, L4 or L5) and at the same time to render the plate circuit of S7 semi-resonant to the harmonic needed. Note also that at the same time SW1 switches out the broadcast-range circuit C1 and L1 and cuts in the small tuning condenser C4. The antenna feed is also changed from inductive coupling to capacity coupling through the small condenser C3. This condenser is of the screwdriver type and is adjusted once for all to give proper selectivity.



Another unique point is in the oscillator which is of the Meissner type—almost forgotten in the enthusiasm about Hartley, tuned grid, and tuned-plate oscillators. It seems to fill all needs, giving a good smooth oscillator working well over the range and permitting the normal grounded-rotor construction.

The automatic-volume control tube S9 operates on the i.f. tubes S2 and S3 in the usual way by feeding the self-adjusting bias to the grids via the r.f. filter composed of R1, C5 and one section of C8.

The rest of the circuit is normal in connections and operation.



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WS 7525	.00025	7500	31	1/2"	13"	18.00
WS 7535	.00035	7500	43	1/2"	16"	19.50
WS 7550	.0005	7500	62	1/2"	21"	23.00
WS 75210	2—.0001	7500	26	1/2"	13"	20.00
WS 75225	2—.00025	7500	62	1/2"	22 1/2"	25.00
WS 410	.0001	4000	7	1/4"	6"	12.00
WS 425	.00025	4000	15	1/4"	7"	13.00
WS 435	.00035	4000	21	1/4"	7 3/4"	14.00
WS 450	.0005	4000	31	1/4"	8 3/4"	15.50
WS 4210	2—.0001	4000	14	1/4"	8 1/2"	15.00
WS 4225	2—.00025	4000	30	1/4"	10 1/2"	19.00

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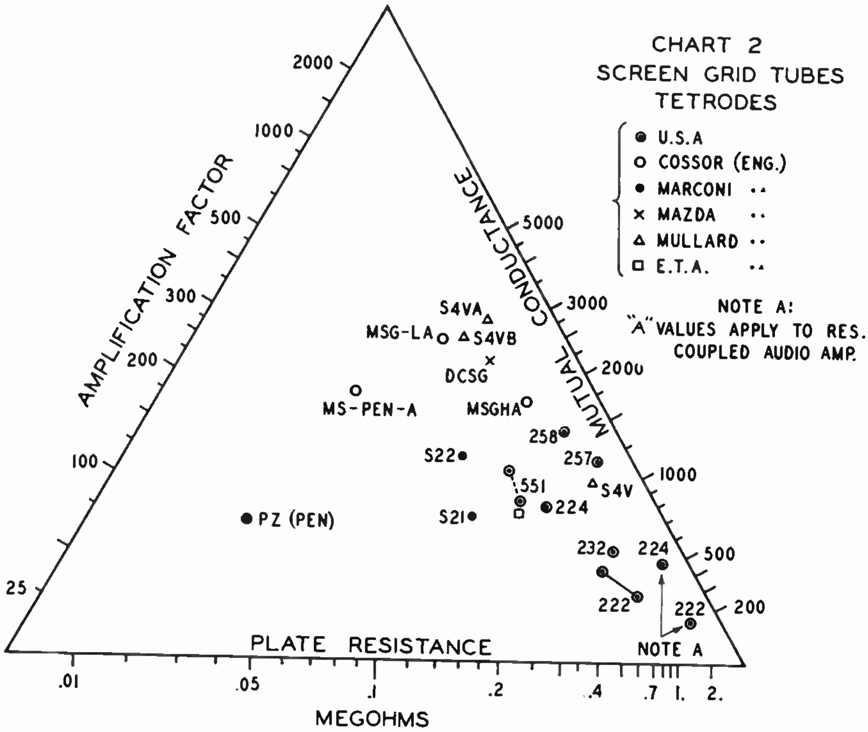


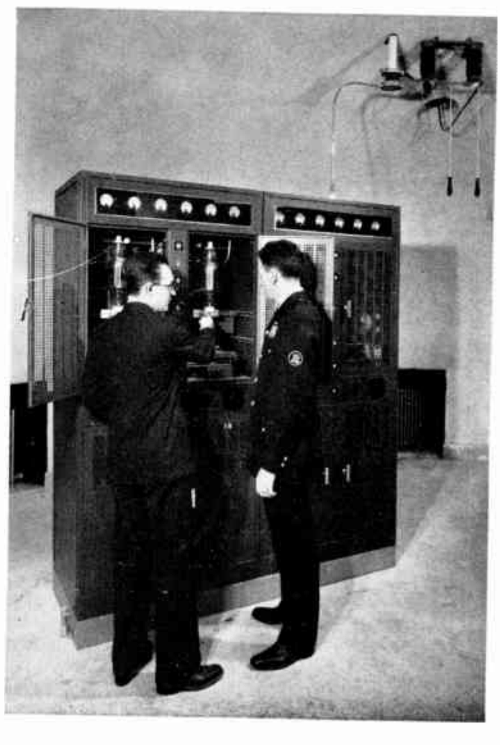
The Perpetual Tetrode Chart

A Batcher Abac

Chart 1 was the triode chart, page 10 of our February issue.

To operate Chart 2: Suppose mutual conductance of the PZ (247) pentode is wanted. Run a line from the triangle corner opposite the conductance side through the PZ dot to the conductance scale. This line will end on the correct value. The other constants may be found by starting from the corner opposite the scale to use and passing through the dot for the tube in question.

New tubes may be added. Locate the new dot from data on the tube carton or "spec" sheet.



NEW 1 KW. NEW YORK POLICE TRANSMITTER

The New York City police department has recently added the W. E. 1 kw. 100% modulated transmitter shown. A Western Electric engineer is pictured explaining the unit to a police department technician preparatory to delivery. New York City has also two auxiliary 400 watt stations.

PATENT MEDICINE

Recent hearings of patents committee of the House are of great interest to all affected by the present operations of the patent office. Consideration is now being given to revision of patent laws, it is the time to get in some licks.

The report of the "Hearings before the Committee on Patents, House of Representatives, Seventy-Second Congress, First Session on General Revision of Patent Laws" is to be had without charge as long as copies of the printed report are available. Order from the United States Printing Office, Washington, D. C.

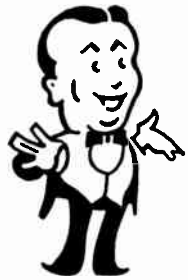
In this the Karl Fenning statement on historical aspects beautifully sums up the background of patent laws. Implicitly, of course, this summary covers the faults of the present laws and the evils they have brought about. Legalities that give exclusive advantages without immediate public benefits and the result that new devices have been withheld by selfish interests so long sometimes that public and inventor alike never benefit.

Mr. Fenning with enjoyable lucidity also sums up the process of getting a patent and the results thereof: this summary is sometimes devastatingly realistic.

The report is a half-inch thick of relatively thin paper—it is heavy reading, aside from Mr. Fenning and the memorandum by R. S. Ould on page 315. Mr. Ould cogently and competently outlines what should be done about the patent laws. Ignoring all else Mr. Ould alone makes the report worth having.

Both Mr. Ould and Mr. Fenning are patent attorneys of wide experience, which they prove amply.

The American Microphone Company is making a neat microphone control box in which any mike may be housed. The box is a neatly finished cabinet of small size in the popular "mantle cathedral" style and contains a microphone transformer, volume control and switch and a quality or tone control. The transformer will match the input of any standard amplifier or can be connected to a receiver in any of the standard manners such as detector cathode to ground, phono-jack, etc.



Now I Think

Now that static means any noise whatever, why not call genuine weather noises by their original name, atmospherics?

NEW 5-METER RECORDS??

On April 2-3 and again 16-17, as an A. R. R. L. week-end stunt, a plane flew Boston-New York and worked 2-way 5-meter voice up to 100 miles with stations on hills and towers, nearly all hands using '45 and '47 tubes. This was "quasi-optical"—like our March Empire State and April New Jersey test story. If you wish details see "QST" for May and June.

Begins to look squally for the 1926-1929 1500 mile 5-meter records held by Phelps, Douglas, Ducati and Santangeli.

ECONOMY HINT

The woods are still full of shortwave receivers for broadcast, 'phone and c. w. which have little or no shielding. They are frequently poor receivers, and in a noisy location may be quite intolerable. Canning such a receiver bodily—not throwing it away, but putting a well-made copper shield around it, will work wonders, though it may be necessary to enclose the A and B batteries with the receiver—or to provide r-f. filters in the 110 volt line of a-c. sets.

A RUMINATION

I am not very quick, but was able to observe that in a recent Canadian broadcast not a one of the nine provincial premiers of Canada spoke English—nor did the acting head of the Dominion. They all spoke American.

"MODERN RADIO'S" ANSWER FACTORY

How?—What?—Why?—Who?—When?

A—Letter with one question . . . . $ .50
No charge for small incidental pencil sketches.

B—Additional questions, each 25

C—Schematic diagrams of battery-driven receivers up to 6 tubes, transmitters up to 5 tubes, antennas (other than beam types), switching schemes, metering, and power circuits of reasonable simplicity 75

D—Matters such as given under C, where all constants are desired 2.00

E—a.c. or d.c. socket-power receiver circuits without constants 1.50

F—Same as E but with all constants 3.00

G—Transmitter diagrams of greater complexity, bibliographies, operating instructions, analysis of complex operating difficulties in apparatus, and other questions not covered by the above will be estimated on receipt of a clear and complete statement of the problem.

NOTES

1. Keep a copy of your letter, including diagrams, numbering questions 1, 2, 3, 4 and lettering diagrams a, b, c, d.

2. The right is reserved to return remittances for any questions which it is impossible to answer.

3. No attention will be paid to radiograms, telegrams or letters (other than those under class G) which are not accompanied by a remittance. Please use money order—loose cash may not arrive.

4. Address letters, "Modern Radio", 101 Allyn Street, Hartford, Connecticut.

WHERE TO BUY "MODERN RADIO"

Associated Radio Buyers, Oakland, Calif.
Ben's Tremont Elec. Supply Co., Boston, Mass.
Blan the Radio Man, Inc., New York, N. Y.
Chicago Wholesale Radio Co., Los Angeles, Calif.
I. S. Cohen's Sons, Ltd., San Francisco, Calif.
T. F. Cushing, Springfield, Mass.
Electric Supply Co., Oakland, Calif.
Ellicott Square News Stand, Buffalo, N. Y.
A. H. Ferris, Los Angeles, Calif.
A. Freed & Son, San Francisco, Calif.
High Frequency Engineering Lab., Los Angeles, Calif.
Hatry & Young, Hartford, Conn.
Inter-City Radio Stores Co., Long Beach, Calif.
Johnson & Weller, Portland, Oregon
S. S. Kresge Co., New Haven, Conn.
McGill's, Melbourne, Australia.
Neismer Bros., Boston, Mass.
Northwest Radio Supply Co., Inc., Portland Ore.
Offenbach Elec. Co., San Francisco, Calif.
R. C. O'Connor, Wellington, New Zealand.
Radio Doc, Los Angeles, Calif.
Radio Exchange, Inc., Los Angeles, Calif.
Radio Mfg. Supply Co., Los Angeles, Calif.
Radio Specialties Co., Detroit, Mich.
Radio Supply Co., Los Angeles, Calif.
San Francisco Radio Exchange, San Francisco, Calif.
Spokane Radio, Inc., Spokane, Wash.
Roy C. Stage, Syracuse, N. Y.
Warner Bros., San Francisco, Calif.
Wedel Co., Inc., Seattle, Wash.
Wedel Co., Portland, Oregon
Wegner-Brill Co., Oakland, Calif.
Zach Radio Supply Co., San Francisco, Calif.

MORE NEXT MONTH

THE BAZAAR

Please abide by these rules:
1. 5c per word, payment with ad.
2. Ads for an issue must reach us the first of the preceding month.
3. Used, reclaimed or surplus items must be so described.
4. Please PRINT your name and address.
5. We reserve the right to refuse any part of an ad.
6. Ads designed to stand out cost extra. 7c a word all capitals, $1.50 an inch for unfilled space.

"Short Circuits"

And when judgment day comes, doubtless people will refuse wings until they see what Ford has to offer.—Hartford Times "Portico".

At the risk of being struck by lightning one wishes that Marconi did not give to the press such fantastic prophecies—as to his own work. Or is he the victim of a Lindbergh persecution?

K. V. R. Lansingh of Hollywood, California, has subscribed to "Modern Radio" until 1940.

Yet much that is called graft would seem legitimate if you got the money. —Hartford Times "Portico".

Water heated to 180 degrees can be frozen quickly by subjecting it to a pressure of 300,000 pounds per square inch. Try it in your home.—The Ohmite News.

In Hartford the depression has fully justified itself by putting out dozens of needless traffic lights.

In New England any pleasant weather in the winter (which lasts until May) is called "unseasonable"—which is practically a curse.

"I'm afraid you are ignoring our efficiency system."

"Perhaps so—but somebody has to get the work done."—Capper's Magazine.

Taxes could be made to do some good. Three months after a tax is put on exhaust gas odor the auto manufacturers will eliminate it. Write a letter to your directo—we mean congressman.

UNIVERSAL MICROPHONE'S NEW HOME

The above is a picture of the new home of the Universal Microphone Company, Limited, makers of microphones and accessories. The new plant having 10,800 square feet is four times as large as the old one, permitting the concern to cope with increased demand. Part of the equipment used by Universal in the new

plant is a complete recording setup as well as a duplicate of the audio equipment of broadcast stations: these being used in practical microphone tests. The new address is 424 Warren Lane, Inglewood, California.

In addition to moving, Universal also announces a complete microphone repair department as an addition to their services.

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TRANSMITTING TRANSFORMERS

375 V. A., both 1500-1500 and 1000-1000	$10.70
300 V. A., 750-750, 7½ v. 3 a., 7½ v. 3 a.	8.80
850 V. A., 2000-2000 and 1500-1500	14.20
850 V. A., 2500-2500 and 1500-1500	16.50
100 V. A., 500-500	6.65

FILAMENT TRANSFORMERS

7½ v. 3 a. and 7½ v. 3 a.	$3.75
10 v. 7 a.	4.60
2½ v. 10 a. (866 insulated)	4.65

FILTER CHOKES

30 henry, 300 ma.	$9.25
30 henry, 150 ma.	3.85

MODULATION CHOKES

10 henry, 300 ma.	$9.50
10 henry, 150 ma.	5.95

REC. FILTER CHOKES

50 hys., 80 ma., 400 ohms	$1.95
30 hys., 100 ma., 200 ohms	1.90
20 hys., 30 ma., 1200 ohms	1.00
20 hys., 60 ma., 500 ohms	1.10

REC. FILAMENT TRANS.

2½ v. 12 a., 5 v. 2 a.	$1.50
2½ v. 12 a., 2½ v. 3 a., 5 v. 2 a.	1.80

MIDGET OUTPUT TRANSFORMERS

Single 245 to voice coil	$ .90
Push-pull 245 to voice coil	.90
Push-pull 247 to voice coil	.90
Single 247 to voice coil	.90

LARGER OR STANDARD OUT. TRANS.

As above in types, all	$1.35

STANDARD REPLACEMENT POWER TRANSFORMERS

575-575 v. 100 ma., 2½ v. 12 a., 7½ v. 3 a., 7½ v. 3 a.	$4.60
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400-400 v. 100 ma., 5 v. 2 a., 2½ v. 3 a., 2½ v. 12 a.	4.10
For midget 325-325 v. 60 ma., 5 v. 2 a., 2½ v. 9 a.	2.10
171a trans. 300-300 v. 60 ma., 5 v. ½ a., 5v. 2 a., 1½ v. 9 a., 2½ v. 2 a.	3.35
171-227 trans. 5 v. 2 a., 5 v. ½ a., 2½ v. 12 a., 285-285 v. 60 ma.	3.25

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Give stability, maintain calibration and insure maximum efficiency and flexibility in ultra short-wave circuits. Made of R-39, wonderful low loss dielectric. 1"d, x 1½" l. For 40-80 MC and 20 and 80 meter phone bands.

SPECIAL ULTRA S. W. TYPE SEU DOUBLE SPACE CONDENSER

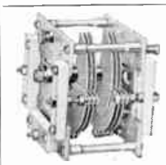
Isolantite insulation. Heavy 270° plates, double spaced, insulated front bearing, constant low impedance pigtail, standard capacity 18 mmf. For ultra s.w. tuning or neutralizing in low power transmitters.

TYPE 100 RADIO FREQUENCY CHOKE

Extremely low distributed capacity, four narrow spaced sections universal wound, on Isolantite form. Has stiff leads for mounting but fits in grid leak clips. 50 ohms DC res.; distr. cap. 1 mmf.; induct. 2½ mh.; rated at 125 M.

NATIONAL ISOLANTITE COIL-SOCKETS

Reduce losses to a minimum in ultra short-wave work. For standard or sub-panel mounting. In standard 4, 5 and 6 prong style and special 6-prong type for National Standard R-39 Coil Forms.



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A split-stator condenser for receivers and low-power push-pull transmitters. Special low-loss Isolantite stator-insulators are used. 1200 volt breakdown. Single spaced. Standard size 100 mmf. per section, but can be furnished up to 350 mmf. per section.

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A smaller dial with the famous V.V. mechanism for small receivers and transmitters. Fixed ratio only. Type BMD dual range 0-100-0; type BMC 200-0 clockwise.

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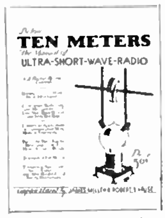
Split-stator type. For medium power push-pull transmitters and "High C" Circuits. Especially suited for five meter work. Isolantite insulation. Polished plates with rounded edges. Special bearings, rigid frame. For 3000 and 6000 volts.



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