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1930
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Design for An All-Wave Receiver

RADIO WORLD

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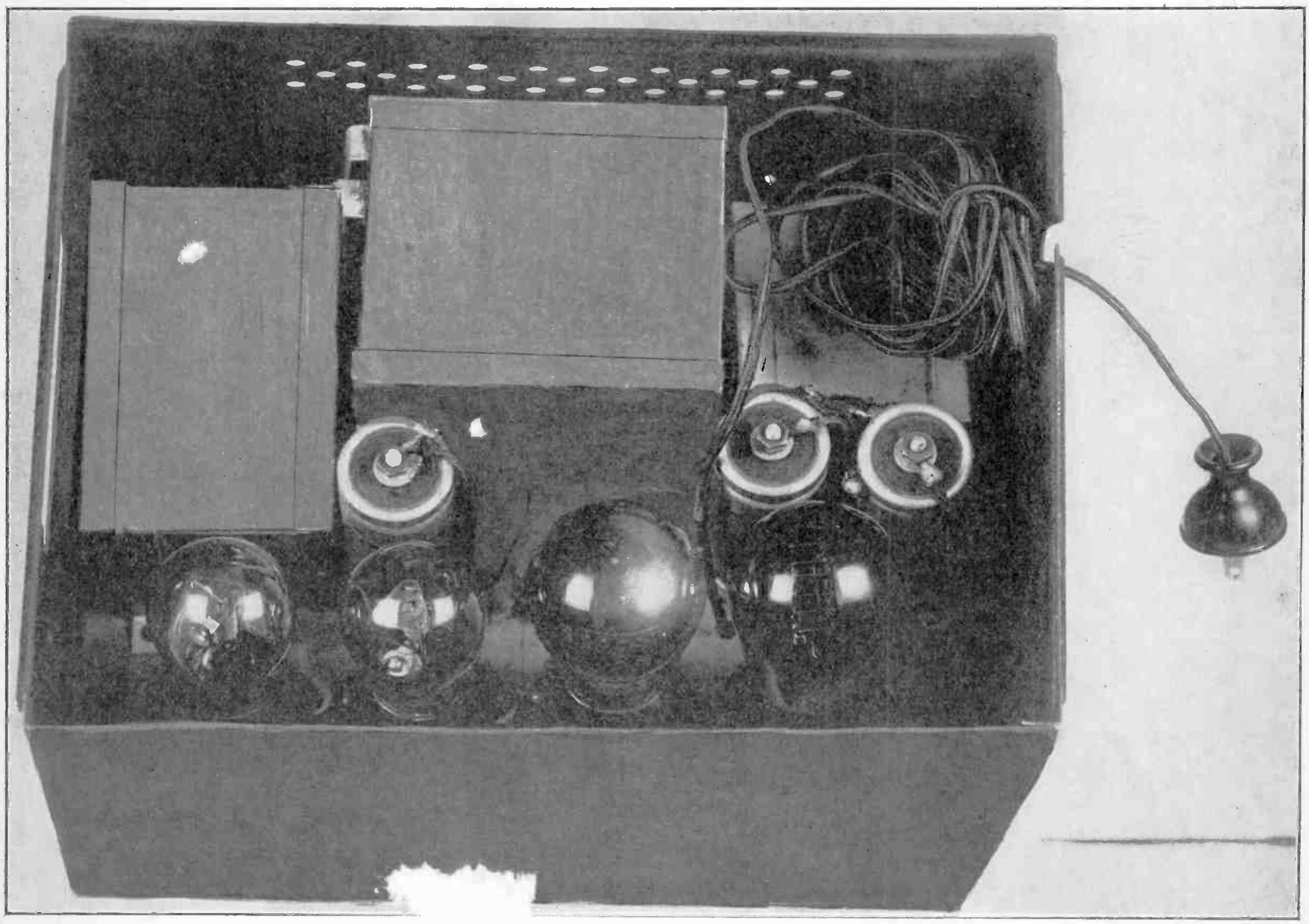
The First and Only National Radio Weekly
453rd Consecutive Issue—NINTH YEAR

How Troubles Are Overcome On Short Waves

Diagrams of Latest Crosley and Grebe Sets

A $25 AUDIO POWER AMPLIFIER



A three-stage resistance-coupled audio power amplifier, with proper filtration, affords superb quality. See article on pages 5 and 6.

RADIO WORLD, Published by Hennessy Radio Publications Corporation. Roland Burke Hennessy, editor; Herman Bernard, managing editor and business manager, all of 145 West 45th Street, New York, N. Y.

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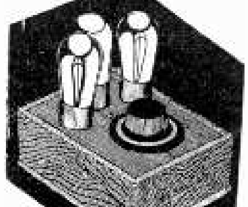
SHORT WAVES

$4.87

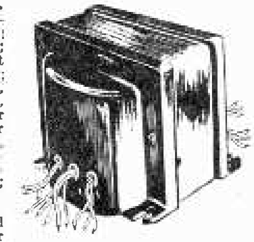
TUNE in short waves with the Supertone three-tube converter in conjunction with any broadcast receiver. Strictly single tuning control. No squeals or howls; no body capacity whatever. Can tune from 30 to 110 meters; yet no plug-in coil is used. It produces great results. Parts supplied exactly as specified by Herman Bernard. Cat. SUP-3A, (less filament transformer, less 227 tubes) is for AC; while Cat. SUP-3B is for 6-v. storage battery (for 227s or 230s). Price, $4.87 for parts for either. Directions and blueprint supplied.



Filament transformer, Cat. SW-FT, in shield case; 8 amperes, 2½ volts (center tap is red) $2.50

Supertone Products Corporation
216 Wallabout Street Brooklyn, N. Y.

POLO PRECISION POWER EQUIPMENT



AC Power Transformer, Cat. 245-PT (illustrated); for 280 rectifier; 300 v. DC output at 100 ma; primary, 110 v, 50-60 cycles, tapped (red) for voltage regulator at 82½ volts, with black common. Secondaries: 280 plates; 2½ v., 3 a.; 2½ v., 10 a.; 5 v., 2 a.; all secondaries center tapped (red). Leads identified on nameplate. Weight, 12 lbs.; size 5 x 4½ x 5". Polished aluminum case. Price $9.50

B Supply Choke, Cat. 245 CH. Rating, 100 ma. 30 henrys; 200 ohms DC; tapped at 40 and 60 ohms. Polished aluminum case. Price $4.00

Filament Transformer, Cat. SP-FLT, for up to six 224s or 227s, and one or two 245s. Primary, 110 v., pri.; secondaries, 2½ v., 12 amps.; 2½ v., 3 a.; both secondaries center-tapped. Cable and AC plug. Polished aluminum case. Price...$4.25

Short-Wave Converter Filament Transformer (Cat SW-FLT), 2½ v., 8 a. Shielded. Price... $2.50

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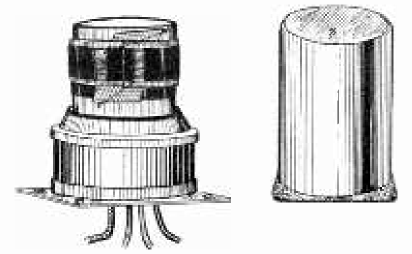

HIGH-GAIN shielded radio frequency transformers for screen grid circuits using 222, 224 or 232 tubes for RF, and any kind of detector. The primary has a high impedance—45 turns—and is closely coupled to the secondary over which it is wound, with an insulating wrapper in between, 42/10,000 inch thick. The diameter of the bakelte tubing is 1¾ inches.

Each coil form is solidly set in a veneer base, to support and elevate the coil, and equalize the distance from the shield walls. The base is secured to an aluminum template over which the drawn aluminum shield fits snugly, so that the coil is utterly rigid inside at all times. The coils are packed in matched sets of fours, tested for identical inductance on a bridge circuit. Thus they are of precision type, necessary for full effectiveness from gang tuning.

Shield size is $2\frac{11}{16}$" x $2\frac{11}{16}$" x 3¾".

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For .00035 mfd. tuning order Cat. 40-80 @ $2.25
Matched set of four for .00035 mfd.
Cat. 40-80-MF 9.00

[The matched four for .00035 mfd. may be used for intermediate frequency amplification at frequencies below 550 kc, by putting a .00035 mfd. fixed condenser across the secondary and a 100 mmfd. equalizer across the same circuit. We can supply the .00035 mfd. fixed condensers @ 15c each and the 100 mfd. Hammarlund equalizers @ 35c each.]

For .0005 mfd. tuning order Cat. 40-70 @ $2.25
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Remit with order for coils and we pay transportation. C.O.D. orders filled.

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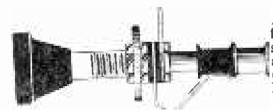

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☐ 199-UX	2.50	59c	☐ 171A	2.25	59c	☐ 224	3.30	59c
☐ 199-UV	2.75	59c	☐ 171AC	2.25	59c	☐ 222	4.50	95c
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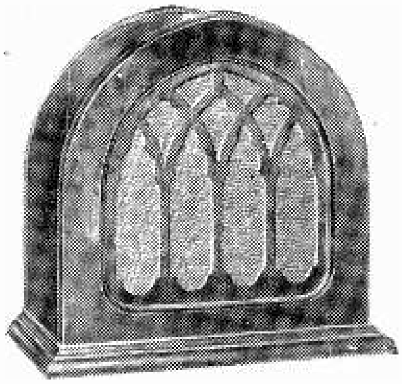

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Square Model (same unit and cone) Cat. AN-S at $3.67

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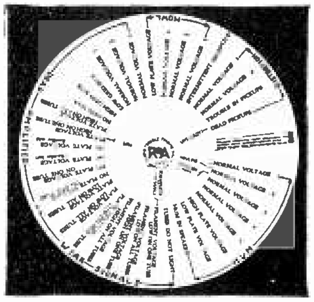

Here is an 8" diameter dial that you slide around to shoot trouble in an audio circuit or B supply or power amplifier. Trouble is divided into five groups: distortion, howl, dead amplifier, weak signals and hum. By sliding the dial to one of fifty different positions the cause of the trouble is read in the slotted opening. Invented by John F. Rider. Send $1.00 for eight weeks subscription for Radio World and get a Trouble-Finding Dial free with instructions on back. If extending an existing subscription please so state.

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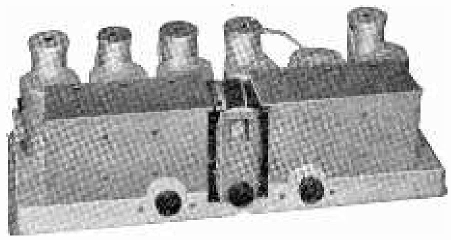
Parts for the Best Circuits



NEW NATIONAL DE LUXE MB-30 SCREEN GRID TUNER—This is one of the most sensitive tuners ever developed, averaging 1 microvolt per meter, and at some frequencies attaining ¼ microvolt per meter. Its selectivity is most remarkable, and without material sideband cutting, due to use of Vreeland band pass filter and preselector circuits. Six tuned circuits, perfectly aligned and tested with laboratory equipment that cost more than $1,000. The circuit, which is for AC only, uses four 224 and one 227 tubes and requires a power amplifier that will power the heaters as well. All parts mounted on chassis, ready for wiring. Steel chassis, 21⅞x10⅝x1⅛". Order Cat. MB-30-P, list price $85 less tubes; net price....$48.97

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MB-29-A TUNER, a smaller version of the MB-30, using four instead of six tuned circuits, but including also the pre-selector and band pass filter circuits. Uses three 224 and one 227. Aluminum chassis 15¼x10¾x1⅛". Order Cat. MB-29-AP, list price $69.50 less tubes; net price.... $40.86

WIRED MODEL, Cat. MB-29-AW, list price $79.50, less tubes; net price....$46.74

NATIONAL VELVETONE Push-Pull Power Amplifier, using one 227, two 245's and one 280; two stages of transformer coupling, with output transformer; heater voltage for five extra tubes; plate voltage for tuner. A matched unit for the MB-30 or MB-29-A. Phonograph jack built in. Velvetone comes completely wired. Licensed by RCA. Order Cat. PPPA, list price $97.50, ess tubes; net price....$57.33

HAMMARLUND HI-Q-31—The latest development in custom-set building, a 9-tube circuit, using a 3-stage band-pass filter pre-selector, three stages of 224 RF, 224 power detector, 227 first audio, two 245's for push-pull output, and a voltage regulator tube. Chassis is 23⅝x12¾". Order Cat. AC-31-R, list price of complete parts, $159.80, less tubes; net price....$91.06

WIRED MODEL HI-Q-31—Order Cat. AC-31-RW, list price, $184.80, less tubes; net price....$111.05

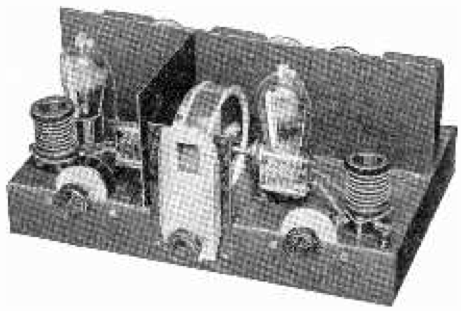
HI-Q AC TUNER WITH POWER SUPPLY (less audio)—Order Cat. AC-31-TPS, list price $148.55, less tubes; net price....$82.78

HI-Q-AC TUNER ONLY (for use with external power supply)—Order Cat. AC-31-T, list price, $107.20, less tubes; net price....$61.09

HI-Q-31 FOR BATTERY OPERATION—Order Cat. BAT-31-R, list price, $119.55, less tubes; net price....$68.14

HI-Q-31 TUNER FOR BATTERY OPERATION (less audio)—Order Cat. BAT-31-T, list price $102.95, less tubes; net price....$58.69

Short Waves



NATIONAL 5-TUBE THRILL BOX—A remarkably sensitive short-wave outfit, noted for reception of foreign stations. Uses 224 RF, 224 detector, 227 first audio, 227 push-pull second audio. A separate A and B supply is required. See below. Standard set of four pairs of coils included (21.2 to 2.61 megacycles). Humless operation, even on earphones. Single tuning control. No grunting, no backlash, no hand capacity. Order Cat. AC-SW-5, list price, less tubes, less B supply, $79.50; net price....$46.74

NATIONAL SW POWER UNIT—Furnishes heater voltage and B voltage for the AC Thrill Box. Uses 280 rectifier. Comes in wired form only. Licensed under RCA patents. Order Cat. 5880, list price, less tube, $34.50; net price....$20.28

BATTERY MODEL THRILL BOX—This uses the new 2-volt tubes; two 232 screen grid, three 230 and one 231, in same general circuit. Order Cat. DC-SW-5, list price $75; net price....$44.10

WIRED MODEL AC THRILL BOX—Order Cat. AC-SW-5-W. List price, $89.50, less tubes, less power unit; net price....$52.62

WIRED MODEL BATTERY THRILL BOX—Order Cat. DC-SW-5-W. List price, $85, less tubes; net price.... $49.98

HAMMARLUND SW HAWK—For one stage of RF and detector; battery operation; uses two 230 tubes or any other pair of battery-operated general purpose tubes. Coils cover 15 to 105 meters. Order Cat. SWR-2, list price $36, less tubes; net price....$21.15

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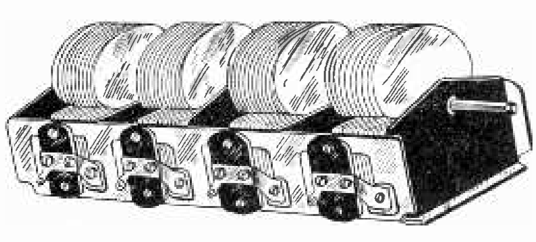
FOUR-GANG .00035 MFD. WITH TRIMMERS BUILT IN !



This condenser, each of four sections .00035 mfd., has aluminum plates that are removable and adjustable, also a ¼" diameter steel shaft that is removable. It is sturdy and is suitable for popular four-circuit screen grdi tuners. Trimming condensers are built in. The condenser may ›e mounted on its bottom or side. Total overall length, including shaft, 11⅞." Overall width, 4". The frame is steel Order Cat. 4-G @.... **$3.95**

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Velvet B Eliminator $16.13
180 Volts (280 Tube Free)

Latest Model National Velvet-B, Type 3530, in handsome crackle finish black metal casing, for use with sets up to and including six tubes. Input 105-120 volts AC, 50 to 60 cycles. Output, 180 volts maximum at 35 milliamperes. Three variable output intermediate voltages. (Det., RF, AF). Eliminator has excellent filter system to eliminate hum, including 80 henry choke and 12 mfd. **Mershon condenser. No motorboating!** (Eliminator Licensed under patents of the Radio Corporation of America and associated companies.)

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First stage de luxe, list (when new) $8.00; slightly used @....$3.90
Push-pull input, list (when new) $12.00; slightly used @....$5.90

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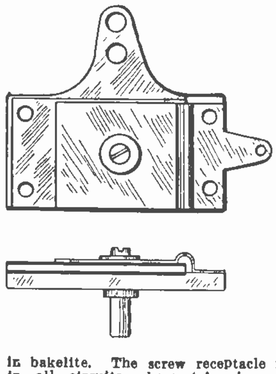
5-DAY MONEY BACK GUARANTEE!

HAMMARLUND
100 MMFD. EQUALIZER



The most precise and rugged equalizing condenser made, with 20 mmfd. minimum and 100 mmfd. maximum, for equalizing the capacity where gang condensers are used that are not provided with built-in trimmers. Turning the screw alters the position of the moving plate, hence the capacity. Cross-section reveals special threaded brass bushing into which screw turns, hence you can not strip the thread. If you turn the screwdriver down with accidental excess of force the screw simply stops, no injury results, as this special equalizer does not rely on the delicate thread in bakelite. The screw receptacle is strong brass. Useful in all circuits where trimming capacity of 100 mmfd. or less is specified. Maximum capacity stamped on the condenser.

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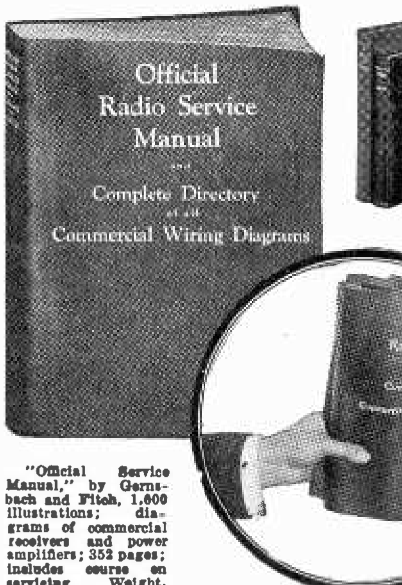

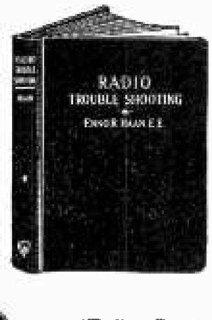

"Official Service Manual," by Gernsback and Fitch, 1,600 illustrations; diagrams of commercial receivers and power amplifiers; 352 pages; includes course on servicing. Weight, 3½ lbs. Complete 5-page index. Flexible leatherette cover, loose-leaf binding. Order Cat. ORSM @........... $3.50

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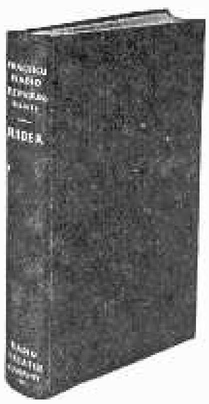
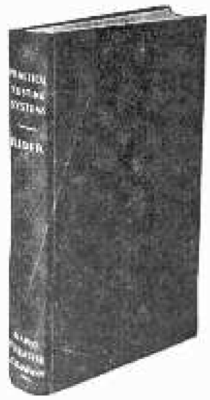
The new edition of "The Radio Manual" answers questions about the principles, methods, or apparatus of radio transmitting and receiving. A complete course in radio operation in a single volume. 20 big chapters include: Elementary Electricity and Magnetism; Motors and Generators; Storage Batteries and Charging Circuits; The Vacuum Tube; Circuits Employed in Vacuum Tube Transmitters; Modulating Systems and 100% Modulation; Wavemeters; Piezo-Electric Oscillators; Wave Traps. Nearly 900 pages, 369 illustrations; flexible fabrikoid cover. Order Cat. MAN @ $6.00

An understanding of audio amplifiers of all types, and of the use of tubes in audio channels, is a prerequisite today, when audio amplification is to the fore in radio, in public address systems and in the talkies.

"Audio Power Amplifiers" is the first and only book on the important subject. The authors are J. E. Anderson, M.A., former instructor in physics, University of Wisconsin, former Western Electric engineer, and for the last three years technical editor of "Radio World"; Herman Bernard, LL.B., managing editor of "Radio World." The book begins with an elementary exposition of the historical development and circuit constitution of audio amplifiers and sources of powering them. From this simple start it quickly proceeds to a well-considered exposition of circuit laws, including Ohm's laws and Kirchhoff's laws. The determination of resistance values to produce required voltages is carefully expounded. All types of power amplifiers are used as examples: AC, DC, battery operated and composite. But the book treats of AC power amplifiers most generously, due to the superior importance of such power amplifiers commercially. Tube characteristic tables and curves profusely included. Cloth cover, 193 pages. Order Cat. APAM ....@ $3.50

BOOKS BY JOHN F. RIDER





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(1)—"Practical Radio Repairing Hints," a handbook for the radio worker. Replete with facts and figures, hints and kinks. No Theory. No Formulae. In it you will find explanations of the modern radio systems, automatic volume control circuits, new forms of voltage distribution . . . automobile radio sets, public address systems, etc. Order Cat. PRRH .... @ $2.00

(2)—"Practical Testing Systems," the first complete collection of accurate and practical testing circuits of interest to the service man, professional se builder and experimenter. Among the many testing systems described in this book are tube testers, capacity measuring systems, signal generators, radio frequency oscillators, audio oscillators, vacuum tube voltmeters, resistance testers, continuity testers, etc. Material for the man who wants a simple test uni or desires a laboraory arrangement. Order Cat. PTS .... @ $1.00

Other books by Rider are:

"Trouble Shooter's Manual," the first comprehensive volume devoted exclusively to the topic. It is not only a treatise for service men, telling them how to overcome their most serious problems, and diagramming the solutions, but it is a course in how to become a service man. It gives details of servicing and includes more than 100 actual factory-drawn diagrams of commercial receivers. 240 pages, 8 x 11," 200 illustrations. Order Cat. TSM .... @ $3.50

"Supplement No. 1," containing 115 diagrams of commercial receivers, supplementing the diagrams in "Trouble Shooter's Manual," but not duplicating any. These 115 diagrams are supplied loose. They are a necessary adjunct to those in "Trouble Shooter's Manual." Order Cat. SUPP-1 ....@ $1.20

"Mathematics of Radio," by R[illegible] 8½ x 11", 119 illustrations, bridges the gap between the novice and the college professor. It gives [illegible] so necessary for a proper understanding of radio and audio circuits and their servicing. Formulas [illegible] inductance, impedance, resistance, etc., are explained. Flexible cover. Order Cat. MOR..@ $2.00

TWO MASTERPIECES BY PROF. MORECROFT

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THREE BOOKS BY MOYER AND WOSTREL

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"Practical Radio," including the testing of radio receiving sets. 378 pages, 223 illustrations. Cloth bound. Order Cat. MWP. .... @ $2.50

"Practical Radio Construction and Repairing," 319 pages, a companion volume to the above. New edition. new price. Order Cat. MWC. .... @ $2.50

The SUPERHETERODYNE

This is a new volume by Anderson and Bernard dealing with the principles and practice of the Superheterodyne method of receiving. It explains the function of the oscillator, the modulator, the pre-modulator selector, and the intermediate frequency amplifier. It explains the cause of repeat points and gives methods for avoiding them or minimizing their effect. It expounds the relative advantages and disadvantages of high and low intermediate frequencies, and shows the effect of selectivity on the quality.

It illustrates various forms of oscillators and tells of the advantages of each. Different types of modulators and pick-up systems are explained and their advantages stated. Different methods of coupling in the intermediate frequency amplifier are shown.

Image inerference is discussed in detail and methods given by which it may be reduced.

A special method of ganging the oscillator to the radio frequency condensers is explained, a method which allows either the high or the low oscillator setting to be selected by means of a variometer in the oscillator circuit.

One section is given over to coil design for the radio frequency tuners, the oscillator, and the intermediate frequency filter.

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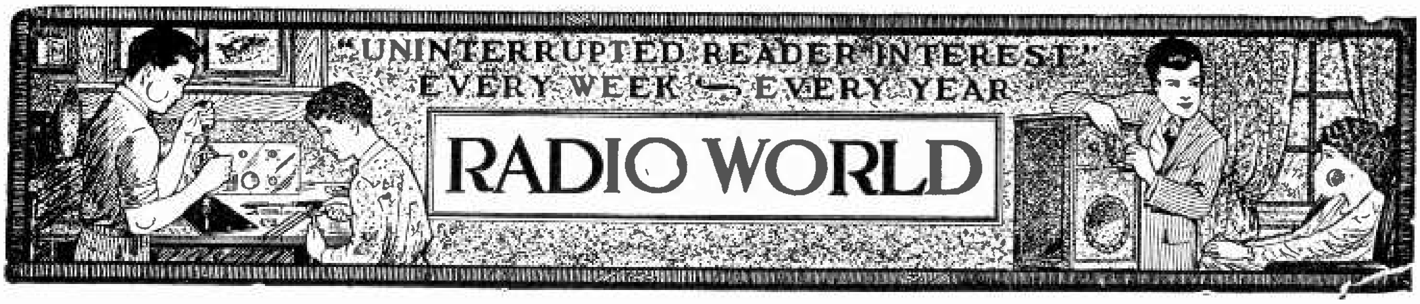

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A $25 Power Amplifier

By Herbert E. Hayden

AN AUDIO power amplifier, using three stages of resistance coupling, may be built up inexpensively, say, for around $25, and yet afford both ample volume and as good a tone quality as is obtainable.

The tubes used are two 227s for the preliminary audio amplification, and a 245 as the power tube. The amplification is enough to work a speaker abundantly, with any tuner, and voltages are obtainable for the tuner operation from the power amplifier itself.

The diagram shows a 2½-volt AC outlet for the heaters of 227 or 224 tubes in the tuner, and the capacity is enough to "pull' five extra tubes, making the total seven, due to the pair in the audio amplifier itself.

The outlet B voltages shown are 50 volts, useful for the screen voltages of the tuner, and 180 volts for the plates, but other and additional voltages may be taken off, if desired, as the multi-tap voltage divider permits a free choice.

Voltage Changes

When more current is drawn than is occasioned by the operation of the power amplifier alone, that is, when tuner is fed, the voltage drop in the section of the voltage divider affected, is greater, hence the remaining voltage is less. Take the case of the 180-volt output post. This will be 180 volts if measured when the audio power amplifier alone is worked, but when five extra tubes draw plate current, say, 25 milliamperes, the voltage readings, which must be taken with a high resistance voltmeter, will be less.

So the best plan is to select the voltage points tentatively, on the basis of the power amplifier operation alone, and then when the extra load is placed on the B supply, note the reduction in voltage.

If it is only a small reduction it will require no readjustment, but if the drop is considerable, say, more than 10 per cent., then move the affected leads higher up on the voltage divider, until the recommended voltages are obtained.

Voltage Divider Asset

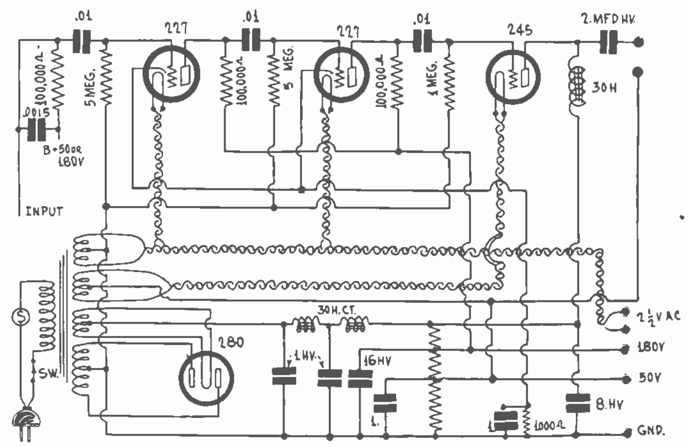
That is one of the great advantages of having a multi-tap voltage divider. It makes certain that the correct voltages are readily obtainable, and, besides, the divider will stand the drain very easily, since no more than 80 milliamperes will flow even if the tuner does have five tubes all by itself.

Some experimenters believe there is something wrong with a B supply when it gives certain voltages under certain conditions, and other voltages under other conditions, but there would be something seriously wrong with it, under modern practice, if the different voltage did not result when the drain was increased or decreased.

Not only has the rectifier tube itself a regulation curve, which means that it changes its resistance with current change, but the power transformer itself also has a regulation curve. Besides, of course, the change in current through the voltage divider and adjuncts affects a change in voltage. If this were not true then there would be no such thing as Ohm's law, and if there were no conditions that rendered Ohm's law tenable there would be no radio!

50 or 180 Volts for Detector

The connection for the detector plate voltage, which is made inside the power amplifier itself, may be 50 volts, if grid leak and condenser detection is used, or 180 volts, if power detection is used, therefore the choice of voltages is stated on the diagram. You may make the connection directly to the voltage divider, or to an equivalent lead thereto, when you have determined the type of detector circuit that is to feed the power amplifier.



AN EXCELLENT AUDIO POWER AMPLIFIER, COMPRISING THREE STAGES OF RESISTANCE-COUPLED AF, WITH 245 OUTPUT. IF A PHONOGRAPH PICKUP IS USED, THE CONNECTION WOULD BE MADE FROM GRID OF THE FIRST AUDIO TUBE (AT LEFT) TO GROUND. WHEN THE PICKUP IS NOT USED ITS TIPS SHOULD BE REMOVED FROM THE "PHONO" ASSEMBLY JACKS.

For quality reasons it would be preferable to institute power detection even if grid leak and condenser detection is present in the tuner now. This change is made easily. Short out the grid leak and condenser, or remove them entirely, from the tuner, and have the connection from the tuning condenser stator and coil go direct to the grid. Then instead of returning the detector cathode to ground, interrupt this lead with a 50,000-ohm resistor, and bypass

LIST OF PARTS

One shielded Power Transformer, 110v., 50c pri.; 2½ v. 12 amp. sec.; 2½ v. 3a. sec.; 724 v. AC sec., all secondaries center-tapped, 80 ma. rating (Cat. PT-OS).
One 30 henry double choke (center tapped) for B filter (Cat. DC-OS).
One 30-henry single choke, for 245 plate circuit (Cat. SC-OS)
One Multi-Tap Voltage Divider, 17,100 ohms, affording 20 different voltages, 0-300 v. (Cat. MTVD).
Three 1 mfd. high voltage condensers (Cat. HV-1)
Three 8 mfd. electrolytic condensers (Cat. EL-8).
Two 200-volt 1 mfd. condensers (Cat. POLY-1)
Two 5 meg. and one 1 meg. grid resistors with mountings.
Two UX (four-prong) and two UY (five-prong) tube sockets.
One speaker output assembly (Cat. SP-AS)
One Phonograph input assembly (Cat. PH-AS)
Five binding posts: input (blank), +45 (though voltage is 50); ground, two 2½ v., and +180.
One .0015 mfd. condenser.
Three .01 mfd. condensers.
One 1,000-ohm resistor.
Twisted pair for 2½v. output
One baseboard, 8" x 11", with four 2" high side pieces

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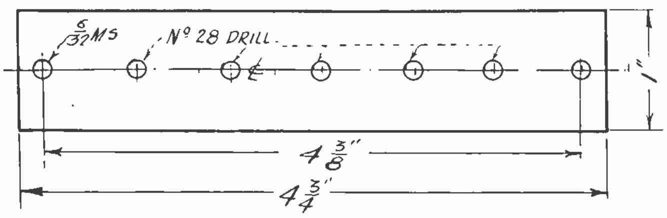
Key to Fine Audio Quality



A BAKELITE STRIP OF THE SIZE MARKED IS DRILLED FOR FIVE BINDING POSTS AND TWO EXTREME MOUNTING HOLES. THE STEEL CASE IS CUT OUT TO RECEIVE THIS. "PHONO" AND "SPEAKER" ASSEMBLIES GO ELSEWHERE ON THE CABINET

the resistor with a 1 mfd. condenser. These directions apply to a 227 tube as detector. If a screen grid detector is used, then the screen voltage should be low, around 20 volts, the plate voltage again high, say, at 180 volts, and the biasing resistor may be 5,000 ohms, since the detecting point of this tube is around 4 volts negative, whereas that of the 227 is around 16 volts negative. For a screen grid detector the plate resistor may be .25 meg. (250,000 ohms).

Stability Assured

The tubes in the first and second audio stages are 227's, because of greater stability resulting, and the circuit will be found to suffer no motorboating or other such oscillating conditions, due to the use of a large reservoir filter capacity, of 8 mfd., across the 300 volts of the voltage divider, the 16 mfd. by-pass capacity from the 180-volt tap to ground, and the reduced grid leak value in the last audio stage, i. e., 1.0 meg.

The way to build the amplifier, however, is to work it with the highest practical value of grid leak in the last stage, up to 2.0 meg. If a smaller value than 2.0 meg. is found preferable, substitute the highest value that gives you the degree of unimpaired amplification that you desire.

The isolating condensers are of .01 mfd. capacity, which is large enough, in view of the high values of leaks recommended. The reproduction is rendered effective down to 24 cycles, which is much better than is obtainable from the run of receivers that have the audio channel built in. Also, the high audio frequencies are well amplified, due the relatively low input capacity.

Speaker Output Filter

To maintain the quality at a high level the condenser coupling to the speaker, in the output filter circuit, should be 2 mfd. or more, and if you have some extra condensers of suitable voltage rating, around 400 volts DC continuous working duty, or higher rating, use them in parallel connection here. Even up to 8 mfd. may be introduced valuably, although capacities higher than that showed no observable difference in the response. The enlargement of this capacity within the stated limits improve the low-note transition.

Quality can not be considered present unless the filtration is more than merely good. The present method is that of the familiar pi-filter, where 1 mfd. is placed across the rectifier output, principally to hold up the voltage, and another 1 mfd. condenser connects from the midsection of the filter choke to ground, with a reservoir capacity, shown at right, of 8 mfd. The 180-volt by-pass condenser two 8 mfd. These three high capacities are electrolytic condensers.

In the diagram the high voltage condensers are marked HV., to distinguish them from the low-voltage condensers, which are not marked. High voltage means at least a 400 volt DC rating. Electrolytic condensers of the dry type have a working voltage of 400 volts DC, or more, so this type will be used even where the voltage is 180 volts.

Condenser Connections

In connecting the paper condensers, either side may be joined to ground and the other side to the higher voltage, except that if paper condensers are used that have only one terminal lug, the case is intended to be grounded, since the other side of the capacity is connected to the case inside the device, so the lug would go to the higher voltage.

The secondary high-voltage is center-tapped, as is always true in the case of full-wave rectification. The rectifier filament winding also is center-tapped, and the positive B lead is taken off the center, although this is not absolutely necessary. It simply represents a refinement, as compared to taking this voltage off either side of the filament. Also, the 2½-volt winding for the power tube is center-tapped, as is necessary if no center-tapped resistor is used across the 245 filament. The 2½-volt high-current winding, for the 227 tubes of the power amplifier, and such other tubes as are in the tuner, has a center tap, which should be grounded experimentally, as shown, but also should be tried with either side grounded and without any connection to center tap, to determine which method produces the least hum.

Uses Discussed

The usual experience is that hum is at a minimum when the center of this winding is grounded. Once in a while you will run into a situation where the grounding of one side or the other of the heater winding, instead of center-tap grounding, will produce the least hum. In some special cases the least hum results when none of these three connections is made to ground. The conservating rating of this winding is 12 amperes. If the load on it consists of seven tubes, the drain will be 12.25 amperes, a trival excess.

The power amplifier, as was said, may be used with any tuner, which includes battery-operated and AC tuners, but in the case of filaments requiring direct current, the voltage must be obtained from a battery or an A eliminator. The AC voltage can not be used on the filaments, say, of 2-volt DC tubes, such as the 230 and 232. Nor can the 2½ volts of the power tube filament be added to the other 2½-volt winding to constitute 5 volts to heat 201A, 112A and similar tubes.

One method of using the power amplifier is in conjunction with a receiver that has an adequate tuning system but poor quality audio amplification. In such an instance the tubes may be removed from the audio channel of the receiver, and the detector plate connected to the first coupling resistor shown at left in the diagram. The amplifier may be placed inside a radio table or console, and the set left where it was.

Hum Is Under 5%

If any long leads are run from the 2½-volt winding to feed tuner tubes, the wire should be no less than No. 18, and preferably No. 16. It is handy to use these sizes of wire in their stranded equivalents, and convert them into twisted pair, for hum reduction.

The hum is extremely low, when the proper connections are made, after tests as already outlined. This is true despite the excellent amplification of the low notes. Since the hum will be 60 cycles or principally the second harmonic thereof, 120 cycles, any hum would receive its share of strong amplification along with the rest of the signal, and would constitute objectionable interference, finally. So by proper filtration and by-passing, hum is kept under the 5 per cent. limitation imposed by engineering standards.

The circuit as shown is designed for 50-60-cycle, 110-volt AC operation. If anybody attempts to duplicate the design for operation on lower frequencies, due regard should be paid to the filter capacities. For 40-cycle operation, the condenser next to the rectifier should be 2 mfd. in this instance, while for 25-cycle operation it would be preferable to use 4 mfd., since 2 mfd. would exceed the 5 per cent. hum limit a trifle for this frequency.

Standard, Dependable Circuit

The power amplifier is a standard one, built no doubt many times by thousands of readers of this article, yet it is one that has produced such excellent results that anybody now desiring a power amplifier well may duplicate the design and profit greatly thereby.

When you enjoy the quality of reception that such a power amplifier affords, you are listening to the best in radio, and when it is gaited up with a fine tuner, as for example the new MB-30, which is one of the most sensitive tuners there is, you will get all the power from the amplifier to run the tuner, and will get selectivity, sensitivity and quality, the three-fold accomplishment that everybody seeks.

Excellent precautions have been taken in every respect to safeguard the quality, and the use of electrolytic condensers helps this, while the choice of isolating condenser capacities, plate load and grid leak values, and even the design of the speaker output filter all tend toward this end. The return of the speaker output filter to the midtap of the 245 filament is one consideration along this same quality line. This connection minimizes feedback.

Filter Not Needed for Standard Dynamics

What results you will get from any audio amplifier system depends much on the type of speaker used. A good one to use with this circuit is the large green model Farrand inductor (12-G), which is inexpensive and requires no field current for operation, being like a magnetic speaker in this respect. The output filter may be used either with the inductor or magnetic type speakers. If you have a dynamic speaker, this also may be connected to the filter; however, since most dynamic speakers have output transformers built in, there is no object in having the additional filter as shown in the diagram. The 2 mfd. condenser and 30-henry single choke

(Continued on next page.)

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Fun in Television Now

By Brainard Foote

TELEVISION is the dream of all radio experimenters and enthusiasts. For it is "seeing" in addition to "hearing." It really completes our radio accomplishments—for it is almost as good as really "being there." So far, however, television is perhaps talked about more than it is actually put into actual practice.

Just where are we today with television? Experimentation is going on ceaselessly, more so this year than ever. Quite a number of stations are broadcasting "vision" nowadays, and a very few are running two stations, one for television, the other for voice or music which accompanies the television. Still, reception of such programs is largely in the hand of radio experimenters rather than any considerable portion of the general public. Some experience is necessary to operate a television receiver and the results are not yet sufficiently spectacular for commercializing.

Problems:

I believe that the Federal Government should set aside a wavelength in the regular broadcast section for the use of television companies that wish to transmit television programs. At present television is confined to the very low waves, and a special receiving set is required to "tune in" such stations. It is argued that television is not yet sufficiently perfected to become entitled to much consideration among regular broadcasters, but such a step would greatly help toward a wider use and wider experimenting which will eventually bring us a type of television that will take its place alongside the regular set.

As television certainly will become a part of the home radio set in the future, just what will this mean so far as radio sets go in make-up and cost? Theoretically, it would double the cost, for you will need two receiving outfits then. Actually, however, it will be possible to save much of the extra expense because it will be possible to employ the same power unit for both the voice and television portions of the set. That is, the same transformers, condensers, filters, rectifier tubes, etc., which now furnish the power to light the receiving tubes and to supply them with 'B' voltage, also will serve the tubes of the television part of the set. In addition to the loudspeaker the set will have a screen of ground glass perhaps a foot square, on which the picture will appear.

How It Works

Television, as now existing, depends upon the transmission of a very rapid succession of impulses which are reproduced one after the other at the receiving set on a ground glass screen. Although the picture is made up by a series of distinct "flashes" of light, the natural slowness of the eye to notice such changes helps to resolve these rapidly flashing impulses into a single picture, much as the eye does not notice the separate, successive pictures which are flashed on the screen to produce a "movie."

Fortunately, the eye is slow to detect changes in the light, when one looks directly at the light. When looking to one side, however, any flickering of the light is very noticeable. Try it on an electric advertising sign sometime.

Photo-electric Cell

The heart of television, both for sending and receiving, is a photo-electric cell. This is a tube or other device on which an electrical change produces an instantaneous change in light given off, or vice versa. Several varying systems are in use. In one method the subject being televised is brightly lighted, and the light reflected from the subject or person passes through small pin-holes in a rapidly revolving disc. The holes are drilled in a spiral arrangement, and in this way, light from only one spot of the subject may reach the photo-electric cell at a time. There is a very great number of such impulses every second—in fact, the entire subject is covered in this manner nineteen or more times per second.

The Receiving Set

At "your" end a special receiver is used, for at present all television is done on very short wave lengths. The ordinary short-wave receiver is suitable, although a special audio amplifier is needed. The amplifier used on the ordinary set, while suitable for voice or music, will not do for television, and resistance-coupling is favored. This amplifies more uniformly the very great variations in frequency encountered in television.

Instead of having the amplifier deliver its output to a loud speaker, a Neon tube is used. A small ground glass screen receives the picture, and between it and the tube, the rotating disc intervenes,allowing the light flashes to strike at the right spot. Absolute synchronism must be maintained, that is, the rotating or scanning discs at both sending and receiving ends must operate at the same speed. At present, hand control of a resistor type is widely used, but automatic controls are also employed to some extent.

Television Reception Thrilling

There are several manufacturers now selling parts and more or less complete outfits for television reception. There's a world of fun and thrills waiting for those who take up this fascinating new science. Costs are small, too. While it is true that present-day television does not give a picture more than a couple of inches square, still, it *is* seeing.

A radio meter is a small instrument with an indicating pointer and scale graduated in volts, amperes, milliamperes, etc. Meters are an important adjunct to successful and economical radio.

Of greatest importance to the user of an electric set is a meter to test the house current. If the voltage exceeds the standard, say, 110 volts, some form of resistance is necessary, or the tubes and other parts of the set will be over voltaged and will not last long. Preferably, this form of meter is assembled in a unit together with a hand controlled resistor, so you can adjust the voltage correctly.

Test Voltmeters a Great Help

Next in importance comes the voltmeter for direct current. The B circuits of the set may be tested out by the proper style meter which your dealer can supply if he knows the make and model of the set. A high-resistance meter is used for this, so that the actual amount of energy absorbed by the meter in making the tests is not large enough to upset the correctness.

The user of battery-operated sets should have a good voltmeter even to test dry B batteries. This meter may draw more current than the high-resistance kind. Tests with very low resistance meters show the amount of current which the dry cell gives on short-circuit, and on this account the test is injurious to the cell or battery.

A useful meter is the tube-tester. This has a cord with a special plug fitting a tube socket. Each tube of the set is withdrawn in turn, this plug inserted in place, and the tube inserted in the socket of the tester. Worn out tubes may be detected and replaced in this way.

A Resistance-Coupled Power Amplifier

(*Continued from preceding page*)

In any event, use a good speaker, and if it is an inductor dynamic or another dynamic, provide a good baffle. Have the baffle and the speaker rim meet closely, with no air gap between them. The baffle may be simply the wood of the cabinet or console, or may be any of the special types of baffle material.

It is preferable to house the power amplifier in a case. A black crinkle finish steel case makes a good container, not only structurally but also aesthetically. The power amplifier may be built up on a board, elevated so that the bypass condensers, filter condensers and voltage divider go underneath, and the whole mounted on the bottom piece of the steel case flap pointing downward. Then nuts and bolts will enable you to tighten the steel bottom to the rest of the steel case, through holes drilled at the factory, and the cover will fit snugly on top, giving a most professional appearance to the entirety.

The fuse, represented in the diagram by a circle with a figure inside like a capital S, should be placed on top of the board on which the amplifier is built.

(*Continued next week*)

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Converter Using 230's

By Herman Bernard

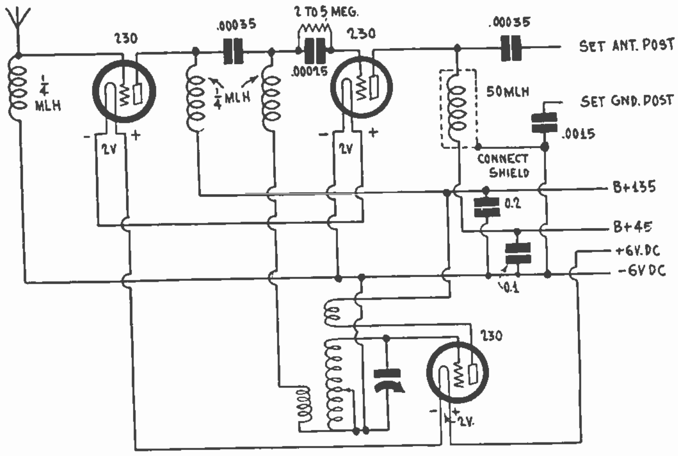

FIG. 1
THREE-TUBE SHORT-WAVE CONVERTER, USING 230 TUBES AND THE GRID MODULATION METHOD

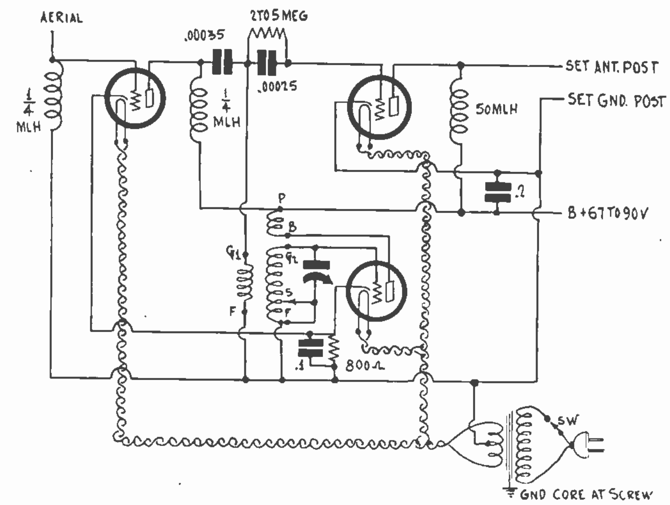

FIG. 2
DESIGN OF A 3-TUBE CONVERTER, USING 227 TUBES, WITH FILAMENT TRANSFORMER BUILT IN

[The construction and operation of a three-tube short-wave converter for AC or battery operation were discussed in the November 8th, 15th and 22d issues. The AC model used 227 tubes, with filament transformer external, or 2½-volts AC for the heaters may be obtained from a power amplifier's transformer. The battery model was the same, except for the use of three 227 heaters in series, with a 6-volt storage battery across them. Thus each tube got 2 volts, which is sufficient. This week a circuit is shown whereby the same parts as for the other battery model may be used for working the new 2-volt 230 tubes.—EDITOR]

WHERE one has a 6-volt storage battery, either the new 230 tubes or the 227s may be used in building a three-tube short-wave converter that operates with any receiver of any sort. Connection of the heaters in series results in each tube getting one-third of the voltage. Hence the 227 tubes would get two volts each, which is one-half volt under the specifications, but is sufficient voltage to work the converter well, while the 230 tubes would get just the recommended voltage.

Storage Battery and 230 Tubes

There is a marked difference in the heater current of the 227s, which is 1.75 amperes, and the 230 filament current, which is .06 amperes (60 ma). Series connection results in any number of tubes drawing no more current than one tube, provided the voltage source across each tube is maintained at the constant value. So if you have a storage battery at hand you are at full liberty to choose either set of tubes, and particularly will you be able to use the 230s to advantage, because of the capability of the storage battery of maintaining an even voltage. The storage battery voltage under full-charge condition may be 6.1 volts, while a run-down battery will be about 5.7 volts, so that when the battery is in no condition to be used, hence will be recharged, the voltage is only .3 of a volt less than 6 volts, or an under-voltage of .1 volt for each tube.

This point is important because the new 2-volt tubes are extremely critical as to filament voltage, and the recommendation of 2 volts should not be altered by more than 5 per cent., if that much. At 6.1 volts, at maximum charge condition of the battery, the excess is .033 volt for each tube, contrasted with 5 per cent. excess or .3 volt.

Dry cells may be used with the 2-volt tubes instead of a storage battery, but may not be used with the 227s because of the heavy current drain. The C battery type of dry cells to afford 6 volts (at a tap on the 7½-volt C batteries) will not do, even though the current drain is only 60 milliamperes, because these small batteries then will not last long enough, and are not intended for a drain even of that amount. Such batteries, if used, would have to be paralleled, but this is no advantage over using four 1½-volt No. 6 dry cells, connected in series to afford 6 volts, for the drain could be up to a quarter-ampere without overstraining the battery.

Watch the Grid Returns

In building the converter for the 2-volt tubes the grid return connections are different than in the model for the 227s. See Fig. 1. Another point of difference, merely one of choice, is the inclusion of a condenser (.0015 mfd.) in sereis with the connection to the ground post of the receiver. When his condenser is included it is assumed that the same A battery that works the receiver will work the converter, for the B minus connection is obtained that way, and positive voltage thus made available to plates of the converter tubes.

Readers are referred to the November 8th, 15th and 22d issues for parts, coil data, constructional details and operating notes, as most of these refer just as much to the model for 230 tubes as to the other models therein discussed.

As for the AC model, it has been presented without a built-in filament transformer, so that coil plugging-in could be omitted, requiring that the single coil used be underneath the top panel, inside the cabinet, in conjunction with a large condenser (.00035 mfd.)

However, a model, with different panel layout, can be built for AC operation with filament transformer inside the cabinet.

Requirements for Transformer Model

This requires use of a smaller capacity tuning condenser, as there would be no room for the .00035 mfd. condenser previously recommended. Instead a condenser of 200 mmfd. might be used, and it is intended to show such a model, incorporating a new junior model condenser of that capacity to be produced by Hammarlund within a month, and which has a midline tuning characteristic.

The design of a 3-tube converter with filament transformer built in is shown in Fig. 2. How the connections are made to the coil was shown last week. All models previously discussed were intended to meet the requirements that the parts (less filament transformer) cost under $5. But with filament transformer built in, Hammarlund condenser and two or three plug-in coils, it is doubtful if the builder's cost could be held under $12. However, the circuit has been built and preliminary-tested, and after calibration of the coils and a week of short-wave reception enjoyment on this model, a report will be made in the form of a constructional article.

Aerial's Relationship to Detector

The reason for a long aerial for all models is that since the detector always lags behind the oscillator in amplitude, the higher the input (from aerial), the nearer will the detector come to the amplitude of the oscillator, and as the mixture will be constituted of two components more nearly alike in quantity, due to the increase of one, the converter output will be larger, the amount of amplification to be required from the receiver will be less and the quality will be better.

In conclusion, may I state quite positively that these simple converters, despite the low cost of the few parts used, aren't toys but a real performer, and that the performance is dependent largely on the receiver with which they are used and the patience and care exercised by the person who tunes in.

You will find all details that you require for selecting parts, winding coils, wiring, testing and operating the three-tube short-wave converters, in the November 8th, 15th and 22d issues. Send 60c for these three issues and a blueprint of the AC Model.
RADIO WORLD,
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An All-Wave Receiver

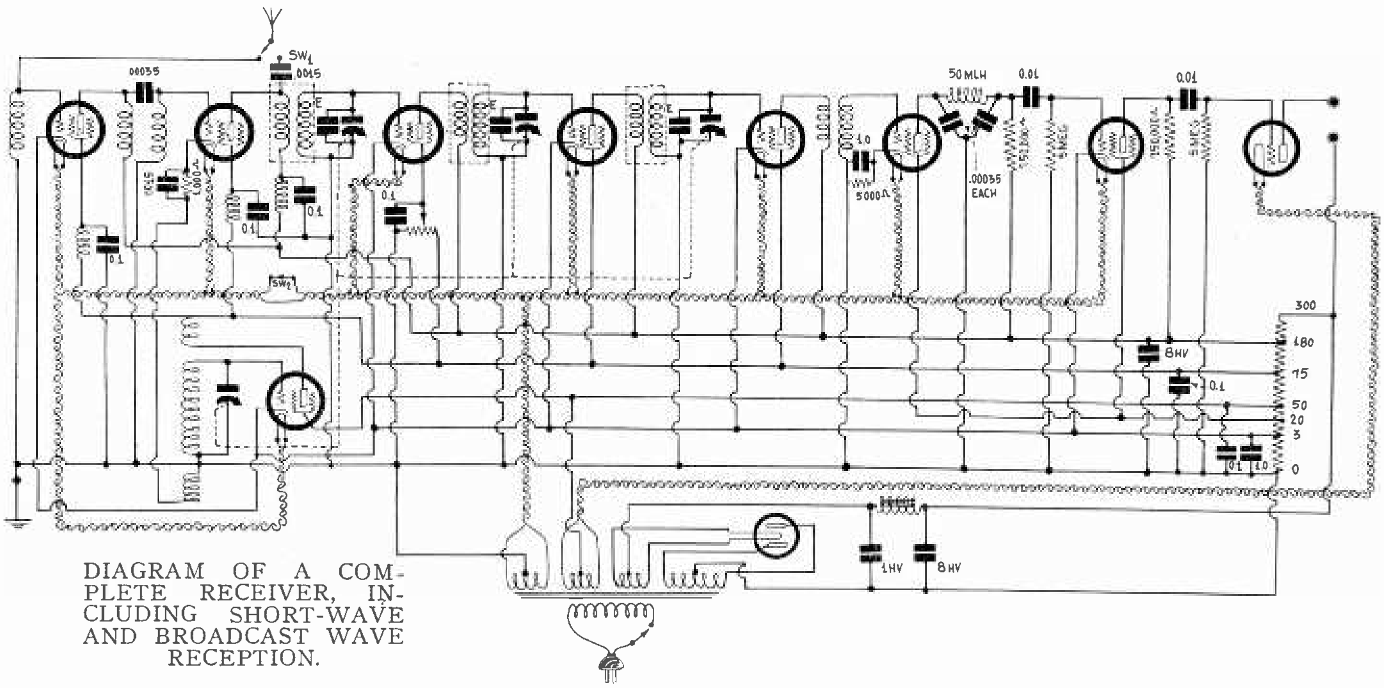

DIAGRAM OF A COMPLETE RECEIVER, INCLUDING SHORT-WAVE AND BROADCAST WAVE RECEPTION.

SHORTLY there will be a great demand for all-wave receivers. Already fans are insisting that they be given designs that will accomplish the result. A few such circuits have been published, but most of them are a long way from simply accomplishing the desired end. It is believed that the author of this article has a real solution, an original one of great worth, the circuit of which will be published next week, issue of December 6th.—EDITOR.

CONSIDERABLE interest now exists in what are termed all-wave receivers. These may be defined as sets that tune from 550 kc up to, say 30,000, kc, or 545 to 10 meters. Perhaps the highest frequency stated is rather too high to expect, so that 15,000 kc, or 20 meters, would be a more reasonable limit.

One way to accomplish this is to have a Superheterodyne in which the intermediate frequency is rather high, say, round 450 kc, or 666 meters, and use plug-in coils.

Another methods is the one outlined in last week's issue, whereby a tuned radio frequency channel is preceded by a short-wave converter. Then a diagram showed a tuner with this system. Now, in Fig. 1, a complete receiver is depicted.

Same Dial Tunes Both

By throwing the switch S1 to the left, antenna input is made to the converter, and at the same time the current is supplied to the heaters of the three converter tubes involved, by closing the circuit with SW2. When the antenna switch is thrown to the right the input is made instead to the broadcast receiver alone, while the heater current is cut off from the three converter tubes, hence all current to them.

The new development enables the tuning in of short waves with the same dial that tunes in the broadcast waves, and involves an ever-changing intermediate frequency. To render this effective the input and coupling between the converter stages must be favorable to short waves and unfavorable to broadcast waves, which is easily accomplished by use of three ¼-millihenry radio frequency choke coils. Then there will be no broadcast pickup when short-wave tuning is done, these chokes being almost short circuits to broadcast frequencies, but adequate impedances to the higher radio frequencies. Hence, no broadcast programs will be tuned in when short waves are worked, with the possible exception of a very strong station that may be within a few blocks of the receiver.

When the system was tried out, within a short distance of WABC, New York City. that station's broadcast wave came in very faintly on the short-wave setting of the switches, thus eliminating one short-wave frequency from the many receivable. However, the exacting conditions imposed will not be duplicated on any scale, and the sacrifice, even so, is small.

Audio Circuit

The audio channel is shown with resistance coupling. A screen grid tube is used as detector and another as first audio amplifier, the output being a 245.

The gain in the radio circuit, if high impedance primaries are used, will be sufficient to produce adequate speaker volume with two stages of resistance coupling, especially as the audio gain is not so small as you might imagine. It is, indeed, as large as from the standard two-stage transformer-coupled circuits using general purpose tubes.

The only thing that bears special watching is that the usual high voltage on the screens, say, 50 to 75 volts, must be strictly avoided in the audio channel and in the detector. No more than 25 volts should be used. A multi-tap voltage divider offers choice of this voltage and lower voltages.

Another Method

Two switches have to be thrown, and as one of these involves heater current, it must be of the AC type.

It is possible, however, to throw only one switch, and a single pole single throw switch, at that, and have an all-wave receiver. This method differs from the one shown this week, in that the three converter tubes remain lighted all the while, no matter what frequency is tuned in, although the oscillation of the oscillator is stopped when broadcast frequencies are received. The switching takes care of this, and also provides the proper load for the respective bands, short-wave and broadcast.

The idea is simple and it does involve only the throwing of one switch one way or the other to have broadcast or short-wave reception.

Uses Six Tuned Circuits

Six tuned circuits are used when the short-wave function is performed, one of these being for the oscillator, two others for a band pass filter entrance to the first tuned radio frequency circuit, and the remaining three for interstage tuning. The condensers are two three-gangs of .0005 mfd. capacity for each section.

How this system, that requires no molestration of the antenna connection, no extinguishing of the converter tubes, can be used with two stages of resistance-coupled audio frequency amplification, will be shown next week, issue of November 29th. There will be a tone control, automatic volume control, manual volume control, long-wave-short-wave switch, phonograph input, and, as a feature, 11 tubes. But, as was said, the 11 tubes will be worked all the time, no matter in what band you are tuning.—Herman Bernard.

[The foregoing is the third of a series of articles on all-wave receivers, outlining various methods of accomplishing the desired result. The methods involving use of a varying second frequency, so that the same dial on the receiver tunes short and long waves, are the invention of the author. who is preparing constructional data on a receiver embodying the inventions.—EDITOR]

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2-V Tubes in

By Stewart

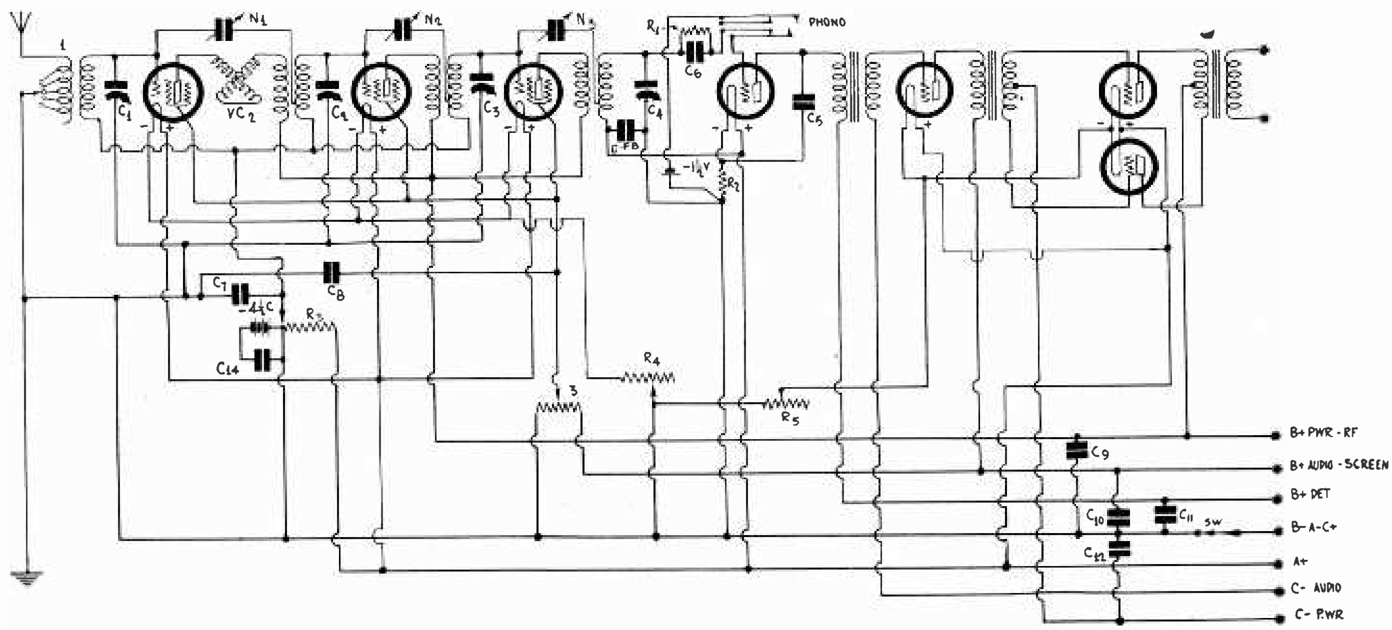

FIG. 1
THE BATTERY OPERATED FORM OF A NEUTRALIZED TUNED RADIO FREQUENCY SET, USING THE NEW 2-VOLT TUBES. AN ASTATIC COIL BUILDS UP THE VOLUME OF THE DISTANT STATION WITHOUT DISTORTION.

[Last week the AC model of this receiver was discussed. This week the battery model for the 2½-volt tubes is treated.—Editor]

ESSENTIALLY this week's circuit does not differ greatly from the AC set, the layout being practically the same, except for some mechanical details which we will now go into. The tube socket holes are to be so drilled that they permit the grid and plate electrode prongs to face the frame of the variable tuning condenser, this being true of the radio frequency tubes as well as the audio frequency ones. The audio transformers are mounted directly to the right of the tubes with which they are associated. The Antenna, Ground, and A B and C voltage terminal binding posts are placed to the immediate rear of the subpanel at a distance of about 1¼ inches beyond the end of the four-gang condenser frame.

Neutralizer Accessible from Top

The two last terminals at the right are for the speaker connection, and are chosen because they are simple to install and wire to.

The neutralizing condensers are mounted so that they are adjustable from the top of the subpanel by means of a screwdriver that is inserted through a drilled hole in the top of the subpanel, the holes being on an axis parallel to that of the tube sockets, but 1½ inches distant from it.

The by-pass condensers that shunt the potential binding posts are to be located close to these posts.

The grid-leak resistor is mounted atop the subpanel, close to the detector tube, its associated condenser being underneath the panel, and the phonograph record pick-up input is located near the edge of the panel next to the detector tube, the volume being controlled by the separate resistor associated with the pick-up.

This connection is a bias changing device, and therefore the usual disturbance that accompanies the plugging in of the pickup will be found to be pleasingly absent, and the change-over from radio to record 'reception' is unmarred by the presence of other noises.

The resistors marked 'under panel' appear to be variable, actually they are fixed by the clamping of the slider terminal which you will be told how to make, once the correct filament voltage has been established, this is also true of the resistor RP which is available for adjustment from the top of the subpanel with a screwdriver.

Optional Connections

The pieces of apparatus marked 1, 2, and 3 are controls that are similar in effect to the three used on the AC model. A 1½-volt bias battery is provided for in the event that its use should be found necessary; it is only a single cell of dry battery, and its use is indicated if the following tubes overload, a condition that can be readily determined by listening to the quality of reproduction.

This connection will have to be used if the pickup voltage is low, but if you should buy one of the so-called theatre style pickups, it will be found that the voltage is high enough to enable it to be hooked in to the grid circuit of the first audio tube by means of the same cut-in system as already outlined; in fact, it will not be necessary for the jack to be moved from its assigned position.

There is perhaps little to be said about the battery-operated form of the standard tuned radio frequency receiver, the AC operated form of which you are by now familiar with.

It was the author's intention to build up this AC model so that the fans might have an idea of what it looked like finished, and this will be done, it is hoped, in the not too distant future, but for the time being it was thought best to progress to the consideration of the battery operated model of which they are really two varieties, but since they are essentially the same it will be unnecessary to publish more than one diagram.

With Standard Tubes

The diagram shows that screen grid tubes are used, and therefore whether they are the 222s or the new 232, the essential connections are the same, but if you should plan to use the three electrode tube, whether it be the 226, 112, or the 201-A the only necessary omission is the screen grid supply voltage lead wire, the other connectitons being the same.

This means then that the only alteration is the value for the filament resistors which can be easily ascertained from the general list of tube characteristics for the type of tube involved, or if you have no such information at hand you may write to the technical editor who will furnish it.

The recommended plate voltages may be exceeded if the recommended grid bias is also increased to compensate for this increase of the applied anode voltage. Care should be taken not to exceed the plate current stated for the given plate voltage, as there is danger of tube paralysis with excessive plate voltage.

This caution, of course, applies to the ordinary tubes also, only the new tubes are more costly to replace.

Emission Loss in Tunbes

Before we pass to the consideration of the other points of interest in connection with the set, a final note concerning tubes will be presented, which deals more or less with the subject of temporary loss of emission. If oxide coated filaments are subjected to excessive temperature, there is danger of throwing off the coating in places, to say nothing of melting the filament ribbon, which is intended to carry a certain maximum current for most effective operation, but on the other hand, the use of excessive anode voltage without sufficient grid voltage may easily mean the permanent exhaustion of the filament coating, because the oxide coating can not be

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Neutrodyne

McMillin

reactivated, as can the thorium coating of the filaments of the 201-A.

Explanation of the Diagram

Due to the nature and double purpose of the wiring diagram there are some symbols used that may not be exactly clear, so we will clear the matter up at first hand. The symbols marked No. 1, No. 2 and No. 3 are panel mounting controls, and the resistors that are marked variable are so marked because they have to be changed when you change the tubes.

But aside from this, it is not a bad plan to be able to alter the value of these resistors, because by so doing you can operate the tubes in a given section of the set at the point that seems to provide the vest volume and reproductive quality.

The potentiometer that controls the radio frequency amplifier tube's grid bias is found to have an additional source of voltage added to the negative end.

This is for the purpose of taking care of the bias requirements of those tubes that must have csome negative bias, and for those that do not require it the battery is simply omitted as is also the associated by-pass condenser C-14, which is one microfarad.

Also, if it is found in your particular case that the additional negative bias, in steps of 1½ volts, is not helpful, as may be the case with the general purpose, three electrode tube, the bias battery may be also eliminated.

Flashlight Cell

This battery is of the flashlight type, and as there is no current drawn from it, its life in this circuit is equal to its shelf life. It will also be noticed that there is a 1½ volt bias battery used, or rather indicated in the phonograph pickup circuit. This is also a flashlight battery, but if the output voltage of the pickup is low the battery is not required. If, on the other hand, the output voltage is high enough to result in a predominance of the higher audio frequencies, the result may be the apparent overloading of the amplifier, and in this event the remedy is to employ a little bias voltage. In some cases the pickup output voltage is high enough to warrant connecting the pickup in the first audio stage tube grid. This is likely to be true if you have a theatre style pickup, but if you have one of the inexpensive variety, the chances are that you will be able to stand the amplification afforded by the present circuit arrangements.

Characteristics of the 2-volt battery operated tubes are given in the tables below.

THE 232 SCREEN GRID TUBE

Fil. volts	2.0
Fil. Current, Amperes	.06
Plate Voltage, Maximum	135
Control Grid Volts	3
Screen Grid Volts, Max.	45
Plate Resistance in Megohms	0.8
Amplification Factor	440
Mutual Conductance, Micromhos	550
Grid to Plate Capacity, mmfd.	0.02
UX Base	Standard

THE 231 POWER TUBE

Fil. Volts	2.0
Fil. Current, Amperes	0.130
Fil. Watts	0.26
Plate Volts, Max.	135
Grid Volts Bias	22½
Plate Current, Milliamperes	8.0
Plate, Resistance, Ohms	4,000
Amplification Factor	3.5
Mutual Conductance, Micromhos	875
Undistorted Output Power, Milliwatts	170
Grid-plate Capacity, mmfd.	6.

230 GENERAL PURPOSE TUBE

Fil. Volts	2.0
Fil. Current, Amperes	0.06
Fil. Watts	0.12
Plate Volts, Max.	90
Grid Bias, Volts	4.5
Plate Current, Milliamperes	2.0
Plate Resistance, Ohms	12,500
Amp. Factor	8.8
Mutual Conductance, Micromhos	700
Grid-Plate Capacity, mmfd.	6.0

220-Met. Sets

CAN special sets be obtained to run on 220 volts A.C./—M. N.

No, but a special transformer is used for this purpose, which delivers 110 volts for operating the regulation type of radio set.

Right or Wrong

QUESTIONS

(1)—In a heavy conductor such as a solid rod in the field of a coil carries current that always flows in the same direction in every point of the conductor regardless of the distance from the surface of that point.

(2)—A resonant antenna circuit always vibrates so that the antenna is equal to one-fourth of a wavelength.

(3)—A power or filament transformer often hums because the assembly bolts are not tightened and the hum can be taken out quickly by drawing up the nuts as tight as possible without stripping the threads.

ANSWERS

(1)—Wrong. The current in the interior may travel directly opposite to the direction of flow on the surface. The force driving the current starts on the surface and travels inward. The effect might be illustrated with an analogy. Consider a radius of the wire as being a string tied to the center and moved rapidly back and forth on the surface. A set of waves will appear on the string. Part of the string will move in one direction and part in the opposite. To test it, take a string a few feet long and tie small beads to it at regular short distances. Tie one end to the floor and shake the other end back and forth. If the rate of shaking is timed properly, the effect may be observed.

(2)—Wrong. It may vibrate so that the antenna is ¼, ¾, 5/4, 7/4, and so on, of a wavelength. That is, it may vibrate at its fundamental or at any of its odd harmonics.

(3)—Right. When a transformer hums, and if the laminations are exposed, the hum may often be reduced by putting the finger on the loose lamination if it can be found. Tightening the bolts, then, invariably reduces the hum and often eliminate almost entirely. Sometimes, however, the notise comes from the case which cannot be bolted down. If it is the case that vibrates, this fact can usually be discovered by pressing here and there with the finger. When the weak spot has been found means can usually be found for stopping the vibration.

Multiple Speakers

I WOULD like to use several loudspeakers in different rooms and one in my shop outside. A friend claims I cannot run all at once.—C. M.

Not successfully, unless you obtain a much more powerful amplifier, and use special coupling transformers. The best way is to install a jack at each point, and have the speaker connect to a plug which may be inserted when wanted. Two speakers might operate well, although it may be necessary to use a series resistance with one of them to equalize the volume.

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Modern Uses of Effect

By John C

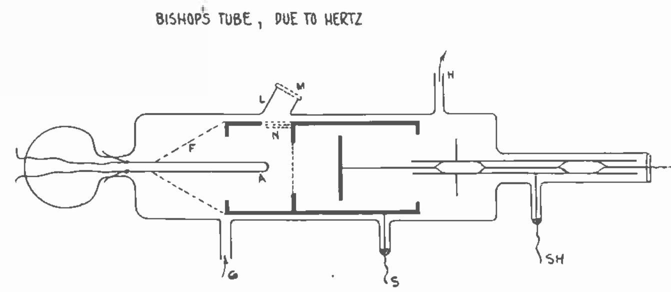

FIG. 1
THE BISHOP TUBE, IN WHICH THE ELECTRONIC ACTIVITY OF SEVERAL SUBSTANCES IS DETERMINED, WITH AND WITHOUT THE PRESENCE OF INTRODUCED GASES, ADMITTED THROUGH G, AND EXHAUSTED THROUGH H.

[*The following article is the eighth of a series dealing with the historic aspect of the development of the radio transmission art. The first article, in the October 11th issue, presented a condensed resume of important scientific steps that led to the successful commercial experiments of Guglielmo Marconi, 1899-1901. The second article appeared in the October 18th issue and consisted of a brief review of the early telegraphic systems, and included data on the first photo-electric work, also the first short-wave transmissions with the aid of concave and parabolic mirrors and traced early stages in the development of the no wwidely-used beam transmission system. Progress was traced from the sixteenth century to the eighteenth century. The October 25th installment traced the development of the Leyden Jar, whence the first oscillatory currents were obtained, and also told of the manner in which short-wave radiations were concentrated by lenses as compared with the previous rexection methods. The article in the November 1st issue dealt with interference in short-wave transmissions, and showed how the experiments of Dr. Thomas Preston established the identity between luminous and electromagnetic radiation, a prediction of by Dr. James Clerk Maxwell made nearly a hundred years previously. The fifth installment, in the November 8th issue, dealt with the early history of the vacuum tube, detailing the methods used to make the first contemporaneously correct estimate of the velocity of light, and also described the first efforts made to register the effects of negative radiation from hot platinum. The November 15th issue continued with early radiation experiments, and showed how the study of tube discharges aided the design of electrodes. The article of the November 22nd issue dealt with the affinity of gas and electronic discharge, presenting two examples of discharge which led to separate conclusions. The exposition of early experiments continues.—Editor.*]

LATER attempts to isolate discharge effects of the gas type tube resulted in the cathode ray tube, of which there were many forms, some of them containing light weight mechanical devices arranged to be operated by the cathode ray stream, and in others the cathode rays are focused by a concave mirror electrode and the concentrated beam is made to fall on a metallic surface, heating it to incandescence.

But by far the most lucrative commercial adaption of the low-pressure tube is the present day luminous electric sign, which consists of a long glass tube filled with a gas which if the color desired is to be red, is hydrogen, or if of a greenish tinge, mercury vapor, and if of a pink tint, neon. Argon also is used, or a mixture of either of the foregoing, depending on the color wanted.

Ionization potential can be expressed in so many volts per foot at some standard pressure, stated in terms of millimeters of mercury.

The possibilities of the gas-filled tube for the time were being considered to be limited, and the attention of the physicists was drawn to the continuation of the work of Dr. O. W. Richardson in the field of emission from hot bodies.

Had Their Troubles

Although the earliest authentic date of the use of the evacuated glass envelope is the year 1873, the attention of physicists was not drawn to the chemical composition of the glass used in this kind of device for some time later, and the investigation was started following the discovery of faults that occurred when certain types of high-potential Leyden Jars broke down, or as we say, punctured. One of the immediate causes of this was the presence of impurities that resulted in the appearance of dense fluorescence in the wall of the jar, which manifestation immediately preceded puncture. An immense amount of locally generated heat thus was the secondary cause of unequal expansion in the wall.

The preponderence of the effect in the case of the Leyden Jar resulted in the study of the chemical composition of the glass and the subsequent improvement of the product, which became ultimately known as the Jena glass, used today for a variety of purposes.

In addition to the foregoing,. relating to the mechanical strains set up in the walls of the glass tube or jar, as the case might be, there was found an influence that affected the distribution of the charge over the surface of the jar, and this provde to be a function of the composition of the glass as finally determined upon. The net result of this finding was the peculiar shape of the high potential jar type of condenser of Fig. 2.

The jar shown is due to Prof. Bergen Davis, of the Phoenix Physical Laboratory, of Columbia University, who designed the first models of this variety. There is much in the line of contributory information that the Leyden Jar has furnished to the world of physics and it behooves us to recognize the pioneer work of Musschenbroek.

When the vacuum tube of the type that we now use in our radio sets was first put on a production basis the number of failures due to one cause and another was terrific, but it was a case of history repeating itself, plus modern production needs, but minus the efficiency of present-day manufacturing methods.

De Forest's Contribution

The work of Dr. Lee De Forest is not able because it is he who put the "grid" electrode in the radio vacuum tube, and was thereby able to make it oscillate.

The history of this phase of the development of the vacuum tube is thus seen to be not so closely related to the subject of radiation that we have been studying lately. In fact it treats of *thermionics*, one of the newest branches of the art of physics.

By this time other physicists had been studying the nature of the distribution of charges on and about the surface and region of electrodes enclosed in an evacuated envelope and many new facts were tabulated, some the outcome of old experiments done under new conditions.

The lines of equi-potential, or points connected where the voltage drop is the same, do not assume a uniform distribution about the surface, inner or outer, of the Leyden Jar, in fact it is very erratic. If the applied potential difference is large enough the resulting mechanical strains set up in the glass heat it up irregularly and the glass wall cracks. This breakdown of the glass structure occurred approximately at the point shown, the inner shaded outline being that of the older style of bottle shape employed, though peculiarly enough the modern jars sometimes will puncture at the same place, this being accompanied by the appearance of the usual fluorescence converging at this point, though at times the puncture occurs between the plates.

The normal place for this phenomenon is at the edge of the electroplated copper coatings of the two surfaces. A simple test by means of which the visual confirmation of the distribution of a charge may be made is the following:

Obtain a shallow pan, such a small tin pie plate, solder a wire to it and connect the other end to one of the high tension terminals of an induction coil. To the other terminal of the induction coil attach a piece of well-insulated rubber-covered wire, the opposite end of which you attach to a pointed metallic end, also well-insulated, so that it may be grasped safely in the hand. If the coil is a half-inch one, the voltage is in theneighborhood of 25,000 volts, though in the event that a spark passes, it is less than this.

Equipment Used

With the metallic pencil point arranged over the center of the pan, say, two inches above it, you fill the pan with some cylinder lubricating oil, then start the induction coil operating.

You will notice that the surface of the oil becomes agitated, but from a central point, the effect being as if the disturbance originated from this point. Actually, it is due to the manner in which the electric field is distributed over the surface of the oil. If now you will bring the point quite close to the oil

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's of Radiation Tubes

Williams

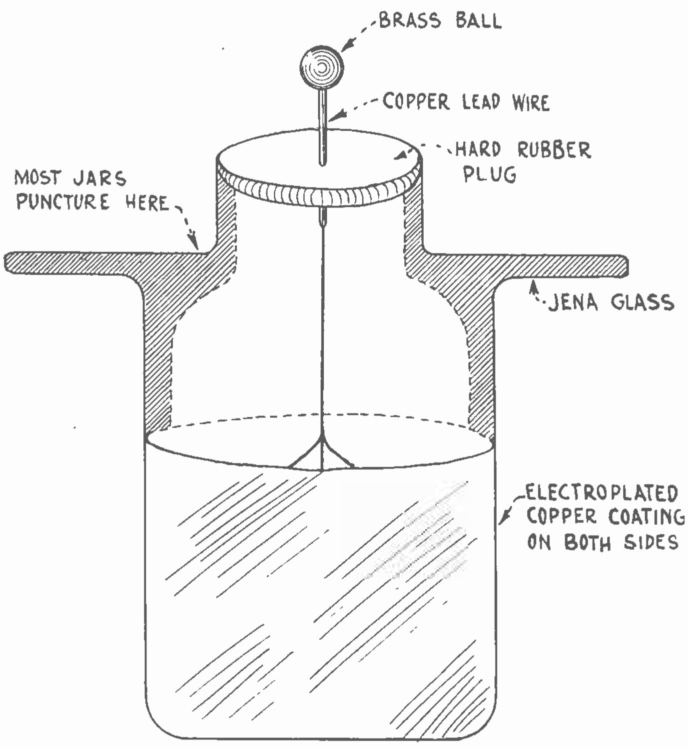

FIG. 2
THE HIGH POTENTIAL TYPE OF LEYDEN JAR THAT HAS SPECIAL REINFORCEMENT AT THE BEND OF THE NECK. THE COATINGS, BOTH INNER AND OUTER, ARE HEAVY COPPER ELECTROPLATE. APPLIED OVER A ROUGHENED SURFACE. A JAR OF THIS TYPE WILL STAND ENORMOUS PEAK VOLTAGES.

surface, you will find this surface is well depressed, perhaps as much as one-quarter of an inch, directly at the center, but progressively less at radially distant points.

If you wish to make the oil film thin enough, a point may be reached where the oil film will break down and at this instant the oil surface disturbances will cease, due to the removal of the field when the spark passes.

A glass plate could be substituted for the oil film, and the manifestation of the presence of the field would be in the form of a series of blue light streamers, appearing to emanate from a central point. and as in the former case the breakdown of the glass will occur if the voltage is raised.

But in the case of the oil film the mobility prevented fracture due to heating effect. The glass molecules are not as mobile, but on the other hand are semi-rigidly arranged, and also are brittle. So when the potential is raised high enough the disruptive effect of the field in its effort to crowd the glass molecules aside produces heat, the secondary effect that finally fractures the material.

Molten Glass Effect

If the experiment could be tried with a film of molten glass the observed effect in all liklihood would be similar to the case of the oil film, modified by the presence of some ionization in the air, due to the high temperature.

Thus it is seen how the presence of strains in the material of a Leyden Jar, or the plates of a glass-dielectric fixed high-tension condenser, due initially to uneven cooling in the annealing process, assists in the puncturing, due to the contributory effect of the distortion of the field just prior to the puncture.

The phenomenon of ionization occurs when the spark passes, and although it is in air, substantially the same evaporation of the metallic surface of the terminals occurs in this case as in the ones previously discussed with the metals in vacuo.

Much of what we know about the marvels of radiation is directly due to what we have learned about the nature of electrical discharge effects in vacuo.

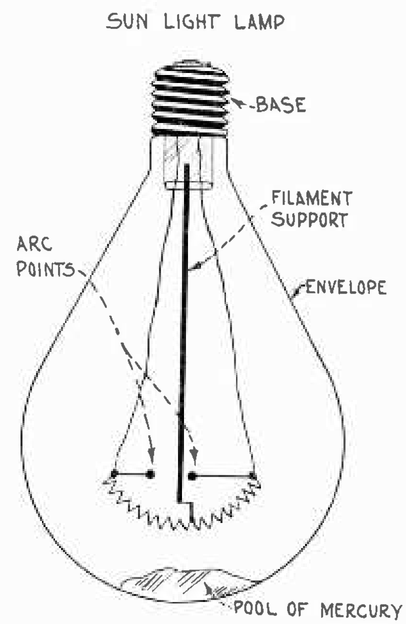

FIG. 3
A RADIATION TUBE OF MODERN DESIGN THAT COMBINES THE OPERATIVE PRINCIPLES OF SOME OF THE EARLIER TYPES OF TUBES. THE ENVELOPE IS AN EVACUATED ENCLOSURE AND A RAY FILTER AS WELL.

To deviate from the subjects of historical importance for a moment, there is at present a type of special radiation lamp, Fig. 3, in the form of an evacuated glass envelope, that is an absorbtive filter, whereby only the desired rays emitted by the lamp electrodes are available for use.

Metallic Vapor Used

The source of radiation is aluminous metallic vapor, whose activity depends upon the maintenance of a satisfactory minimum temperature, which is done without the necessity of the use of the high potential that was the case in the radiation tubes of the past, with the single exception of the "invisible" forms of radiation that include the X-ray.

This lamp is a brilliant example of the result of the application or the principles of radiation, plus the utilizaton of the effect of ionization by impact, which produces the light, the ionizable substance being mercury vapor, always present in the tube, but at the ordinary temperature not copius. The filament is heated from a suitable source. This heat is radiated to the pool of liquid mercury seen at the bottom of the tube, which pool, on heating, begins to give off the necessary vapor.

When suffiicient amount of mercury has been vaporized there is a conducting path established between the two arc points, resulting in the formation of a mercury arc, whose spectrum is rich in the actinic or chemical rays found in the sun's spectrum. This emanation is modified by the selective absorption effect of the specially compounded glass of the envelope.

The potential difference across the arc points is the same as that of the filament operative voltage. The potential is arranged to be slightly above the ionization potential for mercury vapor, but when the arc is formed the filament current drops, due to the added shunt circuit, and the voltage drops too. But the presence of the heated filament acts as a stabilizing influence, tending to offset fluctuations in the line operative voltage, resulting in the intensity of radiation being kept reasonably constant, within the limits of regulation of the lamp.

Dr. Richardson had shown, it will be recalled, that the type of radiation from heated platinum was negative. It was subsequently found that Dr. Hertz, shortly before his last illness, was engaged in the development of a form of tube in which different substances suspected of being electronically active could be heated, and at the same time a potential difference was applied which was to act as the medium for accelerating the departure of charged bodies from the suface of the heated substance under investigation.

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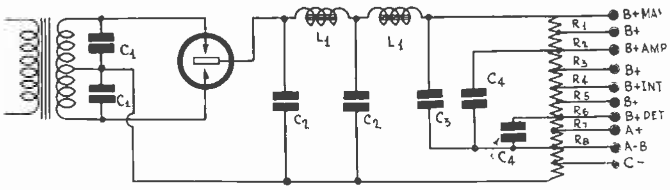

The Raytheon

By J. E.

FIG. 1.

A TYPICAL CIRCUIT DIAGRAM OF AN ABC POWER UNIT UTILIZING THE RAYTHEON BA FULL-WAVE RECTIFIER TUBE TO BE USED IN RECEIVERS IN WHICH THE FILAMENTS OF QUARTER AMPERE TUBES ARE CONNECTED IN SERIES.

THE rectifier tubes previously discussed, namely, the 280 and 281, are filament type tubes of the thermionic type and require a filament voltage source in addition to the high voltage winding supplying the current to be rectified. There is another type of rectifier which works on a different principle and does not require any filament power. This rectifier is exemplified by the Raytheon gaseous type of tubes.

The principle of this rectifier is based on the unilateral conductivity of two electrodes, one sharp-pointed and the other having a large surface, when the two are in an atmosphere of rarefied helium. Electricity flows only when the sharp point is positive with respect to the large surface electrode. For this reason the large surface is positive as viewed from the outside of the tube. That is, it takes the place of the filament in the thermionic tube.

Gaseuos type rectifiers have been constructed both for full-wave and half-wave rectification but modern tubes are only of the full-wave type. Each of these tubes has two sharp-pointed electrodes and one large-surface electrode. The two sharp-pointed electrodes are connected to the large prongs on the base, which are used for the filaments in thermionic tubes, and the large-surface electrode is connected to the plate prong. Thus, with respect to the external circuit the plate prong is the positive.

The base of the tube is the standard UX and fits either the standard UX socket or the old type Navy socket.

Heavy Duty Rectifier

The Raytheon BA tube is a heavy duty rectifier designed to deliver up to 350 milliamperes. It was intended for use with receivers

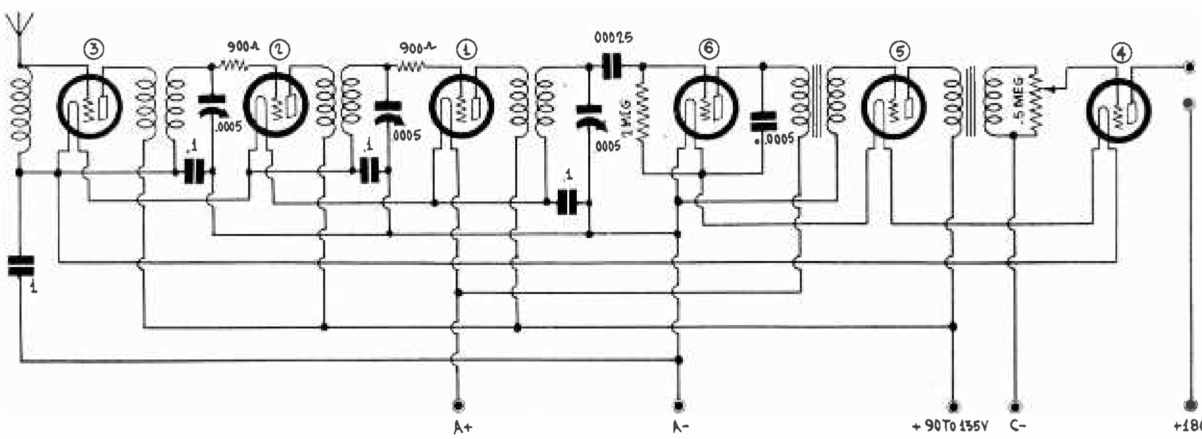

Fig. 3
A typical circuit diagram of a six-tube receiver in which all the filaments are connected in series. Only quarter ampere tubes can be used in the series.

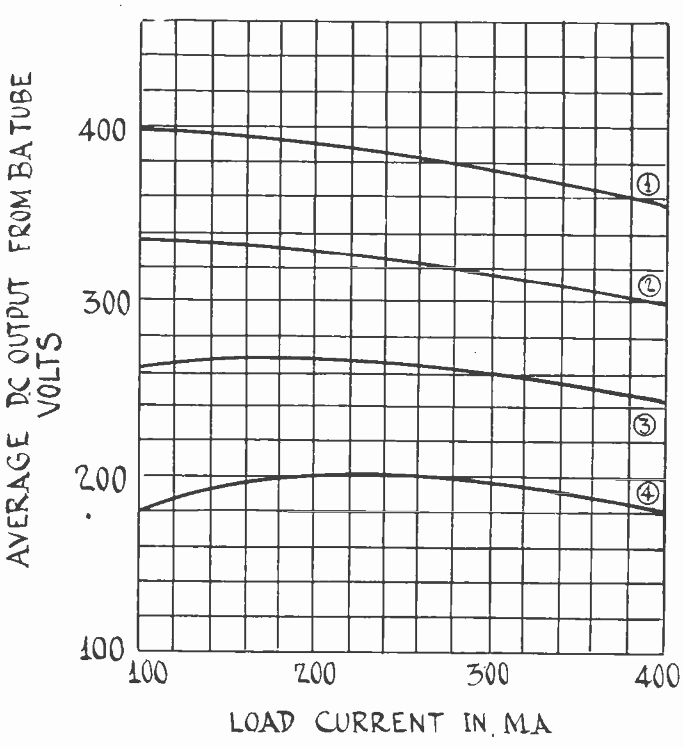

FIG. 2.

REGULATION CURVES OF THE BA FULL-WAVE RECTIFIER TUBE USED IN A CIRCUIT OF THE TYPE SHOWN IN FIG. 1. THE OUTPUT VOLTAGE IS THE VOLTAGE ACROSS THE FIRST CONDENSER IN THE FILTER, ASSUMED TO HAVE A VALUE OF 4 MFD.

in which the filaments of several quarter ampere tubes, such as the 201A, are connected in series, but it may be used for many other purposes, such as charging B supply storage batteries, supplying current for field and electro-magnets, energizing the field of electro-

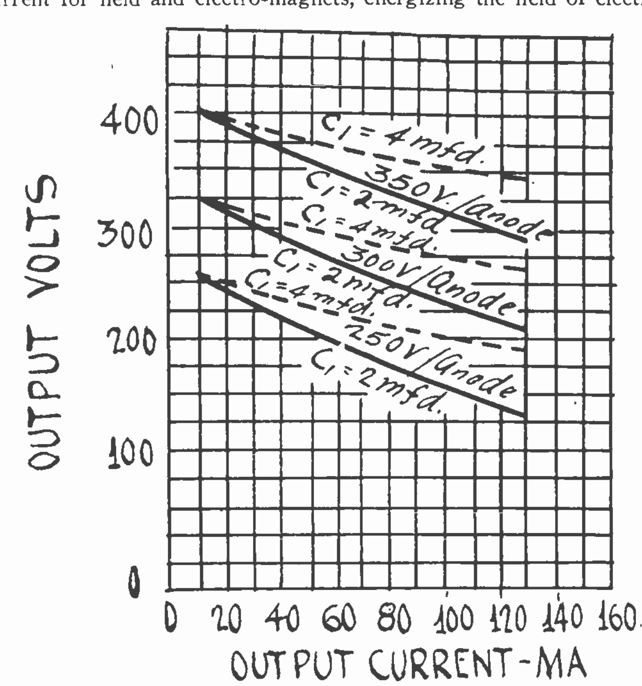

FIG. 4.

REGULATION CURVES OF THE RAYTHEON BH FULL-WAVE RECTIFIER. THE OUTPUT VOLTAGE IS THE POTENTIAL ACROSS THE FIRST BY-PASS CONDENSER IN THE FILTER.

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BH and BA

Anderson

dynamic speakers, and supplying direct current for small electroplating plants.

The maximum effective AC voltage that should be used on the BA tube is 350 volts per anode, but it will work satisfactorily with lower voltages down to 200 volts per anode when a lower output voltage is desired.

A diagram suitable for the BA rectifier is shown in Fig. 1. The filter circuit in this voltage supply is almost identical with that used when filament type rectifiers are used, but there are two condensers, C1, used only with gaseous type rectifiers. These are called buffer condensers and the usual value is 0.1 mfd. across each half of the secondary of the supply transformer.

A heavy duty power transformer and heavy duty chokes must be used when the BA tube is employed, because the rectified current may be as high as 350 milliamperes. The current carrying capacity of the resistances in the voltage divider must also be high since through most of the sections nearly the entire output flows. The only section which does not carry high current is R8, the one that is shunted across the terminals provided for the filaments of the tubes in the receiver. The exact value of any one section depends on the voltage distribution and the number of tubes used in series across the "A" terminals.

While no by-pass condensers are connected from some of the taps on the voltage divider to A minus, one should be used for every tap connected to the receiver. This applies to the grid bias tap below A minus as well as to the positive tap above. The larger the capacity of these condensers the better. The minimum values of the capacities should be as follows: C1, .1 mfd.; C2, 4 mfd.; C3, 8 mfd.; C4, 1 mfd. The voltage rating of C1 should be not less than 600 volts and preferably 1,000 volts. That of C2 and C3, 400 to 600 volts, and that of the others from 200 to 400 volts. These ratings are based on the supposition that the voltage per anode does not exceed 350 volts.

Voltage Regulation Curves

The variation of the rectified output voltage for four different input voltages of this tube is shown in Fig. 2. Curves 1, 2, 3 and 4 are for voltages of 400, 350, 300 and 250 volts per anode, and the output voltage is measured across the first C2 condenser next to the rectifier tube.

These curves show a good voltage regulation, or a very small change in the output voltage for given changes in the output current. Indeed, in some places there is no change in the voltage at all. For example, on Curve 4 at 220 milliamperes the voltage is a maximum and the change in voltage for small changes in the current is zero. Curve 3 has a maximum at about 180 milliamperes.

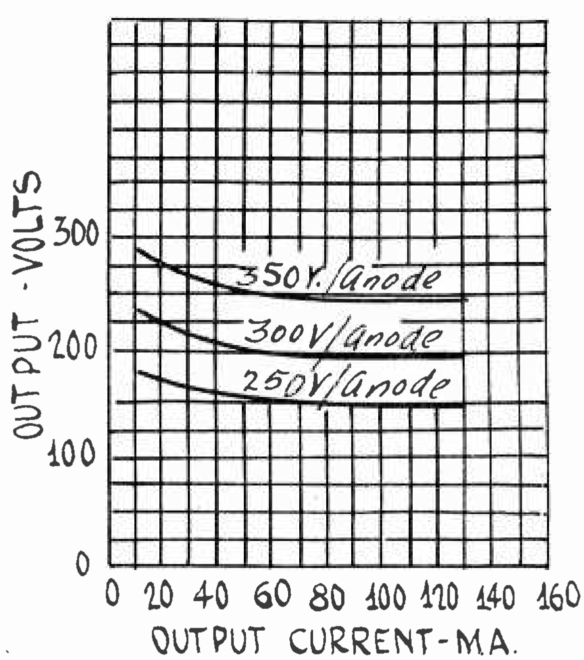

FIG. 5.

REGULATION CURVES OF THE RAYTHEON BH FULL-WAVE RECTIFIER WHEN IT IS WORKING INTO A CHOKE COIL OF 15 HENRIES, OR WHEN THE FIRST BY-PASS CONDENSER IS OMITTED.

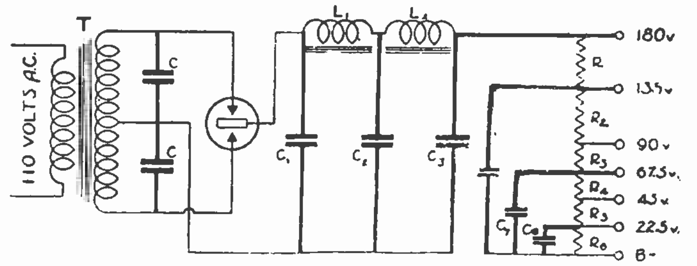

FIG. 6.

A TYPICAL CIRCUIT DIAGRAM OF A B SUPPLY CIRCUIT UTILIZING THE BH FULL-WAVE RECTIFIER TUBE.

In Fig. 3 is a typical circuit diagram of a receiver with the filaments of the six tubes connected in series. When the A and B supply in Fig. 1 is used with this circuit the resistances in the voltage divider should have the following values: R1, R2, R3, 120 ohms each; R4, 140 ohms; R5 and R6, 100 ohms each; R7, 80 ohms; R8, 4,000 ohms, and R9, the lowest resistance section, a 200-ohm potentiometer. All these resistances should be wire wound and be capable of carrying 300 milliamperes, with the exception of R8, which need not be rated higher than 75 milliamperes. In this circuit the last tube may be a 171A power tube, for which a bias of up to 45 volts has been provided in the 200-ohm potentiometer.

The tubes in this circuit are numbered in the order in which their filaments appear in the series, beginning with the positive. This order has been selected so as to give the proper grid bias to the tubes. The grid leads are run so that three of the tubes get a bias of 5 volts and so that the first tube gets zero bias and the detector plus 5 volts. The bias for the power tube is adjustable since the grid return is to be connected to the 200-ohm potentiometer in the A and B supply.

The BH Tube

The BH tube is a smaller full-wave rectifier tube than the BA and is rated at 125 milliamperes with a maximum allowable effective voltage of 350 volts per anode. It may be used as a B voltage supply for receivers using 112A, 171A and even 245 power tubes provided the total current does not exceed the 125 milliampere rating. It may also be used for filament supply in series connected circuits with 199, 230 and 232 tubes provided the circuit is suitably designed.

Regulation curves of the BH tube are shown in Figs. 4 and 5. The dotted lines in Fig. 4 are for the case when the condenser across the line next to the rectifier tube has a capacity of 4 mfd. and the full lines for the case when the capacity of this condenser is 2 mfd. It will be noted that the regulation is considerably better when the capacity of the condenser is 4 mfd. and also that the output voltage is higher. For these reasons the first condenser should have at least 4 mfd. capacity.

Fig. 5 shows the corresponding regulation curves when the capacity of the first condenser is zero. The regulation is excellent but the output voltage is very low. With 350 volts per anode at 100 milliamperes the output voltage is only about 250 volts, while the corresponding output voltage when the first condenser has a capacity of 4 mfd. is over 375 volts.

The terminal arrangement is the same for the BH as for the BA. That is, the prongs in the filament positions are the anodes and should go to the ends of the high voltage winding of the supply transformer and the plate prong is the cathode, which should go to the positive side of the filter circuit.

Typical Diagram for the BH Tube

A typical circuit of a B supply utilizing the BH tube is shown in Fig. 6. The transformer T should have a center-tapped secondary delivering not more than 350 volts, R.M.S., for each half and each buffer condenser should have a capacity of 0.1 mfd., rated at 600 to 1,000 volts. The first by-pass condenser, C1, should have a capacity of 4 mfd. and should be rated at 400 to 600 volts. C2 should be a similiar condenser. C3 should have a capacity of 8 mfd. with a voltage rating equal to C1 and C2. The condensers across the sections of the voltage divider should be 1 mfd. or more.

The inductance of each choke, L1 and L2, should be from 15 to 30 henries and should be designed to carry the full current of 125 milliamperes without saturation.

The resistance values of the various sections of the voltage divider depend on the current drawn from the various taps and cannot be specified without reference to the particular receiver which is to be served by the B supply, but the total resistance should be about 15,000 ohms. If this resistance contains a large number of fixed taps. or a number of movable taps, the proper voltages may be obtained in any case by selecting the proper fixed taps, or by setting the movable taps at the proper places, as determined by a first class, high resistance voltmeter.

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The New Grebe an

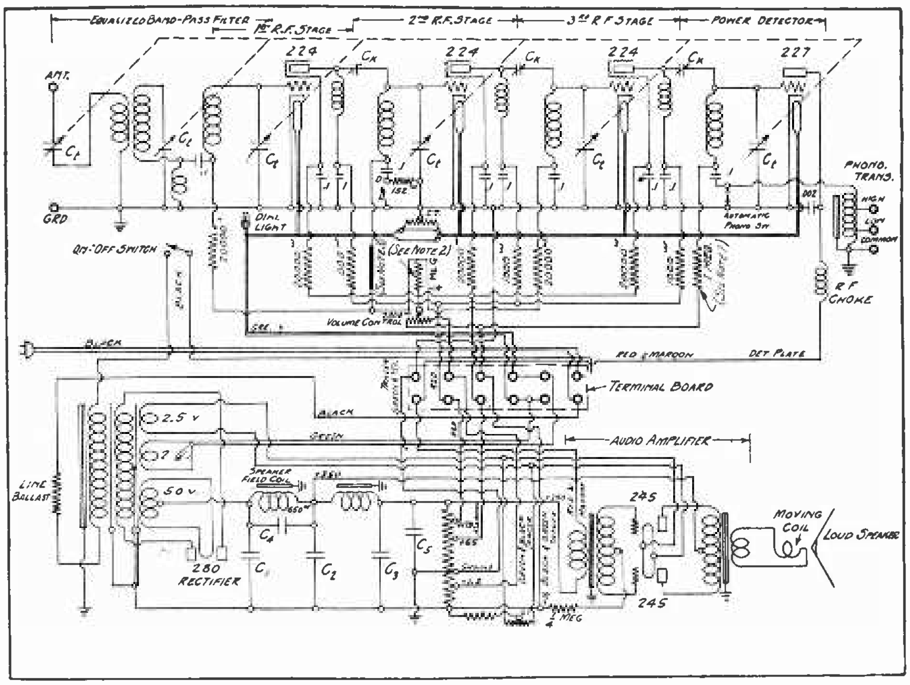

FIG. 1

THE CIRCUIT DIAGRAM OF THE GREBE MODEL SK-4, ONE OF THE NEW MODELS OF THIS LINE.

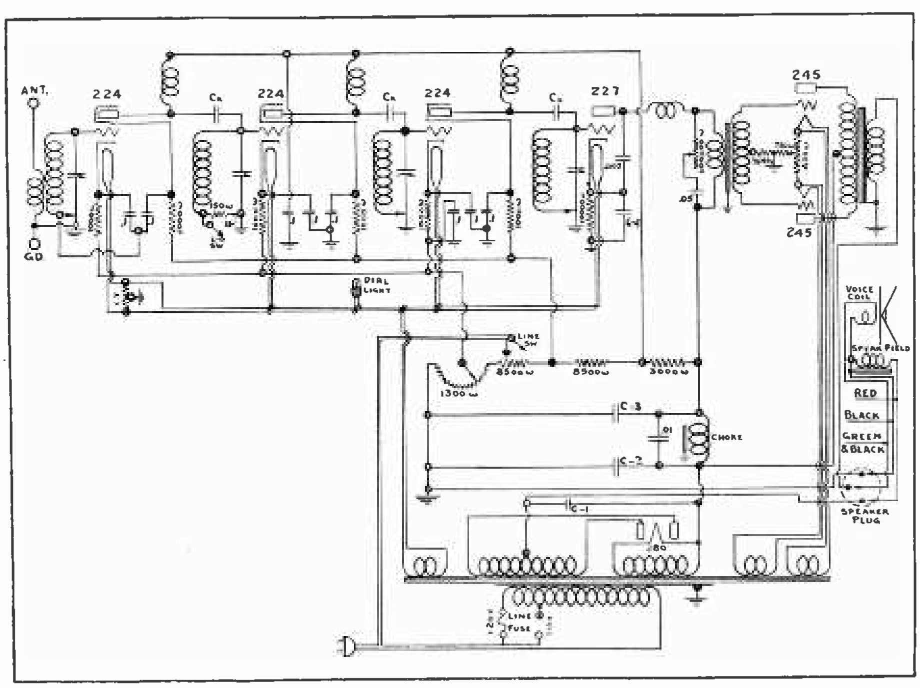

FIG. 2

THE GREBE MODEL AH-1 IS A SIMPLER CIRCUIT THAN THE SK-4 BUT IN GENERAL CONTAINS THE SAME FEATURES.

This is one of the weekly series of articles constituting "Service Men's Guide," containing latest commercial diagrams.

THE Grebe SK-4 is a six-tube receiver incorporating three 224 screen grid tubes, a 227 power detector, and a stage of 245 push-pull amplification and is reproduced in diagram in Fig. 1.

The tuner contains six variable condensers controlled by a single knob. The first of these condensers is in series with the antenna and the primary of the first radio frequency transformer. The second and third condensers are in a band pass filter, and the remaining three condensers are in the interstage couplers. Each of these couplers consists of a choke coil in the plate circuit, a small coupling condenser of adjustable capacity connected between the plate of one tube and the grid of the next, and the usual tuned circuit comprising a tuning coil and a condenser.

Grid Return Resistor

In the grid return of each radio frequency amplifier tube is a resistance of 20,000 ohms and in the grid return of the detector a resistance of one megohm. In the screen return of each 224 is also a 20,000-ohm resistance, and in each plate return one of 1,000 ohms. Each of these resistances is by-passed by a 0.1 mfd. condenser. Thus there is thorough filtering to prevent radio frequency oscillation.

All the cathodes, including that of the detector, are grounded and the grid bias is provided by suitably returning the grids to points on the voltage divider. The screen grid tube grid returns first go to a potentiometer, which is connected across a section of the voltage divider in which the drop is 1.2 volts. Thus the grid bias is adjustable between zero and 1.2 volts, and this adjuster is the volume control. The grid return of the detector tube is made to the negative side of the B supply circuit, which gives the grid a bias suitable for power detection.

Phonograph Pick-up Arrangement

A switch is provided for changing the sensitivity of the receiver to suit local and distant stations. This switch is so arranged that when it is open a resistance of 152 ohms is connected in series with one of the tuned circuits, and when it is closed this resistance is short-circuited.

Provision is also made for a pick-up unit. An auto-transformer is arranged so that its entire winding may be cut into the grid circuit of the detector in series with a 0.1 mfd. condenser and the tuning coil. It does not change the grid bias. A switch is provided for shorting the auto-transformer when radio signals are to be received, and this switch works automatically when the terminals of the pick-up unit are plugged into the jacks. Provision is made for both low and high impedance pick-up units by tapping the auto-transformer.

The first filter choke in the circuit is also the loudspeaker field coil. This is shunted with a condenser of suitable value to improve the filtering. The filter is tapped so that the plate current of the two 245 tubes flows only through the first choke, that is, the field coil.

Grebe AH-1

The Grebe AH-1 is also a six-tube circuit utilizing the same tubes, but it is a considerably simpler circuit, as will be seen from Fig. 2. It employs only four tuning condensers, three of which are in circuits similar to the three interstage tuners in the SK-4 model. The remaining condenser is in the secondary of the radio frequency transformer which couples the antenna to the first tube. A "Local-Distance" switch is also provided in this circuit and it cuts in or short-circuits a 150 ohm resistor in series with the second tuned coil.

There is a 1,000 ohm resistance in series with each screen lead and a resistance of the same value in each screen grid tube cathode lead serving as grid bias resistor. The bias resistor in the detector tube is 10,000 ohms. The cathode returns of the three screen grid tubes are joined at the

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d Crosley Receivers

slider of a 1,300 ohm potentiometer, which is the lowest resistance section of the voltage divider. This potentiometer serves as a volume control by varying the grid bias of the first three tubes.

A tone control is connected across the primary of the push-pull input transformer, and this consists of a .05 mfd. condenser in series with an adjustable resistance of 100,000 ohms maximum value.

As in the preceding circuit one of the chokes of the filter is the field coil in the dynamic speaker, but in this case it is put in the negative side of the line so that one side of the field coil is grounded. The other choke is connected in the positive side of the B supply and this choke is shunted by a .01 mfd. condenser.

An unusual feature in this circuit is the filament supply to the two power tubes. There is one 2.5 volt filament winding for each tube and the two are joined by a 400 ohm potentiometer, to the slider of which a 750 ohm grid bias resistor. The 400 ohm potentiometer is used for the purpose of balancing out hum. There is also a ¼ megohm resistor in series with the lead to the center tap of the push-pull secondary. There is no condenser across either of these resistances. It is not necessary to by-pass the bias resistor when the circuit is balanced and to by-pass the quarter megohm resistance would defeat the object of that resistance.

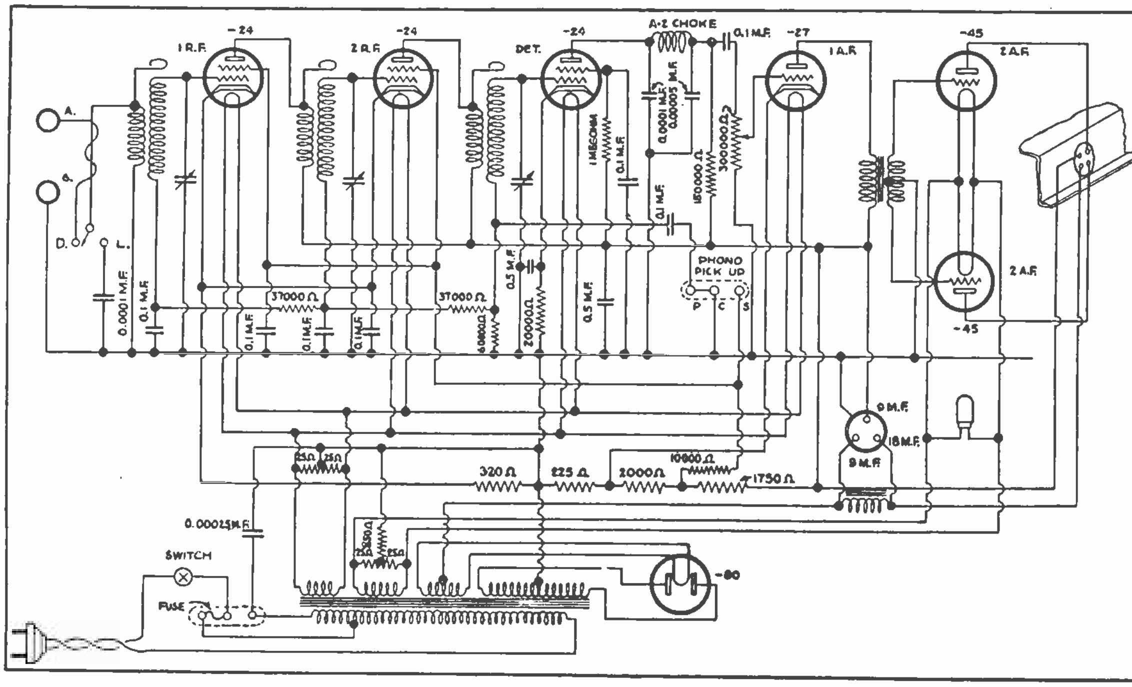

FIG. 3
THE COMPLETE DIAGRAM OF THE CROSLEY MODEL 77 SCREEN GRID RECEIVER.

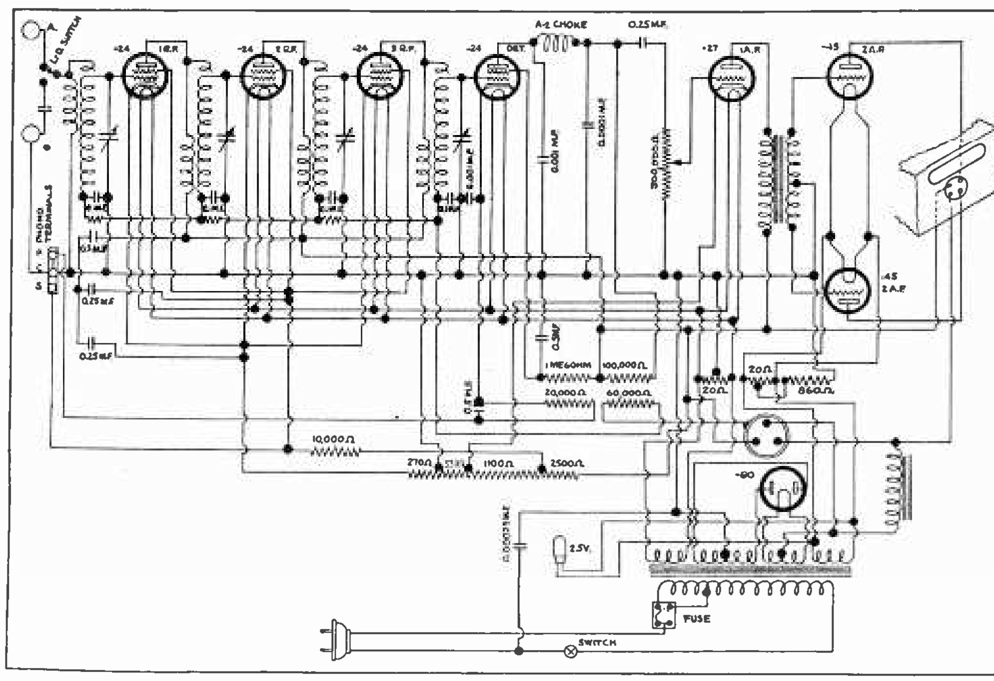

FIG. 4
THE COMPLETE CIRCUIT DIAGRAM OF THE CROSLEY MODEL 84. THIS CONTAINS ONE MORE 224 SCREEN GRID RADIO FREQUENCY AMPLIFIER THAN MODEL 77 BUT OTHERWISE HAS THE SAME DESIGN.

Crosley Model 77

Model 77 is one of the latest Crosley screen grid tube receivers. It contains two 224 screen grid tubes as radio frequency amplifiers, a 224 power detector, a 227 audio frequency amplifier, coupled resistively to the detector, and a stage of 245 push-pull.

There are three tuned circuits in which the primary and secondary windings are coupled both inductively and capacitively. The condenser coupling is very loose but is adjusted so as to equalize the amplification over the tuning range of the condensers.

A "Local-Distance" switch is provided in the antenna circuit. This is arranged so that when it is thrown to the "Local" position a .0001 mfd. condenser is connected across the primary of the first RF transformer, the circuit thus formed being coupled inductively to the antenna by a few turns. When the switch is thrown to the "distance" position the condenser is disconnected and the antenna is connected to the top of the primary.

The fine adjustment volume control is a 300,000 ohm potentiometer in the grid circuit of the first audio frequency amplifier tube, the grid of that tube being connected to the slider. This potentiometer also serves as the grid leak.

The screen grid detector operates on the bias principle and the bias resistor in the cathode lead is 20,000 ohms. There is an additional bias, common to the RF and detector tubes, which is obtained from a 320 ohm resistance in the voltage divider. The normal bias is the drop in this resistance. There are 37,000 ohm resistance in the grid return leads.

The Crosley Model 84 is similar to the Model 77 but it contains one more 224 radio frequency amplifier and one more tuned circuit, the same type of coupler being used in both circuits.

The same method of automatic volume control is used in both, and grid return resistors are 60,000 ohms. The common resistance is also 60,000 ohms as it is in the other model.

The grid bias resistance for the detector is 20,000 ohms and the plate coupling resistance is 100,000 ohms.—J. E. Anderson.

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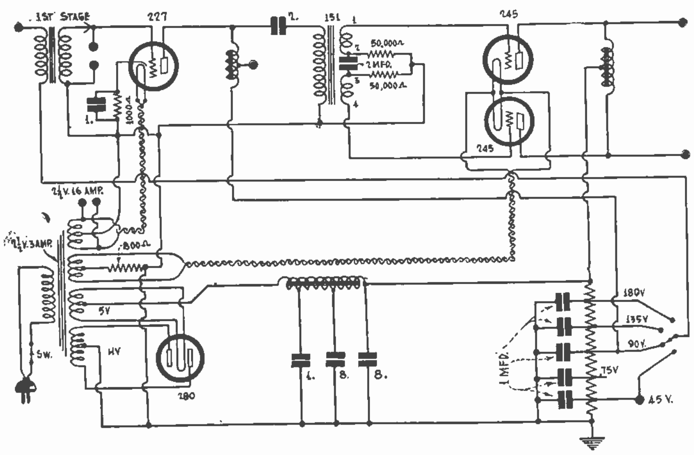

FIG. 864

THE CIRCUIT DIAGRAM OF A POWER SUPPLY AND PUSH-PULL AUDIO FREQUENCY AMPLIFIER SUITABLE FOR USE EITHER WITH A RADIO FREQUENCY AMPLIFIER OR A PHONOGRAPH PICK-UP UNIT.

Push-Pull Amplifier and Power Supply

WILL you kindly publish a diagram of a power supply and a push-pull audio frequency amplifier that can be used either for a radio frequency receiver or a phonograph pick-up unit? Please specify the transformers and chokes that may be used.—C. F.

Fig. 864 is a diagram of such a circuit. The input transformer is an Amertran de luxe, and the interstage push-pull transformer is Amertran 151. The chokes in the amplifier are Polo center-tapped audio chokes and the choke in the filter is a Polo 245 choke. The power transformer is a Polo 245 PT. The output is arranged for a magnetic or other high impedance speaker, to be connected from plate to plate of the output tubes. If a dynamic speaker is to be used the output transformer primary should be connected to the same points. Without a suitable output transformer a dynamic speaker will not give good results, but more dynamic speakers are provided with such transformers.

* * *

Biasing for Modulation

WHEN grid bias is specified for radio frequency amplifiers it is done with the amplitude of the carrier in mind only. That is, the bias is made high enough so that the grid can never go positive when the signal is unmodulated. But suppose the signal is modulated 100 per cent. The signal amplitude may then be twice as great as the unmodulated carrier amplitude and the bias provided will not be nearly high enough.—L. G. S.

The question of specifying adequate bias comes up usually when dealing with audio frequency amplifiers, but rarely when dealing with radio frequency amplifiers. The bias values recommended by the tube manufacturers are used whether or not the signal voltage is high enough to require this bias. As a rule, the bias provided is high enough not only to support the unmodulated signal but even a 100 per cent. modulated signal. There may be exceptions when power detection is used, when the signal voltage level in the RF amplifier in the tube ahead of the detector may be so high that there may be some overloading if the usual bias values are used. However, a properly placed volume control takes care of this problem.

* * *

The "Donkey Effect"

WHAT is the main reason why the high frequency modulation will not carry through a highly resonant circuit as well as the low frequency modulation? If the answer can be given only in mathematical terms, don't bother about it, because probably I would not get the point.—C. J.

If the suppression can be ascribed to any one cause, it is what we might call the "donkey effect," the tendency for a body to remain as it was before attempts were made to budge it. In more polite terms this property of matter is called inertia. It takes time to effect changes and in a longer time a greater change can be effected. Thus a greater amplitude change can be produced with a given force in the period represented by a low frequency modulation than in the period represented by a high frequency modulation.

* * *

All-Wave Superheterodyne

IS it possible to build a Superheterodyne so arranged that it can be used for receiving both broadcast and short waves? If so, how should it be constructed?—L. D.

It is quite possible, and one simple way is to use plug-in coils. The intermediate frequency amplifier should be tuned to a rather high frequency so that there will be no trouble by interlocking of tuned circuits when very high frequencies are being received. A frequency of 450 kc should be high enough. A set of coils covering the desired band of frequencies should be provided. If the tuning condensers are .00025 mfd. a set of four coils should be sufficient to cover the band from 450 to 20,000 kc.

* * *

Neutralizing Screen Grid Tube Amplifiers

IS there any advantage in neutralizing radio frequency amplifiers in which screen grid tubes are used? I have noticed a few receivers in which neutralization was employed, but I can see no advantage in view of the fact that the plate to grid capacity in these tubes has been reduced to negligible values.—B. F. L.

The feedback through the inter-electrode capacity of a screen grid tube is very small and neutralization is not necessary unless the amplification is enormously high. But the plate to grid capacity is not the only capacity which may cause trouble. Capacity between the grid lead and the plate lead outside the tube is just as effective in causing oscillation. It is either necessary to shield the leads so that this capacity is zero or else to employ neutralization of some form. It is a question as to which is preferable, neutralization or such special shielding. It would seem that shielding alone would be sufficient precaution to prevent oscillation except when the amplification is enormous. Experience has shown that for practical broadcast receivers shielding alone is sufficient.

* * *

Volume Control in Screen Grid AC Sets

IS there no other way of controlling the volume in an AC screen grid tube receiver than manipulating the screen voltage? If there are any other methods that have been proved satisfactory will you kindly give them?—F. W. C.

The volume may be varied by many different arrangements. One of the best is a voltage divider, or potentiometer, of high resistance in one of the grid circuits, preferably the first. By means of this the signal voltage can be divided so that any part of the voltage in the antenna coupler can be impressed on the grid. A similar device in the grid circuit of the first audo frequency amplifier is also effective, or it may be put across the detector input circuit. A variable condenser in series with the antenna is another means of varying the volume, but this is not so good as the voltage divider arrangement.

* * *

Interpretation of Voltage Regulation Curves

VOLTAGE regulation curves show that the voltage across the voltage divider varies with the current drain. Therefore all the voltages impressed on the receiver will vary with current drain. Now the current varies with the signal. Does this not result in undesirable effects, such as feedback, which in some instances may be very high. Will you please explain why this does not seriously impair reception?—G. M. C.

It is true that the voltage varies with current drain, but this seriously affects the steady voltages only when changes are made in the grid bias on the tubes, especially those tubes which draw a heavy current. The only time the signal affects the voltage is when these is considerable rectification by the tubes, but even this is not serious because it would only result in a slight distortion in the audio signal, too small to be appreciable. During normal operation of the circuit there is no average change in the current drawn from the rectifier. The filter prevents this. When the signal demands a greater current, that current is supplied by the charge in the filter condensers, especially the last one, which usually has a high capacity. The condenser is charged up again when the signal swings in the direction requiring less current. The condenser is a reservoir and in a sense acts the same way as the starting battery in a car.

* * *

Filtering Output of Half-Wave Rectifier

WHY does it require more inductance in the filter chokes and more capacity in the filter condensers to effect a given degree of filtering in a half-wave rectifier than in a full-wave rectifier?—R. M.

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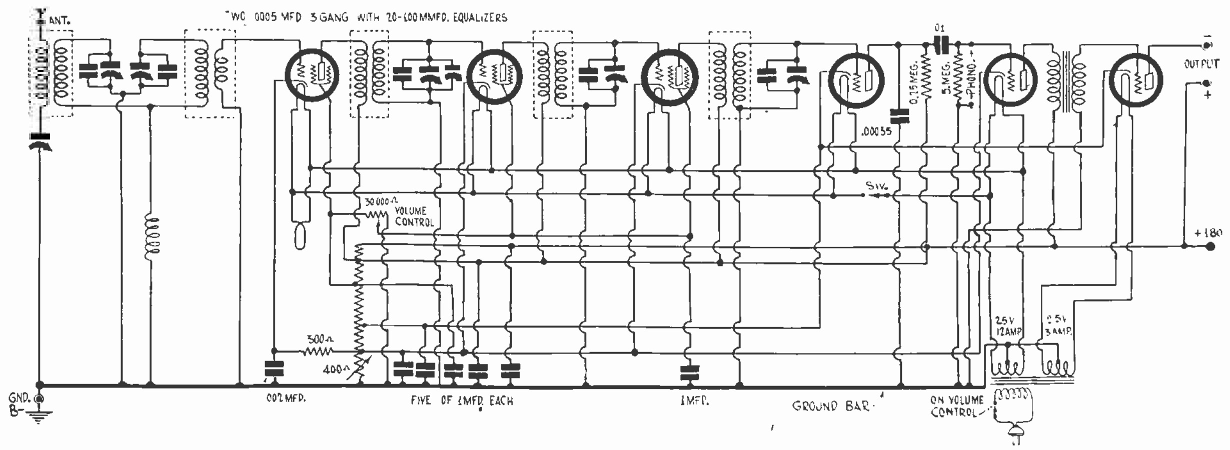

FIG. 865

SIX TUNING CONDENSERS IN TWO INDEPENDENT OR COUPLED SECTIONS ARE USED IN THIS RECEIVER. A FILAMENT TRANSFORMER SUPPLIES THE HEATER AND FILAMENT VOLTAGES FOR THE TUBES.

Because during half of the time no current is supplied the filter and these voids must be filled up by the filter. In a full-wave rectifier current is supplied all the time except at those instants when the current changes direction in the supply transformer.

* * *

Use of Short-Wave Converters

CAN the short-wave converter you described in the November 15th issue be used with a Grebe SK-4 receiver? If so, please tell how to make the connections?—L. W. H.

Any converter which we described can be used with any broadcast receiver. If a circuit cannot, it is not a converter.

* * *

Pointers on Rectifier Construction

COULD the Polo power transformer and chokes be used in the construction of a half-wave rectifier and filter such as shown in Fig. 3, page 16, November 22 issues, by substituting a 280 tube for the 281 and connecting the two plates of the 280 together?—G. S. S.

Yes, they can be used, but they can be used to better advantage in a full-wave rectifier using the 280 tube. For the proper way to use this transformer and these chokes see the circuit in the November 15 issue under the 280 tube.

* * *

Ultra Short-Wave Receiver

IS it possible to construct a receiver with 224 screen grid tubes which will tune to waves of the order of one meter? If so, what kind of tuner is necessary?—J. C. W.

For capacity it would be almost imperative to use the distributed capacity of the tube and the circuit and for inductance a single turn of wire of a few inches in diameter. The tuning would be done by varying the amount of wire on this turn in the circuit. Another way would be to make the inductance a rod of wire the length of which could be varied. Little work has been done on these very short waves and information on the subject is not plentiful.

* * *

Ionization in Vacuum Tubes

WHAT occurs when a blue glow appears in a vacuum tube, and why does it appear?—P. D.

The blue glow is due to the ionization of the gases remaining in the tube. By ionization is meant the breaking up of the gas atoms into electrons and positive ions, the tearing away of electrons from the atoms. It is due to collision of free lectrons with slower gas atoms. The high voltage between the plate and the filament or cathode give the electrons a high velocity toward the plate. If they find no obstruction, such as an atom of gas, until they have traveled a considerable distance, the velocity is so great that when a collision does occur one or more electrons are knocked out of the atom and the light appears. The higher the voltage betwen the plate and the cathode, the shorter the necessary distance an electron has to travel before it has been accelerated enough to cause ionization on collision. For that reason the blue glow occurs most frequently when the voltage is high. A blue glow indicates a high plate current because every electron that is knocked free of an atom adds to the current.

* * *

Removing Speaker Rattle

I HAVE a dynamic loudspeaker which worked fine for about a year, but then started to give out a queer buzz, especially when I turn up the volume. What is the cause of this noise and how can it be removed?—A. A. F.

Probably particles of dust have lodged between the pole pieces and the armature, possibly iron filings. Clean them out and the speaker should work as well as ever. Sometimes the armature coil warps so that it will no longer run freely between the pole pieces without striking. If this is the trouble, a new armature may be necessary.

Signal By-pass Condenser

IN each of the two models of Fada receivers you published in the November 15th issue there is a .00025 mfd. by-pass condenser across the secondary of the push-pull input transformer. What is the function of this condenser?—W. A. T.

This condenser serves as an equalizer to by-pass the high audio frequencies which otherwise would be too prominent.

* * *

All-wave Receiver Coupler

IN building an all-wave receiver is it all right to use one of the ¼ millihenry chokes in series with a 50 millihenry choke in the grid circuit of the first tube? Would it be necessary to short-circuit the larger coil when receiving short-wave signals? If not, would there be any disadvantage in leaving it in the circuit?—F. W. W.

It is not necessary to short-circuit the larger coil because it can do no harm as far as the reception of short waves is concerned. However, if it is left in the first tube it is effective as an amplifier over the whole range of frequencies and it may be that you will have some interference with broadcast stations. If you have a radio frequency tuner following the first tube the broadcast stations will be suppressed sufficiently.

* * *

Six-Tuned Circuit Receiver

I SHOULD like to have a diagram of a receiver in which I can use six tuning condenser that I have. These condensers are in two sections of three each. I don't mind having two controls.—H. A. C.

The circuit of a receiver meeting these requirements is shown in Fig. 865. One of the tuning condensers is in the antenna circuit and two of the first section are in a band pass filter. The other three units are in interstage transformers in the regular way.

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COURT SHIFTS; LANGMUIR TUBE PATENT UPHELD

Philadelphia.

The Federal Circuit Court of Appeals here has reversed its own decision of a year ago in the suit of the General Electric Co. against the De Forest Radio Company, now upholding the validity of the Langmuir patent No. 1,558,436 on radio tubes granted in October, 1925.

Last year Hugh M. Morris, as judge of the Federal District Court of Delaware, dismissed the suit on the ground that the patent was invalid. The case was appealed by the General Electric Company and the court sustained the decision of the lower court, three-to-one, Judges J. Warren Davis and Victor B. Woolley assenting, and Judge Joseph Buffington dissenting. This is the decision the court reversed after hearing rearguments. Judge Victor B. Woolley filed a dissenting opinion holding that the patents were invalid.

Important to Industry

The decision is important to the radio industry because the patent covers the non-gaseous tubes used in all radio receivers and transmitters and it paves the way for a monopoly on the manufacture, production and sale of these tubes by the General Electric Company, provided the verdict is upheld by the Supreme Court, to which the De Forest Company is expected to appeal.

David Sarnoff, president of the Radio Corporation of America, issued a statement, saying:

"This patent covers the revolutionary improvement in vacuum tubes made by Dr. Irving Langmuir, assistant director of the Research Laboratory of the General Electric Company. The court holds that this tube, covered by the Langmuir patent, 'because of its stability, reproducibility and power, has made possible radio broadcasting, modern radio reception and long distance telephony,' and that 'next to the telegraph, the telephone and the wireless,' it 'is probably one of the most far-reaching and beneficent in human progress.'

Hopes Litigation Is Ended

"These tubes are being used extensively for telephone and certain other purposes by the American Telephone & Telegraph Company and its subsidiaries under license from the Radio Corporation and the General Electric Company, and are being sold by the Radio Corporation's subsidiary, the RCA Radiotron Company, and by a number of other manufacturers under license from the Radio Corporation. They are the standard tubes used in radio transmission and in radio receiving sets, as well as in electric phonographs, talking movies, etc.

"I trust that this marks the end of this long-drawn-out litigation which has lasted over ten years in the patent office and nearly five years in the courts."

WORTH THINKING OVER

WASHINGTON tells us that 13,000,000 radio sets are in use in the United States. What's the matter with our radio manufacturers and dealers? If they were as smart as the makers of miniature golf courses they'd get the other 17,000,000 non-buyers of sets to come across and make it unanimous.

Literature Wanted

Readers desiring radio literature from manufacturers and jobbers concerning standard parts and accessories, new products and new circuits, should send a request for publication of their name and address. Send request to Literature Editor, RADIO WORLD, *145 West 45th Street, New York, N. Y.*

Louis N. Beers, 4248 E. Whittier Blvd., Los Angeles. Calif.
H. S. Black, 245 Eglinton Ave., E., Toronto, Canada.
Apex Radio Service, H. Samchick, 303 So. 6th St., Philadelphia, Pa.
William James Reid, 883 Longfellow Ave., Bronx. N. Y. City.
W. L. Barnes. 125 E. Willow St., Kankakee, Ill.
Suburban Radio Service, W. Geo. Dillon, Mgr., 203 15th St., Sharpsburg, Pa.
C. Seward, 20 N. Ohio Ave., Atlantic City, N. J.
D. M. Fuller, 1625 Garland Ave., Wichita, Kans.
J. Milligan, Box 424, Blackwell, Okla.
Charles J. Markey, 237 9th Ave., New York, N. Y.
Dr. T. B. Enders, Mystic. Conn.
John Meldrum, 1340 Athol St., Regina, Sask., Canada.
Geo. T. Holden, 58 Hemlock St., St. Thomas. Ont., Can.
Mark T. Cox, Star Route, Forest Grove, Ore.
Eastern State Normal School, Madison. So. Dak.
O. G. Messenger, 909 Leader Blvd., Cleveland, O.
J. S. Power, 1015 Hibbard St., Detroit, Mich.
Herbert S. Janďus, 2260 E. Grand Blvd., Detroit. Mich.
J. W. Crowe, 3868 Lusk St., Oakland, Calif.
H. G. Tighe. 527 3rd St., Havre, Mont.
L. Hansen. 811 Grove St., Aurora. Ill.
Peter Ambrose, 3900 "E" Sr., Detroit. Mich.
M. Godfrey Mattson, R.F.D. No. 1, Sanbornville. N. H.
Francis S. Miller, 123 N. Broad, Penns Grove. N. J.
John Rote, 513 E. 83rd St., New York. N. Y.
Alex G. Cupid. Box 7, Waverly. Mass.
G. E. Lusby, 214 Macon St., Brooklyn. N. Y.
Arthur N. Duckworth, 1 Summer Court, Westboro. Mass.
Ralph S. Mullen. P. O. Box 500, Elmira. N. Y.
Carl Anderson, 9 N. Harrison St., Batavia. Ill.
Jack Brown, 653 Montrose Ave., Morse Place P. O., Winnipeg, Man., Canada.

Blurbs Killing Radio Goose, Says Robinson

Washington.

In a recent oral statement concerning the growing influence of the tendency of advertising matter predominating in the matter broadcast over the radio, Federal Radio Commissioner Ira E. Robinson said that in his opinion the various stations are helping to slay the goose that laid the golden egg.

Commissioner Robinson cited the "rapidly growing sentiment" against the commercializing of radio transmission, which commercialization, he declares, is due to the greed of the broadcasters, who do not stop even at the injection of advertising matter on election returns broadcasts.

New Incorporations

World Radio Corp.—Atty. C. Planick, 19 Cedar St., New York, N. Y.
Kingdon Radio and Service Co.—Atty. F. E. Kohner, 42 Broadway, New York, N. Y.
Popular Radio Hits Corp., Wilmington, Del., music—Colonial Charter Co.
Benson Radio Shop—Atty. J. Leiman. 275 5th Ave., New York, N. Y.
Reilly & Rost, radio business—Atty. R. E. Camp, 32 Court St., Brooklyn, N. Y.
Radio Chamber of Commerce of the United States, Inc., Philadelphia, Pa., to operate broadcasting stations—Corp. Guarantee and Trust Co.
Transitone Automobile Radio Corp., Philadelphia, Pa., radio sets—U. S. Corp. Company.
Television, Inc., Wilmington, Del., patents—Corporation Trust Co.
Fulton Radio Corp.—Atty. J. Siegel, 11 West 42nd St., N. Y.
Durham & Co., Wilmington, Del., radio broadcasting—Corp. Trust Co.
Whitman Sound Corp., New York, N. Y., radio, motion picture instruments—U. S. Corporation Co.

Two Compete for Manchester Station

Washington.

The Federal Radio Commission has been petitioned by two of Manchester's most prominent citizens, Henry P. Rines and G. Colby Blackwell, in two separate applications for permission to erect transmitters within the City of Manchester, N. H. Mr. Blackwell, a former assistant secretary of the Commission, applied for permission to erect a 500-watt station, to use 1,430 kc on unlimited time, while Mayor Arthur E. Moreau, urged the granting of the application of Mr. Rines, president of the Rines Hotel Company, who is also president of the Congress Square Hotel Company that owns and operates WCSH, at Scarborough, Maine.

Mr. Rines stated that the engineering facilities of that station, would be available for the help of the personnel of the proposed station, in the event that the permit was granted. It was stressed that Manchester needs a radio station, as the Commission discontinued the operation of a station at Tilton, 38 miles distant, leaving the city without local radio service.

Marconi Experimenting With Radio Phone Link

Rome, Italy.

Senator Guglielmo Marconi and his laboratory-equipped yacht Elettra have again figured in the news. Since the recent fire, the yacht has been refitted and the important experiments have been in progress. This time it is the perfection of a radio-phone link by means of which the telephone systems of Rome and Cagliari are connected via the wireless stations at Fiumicino and Porto Aranci.

It is thus possible for a subscriber of either phone system to dial another party in the distant city, the impulses being transmitted by short waves. The speech communication however is transmitted through the medium of a carrier wave, on which is superimposed a sharply tuned modulation frequency, which it is said renders the conversation of two parties absolutely private, those with ordinary receiving sets being unable to tune in this intelligence.

10 Out of 26 Large Stations Lose Money

Washington.

Incidental to the hearings on applications of twenty-six petitioners for classification under the 50,000-watts maximum power there have been some other matters of interest brought to light by the tabulations noted on the applications. The high or rather consistent quality service radius was shown to be in the neighborhood of thirty-five miles, while the average maximum good reception radius did not exceed eighty-five miles.

The average monthly income was shown to be $23,500, and the average cost over the same period was $22,000. Paid programs averaged 30% of the total time, while free programs and music occupied the remaining 70%.

While the above figures would tend to show a healthy condition, ten of the stations had operating expenses in excess of income as high as $54,000, in one instance, for the fiscal year.

THE HOLIDAY GIFTS NUMBER — December 6th — next week—will contain a Constructional Article on a 3-tube short-wave converter with filament supply built in. Cost of parts, $12 or less. Read the details.

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RCA IN APPEAL FIGHTS WRIT ON TUBE CLAUSE 9

Washington.

Clause 9 is still before the courts. This is the clause the Radio Corporation of America inserted in contracts with set-manufacturing licensees, whereby RCA tubes had to be used for initial equipment of the receivers. The clause was withdrawn by RCA as one representing a doubtful commercial policy, but a suit started by the De Forest Radio Co. and others, to have RCA punished for monopoly, tsill is going on.

RCA filed briefs in the Circuit Court of Appeals, of the Third District, denying its formation of and sustainence of a monopoly on tubes.

Clause 9 Quoted

The plaintiff's allege that the licensing agreement of the defendant was monopolistic and confiscatory under the provisions of the Clayton Act. The challenged part (clause 9) of the license reads:

"The Radio Corporation hereby agrees to sell to the licensee and the licensee hereby agrees to purchase from the Radio Corporation the number, and only the number, of vacuum tubes to be used as parts of the circuits licensed hereunder and required to make initially operative the apparatus licensed under this agreement, such tubes to be sold by the Radio Corporation to the licensee at the terms and at the prices at which they are then being sold by the Radio Corporation to other manufacturers of radio sets buying in like quantities for the same purpose."

Manufacturing Ban Disclaimed

The District Court of Delaware granted a permanent injunction against RCA, which now contends in its brief on appeal that this clause does not violate the provisions of the act, and furthermore that RCA's interest is solely to the extent of protecting its customers who buy licensed sets to the extent of preventing the insertion of tubes that may be faulty in a set that would otherwise be operating normally, if the tubes were good.

Furthermore RCA contends that the question of the right to manufacture is not involved in the interpretation of the clause.

The affidavits of the complaining companies state otherwise, and declare that their business had been wiped out, and even the existence of the replacement market made impossible due to the enforcement of clause 9.

"Main Studio" Redefined

Washington.

The "main studio" has been defined by the Federal Radio Commission in General Order No. 98, superseding General Order No. 28, to be the studio from which the majority of the local programs originate and from which the majority of station announcements are made of programs originating at remote points.

A THOUGHT FOR THE WEEK

THE printing press started the first great movement for the wider education of the world's civilized millions. Radio is carrying on that magnificent undertaking to heights we know not of!

TRADIOGRAMS

An historical souvenir of the pioneer days of radio broadcasting and moving pictures, dedicated "to those inventors, artisans, engineers and scientists who through their development and use of the three-element vacuum tube, have made a distinct contribution to human progress," is announced by The Smedley Press, publishers, at 10 East 43rd Street, New York City. This souvenir of early radio days is to take the form of an author's limited edition of "The Life and Works of Dr. Lee de Forest, physicist, inventor and engineer," known as The Father of Radio Broadcasting. The author, a lifelong friend of the inventor, is C. S. Thompson, a former publicity director of the De Forest Radio Company. The edition will be offered for private subscription only. The publication price is $52.50 per copy.

* * *

The officials of the Dickel Distributing Company, New York distributors of Fada radio, entertained their North Philadelphia Dealers at a dinner at a hotel.

* * *

Max H. Krich, President of Radio Distributing Corporation of Newark, N. J., announced the inauguration of a campaign to contact the principals of schools in the Radisco territory, comprising Northern New Jersey, Northeastern Pennsylvania and Staten Island. Because of the special discount conceded the schools by RCA, Mr. Krich believes the 400 dealers in the Radisco organization should get this business. Mr. Krich plans to furnish authorized dealers with leads as to school executives who are in a receptive mood to arrange to make their schools a Christmas present of a Radiola Superheterodyne set.

* * *

Ernest Kauer and E. T. Maharin, president and vice-president, respectively, of the CeCo Manufacturing Co., passing through New York on their way home to Providence after a business trip to Eastern and Middle West cities, made this joint statement: "There is considerable activity in the trade. In sets, this is particularly noticeable in the case of midgets and Superheterodynes. The tube business is becoming exceedingly active again. Sales of new sets and replacements of tubes in presently-owned sets have caused sales to mount above expectations."

* * *

To provide entertainment on long trips, a Delco Automotive Radio has been installed in the de luxe motor coach, Bonne Entente II, owned by General Motors of Canada, Ltd., and used by company officials for making business tours.

* * *

In the design of the midget set in which a fewer number of tubes are used for reasons of compactness and cost, it is most essential that the screen-grid tubes provide as much voltage gain as possible, say DeForest engineers. They have developed a special screen-grid tube of much higher amplification constant than the usual screen-grid tube. Tubes of this new type have been checked in a number of midget sets, and it has been reported that the sensitivity of the average midget set can be doubled. If a set has a gain of 20 microvolts per meter, with the usual screen-grid tubes, the sensitivity may be increased to 10 microvolts per meter, it is said.

Station Proposed for Classroom Teaching

Atlanta, Georgia.

Apparently the idea of a suitably operating system of education via radio seems not an impossibility, and to lend a semblance of substance to the proposition we find a man who is willing to back up his conviction with money. The proposition is that there be established in the public schools of Atlanta, Georgia, a system of centralized teaching, the new proposed center in this case being a new radio transmitter, to operate on the 1,300 KC channel with 100 watts power.

The plan is now before the Federal Radio Commission, and according to the sponsor, A. L. Bellinger, the granting of the application will inaugurate a new era in teaching methods, and also will put the public school before the public where it belongs.

When not in use for its stated purpose it is planned to have the station used for the dissemination of light music for the benefit of the working people. The sponsors of the project are F. S. Holliday, J. C. Mahoney and Mr. Bellinger. Mr. Mahoney expects to finance the project.

The idea is to transmit programs directly to the classrooms, where there are now radio receivers installed. The plan was opposed by George W. Sutton, counsel for station WGST, in Atlanta, on the ground that the city is now well served.

High Power Protested By Smaller Stations

Fearing that the Federal Radio Commission will assign the cleared broadcasting channels to the so-called superpower station, to operate with an output of 50,000 watts or more, "independent" stations objected in a joint letter to the Commission. High power, it was said, strikes a blow at and destroys the usefulness of the units of lower power, which constitute nearly 600 stations, these comprising the "independents."

The letter protesting the division of broadcast station assignments was addressed to the Commission by Oswald F. Schuette, in the name of the Radio Protective Association, of which he is executive secretary. He said that it would be necessary to reallocate the 570 lower-power units to different frequency ranges, so that they would be receivable clearly. To carry out the present scheme of allocation of the high-power stations would seriously interfere with the operation of many stations over the entire country, Mr. Schuette wrote.

U. S. Files Briefs in Dubilier Case

Washington.

The Federal Government, represented by the Department of Justice, has filed briefs in its case against the Dubilier Condenser Corporation, and Lowell and Dunmore, in the District Court of the District of Delaware. The case involves the Government's claim of ownership to three patents, which, it asserts, were developed with its time and materials, by the defendants, while employed by the Bureau of Standards.

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Three-circuit tuner for .0005 mfd. Order Cat. 3-CT-5 @.......... .75
Antenna coil for .00035 mfd. Order Cat. ANT-3 @.......... .47
Three-circuit tuner for .00035 mfd. Order Cat. 3-CT-3 @.......... .79
Screen grid RF transformer, for .0005 mfd., to couple screen grid tube to next tube. Order Cat. SG-5 @.......... .45
Screen grid RF transformer, for .00035 mfd., to couple screen grid tube to next tube. Order Cat. SG-3 @.......... .47
AC electric motor and turntable, for playing phonograph records. A synchronous motor, 60 cycles; 80 turntable revolutions per minute. Order Cat. SYN-M @........ 4.45
A battery switch (Benjamin). Order Cat. A-SW @.......... .13
A eliminator or dynamic speaker transformer (Jefferson), 20-volt secondary. Will pass 2¼ amps. Order Cat. 20-V-T @.......... .49
30-henry shielded choke for B supply filtration or filtered speaker output. Will stand 100 ma. Order Cat. OS-30HS @.......... 1.65
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One 30 henry single choke, for 245 plate circuit (Cat. SC-OS) 1.75
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Three 1.0 mfd. high voltage condensers (Cat. HV-1) 3.60
Three 8 mfd. electrolytic condensers with brackets (Cat. EL-8) 3.60
Two 200-volt 1 mfd. condensers (Cat. POLY-1).... 1.00
Three 100,000 ohm plate resistors with mountings.. .60
Two 5.0 meg. and one 1.0 grid resistors with mountings .... .60
Two UX (four-prong) and two UX (five-prong) tube sockets .... .48
One speaker output assembly.......... .20
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Two binding posts: input (blank); ground + 45 (though voltage is 50), and + 180, 2½ v. AC (two) .50
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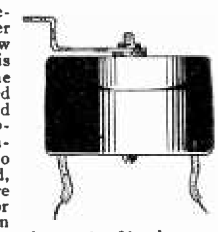

A 50-millihenry radio frequency choke coil, in a copper shield, with mounting screw and bracket attached. This choke is excellent for the plate lead of a detector, placed in series with the plate and the load impedance, for keeping RF out of the audio channel, broadcast receivers. Also excellent for RF plate lead, between the end of the plate load and B plus, and for screen grid leads, between screen grid and B plus, for thorough filtering and stabilizing. This choke will pass 25 ma. In all cases ground the shield. Order Cat. SH-RFC. List price, $1.00; your price.... **57c**

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WIRING AND ASSEMBLING MAN on radio sets desires prompt connection. Good character. Ben Schurman, 196 Bristol St., Brooklyn, N. Y.

EDITORIAL or CORRESPONDENCE position desired by woman experienced in newspaper Editorial and Radio Departments; also has had sales experience. Steady worker. Phone Havemeyer 8996-J.

Quick Action Classified Ads

Radio World's Speedy Medium for Enterprise and Sales

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NATIONAL MB29 TUNER, wired, walnut Bakelite panel. 4 screen grid tube shields. Twenty-five dollars. J. Mitchell, Box 311, Durham, N. C.

EQUIPMENT—MACHINERY OR TOOLS
BATTERY CHARGERS for Service Stations. Prices lowered. Direct from factory. Write for bulletin. 20 Adams—Barre, Columbus, Ohio.

MAJESTIC, RADIOLA, etc. Drum Dial Cable by foot or mile. Service men's test prods, 50c, 75c, $1.00. Blan, the Radio Man, Inc., 89 Cortlandt St., New York.

H.F.L. MASTERTONE. List $195. Sell $85. World's finest radio. W. J. Reed. Aurora. Ill.

MEN WANTED
Earn $22 to $30 a week while learning Electric and Acetylene Welding in all branches and $10 to $14 a day after short period of training. This is the best and fastest growing trade in America. Big demand for trained men. Learn this big pay trade in the finest equipped shops in America. Union card when finished. Act now! Write Mr. Flint, Superintendent of Shop.
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PERMACHARGE: New permanent battery charger for motor cars. Easily installed on any car. Will keep your battery up under all weather conditions by simply plugging into light socket. A real help to automobile radio. For particulars write. Permacharge, Inc., 4394 Pearl Road, Cleveland, Ohio.

GOOD VOLUME, 4 tube, loop Auto Radio blue print 50c; parts cost $12 complete. Write me. C. C. Burge (Radio Engineer). 301 E. Park Blvd., Villa Park, Ill.

NEW TUBES 50c, 226-227-224-245-280. For particulars write, R. B. Jolley, Valdosta, Georgia.

HORN UNIT, $2.25—This is the Fidelity Unit and has stood the test of time. Guaranty Radio Goods Co.. 143 W. 45th St.. New York.

"A B C OF TELEVISION" by Yates—A comprehensive book on the subject that is attracting attention of radioists and scientists all over the world. $3.00, postpaid. Radio World, 145 West 45th St., N. Y. City.

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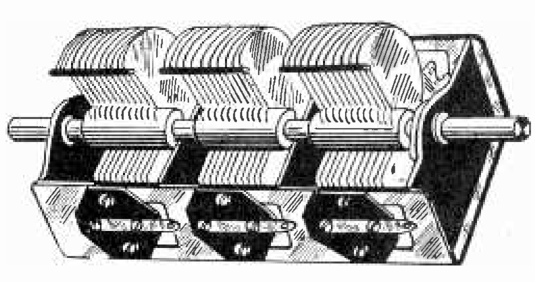
THREE-GANG SCOVILL .0005 MFD. WITH BRASS PLATES



One of the best three-gang condensers made. Plates, utterly rigid and expertly aligned, are of brass, the most expensive metal used for this purpose. Capacity of each section, .0005 mfd. Shaft, 3/8" diameter, of genuine steel, protrudes at both ends. For 1/4" diameter dial use an extension shaft (Cat. XS-4 @ 12c extra). Trimming condensers not built in, but mounting holes are provided for them. Condenser should be mounted on narrow side for drum dial operation. Rotor tension adjusters are built in. Frame is steel. Total shaft length overall 8 1/2", total frame width overall, 4 1/2". Order Cat. S-G @ **$3.20**

RELIABLE RADIO COMPANY
Room 504, at 1562 Broadway, N. Y. City
(Between 46th and 47th Streets)

Horn Unit $2.25

Fidelity Unit, Cat., FDU, price $2.25

The Fidelity unit is preeminent for horn type speakers such as exponential horns. The faintest word from a "whispering tenor" or the tumultuous shout of the crowd or highest crescendo of the band is brought out clearly, distinctly. Stands up to 450 volts without filtering. Works right out of your set's power tube, or tubes requiring no extra voltage source. Standard size nozzle and thread. Works great from AC set, battery set or any other set, push-pull or otherwise. The casing is full nickel finish, highest polish.

This unit can be used in a portable without any horn attached and will give loud reproduction.

Order Cat. FDU, with 50-inch tipped cord; weight, 2 1/4 lbs.; size, 2 3/4-inch diameter, 2 5/8-inch height. (This is the large size). Price........................... $2.25

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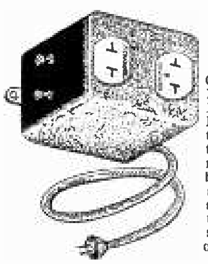
BRACH RELAY

ONLY 99c

List price, $4.50



Connect relay's cable plug to 105-125 volt AC line. Connect B eliminator cable plug to relay socket so marked; connect trickle or other charger's plug to relay socket so marked; connect one side of A battery to binding post, other side to A set. Then turning on your set twins on B eliminator and turns off charger, turning off set turns on charger and turns off B eliminator.

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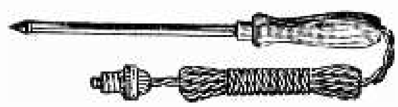
New York City—Just E. of B'way

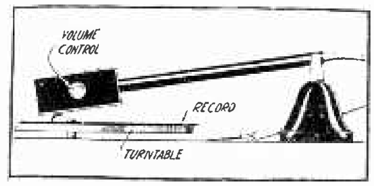
SOLDERING IRON FREE!



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

RADIO WORLD
145 West 45th St. N. Y. City

PHONOGRAPH PICK-UP $3.32



The famous Phono-link, made by Allen-Hough, enables playing phonograph records electrically, on your set. Volume control is built in.

Adapter, free with each order, enables immediate connection to your set. Instruction sheet enclosed. Order Cat. PHL @ $3.32.

RELIABLE RADIO COMPANY
Room 504, at 1562 Broadway, N. Y. City
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AMER-TRAN AUDIOS

First stage, de luxe (illustrated), primary, in detector circuit, has 200 henrys inductance at 1 ma; turns ratio, 1-to-3. Cat. DL-1, list price, $8.00 net $4.70.

Push-pull input transformer, turns ratio, 1-to-2 1/2; single primary; two separate windings for secondary; Cat. 151, list price, $12; net, $7.05.

[Remit with order and we pay transportation.]

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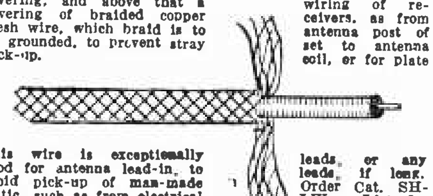
143 West 45th Street, New York, N. Y.

SHIELDED LEAD-IN WIRE

No. 18 solid wire, surrounded by a solid rubber insulation covering, and above that a covering of braided copper mesh wire, which braid is to be grounded, to prevent stray pick-up.



Also used to advantage in the wiring of receivers, as from antenna post of set to antenna coil, or for plate leads, or any leads, if long.

This wire is exceptionally good for antenna lead-in, to avoid pick-up of man-made static, such as from electrical machines.

Order Cat. SH-LW. List 9c, net, 5c per ft.

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143 West 45th St., New York, N. Y.

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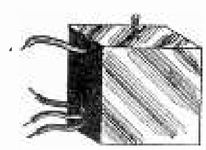
RADIO WORLD, 145 West 45th Street, New York, N. Y.

Three 0.1 mfd. in One Case



Cat. SUP-31

Three Supertone non-inductive fixed condensers of 0.1 mfd. each, (250 v.) in steel case, provided with a 6/32 mounting screw, built in. The black lead is common to the three condensers, the three red leads are the other sides of the respective capacities. Size, 1 1/2" square by 7/8" wide. Order Cat. SUP-31, list price, $1.00; net price, 57c.

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143 West 45th St., New York, N. Y.

Fixed Condensers

Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.0001 mfd.	10c	.006	20c
.00025 mfd.	10c	.00025 with clips.	20c
.0003 mfd.	10c	All are guaranteed	
.00035 mfd.	15c	electrically perfect and	
.001	17c	money back if not	
.0015	17c	satisfied within five	
.002	18c	days.	

Order Cat. MICON .0001 etc. at prices stated.

GUARANTY RADIO GOODS CO.
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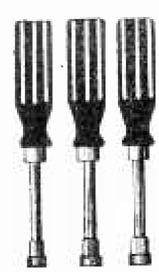
ERLA-DYNAMIC CHASSIS, WESTINGHOUSE RECTIFIER. Sensitive and efficient dynamic speaker chassis. List price, $25; our net price, $12.50. Guaranty Radio Goods Co., 143 W. 45th St., New York.

DOUBLE RANGE POTENTIOMETER; made by Centralab, designed for volume control. 10,000 and 20,000 ohms. Price, $1.05. Guaranty Radio Goods Co., 143 W. 45th St., New York.

Set of SOCKET WRENCHES *FREE*



FOR turning nuts down or up there is nothing as efficient and handy as a socket wrench. Here is a set of three wrenches for hexagonal nuts, enabling use with 5/32, 6/32, 8/32 and 10/32 nuts. Fit the nut into the proper socket and turn down or up. The three different size sockets, one size on each wrench, enables use of three different outside diameters of nuts, but at least ten different sizes of threads. Send $1.00 for eight weeks subscription for RADIO WORLD and get this set of three wrenches FREE!

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Enclosed $1.00 for 8 weeks. Send wrenches.

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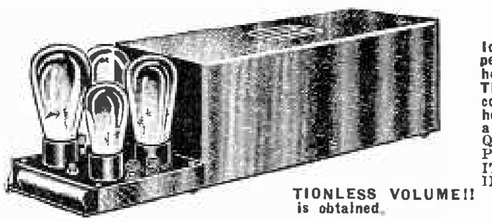
SILVER MARSHALL 250 Super Power Auditorium Amplifier



CONTAINS 2 STAGES SUPER POWER A. F. AMPLIFICATION

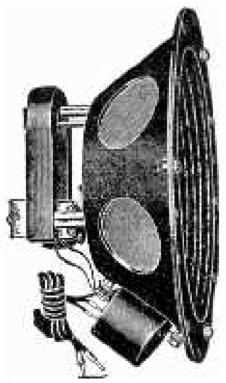
Ideal for theatres seating approximately 3,000 people, dance halls, schools lectures, hospitals, hotels, auditoriums, outdoor gatherings, etc., etc. The gigantic power is at all times within control—for that matter it can be used in any home, as the volume can be regulated down to a whisper! But most important of all, the QUALITY OF REPRODUCTION IS AS NEAR PERFECT AND LIFE-LIKE AS POSSIBLE! ITS POSSIBILITIES CAN BE SUMMED UP IN THREE WORDS: ABSOLUTELY DISTORTIONLESS VOLUME!! The full benefit of the 450 volts produced is obtained.

A PHONOGRAPH AMPLIFIER—PUBLIC ADDRESS AMPLIFIER SYSTEM—RADIO TUNER AMPLIFIER. When you remove it from its shipping crate, all you need do is to insert the necessary tubes. PLUG INTO ANY 60 CYCLE A.C. 110 VOLT ELECTRIC SOCKET and connect the input binding posts. Either a radio set tuner output, a phonograph pick-up, "phono-movie" or microphone arrangement can be easily adapted to this amplifier.

TUBES REQUIRED

Self-contained unit. Supplies all necessary A, B and C power to its own tubes. Operation requires one type X250 power tube, one X226 A.C. tube (permits amplifier to be in immediate operation not subject to a 7 to 30 second delay if a 227 were used!) and two type X281 rectifier tubes. Attractive crystalline finish metal cabinet. 21"x5¾x5½". Shpg. wt., 38 lbs. You can very easily obtain "B" plate voltages from this amplifier for the tubes in any tuner. Use a RELIABLE 2½ volt filament transformer to light the 2½ volt A.C. tubes in a Radio tuner, to which this amplifier will be coupled.

No. 438. FULLY GUARANTEED. Shipped in original cases. List $150.00. ($5.00 additional with FULLY GUARANTEED TUBES!) YOUR PRICE, without tubes........................ **$22.50**

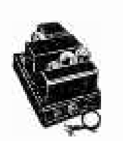


R-C-A Magnetic Speaker Chassis

This chassis is the identical one used in the RCA Model 100A and 100B and 103 Speakers, WHICH LIST FOR AS HIGH AS $30.00. Note built-in OUTPUT TRANSFORMER—permits use of 450 volts, without distortion, rattling or blasting. GENEROUS OVER-SIZED MAGNETS. The thick armature is ACCURATELY CENTERED. The STURDY METAL FRAME IS LINED WITH A SPECIAL SELF-BAFFLING FABRIC, greatly improving the acoustic properties of this sensational speaker! NOTE THE CORRUGATED SURFACE OF THE CONE, AN EXCLUSIVE FEATURE — ENHANCES PERFECT TONAL REPRODUCTION QUALITIES CONSIDERABLY. MOST COMPACTLY MADE: 9 INCHES OUTSIDE DIAMETER, 4½ INCHES DEEP OVERALL. IDEAL FOR AUTOMOBILE INSTALLATION! Shpg. wt., 4 lbs.

No. 410. YOUR PRICE.................... **$3.75**

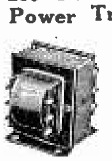
BOSWORTH 250 TWO-STAGE POWER AMPLIFIER



Connects to any radio-tuner output (detector plate lead), microphone or phonograph pick-up. Supplies 450 volts to 250 plate, "C" bias and filament voltage. Requires two 281 rectifiers, one 226 (permits instantaneous use) and one 250. Produces auditorium volume—no blasting—no distortion. Ideal for home installation. 11" long, 10½" deep, 6" high. Output characteristics suited for any dynamic speaker. For 110-120 volt, 50-60 cycle A.C.

$17.87

250 Push-Pull A.C. Power Transformer



Furnishes filament voltage for 3 to 5 227 or 224 tubes, two 281, and two 250's, and 1300 volts high voltage! An excellent A.C. transformer for transmitters or power packs, for the finest power amplifiers! For 110-120 volts 50-60 cycle A. C. Shpg. wt., 15 lbs.

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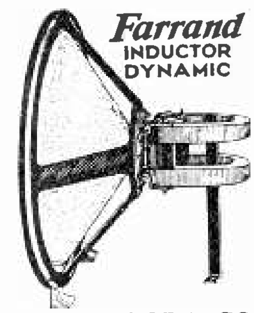

The inductor dynamic offers high sensitivity and true tonal response. It requires no exciting field current, unlike other dynamics. Order model R for 112 or 112A, and Model G for all other output tubes.

Cat. 9-G (9" extreme outside diameter) $8.49

Cat. 9-R $8.49

Cat. 12-G (12" extreme outside diameter) $10.03

Cat. 12-R $10.03

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Hammarlund SFL

Hammarlund's precision .0005 mfd. condenser, with removable shaft; single hole panel mount. Excellent for calibrated radio frequency oscillators, short-wave converters and adapters and TRF or Superheterodyne broadcast receivers. Lowest loss construction; rigidity; Hammarlund's perfection throughout.

Order Cat. HAM-SFL, list price $5.50; net price..........$3.00

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Nine out of every ten people suffer more or less after eating. They believe they have indigestion. If the truth were known, they are suffering from excess acid. There is one way to get quick relief and that is to stabilize or correct the acid condition. A teaspoonful of NaDox in water taken after meals usually gives immediate relief. NaDox contains one of the greatest starch digestives in the world, and is prescribed by leading physicians. Acidity, indigestion, sour stomach, heartburn and sick headache generally relieved at once by taking NaDox.

A full size box of NaDox will be mailed to you, all charges paid, upon receipt of seventy-five cents.

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- ☐ $1.50 for three months, 13 issues.
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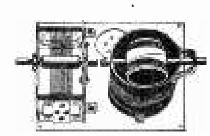
TUNER ASSEMBLIES



A tuning condenser with coil to match, mounted on an aluminum base that has socket built in. The condenser shaft goes in a dial (not furnished). The tuned circuit includes a fixed and a movable winding (rotor coil) in series. The moving coil is used as a trimmer, set once and left thus, so two separate dials are made to read alike, or gang tuning is made pactical. No equalizing condensers needed. Do not couple the adjoining shafts.

For antenna circuit, input to 226, 201A, UX199, 240, 230, 232 and 222, or an other tube fitting four-prong UX socket, or for interstage coupling for 226, 201A, 199, 240 or 230, but NOT interstage for 232 or 222, order cat. BT-L-DC .... @ $1.25

For interstage coupling for 232 and 222, order cat. BT-R-DC .... @ $1.25

For antenna circuit as RF input to 224 or 227, or for 227 interstage coupling, (five-prong UY socket furnished) order cat. BT-L-AC .... @ $1.25

For interstage coupling for 224 (5-prong UY socket furnished, order cat. BT-R-AC .... @ $1.25

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

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If the expiration date line on your wrapper indicates that your subscription has expired or is about to expire, please send in renewal so that you will not miss any copies of the paper. Subscription Dept., Radio World, 145 W. 45th St., N. Y.

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