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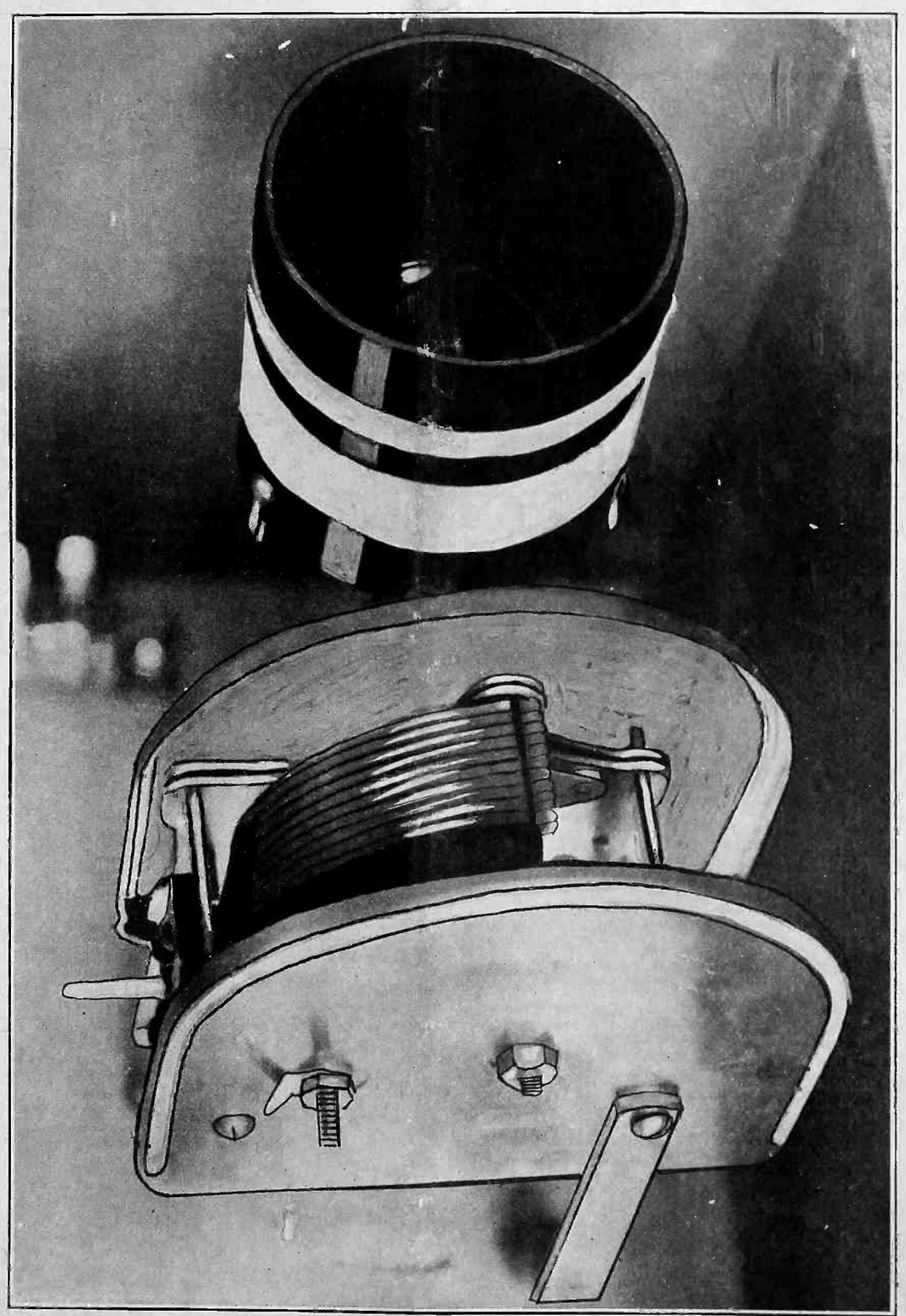

How Bernard Tuner is Used in HB Compact. See pages 10, 11, 12, 13.

388th Consecutive Issue— Eighth Year

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JOHN F. RIDER
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R. G. A.
60, 62, 20, 64, 30, 105, 51, 16, 32, 50, 26 A.C., 20 A.C., 41, Receptor S.P.U., 17, 18, 83.

FEDERAL
Type F series filament, type E series filament, type D series filament, Model K, Model H.

ATWATER-KENT
10B, 12, 20, 30, 35, 48, 32, 33, 49, 33, 36, 37, 40 42, 52, 50, 44, 43, 41 power units for 37, 38, 44, 43, 41.

CROSLEY
XJ, Trirdyn 3R3, 601, 401, 401A, 603, 704, B and C supply for 704, 704A, 704B, 705, 706.

ZENITH
38, 39A, 392, 392A, 40A, 35PX, 35APX, 352PX, 352APX, 37A, 35P, 35AP, 352P, 352AP, 34P, 342P, 33, 34, 35, 35A, 342, 352, 352A, 262, 31, 32, 333, 353A, power supply ZE17, power supply ZE12.

MAJESTIC
70, 70B, 180, power pack 7BP2, 7P6, 7P3 (old wiring) 8P3, 8P6, 7BP6.

FRESHMAN
Masterpiece, equaphase, G, G-60-S power supply, L and LS, Q15, K, K-60-S power supply.

FADA
50/80A receivers, 460A Fada 10, 11, 30, 31, 10Z, 11Z, 30Z, 31Z, 16, 17, 32, 16Z, 32Z, 18, special, 192A-192S and 192BS units, R80A, 480A, and SF 50/80A receivers, 460A receiver and R60 unit, 7 A.C. receiver, 475 UA or CA and SF45-75 UA or CA, 50, 70, 71, 72, C electric unit for special and 7 A.C. receivers, ABC 6 volt tube supply, 86V and 82W, E180Z power plant and E 420 power plant.

FREED-EISEMANN
NR5, FE18, NR70, 470, N R 5 7, 457, NR11, NR80 DC.

STEWART-WARNER
300, 305, 310, 315, 320, 325, 500, 520, 525, 700, 705, 710, 715, 720, 530, 535, 750, 801, 802, 806.

GREBE
MU1, MU2, synchrophase 5, synchrophase A C 6, synchrophase AC7, Deluxe 428.

PHILCO
Philco-electric, 82, 86.

KOLSTER
4-tube chassis used in 6 tube sets, tuning chassis for 7 tube sets, power amplifier, 7 tube power pack and amplifier, 6 tube power pack and amplifier, rectifier unit K23.

STROMBERG-CARLSON
1A, 2B, 501, 502, 523, 524, 635, 636, 403AA power plant, 404 RA power plant.

ALL-AMERICAN
6 tube electric, 8 tube 80, 83, 84, 85, 86, 88, 6 tube 66, 61, 62, 65, 66, 6 and 8 tube A.C. power pack.

DAY FAN
OEM7, 4 tube, 5-5 tube 1925 model, Day Fan 8 A.C., power supply for 6 tube A.C., B power supply 5524 and 5525, motor generator and filter, 6 tube motor generator set, 6 tube 110 volt D.C. set, 6 tube 32 volt D.C. set.

COLONIAL
26, 31 A.C., 31 D.C.

WORKRITE
8 tube chassis, 6 tube chassis.

AMRAD
70, 7100, 7191 power unit.

SPARTON
A.C. 8v.

MISCELLANEOUS
DeForest F5, D10, D17, Super Zenith Magnavox dial, Thermodyne, Grimes 4DL inverse duplex, Gared neutrodyne, Gared EA, Ware 7 tube, Ware type T. Federal 103 special, Federal 59, Kennedy 220, Operadio portable, Sleeper RX1, Armad inductrol.

Here are the 22 chapter headings:

SERVICE PROCEDURE
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"A" BATTERY ELIMINATORS
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TROUBLE SHOOTING IN "A" ELIMINATORS
"B" BATTERY ELIMINATORS
TROUBLES IN "B" BATTERY ELIMINATORS
TROUBLE SHOOTING IN "B" BATTERY ELIMINATORS
SPEAKERS AND TYPES
AUDIO AMPLIFIERS
TROUBLE SHOOTING IN AUDIO AMPLIFIERS
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RADIO FREQUENCY AMPLIFIERS
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SERIES FILAMENT RECEIVERS
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TROUBLES IN DC SETS
TROUBLES IN AC SETS

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Securing information from the receiver owner, list of questions, practical chart system of repairs, circuits and operating conditions.

Repairs in the home, method of operation, spare tubes, the process of elimination, recognizing symptoms, examples of practical application, tracing distortion, tracing electrical disturbances; vacuum tube tests; neutralizing systems, filament circuits, grid circuits, methods of securing grid bias, plate circuits; long aerials, short aerials, selectivity, imperfect contact, directional qualities, grounds; "A" battery eliminator types, design, operating limitations, requirements for perfect operation, AC eliminators, DC eliminators; "A" eliminator hum, reasons, voltage, reasons, noise; full wave, half wave, B battery eliminators, filament rectifiers, gaseous rectifier, dry disc rectifier, wiring, parts used, design, voltage regulation, operating limitations, requirements for perfect operation, combination filament and plate voltage eliminators, AC and DC types; B battery eliminator output current and voltage, excessive hum, dead eliminator, poor design, reasons for defects, motorboating, punctured condensers, shorted chokes, voltage regulator tubes, function of filter system, C bias voltages, voltage divider systems, filter condensers, by-pass condensers, voltages in the system; determining voltages in B eliminators, AC, DC, voltage drop, effect of shorted filter system, defective rectifiers, defective transformer, defective chokes, defective by-pass condenser, design of filter system, defective voltage divider network, relation between hum and output voltage, isolation of troubles, external filters, noise filters; cone, dynamic, exponential speakers, troubles, dead, weak output, distorted output, rattle, continuity testing, windings, magnets, frequency filters, testing, chokes, condensers, hum elimination; audio amplifier types, transformer, resistance, impedance, auto-transformer, combinations, requirements for perfect operation, operating limitations, tubes, forms of coupling, plate voltage, grid voltage, filament voltage, isolating condensers, voltage reducing resistances, noises, analysis of trouble, plate current, grid current.

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A POWER PACK

That Fits Into Cabinet with Tuner

By H. B. Herman

A POWER AMPLIFIER, to work 224, 227 and 245 tube, with a two-stage audio channel of resistance-coupling, all in a 5x17½" space, provides to personal set constructors, for the first time, an opportunity to enjoy compactness and ready adaptability, where formerly so much room was taken up with the power pack that it had to be a thing apart from the receiver. Now it is possible to build this small-sized but a large-performing unit so that it will fit in the rear of a 7x18" cabinet, hence in any wider cabinet, leaving 7 full inches, measuring toward the front panel, for the radio frequency amplifier and detector, with the tubes that the tuner requires. Thus the nuisance of having the power pack physically independent of the rest of the receiver is averted, and a table model AC receiver can be built, using any radio frequency and detector system desired. The only qualifying considerations are that 224 and 227 tubes alone can be used in the tuner, that the total number of tubes in the tuner alone must not exceed six, and that the cabinet have the usual 12" depth. The tube accounting is exclusive of the rectifier and two audio tubes. Hence an 8-tube receiver, with rectifier additional, in other words an 8-1 set, may be built.

Handy for RF Experiments

The limiting factor in the number of tubes to be used in the tuner is mainly the 2.5 volt winding that feeds the heaters of the tuner tubes. The power transformer has a winding for this purpose rated at 12 amperes. As the required types of tubes draw 1.75 amperes each, for energizing the heaters, a total of seven such tubes would draw 12.25 amperes. The first audio tube, in the power amplifier, accounts for one of the seven, hence only six additional are permissible. The fact that the rated 30 watts (12x2.5) is exceeded by .625 watt (2.5x.25) is negligible.

The layout not only is highly advantageous for permanent installation in conjunction with one's favorite tuner, but it is also handy as a permanent power amplifier to be used with any experimental tuner. So often a circuit-builder likes to try out some new tuning system, or arrange cascaded stages of tuned radio frequency amplification, to determine how the circuit will behave, particularly if he has some original ideas to test, that he will appreciate the opportunity to build a power amplifier that may be used again intact, in some permanent construction, or in other experimenting.

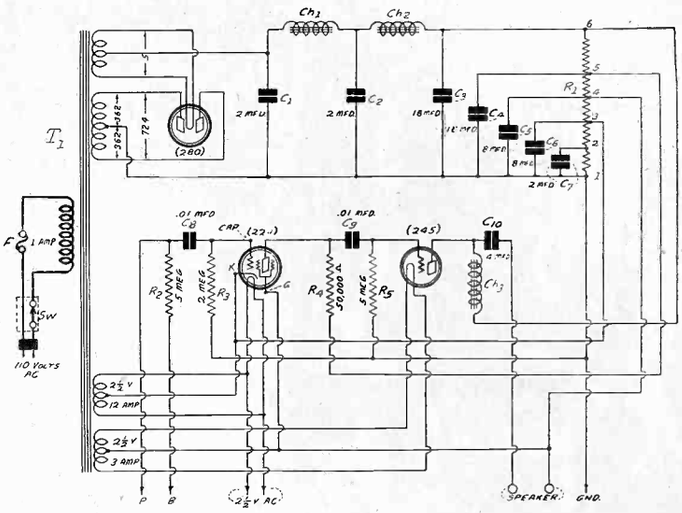

FIG 1

THIS ABC SUPPLY FOR 245 OUTPUT, WITH AUDIO AMPLIFIER BUILT IN, IS CONSTRUCTED ON A 5X18½" BASE, AND MAY BE SLIPPED IN THE REAR OF A TABLE MODEL CABINET THAT HOUSES A TUNER.

The circuit diagram is shown in Fig. 1 and the suggested layout of parts is illustrated likewise (Fig. 2), so that no difficulty will be experienced in following the pattern and conforming all the parts to the space requirements.

The plate voltages available depend somewhat on the current

(Continued on next page.)

LIST OF PARTS

T1, Ch1, Ch2—One Polo 245 power supply, consisting of one 12 amp., 2.5 volt winding, one 3 amp., 2.5 volt, one 5 volt, 2 amp., one 724 volt, all center-tapped; primary winding and two chokes; all in one cadmium-plated case.
C1, C2, C7—Three 2 mfd. HV filter condensers, 550 volts rms working voltage.
C3, C4, C5, C6—Mershon electrolytic condensers, consisting of two 18 mfd. anodes and two 8 mfd. anodes in one copper case, with mounting bracket.
C8, C9—Two .01 mfd. mica dielectric condensers.
C10—Two HV filter condensers, 550 volts rms working voltage, connected in parallel.
R1—One voltage divider: (1) to (2) 8 ohms, (2) to (3), 40 ohms; (3) to (4), 775 ohms; (4) to (5), 4,400 ohms; (5) to A6) 2,500 ohms.
R2—One Lynch .5 meg. metalized resistor.
R3—One Lynch 2 meg. metalized resistor.
R4—One Lynch 50,000 ohm (.05 meg.) metalized resistor.
R5—One Lynch 5.0 meg. metalized resistor.
Ch3—One output impedance.
F—One 1 ampere cartridge fuse with fuse holder.
SW—One pendant switch with AC cable and male plug.
One five-prong (UY) socket and two four-prong (UX) sockets.
Speaker—Two binding posts.
One 5x17" baseboard or subpanel.
Three Kelly tubes; one 280, one 224 and one 245.

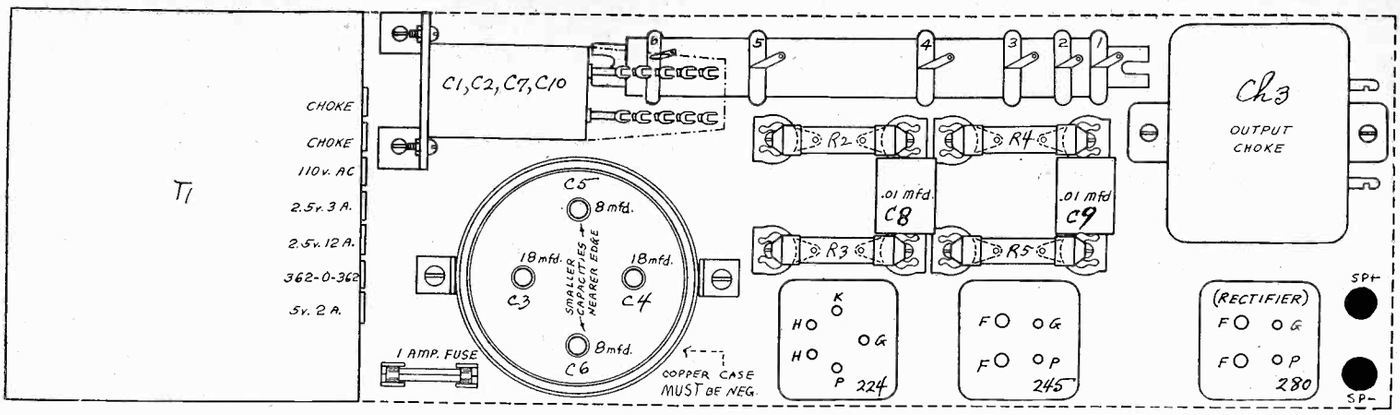

FIG. 2

HOW THE PARTS ARE LAID OUT. SUGGESTIONS FOR SHORT-LEAD WIRING ARE SET FORTH IN THE TEXT.

drawn, that is, the number of tubes in the tuner, as the rest of the plate current is of fixed value. At a maximum of 80 milliamperes flowing in the voltage divider, between points (3) and (1), the voltages would be 250 for the 245 tube (6) in Fig. 1; 180 volts for the plates of all other tubes, except possibly the rectifier (5); 50 volts for the screen grids of 224 tubes, or for the detector voltage additionally, if leak-condenesr detection is used (4); a positive connection for all cathodes except the detector cathode in some instances (3); a point for providing the unusual positive cathode voltage of .5 volt, for negatively biasing a space charge detector (2); and a negative lead (1), to which all grid returns are made.

The detector cathode, if leak-condenser detection is used, may be connected to the negative lead directly, or if negative bias detection (power detection) is used, a bias of about 3 volts will be obtained with cathode to point (3) and grid return to negative (ground). In that event the detector plate may be connected to (4). The drop from (4) to (1) is the grid biasing voltage for the power tube, 50 volts, used negatively, since the filament of the 245 is connected to the positive voltage, point (4). But since heater type tubes are electrically independent of the directly-heated filament tube, such as the 245, the same voltage drop used for biasing the power tube may be used for positively polarizing screen grids or plates of the other tubes, an economical arrangement. Actually the voltage is not full 50 volts positive for these supplementally supplied tubes, as their bias voltage is taken from the 50, hence if a bias of 3 volts negative is used, the positive voltage obtained from the power tube's biasing resistor is 47 volts. This resistor, (4) to (1), is, of course, common to the bleeder current.

Two Open Leads Explained

The detector would be connected with plate to the lead marked "P" in Fig. 1, while the detector's plate voltage would be obtained by connecting the adjoining "B" lead to a suitable voltage point on the divider. No connection is shown to "P" because the detector tube is in an independent circuit, one the experimenter will choose, while the "B" connection is omitted mainly because different voltages are required for different types of hook-ups (power detection and leak-condenser detection.)

The amplification obtained from the audio channel is at least as great as that obtained from two transformers in more familiar circuits, since a screen grid tube is used here as the first-stage audio amplifier. It is worked at a gain that accounts for the high overall amplification of the audio channel.

Adequate capacity provides good filtration and by-passing. Next to the rectifier tube is only a 2 mfd. condenser, a low capacity, chosen mainly because the strain on the filament of the 280 is somewhat lightened when the amplifier is put into operation, as compared with the starting drain when a large capacity is used here. A large capacity sometimes accounts for a drumming sound heard when the amplifier is turned on, if resistance-coupled audio is used, but the drumming is absent when the lower capacity is next to the rectifier. Also 2 mfd., same voltage rating of 550 volts rms., is used at the midsection of the chokes, as it was found large enough for the purpose, and besides the high voltage rating made it desirable to use this rectifier at the second highest voltage point on the rectified side.

The values of the component sections of the voltage divider R1 are not critical. Between points (1) and (2) use 8 ohms; between (2) and (3), 40 ohms; between (3) and (4) 775 ohms, **between (4) and (5), 4,400 ohms, and between (5) and (6),** 2,500 ohms. If any difficulty is experienced obtaining the 8, 40 and 775, and 4,400 ohm values, use 10 ohms, 800 ohms and 4,500 ohms respectively.

The bleeder current will be about 30 milliamperes, flowing through the entire voltage divider. In addition the plate currents of the various tubes will flow through such part of the voltage divider between the cathode or filament center tap and the negative lead (1). This current is in addition to the bleeder current. So the most current would flow between points (1) and (2), provided (2) is used, the next highest current between points (2) and (3), and so on. However, the 32 milliamperes drawn by the plate of the 245 tube at full effective 300 volts constitutes the preponderating plate current between (4) and (1) or any subdivision thereof, so the plate current drawn by tuner tubes will reduce the biasing and plate voltages only a little.

The substantial bleeder is helpful in making the operation of the power supply steady, since any change in plate current is a smaller part of the total current, therefore the operating regulation is better. Besides, the bleeder current makes possible the use of smaller resistance values in the potential divider than would be possible otherwise, and this is helpful in making the bypass condensers more effective, as they need bypass a smaller impedance.

The output impedance, Ch 3, may be the secondary of an old audio transformer, or any other audio choke coil of high impedance. The full winding of the Silver-Marshall output choke 258 may be used to advantage.

Constructional Hints

The 2.5 volt leads to serve the tuner tubes are brought out as unconnected wires, as these will be soldered to the heater terminals of one of the tuner tubes and the connections carried along by additional wires to the rest of the tuner tubes. The ground connection likewise is brought out "loose," this being the negative lead of the B supply, and going to the ground post of the tuner. The "P" and "B" connections, shown at lower left in Fig. 1, have been discussed. The only fixed outlets therefore are for speaker connections. A pair of binding posts, shown at extreme lower right in Fig. 2, serve this purpose.

No provision is made on the power amplifier for a switch. The AC cable also has to be provided additionally. The reasons for omitting the switch from the constructed supply is that if a tuner is used in conjunction with the 245 power amplifier, then a switch is on the tuner, but it should be of the AC type, not the cam type switch used in a battery set, as that might arc. Because the fuse interrupts the 110-volt primary lead, and the switch the other side of the line, it is not advisable to have an AC cable with plug built into the power supply. The cable would have to be cut anyway, to enable switch and fuse inclusion. Therefore the pair of leads for the 110-volt connection goes to the switch and the fuse. The AC cable is connected into the switch.

A good plan is to use a pendant switch of the open-ends type, so that one side of the line is switched, while the other continues uninterruptedly, but there is a place in the switch for anchoring and continuous side. At this anchorage point attach one of the power transformer primary leads and one of the AC cable leads.

The Importance of C 3

The leads emerging from the power transformer block are marked at the insulated openings where they emerge. The center taps are red. The two chokes are represented by four leads. Be sure to use a pair of leads representing connections to one choke, for Ch1, and the other pair for connection to the other choke, Ch2. This distinction can be made easily. With a 22.5 volt battery and indicator test the leads for continuity. The pair that current passes through represent one choke, and naturally the other pair constitutes the other choke. It makes no difference which choke is placed nearer the rectifier, as the DC resistance and the inductance of both chokes are the same.

At the end of the choke chain, the so-called "reservoir" con-

denser, C3, is 18 mfd., and is one of the anodes of the Q 2-8, 2-18 Mershon. This code number means that the copper case contains two 8 mfd. anodes and two 18 mfd. anodes. The condensers are electrolytic. The capacities may be distinguished easily, since the smaller capacity is nearer the periphery or edge of the copper case.

The 18 mfd. capacity provides an abundant reserve for the power tube, which does not draw its plate power directly from the tube but largely from the reservoir condenser, and the larger the capacity here, the greater the power that the output tube can command, which is extremely helpful on loud passages, especially loud, low notes, which call for extra current, often much more than the total direct current flowing through the rectifier tube. The storage of power in the reservoir condenser accounts for the phenomenon that more power can be delivered to the power tube than was delivered by the rectifier tube at any given instant.

With resistance-coupled audio is it also advisable to use a high capacity to bypass the plate voltage, so the other 18 mfd. anode is used for that purpose, leaving the two 8 mfd. anodes for bypassing the total section used for biasing the power tube, and for bypassing that part of the same section used for biasing the grid voltage supply for the first audio amplifier and the radio frequency tubes, including possibly the detector also, depending on the type.

Include C7 Anyway

While the .5 volts biasing point may not be used by the experimenter, the condenser C7 should be included nevertheless, being connected instead in parallel with C2, by moving the "high" connection of C7 to the midsection of the choke system. If ever the .5 volt point is desired, for experimental or other purposes, the condenser should be connected back the former way, as shown in Fig. 1.

The copper case of the Mershon is negative and should be connected to point (1). The condenser will not work if one of the lugs on top (an anode) is connected to negative, and the case connected to positive. The mounting bracket may be used as the negative, as this is conductively coupled to the copper case by physical contact. Put a mounting screw, used on one of the bracket holes, through a lug, and solder to the lug the connection to the midtap of the high voltage secondary winding, which is negative, and goes also to point (1) and to all grid returns. This is the grounded lead.

How AF Resistors Are Wired

The resistors in the audio channel are connected so that the leads to the grids of the two tubes are the shorter ones. The plate of the detector tube is connected to the right-hand side of R2, the other end of R2 to B plus, which will be 50 volts, or 180 volts, depending on the type of detection used. R2 may be less than .5 meg. for some types of tubes, especially a screen grid tube used as detector, but .5 is all right for a 227 detector. The right-hand side of R3 goes to grid of the five-prong socket, while the other end of R3 goes to the B supply's negative lead. The same system is used in connection the other pair of resistors.

The five mfd. high-voltage condensers, C1, C2, C7 and C10, are stacked one atop the other and secured to the base by a bracket. Mount the transformer block, then the stack of condensers, then put the voltage divider in place, to be sure that the divider clears the condensers. It will be noted only four constants are given for the five condensers. This is because the 4 mfd. for C10 consists of two 2 mfd. condensers in parallel.

If more than a total of six tubes and rectifier will be used, instead of incorporating a 1 ampere fuse, put in a 2 ampere fuse.

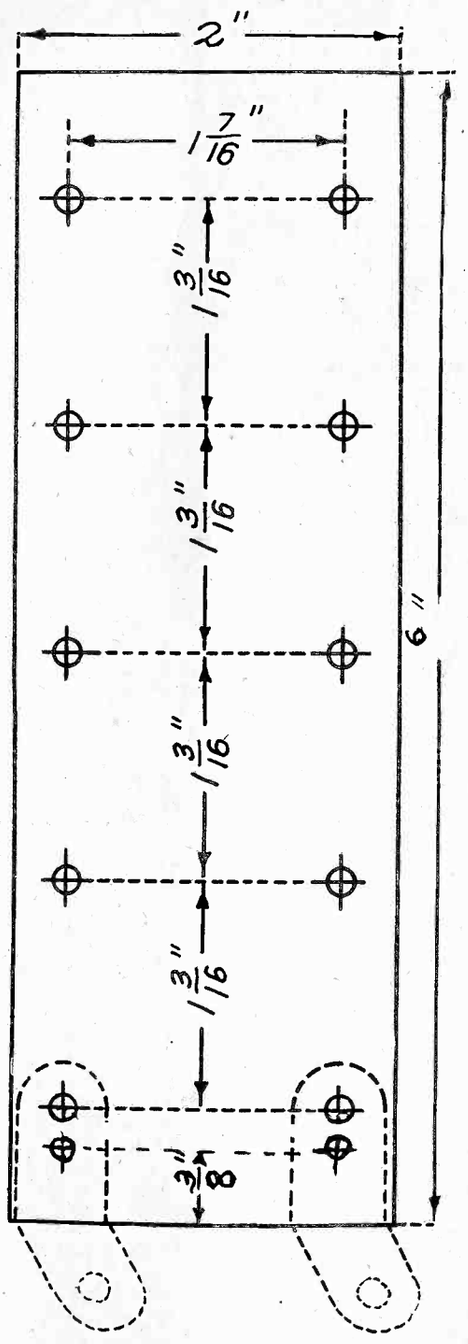

FIG. 3

DETAIL OF MOUNTING BRACKET FOR THE CONDENSERS C1, C2, C7, C10. THE CONDENSERS WOULD BE MOUNTED FACING *YOU*. ANY ANGLE BRACKETS WITH HOLES 3/8" FROM THE ANGLE MAY BE USED.

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W. T. Robertson, 10736 Calumet Ave., Roseland, Chicago, Ill.
Harol L. Hanson, Abita Springs, La.
Radio-Fleming, P. O. 140, Nairobi, Kenya, B. E. Africa.
A. L. Benham, 17 West St., Braintree, Mass.
Ray T. Lowder, 139 W. 113th Pl., Chicago, Ill.
Joe E. McConnell, 1160 So. Broad St., Newark, N. J.
E. A. West, Box 33, Memp, N. C.
Wm. Bain, 356 Washington St., Oil City, Pa.
H. E. Stocker, 1118 12th St., N. E., Canton, Ohio.
Wm. B. King, 1435 Homestead St., Baltimore, Md.
Calmes Bros., 721 Jackson, Baton Rouge, La.
A. Abramsen, 910 E. River Terrace, Minneapolis, Minn.
W. P. Koepp, 531 North Vine Ave., Tucson, Ariz.
Meyer Neff, 3227 W. Berks St., Philadelphia, Pa.
B. M. Lukey, 435 W. 24th St., N. Y. City.
O. A. Richter, 1259 Gates Ave., Brooklyn, N. Y.
J. S. Hearn, 23 V St., Prichard, Ala.
A. Hardy, 615 N. Carrollton Ave., Baltimore, Md.

New Corporations

Better Radio Corp., Newark, N. J.—Atty. Samuel Rusinow, Newark.
Sound Studios of New York, Inc.—U. S. Corporation Co., Wilmington, Del.
Union Radio Corp.—Attys. Chadbourne, Stanchfield & Levy, 120 Broadway, New York, N. Y.
Knight Radio and Television Co.—Atty. S. M. Wittner, 11 West 42 St., New York, N. Y.
Somerset Radio Service, Inc., Somerville, N. J.—Atty. Leon Gerofsky, Somerville, N. J.
National Radio Tube Corp., Brooklyn, N. Y.—Prentice Hall, Inc., of Delaware, Dover, Del.
Bergen County Radio Co., Hackensack—Atty. Warren Dixon, Jr., Hackensack, N. J.
George L. Paterson, Radios—W. H. O'Hare, 215 Montague St., Brooklyn, N. Y.
State Automatic Radio Corp., Union City, N. J.—Atty. A. Lieberman, Union City, N. J.
Dixie Radio Corporation, Wilmington, Del.—Atty. Franklin L. Mettler, Wilmington, Del.
Peerless Sound Reproducer Company, Philadelphia, Pa.—Corporation Guarantee and Trust Co.
Brills Radio Shop—Atty. M. M. Bleiman, Richmond. New York, N. Y.
Duration Radio Tube Corporation, Newark, N. J., radio—Corporation Trust Company of America.
Carroll Radio Sales, Rochester—Atty. L. J. Rice, Rochester, N. Y.
Morris Distributing Company, Binghamton, radios—Attys. Lee, Levine & Verreau, Binghamton, N. Y.
Checker Auto Supply Stores, Trenton, radio supplies—Atty. David Frankel, Trenton, N. J.

THE FOURTH ELEMENT

What the Screen Grid Tube Means to Receivers

By Ralph H. Langley

EVERYONE who has given the matter any thought admits that the screen grid tube is a logical and valueable new contribution to radio receiving sets. It eliminates that small feedback capacity between plate and grid which was the outstanding defect of the three-element tubes. All the work that was done to develop methods of balancing, all the neutralizing methods, all the complicated transformers and condensers and wiring, all the careful balancing and re-balancing of the sets are swept into history by the screen grid tube.

It would seem as if this alone was sufficient reason for using the new tube in the sets today. There are those, however, who hesitate about it. They ask questions about life and uniformity, and wonder whether it would not be the part of wisdom to stick to the tried and proven three-element tube. It is the same old story of those for whom the march of progress is too swift. But their questions can be answered, and their doubts will soon be resolved.

Same Filament System

The filament system in the screen grid tube is exactly the same as it was in the well-established heater type tube. This answers any question about life.

So far as uniformity is concerned, it is perhaps true that the new tube may show a somewhat greater variation for the next few months. But it was the variation in that troublesome feed-back capacity in the old tubes that really caused the trouble, and in the new tubes this capacity has been reduced to a negligible value.

No one claims, of course, that the tremendous amplification of which the new tube is capable, can actually be utilized in a broadcast receiver. No one would want a receiver ten or twenty times as sensitive as last year's models. They were powerful enough to reach down to signals no stronger than the static and noise on a cold winter night, and any greater sensitivity would be useless.

But the greater amplification of the screen grid tube nevertheless can be very effectively used to make a much better receiver. With it, it is possible to get considerably greater gain in the radio frequency portion of the set, and thus to cut down on the audio amplification.

Aids to Good Quality

This permits the use of resistance coupled audio stages, which give a tremendous advantage in the quality of reproduction. It also permits the use of the bias type of detector, instead of the grid-leak type, which is another great step in the direction of good quality. Both of these features were the dream of set designers years ago, but never until the screen grid tube came, was it possible to utilize them.

Because the tube itself gives greater amplification, it is not necessary to use such high ratios in the radio frequency transformers. This makes possible the use of types of transformers that give practically uniform gain and uniform selectivity over the whole range of broadcast frequencies. Thus while last year's set was quite sensitive in the middle of the dial, and relatively weak at one end or both, the new screen grid sets are sensitive and selective over the entire dial.

Radio frequency transformers for the three element tubes had to have three windings. The third winding was for balancing the feed-back capacity, and with it was associated the troublesome balancing condenser. All these parts are gone in the screen grid set. The saving in parts and wiring complication alone is important, but when it is remembered that these additional parts were tacked onto the tuned circuits, and contributed there losses to cut down amplification and selectivity, the advantages of screen grid tube become more apparent than ever.

The set of today and tomorrow uses screen grid tubes. It is perhaps the most important contribution yet made to broadcast reception.

Right or Wrong?

[Herewith are ten questions. They are propounded from articles published in last week's issue, August 24th. If you read that issue carefully, then you should be able to answer all ten questions accurately. Read this week's issue from cover to cover and you will know the answers to next week's questions even before the questions are put.—Editor.]

(1)—Aluminum and copper are the best metals for shielding purposes in a radio set.

(2)—If an automatic volume control is to function satisfactorily, the sensitivity of the receiver must decrease as the volume increases and vice versa. This change in the sensitivity of the circuit must be performed by the signal voltage.

(3)—The grid of an amplifier tube which is connected to the cathode through a transformer can be permitted to become positive because the winding has comparatively low DC resistance.

(4)—If the grid in a resistance coupled circuit goes positive for a considerable portion of the signal voltage cycle, wave form distortion is introduced into the signal.

(5)—If Io is the maximum value of the current during a cycle, corresponding to the minimum plate voltage Vo, and is I1 is the minimum current during a cycle and V1 the corresponding plate voltage, current being measured in milliamperes, then the output power of the tube is ⅛ (Io—I1) (V1—Vo) milliwatts.

(6)—Resistances in a voltage divider can be determined from the required voltages alone. It is not necessary to the current in each resistance section.

(7)—In an AC operated receiver having heater tubes, it is necessary to connect all the cathodes to one point on the voltage divider.

(8)—It is desirable to have a large bleeder current in a B supply unit in order that the voltages should remain constant as the signal changes the demand on the various taps.

(9)—An electromagnetic monochord is a new type of musical instrument which is excited by means of a loudspeaker magnet.

(10)—The volume control in a receiver should be as far forward as possible in order that signal level in all the tubes be as low as practical.

(1)—Practically correct. Silver is a better shield material than either copper or aluminum, but silver is ruled out practically on account of cost. Soft iron is also a good shield material at low frequencies—the best of all, in fact.

(2)—Right. In the more successful volume controls the signal, usually at the grid of the detector, is taken and rectified and the rectified and filtered current is used for establishing a grid bias on one or more radio frequency tubes. The higher the signal the greater the bias, and the less the sensitivity.

(3)—Wrong. There is as much distortion due to the flow of grid current when the tube is preceded by a transformer as by a resistance.

(4)—Right. The positive current loops are cut off because the flow of grid current prevents the grid from assuming the voltage demanded by the signal.

(5)—Right. The difference between the two currents gives twice the value of the peak value of the signal current, and the difference between the two voltages gives twice the amplitude of the signal voltage drop in the load. The power is ½ the product of the amplitudes of the current and the voltage drop.

(6)—Wrong. The resistance values cannot be determined unless both the voltage drops and the currents are known.

(7)—Wrong. The cathodes can be connected to different points if the circuit design demands it. If two tubes of the same type are on the same heater winding, the cathodes should not be connected so that there will be a very high voltage between the heater and the cathode.

(8)—Right. The larger the bleeder current is compared with the currents drawn from the various voltage taps, the more steady will the voltage be at the taps.

(9)—Wrong. The electromagnetic monochord is an instrument for measuring audio frequencies. The chord, which is of steel, is excited with the current the frequency of which is to be measured, and the frequency is then determined from the number of nodes on the wire and from the fundamental frequency of the chord.

(10)—Right. The farther ahead the volume control is the less wave form distortion there will be in the set as a whole, because no tube following the control is operated at a higher level than is necessary to get the desired output.

WHAT'S WRONG?

"Adroit" Circuit Evolves Interesting Replies

In last week's issue, August 24th, was published a pseudo-scientific article by Herbert E. Hayden, about the triple use of a single 227 tube as (1) and automatic volume control, (2) a coupling resistor common to the plate circuit of one tube and the grid of the next tube and (3) as an automatically varying biasing resistor of the output tube, a 245. The representations were made that the 227, the center tube in the accompanying diagram, was used so as to take advantage of the changing resistance values of a vacuum tube under changed conditions of operation, for serving the three-fold purposes. The external resistor immediately following the plate of the detector tube, at point plus 45 volts, was stated as being a biasing resistor that altered the plate-to-cathode resistance of the coupling tube (used as a resistor only), higher plate currents causing higher bias, hence less amplification, hence volume-levelling. It was set forth that proper arrangement of voltages enabled the use of the same coupling resistor tube in the detector plate and the grid of the 245, and that the bias on the power tube also was obtained by using the drop in the plate-to-cathode resistance of the 227. The editor's subscript was printed, stating that "the circuit as described in the foregoing article, and several of the conclusions in the text, are utterly fallacious." Correspondence from readers was invited. Much interest was aroused and hundreds of letters received during the first few days. Here are examples:

"It's a Great Idea"

TECHNICAL EDITOR:

THE circuit shown on page 8 of the August 24th issue, which the author set forth as doing three things, and doing them well, is not only unusual but wholly scientific, and I am surprised that the editor of such a high-standing magazine as RADIO WORLD should append a notation that the circuit operation and some of the conclusions in the text were founded on fallacy.

I have carefully checked everything and I say it's a great idea, and not a hoax.

The same resistance used doubly in the plate circuit of the detector tube and the grid circuit of the power tube is the plate-to-cathode resistance of the 227, which is not used as a tube but as a resistor. The well-known resistance-changing qualities of a tube under altered bias need no discussion. Starting at the output, if the voltage is dropped properly, you have what you desire: say 200 volts on the plate of the last tube, the difference between 300 and 100; a negative bias of 50 volts, due to the grid return being made to a point 50 volts negative in respect to the filament center-tap, the difference between 100 and 50; and the external resistor directly after the detector plate is more negative nearer the plate, hence putting the 227 grid at the detector plate causes the bias on the resistor-tube to be negative, and to change in the usual manner with variations in plate current.

The only point I am not clear on is how to get a 50-volt drop in the 227 tube's plate-to-cathode resistance, which is about 8,500 ohms at 50 plate volts and a negative of 2 volts average. Therefore the load on the plate circuit of the detector, and on the power tube's grid, is an average of 8,500 ohms, which is too low, but a different type tube would solve this problem.—Hutchins Woodstock, Bangor, Me.

* * *

Four Smashing Blows

TECHNICAL EDITOR:

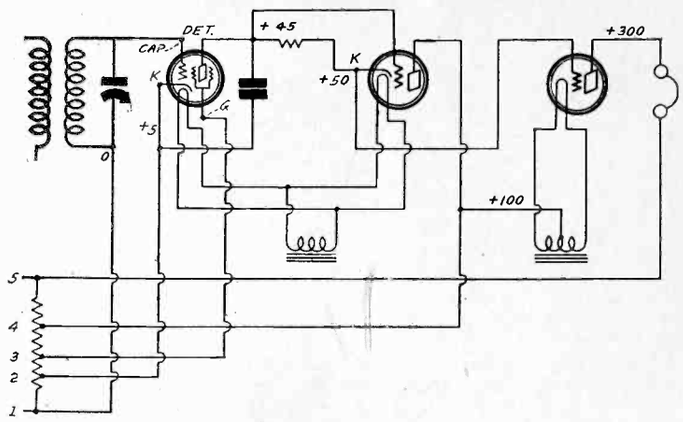
THAT humorous article by Herbert Hayden is full of palpable and intended mistakes. I am delighted at the opportunity to point out four of them:

(1)—The plate-to-cathode resistance of the 227 tube is increased as the signal is increased, due to the augmented bias when the heavier current caused by the raised signal level passes through the external resistor immediately following the detector plate. Therefore the louder the signal, the higher the resistive load, and the louder the signal. I thought the object of an automatic volume control was to level the volume, not to make loud passages louder and leave soft ones unaffected.

(2)—The load on the common detector plate and audio grid circuit is only about 10,000 ohms at 50 volts on the plate and 1.5 volts negative bias, obtained through the average voltage drop in the biasing resistor. This is virtually a short circuit, as it offers wholly inadequate impedance.

(3)—The article set forth that the changing bias affected the amplification of the 227 tube, along the usual lines, but the 227 is used merely as a resistor (not as a detector or amplifier), hence is does not of itself amplify, and the assertion that higher bias reduced the amplification was therefore false, as explained from another viewpoint in my first subdivision.

(4)—The biasing of the output tube through a resistor of whatever kind requires a low impedance to signal frequency, hence a large capacity bypass condenser, which is impossible to include in this circuit, as it would short-circuit the signal, since the same resistance (plate-to-cathode) is a plate-grid common load impedance.—J. Haskins Montmorency, Savannah, Ga.



THIS IS THE CIRCUIT DISCUSSED LAST WEEK IN A PSEUDO-SCIENTIFIC ARTICLE. READERS' COMMENTS ON THE CIRCUIT ARE PUBLISHED HEREWITH.

* * *

Point on Modulation

TECHNICAL EDITOR:

THE automatic volume control diagram concerning which the question of fallacy has been raised is hooked onto the output of a negatively grid biased detector, assuming there is resistance between points (1) and (2), for otherwise there is only stray detection. This type of detector modulates upward, that is, strong signals increase the plate current. Therefore the resistance of the 227 resistor-tube is increased and the amplification of the circuit increases, the louder the signal. This is in the wrong direction. It should be pointed out that the leak-condenser method of detection modulates downward, so that strong signals evoke diminished plate current, hence there might be something to the idea, if that method of detection were shown. The plate-to-cathode resistance of the 227 tube is too low, however, for service as an audio resistor coupler.—Hyman Bruen, Oakland, Calif.

[*Mr. Montmorency's criticism of the circuit is entirely correct. Mr. Bruen's statement of the difference between the two types of detectors is correct.—Technical Editor.*]

Why Not More Tuned Primaries?

WHAT is the object of using a tuned primary in the HB Compact, and not in other receivers, where there are several stages of RF amplification? It seems to me the high gain would be all the more valuable in the cascaded chain. The HB Compact uses only one RF stage. Is this enough?—G. H.

Where there are several stages of tuned radio frequency amplification the custom is to use a smaller gain per stage than if only one TRF stage is used. The reason is that too high amplification the custom is to use a smaller gain per stage than hard to manage. Oscillation trouble arises. This is true even if the stages are shielded. Therefore the amplification is usually kept down a little, at least enough, however, to insure stability. In the HB Compact, as there is only one RF stage, this is built up to the highest attainable amplification point, and with most extraordinary results in volume and sensitivity. One TRF stage is certainly enough for this receiver, as a 1,500-mile night range, speaker volume, is easily practical in a good location. The circuit is sensitive, selective and amazingly loud.

NEW AC H

HAS STABILITY AT

First News Ever to Be Published Anywhere

and Audio Amplifier with Resistance Plate

By J. E.

Technical

WHEN the 240 high mu tube was introduced resistance coupling advanced greatly in popularity, and the quality of reproduction advanced with it. That tube has an amplification factor of 30 and will give a voltage amplification in a suitable resistance-coupled circuit of about 25 per stage. This is comparable with the amplification obtainable with the transformer coupling.

When AC tubes were introduced all were for transformer coupling, that is, all the tubes of the AC types had low amplification constants and low plate output impedance. Of the three-element tubes only the heater type tube, the 227, could be used in resistance-coupled circuits, and as that has an amplification factor of only 9, the step-up per stage in a resistance-coupled circuit using this tube is not more than about 7 times. This does not compare favorably with the step-up per stage in transformer-coupled circuits.

Those fans who favor resistance coupling above all others have felt a distinct need for a heater type tube having a high amplification factor, so that they could avail themselves of the advantages of resistance coupling in AC circuits, without using screen grid tubes that might give rise to instability.

Lacuna Is Filled

With the object of filling this need new tubes of the heater type were designed, built and tested and they gave exceptionally promising results. Grid voltage, plate current curves of one of these tubes are shown in Fig. 1. Curve A is for no load in the plate, and Curve B for a load resistance of 100,000 ohms.

A noteworthy feature of this new, special purpose tube is that it has an exceptionally high amplification factor. Nominally. it may be taken as 45. fifty per cent, higher than the amplification factor of the 240 tube. Of course the factor varies with the grid bias, but the variation is not great.

The fact that the tube has a high amplification factor suggests that the tube is admirably suited for use in a resistance-coupled audio amplifier and that it is an effective detector whether the grid bias or the grid leak-resistance method be employed.

Curve B shows the capability of the tube as a voltage amplifier in a resistance-coupled circuit. This curve was taken with a load resistance of 100,000 ohms, so that if the plate current change for any given grid voltage change be multiplied by this resistance the output voltage corresponding to the given grid bias change is obtained. If the plate output voltage be divided by the grid bias change, the actual voltage amplification per stage is obtained. At one point near a negative bias of one volt this amplification is in excess of 25. This gain compares favorably with transformer coupling. And it is possible to get a much higher amplification per stage out of the tube by using a higher plate load resistance.

Sole Voltage Amplifier

Suppose the tube be operated at a negative bias of 1.5 volts with a load resistance of 100,000 ohms. The plate current at the operating point is .595 milliampere. At one volt negative bias the current is .715 and at two volts .475 milliamperes. The current change for a change of one volt is .240 milliampere, and this change is symmetrical about the operating point so that there is no distortion.

The corresponding plate voltage change is 24 volts. Therefore at a bias of 1.5 volts the amplification is 24 times. The signal amplitude on the following tube for a signal input amplitude of only .5 volt would be 12 volts. This is sufficient to load up a power tube of the 112A type. Any grid bias detector tube can deliver a signal of .5 volt amplitude without any trouble at all.

But suppose it is desired to use this new tube between a detector and a power tube of the 245 type. The signal amplitude on the power tube should be 50 volts. If the voltage amplification of the new high mu tube is 25, a signal amplitude of 2 volts would have to be impressed on the tube to produce 50 volts across the load resistance. The bias must, therefore, be in excess of 2 volts on the high mu tube. Let it be 2.5 volts. The signal voltage on the grid of the high mu tube, therefore, should swing between .5 and 4.5 volts.

At .5 volts the plate current, as read on Curve B, is .85 milliampere. At 4.5 volts it is .02 milliampere. The change is .83 and the voltage across the load resistor is 83 volts. This is not quite enough to load up a 245 tube, but it is enough for a 171A tube. The amplification in this case is 20.8. However, the amplification is not distortionless because the increase in the current from the operating point value is .49 milliamperes and the decrease is only .34.

Higher Plate Voltage

Apparently there is only one thing to do to make this tube deliver enough to load up a 245 tube, and that is to raise the plate battery voltage. It should be at least 180 volts. If the plate voltage has this value there will be ample output voltage to load up the power tube provided that the negative bias is 2.5 volts and the signal amplitude about .25 volt less.

A considerable improvement can be effected both in the degree of amplification and in the quality by increasing the plate load resistance. There is no reason at all why it should not be 250,000 ohms. But increasing the plate coupling resistor is no substitute for plate battery voltage, for the voltage in the plate circuit must be considerably larger than twice the amplitude of the signal voltage that is to be impressed on the grid of the tube following.

Ordinarily, high mu tubes have low mutual conductance values and high internal plate resistances. The present special purpose tube is an exception. At one point the slope of Curve A Fig. 1, or the mutual conductance of the tube, is 1,040 micromhos. This compares with 200 for the 240 type of high mu tube. Of course, the mutual conductance depends on the grid bias. The maximum value occurs at about .75 volt bias. For larger bias values the mutual conductance decreases considerably, as can be judged from the shape of the curve.

No direct measurement has been made of the internal plate resistance of the tube, but its value may be obtained from the amplification factor and the mutual conductance. The resistance is equal to the ratio of the amplification factor to the mutual conductance, provided this is expressed in mhos. Thus we have 45/.001, or 45,000 ohms. This brings to light another unusual feature of the tube, a very low internal resistance for such a high

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GRID MADE OF FINER FARTHER FROM PLATE

IGH MU TUBE

AMPLIFICATION OF 45

on the 228 Shows It Is Excellent Detector Load—Mutual Conductance Amazingly High

Anderson

Editor

amplification factor. The significance of this is that only a moderately high load resistance is needed to obtain a voltage amplification approaching the amplification constant.

Transformer Coupling Possible

The internal resistance is not so high that it would be unpractical to employ a transformer as a coupling means between the tube and the next. It would be quite feasible to design a transformer which had a primary impedance at least twice as high as the internal impedance of the tube, in the musical range of frequencies, and still have a considerable voltage step-up ratio. Due to the small current that would flow, special high permeability steel could be used. However, this is speculative. That the new tube is suitable for a voltage amplifier and a detector in AC operated, resistance coupled circuit, is an experimental fact.

The new tube will be studied thoroughly, and as soon as more data are available they will be published. New circuits will also be designed in which this tube will work most effectively as a grid bias detector and as a voltage amplifier in resistance coupling.

The physical dimensions of the new tube are the same as those of the 227 tube, and it fits into the same type of socket. The filament voltage and current are also the same, so that the tube may be used as a replacement without making any alterations, except grid bias and load resistor changes in some instances. Since the filament requirements are standard, auxiliary equipment designed for the 227 tube will fit the new tube.

The only difference between the 227 type of tube and this new high mu tube is that the spacing of the grid turns is smaller, so that a given potential on the grid has a much greater effect in controlling the electron stream between the cathode and the plate.

An Experimental Tube

The new special purpose tube, which has been assigned the code number 228, is merchandized by the Kelly Tube Company, one of whose engineers designed it. The tube is to be judged on the basis of its utility in a resistance-coupled amplifier working between a grid bias detector and a power tube, as well as on its utility as a grid bias detector. It would seem that the characteristics of the tube represented in Fig. 1 would be difficult to improve for those purposes.

It is hoped that a four-tube receiver involving one 224 screen-grid tube, two of the 228 tubes and one 245 will be designed, which will have all that is desired in selectivity, sensitivity, volume, fidelity of response and stability both in the radio and audio frequency levels, plus low cost and economy of operation. This is a great deal to demand of a single receiver, but it is not too much to hope for in view of the present available tubes.

As appears from the lower curve in Fig. 1, the proper grid bias for detection, when the plate batery voltage is 135 volts, is approximately 4 volts. This is not easily obtainable with batteries, 4.5 volts being the nearest voltage obtainable with dry cells. At this point the detection is good.

Since the tube will be used in A.C. circuits the bias will usually be provided by a voltage drop in a resistor, either in series with the cathode lead or on the voltage divider. By this means any desired bias can be obtained. Best results will be obtained if the bias is obtained from a drop in the voltage divider.

[Read next week's issue, dated September 7th, for more details about the 228 tube, concerning which the above article is the first news ever to be published anywhere.—Editor.]

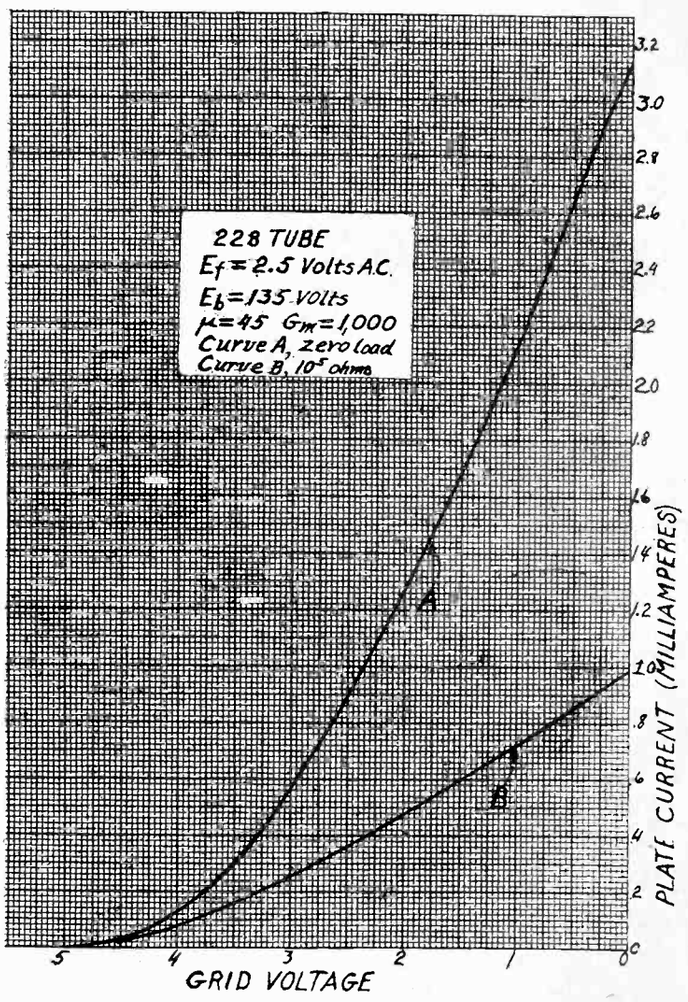


FIG. 1

GRID VOLTAGE, PLATE CURRENT CHARACTERISTICS OF A NEW, HIGH MU, SPECIAL PURPOSE HEATER TYPE TUBE

MESH AND MOVED PRODUCES NEW TUBE

WIRING THE BATTERY

Textual Details in Conjunction with Full-Sized

By Herman

Managing

[The first installment of the article on the actual construction of the HB Compact, battery model, was published last week, issue of August 24th. This is the first circuit to use the new Bernard tuner, which consists of a moving coil coupled to the tuning condenser shaft, to insure full frequency coverage when the primary of a screen grid tube is tuned for maximum amplification. The circuit uses on 222 as RF amplifier, a 240 bias detector, a 222 first audio and a 112A output tube. In the July 27th and August 3d issues were some preliminary discussions of the circuit. Herewith, in the second installment of the constructional article, intimate facts on the wiring itself are presented. Next week, issue of September 7th, tuning information will be given, and in the subsequent issue, September 14th, trouble-shooting will be discussed. Thereafter questions will be answered by the author, so meanwhile queries may be addressed to him in care of RADIO WORLD, 145 West 45th Street, New York City.—Editor.]

THE small size of the high-gain screen grid receiver, known as the HB Compact, makes possible the publication in the columns of RADIO WORLD of the picture diagram of the wiring, full size. Therefore this diagram, published on pages 12 and 13 of this issue, is not only a wiring guide, but a template for the position of parts as well.

Before proceeding to an intimate discussion of the wiring it is well to clear up a few points that might be confusing otherwise.

In last week's issue, August 24th, the schematic diagram of the wiring was published, but the pilot light was not shown. The caption under the diagram then set forth that the pilot light, if used, should be connected from A minus to A plus. The positive connection should be made to the set side of the switch, as the caption advised. In that way the switch that governs the heating of the tube filaments also turns the pilot light on or off at the same time. Otherwise the pilot light would be burning always. So connect the pilot light as prescribed.

This week, in the pictorial diagram of the wiring, again no connections to the pilot light are shown, but the position of the lamp bracket is clearly set forth.

The reason for omitting the 6-volt pilot light from the wiring is not to discourage the use of this tell-tale indicator at all, for it is well to include it, but because quite a few builders, you will be surprised to learn, state that they prefer not to have a pilot light burning that draws almost .25 ampere from the storage battery. This consideration is not to be sniffed at, if one has to send the storage battery to a service station for recharging. But those who have chargers, of the fast-rate or trickle type, and the many others who, while they have no chargers, nevertheless enjoy the convenience and brilliant appearance of a pilot light, may connect it in circuit.

Difference in Coil Connections

As was stated in previous issues, commercial coils for this receiver are manufactured by two companies—the National Company, of Malden, Mass., and the Screen Grid Coil Compay, of New York City. These coils differ a little in construction and in the method of connection. The schematic diagram, of course, applies to one as well as to the other type of coil, but not quite so of the pictorial diagram published this week.

The full-sized picture of the wiring shows the National Company's coils. You will notice that these coils have five possible connecting points. The fifth possible connection is *not used,* and the pictorial diagram specifically sets forth where this lug appears, although not showing it as a lug, while the warning the lug is not used is printed right on the picture diagram.

The wiring difference between the two coils is this: Antenna winding, no difference. Grid connection of secondary coil, no difference. Grid return connection of secondary of antenna coil goes to the lug that emerges from the tickler shaft fixture, in the National Company's coil, as shown in the pictorial diagram. In the Screen Grid Coil Company's antenna coil (BT5A for .0005 mfd., BT3A for .00035 mfd.) the grid return connection is not made to any lug at the tickler shaft hardware, for there is no such lug on that coil, but instead the grid return goes to the binding post located where the legend "lug here not used" is printed next to the antenna coil, on following pages in the picture layout.

In the instance of the interstage coupler, the coil located at the right-hand side, the same relative difference of connections exists. The left-hand connections are the same, these going to grid and grid return. The connection from plate of the RF tube, extreme left, rear, to the interstage coil, is the same for both makes. But the plate return or B plus 135 volt lead in the instance of the National coil, goes to the tickler shaft lug, while in the instance of the Screen Grid Coil Company's model this connection goes instead to the binding post located where the words "lug here not used" are printed.

Those are the only differences in the wiring of the two makes of coils. Really, there is only one difference, and it is repeated once.

The diameters of the two makes of coils differ. The National Company uses a 2" diameter and the Screen Grid Coil Company a 2½" diameter. That of course causes the condenser, which is mounted on brackets behind the coil, to be pushed back ½" farther in the instance of the Screen Grid Coil Company's inductance. But another point causes the difference to be 11/16", instead of ½", and that is the fact that the single hole mounting fixture of the Screen Grid Coil Company's model extends outward 3/16" more than does the other. There is plenty of room rearwards for the rest of the parts, no matter if the Screen Grid Coil Company's model is used, and to facilitate the interchangeable use of the coils of both companies, the official satin-finish aluminum subpanel has condenser bracket holes drilled in the proper places to accommodate either type coil. Of course the elevation of the condenser and coil is the same in both instances, measured from the center of the shafts, as the position of the front panel holes really determines this. The dimensions and positions of these panel holes were given in a diagram published last week, issue of August 17th.

The mounting brackets for the condensers are designed for the specified dust-proof condensers used as the tuning capacities in the laboratory model, but if other makes of condensers are used, suitable holes may be drilled in the three small auxiliary condenser brackets. The main bracket will fit any condenser, particularly one that has a single hole mounting feature, and no oversized threaded shaft. This mounting bracket is made especially strong and is the main support of the condenser, while the three other brackets are subordinate, and are used for prevention of shifting as the dial is turned. Some of the illustrations previously suggested that two brackets be used at the back of the condensers, but it is preferable to use two in front and only one in back, and to utilize the extra room for accommodation of audio resistors. These resistors are shown as R4 and R1 in the pictorial layout.

Details on Insulated Points

Insulation is important, although easily solved. If the Screen Grid Coil Company's coils are used, and are panel mounted, no front panel insulation is necessary, although the provided insulation may be used, if desired. The reason none is necessary is that the mounting fixture and tickler shaft of which it is a physical part are not connected in any way to the radio circuit, but the flexible couplers must not be used with blades jammed together, for then the insulation that these couplers or links provide ceases to exist, and the condenser shafts, hence rotors, connect to ground (through the steel front panel) and short-circuit a filament resistor in the instance of the antenna input stage and the B supply in the instance of the detector tuner.

If the flexible couplers or links at rear of the coils, show any tendency to turn within themselves, that is, instead of turning the condenser shaft, one blade of the link merely succeeds in turning the other blade, while the condenser is ungoverned, simply solder the moving brass bushing, which is the offender, to the corresponding copper blade of the link. Scrape off any plating or grime before soldering.

If you use the National coils, insulate the two coils. This statement is correct and applies if the steel cabinet is used. This steel cabinet is in two pieces, the back and top being made one piece by joining at the factory, and the rest being the other piece, so that the front panel is really an integral part of the cabinet and should not be assumed to be separate and removable.

However, those preferring not to use this cabinet, may resort to the traditional 7x14" front panel, and while the aluminum sub panel is oversized for that dimension, in the width, there is plenty of subpanel room to spare, and the extra 1" may be shaved off, or a little more, by taking ½" or ⅝" off each side. This can be done with a pair of tinsmith's shears and is no job whatever. In fact, a sharp knife, ridden over the desired line a few times, will make enough of an impression on the aluminum to permit bending off the extra width with a pair of pliars.

The volume control rheostat, 75 ohms, to which is attached the A battery switch, as an integral part of the manufacture, had

Model HB Compact

Pictorial Diagram Printed on Pages 12 and 13

Bernard

Editor

better be insulated, too, if a steel cabinet is used, and the insulators for all three holes (two dials and rheostat) are provided with the cabinet. A bakelite or hard rubber front panel requires no insulators as it is itself an insulator.

Some other points are insulated, since the subpanel is metal, but these are automatically taken care of in the subpanel construction at the factory. In the instance of the antenna, ground and speaker posts in the pictorial diagram, and elsewhere, these insulated points are designated by large rings, whereas the mounting brackets for both condensers, which must be insulated too, are so designated in printing. The official subpanel has the bracket holes insulated, but the large rings do not show up, because the insulators are reversed, that is, they have an elevated head, and this head is pointed downward, being under instead of on top of the subpanel.

Proper Way to Insure Insulation

How to use these subpanel insulators requires a word. The holes are factory-drilled in the subpanel to receive these insulators, which are of the collar type, and are cemented lightly to the subpanel. It is not the intention to make them adhere perfectly, but simply to have them in their proper places, for fixation by the constructor, as will appear.

Besides these built-in insulators, of the collar type, there are others, simply flat pieces of round, punched bakelite, with a hole in the center. These are the companion pieces of the collared type and are placed on the opposite side. Thus, if a collar emerges at top, as in the instance of the antenna binding post, let us say, that binding post is insulated from the subpanel by inserting the screw shank of the binding post through the top of the subpanel and through the collared insulator, turning the subpanel bottom up, and placing the flat insulator against the under side. Then the nut is fastened onto the shank. The tightening of the nut against the flat insulator completes the job and makes the insulation permanent and strong, and independent of the light cement used at the factory. So, if any of these collared insulators fall off, it is not harmful. Simply put them in their proper places and proceed as outlined.

With each subpanel is supplied a sufficient quantity of both collared and flat insulators, so that you will have plenty, and if the subpanel comes with collared insulators properly in place, do not regard the extra collared insulators as necessary. They are furnished merely as a precautionary extra supply.

Speaking of insulation, there is another although diametrically opposite consideration, that is, non-insulation or conduction. Take the 1.3 ohm resistor, for instance. One end of this has no insulator. Therefore it goes to the subpanel. It is the A minus, B minus lead and is grounded. So if you used a subpanel that is not metal, be sure to connect this point to ground, to minus A and to minus B. There are only two other points where this precaution need be taken—the ground end of the antenna coil and the ground biding post. If other than a metal subpanel is used, be sure to connect the ground end of the antenna coil and the ground post of the binding post, as well as the otherwise unconnected end of the 1.3 ohm resistor, all to A minus, B minus and ground.

The metal subpanel is not used for conduction in any other instance, except that it automatically grounds the steel cabinet if such type cabinet is used.

The switch on the rheostat is not in view in the pictorial diagram. But it consists of two flanges easily identifiable on the instrument itself, and the leads running thereto are marked "to SW" on the pictorial diagram.

In doing the actual wiring it is not necessary to follow the absolute positions of the leads as shown in the pictorial diagram, although connection must be made to designated terminals. To avoid having so many lines cross one another as to create confusion, the leads were drawn apart, hence in some instances are longer than what they need be. For instance, examine the lead from the P post of the screen grid radio frequency amplifier, left rear. This parallels the edge at back, and the side at right, to reach the coil post, but of course a much shorter lead would result if the wire simply were extended directly in a straight line from the P post to the coil. This should be done. Also any similar shortening of actual leads is commendable practice.

The wiring is shown in dotted lines and in solid lines. Where dotted lines appear, the wiring is under the subpanel, and the holes are pre-drilled to permit dropping the wire through. A glance will show that the dotted lines predominate by far. You may well immagine what a neat appearance the finished receiver will have, with so little wiring showing on top.

The lead from the equalizing condenser CT to the grid lug of the first tuning condenser is the only actual wiring lead that strikes the eye, although of course the flexible wire joined to the clips for the caps of the screen grid tubes are above, hence in solid line.

Mounting of the equalizing condenser is effected by bending its lug to a right angle and screwing the lug to the back shield of the dust-proof condenser, the same point used for a bracket. *The 6-32 screw removed from the tuning condenser rear plate must be replaced with a longer screw, say, ½" long, 6-32. This applies to three points on each condenser.* Thus the adjustment of the equalizer can be made with a screwdriver from the top when the set is in operation. It is preferable to use a wooden dowel, cut to a driving edge to engage the slot in the equalizing condenser's setscrew.

Sequence of Wiring

Often beginners, even more eager than others to wire a set well, are at a loss where to begin, when they see a wiring piagram, whether it be pictorial or schematic. A good suggestion is to wire the A leads and filament circuit first. Then the switch can be tested and the tubes as well, so far as filament lighting goes. With this encouragement the rest of the wiring is made lighter, by psychological effect, although, of course, the wiring of the entire battery-model receiver is no job whatever.

After the A leads and tube filaments are wired the order of wiring may be from input to output. Therefore the next step is to connect aerial post to the left-hand lug of the first coil farther from front panel, and the ground binding post to the other corresponding lug. Then the grid lug (stator) of the first tuning condenser is connected to the grid lug of the coil, and the lead with clip on is measured to a screen grid tube, 222, and soldered in place at the stator lug to fit.

The equalizing condenser is connected with one lug to the grid lug (stator) of the first tuning condenser, while the rotor of the tuning condenser, represented by a lug at right rear, goes to the joint of the two filament resistors, and to the grid return lug of the coil.

Completion of Wiring

As explained, this lug is part of the tickler shaft fixture at rear on the National coil, but is a binding post in line with the antenna binding post on the Screen Grid Coil Company's model, which does not have the tickler lug that the National Company provides.

The equalizer is automatically connected to the grid return because the back shield of the tuning condenser is the same lead as the rotor lug of the tuning capacity.

Next wire plate and B plus of the first tube, through the tuned primary winding of the interstage coil, then proceed to the detector input, then to the detector output, first audio input, first audio output and second audio input. The output of the power tube is brought to the two binding posts, Sp— and Sp+.

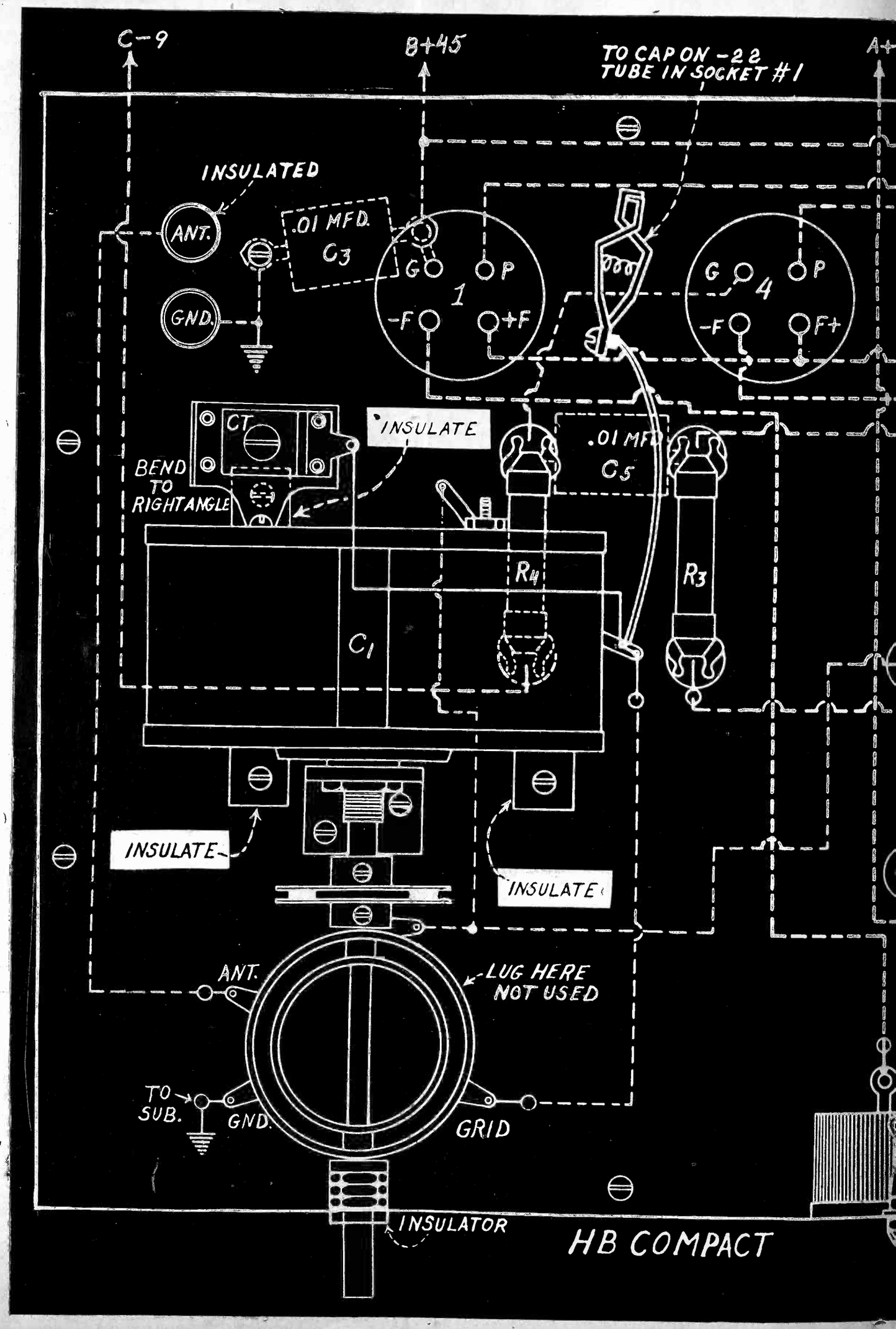
The battery cable is affixed next. Use as anchorage firm places, such as socket lugs, subpanel lugs or coil lugs. If a lead connects to a lug above the subpanel, knot the cable to prevent strain on the lug by accidental pressure.

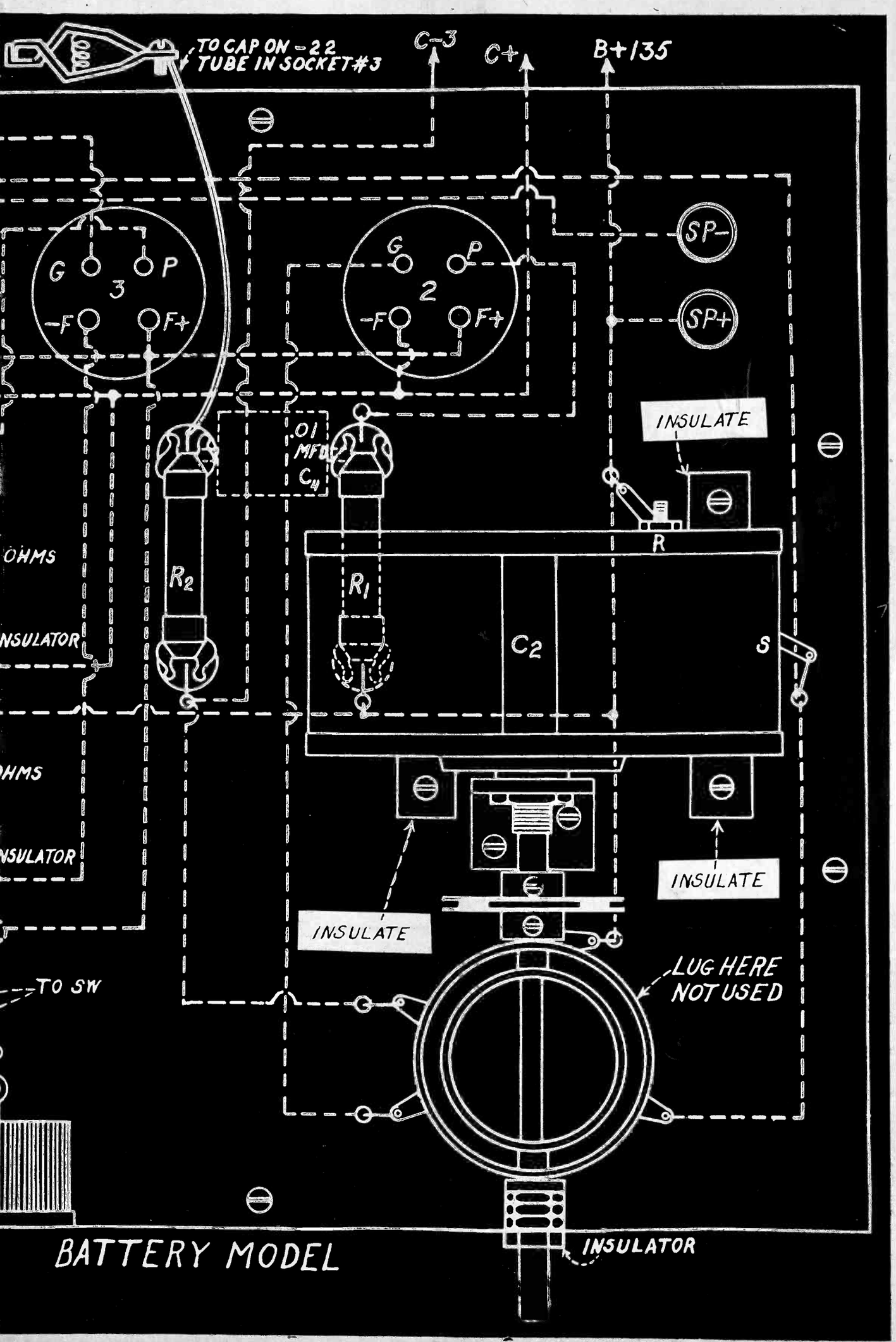
Use a different color for each lead, as in the specified battery cable, which has seven leads. An additional precaution, lest you forget what the colors stand for, or lose the record of their identities, is to tie small blank tags, one to each lead, Mark the tags. In almost any stationery store you can purchase these small tags at 5c a dozen. I bought some for 15c a hundred.

If preferred, metal cable markers may be attached to the cable leads. These markers are made by several companies, one of them Yaxley. You buy a complete assortment for a few cents, and use whichever ones you need.

In connecting the batteries, join A minus to B minus with a separate wire, from battery to battery, as a single lead emerges from the receiver for both, and the union of the two must be provided therefore at the batteries themselves.

The wiring should not be begun until the subpanel is anchored to the steel cabinet base.


C-9
B+45
TO CAP ON -22 TUBE IN SOCKET #1
A+
INSULATED
ANT.
.01 MFD. C3
GND.
G
P
1
-F
+F
G
4
P
-F
F+
CT
INSULATE
BEND TO RIGHT ANGLE
.01 MFD. C5
R4
R3
C1
INSULATE
INSULATE
ANT.
LUG HERE NOT USED
TO SUB.
GND.
GRID
INSULATOR
HB COMPACT


TO CAP ON -22 TUBE IN SOCKET #3
C-3
C+
B+135
G
P
3
-F
F+
G
P
2
-F
F+
SP-
SP+
.01 MFD
C4
INSULATE
R
R2
R1
C2
S
OHMS
NSULATOR
HMS
NSULATOR
TO SW
INSULATE
INSULATE
INSULATE
LUG HERE NOT USED
INSULATOR
BATTERY MODEL

DETERMINE POWER C

By J. E. Anderson an

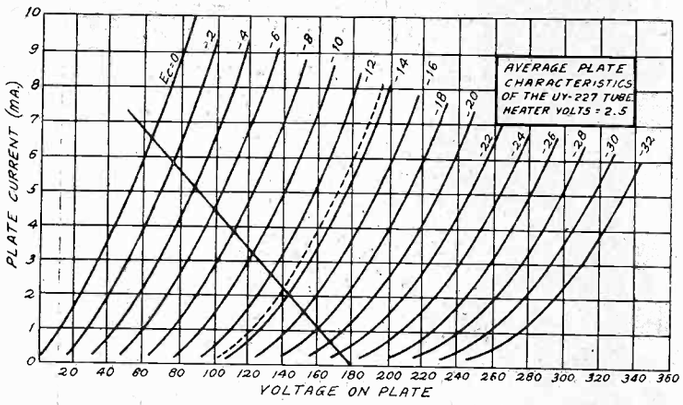


FIG. 75
PLATE VOLTAGE, PLATE CURRENT CHARACTERISTICS OF THE 227 HEATER TUBE WITH ONE LOAD LINE.

[*The following article is one of the series on "Power Amplifiers," begun in the June 1st issue, and published each week since then. Next week another interesting instalment will be published—Editor.*]

Now suppose the plate battery voltage is 225 volts. The load line crosses the line of minimum current at 216 volts and the line for zero bias at 90 volts. The corresponding plate currents are 1 and 13.75 milliamperes. Hence the output power is ⅛ (216—90) (13.75—1), or 200 milliwatts. The voltage amplification in either of these cases is approximately 5.5.

The rated power output of this tube when the plate voltage is 157 volts is 195 milliwatts.

The 171A is a real power tube for both AC and DC receivers. Its rated output with 180 volts on the plate is 710 milliwatts. Let us see how this compares with the results obtained from the family of plate voltage, plate current curves in Fig. 74.

Both of the load lines in this figure are for a pure resistance of 4,000 ohms, which is twice the value of the internal plate resistance of the tube. The minimum current in this case is taken as 2 milliamperes.

We note that the 180-volt line crosses the minimum current line at 175 volts and that it reaches the curve for zero bias at 73 volts. Hence the plate voltage change is 102 volts. The corresponding plate currents are 2 and 27.2 milliamperes, the difference between which is 25.2 milliamperes. Hence the output power is 102x25.2x⅛, or 321.3 milliwatts. Actually it would be little less since the grid voltage should never be allowed to reach zero. This power is less than one half the rated value.

Consider the line for 255 volts in the plate circuit. The extreme plate voltages are 247.5 and 92.5 and the corresponding currents are 2 and 40.3 milliamperes. Hence the power is 742 milliwatts. The proper grid bias in this case is 39 volts. At this bias the plate current is 19.5 milliamperes and the effective plate voltage is 177 volts. These are nearly the conditions under which the tube is rated. It is clear that this requires an applied plate voltage of 255 volts, and it should be remembered that the steady plate current through the choke coil will be higher than 20 milliamperes.

When 180 volts are used in the plate circuit, the bias on the grid should be 27 volts, because this lies half way between the grid voltage for which the plate current is 2 milliamperes, the minimum allowable, and zero bias. One half volt is allowed in this case to prevent the bias from reaching zero.

The 227 heater type tube is used most frequently as a voltage amplifier in transformer coupled circuits, but it is also used quite often as a voltage amplifier in direct coupled circuits. Sometimes it is also used as an output tube in a push-pull stage.

The maximum undistorted power output from this tube when the effective plate voltage is 180 volts is 164 milliwatts. But the maximum undistorted output when the battery voltage is 180 is only 80 milliwatts, as is easily determined with the aid of the curves and the load line in Fig. 75.

The most popular output tube at this time is the UX245, the plate circuit characteristics of which are given in Fig. 76. This tube has an internal plate resistance of 1,900 ohms when the effective plate voltage is 250 volts, requiring a load resistance of 3,800 ohms for maximum undistorted output. The lower load line drawn across the family of curves in Fig. 76 is for 3,600 ohms and a battery voltage of 250 volts. The higher load line is for a resistance of 3,800 ohms and a battery voltage of 370 volts. Load lines for other battery voltages can be drawn parallel with either of the lines in the figure by making any curve pass through the desired voltage on the axis.

The maximum undistorted output of the 245 tube when the load resistance is 3,800 ohms and the effective voltage on the plate is 250 volts is 1,600 ohms. The bias on the grid should be 50 volts and the plate current 32 milliamperes. The upper load line in the fiugre represents these conditions.

In Fig. 77 is given a family of plate voltage, plate current curves for the 224 AC heater type screen grid for a screen voltage of 75 volts. A screen grid current curve is also given for a bias on the control grid of 1.5 volts.

This tube is supposed to be operated with a load resistance of 100,000 ohms, a grid bias of 1.5 volts, a plate voltage of 180 volts and a screen voltage of 75 volts. These are the operating conditions when the tube is used in a radio frequency circuit. When it is used in a resistance coupled circuit in the audio amplifier may be changed considerably. The plate battery voltage may be increased to 300 volts, provided the coupling resistance is of the order of 250,000 ohms, the screen voltage may be decreased to about 30 volts. Under these conditions the control grid bias should be increased to 3 or 4.5 volts.

If these changes are not made the tube will not function well as a voltage amplifier.

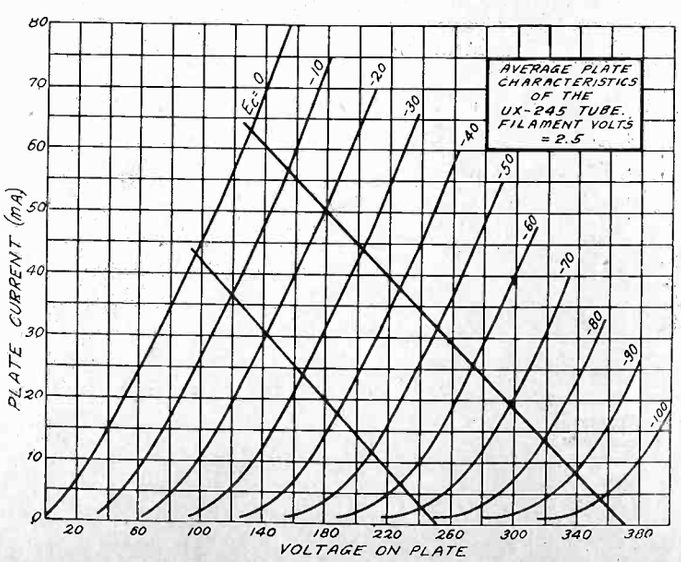


FIG. 76
PLATE VOLTAGE, PLATE CURRENT, CHARACTERISTICS OF THE 245 TYPE TUBE WITH TWO LOAD LINES.

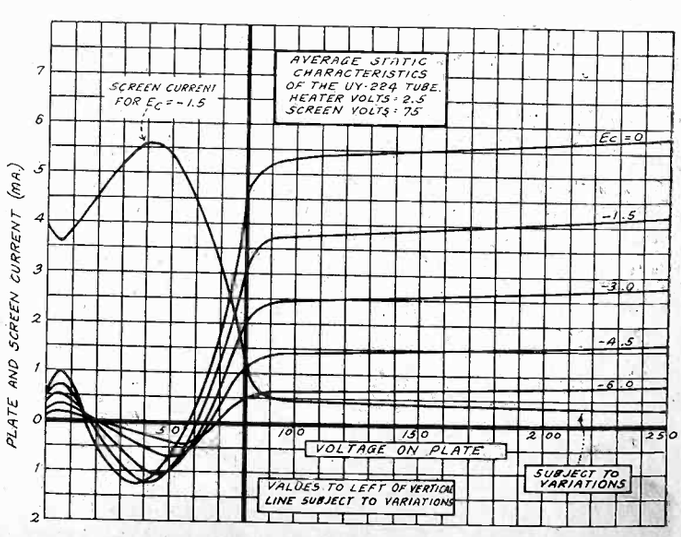


FIG. 77
PLATE AND SCREEN CIRCUIT CHARACTERISTICS OF THE 224 HEATER TYPE SCREEN GRID TUBE.

TPUT, VOLTAGE GAIN

rman Bernard

TABLE I.
Average Characteristics of Amplifier Tubes.

Type	Use	A supply voltage	Filament voltage	Filament current (amperes)	Hot filament resistance (ohms)	Detector "B" voltage	Amplifier "B" voltage	Amplifier grid bias (volts)	Detector grid bias (volts)	Plate current at stated bias (M.A.)	Plate resistance A.C. (thousands ohms)	Mutual conductance (micromhos)	Voltage amplification factor (Mu)	Maximum undistorted output (milliwatts)	Overall Dimensions (inches) Max. dia n.	Max. height
UX220	....	..	..	...	..	..	90	16.5	25.0	3.2	7.7	428	3.3	...	...	...
	P.A.	4.5	3.3	.132	25	..	135	22.5	40.0	6.5	6.6	500	..	110	1 3/16	4 7/8
UX200A...	D.	6.0	5.0	.25	20	45	..	0	...	1.5	30	670	20	...	1 13/16	4 11/16
UX201A...	D.,A.	6.0	5.0	.25	20	45	45	.5-1.5	3.0	0.9	18.5	430	8.0	...	...	...
	....	..	..	...	..	..	67.5	1.5-3.0	6.0	1.7	14.0	570	..	...	1 13/16	4 11/16
	....	..	..	...	..	..	90	4.5	9.0	2.5	11.0	725	..	15	...	...
	....	..	..	...	..	..	135	9.0	13.5	3.0	10.0	800	..	55	...	...
UX112A...	P.A.,D.	6.0	5.0	.25	20	45	90	4.5	7.5	5.5	5.3	1,500	8.0	30	...	...
	....	..	..	...	..	..	135	9.0	13.5	7.0	5.0	1,600	..	120	1 13/16	4 11/16
	....	..	..	...	..	..	157	10.5	16.5	10.0	4.7	1,700	..	195	...	...
	....	..	..	...	..	..	180	13.5	18.0	10.0	4.7	1,700	..	300	...	...
UX171A...	P.A.	6.0	5.0	.25	20	..	90	16.5	27.5	10.0	2.5	1,200	3.0	130	...	...
	....	..	..	...	..	..	135	27.0	40.5	16.0	2.2	1,360	..	330	1 13/16	4 11/16
	....	..	..	...	..	..	157	33.0	48.0	18.0	2.15	1,400	..	500	...	...
	....	..	..	...	..	..	180	40.5	55.0	20.0	2.0	1,500	..	710	...	...
UX222.....	D.,A	4.5 or 6	3.3 (*Screen grid voltage = +45)	.132	25	..	90	1.5	...	1.5*	500	340	175	...	...	...
							135	1.5	...	1.5*	850	350	290	...	1 13/16	5 5/8
							135	3.0	4.5 or 6	1.0*	1,100	280	300	...	...	...
UX240.....	D.,A.	6.0	5.0	.25	20	90	90	1.5	2.5	0.2	150	200	30	...	...	...
	High mu	..	..	..	..	..	135	3.0	3.75	0.2	150	200	..	...	1 13/16	4 11/16
	....	..	..	...	..	..	180	4.5	6.00	0.2	150	200	..	...	...	...
UX226.....	A.	A.C.	1.5	1.05	1.43	..	90	6.0	...	3.5	9.4	875	8.2	20	...	...
	....	..	..	...	..	..	135	9.0	...	6.0	7.4	1,100	..	70	1 13/16	4 11/16
	....	..	..	...	..	..	180	13.5	...	7.5	7.0	1,170	..	160	...	...
UY227.....	D.,A.	A.C.	2.5	1.75	1.43	45	90	6.0	11.0	3.0	10.0	900	9.0	30	...	...
	....	..	..	...	..	..	135	9.0	15.0	5.0	9.0	1,000	..	78	1 13/16	4 11/16
	....	..	..	...	..	..	180	13.5	22.5	6.0	9.0	1,000	..	164	...	...
UY224.....	D.,A.	A.C. (*Screen voltage + 45 load resistance 250,000)	2.5	1.75	1.43	..	180	1.5	4.5*	4.0†	400	1,080	420	...	1 13/16	5 1/4
										(†Screen voltage +75)						
UX210.....	P.A.	8 D.C.	7.5	1.25	6.0	..	180	12.0	...	7.0	7.0	1,100	8.0	145	...	...
	Osc.	or	..	...	..	..	250	18.0	...	12.0	5.6	1,330	..	340	2 3/16	5 5/8
	....	7.5	..	...	..	..	350	27.0	...	16.0	5.15	1,550	..	925	...	...
	....	A.C.	..	...	..	..	245	35.0	...	20.0	5.0	1,500	..	1,540	...	...
UX250.....	P.A.	A.C.	7.5	1.25	6.0	..	250	45.0	...	28.0	2.1	1,800	3.8	900	...	...
	....	..	..	...	..	..	300	54.0	...	35.0	2.0	1,900	..	1,500	2 1/16	6 1/4
	....	..	..	...	..	..	350	63.0	...	45.0	1.9	2,000	..	2,350	...	...
	....	..	..	...	..	..	400	70.5	...	55.0	1.8	2,100	..	3,250	...	...
	....	..	..	...	..	..	450	84.0	...	55.0	1.8	2,100	..	4,650	...	...
UX245.....	P.A.	A.C.	2.5	1.5	1.67	..	180	33.0	...	26.0	1.95	1,800	3.5	780	...	...
	....	..	..	...	..	..	250	50.0	...	32.0	1.90	1,850	..	1,600	2 3/16	5 5/8

D = Detector
A = Amplifier
P.A. = Power amplifier
Osc = Oscillator

It is often convenient to be able to tell what the effective grid bias on a tube is when the plate current is known, or to tell what the effective plate voltage is when the grid bias is known. These problems can be solved approximately by the use of the family of plate voltage, plate current curves for the tube in question or with the aid of grid voltage, plate current curves when these are available. But many prefer to take the normal current values from tables rather than from curves, and therefore the data contained in the curves are given in tables. In these tables, beginning with Table II, the plate currents are given only for selected values of grid bias. If the object is to find the effective plate voltages, it is always possible to use one of the grid bias values listed, and likewise if the object is to determine the effective grid bias, it is always possible to use one of the plate voltages listed.

The use of these data is best explained by examples. Suppose it is required to determine what the bias on a 220 type tube is. A suitable voltage, say 45 volts, is applied in the plate circuit. Then the plate load is short-circuited to insure that the voltage on the plate is equal to the voltage of the battery. Then the plate current is measured with a suitable milliameter inserted in the plate circuit next to the tube. The reading obtained on this meter is then compared with the values in the proper table. Suppose the reading is 2.5 milliamperes. In Table III under 45 volts this value of plate current is opposite -5 volts, which is the required bias. If the reading had been 4.4 milliamperes, the bias would have been zero. If the reading of the milliammeter had been somewhere between these values, the bias would have been between zero and 5 volts. It is possible to estimate quite closely what the bias is by interpolation.

Suppose the meter did not show any reading at all. This would indicate that the bias was greater than 15 volts. To get the value in this case it would be necessary to raise the voltage in the plate circuit to 90 volts, or to some higher value. It is always advisable to use the lowest plate voltage which will give the required result. High plate currents should be avoided, because they not only endanger the milliammeter but they shorten the life of the tube.

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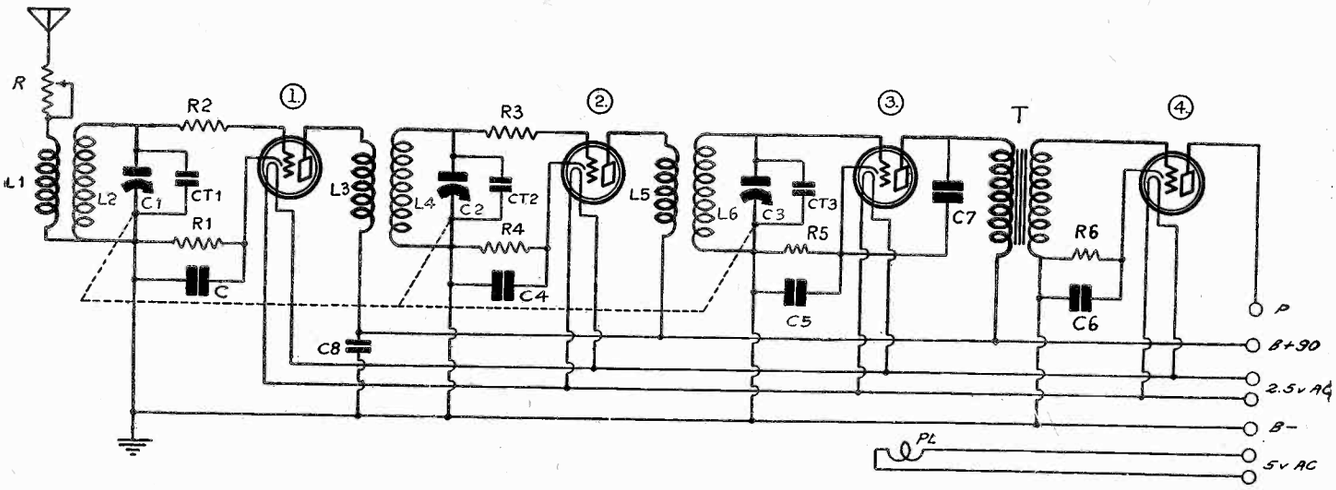

FIG. 780

METHOD OF USING GRID SUPPRESSORS TO STOP SQUEALING. THE VALUES OF THE RESISTORS R2, R3, MAY BE 800 OHMS OR HIGHER. USE THE SMALLEST VALUE OF RESISTANCE THAT AFFORDS STABILITY ON THE LOWEST RECEIVABLE WAVELENGTH

Full-Waving the Universal

I HAVE a 4-tube universal, battery model receiver, that I built from a diagram published in RADIO WORLD last year, and, as pointed out in a recent article in your publication, some of the low wavelengths don't come in, and I am wondering if it would be practical to use the new Bernard tuner to insure full coverage of the wave band? Would I need one coil or two coils? The specified Hammarlund condensers were used, fortunately; therefore, as they have rear extension shaft, the coupling to the tuners is easy, and there is enough room.—J. K.

The new Bernard tuner may be used, indeed, and you will cover the entire wavelength band, whereas now you miss out on a small part of the lower wavelength spectrum. You will need only one coil, the interstage coupler. As you used .0005 mfd. tuning condensers, as specified for the Universal, you will require model BT5B coil, manufactured by the Screen Grid Coil Company. The dials will not track absolutely, since you have a standard coil in the antenna circuit. If you want to assure dial-tracking, then insert two Bernard tuners, the other, BT5A, being the antenna coupler. Put a fixed capacity across the first or antenna tuning condenser. About 80 mmfd. is suggested, but it may have to be larger, in which event use two 80 mmfd. in parallel. Set the equalizing capacity until the dials read exactly alike for some low wavelength station, preferably below 250 meters. This same remedy may be applied to any Universal receiver built on the dimensions specified in the articles published last year.

* * *

Which Type of Tester?

IN testing tubes and circuits, for performance and continuity, is it necessary that I have a highly expensive meter outfit, or may the moderately-priced testers be used with satisfaction?.—G. F.

Very accurate meters are expensive to manufacture, requiring costly components and expert labor to insure a worthwhile product. Therefore a testing outfit that costs $100 to $150 is not expensive in the sense that it costs more than it is worth. It is the only way to obtain real accuracy. However, for ordinary purposes such a high degree of accuracy may not be necessary. A person desiring to ascertain if tubes are getting approximately their correct voltages at approximately correct currents, may do so with an inexpensive outfit, since it is hardly to be expected either that absolute accuracy will be obtained with the low-priced testing apparatus, or that any such experimenter will require laboratory exactness of measurements, especially where the testing is a hobby. Where professional work comes in, such as servicing, the question arises whether the service man can afford the highly accurate outfit, even if he feels he needs it. The usual plan is to let one's income and purse determine the answer. If funds are meagre a low-priced outfit is obtained, and if business prospers, some allowance can be obtained on the old tester if a new, highly accurate tester is purchased. The low-priced testers serve a rael purpose and their use is to be encouraged under the stated circumstances, with the preferance being for highly accurate instruments when finances permit.

* * *

Higher Negative Biases

RECENTLY I have been experimenting with biasing voltages on tubes of high amplification constant, particularly 240, 222 and 224. I find that I can increase the negative bias to higher than recommended values for given plate voltages and that the amplification reduction is very little, but the quality is improved. Is it advisable to use higher than the rated biases for stated plate voltages?—H. F.

The tubes of high mu may be used at higher than rated biases, and this has been pointed out in articles published in RADIO WORLD during the past several months. One reason for the higher bias is better tone quality, where otherwise some of the tubes may be overloaded. The biases refer to tubes used as amplifiers. In the detecting region (grid bias detection) there is not so much leeway. In amplifying circuits the high amplification tubes will tune considerably more sharply when the bias is increased.

* * *

Winding Data for Coils

PLEASE give winding directions for coils to be tuned with a .0005 mfd. condenser, on 2½" diameter tubing. I want to build a TRF receiver, one stage of RF detector and one audio, to work into a power pack.—I. G.

On a 2½" diameter tubing, 2" high or more, using No. 24 silk-covered wire, wind 14 turns for the primaries, and 50 turns for the secondaries, leaving ¼" space between primary and secondary windings. For .00035 mfd. the directions would be the same, except that the secondary would have 62 turns. The receiver will require stabilitzation, so neutralizing condensers or grid suppressors should be used, wire-wound suppressors of about 800 or 1,000 ohms each, in the two RF stages, should be high enough resistance, but if not, use higher values. Such resistors are manufactured by Electrad. Where to connect the suppressors is shown in Fig. 780. They are R2 and R3. The B supply for this diagram would have to be provided additionally, also the filament voltages.

* * *

Books for the Initiate

FOR five years I have been reading the radio magazines, building sets and power packs, experimenting and studying, and as I have a little mathematical knowledge, too, I was wondering if you would recommend some text books to me. I want only the best.—Y. T. W.

The best text mook on radio is Prof. John H. Morecroft's

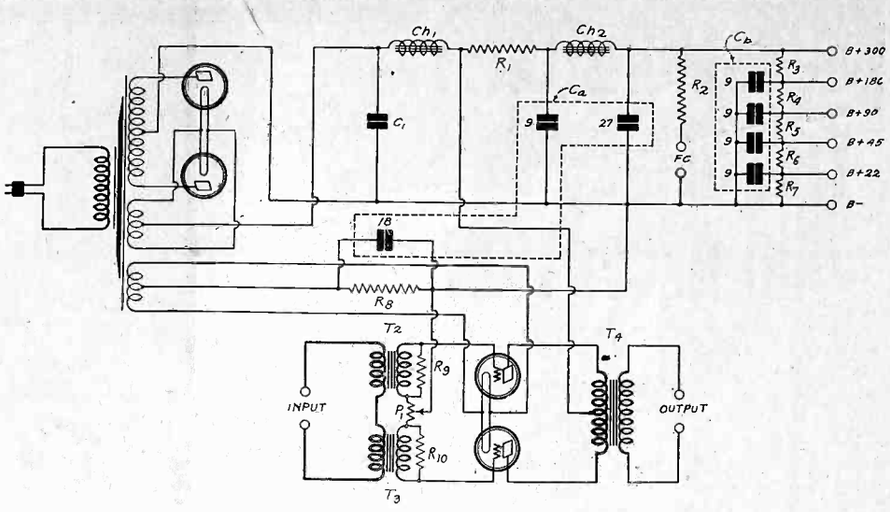

FIG. 781

METHOD OF USING LOWER RATING CONDENSERS IN A HIGH-VOLTAGE POWER SUPPLY. THE POWER TUBE'S PLATE CURRENT IS TAKEN FROM THE FIRST CHOKE, CH1, AS SHOWN BY THE CONNECTION OF THE PUSH-PULL OUTPUT TRANSFORMER T4. THEN THE VOLTAGE FOR THE OTHER TUBES IS DROPPED THROUGH R1 TO A SAFE LIMIT, FOR THE LOWER VOLTAGE CONDENSERS. IF THE CURRENT THROUGH R1 IS 100 MILLIAMPERES, THEN R1 SHOULD BE 1,000 OHMS, TO DROP 450 VOLTS DOWN TO 350 VOLTS.

"Principles of Radio Communication," of which a new second edition has just been published. This is a work for persons of your standing, who have considerable radio knowledge to begin with, and particularly if equipped with some knowledge of mathematics, as there is considerable mathematics in the book. The price of the book is $7.50. Also you should have a copy of Moyer & Wostrel's "Radio Receiving Tubes," which, while it sets forth the tube phenomena in as simple a manner as practical, nevertheless requires at least a little knowledge of radio, for full comprehension of all its interesting chapters. This book costs $2.50. "The Thermionic Vacuum Tube," by Hendrik Van der Bijl, an older book, is more technical and is still the best authority on the subject. ($5.00.) If you are doing considerable work on power amplifiers you should get recent numbers of RADIO WORLD, beginning with the June 1st issue, and read the instalments published each week of "Power Amplifiers," by J. E. Anderson and Herman Bernard. This is really a serial publication of their book, which will be published in October, the only book on the subject. The articles will continue in RADIO WORLD from week to week, and will include constructional chapters. The price of the book will be $3.50. If you are interested in servicing you should get the two books comprising "The Service Man's Manual," by John F. Rider. These books are primarily for novices and are "The Mathematics of Radio" ($2.00), and "Trouble Shooters' Manual" ($3.50).

* * *

Use of a B Eliminator

MY B batteries are run down and I would like to use a B eliminator, therefore ask you kindly to recommend one. The output tube is a 171, while the other tubes are 201A. The set has six tubes, all told, and draws 35 milliamperes.—P. O'T.

The National Velvet B, Cat. No. 3580, is recommended. This provides the full 180 volts necessary for the power tube, and has three adjustable intermediate voltages. The circuit is a simple, dependable one, and the filtration is good, as a husky choke is used, and a large capacity Mershon electrolytic condenser.

* * *

Condenser Versatility

I HAVE a high voltage (550 rms) filter condenser of 4 mfd., also some other filter condensers, of lower working voltage rating (400 volts DC). Yet I desire to build a B supply that will provide power for a 250 tube, with full-wave rectification. Please show how I may utilize these condensers nevertheless.—O. U. R.

See Fig. 781. The high voltage condenser is C1. The lower voltage condensers, but not less than 400 volts DC working voltage, are marked 9 and 27. The condenser marked 18 may be of any voltage rating above 100 volts DC working voltage, but should not be less than 4 mfd. capacity. The resistor R1, interposed between the chokes, drops the voltage to suitable limits, so the lower-rated condensers may be used. Of course the power tube would be connected just to the left of Ch1, to obtain plate voltage. The value of R1 will depend on the current through it. If you are to pass 100 ma through R1 and want to drop 400 volts to 300, R1 would be 1,000 ohms.

* * *

Effect of Misplaced Voltage

COULD any harm result if the C battery in my battery-operated set were connected the wrong way?—H. F. D.

The amount of harm depends on the magnitude of the error. If the battery serving an amplifier, is reversed, the grid would be made positive instead of negative, and distortion would be severe. If the battery were united in series with the filament circuit, the filament of such tubes served by the mistaken connection would be over-voltaged by the extent of the C battery voltage, and the tube filaments likely would burn out, and if they didn't, the battery would go dead in a hurry on account of the heavy current.

* * *

Revamping for Screen Grid

AT present I am using a three-year-old battery set. I desire to stick to batteries. Do you think it advisable to revamp my hookup, so as to include screen grid tubes? My reception at present is satisfactory, but I do not get much distance and could stand a little more volume.—U. T.

Revamping is usually most unsatisfactory in a radio receiver, no matter what the objective. It is far better to tear down an existing receiver and, using as many of the parts as possible, build a new one, following a modern, tested design. Several screen grid radio receiver designs have been published in RADIO WORLD recently. You could use nearly all your present parts except the coils. Tube for tube, you would get better performance by using screen grid tubes, especially along the lines that interest you most, that is, improved distance reception and greater volume. You need have no hesitancy about making the change, unless you insist on doing it by the revamping process, in which instance you are very likely to experience a sad disappointment.

WAVE MONITOR TO POLICE AIR, AID RECEPTION

By W. D. Terrell

Chief, Radio Division, Department of Commerce

The only one of its kind, a proposed constant frequency monitoring station, to be erected in December at Grand Island, Nebraska, will serve as a check on radio frequency transmission channels or wavelengths, and will be able definitely to place a transmitting station back on its frequency by the simple method of calling up the Grand Island station by telephone.

For instance, if the operator of any commercial or broadcasting station finds that his station is not operating on its authorized frequency, or wavelength, he may telephone the monitoring station at Grand Island and request that his frequency be checked or measured, the station making the request paying the toll charges. By doing this, experts in the radio division pointed out, the broadcasting station will be "put right" on its frequency, and will be able to eliminate the heterodyne, or "whistle" from the receiving set, thus directly benefiting the users of commercial radio sets.

Where Idea Originated

An outgrowth of an idea developed in the Commerce Department's radio division, and the result of more than three years' planning and research, it is believed that the work of the station will be of unique value to all radio transmitting stations in the United States and, when the purpose of the station becomes more widely known, to all foreign stations who care to avail themselves of the service.

More than 600 commercial broadcasting stations, 2,000 ship stations, all of the commercial trans-oceanic and transcontinental services, short-line point-to-point services, 16,000 amateur transmitting station, appromixately 1,000 government stations and more than 1,000 other types of stations in the United States will be able to avail themselves of this service before the end of the year, it was pointed out, at which time it is believed that all the preliminary work on the Grand Island station will be completed and operating forces at work.

Measures 7 to 30,000 Meters

The delicate and sensitive instruments with which it is possible to measure the operating frequencies of various radio transmitting stations throughout the world, covering a range from 7 metres to 30,000 metres, will be installed in a modern and attractively designed two-story brick structure, situated on the sage brush and cactus Nebraska prairies, near the town of Grand Island, which has a population of about 16,000, and is directly on the path of the air mail lines from Omaha to the West.

Stretched aloft 70 feet above the 50-acre tract comprising the government reservation will be the antennae, running in all directions, and in some cases two miles in length. The Europe and Asia antennas will be strung East and West. It was pointed out that the reservation will be brightly marked day and night, thus serving as an excellent guide-mark for the mail planes.

About 20 men will comprise the personnel of the plant, when in full operation. It will be a self-sustaining station, generating its own power, and functioning autonomously within its scientific confines.

Life Extension of Board Proposed

Washington.

Returning from London, where he attended a world conference on safety at sea, Representative White, of Maine, said he would introduce a bill to extend the life of the Federal Radio Commission beyond December 31st, 1929, when it would otherwise become a purely administrative body.

He visited President Hoover and said he found the President favorably disposed toward such a bill.

AIR KEY ASKED BY WIRED RADIO

Washington.

Wired Radio, Inc., of New York, which plans to introduce to the country "radio" program service reaching into homes along telephone and power lines, filed with the Federal Radio Commission applications for experimental relay broadcasting stations to be employed in linking cities which would be served by the wired radio project. Previous applications for short waves were denied by the Commission.

It was stated at the Commission that C. W. Hough, president of Wired Radio, Inc., had explained that he has had difficulty in procuring the land lines with which to connect the cities and that the short waves are desired as a temporary expedient. When these lines are obtained, it was said, Mr. Hough declared his company would turn the channels back to the Commission. Wired Radio, Inc., is a 100 per cent subsidiary of the North American Company, of New York, which controls public utilities in various sections of the country.

In testimony before the Commission last Spring, Mr. Hough explained that a choice of three programs would be offered the public through the Wired Radio system. These programs would travel along telephone or power lines, without disturbing conversation or other service. He told the Commission that hundreds of patents have been purchased.

Daniel, Announcer, Dies on Bridal Eve

John Daniel, twenty-nine, radio announcer, died recently at St. Elizabeth's Hospital, New York City, of peritonitis following an operation.

Daniel worked in the National Broadcasting Company studios the previous Saturday night. The attack came while he was at work and he was taken home. Later he was rushed to the hospital for the operation.

Daniel was operated on the eve of the day set for his wedding to a daughter of a retired Naval officer. Daniel was born in England and was the son of Tom Daniel, noted English basso. His first years of school were in Scotland and his education was continued in the United States.

NEW DEJUR-AMSCO CONDENSERS

The DeJur-Amsco Corporation, Broome and Lafayette streets, New York City, announce a new line of Multiple Condensers of the Bathtub type with dial assembly completely matched and balanced, two, three or four-gang, with or without dial, and in two to eight-gang with dial. Those requiring further information should address the concern and mention RADIO WORLD.—J. H. C.

RCA DEFEATED BY DUBILIER IN AC PATENT WAR

Wilmington, Del.

A suit by the Dubilier Radio Corporation, of New York, against the Radio Corporation of America, in which the plaintiff alleged violation of a patent it purchased for elimination of hum in the use of house socket alternating current in radio receivers and amplifiers, was decided in favor of the Dubilier Corporation by Judge Morris in the United States Circuit Court.

Another patent at issue was that of obtaining grid bias, and the Dubilier Corporation was sustained in this, too. Both patents held valid and infringed.

A third patent, relating to loud speakers, was held not to be infringed.

All three actions were against the RCA.

William Dubilier, technical adviser of the Dubilier Condenser Corporation, said that the alternating current patent decision was far-reaching, and said something about infringement damages totalling $10,000,000 that may be asked against manufacturers, since the use of alternating current for receivers is general.

The two patents in the prosecution of which the Dubilier Corporation was successful were No. 1,455,141, involving a method of overcoming or eliminating hum from a receiving set operated from the lamp socket, and No. 1,635,117, involving the use of rectified alternating current to obtain negative grid bias. Both patents were bought from the inventors, Percival D. Lowell and Francis W. Dunmore.

Maj.-Gen. James G. Harbord, president of RCA, said that the two decisions were not as serious as some would represent them to be, and announced an appeal taken by his corporation.

The suits were begun in 1926 and may not be finally decided until 1934.

Hammarlund Device Is Record Seller

The sales of the popular manufacturer's special E C model equalizing condensers, manufactured by The Hammarlund Manufacturing Company, Inc., 424 West 33rd Street, New York City, increased 30% during the six month period of January to June, according to a report recently made by Lloyd Hammarlund, director of sales.

Lloyd Hammarlund

"Over a quarter of a million of these ingeniously designed condensers were sold during that time," states the report.

"And," continues Mr. Hammarlund, "it will not be long before this record will be broken, for there are orders for over a quarter million on the books."

These condensers are used for balancing as well as for controlling feedback.

WARNING GIVEN TO STOP FRAUD IN RECORD USE

By Harold A. Lafount

Federal Radio Commissioner

While the broadcasting of music performed through the agency of mechanical reproductions, such as records or perforated rolls, is not in itself objectionable, the failure clearly to announce the nature of such broadcasting is in some instances working what is in effect a fraud upon the listening public.

In view of the scarcity of channels these valuable government franchises should be used in such a manner as to render the broadest public service.

The basic reason back of the general orders requiring announcements of phonograph records is the fact that the public in large cities can easily purchase and use at its leisure phonograph records of the ordinary commercial type.

Stations That Give Nothing

A station which devotes the main portion of its hours of operation to broadcasting such phonograph records is not giving the public anything which it cannot readily have without such a station. If the station is located in a city where there are large resources in program material, the continued operation of the station means that some other station is being kept out of existence which might put to use original program material.

Of course the situation is not the same in some of the smaller towns and farming communities, where first-class original program resources are not available.

Tricky Subterfuges

Ingenious and subtle methods are often resorted to by broadcasters to hide the fact that mechanical reproductions are being used. But the most alarming feature of the situation is the fact that stations using phonograph records, which programs are sponsored by advertisers, are able to quote such low prices that other stations using original material cannot compete with them.

The result is there is a decided drift of advertisers apparently to stations offering low advertising prices because of the extensive use of phonograph records, so that there is grave danger that the present high grade original programs of stations not connected with chains may soon be seriously hampered for lack of sponsors.

Danger of Deterioration

Because of the fixed government policy not to tax listeners, broadcasting in this country depends, to a large extent, upon revenues from advertisers. If the advertiser feels he can get fair results from a small outlay by sponsoring phonograph record programs, then he is not in the market as a sponsor for an original program, with high educational and entertainment value.

Unless this situation is remedied, broadcasting programs will rapidly deteriorate in this country.

PIANO TUNERS GRATEFUL

Chicago.

Piano tuners, in national convention, praised radio as an ally. Tuners report they get the right pitch by turning on the customer's radio set.

Radio Week Begins on September 22d

National Radio Week will be celebrated this year beginning Sunday, September 22nd. The radio industry, broadcasting stations and listeners will unite to make this a musical festival week besides.

The idea of a national radio week was first proposed a few years ago by Roland Burke Hennessey, editor of RADIO WORLD, and was adopted by the trade with enthusiasm.

This year set manufacturers and parts accessory manufacturers have laid elaborate plans, through the leading trade organizations, to make "the" week outstanding.

The Radio World's Fair will be held during the same week (September 23rd to 28th. at Madison Square Garden, New York City.

POLICE WAVE, IS CLEVELAND AIM

Washington.

The Cleveland Police Department filed with the Federal Radio Commission an application for permission to create a radio crime detection and criminal apprehension service, employing short waves.

The application, filed by W. R. Hopkins, City Manager, stated that the city desired to install a transmitter for the use of the Police Department through which it would communicate with police "cruising" automobiles, and dispatch them to scenes of crime. The application requested assignment to the 1,712-kilocycle channel with from 150 to 1,000 watts power, so that a radius of 20 miles could be covered.

Similar applications have been filed by other cities, including Chicago, which outlined elaborate plans for the radio system to the Commission.

Talkie Televised In London Tests

London.

A talking film was transmitted recently by television methods and received with considerable success with apparatus ordinarily employed for receiving television images. The experiments were conducted by the Baird Television Development Company. George Robey, British vaudeville performer, made a short speech, which also was transmitted.

The voice transmission was clearer than in a talking movie house and the synchronized pictures were on a par with those attained in television.

In transmitting the talking film, the visual effects are obtained by scanning the picture portion of the film in the usual manner with a disc perforated with holes located in a spiral and the visual effects are reproduced at the receiver by a similar disc rotating in synchronism with the transmitting disc. The receiving disc scans a neon lamp, the intensity of which varies as the visual signal received. The sound effects on the films are a pick up from the marginal record and the signal thus obtained is broadcast simultaneously with the visual signal.

KOLSTER-EARL MERGER

Conferences are being held looking toward the merger of Kolster and Earl, both set manufacturers.

FILMED SOUND TO BE SENT BY C.B.S. STATIONS

Reels of film will be used by the Columbia Broadcasting System this Winter, in an effort to provide wide distribution of program material, to many stations, without having to pay telephone wire charges. The film recording has been developed especially for radio use in the laboratories of Paramount-Famous-Lasky Corporation, which bought a half-interest recently in the C. B. S.

Reels of radio programs can be sent to broadcasting stations for use at any time. A device at the radio studio would reproduce the program over the microphone.

Paramount recorded speeches by film stars in Hollywood and later broadcast to the Byrd Antarctic Expedition from Atlantic City.

Commander Byrd's favorable report of the clarity of the program is said to have developed the idea of using films in regular broadcasting.

It was said film is more economical and easier to handle than wax records.

Television License Granted to WENR

Washington.

The Great Lakes Broadcasting Company, at Chicago, which operates WENR, the 50,000 watt broadcasting station supported by the Insull utility enterprises, has been granted a license to broadcast television with 5,000 watts power.

The Chicago station has been allocated the visual broadcasting channel ranging from 2,850 to 2,950 kilocycles for television transmission on regular schedule, it was explained orally at the Commission. There are now approximately a dozen stations licensed to broadcast television, it was stated, but all on an experimental basis.

Sams in Sales Post With Silver-Marshall

Howard W. Sams has been appointed director of territorial sales for Silver-Marshall, Inc., Chicago. He was New York district sales manager of E. T. Cunningham, Inc. He will make his headquarters in Chicago.

Mr. Sams, a native of Chicago, has spent eight years in the radio field.

Vulcan Arrestor

The Corwico Vulcan Lightning Arrestor, nicely finished, and made to stand up under all conditions, functions to protect the set and installation against lightning discharges, and aids detouring of static. In each container is a guarantee in which the Cornish Wire Company agrees to repair, or to have repaired, up to a cost of $100, any radio receiver protected by a Corwico Vulcan Lightning Arrestor that has been damaged by lightning. It is approved by the Board of Underwriters.

The Cornish Wire Company also makes Corwico Braidrite wire for radio use. For full information on these products address the concern at 32 Church Street, New York City. Mention RADIO WORLD.—J. H. C.

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One 90 mmfd. equalizer	.35
Three .01 mfd. at 40c each	1.20
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One 5.0 meg.	.30
One .75 meg.	.40
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One 1.3 ohm	.15
One 6.5 ohm	.30
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Satin aluminum subpanel, socketed, bracket, insulators, 4 resistor clips	2.00
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Two dial pointers at .10 ea.	.20
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Two links at .35 ea.	.70
	$23.00

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Same Base; Same Prongs, Same Heater Voltage as 227, and, therefore, can be used to replace 227.

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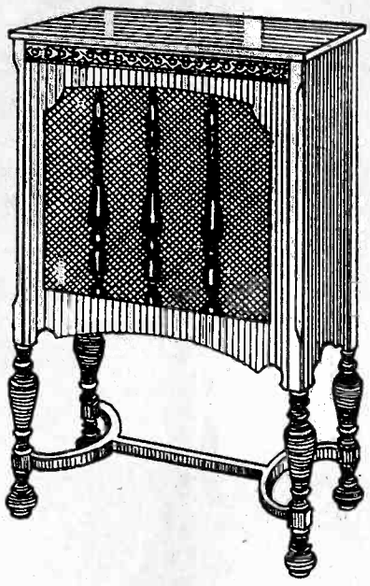
With Molded Wood Horn of 8 ft. tone travel (exponential type) with baffle and horn meter built in. Extraordinary bargain. **$20.00**



The speaker cabinet is walnut finish, 33" high, 24½". wide,. 17½". deep,. with. carved. legs. Golden cloth grille covers front opening. Built inside is No. 595 molded wood horn with baffle and No. 203 driving motor unit that stands 250 volts without filtration. Horn and motor removable. Table alone is worth price asked. Remit with order and we pay cartage on Aristocrat Floor Speaker.

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245 PP Power Amplifier, built up, $55.00

Thrill Box, Complete Parts, all 6 coils, cabinet—$33

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245 Power Amplifier

for 5 x 17½" Base

T1, Ch1, Ch2—One Polo 245 power supply, consisting of one 12 amp. 2.5 volt winding, one 3 ampere 3 amp. 2.5 volt, one 5 volt, one 724 volt, all center-tapped; primary winding and two chokes; all in one cadmium-plated case	$10.00
C1, C2, C7—Three 2 mfd. HV filter condensers, 550 volts rms working voltage, @ $1.70	5.10
C3, C4, C5, C6—One Mershon electrolytic condenser, consisting of two 18 mfd. anodes and two 8 mfd. anodes, with mounting bracket	5.67
C8, C9—Two .01 mfd. mica dielectric condensers @ .35	.70
C10—Two HV filter condensers, 550 volts rms working voltage, connected in parallel @ $1.70	3.40
R1—One voltage divider: (1) to (2) 8 ohms, (2) to (3), 40 ohms, (3) to (4) 775 ohms, (4) to (5) 4,400 ohms, (5) to (6) 2,500 ohms.	1.75
R2—One .5 meg. metallized resistor	.30
R3—One 2 meg. metallized resistor	.30
R4—One 50,000 ohm (.05 meg.) metallized resistor	.40
R5—One 5 meg. metallized resistor	.30
Ch3—One output impedance	3.00
F—One 2 ampere cartridge fuse, with fuse holder	.40
Mounting bracket for C1, C2, C7, C10	.25
Speaker—Two binding posts @ .10	.20
	$31.07

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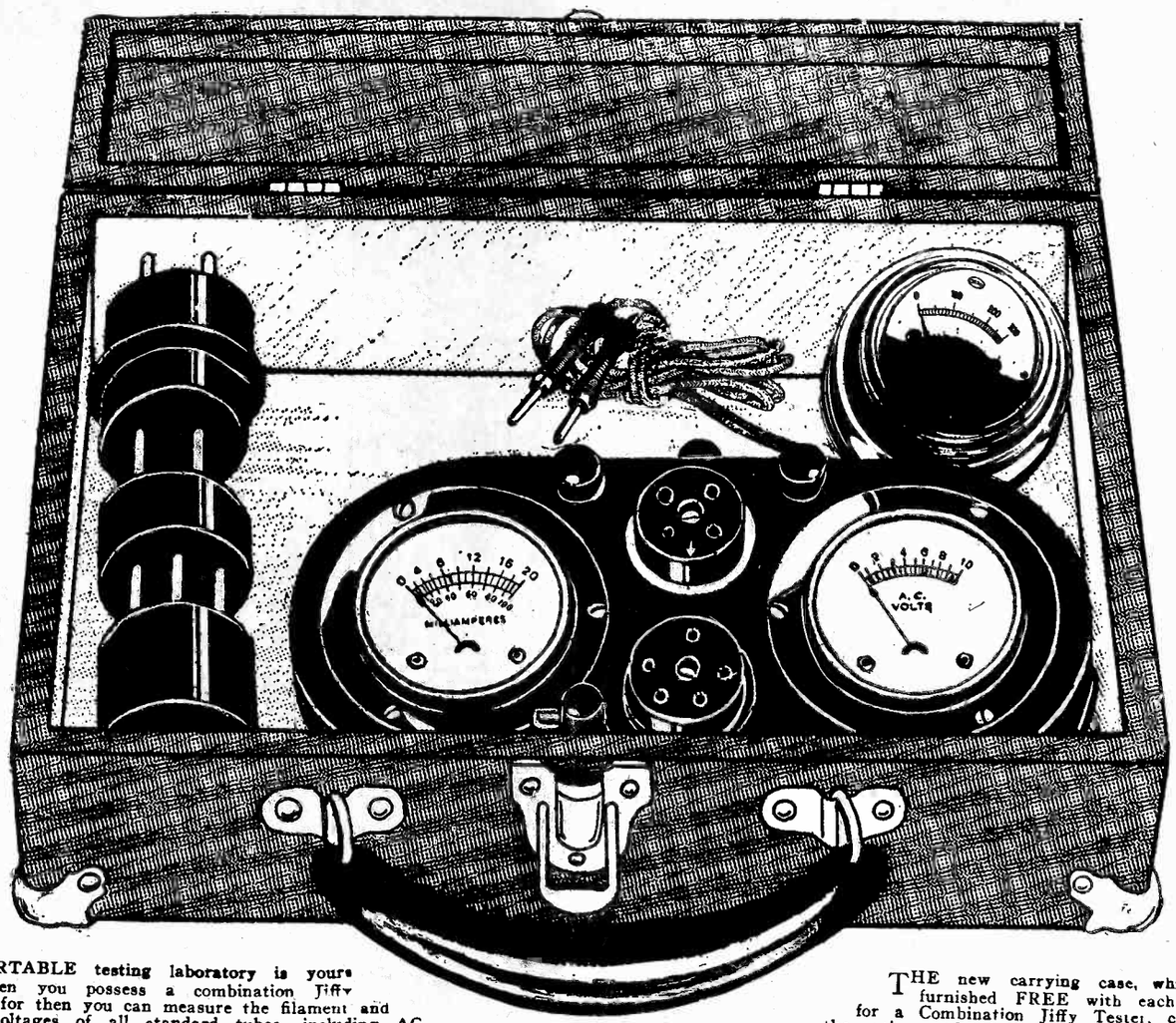
New Style DeLuxe Leatherette Carrying Case FREE with each Jiffy Tester!

This combination of meters tests all standard tubes, including the new AC screen grid tubes and the new 245 tube, making thirteen tests in 4½ minutes! Instruction sheet gives these tests in detail.



A PORTABLE testing laboratory is yours when you possess a combination Jiffy Tester, for then you can measure the filament and plate voltages of all standard tubes, including AC tubes, and all standard battery-operated or AC screen grid tubes; also plate voltages up to 500 volts on a high resistance meter that is 99% accurate; also plate current.

The Jiffy Tester consists of a 0-20, 0-100 milliammeter, with change-over switch and a 0-10 volt AC and DC voltmeter (same meter reads both), with two sockets, one for 5-prong, the other for 4-prong tubes; a grid bias switch and two binding posts to which are attached the cords of the high resistance voltmeter; also built-in cable with 5-prong plug and 4-prong adapter, so that connections in a receiver are transferred to the Tester automatically. Not only can you test tubes, but also opens or shorts in a receiver, continuity, bias, oscillation, etc. The instruction sheet tells all about these tests.

In addition you can test screen grid tubes by connecting a special cable, with clip to control grid (cap of tube) and other end of special cable to the clip in the set that went to the cap before the tube was transferred to the tester.

THE new carrying case, which is furnished FREE with each order for a Combination Jiffy Tester, contains the entire outfit, including the three meters, cable and plug, and three adapters (one for 4-prong tubes, two for 199 tubes). This case is 10½x7¾x3½" and has nickel corner pieces and protective snap-lock. The case is made of strong wood, with black leatherette overlay.

To operate, remove a tube from the receiver, place the cable plug in the vacant receiver socket, put the tube in the proper socket of the Tester, connect the high resistance meter to the two binding posts, and you're all set to make the thirteen vital tests in 4½ minutes!

The Combination Jiffy Tester is just the thing for service men, custom set builders, experimenters, students, teachers and factories. Order "Jiffy 500." The price is only $14.50.

If a 0-600 AC and DC high resistance meter (99% accurate) is desired, so house electricity line voltage and power transformer voltages can be measured, as well as plate voltage, instead of the 0-500 DC voltmeter, order "Jiffy 600" at $15.50.

GUARANTY RADIO GOODS CO., 145 W. 45 St., N. Y. City. (Just East of Broadway).

☐ Please ship at once on 5-day money-back guaranty one "Jiffy 500," at $14.50, consisting of

(1) One Two-in-One 0 to 10 voltmeter for AC and DC. Same meter reads both. Scale especially legible at 1½ to 7½ volts. This meter reads the AC and DC filament voltages.
(2) One DOUBLE reading DC milliammeter, 0 to 20 and 0 to 100 milliamperes, with change-over switch. This reads plate current.
(3) One 0-500 volts high resistance voltmeter, 99% accurate; with tipped 30" cord to measure B voltages.
(4) One 5-prong plug with 30" cord for AC detector tubes, etc., and one 4-prong adapter for other tubes.
(5) One grid switch to change bias.
(6) One 5-prong socket.
(7) One 4-prong socket.
(8) Two binding posts.
(9) One handsome moire metal case.
(10) One instruction sheet.
(11) One de luxe carrying case.
(12) One screen grid special cable.

☐ If 0-300 DC high resistance 99% accurate voltmeter is preferred to 0-500, put check here. Price is same, $14.50.

☐ Same as above, except substitute a 0-600-volt AC and DC high resistance 99% accurate voltmeter (same meter reads both) for the 0-500 DC meter. Price $15.50.

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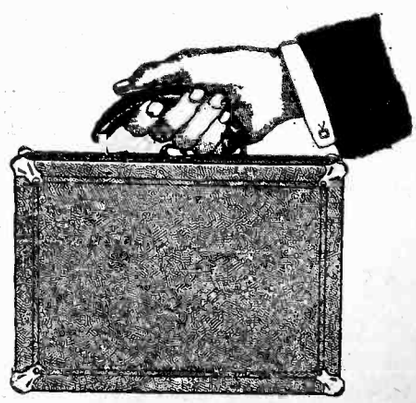
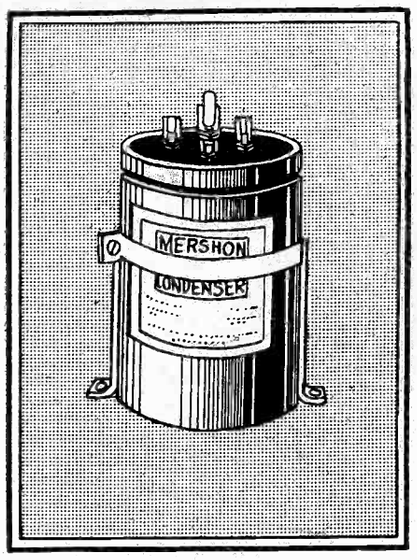


The new de luxe leatherette carrying case is compact and handy. Size 10½" long, 7¾" wide, 3½" deep.

MERSHON

Electrolytic Condensers at Professional Discounts



Mershon Electrolytic Condensers for Filtering Circuits of B supplies, rated at 400 volts D.C., or for by-pass condensers, give enormous capacities in compact form. We offer, at attractive discount, genuine Mershons made by the Amrad Corporation.

Cat. No. Q 8

Consists of four Condensers of 8 mfd. each, all in one small copper case (less brackets), List Price, $7.95.....

$4.67 NET

LIST PRICE, $7.95

[Cat. Q 8B same as above, but includes mounting bracket. No brackets sold separately..... $4.87]

Cat. Q 2-8, 2-18

Consists of four Condensers, two of 8 mfd. each, and two of 18 mfd. each, all in one small copper case (less brackets), List Price, $9.45.....

$5.55 NET

LIST PRICE $9.45

[Cat. Q 2-8, 2-18B, same as above, but includes mounting bracket. No brackets sold separately..... $5.75]

Mershon electrolytic condensers are instantly self-healing. They will break down only under an applied voltage in excess of 415 volts D.C. (commercial rating; 400 volts D.C.) but even if they do break down because overvoltaged, no damage to them will result, unless the amount of leakage current and consequent heating of the electrodes and solution cause the solution to boil. Voltages as high as 1,000 volts will cause no particular harm to the condenser unless the current is high enough to cause heating, or the high voltage is applied constantly over a long period.

High capacity is valuable especially for the last condenser of a filter section, and in bypassing, from intermediate B + to ground or C + to C —, for enabling a good audio amplifier to deliver true reproduction of low notes. Suitably large capacities also stop motorboating.

Recent improvements in Mershons have reduced the leakage current to only 1.5 to 2 mils total per 10 mfd. at 300 volts, and less at lower voltages. This indicates a life of 20 years or more, barring heavy abuse.

How to connect: The copper case (the cathode) always is connected to negative. The lugs at top (anodes) are connected to positive. Where there are two different capacities **the SMALLER capacity is closer to the copper case.**

Mershons of equal capacity may be connected in series for doubling the voltage rating, or in parallel (any combination) to increase the capacity to the sum of the individual capacities, the rating remaining the same, 400 volts.

When series connection is used, the copper case of one condenser the anode of which goes to the high voltage should be connected to a lug or to lugs of the other condenser. The copper case of the second condenser goes to the negative.

In B supplies Mershons are always used "after" the rectifier tube or tubes, hence where the current is direct. They cannot be used on alternating current.

OTHER CAPACITIES OF MERSHONS

["S" stands for single condenser, "D" for double, "T" for triple and "Q" for quadruple. First figure between hyphens denotes quantity, second capacity per anode.]

Cat. No. S-8, list price $4.10; net, $2.41
Cat. No. S-9, list price $4.25; net, $2.49
Cat. No. S-18, list price $4.80; net, $2.82
Cat. No. S-40, list price $5.40; net, $3.17
Cat. No. S-72, list price $10.00; net, $5.88
Cat. No. D-8, list price $5.25; net, $3.08
Cat. No. D-9, list price $5.75; net, $3.38
Cat. No. D-18, list price, $6.15; net, $3.62
Cat. No. T-8 list price $6.30; net, $3.70
Cat. No. T-9, list price $6.45; net, $3.79
Cat. No. T 1-8, 2-18, list price $7.90; net, $4.65
Cat. No. 1-18, 2-9, list price $7.50; net, $4.41

[Note: Add 20c to above prices if bracket is desired. No brackets sold separately.]

No. C.O.D. orders on Mershon Condensers

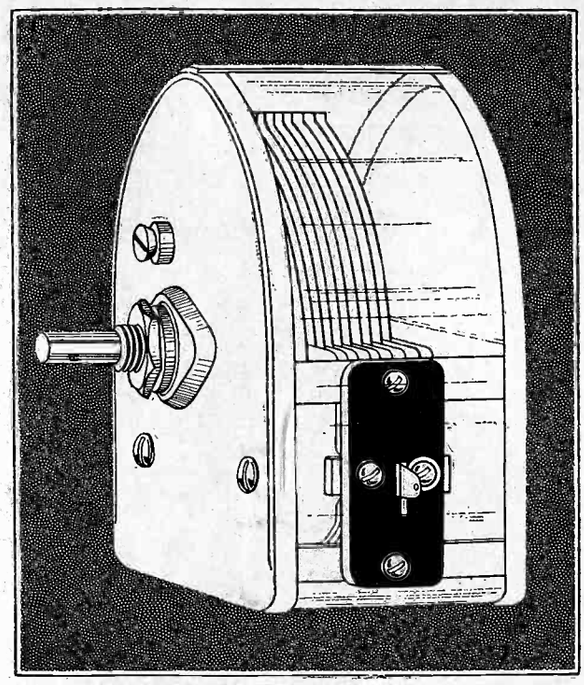
GUARANTY RADIO GOODS CO.
143 West 45th Street, New York, N. Y.
(Just East of Broadway)

DO YOU LIKE

Dust in Your *Eye?*

HERE is a .0005 mfd. tuning condenser carefully encased in a housing consisting of metal front and back with transparent celluloid cross-piece sealed in between, all the way around, *to keep out dust.* The accumulation of dust on the stator and rotor plates of a condenser and about the bearings tends to build up a high resistance to radio frequencies. Keep out the *dust* and you keep the selectivity and sensitivity high, because of unimpaired efficiency.

Do you like dust in your eye? The condenser is the eye of the receiver, just as the tube is the heart.



Easy-Turning Rotor

MADE to last, and to work at highest efficiency from first to last, this condenser is sturdily constructed. The plates are accurately soldered in place to make best contact and permanent, lasting, accurate alignment. The contact is positive.

The back and front metal housing pieces are connected to the rotor as a part of the construction of the condenser itself, and these metal pieces shield the built-in condenser from outside disturbances.

The only dielectric insulation are two pieces of specially selected hard rubber, 1⅜" x ⅝". This is a fine minimum, and it consists of the best insulator.

Connection to stator plates is made from the receiver to a tinned lug protruding from one of the insulators. At rear another tinned lug is for rotor connection.

Single hole panel mounting is provided with ¼" shaft projecting. Two-hole mounting is optiional. Sub-panel mounting, by means of brackets, is optional, the screws for this purpose being in tapped holes of the front and rear shields.

The rotor turns so easily that you'll be delighted at the result. Moreover, the tension of the roto is adjustable at rear.

Helps You Get DX

NOT only is the dust-protected condenser sturdy and dependable, but it is handsome as well. Those who want excellence surely can obtain it from this condenser. Because of the retained efficiency, you will find this condenser helps you to bring in distant stations.

Equip your set now with dust-protected condensers. Order Cat. No. DUP5 at $2.50.

GUARANTY RADIO GOODS CO.,
143 West 45th Street, N. Y. City
(Just East of Broadway)

Gentlemen: Please ship at once..... dust-protected .0005 mfd. condensers, Cat. DUP5, at $2.50 each.

☐ Enclosed please find remittance. You are to pay cartage.
☐ Ship C.O.D. I will pay cartage.

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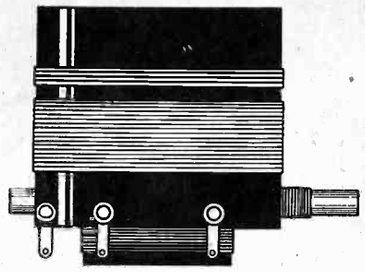
A NEW IDEA IN COILS!

The Bernard Tuner Works Screen Grid Tubes Up to the Hilt!



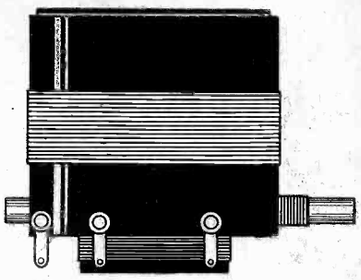
Cat. No. BT5A—$2.50
FOR .0005 MFD. CONDENSERS

Bernard Tuner for antenna coupling, the primary being fixed and the secondary tuned. This coil is used as input to the first screen grid radio frequency tube. The double-action tuning method invented by Herman Bernard is employed. Adjust an equalizing condenser across the tuning condenser so that exactly the same dial settings prevail through all circuits. This equalizer, 90 mmfd., once set, is left thus.
Cat. No. BT3A for .00035 mfd. $2.55

FOR the first time in radio a coil has been designed that permits working the screen grid tube up to the enormous amplification level that theory long promised but practice long denied.

The secret lies in tuning the plate circuit of the screen grid tube, and still covering the entire broadcast band. Herman Bernard, noted radio engineer, invented the solution—a tuned coil consisting of a fixed and a rotating winding in series, the moving coil turned by the same dial that turns the tuning condenser. An insulated link physically unites condenser shaft and moving coil. Thus when the condenser plates are entirely in mesh the moving coil is set for maximum inductance, that is, it aids the other part of the tuned winding. As the condenser is turned to lower capacity setting the moving coil aids less and less, until at the middle of the dial it acts as if fixed. From then on the moving coil bucks the fixed winding, greatly reducing the total effective inductance, and thus nullifying the effect of the high starting capacity.

The Bernard Tuner is a two-winding coil for interstage coupling, working out of a screen grid tube, 222 or 224, and into any type tube. The tuned primary has coupled to it a still larger inductance, on separate inside form, for step-up, thus greatly increasing an already enormous amplification! This is Cat. No. BT5B for .0005 mfd., BT3B for .00035 mfd. Use BT5A or BT3A for antenna coupler, tuning the secondary, with an equalizing condenser across the antenna tuning condenser, so that the high minimum capacity of the tube's output will be duplicated at the input.

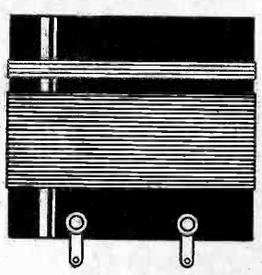


Cat. No. BT5B—$2.50
FOR .0005 MFD. CONDENSERS

Bernard Tuner for working out of a screen grid tube, consists of a rotary coil in series with a fixed coil, the two constituting a tuned primary, for tuning the combined rotary and fixed windings to exceed the broadcast band of wavelengths. The condenser shaft and rotary coil shaft are physically coupled so one motion turns both. Develops the highest possible amplification from the screen grid tube.
Cat. BT3A for .00035 mfd.....$2.55

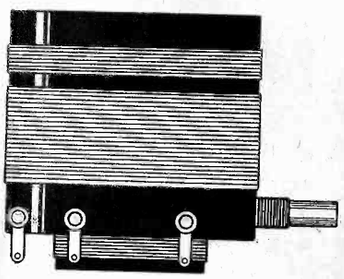
The Diamond Pair

Since 1925 the Diamond of the Air has been an outstanding circuit. It has undergone few changes. When power tubes and screen grid tubes appeared these were included. When AC operation became practical, the model was described for such use. Whether battery-operated or AC-operated, the Diamond of the Air is a dependable and satisfactory circuit. It uses a screen grid RF stage, tickled detector and two stages of transformer coupled audio. The same coils are used for both models, battery or AC. The secondaries are tuned. They are matched with fine precision, to permit ganged tuning.



Cat. No. RF5—$0.75
FOR .0005 MFD. CONDENSER

Antenna coil for any standard circuit, and one of the two coils constituting the Diamond Pair. The secondary is carefully wound to match the inductance of the companion coil's secondary, so equality of tuning prevails.
Cat. No. RF3 for .00035...$0.80

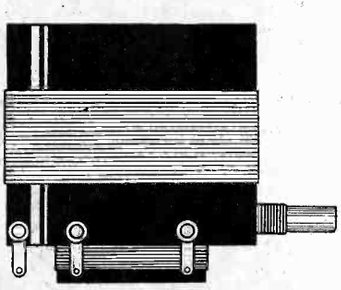


Cat. No. SGT5—$1.25
FOR .0005 MFD. CONDENSER

Interstage 3-circuit coil for any hook-up where an untuned primary is in the plate circuit of a screen grid tube. This primary has a large impedance (generous number of turns), so as to afford good amplification. Used in the Diamond of the Air.
SGT3 for .00035 mfd.....$1.30

The Diamond Pair of coils for .0005 mfd. tuning are Cat. Nos. RF5 and SGT5. A circuit of excellent stability, extremely high selectivity and good sensitivity, the Diamond of the Air should be built with coils that permit full capitalization of the virtues of the circuit. Not only is the number of turns correct for this circuit on each coil, but the spacing between aperiodic primary and tuned secondary is exactly right. Note that the 3-circuit coil SGT5 (or SGT3) has a high impedance primary. This means good amplification from the screen grid tube, obtained in a manner that guarantees selectivity attainment.

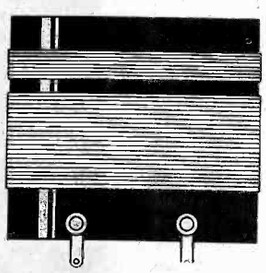
ANTENNA COUPLER



Cat. No. VA5—$1.10
FOR .0005 MFD. CONDENSER

Moving primary and fixed secondary, for antenna coupling, adjustable from a knob at the front panel, thus providing volume control.
Cat. No. VA3 for .00035 mfd.....$1.15

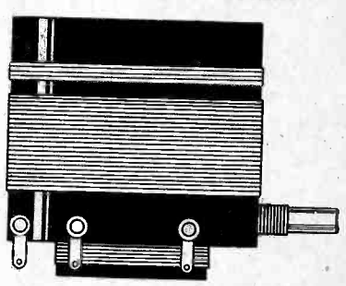
SG TRANSFORMER



Cat. No. SGS5—$0.75
FOR .0005 MFD. CONDENSER

Interstage radio frequency transformer, to work out of a screen grid tube, where the generous-sized primary is in the untuned plate circuit.
Cat. No. SGS3 for .00035 mfd.....$0.80

STANDARD TUNER



Cat. No. T5—$1.25
FOR .0005 MFD. CONDENSER

Standard three-circuit tuner, for antenna stage, or interstage coupling where primary is in the plate circuit of any tube except a screen grid. Provides abundant selectivity and gives smooth tickler action.
Cat. T3 for .00035 mfd.....$1.30

SCREEN GRID COIL COMPANY, 143 West 45th St., New York, N. Y. Just East of Broadway

Enclosed please find $..... for which please ship at once, parcel post prepaid, the following coils:

Quantity	Cat. No.	Price	Quantity	Cat. No.	Price	Quantity	Cat. No.	Price	Quantity	Cat. No.	Price
☐	BT5A	@$2.50	☐	RF5	@$0.75	☐	VA5	@$1.10	☐	SGSF	@$0.75
☐	BT3A	@$2.55	☐	RF3	@$0.80	☐	VA3	@$1.15	☐	SGS3	@$0.80
☐	BT5B	@$2.50	☐	SGT5	@$1.25	☐	T5	@$1.25	☐	FL4	@$0.35
☐	BT3B	@$2.55	☐	SGT3	@$1.30	☐	T3	@$1.30	☐	EQ90	@$0.35

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Insulated Link

A flexible coupling device to unite two independent ¼" shafts for single dial operation of a tuning condenser and a Bernard Tuner. If the condenser has shaft protruding from the rear, then the condenser may be panel-mounted and the coil shaft coupled by the link to either extension shaft of the condenser. If the condenser has no shaft protruding at rear, mount the Bernard Tuner on the front panel. It has shaft protruding at rear for coupling by the link to the condenser's front shaft. To make sure of insulated protection do not force the receptacles of the link together when mounting.

Data on Construction

The coils are wound by machine on a bakelite form 2½" wide, and the tuned windings have identical inductance for a given capacity condenser, i. e., .0005 mfd. or .00035 mfd. Full coverage of the wave band is assured. The wire is silk insulated.

All coils with a moving coil have single hole panel mounting fixture. All others have base mounting provision. The coils should be used with connection lugs at bottom, to shorten leads.

Only the Bernard Tuners have a shaft extending from rear. This feature is necessary so that physical coupling to tuning condenser shaft may be accomplished by the insulated link.

[Note: Those desiring the 90 mmfd. equalizing condenser for use with the antenna model Bernard Tuner, BT5A or BT3A, should order EQ90 at $0.35.]

SCREEN GRID COIL COMPANY
143 West 45th Street, New York City