NOV. 1
1930

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449th Consecutive Issue—NINTH YEAR

6-Tube Compact AC Set

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Battery Short-Wave Converter

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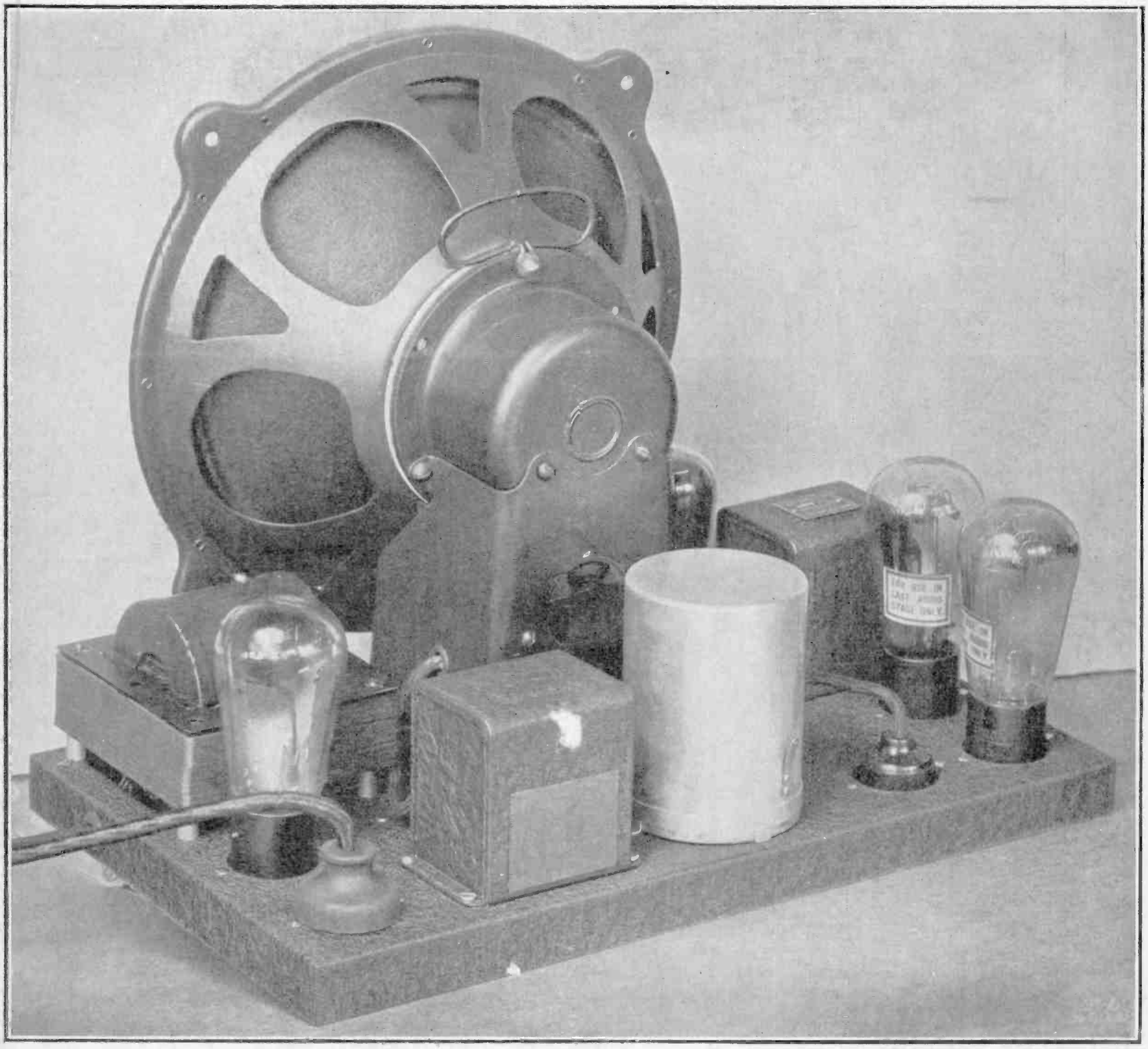
How to Improve Your Aerial



Space is gained by building a speaker-power amplifier combination. See page 7

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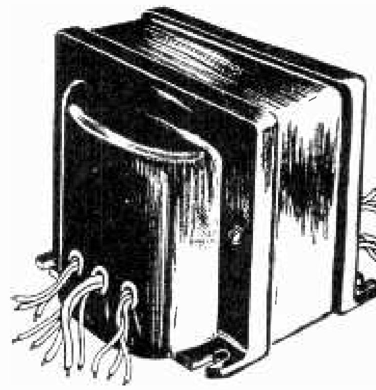
NEW POLO

POWER EQUIPMENT
in Polished Aluminum Shield Cases



245 POWER TRANSFORMER

The 245 power transformer is for use with a 280 rectifier tube, to deliver 300 volts DC at 100 milliamperes, slightly higher voltage at lower drain, from a 110-volt AC line, 50-60 cycles. The primary is tapped at 82½ volts in case a voltage regulator (Clarostat or Amperite) is used. The black primary lead is common. If no voltage regulator is used the other primary lead is the green one, so tape the end of the red. If regulator is used, tape the end of the green and use the red with the black. The secondary voltages are all center tapped: 672 volts AC for 280 plates, 2½ v. 3 amps. for 245 output single or push-pull; 5 v. 2 amps. for 280 filament; 2½ volts 16 amps. for up to eight 224 or 227 tubes. Center taps are red and all leads are identified on name plate. The core is larger than formerly and won't saturate at 100 ma. Laminations hidden except at bottom. Eight-inch leads emerge from the sides, but if preferred may be taken off through the bottom of the transformer by pushing them through the rubber grommets. Shipping weight, 12 lbs. Overall size, 5" from left to right as illustrated; 4¼ from bulging bell end to other bell end; 4¼" high.
Order Cat. 245-PT (12 lbs.) @............$ 9.50

245 CHOKE COIL

100 ma choke coil for B filtration in 245 push-pull or single 245 circuits, 200 ohms DC resistance, inductance 30 henrys, a continuous winding tapped in two places, giving three sections and four outleads, and permitting a "choke input" to filter. By this method rectifier tube life and filter condenser life are lengthened yet filtration is splendid. The black lead goes to the rectifier filament center, the red, green and yellow leads are next in order. Capacities suggested: black, none; red, 1 mfd.; green, 8 mfd.; yellow, 8 mfd. In shielded polished aluminum case. Shipping weight, 4 lbs. Order Cat. 245-CH @ $4.00.

SPECIAL FILAMENT TRANSFORMER

A special filament transformer, 110 v., 50-60 cycles, with two secondaries, one of 2½ v. 3 amp. for 245s, single or push-pull, other 2½ v. 12 amperes for up to six 224, 227, etc., both secondaries center-tapped. Shielded case. 6 ft. AC cable, with plug. Shipping weight, 4 lbs.
Order Cat. SP-FLT (4 lbs.) @............$4.25
For 40 cycles, Cat. SP-FLT-40 (5 lbs.) @ 5.00
For 25 cycles, Cat. SP-LT-25 (6½ lbs.) @ 6.00

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☐ 226	1.75	49c	☐ 200A	4.00	59c	☐ 280	1.90	59c
☐ 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	59c
☐ 120	3.00	59c	☐ 112A	2.25	59c	☐ 281	7.25	95c
☐ WD-11	3.00	59c	☐ 227	2.20	59c	☐ 210	9.00	95c

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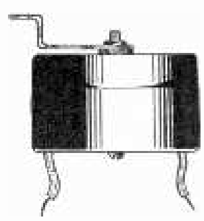
RF Choke in Copper Shield



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 rgid 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**

For short waves, an unshielded RF choke, 10 millihenrys, with mounting bracket. Order Cat. SW-CH, list price 80c; your price.... **47c**

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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.

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

Order Cat. FDU, with 50-inch tipped cord; weight, 2½ lbs.; size, 2¾-inch diameter, 2⅝-inch height. (This is the large size). Price.............................. $2.25

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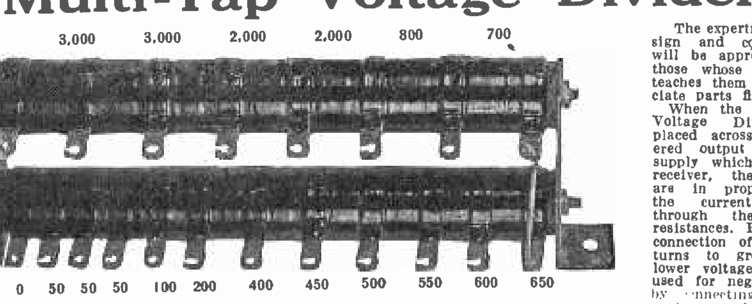
Multi-Tap Voltage Divider



The resistance values between the twenty taps of the new Multi-Tap Voltage Divider are given above. The total is 17,100 ohms and affords nineteen different voltages.

The Multi-Tap Voltage Divider is useful in all circuits, including push-pull and single-sided ones, in which the current rating of 100 milliamperes is not seriously exceeded and the maximum voltage is not more than 400 volts. Higher voltages may be used at lesser drain. Conservative rating, 40 watts.

The expertness of design and construction will be appreciated by those whose knowledge teaches them to appreciate parts finely made.

When the Multi-Tap Voltage Divider is placed across the filtered output of a B supply which serves a receiver, the voltages are in proportion to the current flowing through the various resistances. By making connection of grid returns to ground, the lower voltages may be used for negative bias by connecting filament center, or, in 227 and 224 tubes, cathode to a higher voltage.

If push-pull is used, the current in the biasing section is almost doubled, so the midtap of the power tubes' filament winding would go to a lug about half way down on the lower bank.

Order Cat. MTVD, list price $6.50, net price.. **$3.25**

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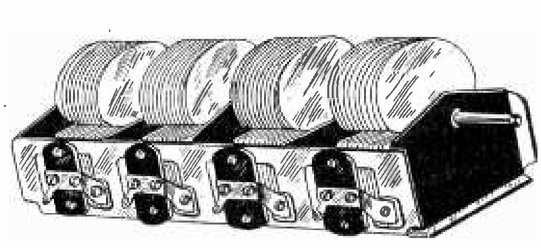

This condenser, each of four sections .00035 mfd., has aluminum plates that are removable and adjustable, also a ¼" diameter steel shaft that is removable. It is sturdy and is suitable for popular four-circuit screen grdi tuners. Trimming condensers are built in. The condenser may be mounted on its bottom 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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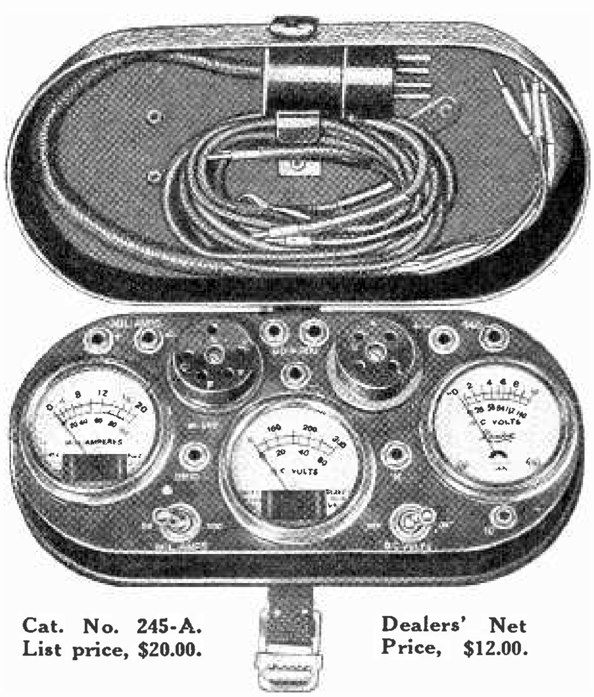
ANNOUNCING NEW READRITE METERS *for* SERVICING

No. 245-A SET AND TUBE TESTER



Cat. No. 245-A. List price, $20.00.

Dealers' Net Price, $12.00.

The 1931 model set and tube tester, No. 245-A, affords still greater adaptability for servicing every kind of radio receiving set. Incorporated in this new model are the new D.C. instruments with their exposed solenoids on finely made bakelite frames. An achievement in fixed coil instruments. Rugged for hard field use, yet especially sensitive and accurate.

Thousands of service men use only the No. 245-A Tester for all their outside work. The most compact three-meter tester made. Tests all circuits and tubes direct from the set socket. Both plates of rectifier tubes are tested without adapters or special switches. Simple to use. Dependable. Supremely practical. Beautiful baked enamel finished seamless steel case. Complete with cords, cable and full illustrated instructions, including resistance, capacity and set analysis charts.

The Readrite big line includes D.C. and A.C. Panel, Portable, and Pocket Type Ammeters, Milliammeters, Voltmeters and Voltammeters, Voltage Regulators, Ohmmeters, Test Kits, Resistors and Adapters.

Good jobbers have them in every section. If yours doesn't, send us your inquiries. Use the attached coupon or your letterhead.

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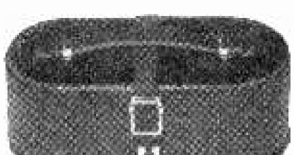

No. 245-A Closed. The most compact three-meter Set Tester.

No. 500 Ohmmeter. O-10,000 ohms. O-4.5 volts. Self-Contained. Direct Reading. List price, $6.00; dealers' net price, $3.60.

No. 400 Counter Tube Tester. Two Plate current readings by grid shift method. Simple. Complete. Beautiful finish. Attaches direct to A.C. Line. List price, $20.00; dealers' net price, $12.00.

No. 501 Resistance Meter. O-10,000 ohms. List price, $2.50; dealers' net price, $1.50.

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- ☐ No. 503 Resistor (list, $1.50; net, 90c.). Increases No. 500 to 60,000 ohms when using 22½ v. battery.
- ☐ No. 501 Resistance meter O-10,000 ohm
- ☐ Send free catalog
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.00015 mfd. tuning condenser for short waves. Order Cat. SWC-15 @........ .60

.00025 mfd. tuning condenser for regeneration in short-wave circuits. Order Cat. SWC-25 @ .... .60

Flexible insulated coupler for uniting coil or condenser shafts of ¼ inch diameter. Provides option of insulated circuits on both sides. Order Cat. FL-C @............ .26

Brach relay, for making the switch in a set with battery-operated filaments turn on the trickle charger when set is turned off, and turn charger off when set is turned on; also will make set switch turn B eliminator off when set is turned off. Order Cat. BR-REL @........ .99

Antenna coil for .0005 mfd. Order Cat. ANT-5 @........ .45

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

60-henry shielded center-tapped choke (30 each side of center) for B supply filtration or filtered output of push-pull tubes. Will stand 100 ma. Order Cat. OS-60HCT @........ 1.95

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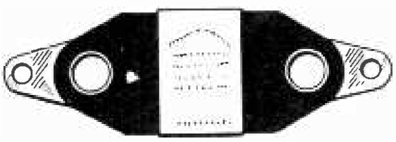

Dubilier Micon fixed condensers, type 642, are available at following capacities and prices:

.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.

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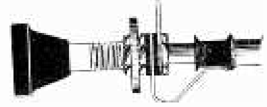
"A" BATTERY SWITCH



A push-pull switch for battery-operated sets. Made by Benjamin. Firm, sure contact, extremely long life. Special price, only......13c

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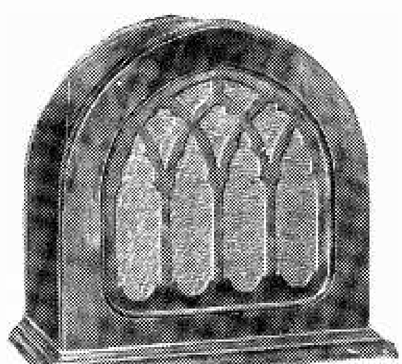

Magnetic speaker in genuine, beautiful walnut cabinet. Order Cat. AN-G at $3.95.

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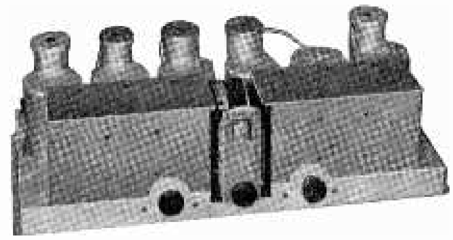
Parts for the Best Circuits



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 pre-selector 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

WIRED MODEL, Cat. MB-30-W, list price $95 less tubes; net price........$54.86

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, less 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

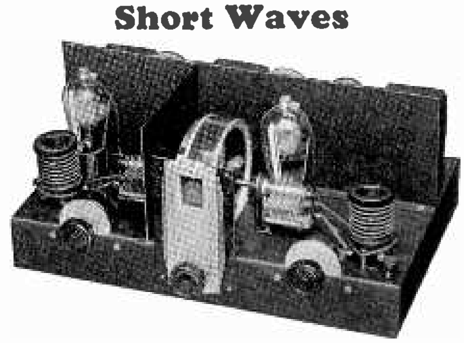
HI-Q AC TUNER WITH POWER SUPPLY (less audio)—Order Cat. AC-31-TPS, list price $148.55, less tubes; net price........$82.78

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 TUNER—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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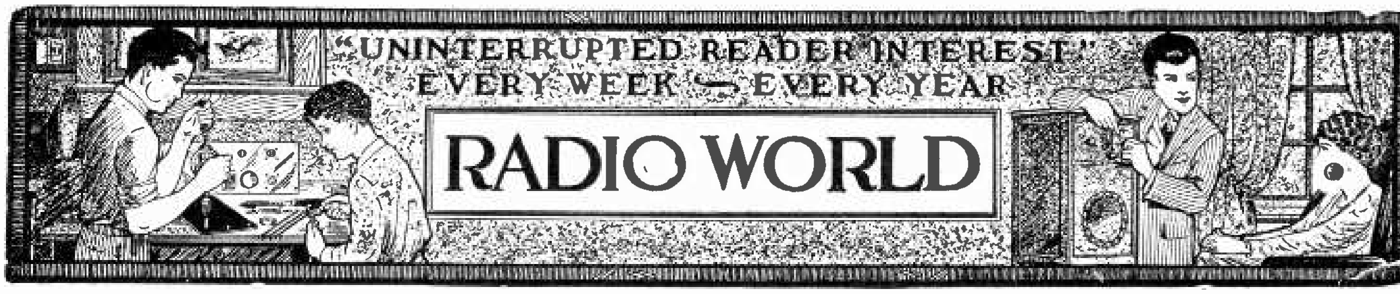

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Build a Power Amplifier

By Einar Andrews

WHO does not want to own a first-rate audio frequency amplifier and power supply? Everybody who has a radio receiver or who plans to get one demands quality first, and there is no other way of getting the best quality than to have an audio amplifier capable of turning it out.

There are many reasons why a separate first-rate audio amplifier should be used, that is, one that is not an integral part of the radio receiver. There are countless persons who have radio frequency tuners and amplifiers which they have built, either from the ground up or from kits, or who have radio receivers the audio quality of which is not satisfactory, or who desire to play phonograph records electrically, or who want to play talkie records at home, or who want to make phonograph records at home. All these need a really good audio frequency amplifier capable of first-class quality and a great deal of undistorted power output.

There is no reason now why every one should not have such an amplifier because the parts may be had for a price that is within the reach of all.

Design of Audio Amplifier

How should such an amplifier be constituted? What are the necessary parts and the design? What power supply is adequate, not only to power the amplifier but also the radio frequency amplifier and the detector? Questions like these are asked daily, and in this article we shall endeavor to answer some of them and in the process describe an audio frequency amplifier and a power supply.

When considering the design of an audio frequency amplifier the proper course is to start with the loudspeaker and proceed back to the output of the detector or other source of audio frequency signal. We have to consider the design in this direction rather than in the reverse because every part of the amplifier depends on the output desired. Once we have decided what the amplifier is expected to do we have to go back and see that it does it in the best possible way without overloading at any point. And when the design of the amplifier has been decided we have to consider the power supply and to make sure that that also is adequate to meet the demands of it.

It is scarcely necessary to call attention to the fact that a dynamic type loudspeaker should be used. While there are other types of speakers which can handle the signal intensity now demanded, they are not so easily obtainable as suitable dynamic speakers.

But how much maximum undistorted output is necessary? In respect to bare necessity not much is needed, and perhaps a single power tube of the 120 type, or of the new 231 type, would meet the requirements, for such a tube would make enough noise, properly fed from a preceding amplifier, to make the loudspeaker heard entirely too well by the neighbors of the owner of the receiver.

Reserve is Needed

But such a tube would not have enough reserve to handle exceptional demands, such as those required for a dance, or for recording phonograph music, or to handle the low bass notes of certain instruments. Moreover, if the neighbor is to hear the set, which he will most of the time, is he to speak derogatorily of the quality or is he to praise it, even though it may be too loud at times to please him? There is nothing more exasperating than the knowledge that the set will break into a raucous noise whenever a loud, bass sound is played, when it should carry the low notes without a sign of distortion.

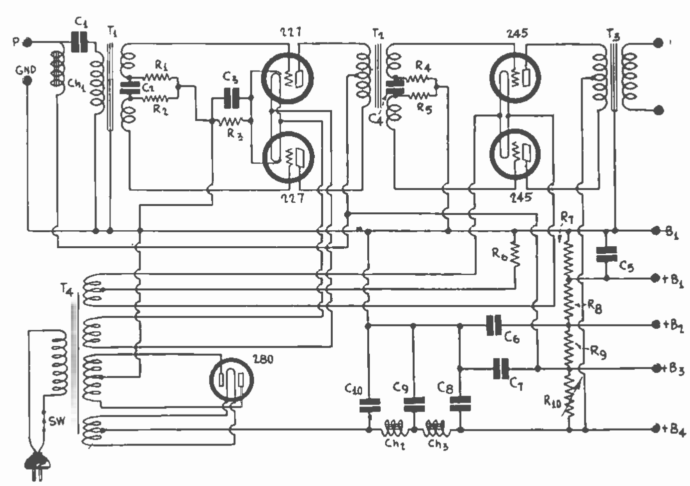

FIG. 1.

DIAGRAM OF A DOUBLE PUSH-PULL POWER AMPLIFIER, USING 245 OUTPUT.

The vote for plenty of reserve is unanimous, even though the reserve be not drawn from more than once a year.

Of course, it is quite easy to go to extremes in the matter of providing a reserve of power, and it would seem that the choice of two 250 tubes in the final stage, with maximum plate and grid voltages, is extreme, if the set is to be used for home entertainment. Nobody would tolerate the maximum sound that such an amplifier could throw out. Even one half of the maximum would be much too great. Therefore we would choose smaller tubes in the output stage.

A sensible compromise is to choose a pair of 245 power tubes

LIST OF PARTS

Ch1—One Polo center-tapped choke CT-CH (total winding used).
Ch2, Ch3—Two Polo 245-CH chokes.
T1—One Amertran push-pull input transformer.
T2—One Amertran push-pull interstage transformer.
T3—One Amertran push-pull output transformer.
T4—One Polo 245-PT transformer (for 60 cycles).
C1, C2, C3 (optional), C4—Four 2mfd. condensers, 200 volts' test or higher.
C5, C6, C7—Three 1 mfd. condensers, 200 volt test or higher.
C8, C9—Two 8 mfd. electrolytic condensers.
C10—One Flechtheim 2 mfd. 1,000 volt condenser.
R1, R2, R4, R5—Four 50,000 ohm Lynch resistors.
R3—One 1,000 ohm resistor.
R6—One 750 ohm resistor, 10-watt capacity.
R7, R8—Two 4,500 ohm resistors in voltage divider.
R9—One 3,000 ohm resistor in voltage divider.
R10—One adjustable 5,000 ohm resistor.
Two UY sockets.
Three UX sockets.
Nine binding posts.

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Double Push-Pull AF

in push-pull. They are capable of delivering a maximum undistorted output which is greater than is desirable for home entertainment, but it does not cost a fortune to build the necessary equipment for such tubes nor to maintain them in operation. We can operate them with moderate and comfortable volume with the assurance that in case of exceptional demand they have the reserve power.

Voltage Requirements

These tubes require a plate voltage of 250 volts and a grid voltage of 50 volts, a total of 300 volts, which must be delivered by the power supply. When these voltages are applied, the maximum undistorted power of two of these tubes in push-pull may be put, conservatively, at 3.2 watts. But to deliver this power the signal voltage must be 50 volts, peak value, on the grid of each tube; that is, a total of 100 volts, peak value.

What type of amplifier should be put ahead of the power stage to deliver this voltage without any appreciable distortion? A single 227 will hardly do it and therefore we decide on two of these tubes in push-pull. Certainly two of them will handle the signal. Each of these tubes will then be called on to maintain only 50 volts, peak value, under the most severe conditions.

If we assume that the step-up ratio of the interstage transformer is one-to-three, the signal voltage across each half of the transformer, T2 in Fig. 1, will be only about 17 volts. This will be accounted for if we make the grid bias on the 227 tubes not less than 3.2 volts, provided that the plate voltage is high enough. To be on the safe side let us make the applied plate voltage on these tubes 180 volts and the grid bias 13.5 volts. It would seem that if 3.2 volts are just enough to insure sufficient undistorted input to the power stage, that the 13.5 volts would be excessive, but that is not so, for with the high plate voltage and the appropriate grid bias there will be much less distortion in the signal.

Input to First Push-pull Stage

The point is that we need only 3.2 volts signal input to each of the 227 tubes in the first stage, or 6.4 volts to the amplifier. Now, again, if the step-up ratio of the entire transformer, T1, is one-to-three, we will need a signal voltage of a little more than 2 volts across the primary. This can be supplied by any high-level detector or phonograph pick-up unit, but it may overload the ordinary grid leak and condenser type detector. However, our margins of safety throughout have been such that even this type of detector will work satisfactorily with the amplifier.

We use push-pull in both stages because we want to avoid harmonic distortion as much as possible.

Refinements of Circuit

The input to the amplifier contains a filter consisting of a choke, Ch1, and a condenser, C1, the object of which is to keep the direct current component of the plate current out of the primary of the transformer. This permits the use of the highest quality transformer without any danger of saturating the core. The capacity of the condenser should be not smaller than 2 mfd. and the inductance of the choke not less than 30 henries. This filter is not needed when the input to the amplifier is taken from a phonograph pick-up unit, but there is no reason why it should not be used with this as well as with a detector tube.

The input terminals P and Gnd should be connected to the plate and ground of the radio frequency amplifier, respectively, assuming that B minus in the set is grounded, and they should also be used for the pick-up unit. Usually it does not matter which way the pick-up unit is connected, unless one of the leads is grounded, in which case that lead, of course, should be connected to Gnd.

In the grid circuits of each stage is a resistance-capacity filter consisting of two resistances and one condenser. The value of each resistor may be 50,000 ohms, although as low as 20,000 ohms may be used if desired, and the capacity of each condenser 2 mfd. The values of the resistances are not at all critical but each of a pair should be as nearly equal as possible. That is, R1 should be equal to R2 and R3 should be equal to R4. The reasons for the use of these filters is entirely practical. They effect a marked improvement in the quality.

Grid Bias Resistances

R3 is a resistor of 1,000 ohms and is used to bias the grids of the first tubes. C3, the condenser across it, is not absolutely essential, but if used should have a capacity of 2 mfd. R6 is the bias resistor for the 245 tubes and should have a resistance of 750 ohms. It is not by-passed.

The interstage transformer T2 has two equal secondary windings and one center-tapped primary. No filter arrangement is used in the primary circuit, because the plate current has no tendency to saturate the core, due to the balanced arrangement. The same applies to the output transformer T3.

The power supply contains a power transformer, T4, containing four center-tapped windings, two 2.5-volt windings, one 5-volt winding, and one high voltage winding. The rectifier tube is a 280, which has a current capacity considerably in excess of the demand of the audio frequency amplifier. The filter is a typical two-choke arrangement with suitable by-pass condensers.

The Power Supply

Binding posts are provided for different output voltages for the radio frequency amplifier. No definite values can be assigned to the resistance in the voltage divider, since it is not known what currents will be drawn from the various taps. However, if B1 be used for the screen voltage of 224 tubes, we may assume that the current in this tap is negligible and we can assign values to most of the resistances.

Let us assume that the voltage at B1 is to be 67.5 volts and that the bleeder current in R7 is 15 milliamperes. This fixes R7 at 4,500 ohms. If the voltage at B2 is to be 135 volts, the drop in R8 should be 67.5 volts, and since the current in tap B1 is negligible, the value of R8 should also be 4,500 ohms. The current to tap B2 is unknown, but if the radio frequency amplifier contains all 224 and a power detector, there will be no current, for there is no plate circuit connected to 135 volts. Also, if the plate return of a resistance coupled amplifier or a detector is connected to B2, the current may be neglected, for it will be so small that it will not affect the voltage distribution much.

Adjustable Resistor Used

If the voltage at B3 is to be 180 volts, the drop in R9 will be 45 volts and the current will be 15 milliamperes. Therefore R9 should have a value of 3,000 ohms. Most current will be drawn from B3. The 227 tubes in the audio amplifier alone will take 12 milliamperes, and if three 224 tubes are connected to this tap in addition, there will be another 12 milliamperes. Hence the total current through R10 will be 39 milliamperes. The voltage difference between B3 and B4 is 120 volts, and therefore the value of R10 should be about 3,000 ohms. Since the current and the voltage may vary, the resistance is made adjustable to permit adjustment in any case until the voltage at B3 is 180 volts. In case no current is tapped from B3 for the radio frequency amplifier, R10 should have a value of nearly 4,500 ohms.

If additional current is drawn from tap B4, the voltage distribution in the voltage divider does not change, except in so far as the total voltage changes due to resistance in the tube and the chokes. This variation is small as long as the total current drawn from the power supply does not exceed the rated value and it cannot be avoided. However, it is another reason for making R10 adjustable so that the voltages at the lower taps may be kept at the desired values.

Blind Boy Winner

Frank Anthony O'Neill, a 21-year-old blind baritone of Merced, Calif., won the Merced district audition in the Atwater Kent Foundation test.

He earned the right to represent California in the District Audition to be held on November 17th over KPO, in which winners from nine Western states will compete for the honor of going to New York for the finals, scheduled for December 15th.

More Talks from Stations

The trend of many broadcasting stations from "jazz" to informative and instructive talks by prominent officials and experts on a variety of subjects is a move toward "one of the most important uses to which broadcasting can dedicate itself," declares Federal Radio Commissioner Harold A. Lafount.

New Station Licenses

The following applications were granted by the Federal Radio Commission:

WSAN, Allentown Call Pub. Co., Inc., Allentown, Pa., license on 1,440 kc., 250 watts, shares with WCBA.

KFEQ, Scroggin & Co., Bank, St. Joseph, Mo., license 680 kc., 2½ kw. power, 6 a. m. to local sunset.

KGHL, Northwestern Auto Supply Co., near Billings, Mont., license 950 kc., 1 kw., unlimited time.

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Speaker-Amplifier Unit

By Haddon Hastings

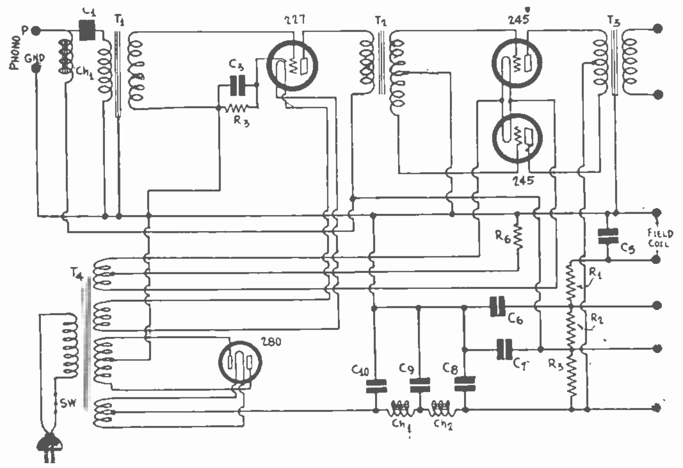

FIG. 1
A CIRCUIT OF THIS TYPE CAN BE BUILT COMPACTLY ON THE BASEBOARD ON WHICH THE DYNAMIC LOUDSPEAKER IS MOUNTED SO AS TO CONSERVE SPACE IN THE CONSOLE.

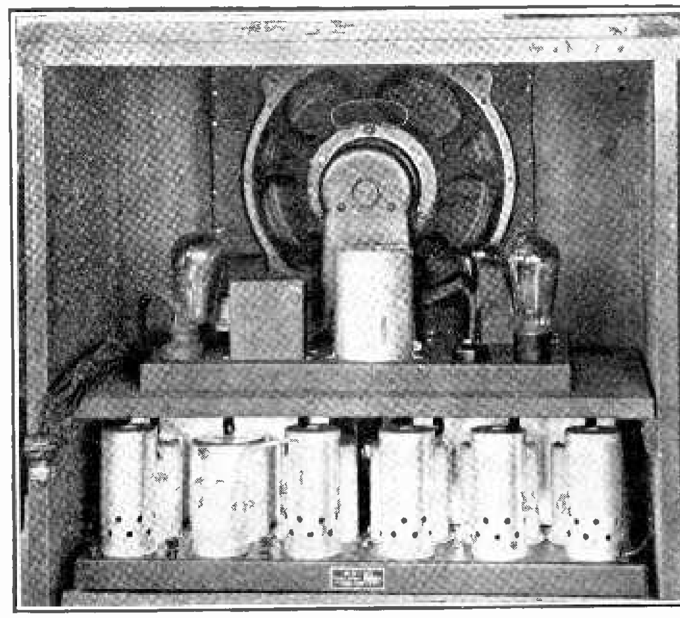

FIG. 2
THE POWER AMPLIFIER WITH SPEAKER ATTACHED WORKS WELL INTO THE SCHEME OF HAVING A SEPARATE TUNER. THE MB-30, ONE OF THE MOST SENSITIVE TUNERS EVER DEVELOPED FOR BROADCAST USE, IS ILLUSTRATED.

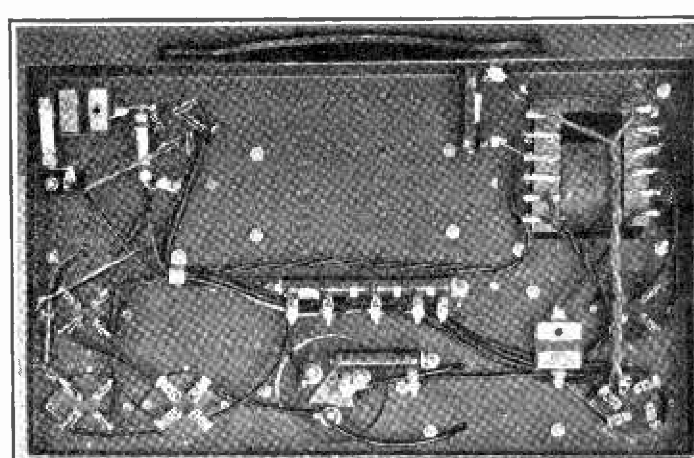

FIG. 3
UNDERNEATH VIEW OF THE WIRING OF NATIONAL COMPANY'S NEW PUSH-PULL POWER AMPLIFIER WITH SPEAKER ATTACHED. THE SPEAKER IS SHIPPED SEPARATELY FITS INTO THE ALLOTTED SPACE.

WHERE to put the power amplifier and the power supply in a console that has already been filled with the tuner, radio frequency amplifier, and the loudspeaker is often a problem. Of course, this problem never arises when the receiver is complete, for it has already been solved by the designing engineers. But it does arise when the fan assembles his own outfit. He may buy a first rate tuner and radio frequency amplifier and finds that this part takes up an entire shelf in the console which he has or which he prefers to use. Then he may have his heart set on a particular loudspeaker of generous proportions. If this speaker is to do justice to the receiver it should be placed in a favored location in the console, and as a rule it takes up one of the shelves in the console, usually the lower one.

In most consoles there are only two shelves, and these two have already been used, so where are we to put the power amplifier and the power supply? There is really no reason why the loudspeaker should monopolize one of the shelves, for there will be much room around it, on the side and at the back.

Speaker and Power Supply on One Base

If a baseboard large enough just to fit the shelf occupied by the loudspeaker be obtained, it is possible to mount the speaker thereon in the appropriate central position and leave enough room for both the audio frequency amplifier and the power supply. Since audio frequencies are involved, it is not necessary to lay out the circuit so that the leads are the shortest possible, as in the case of an RF amplifier, because there will be little feedback and if there is any it is permissible to shield certain vital leads. However, this should not be necessary if proper by-pass condensers and filters are used in the circuit.

An advantage of this contribution is the compactness it permits. The loudspeaker is near the amplifier so that long cables are unnecessary. For example, the output transformer may be mounted within a few inches of the loudspeaker input terminals. Also, the power supply is within easy reach so that the leads from the voltage divider to the amplifier need not be more than a few inches. If the field current for the speaker is taken from the power supply an additional advantage is gained in the same way.

Suitable Circuit

The diagram in Fig. 1 is a circuit of a power amplifier and power supply suitable for such an arrangement. There are four tubes in this circuit, one of which is the rectifier, and there are four transformers, one of which is the power transformer T4. The only other bulky parts, aside from the loudspeaker, are the two choke coils Ch1 and Ch2. In laying out the baseboard, first mount the loudspeaker and then select the most suitable places for the other parts. Before mounting any of the parts permanently, other than the speaker, move them around a bit with the idea of finding the most suitable arrangement. It should be remembered that there is no best arrangement, although some arrangements may result in shorter grid leads and others may result in better appearance.

One would naturally place the output transformer so that it is near the input terminals of the loudspeaker, but it may be that this transformer is an integral part of the speaker, when it is not necessary to worry about its placement. Also, one would naturally place the input transformer T1 so that the input terminals are easily accessible from the front. This is important because it is very inconvenient to have to turn the console around every time the leads are to be reached for connecting the phonograph pick-up or for any other reason.

Field Coil Connection

The field coil for the dynamic speaker in this case is connected in series with the voltage divider and forms a part of it. Thus the bleeder current is put to good use. In order to get the proper voltage across the terminals of the field coil it is necessary to adjust the resistances R1, R2 and R3 to the proper values. These values depend entirely on the design of the field coil and cannot be given even approximately. However, when the field is connected as in the drawing a high resistance field must be used, one wound for a voltage of the order of 90 volts. One wound for a voltage of 6 volts cannot be connected in that manner and in fact cannot be energized from a power supply of this type.

The speaker-amplifier unit illustrated herewith and on the front cover is the new National Velvetone, made by National Company, of Malden, Mass. The diagram shown is symbolic of such designs, but is nct exactly the same as the one National Company uses.

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The Supertone

By Roger

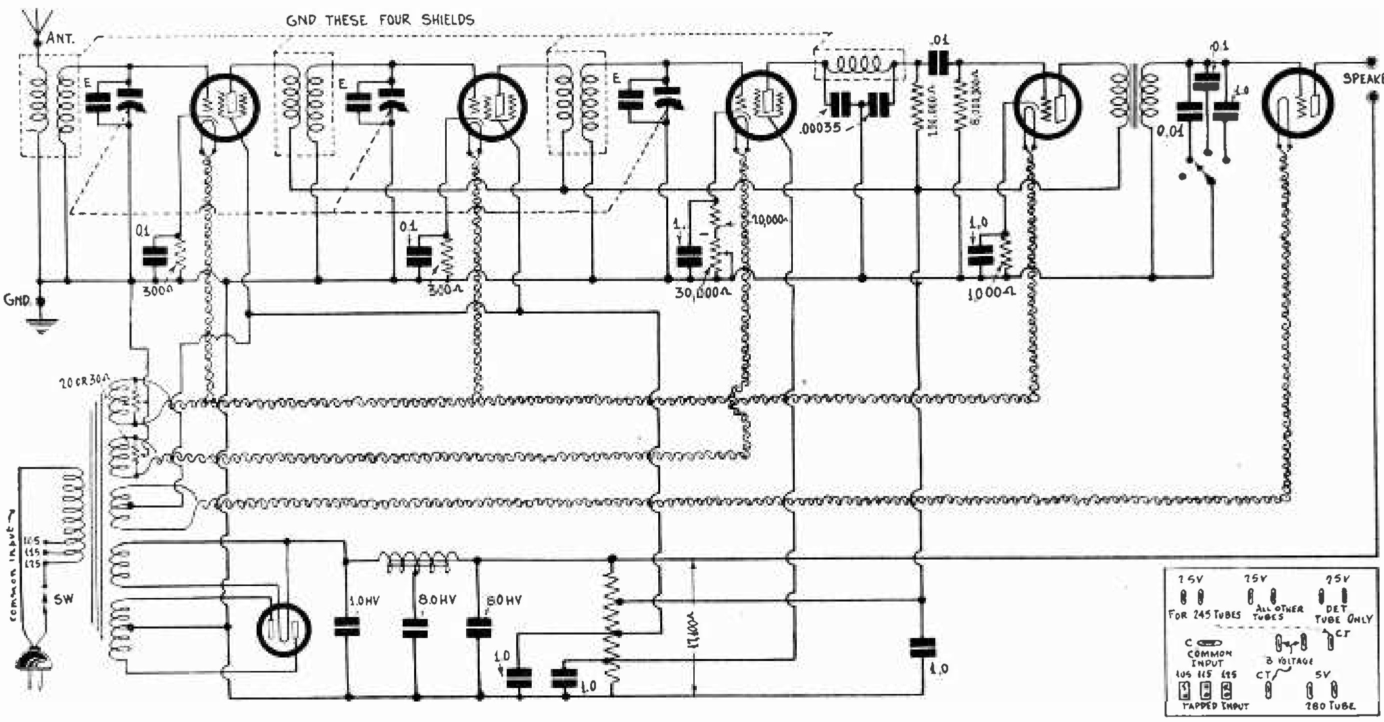

FIG. 1
CIRCUIT DIAGRAM OF A COMPACT RECEIVER, BUILT ON A CHASSIS 11½ INCHES SQUARE. A TONE CONTROL IS INCLUDED, ALSO A SCREEN GRID DETECTOR. THE POWER TRANSFORMER LUGS ARE IDENTIFIED AT LOWER RIGHT

AMERICA has become miniature-minded, judging by the midget, junior, tot, dwarf, lilliputian, mantel clock and consolette receivers, as well as by the miniature golf courses. Perhaps after a person finishes eighteen miniature holes he feels like tuning in eighteen stations on a miniature receiver.

The mantel clock type of set blossomed forth in California last year, achieved considerable popularity, and the gentle winds of that fair part of the country wafted the popularity eastward, until now the East is busier than the West on this project, and no radio dealer's store window can be passed without the danger of one being tempted by a miniature receiver on display.

The next step has been a floor model receiver, one that fits into a consolette or smoking stand or disguised table. The reason for the floor model is that it permits making a somewhat better receiver because there is more space, for the mantel clock type imposes heavy restrictions that call for sacrifices otherwise avoided.

Design of a Good Receiver

Fig. 1 shows the design of a good receiver, to fit in a space 11½ x 11½ inches, which isn't quite small enough for a mantel clock type cabinet where speaker has to be included inside, but which works into the consolette or smoking stand idea perfectly, and, by the way, fits into any regular console you may have.

It is by no means a compromise receiver, but gives splendid results, and is selective enough for most needs, indeed, surpasses the selectivity of most three-tuned circuit receivers, for reasons which will be explained.

The receiver, called the Supertone Compact, can be fitted into a most inexpensive smoking stand, using the front elevation of the stand as a panel, while under the set compartment is a platform recessed for a small loudspeaker which you supply.

The main parts are laid out on top of the chassis, as shown in Fig. 2. The shields are not permitted to enclose the coils completely, but are elevated on bushings to escape total shielding, because the circuit then remains stable without sacrificing too much gain, which sacrifice would take place if total shielding were used in a three-tuned circuit. The same action in reducing the damping effect improves the selectivity over what it would be with totally-shielded coils in a three-tuned circuit. Where more stages are used, of course, total shielding is required.

Detector Plate Load Considered

Two stages of screen grid radio frequency amplification provide good gain, while the screen grid detector gives as much pep as would a transformer in this position were a general purpose tube used. The plate load must be high to make this possible and a resistor of 250,000 ohms is recommended, although 100,000 ohms may be used with less resultant volume. Much more than 250,000 ohms would hardly be suitable, as high-note suppression would become serious, due to the heightened input capacity (grid to cathode), the increased plate capacity (plate to cathode) and the greater relative effect of the grid-to-plate capacity in the tube, due to the larger amplification.

The voltage steadily applied to the screens of the two radio frequency amplifiers is 50 volts, which is enough under the circumstances of elevated shields. This same voltage may be used, therefore, to bias the 245 output tube, since the negative

LIST OF PARTS

Three shielded RF coils (Cat. 40-80 for .00035 mfd; Cat. 40-70 for .0005 mfd.)
One three-gang condenser, preferably .0005 mfd.
One extension shaft for condenser.
Two Electrad 300-ohm flexible biasing resistors.
Two Electrad 300-ohm flexible grid bias resistors.
One Supertone condenser block, 0.1, 0.1 and 0.1 mfd.
Five 1 mfd. condensers, 200-volt type.
One 1 mfd. high-voltage type (Flechtheim Cat. HV-1).
Two 8 mfd. electrolytic condensers.
Four UY and two UX sockets.
Two binding posts (Ant., Gnd.)
One speaker output assembly post.
One 20,000 ohm biasing resistor cartridge, with mounting.
One 30,000-ohm wire-wound potentiometer with AC switch attached.
Two 20 or 30-ohm potentiometers.
One 1,000 ohm wire-wound biasing resistor.
One audio frequency transformer 1-to-3 or 1-to-5 ratio.
Two 0.01 mfd. condenser.
One RF shielded choke, 50 millihenries.
Two .00035 mfd. fixed condensers.
One 0.25 meg. resistor cartridge (250,000 ohms).
One 5.0 meg. grid leak (5,000,000 ohms).
One 4-point switch.
One multi-tap voltage voltage divider, 17,100 ohms total.
One Supertone shielded power transformer, with lugs at bottom (tapped for 105, 115 and 125 v AC).
One Supertone shielded double choke.
Three screen grid clips.
One vernier dial, 1-to-5 ratio, with 2½ volt AC pilot light.
Two knobs (for tone control and volume control-switch).
One chassis, 11½ x 11½ x 2½" to fit in smoking stand cabinet.
One smoking stand cabinet.

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Compact Six

Brierly

bias requirement is 50 volts. To accomplish this double purpose, then, connect the center of the 245 filament winding to B plus 50. Since the grid return of the power tube stage is made to ground through the secondary of the audio transformer, the grid return is 50 volts negative in respect to the filament.

Detector Bias Varied for Volume Control

Volume control is effected by means of varying the bias on the detector tube within bounds restricted to good detection throughout. Notice that the screen grid voltage, which is critical usually in screen grid detectors, is less than the screen voltage on the radio frequency amplifiers. A voltage of 22 volts or less is recommended, but you have your choice of voltages from the multi-tap voltage divider. It is not necessary to use any meter to select the most appropriate voltage for this screen. Connect to a tap lower than the positive 50-volt tap, leaving the soldering to be done when you have the receiver finished, and can select the voltage for most sensitivity. Turn the volume control until full resistance is in circuit, that is, its 30,000 ohms as well as the 20,000-ohm cartridge, when selecting the voltage for the screen. You will get good results on any tap below 50 volts, but the desire is to obtain best results, and this is usually at from 16 to 22 volts, for 3 volts negative bias and 180 plate volts.

The first audio stage, using a 227, feeds the power tube through a transformer, which may be of 1-to-3 or 1-to-5 ratio, or any ratio between. The higher the ratio, the greater the volume, usually, except for very skinny primaries, where the ratio is built up by robbing the primary instead of paying the secondary.

Tone Control Analyzed

The tone quality is fine up to the audio transformer, and what transformer you select will determine the ultimate tone, with tone control at off position, and with the usual reservation that speaker characteristics be at least fairly indiscriminate. The vacant tap of the tone control switch represents the "off" position, for "natural" response, all other positions of all tone controls account for various degrees and types of distortion, some of which distortion is wholly agreeable. as when the highs are cut off in dance music or crowd cheers.

The cut-off of the highs is enormous when 1 mfd. is introduced, but many like this effect, although volume suffers somewhat when such a high capacity is across the line. Those desiring less extreme cutoff of the high audio frequencies may use 0.5 mfd., which can be improvised by connecting two 1 mfd. condensers in series. Suit your own tastes as to this extreme effect on the highs.

The output carries only 32 milliamperes of plate current. You may feed a dynamic speaker, which will have output transformer built in, or you may connect a magnetic speaker directly into this circuit. The magnetic speakers, including the inductor, of the last few years will stand the 32 milliamperes.

Extra Good Filtration

The whole receiver draws 65 milliamperes or a little less, but despite this modest drain the filtration in the B supply is as if intended to work a 150-milliampere supply. First, the 30-henry B choke is husky, with a large core and large-diameter wire (Np. 38), and the capacities used are 1 mfd. (paper dielectric) next to the rectifier, to keep the voltage up; 8 mfd. and 8 mfd. respectively at the midsection and reservoir positions, these two being electrolytics. The condensers marked HV are for high voltage use, as distinguished from all other condensers in the receiver, which need be of only 200 volt DC rating. The paper condenser will stand 500 volts DC, as will the electrolytics recommended.

The filter capacities are placed inside the chassis, instead of on top, and so are the bypass capacities. The volume control and the tone control switch are mounted in holes provided in the front elevation of the chassis. The total height inside the smoking stand cabinet with which it is primarily intended this receiver shall be used is 8½ inches. Thus there is enough room, and some to spare, with a subpanel elevation of 2¼ inches.

Key to Power Transformer Connections

Taps on the power transformer primary make possible the adjustment to usual line conditions in the locality in which the receiver is to be used.

The key to the power transformer connections is shown as part of Fig. 1. Note that a separate winding is used to heat the detector. If a pilot light is used, as recommended, it should be connected across the winding that supplies the heaters of the screen grid tubes and the first audio amplifier.

The tubes required are: three 224, one 227, one 245 and one 280.

All parts for the receivers, less tubes, should not cost you more than $30 net, and possibly you have some parts around the house that you can press into service for this outfit. A walnut finish smoking stand cabinet, once highly popular at around $30 list, should be obtainable for not more than $7, due to decline in popularity of this adjunct of the furniture business which radio is now resurrecting.

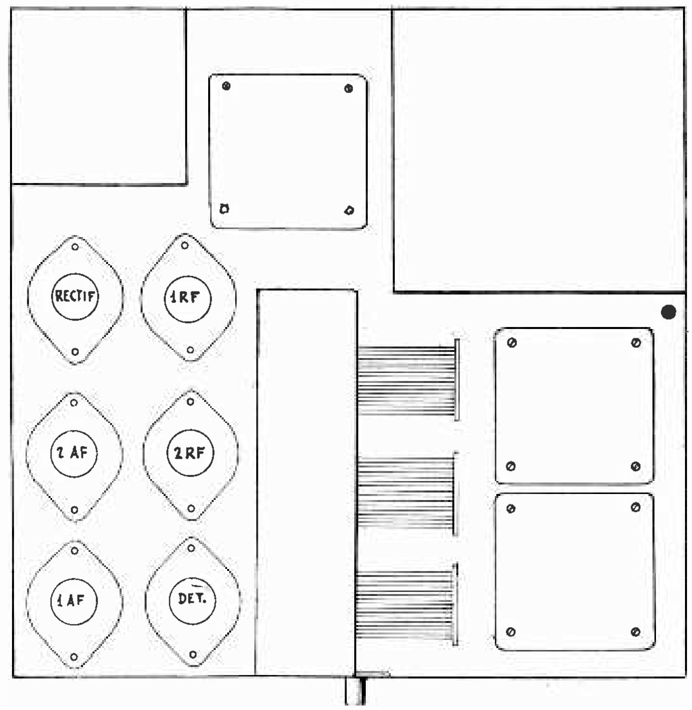

FIG. 2
LAYOUT OF PARTS OF THE COMPACT SIX DIAGRAMMED IN FIG. 1.

If you want to reduce the cost of the total parts by home-made contributions of time, you may wind your own coils, using 1¾-inch diameter bakelite tubing at about 20c each, and putting on the secondaries, 70 turns of any size wire you have handy, from No. 30 to No. 24, for .0005 mfd., and 80 turns for .00035 mfd., although it is recommended that .0005 mfd. be used for assurance of wave band coverage. All the primaries may have 40 turns of whatever wire is at hand, wound over the center of the secondary, separated therefrom by Empire cloth or wrapping paper. You will have to provide the shields or buy them at a quarter each. Use aluminum if you can't get copper. Don't use tin or iron.

Reason for High Impedance Aerial Coil

It is true that 45 turns constitute a large primary in the antenna circuit, but that merely means the aerial does not need to be so long, and also simplifies the gang tuning by making the secondary inductances more readily equal. The presence of a large primary on the other coils, which size is necessary for proper plate impedance, causes the inductance of the secondary to be less than what it would be were the primary absent. This is a reflection loss. If the antenna winding has a skinny primary then the secondary of that coil is not subject to the reflection loss, except to a slight extent, and the number of turns on the secondary would have to be less, and someone would have to ascertain how much less. The better way, because of good results more readily obtained, is to make all primaries alike and use a shorter aerial. Indeed, the whole idea of miniature sets, consolettes and smoking stand installations is to achieve compactness at low cost, so why not a compact aerial, say, only a wire around the molding, or under the carpet, with a good ground carefully provided?

Oscillator Phasing

When a Superheterdyne fails to work, or when any regenerative receiver fails to regenerate, one of the first things that enters the mind of the fan is that the windings of the tickler and the grid coil may not be phased right for regeneration. There is a very simple test for determining whether the connections are right provided that the leads and the wires on the coils are visible. Suppose the coil is a single layer solenoid with the tickler and grid windings on the same form, and both wound in the same direction, that is, so that the two windings could be produced by cutting single winding. If the two extreme leads run to the grid and plate of the same tube, then the phasing is right if the other grid coil terminal runs to cathode and the other plate coil terminal runs to the B battery.

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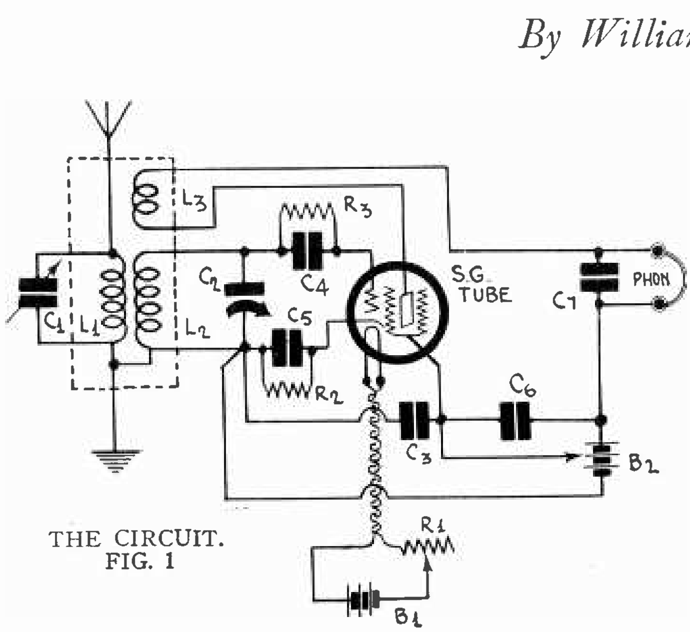
All Waves on One Tube

By William C. Johnson



THE CIRCUIT.
FIG. 1

SELECTIVITY is difficult to acquire in one tuned stage Also those fans who read up on the subject of radio know that the order of tuning in multitube sets that have three stages of tuned RF is a geometrical progression, which interpreted in practical terms means that the various stages of the radio frequency amplifier looking from the detector stage to the input RF terminals have progressively less practical selectivity.

It must be remembered though that the present argument concerns only the arrangement of one RF stage. The properties of a single stage must be so coordinated that the selectivity of one coupler provides the operative condition that was an attribute of the multitube set. We are therefore going to resort to a kind of fixed inductive tuning, in part, by furnishing a special type of winding on a standard coil form. The coils thus made will be intended to cover only a limited portion of the broadcast wave band, but each coil will be so designed that it will do its assigned job well, and will be found to be a pleasing contrast to compromise designs.

What About the Necessity of Shielding?

The diagram furnished herewith shows a dotted line around the coils and it denotes that shielding is used.

When the operator of a single-tube set complains of non-selectivity it is in all probability thought that the side noises and admixture of voices and general acoustic bedlam that accompany all efforts to tune in when the local stations are on the air, are a fault of the set.

True of the prevailing conditions in metropolitan areas, it is untrue of rural areas, hence prospective constructors who live in rural districts need not use shielding.

Those living in the area where interference is present, however, will have to consider the use of shielding, and in addition the fact that the inductive loss from this treatment of the circuit must be kept as low as possible, hence the overall dimensions of the shield will be relatively large as compared to what is prevalent in modern multitube sets.

Also, if shielding is used, the best plan is to enclose the working parts entirely, permitting only the two condenser shafts, and the volume control shaft to protrude.

Constants Given

C_1 is a .00035 mfd. variable condenser actuated by the right-hand dial, Fig. 1, and is of the modified tuning characteristic. Type C_2 is the main tuning condenser, and is .0005 mfd. straight-line frequency type variable condenser which tunes secondary coil L_2. C_1 tunes L_1, the antenna-ground series inductance forming an adjustably tuned filter. The left-hand dial operates C_2, and the coil design is such that the dialing of the two condensers is similar. The variation between the two is never more than plus or minus three dial dial divisions over the kilocycle response range of the particular coil used.

C_5 and R_2 are .01 mfd. and 300 ohms respectively, while C_4 and R_o are .00025 mfd. and 2 megohms respectively. C_3 is 1 mfd. C_6 may be from 0.1 to 1.0 mfd., and C_7 .0015 mfd.

This set is strictly a one-tube affair. Novel features are that it is fairly selective.

Pointers on Top View

The top view of the chassis presents a wiring feature that may be new to some fans, namely, that heavy gauge copper wire is used to form the radio frequency circuits, and the underneath view shows how the wires are to be arranged, especially the heavy ones. No acid content soldering paste is to be used.

The two panels are the same size, 7x12 inches, and either 3/16 or 1/4 inch thick.

The shaft holes are drilled 2½ inches in from each side, or they are 3½ inches to centers, which makes them 7 inches apart.

Mounting Details

The two condensers are provided with mounting holes which are so placed that 6/32 screws an inch long afford a simple and permanent fastening, and the necessary holes for the screws are easily laid out. The National VBD dials have a drilling template which shows what sized drills to use, and the shaft of the .00035 mfd. condenser requires a shaft extender which is furnished.

Leak-Condenser Mounting

The coil socket mounting holes are drilled on a line parallel to the rear edge of the subpanel, and 2½ inches from it, and are 4 5/16 inches apart, the right-hand one being 1 11/16 from the right-hand edge. The coil socket is blocked up from the panel surface ¼ inch, and six lead holes are drilled directly under the terminals for the tickler, F, P, G and B.

The screen grid tube is mounted at the left-hand of the subpanel, and the socket center is exactly 2 inches from the left-hand edge of the panel, with the grid terminal hole drilled right on the aforementioned line. The socket assembly is mounted below the subpanel, and the tube prong holes are to be drilled, using the socket assembly as the template.

The grid-leak and condenser assembly is to be mounted just 1¼ inches from the grid terminal, but underneath the subpanel.

The wiring of all the RF circuits is done with No. 12 B&S gauge bare copper wire, and the runs between the various points that you see in the picture where the heavy wire is not used are made with No. 18 rubber covered chassis wire, stranded or solid. The inside view shows a potentiometer that is not depicted on the wiring schematic, as for battery-operated sets, it is not imperative, but may be used on B power supplies or eliminators.

The view of the inside with the coil not plugged in is for the express purpose of showing the heavy bare copper lead wire that runs to the .0005 mfd. condensers and it is also stressed that the same sized wire runs from the terminals of coil L_1 to condenser C_1, making a parallel circuit.

Broadcast Coil

For those who will want to build up the circuit to the point that it will be ready for the coils whose data will appear later, the turns and wire size for a good broadcast coil are, on the basis of a 2¾ inch diameter tubing of bakelite three inches long, 58 turns of No. 22 single cotton covered copper wire, cemented with liquid collodion, and the primary coil is wound on a 1¾ inch piece of tubing of the same length, using 30 turns of No. 24 single cotton covered magnet wire, also cemented in place with liquid collodion, both coils are wound in the same direction, and so connected as to oscillate.

The constructor may devise his own method of keeping the primary coil concentric with the secondary.

[*Concluded next week*]

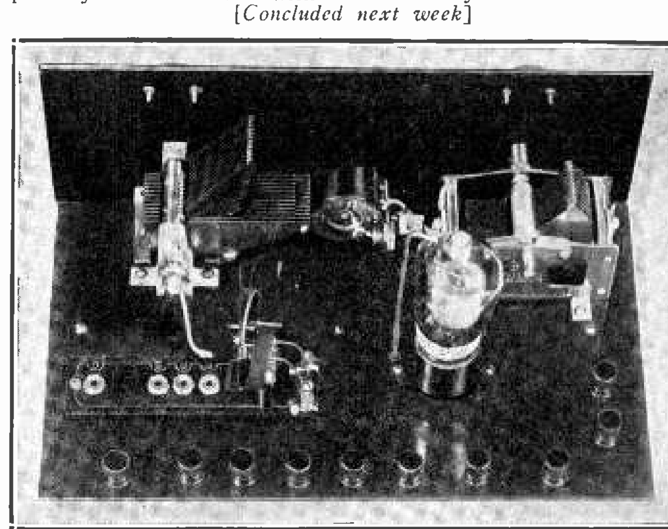


FIG. 2
THE REAR VIEW OF THE ONE-TUBE RECEIVER THAT BRINGS IN BOTH BROADCAST WAVES AND SHORT WAVES. ON THE SHORT WAVES PRACTICAL SELECTIVITY IS GOOD. ON BROADCAST WAVES IT IS ONLY FAIR.

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A Battery SW Converter

By Herman Bernard

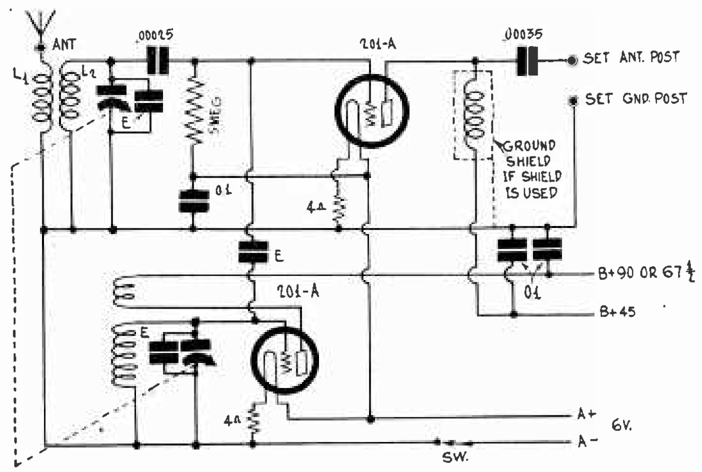

FIG. 1
A BATTERY-OPERATED SHORT-WAVE CONVERTER.

A BATTERY-OPERATED short-wave converter is even easier to make than the AC model described last week in the October 25th issue. The design used is along the same line exactly, only such modifications being introduced as are required for battery operation. These are omission of the filament transformer, inclusion of the filament resistors, change in the grid return of the modulator, substitution of 201A tubes for 227 tubes and split-up of B voltages. Fig. 1 embodies the design of the battery circuit for bringing in short waves on any receiver.

45 for Detector, 67½ or 90 volts for Oscillator

It is true that the AC model can be used on any receiver, whether the receiver is battery-operated or AC-operated, or of any other type, but you would have to use AC for the filament transformer, and perhaps there is no AC in your home. To those who must rely on batteries, the design in Fig. 1 should be attractive, as this is indeed the simplest two-tuned short-wave converter it is possible to build, and it does work.

The fact that battery operation is stressed this week permits the easy use, if desired, of different plate voltages for the detector and the oscillator. The usual recommendation for grid leak detection is 45 volts on the plate, and just this voltage is obtainable from the B batteries. If a higher voltage is desired for the oscillator, and it is recommended that 67½ or 90 volts be used for this purpose, either of these higher voltages likewise is directly obtainable from the B batteries. So it is very easy indeed.

The same dimensional factors apply, and these were given last week.

The coils are the same as for the other model. On a diameter of about 2¾ inches you may wind three turns for the secondary and five turns for the primary, spacing the two about ½ inch from each other. If air dielectric forms are used, as in the commercial model precision short-wave coils that worked the laboratory model, bring out the grid and grid return leads to the extreme posts on the coil base, and in one case the primary and in the other the tickler to the two inside terminals on this base.

Watch Oscillator Connections

The oscillator coil is wound just like the antenna coil. However, here you have to watch the connections for the oscillator coil alone. Connected one way you won't get oscillation, while connected the other way you will. Assuming winding of the oscillator coil in the same direction, put and regarding only the wire wound on the coil, connect the adjoining terminals of the secondary and tickler windings to B plus and ground respectively, the other ends to plate and grid, and you will get oscillation.

With .0005 mfd. Hammarlund straight frequency line condensers you need only two coils for each tuned circuit. The two coils for one range have been discussed. The others would require 17 turns on the secondary, 10 turns on the tickler, spaced about ⅜ to ½ inch from each other. This refers to the distance between the two coils. If oscillation fails, reverse connections to either the secondary or the tickler, but not to both. The antenna coil would be the same as the oscillator coil, but with the second oscillator coil the same polarity observations apply, while the polarity of the antenna coil in either instance is unimportant.

Use No. 24 silk insulated wire for antenna-ground and on tickler, and either that or No. 22 or 20 for the tuned circuit.

Avoids Broadcast Pickup

To reduce or prevent pickup of broadcasting stations, a shielded wire lead, about 5 feet long, may be used, as was explained last week. Fig. 2 shows how this single unit used both for the connection to ground of the receiver and for making the input to the receiver from the output of the converter. The shield wire reduces sensitivity a little in this particular instance.

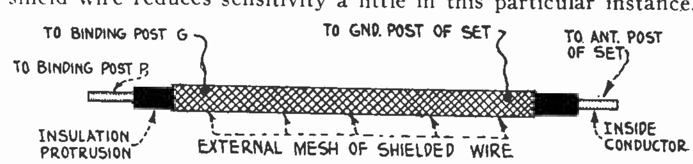

FIG. 2
CHANGING THE INTERMEDIATE FREQUENCY BY TURNING THE DIAL OF THE RECEIVER MAY CAUSE BROADCAST CARRIERS TO GO THROUGH THE RECEIVER. SHIELDED WIRE CONNECTION FROM SET TO CONVERTER AVOIDS THIS, AT THE EXPENSE OF SOME REDUCTION IN SENSITIVITY.

LIST OF PARTS

Two sets of Precision Short-Wave coils wound on air dielectric forms, two coils to a set; total number of coils, four
Three binding posts
One .00025 mfd. fixed condenser with clips
One .00035 mfd. Dubilier Micon fixed condenser
Three 0.1 Supertone fixed condensers in one case
Three Hammarlund equalizers, 100 mmfd.
One two-gang .0003 mfd. condenser
Two 4-ohm filament resistors (201A) with mountings
One shielded radio frequency choke, 50 millihenries
One 2 to 5 meg. grid leak, with mounting
One wooden cabinet, walnut finish
One National VBD velvet vernier dial with 6-volt pilot lamp and bracket
One Benjamin "A" battery switch
One 7x14-inch bakelite panel, with two UX (four-prong) tube sockets and two coil receptacles built in; drilled for National VBD dial, for switch, for trimmer and for the binding posts
One bakelite bushing to mount modulator trimmer, and one shaft to engage trimmer.
Two ¼ inch knobs

Right or Wrong?

QUESTIONS

(1)—If the electrical amplification in a receiver is the same for all frequencies in the audio range and if the loudspeaker is well damped, the quality of the output will be excellent because a damped speaker will not introduce distortion by resonance.

(2)—If there is much damping in the tuned circuits of a radio frequency amplifier, there will be very little sideband cutting.

(3)—Air is disobedient of the rule that degrees compressions are equal to the degrees of measure, although the deviation does not amount to much.

ANSWERS

(1)—Right. If the amplification is satisfactory in a circuit the only source of serious distortion is in the loudspeaker, mainly due to resonance effects at certain frequencies. If the speaker diaphragm is well damped appreciable resonance cannot occur. Of course, if the diaphragm is strongly damped it will take a greater input to the speaker to give out a specified amount of sound.

(2)—Right. If there is much damping in the tuners there is practically no selectivity and hence there is no sideband cutting at any frequency.

(3)—Right. Air does not exactly obey the law that equal pressures produce equal compression. While it is very nearly true there is a slight deviation when the pressures are great. The effect, however, is so small that it is undoubtedly inaudible. Variation in the quality of a certain sound with intensity is due to defects of the ear rather than of the medium through which the sound is carried from the source to the ear.

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Diagrams of the 19

By J. E

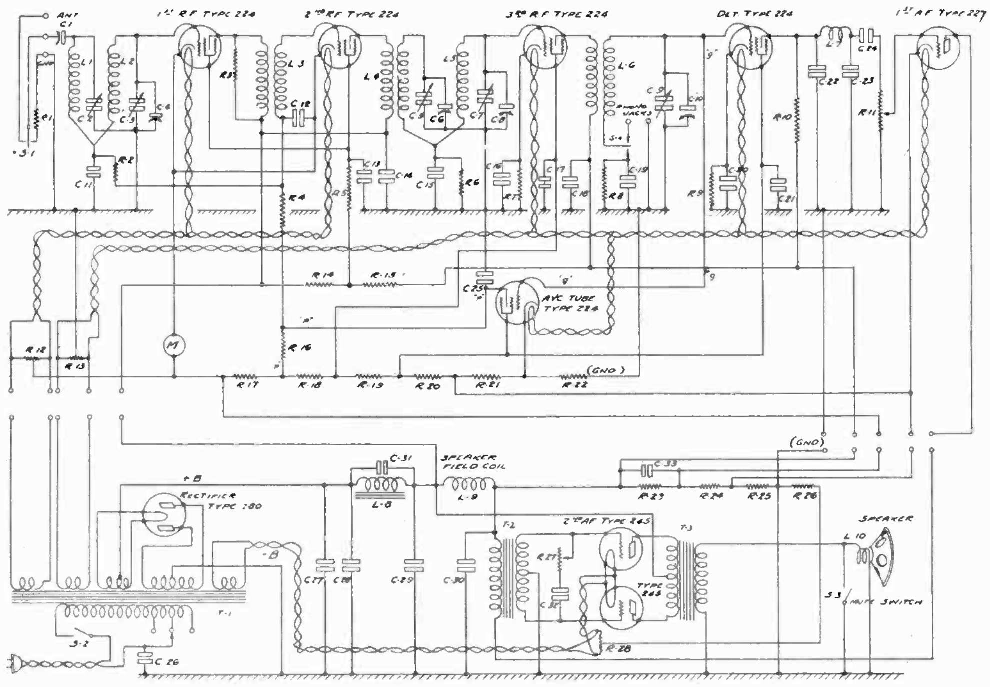


FIG. 1

COMPLETE CIRCUIT DIAGRAM OF THE BOSCH MODEL 60 RECEIVER. A SCREEN GRID TUBE IS USED FOR AUTOMATIC VOLUME CONTROL. RESISTANCE COUPLING IS EMPLOYED BETWEEN THE DETECTOR AND THE PUSH-PULL AUDIO FREQUENCY AMPLIFIER. A TONE CONTROL CONSISTING OF A CONDENSER AND A VARIABLE RESISTANCE IS CONNECTED ACROSS THE SECONDARY OF THE PUSH-PULL TRANSFORMER.

IT is interesting to note that more and more attention is given to small but important details in the design of commercial receivers. Take, for example, the filter in the plate circuit of the detector, which is supposed to separate the carrier frequency currents from the audio by shunting the high frequency current to ground and choking it out of the line to the audio coupler. In the early days a by-pass condenser alone was used, and of course, it was quite effective. However, due to certain undesirable effects in the amplifier it was thought that the separation of the audio and radio frequencies was not sufficient and therefore a radio frequency choke coil was put in series with the line to the first audio transformer or the first coupling resistor.

In many circuits this choke was about as effective as if it had been hung on a peg in the closet. Yet it was used and pointed to as a choke coil that prevented all radio frequency currents from getting into the audio amplifier. To make the coil really effective it was only necessary to put in another by-pass condenser from the audio transformer, or resistance, side of the choke to ground.

In many up-to-date sets this is done. For example, in the Stromberg-Carlson Nos. 12 and 14 the filter consists of two .001 mfd. condensers and one 10 millihenry choke. This choke is much smaller than the type ordinarily recommended, but because of the use of the second condenser it is effective, whereas without this condenser a choke even as large as 250 millihenries would merely be a useless appendix.

Method of Phonograph Pick-up

Another interesting feature of the Stromberg-Carlson receivers is the phonograph pick-up arrangement. A jack is provided for plugging in the pick-up unit into the grid circuit of the first audio amplifier. When the plug is inserted the secondary of the audio transformer is disconnected and the pick-up unit takes its place without any change in the grid bias on the tube. Thus the tube remains the distortionless amplifier that it is in the radio receiver. At the same time the pick-up unit is connected the radio frequency amplifier is rendered inoperative by opening the cathode lead of the second radio frequency tube, the circuit in which the visual resonance indicator is located. While the switching eliminates the volume control in the audio amplifier, another control is substituted as an unit.

There are really jacks for two series. The second jack remains clo that it does not interfere with t first jack.

Manual Volum

The manual volume and sensitivi an interesting feature. It is divide antenna circuit and the other in the transformer. The antenna may be circuit through either a small or a with long antenna and the other course, these connections are for vo is also a condenser of 0.015 mfd. ca which may be connected across th by means of a "range control" swi connected the input is partly short stations may be received.

This control arrangement in the every amplifier. tinuous but changes the sensitivity tinuous, manual control the 250,00 across the secondary of the first a of this potentiometer is connected grid, which is a refinement in deta every audio frequency amplifier.

Volume Control in I

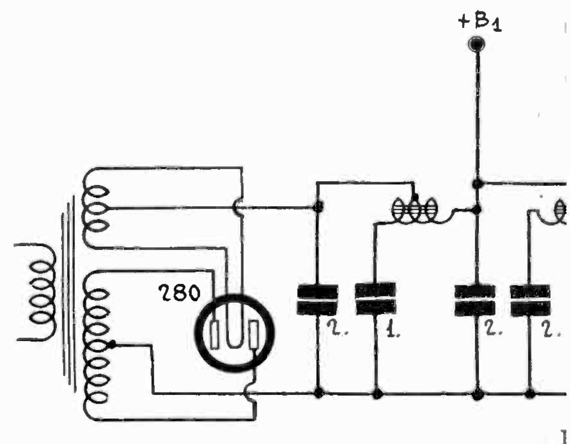
The volume control employed in different. A variable condenser is tuned circuit and the antenna and the antenna may be connected to that a high resistance is cut in pa and the variable condenser.

In the input to the first audio sta sistance potentiometer taking the p a resistance coupled stage. The s connected to the first audio tube. the cathode to the slider when re for that reason the grid is joined

In the plate circuit of the detecto small condensers and one radio frequency choke connected between them. When resistance coupling follows the detector it is imperative to use the second condenser if the radio frequency choke is to have any effect in choking out the radio frequency currents. In Fig. 1 this condenser is marked C29 and in Fig. 2, C23.

Tone Control

Models 58 and 60 incorporate a control for varying the relative intensities of the high and the low notes. This consists of a condenser and a variable resistor, connected in series, placed across the secondary of the push-pull amplifier. The smaller the resistance used in series with the condenser the less is the amplification of the high notes, and since the resistance may be set at zero and the condenser is of fairly large size, a very appreciable diminution in the strength of the high notes.



THIS IS A SIMPLIFIED DIAGRAM OF THE MODEL 12 AND 14 RECEIVERS. THIS PART DYNAMIC SPEAKER FIELD, ANOTHER REC PU

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›0-31 Bosch Receivers

Anderson

ıtegral part of the pick-up

ck-up units connected in
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:ontrol

control of this set is also
into two parts, one in the
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for a short antenna. Of
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ıcity in the antenna circuit
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sch Models

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e of Model 60 is a high re-
ce of the usual grid leak in
er of this potentiometer is
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tance coupling is used and
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is a filter consisting of two

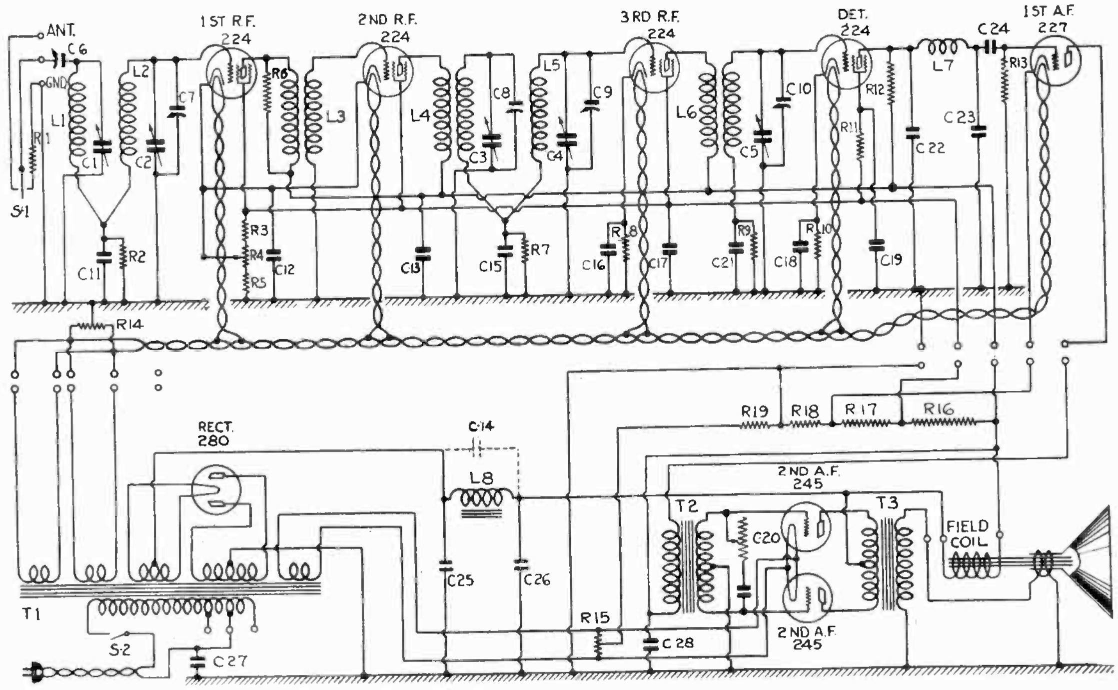
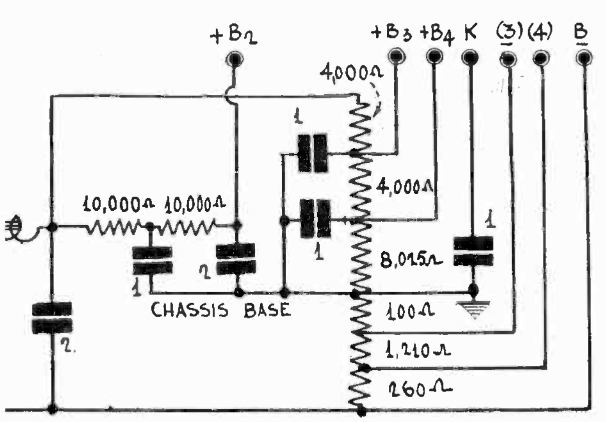


FIG. 2

COMPLETE CIRCUIT DIAGRAM OF THE BOSCH MODEL 58 RECEIVER, WHICH IS SIMILAR TO THE MODEL 60 EXCEPT THAT IT DOES NOT INCORPORATE AN AUTOMATIC VOLUME CONTROL. THE DYNAMIC SPEAKER FIELD COIL IS CONNECTED SO THAT IT IS EFFECTIVE AS A CHOKE IN THE FILTER FOR THE PLATE SUPPLY FOR ALL THE TUBES EXCEPT THE POWER TUBES.

Whether a preponderance of low notes or an even balance is obtained from the set is in the control of each individual listener.

A very simple method of connecting the phonograph pick-up is employed in Model 60 Bosch. One side of the pick-up unit is connected to ground permanently and the other terminal is connected to one side of a single pole, double through switch, the moving blade of which is connected to the low end of the tuning coil ahead of the detector. Thus when the switch is thrown one way the phonograph pick-up unit is connected in the grid circuit and the tube becomes an amplifier. When the switch is thrown in the opposite direction the coil is connected to negative C and the tube becomes a high signal detector. The switch is placed in the low potential side of the tuned circuit and therefore it does not affect the tuning characteristics of the set.



G. 3
SUPPLY USED IN THE STROMBERG-CARLSON
›OES NOT SUPPLY THE CURRENT FOR THE
IFIER AND FILTER BEING USED FOR THIS
ꝛPOSE.

A Proposition Concerning a Preposition

I WISH to compliment you on your article, "A Vacuum Tube Voltmeter," by Compton Cornwall, issue of September 20th, page 9. He says: "This unknown voltage is measured with voltmeter V, although V is not connected to the unknown voltage source at all." How come? It certainly isn't as shown in Position 1 in the diagram, but I suppose this is to keep null point from drifting back through electric emission of the 227 tube toward centre of the milliammeter. Give us more articles like this.

CONSTANT READER.

This criticism relates to the use of the preposition "to" where "across" would have been preferable. It is assumed that this is the part to which you took exception. There is nothing else in the quoted sentence that could be construed as wrong. The article described an excellent vacuum tube voltmeter, or rather, a potentiometer, which may be constructed by any one who has the usual radio parts around.

* * *

Synchronized Broadcast Stations

WHAT success have been achieved in synchronization experiments of two broadcast stations? Is there any likelihood that more high power stations than one will be put on the same wave?—N. P. W.

The experiments have been fairly successful, especially those depending on the use of matched quartz crystals. At this time there is nothing to indicate that stations will be doubled up on the same channel because radio engineers have not yet solved the problem to their satisfaction. Two members of the Federal Radio Commission, both lawyers, are ready to force synchronization, but the other three are opposed to it.

* * *

Comment on Automatic Volume Control

WHEN an automatic volume control is built into a receiver is it better to put it into the screen circuits or into the the grid circuits, that is to say, is it better to vary the grid bias than to vary the screen voltage?—W. G. O.

It is better to operate on the grid bias because smaller change in the bias will have a greater effect on the amplification. Practically all commercial sets incorporating automatic volume controls have the control in the plate circuit.

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October "Proceedings"

By Brunsten Brunn

THE October issue of "Proceedings of the Institute of Radio Engineers" is largely devoted to descriptions of modern radio transmitting apparatus and communication systems, although it includes a few articles on theory.

In "Some Developments in Broadcast Transmitters," I. J. Kaar, General Electric Co., Schenectady, N. Y., and C. J. Burnside, Westinghouse Electric and Manufacturing Co., Chicopee Falls, Mass., describe transmitters of different powers, with special emphasis on 100 per cent. modulation and crystal control of frequency.

The paper is illustrated with numerous characteristic curves, functional and circuit diagrams, and photographs of actual transmitters and installations. Transmitters ranging in power from 100 watts to 50 kilowatts are described in detail and the precise circuit diagrams given, including tubes used in the various stages, the method of modulation, the type of power supply, and the method of coupling the output tube to the antenna.

Sound Recording and Reproduction

Alfred N. Goldsmith, vice-president, Radio Corporation of America, and Max C. Batsel, chief engineer, RCA Photophone, Inc., contribute a paper on "The RCA Photophone System of Sound Recording and Reproduction for Sound Motion Pictures." They analyze the general considerations governing the selection of a sound-on-film recording and reproducing system, and the variable width track for recording and the dynamic cone with directional baffle for reproduction are described with reference to suitability for studio and theatre applications.

Detailed descriptions of recorders, sound heads for projectors, amplifiers, switching and control devices, power supply, and loudspeaker systems of various types of RCA Photophone equipment.

A dynamic type speaker fitted with a directional baffle has been selected for the equipment, and curves are shown giving a comparison of the output characteristics of this speaker and also on using an exponential horn. The curves show that the low note reproduction on the directional baffle speaker is greatly superior to that of the exponential horn, that in the middle register there is practically no difference, and that at the high notes, again, the directional baffle is superior. A curve is also given which shows the frequency characteristic of a representative RCA Photophone amplifier. It has nearly straight response between 50 and 7,000 cycles per second. Above 8,000 cycles the output drops rapidly.

Radio Developments in Great Britain

A. G. Lee, Engineering Department, General Post Office, London, England, contributes a paper on "The Radio Communication Services of the British Post Office." The principal services operated by the British Post Office may be classified under the following headings:

I. Ship and shore radio telegraphy operated from stations located around the coast.

II. Long distance, long wave telegraph services operated from the high power station at Rugby.

III. Point-to-point radiotelegraphy services to a number of European countries.

IV. Point-to-point radiotelephony.

V. Radio telephony to ships.

Special emphasis is given to beam transmission on short waves. The paper is illustrated with characteristic curves of transmitters, field patterns of beams, diagrams of circuits used, functional diagrams, layouts and with photographs of components, and maps of the locations of various transmitters.

RCA World-Wide Network

"The RCA World-Wide Radio Network" is a paper by Arthur A. Isbell, RCA Communications, Inc., which tells about the extent of radio communication development by the RCA since its organization in 1919. The paper is entirely non-technical and is largely historical. A list of the main domestic and international communication circuits operated by the RCA Communications, Inc., at this time, and of those to be opened in the near future, is given.

A Vacuum Tube Wattmeter

H. M. Turner, associate professor of electrical engineering, Yale, and F. T. McNamara, assistant professor, Yale, describe "An Electron Tube Wattmeter and Voltmeter and a Phase Shifting Bridge," by means of which it is possible to measure power of a few microwatts or more.

The current component of the power to be measured is measured in terms of a voltage drop in a resistance of very low value connected in series with the line, and the voltage component is obtained from the drop in a very high resistance connected in shunt with the line.

The small series resistance is divided into two equal parts, each half being connected in the grid circuit of a push-pull circuit. The voltage is connected in the common grid return lead. One of the vacuum tubes is impressed with a voltage which is the sum of the drop in one-half of the series resistance and the voltage component, and the other gets the difference. In the output circuit are two equal resistances, one in each plate circuit, and a microammeter is connected across the two. It is shown mathematically that the microammeter indicates the power delivered to the load.

Magnetron Oscillator

Kinjiro Okabe, Nagoyo Higher Technical College, Nagoya, Japan, contributes a note on the operation of magnetron oscillators. The same author contributed a detailed report of work on the same type of oscillator in Proc. I.R.E., 17, 652; April, 1929, and the present note is an extention of that paper and deals with oscillations depending for their frequency on the external circuit. Intense oscillations of as low as 10 centimeters could be obtained. A magnetron is a thermionic vacuum tube in which the electron stream is controlled by means of a magnetic field instead of an electric field.

Variation of Inductance

K. L. Scott, Western Electric Co., Inc., Chicago, Ill., discusses "Variation of the Inductance of Coils Due to the Magnetic Shielding Effect of Eddy Currents in the Cores." A mathematical theory is developed based on certain assumptions the correctness of which are tested by comparing computed values with measured values. The agreement between the experimental and the observed values is very close. The expressions derived take into account the effect of frequency, conductivity, and permeability of the core material.

Right or Wrong?

QUESTIONS

(1)—When a screen grid is used in a resistance-coupled circuit the amplification is greater the higher the screen voltage.

(2)—A radio frequency choke designed for use in a broadcast receiver as a coupler can also be used in a short-wave receiver and it will work much more efficiently in it.

(3)—For extremely short waves a straight wire of suitable length can be used as a tuner provided there is a means for varying the length.

(4)—Short-wave converters utilizing AC cannot be constructed so that they are free from hum because such waves pick up line hum more readily than broadcast waves.

ANSWERS

(1)—Wrong. If the screen voltage is high enough there will not be any amplification, and it does not take a very high voltage to bring this about, especially when the plate coupling resistance is high or when the applied plate voltage is low. The screen voltage should be much less in a resistance coupled circuit than in a transformer or choke coupled circuit.

(2)—Wrong. While the choke may be used for some short-wave frequencies, it would not be safe in most instances to use it because it may be a capacity for some frequencies. It changes from an inductance to a capacity at the frequency where the inductance resonates with the distributed capacity of the coil. Suppose the inductance is 85 millihenries and the distributed capacity is 5 mmfd. Then the natural frequency of the coil, is 244 kc, and therefore the coil would not even be suitable for broadcast frequencies.

(3)—Right. Every wire has a certain capacity as well as inductance, and both depend on the length of the wire. Therefore the wire has a natural frequency of vibration which can be changed by changing the length.

(4)—Wrong. When heater type tubes are used and the set is constructed with reasonable care there is no audible hum even when a headset is used for listening in. Of course it is easy to get more hum than signal.

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Improve Your Aerial!

By Brainard Foote

IF you're installing a new radio set, or if you are anxious to improve the results you are getting with your present outfit, start with your aerial. This part of the radio receiving system is usually given scant attention.

Your aerial or "antenna" is a wire sticking up into space. Radio waves flashing past "cut" across the aerial, and in doing this their electro-magnetic effect is to cause a faint electric current to flow in the aerial wire. The stronger this current, the louder and better your reception, within certain limits.

Aerial Size

If your aerial is too large for your location you'll be troubled with interference and noisy reproduction. The "natural wavelength" of your aerial ought to be lower than the lowest radio wave ordinarily receiver (200 meters, or 1,500 kc). Your location, however, alters the requirements.

Your distance from broadcasting stations greatly affects the best size of aerial. If there are several stations within 25 miles of your home, your aerial should be relatively small in size, say 75 feet in total length, or certainly not over 100 feet, including the lead-in wire to the set. Otherwise the stations nearby will be too strong and will cause too much interference.

If you are moderately distant—say, 50 miles—a somewhat longer aerial is permissible, not over 125 feet in over-all length. For still greater distances from stations, larger aerials are advisable, up to 150 or even 175 feet in length.

Aerial Characteristics

Here are the main features about a radio antenna:

(1)—Height from ground or surrounding objects.
(2)—Length, including complete lead-in.
(3)—Shape.
(4)—Losses due to leakage, capacity, shielding.
(5)—Natural wavelength.
(6)—Materials, wire and insulation.

The most important characteristic is probably the height. Adding 10 feet of height is worth more than adding several times that in length, for height does not increase the natural wavelength noticeably, as length does. It's best to have an aerial with plenty of height but with a low natural wavelength.

Length should be held to a minimum consistent with good reception. A shorter but higher aerial should be your aim.

As to shape, the best aerial is straight, not necessarily parallel to the ground, for it may slant up or down, but zig-zag forms, coils, curves and bends are to be avoided. Some deviations from the straight line are often necessary, however, to avoid other objects.

Electrical Losses

The radio frequency current obtained from the aerial may be diminished by electrical losses. If the aerial is too close to a building, metal sign or gutter, tree, etc., there is a "capacity" effect whereby some of the energy transfers to such objects and passes on to the earth without first traversing the radio set's circuits.

Another form of loss is through leakage, where the insulators are imperfect, dirty or grimy, and some current, even though very minute, may escape. Resistance may obstruct the passage of the current, for example at joints in the aerial that are not soldered, or where the soldering or other connection is not good.

Aerials may be shielded from reception in certain directions by buildings, gas tanks, metal structures trees, hills, etc., which intervene between your aerial and stations in those directions. If possible the aerial should be higher than these obstacles, or at least as far from them as humanly possible.

Preferably incorporate in your own aerial as many features of the ideal aerial as you can. You have to plan in accordance with your own limitations. But knowing what to "shoot at" is half the job.

Adapting to Suit Location

If you raise the height of the aerial by means of iron pipes or masts, be sure to have a good job done, and better pay a roofer to do the risky part of it, rather than take a chance yourself on dangerous climbing. Have the poles well fastened and strongly "guyed" in at least three directions by No. 10 or 12 galvanized iron wire so that no wind or other force will dislodge them. Do not depend on the aerial wire for any of the support. Have pulleys and strong rope such as sash cord to raise and lower the aerial.

Watch out for possible sources of losses in the radio current picked up by your aerial. If you use a tree to hold one end of the wire, interpose 15 or 20 feet of rope or guy wire between the tree and the aerial, with an insulator between the aerial wire and the rope, so the aerial itself will not be close to the tree. Similarly, avoid nearness to buildings and other objects.

Be Careful About Insulators

As to materials, use a good aerial wire and good insulators. There is much disagreement on the best type of wire, so you can realize that a heavy, well-made wire of any kind will do. Stranded copper stands more bending without breakage. No. 14 or heavier should be used. Enamelled wire is claimed to be better because its surface cannot corrode. I prefer glass insulators, but this is not essential.

They must not be cheap ones, as they must stand the strain of the wire when it is pulled up taut, as well as prevent all current loss. The insulator should have a very smooth surface, so that dust and dirt cannot collect on it, and so that it may be cleaned readily. Good insulators are a worthwhile investment.

To avoid soldered joints, or even worse, joints made by merely twisting the wire together, even though covered with tape, be sure to buy a piece of wire long enough to reach from the set itself to the farthest point of the aerial. Then you're certain to have no resistance losses.

Disregarding local stations, which are heard with most any sort of antenna, place your aerial, if you can, parallel with the direction of the distant stations you wish to receive, and with the lead-in end pointing towards that direction. For instance, if you find that most of the distant stations you receive are to your west, place the antenna wire east and west, with the lead-in at the west end. Of course, in many cases, this can't be followed at all.

Lead-in

The lead-in wire should not be fastened against the wall of the house if you can avoid it. Allow 5 or 10 feet clearance, to avoid capacity loss to the wall. The ideal lead-in insulator is a piece of heavy gauge-glass tubing inserted in a hole bored through the window sash or frame. Pass the wire through this. A good lightning arrester should be provided, placed outdoors or inside, according to requirements. Ask your insurance agent about it.

Where the aerial is very long, or where you have a very long lead-in wire, the natural wavelength may be too high. Reception below 300 or 350 meters will then be poor. So, insert a small fixed condenser, about .0005 or .00025 mfds. capacity, between the lead-in wire and the aerial post of the set. If desired, rig up a simple switch to "short-circuit" this condenser when receiving the longer wavelengths.

Attention to your aerial will pay every listener—whether his set is a good one or not. Read the instruction sent with your set, too. Next week, we'll discuss the matter of good ground connections.

Tall Buildings Held a Jonah to Stations

Engineers associated with KYW have decided that high skylines are all right in pictures, but something to be avoided when erecting a station. The large buildings seem to be particularly fond of devouring radio waves, thus creating "dead spots." The station sets forth:

"The story starts two years ago when KYW changed from 526 meters to the 204-meter wavelength. On the higher wavelength engineers had experienced no difficulty, but on the shorter wave the transmitter—located in the heart of Chicago's big business district—worked erratically.

"Certain locations heard the station but others could not. Various schemes were tried out but complete coverage was not obtained in the city until the present super-power Westinghouse transmitter was built some miles from the city, then results were far better than on the old high wavelength.

"KYW's engineers now are watching with interest a short-wave television station recently built by another group of engineers in the business district. All seems to be haywire. Nothing works correctly and talk is being passed around that the television station will soon have to follow KYW's lead and move into the open country."

Many stations have "country estate" transmitters.

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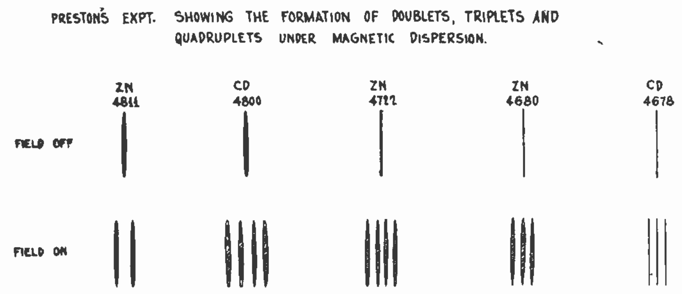
The Affinity of Light

By John C.



THE historic progress of radio has shown us so far that the early stages in the development of the transmission art were for the most part confined to the mechanical improvements such as semaphores and lanterns and other signalling devices operative solely by the efforts of man.

Then followed an era in which experiments of a more or less electrical nature were performed, but these provided a greater impetus to further study and the colleges began to be the gathering-places of the ones interested in the then new art. With the formation of debating and scientific societies the foundations of the philosophical magazines of various countries came into being, and though the results that were recorded in the early days of publication are not to be compared to the present-day degree of technical accuracy, the historic importance was great in the early days as well.

There have been two pronounced mechanical eras and two periods when the experimenters held their sway. One of the most distinguished traits in the development of man has been his efforts to get into communication with his neighbor, and whatever facts of history you overlook, this one just mentioned is inescapable, but none the less remarkable.

Goes Far Back Into History

It is true that the historic background of radio development is remote, if you go into it fully, but if the subject is to be treated with any degree of consistency the development of the various devices that have gone into its making must be reviewed. Take for example, Dr. Pieter Musschenbroek's experiments prior to his invention of the Leyden jar, and a parallel case in modern physics, that of the pioneer work of Dr. O. W. Richardson, Professor J. J. Thompson, and Dr. McClelland, all of whom worked in or around the subject a long time before their results were announced. Though others have since been more prominently associated with the development of the vacuum tube, the theories that were worked out before 1882 have been instrumental in modern tube design, strange though it may seem. A book entitled, "Heat, a Mode of Motion," by the eminent lecturer, Sir John Tyndall who in March 1863 delivered one of a series of popular lectures on the subject of radiation through the earth's atmosphere is a collection of his lectures. In its covers there is much of interest to the seeker after historic facts.

So diverse in fact have been the contributions to the radio art by the various physicists whose works have claimed public attention that it is entirely possible there are to this day men who were justly eminent in their chosen field but destined to be obscure, an example that has been presented in the case of Dr. Thomas Young, one of the early exponents of the undulatory theory of the propagation of light, whose work was threatened for a time with non-recognition, despite its authenticity.

The concentration of electric waves by means of lenses, an experiment performed by Dr. James Howard under the direction of Dr. Oliver Lodge, at University College, Cambridge, England, is of diverse interest because it is one of the many links the science of radio has with the phenomena of radiation, which branch of electromagnetism had still so much to contribute to the communications art.

Sought to Direct Light Waves

In other words, if electric waves could be directed along a definite path, then, it was reasoned, as the same thing could be done with visual light waves there must be some identity between electric waves and visual light waves.

Direct evidence of this fact was not brought to light in what we would term chronological order, that is, by this time (1887) several workers had entered the field of research in the search of certain facts pertinent to radiation, a process of investigation that eventually proved to be a direct method of attack on the solution of problems involving Maxwell's theory of electromagnetism. Meanwhile continuation work with parabolic mirrors was being done by Lodge, who was profoundly affected by the untimely passing of Dr. Heinrich Hertz, and who therefore wished to continue the classic experiments, and so we present one of the interference experiments, inspired no doubt by Lodge's desire to confirm the views of Huygens and Young, using electric waves.

The source of the wave-front, as diagrammed is a mirror, and the waves are oscillatory ones instead of the usual visual light variety.

Also the indicating device in the focus of the convex mirror is a spark-gap.

The setup concerns the use of a parabolic mirror as a radiator of a concentrated parallel beam of electric waves, and a receiver-mirror that is so mounted as to focus any reflected energy on the oscillator-gap at its immediate right.

Patterns Formed

The dotted circles located in the path of the reflected wave that is propagated from the parabolic mirror are hollow copper conductors in the form of cylinders, and are made of one millimeter thickness stock.

The interposition of one of these pieces of tubing results in the formation of a simple pattern and the image does not check the appearance of the spark at the secondary gap but as more lengths of tubing are placed parallel to one another, in the path of the radiation the spark at the secondary gap is reduced, and finally the radiation is completely stopped.

A study of the diagrammed pattern will show that the most prominent interference lines converge upon the area directly in front of the oscillator plates. That means that there is an area of no voltage change directly in front of the concave mirror, a condition under which there can be no response from the secondary gap-oscillator, and though the pattern in the diagrammed case is not carried out completely, as by so doing the resulting complication of lines would make the drawing unreadable, it should be assumed that the stray energy received by the secondary gap would preclude the formation, or rather generation, of a sufficiently high voltage to produce a visible spark. It is admitted that some slight potential difference would be present.

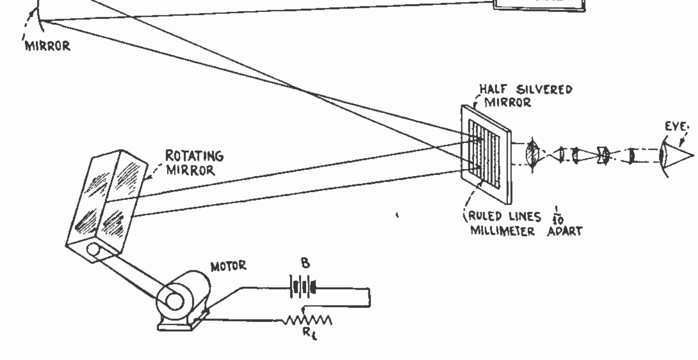
This arrangement corresponds to the series of slits in the Young experiment, except that here the resultant effect is obtained by transmission through comparatively wide openings, whereas the others were less than a millimeter wide.

All of the above work merely served to extend the growth of the bond that was now apparent between radio transmission and the associated development sciences, and resulted in many new disclosures.

Connection Between Light and Radio

A number of scientists prior to 1897, in Germany, France, Italy and England, considered the relationship of radio and visual light. It is feared that much evidence of this historical work never was recorded, as the first evidence of the discovery of any direct relationship of the two comes from "Transactions of the Royal Philosophical Society of Dublin," March, 1897, which contains an unusually lucid description of the methods employed by the discoverer, Dr. Thomas Preston, in the years 1894-1898, during which period he worked on experiments in the physical laboratory of the Royal College of Dublin.

Shortly before Dr. Preston's results were publicly announced, Dr. Zeeman in Berlin announced the important discovery that when white light is passed across the path of a concentrated magnetic field the appearance of the spectral lines is sensibly



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and Radio Established

Williams

modified, confirming Dr. Lorenz's theory that three separated images should result for each spectral line, and would be oppositely plane-polarized.

But all experiments prior to the ones of Dr. Preston gave negative results, it not being realized apparently that either the incident light was wrongly directed relative to the field, or that the dispersion effect was not of sufficient intensity to provide the effect predicted by Lorenz.

Preston's first experiments were made with sunlight after dispersion by a prism, was allowed to traverse the pole-face gap of an electromagnet, at right angles to the direction of the flux flow, the spectral image deflection being noted by the spectroscope so mounted that its angular motion was measured by a semi-circular scale. The spectral image was formed at the collimator, in line with the slit.

Preston Got Help when Badly Needed

Preston soon found that to obtain a larger dispersion effect a heavier magnetic field would be required, and in due course the requisite larger electromagnet was furnished by the Royal College of Dublin, by courtesy of Prof. Barrett, and in addition a large concave grating was loaned by the Royal University of Ireland, which measured 21½ feet radius and was ruled 14,438 lines to the inch.

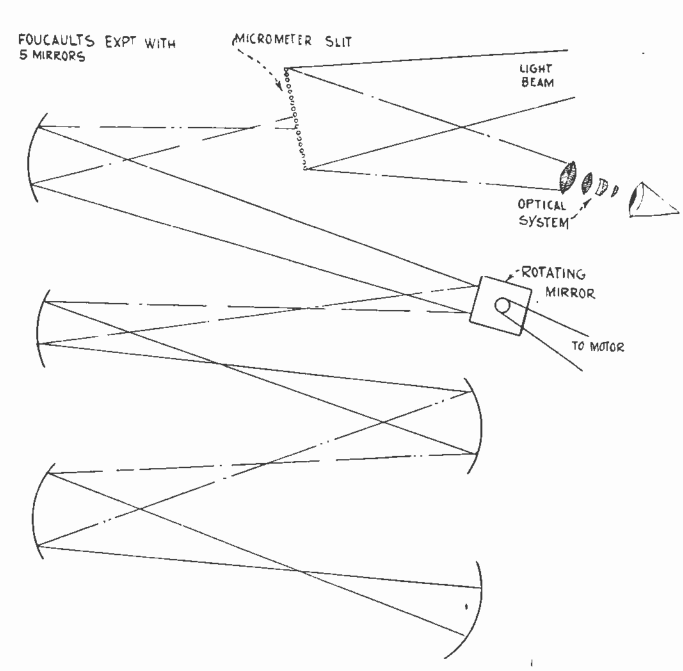
In this second experiment the light source was a spark that was arranged to pass between balls of metallic substance whose spectral lines were the object of study in the previous experiment, that is, whose spectral line shift under the influence of the magnetic field, though predicted, was not observed.

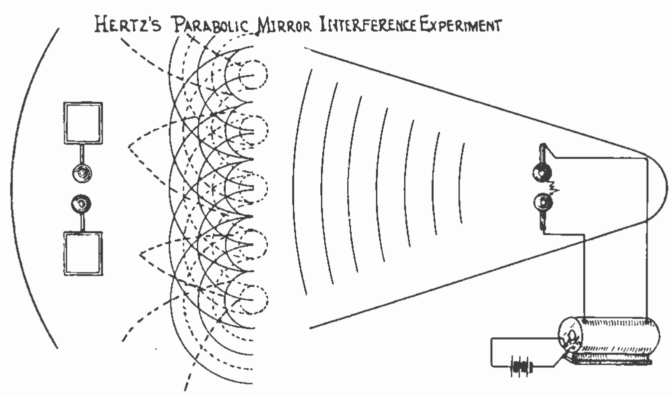
But with the aid of the new apparatus the presence of components in the line spectra of metals was proved and Lorenz's theory was vindicated. The line spectra of zinc and cadmium, as they appeared by reflection from the grating without the effect of the magnetic field, are shown herewith, and below are seen the same lines after the field is turned on.

The formation of what are called doublets, triplets and quadruplets is somewhat analagous to the effect in radio transmission, where an unmodulated wave of radio frequency energy appears to be a single, or fundamental frequency, but when the modulation is applied there immediately coexist two other components related to the fundamental, the relationship depending on the frequency-amplitude of the added component. The width of separation of the components in the line spectra of a luminous substance depends on the magnitude of the dispersive force that acts to resolve the mixed components into their separate entities, thus making them visible.

Affected by Distortion Too

But just as there are harmonics in a radio frequency wave, there are also harmonics of visible light frequency in the line spectra of luminous substances which are made visible in this case when a magnetic field of sufficient intensity is applied to the light beam in a direction at right angles to the direction of propagation.





Thus the spectrum of zinc is seen to have three principal parts or components, each of which can be resolved into a sub-fundamental, and components whose frequency is measured in the same terms as those of the parent lines.

Since these lines are made originally on a photographic plate there is absolutely no doubt as to their existence, but when it is remembered that their presence was predicted mathematically in the form of equations based on Maxwell's theory, it will be apparent that the relationship betwen the radio wave, and visible light is a demonstratable fact, and Dr. Preston was the first physicist to show this relationship so clearly and convincingly that he paved the way for other vital contributions to the art of radio communication.

In order fullty to appreciate the degree of development of the present-day status of radio it is necessary to delve in to the historical aspect of the early efforts made to get at a reasonably accurate estimate of the velocity of light, since it had been proven to the satisfaction of many that the identity of the light and radio was established by the works of Preston and Zeeman, and therefore a knowledge of the value of the velocity was especially desirable.

[*Continued next week*]

Chronology of Scientists Who Helped Evolve Radio

FOLLOWING is a chronology of some of the physicists whose labors have contributed directly to the transmission and reception art, with a brief description of their outstanding contributions. Their work has been reviewed in these articles:

Dr. Pieter Van Musschenbroek, 1692-1761, invented the Leyden Jar, at Leyden, Holland.

Dr. John C. Adams, 1798-1868, performed the first electrostatic induction experiment.

Dr. Macedonio Melloni, 1798-1854, early exponent of the calorific school, who wrote on radiation.

Sir William Herschel, 1738-1822, demonstrated the refracting telescope, and contributed to studies on heat and radiation.

Dr. John William Draper, 1811-1882, worked on invisible rays.

Dr. James Clerk Maxwell, 1831-1879, electromagnetic theory of light, and other related subjects; translated the experimental results of Henry and Faraday into mathematical form.

Dr. Heinrich Dannel Rhumkorff, 1803-1877, developed the commercial form of induction coil later known by his name.

Dr. Charles Grafton Page, 1812-1868, inventor of the induction coil; also constructed the first closed-core transformer.

Dr. Heinrich Rudolph Hertz, 1857-1894, first physicist to show electric wave transmission, and also the concentration of electric waves by reflection.

Sir Oliver Lodge, 1887 to date, first showed the concentration of electric waves by refraction.

Dr. Jean Leon Foucault, 1819-1896, made the first successful measurements that led to the present-day methods of determining the velocity of light.

Dr. Wilhelm Konrad Roentgen, 1845-1923, discoverer of a new type of radiation which he called Unknown, or X rays. The discovery of these rays extended the known range of the light Spectrum.

Dr. O. W. Richardson, experimented with thermionic emission from hot metallic surfaces.

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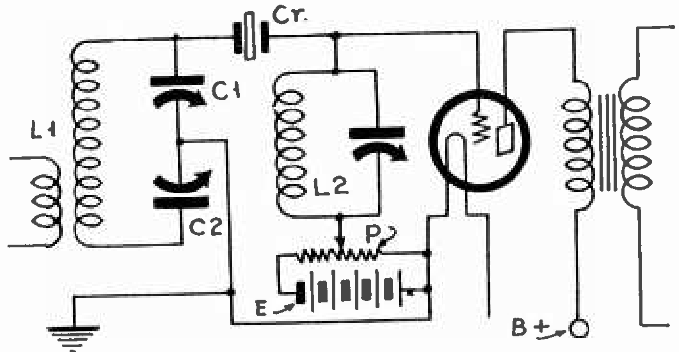

Fig. 860

A diagram illustrating the connections of the detector in the Stenode Radiostat receiver showing the crystal Cr through which the signal must pass.

Carrier Used in Automatic Volume Controls

WHAT is the reason that in automatic volume controls the control tube is always fed with voltage at radio frequency? Would it not be better to put audio voltage on the tube since this is always much more intense and would have a greater control of the amplification?—C. W. C.

There are two reasons for using radio frequency voltage. The first is that the voltage must produce rectified current in the plate circuit of the control tube and this current must be filtered so that only DC is impressed in the amplifier grid circuit as bias. It would be difficult to filter out audio frequencies especially bass frequencies. The second is that if audio were used the sensitivity of the amplifier would not vary inversely as the signal strength but inversely as the modulation. The effect of this would merely be to level out the tone variations. That is, a very loud sound would be weakened and the true relation between sound intensities would be upset.

* * *

Discussion of Filter Condensers

IF you have a 2,000-ohm bias resistor in an audio amplifier what should the capacity of the by-pass condenser be to reduce the effective impedance of combined impedance at 50 cycles per second to one-tenth the value of the resistance alone? How much will the same condenser reduce the impedance at 10,000 cycles?—P. D. A.

You will need about 16 mfd. to cut the effective impedance to one-tenth the value of the resistance alone. At 10,000 cycles the impedance of the resistance and the condenser in parallel will be about one ohm. That is, it will be .0005 of the resistance alone.

* * *

Meaning of Conversion Constant

WHERE does the constant 300,000 used in converting wavelength to frequency come from and what does it mean if it is anything but a pure number? I would appreciate an explanation if one can be given in simple terms.—L. W.

The constant 300,000 is the velocity with which radio waves travel, expressed in kilometers per second. In all wave motion, such as that of sound, water and light, the velocity of propagation is equal to the product of the wavelength and the frequency because the frequency is the number of waves that pass a given point in space per second and when this number is multiplied by the length of each wave the product gives the number that tells how far any one wave has traveled in a second. The formula connecting the velocity, wavelength and frequency is therefore $WF=V$, in which W is the length of each wave, F the frequency in cycles, or waves, per second, and V is the velocity. If W is given in meters and F in cycles per second, the velocity is given in meters per second. In the case of radio waves the velocity is 300,000,000 meters per second, or it is 300,000 kilometers per second. If the wavelength is given in meters and the frequency in kilocycles, the constant is also 300,000 kilometers per second, and it is in this form that it is usually employed in radio work.

* * *

Trick Circuit Possibility

COULD the grid bias used on a 245 tube push-pull amplifier be used as plate voltage for a detector requiring 45 volts? If so, are there any special precautions that must be observed in making the connections? Should the grid bias resistor be larger or smaller than if the plate return of the detector is connected to the positive end of the bias resistor?—W.H.J.

It is quite possible to get the plate voltage for the detector in this manner provided that the cathode of the detector tube is connected to the negative end of the bias resistor. If the cathode is grounded, as it usually is, and also if the negative end of the bias resistor is grounded, which it is in nearly all cases, no special precaution need be taken about the negative end since the proper connection will be made automatically.

The voltage on the plate of the detector will be 50 volts if the bias resistor has the proper value and if the plate voltage on the power tubes is 250 volts, that is, if the total voltage from the plate return of the power tubes and ground is 300 volts. If only the plate return of the detector is connected to the bias resistor no change need be made in the resistance because the change in the current through it is negligibly small. The power tube current is 64 milliamperes and the plate current of the detector is only about one milliampere. Hence the bias resistor current will be 63 milliamperes and the bias on the power tube will be reduced by one part in 64, or less than one volt. The current through the bias resistor is reduced because the plate circuit of the detector tube is connected in parallel in effect.

The main precaution that must be observed is that all AC be filtered out of the bias resistor for if it is not the arrangement might turn out to be a vicious oscillator. In a push-pull stage there is very little signal current so the scheme should be quite feasible and might well be used if there is a good reason for doing so. There is no object in doing it just to have a trick circuit.

* * *

Improvising a High Resistance Voltmeter

I WISH to turn a 0-1 milliammeter into a high resistance voltmeter but I don't know how to go about it. I understand that high resistances are needed in series with the meter. If that is correct will you kindly give me the necessary values to convert the instrument into a voltmeter? I should like to retain it as a milliammeter if that can be done.—S. G.

To convert the 0-1 milliammeter into a voltmeter connect 1,000 ohms in series for each volt on the scale. For example, if you want the meter to have a range of 0-10 volts connect 10,000 ohms in series, if you want a scale of 0-100 connect 100,000 in series. Just multiply the highest voltage reading on the scale by 1,000 and you get the proper resistance for that range. Grid leaks and plate coupling resistors of the usual type are not suitable if you want an accurate meter. Use wire-wound resistors. You can get them in all sizes. It is better to use one resistor for each range than to attempt to tap a single resistor at suitable points, or to connect resistances in series with the idea of saving total resistance.

* * *

Community Antennas

I LIVE in a large apartment house which has been wired for antenna and ground in every apartment. I had been led to believe that antennas of this sort could be made exceptionally effective and that the ground would be about all that is desired of a ground. I am sorely disappointed with mine, for the antenna is practically dead and the ground is quite lively. If I reverse the connection I get much better results than when I use the two leads as they are supposed to be used. Moreover, if I disregard the built-in antenna and use a short wire strung around the picture molding of the room I get real results. Is there any reason why the built-in antenna should not be really good and why the ground should not be dead? If this is typical of a community antenna, apartment house builders might as well save the expense of putting them in.—D. L. W.

In an apartment house there are grounded conductors all around every apartment, and particularly, there are grounded conductors above. In some instances there is a ground higher than the highest point of the community antenna. This is the case, for example, when there is a water tank on top of the building which is connected to all the plumbing. This is one reason why the built-in antenna is often dead or almost dead. Another reason is that the antenna lead-in wire often runs parallel to grounded conductors for long distances, and quite close besides. Radio currents induced in the antenna wire are shunted to ground through the capacity before they get to the set. That the ground should be lively is not strange. A metal structure the height of a modern apartment building is grounded at the ground only. It would serve as a good ground only if the ground post on the set were connected to the highest point and if the antenna post were connected to a wire which runs still higher. If the reverse is the case louder signals may be obtained if the connections to the receiver are reversed also.

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Time of Long-Distance Short-Wave Reception

WHAT is the best time of the day to try for the European short-wave stations? I have tried many evenings with a set that has received them but I have never been able to coax in a single station from the other side of the Atlantic.—A.B.

The best time, naturally, is to listen in when they are broadcasting. Most of them sign off at 11 p.m. their time. Between New York and London there is a time difference of five hours so that if you want to get the London stations, or any English short-wave station, you must listen in before 6 p.m., Eastern Standard Time. If you want to get other European stations which are farther East you have to listen in still earlier. Start about 1 p.m., Eastern Standard Time. Be also prepared to have the right coils so that you will be able to cover the frequencies used.

* * *

Grid Bias Resistor in Resistance Coupling

IS IT practical to use a bias resistor for maintaining the grid negative with respect to the cathode in a resistance coupled amplifier or detector? The plate current is so small that it would seem to require an enormously high resistance and that this resistance would make the tube inoperative. Will you kindly explain how to determine the resistance to use if it is practical? —L.L.W.

It is practical provided that the bias resistor is properly by-passed with a large condenser. It is true that the resistance must be very high, but this fact makes by-passing easier. To determine what resistance should be used it is necessary to know what current flows, and this can only be found with a milliammeter. When the current is known just divide the grid bias in volts desired by the current expressed in amperes and the result is the resistance. It will depend on the resistance used for coupling in the plate circuit. This will give the bias resistor whether the tube is used as detector or as amplifier, but in either case the current must be measured when the desired grid voltage is on the tube, preferably applied by a battery.

* * *

Receiving Harmonics

I HAVE a short-wave receiver with which I have picked up many broadcast stations, many of which do not transmit on short waves at all. How is this possible?—W.M.B.

What you receive are harmonics of the broadcast stations. Some stations send out waves rich in harmonics and these harmonics can be received as short waves with a good short-wave receiver. Other stations send out waves so pure that it is impossible with any practical receiver to receive the harmonics directly unless the receiver happens to be very close to the station. Yet it is possible to pick up the signals from these stations. In such cases the fundamentals of the broadcast waves are impressed strongly on the short-wave receiver and the harmonics are generated in the tubes of that circuit by detector action. Hence they are received just as if they were short waves to begin with.

* * *

Heat Waves Are Radio Waves

IF heat waves, radio waves and light waves are of the same nature, why is it not possible to reflect, focus and refract heat waves just like light waves?—S.G.

It is possible and it is being done every day. Any wave in any medium can be subjected to these operations provided that the devices bear the proper relation to the type of wave and the wavelength. An electric heater that is built like a searchlight is a case where heat waves are reflected and focused by reflection.

* * *

Stenode Radiostat

SOME TIME ago you published an article on the Stenode Radiostat but I failed to note where you explained the functions of all the parts in the circuit. Will you kindly discuss it more fully?—T.C.R.

We reproduce the circuit diagram in Fig. 860. In this circuit L1 is an ordinary radio frequency transformer the secondary of which is tuned with two condensers, C1 and C2, connected in series. The input to the tube is the voltage drop in only one of these condensers, C1. The object of dividing the input voltage is to secure looser coupling and greater selectivity. Cr is the quartz crystal through which the signal must pass since it is in series. This is the principal selector, for it has a much greater selectivity than the two tuned circuits combined. The parallel tuned circuit between the crystal and the tube adds more selectivity. Since the crystal is in effect a small condenser through which no direct current can flow the coil L2 serves as a grid leak or grid return. The low side of this tuned circuit is connected to the slider of a potentiometer by means of which the bias on the grid can be adjusted, since the potentiometer is connected across a battery E. The tuned circuits and the crystal are adjusted to a fixed frequency since the circuit is the detector part of a super-heterodyne.

* * *

How Voltage Divider Works

ALTHOUGH you have described and explained how to figure resistances in a voltage divider so as to give the desired voltages at the taps I seem to be unable to get the idea, for I have applied the rules carefully, measuring the resistances and the currents, yet when I have measured the voltages they have not been what they were supposed to be. Will you kindly explain once more in the hope that my difficulty will be cleared up?—E. S.

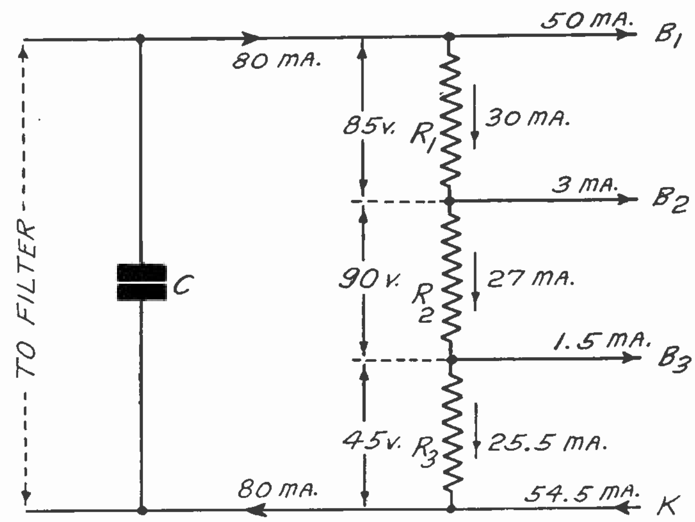

Fig. 861

A circuit illustrating the method of evaluating the resistances in a voltage divider to give the desired voltages. The currents in the bleeder, R3, and to each tap must be known either by measurement or by accurate estimation.

If you measure the resistances and the currents and still don't get the right voltages you undoubtedly make some mistake in measuring or in the computation. Or it may be that you do have the right voltage and assume that these will be registered by your voltmeter. If you use a low resistance voltmeter you may be sure that what you read on this meter is not the voltage that exists when the meter is not there. In Fig. 861 is a diagram of a voltage divider and the voltage and current distribution in one particular case. It shows the currents flowing into the different taps and in the bleeder resistance R3. If you divide the voltage between any two adjacent taps by the current in the resistance between those taps, you get the values of the resistance. But these resistances will not give the right voltage unless the currents drawn by the various taps and the bleeder are exactly as indicated. When a voltmeter is connected in addition to the assumed load the currents are different and so are the voltages.

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Ninth Year

Owned and published by Hennessy Radio Publications Corporation, 145 West 45th Street, New York, N. Y. Roland Burke Hennessy, president and treasurer, 145 West 45th Street, New York, N. Y.; M. B. Hennessy, vice-president, 145 West 45th Street, New York, N. Y.; Herman Bernard, secretary, 145 West 45th Street, New York, N. Y.

Roland Burke Hennessy, editor; Herman Bernard, business manager and managing editor; J. E. Anderson, technical editor

"Buy Now" Plan Captures Country

RADIO WORLD jumps into the ring with the suggestion that the entire radio field — manufacturers, distributors, dealers and consumers—immediately take advantage of the "buy now" drive going on in some of the principal cities of the country.

This "buy now" idea started in Philadelphia and has spread to many cities, including St. Louis, Chicago, Cleveland and Atlanta. It is a simple plan. Various trades have been asked to make specal offers of worthwhile goods—not mere "bargains" but worth-while goods at attractive prices—and the public has been urged to make its purchases now, and thus help trade in general.

There isn't the slightest reason in the world why the radio industry should not share in the success of this promising plan. It means that the radio manufacturers' stock will begin to move when the radio dealers find their stocks are getting low, because the public is buying in mass once again. This will help unemployment, because the manufacturers would be obliged to start full force to turn out their goods again to meet the increased demand. The public will be able to buy goods at compelling prices, and thus will itself benefit while helping commercal radio in all its ramifications to get on its feet solidly again.

RADIO WORLD calls on the radio trade to start the ball rolling with such force and effectiveness that the results will be apparent in no uncertain way.

Now—all together for a long, strong, effective pull, so that radio will share in the general prosperity.

But let's start at once. RADIO WORLD will do its share. Will you?

A Radio Christmas is Coming!

WITH Christmas only about two months away, many are now turning their thoughts to what they will purchase as gifts for friends and relatives, and it behooves all those who have more than a superficial knowledge of radio to concentrate on the radio field as a fruitful source of suggestions for gifts.

It is obvious that the radio-minded have many friends and relatives who, when purchasing radio sets or accessories, if acting without any expert advice, why not make the best possible choice. It is also true that where one possesses that expert knowledge, he had better select his gifts from the material to which his expertness applies, for then he is making not only the tangible gift itself, but an intangible but nevertheless valuable contribution from his own fund of knowledge.

Radio offers enough opportunities for variety to suit every need or purse, what with tubes, home recording apparatus, speakers, short-wave converters, tone controls, receivers and the like, among the many things from which to choose. If one desires to present a receiver, he can do the donee more than a good turn by building the set, thereby giving also something of his labor, knowledge and personality, which adds charm and sincerity to the gift. If one desires to show consideration to radioists technically inclined, a soldering iron, drill, vise, or other tool, or a kit of tools, would be highly acceptable.

At all hazards let's make this a radio Christmas.

Wanted: A Gadget

IT IS the delight of the radio experimenter to keep ahead of the developments in the commercial receiver field, and at present this delight asserts itself principally in the reception of short waves.

Analyzing the fascination of short-wave reception, one can find only that of the reception of far-distant stations, for the average listener, while the amateur, of course, has his own additional delights in two-way communication or just plain pick-up of stations on the other side of the earth.

There is nothing in short-wave reception that offers better quality than does the broadcast range. Many of the domestic stations that will be tuned in will be simply short-wave adjuncts of transmitters operating in the regular broadcast channel, and sending the same program on short waves. The point is that stations that do this pleasant duplication can be tuned in on short waves, although far beyond reach of the broadcast receiver.

Those who use short waves are mostly interested in foreign stations, and excluding our two neighbor countries, we don't bring in anything from foreign shores on broadcast receivers. Yet short waves will produce the most exciting surprises, and we will sit perhaps for an hour, listening to some foreign country's noble representative pouring his own language, which we do not understand, into a willing microphone. Fortunately, announcements are usually repeated in English, as are some introductory or closing remarks, so all's not quite in vain.

For several years short-wave reception has been accomplished in separate short-wave receivers. This is certainly a good way to insure results. Later there was some vogue for adapters that plugged into the detector socket and brought in short waves, or did not, depending on the detector circuit and other factors.

In those days the radio frequency gain of broadcast receivers was low and the audio gain was high, so that a feeble signal fared well enough when delivered by the adapter to the first audio plate impedance. But nowadays the radio gain is high and the audio gain is low. For instance, the favorite audio circuit of leading 1931 commercial receivers is one stage of resistance coupling followed by push-pull transformer coupling. The little adapter becomes next to useless, if not completely a dud, for the resistor results in low plate current, sometimes around 25 microamperes in screen grid detectors, and just about ruins any attempts to obtain regeneration. Denied regeneration, you are denied reception. Even if a little regeneration is obtained, or indeed a satisfactory amount, the audio amplification is low, and what's heard isn't loud enough.

So the adapter may as well be read out of the party.

A different story must be told about the short-wave converter. This device operates as a short-wave radio frequency amplifier and mixer of the tuned-in frequency with an oscillator frequency, so that the mixing produces a different frequency to which a broadcast receiver will respond.

Thus the converter changes short waves that it tunes in into an intermediate frequency within the broadcast band, or just beyond that band, and constitutes the combination a Super-Heterodyne. There is now quite a fad for these devices, which were brought into their present popular state through the publication of a series of articles in RADIO WORLD, beginning last May.

Results are excellent on converters. Not only are North Americans interested but South Americans as well, and Antipodeans no less. The British West Indies and other tropical places that have bad spells of static that make broadcast wavelength reception impossible for months on end, cure the situation by using converters with broadcast sets, and listening to short waves, including those from stations in the United States and Europe.

At present a separate short-wave set, or a short-wave converter, to be used with a broadcast set, is highly acceptable, and these constitute about the only inviting circuits for such reception. Either costs somewhat more than what non-technical folk, for instance, would care to pay for listening to short waves that they know little about. Those familiar with short waves will gladly pay the price, but the other field is larger, and some day soon, it is hoped, someone will come along with a little gadget that you plug into a socket of your broadcast set, and lo! in come the short waves. That kind of a contribution to radio's advance should cause a small revolution of a highly pleasant type, sell many parts, encourage the building and sale of more broadcast receivers, relieve tropical countries of a burden and add much to radio enjoyment.

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.*

F. A. Heyn, 51 West 92nd St., New York, N. Y.
O. L. Heyn, Pasto Viejo, Humacao, Porto Rico.
S. Malinowski, 371 B'way, Bayonne, N. J.
Felix F. Janus, 1351 East 96th St., Brooklyn, N. Y.
E. H. Croskey, P. O. Box 243, Loveland, Colo.
H. S. Congdon, 2092 Juliet St., St. Paul, Minn.
T. L. Goods, Marlin, Texas.
Carl A. Kellerman, Huron St., P. O. Box 194, Oakland Beach, R. I.
Chas. S. Waldie, 107 Shonnard Place, Yonkers, N. Y.
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Thomas W. Peterson, Rolling Prairie, Ind.
Millard L. Beyer, 919 St. Johns Pl., Brooklyn, N. Y.
H. J. Sapponfield, 3260 Maypole Ave., Chicago.
A. T. Thompson, 2856 E. 79th St., Chicago, Ill.
W. E. Bonner, c/o Papoose Oil Co., Route 3, Seminole, Okla.
F. P. Manto, 61 Main St., Buffalo, N. Y.
William J. Truss, 580 W. Preston St., Baltimore, Md.
Clarence J. Friess, 126 Hilbert St., Cedarburg, Wisconsin.
E. W. Orandall, Scandia, Kansas.
Russell H. De Jonge, Route 3, 38 N. 85, Grand Rapids, Mich.
G. J. McCallum, Box 223, Ajo, Ariz.
J. Ilanas Puente, Bolivar 92, Jalapa, Ver., Mexico.

New Incorporations

Climax Radio Corp.—Atty. A. P. Waker, Jr., 300 Madison Ave., New York, N. Y.
Speak-o-Phone Recording Studios, Inc., New York, N. Y., talking machines—United States Corporation Co., Dover, Del.
Kenola Radio Corp.—Attys. Stockridge & Borst, 41 Park Row, New York, N. Y.
Harben Radio Service—Atty. H. Wiesenthal, 225 Broadway, New York, N. Y.
Radio Authors, employ artists—Attys. Thomas & Friedman, 11 West 42nd St., New York, N. Y.
Fairmont Radio Co.—Atty. S. Bloch, 350 Broadway, New York, N. Y.
Radio Research Co., Inc., Wilmington, Del., radios, parts—Corp. Service Co.

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SYNCHRONIZED WAVE SUCCESS, N. B. C. REPORTS

Washington.

"It is now possible to operate two or more stations on the same radio frequency without distortion."

So Merlin H. Aylesworth, president of the National Broadcasting Company, wrote in a letter to Chairman Charles McK. Saltzman, of the Federal Radio Commission, in reporting the successful synchronization of WEAF, New York City, with WGY, Schenectady, and KDKA, Pittsburgh, on WEAF's frequency of 660 kc. all on high power.

It is possible, though there are economic and legal obstacles, to establish booster stations that have no identity, and thus carry the snigle wave's penetration to great distances, enabling what amounts to chain operation on a single frequency.

What Aylesworth Wrote

In his letter Mr. Aylesworth said:

"I am gratified to inform you that synchronization in the field of radio broadcasting is now out of the laboratory. Experiments and tests which we have been conducting have definitely demonstrated that from a technical standpoint at least, it is now possible to operate two or more stations on the same frequency without distortion.

"I am particularly impressed with the importance of synchronization in connection with network broadcasting, but the difficulties in this connection must be carefully studied. It will be necessary to try out an experimental group of stations to learn more of the practical activities of synchronization. As the stations on present networks are all individually owned and serve important local interests, as well as national programs, they cannot and should not be operated in synchronism.

"In fact there are so many limitations in a technical field that synchronization should be allowed to grow gradually, so that its primary purposes and value should not be dissipated by hasty or immature practice or application.

Important Companies Co-operated

"Our synchronization tests have consumed months of tireless experimental work. They have been conducted by the National Broadcasting Company, with the aid of the Radio Corporation of America, the General Electric Company, the Westinghouse Electric and Manufacturing Company, and with the cooperation of the American Telephone and Telegraph Company.

"I desire to be conservative, but I firmly believe we have reached the stage where synchronization of radio stations is possible, and that from now on we will be able to concentrate on refinements and improvements. When completed, I am confident the principles of synchronization can be satisfactorily applied to radio activities other than broadcasting, such as radio communications and television."

Other Experiences

The only other fully successful synchronization recently reported was that of WHO, Des Moines, and WOC, Davenport, Ia., 200 miles apart. WBZ-WBA had fair success, while WGY, Schenectady, N. Y., and WGO, Oakland, Calif., with a continent between, didn't do so poorly either.

Owner of KTNT Answers Charges

Washington.

Accused of operating KTNT, Muscatine, Iowa, against the public interest, by advertising medical "cures" and permitting direct quotation of pieces of commodities for sale by other air advertisers, Norman Baker, station owner, appeared before Ellis A. Yost, chief examiner of the Commission's staff. His license is at stake.

He renewed charges of a "conspiracy" of medical and other interests of the State to have the station removed from the air. He said he had attacked what he termed the "medical trust" over his station, and that at various times has mentioned all of his enterprises, including the Baker Institute for the Cure of Cancer, the Baker magazine, the Baker gasoline station, and various other interests.

He asserted he had repeatedly stated in talks over the station that "95 per cent of all operations are unnecessary."

50 STATIONS ON PROBATION NOW

Washington.

All broadcasting station licenses were renewed recently by the Federal Radio Commission, although not all for the full 90-day period, due to infractions of rules charged against the penalized stations, or to the fact the stations have appealed Commission rulings and obtained injunctions. More than fifty stations received only probationary licenses.

Among the complaints that caused issue of only probationary licenses were failure to announce phonograph records as such; excessive deviation from assigned frequencies; failure to announce call letters at 15-minute intervals, and broadcasting with power in excess of that authorized. Thirty-day probational licenses, instead of regular 90-day licenses, were given to the following, due to charges were under investigation:

WIBX, Inc., Utica, N. Y.; WCLB, Long Beach, N. Y.; KPRC, Houston, Tex.; WRBX, Richmond, Va.; WDBJ, Roanoke, Va.; WIBA, Madison, Wis.; KFJF, Oklahoma City, Okla.; KTSM, El Paso, Tex.; WDEL, Wilmington, Del.; WMSG, New York City; KQW, San Jose, Calif.; WMRJ, Jamaica, N. Y.; WSGH, WSDA, Brooklyn, N.Y.; WOWO, Ft. Wayne, Ind.; WDAF, Kansas City, Mo.; KGFL, Raton, N. Mex.; WAAM, Newark, N. J.; WCBM, Baltimore, Md.; WNBX, Springfield, Vt.; KGB, San Diego, Calif.; KGIQ, Twin Falls, Idaho; WILM, Wilmington, Del.; KJR, Seattle, Wash.; KFPY, Spokane, Wash.; KVL, Seattle, Wash.; WORC, Worcester, Mass.; KRE, Berkeley, Calif.; WDBR, Baltimore, Md.; WTAD, Quincy, Ill.; KRLD, Dallas, Tex.; WCDA, New York City; WNBR, Memphis, Tenn.; WOL, Washington, D. C.; WLBX, Long Island City, N. Y.; WFAA, Dallas, Tex.; WDWF-WLSI, Providence, R. I.; WNJ, Newark, N. J.

WREC-WOAN, Memphis, Tenn.

KFQW, Seattle, Wash.; WAIU, Columbus, Ohio.

WMBD, Peoria Heights, Ill.

The stations given conditional licenses because of appeals are: KYW, Chicago; WHAS, Louisville; WHAM, Rochester, N. Y.; WCBM, Baltimore; WGBS, New York; WICC, Hartford; and KFKB, Milford, Kans.

QUACKS FLOCK TO AIR, HEALTH CHIEF REVEALS

That medical fakers are using broadcasting stations, and particularly small stations, and in high-presure talks victimizing the listeners, was charged by Dr. Shirley W. Wynne, Health Commissioner of New York City.

He said:

"While reputable persons have broadcast health talks under the auspices of State and city departments of health and given helpful and honest advice over large stations, many charlatans, fake doctors and peddlers of strange machines have used the smaller, unsupervised stations as platforms from which to cry their spurious wares.

"We found that many individuals who represented themselves over the radio as physicians, and gave advice on medical matters, were not licensed physicians at all. Self-dosing with numerous quack medicines for a variety of ailments was being urged. Pills, socalled health foods, compounds supposed to contain roughage, and other patented preparations, were being fraudulently advertised as scientific products made under the direction of physicians.

"Outlaws" Take to Radio

"We found, in short, that virtually all of the various faddists, exploiters, and the like, who of recent years have been barred from advertising in reputable newspapers and magazines had taken to the radio, where, particularly in smaller stations, they had found a new haven of activity.

"The danger of this is that the charlatan now gains direct access to the family circle, through the radio. His manner is so clever that you can not tell whether his advice is genuine or whether he is merely trying to sell you something which for your health's sake you should not have.

"Powerless Cures"

"In many cases the devices or medicines sold by these radio fakers had power neither to cure nor to destroy. The menace of these apparently harmless frauds lies in the fact that they do no good. They induce a false sense of security, which may cause the patient to neglect his disease until it is too late.

"Beware also of radio speakers who advocate systems of healing which they claim may be applied hit-or-miss to all diseases. Such advice is open to even greater suspicion when offered in connection with the sale of imposing contraptions, and so-called "shotgun" pills, alleged to contain "an herb for each symptom."

"It is natural for a sick person to try any cure offered him. The hope and enthusiasm thus aroused may perhaps help him temporarily. An honest and ethical physician will never promise or guarantee cures; for this reason he is hardly on a competitive basis with the quack who is willing to guarantee anything and promise everything."

Interested in Short Waves?

If so, read next week's issue.

The date is November 8th.

Short-wave converters and adapters built for a few dollars—under $5, say.

Yep. See next week's Short-wave Issue of Radio World.

www.americanradiohistory.com

End Radio Bothers

DO YOU KNOW what's wrong when your radio set isn't working right? Ten to one, you don't. Twenty to one, you would if you had a copy of

Hoff's Radio Trouble Finder

Ever hear of M. M. Hoff, radiotrician, of Philadelphia? He was one of the very first "radio bugs" and has been building and studying sets ever since. And now, out of his broad experience, this man has written a book to tell radio owners how to keep their sets working right.

He tells in plain words and illustrations how a set is made, what the parts are called, what are the few usual troubles and how to fix them. Then he lists 103 troubles that sometimes happen and tells how to detect and fix each one.

The book is a regular cyclopedia of radio information—only it's in a language anyone can understand. Read it five minutes and you'll know more about radio than you ever dreamed of.

It will save you many a repair man. It will save you hours of guessing and fussing and fuming. It will help you to keep the tone of your set always sweet and strong. It will keep you from losing many programs. And, best of all—

IT WILL MAKE YOU STOP SWEARING—MUCH TO THE SURPRISE OF YOUR FAMILY—because radio repairs are expensive. Why hire them done when you can easily learn how to keep your set from needing them?

All It Costs Is $1

Send cash with your order and you get also a Dictionary of Radio Terms and the latest list of Radio Broadcasting Stations with call letters and the new Federal Radio Commission wave lengths. Send your dollar today while the copies last. Six copies for $4.00.

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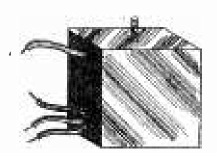

Cat. SUP-31

Three Supertone non-inductive fixed condensers of 0.1 mfd. each, encased in aluminum and 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, 1½" square by ⅞" wide. Order Cat. SUP-31, list price, $1.00; net price, 57c.

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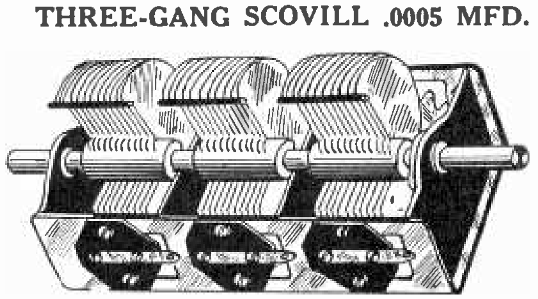
THREE-GANG SCOVILL .0005 MFD. WITH BRASS PLATES



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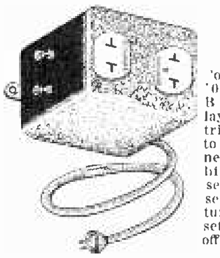

'onnect relay's cable plug to '05-125 volt AC line. Connect B eliminator cable plug to relay socket so marked; connect trickle or other charger's plug to relay socket so marked; connect one side of A battery to binding post, other side to A set. Then turning on your set twins on B eliminater and turns off charger, turning off set turns on charger and turns off B eliminator.

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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.

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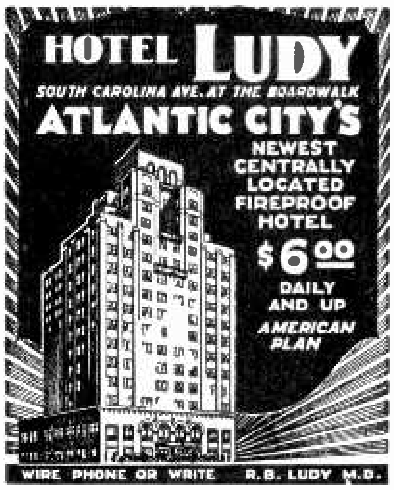

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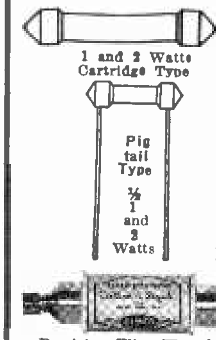

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Wired model (less cabinet) 29.88
Smoking stand cabinet, walnut finish...... 5.79

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Valuable information is also given as to how you can use the mails to secure orders and inquiries for your products or services.

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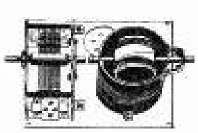
TUNER ASSEMBLIES



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 practical. 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
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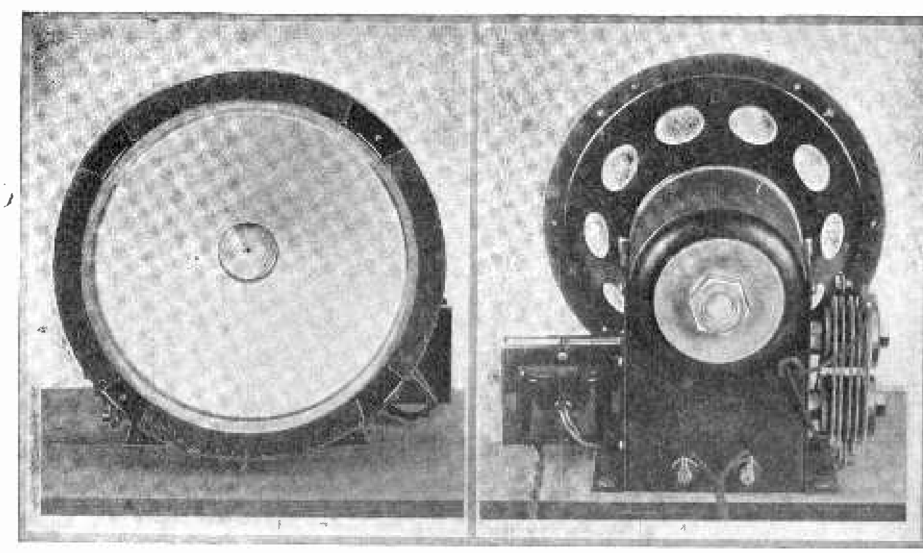
Erla Dynamic Chassis, Westinghouse Rectifier



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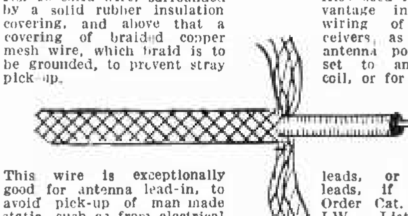

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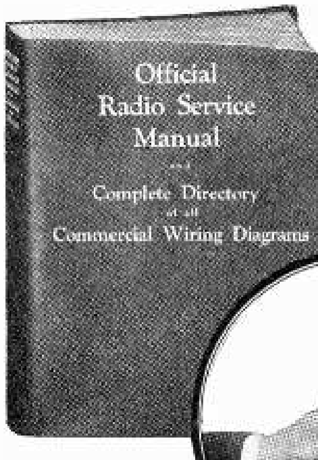

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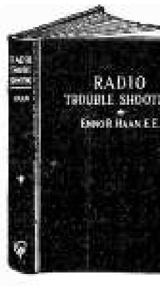

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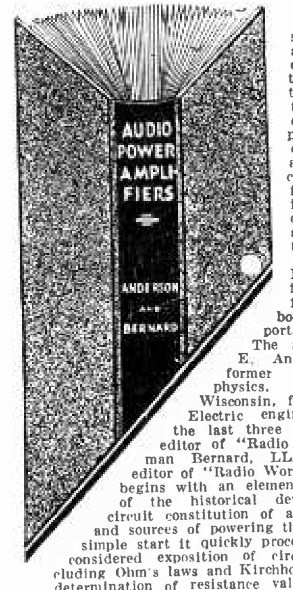

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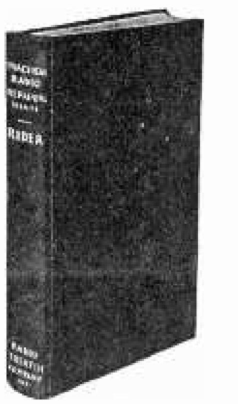

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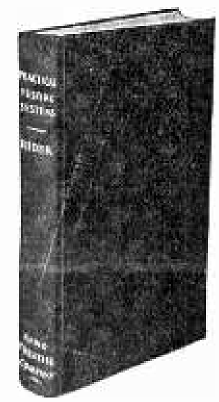

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