The De Luxe System of Radio Broadcast Reception

Dealing with the Construction of a Socket-Operated Receiver

By ARTHUR H. LYNCH

THIS article, the last of a series of three on the Modernized Browning-Drake circuit, covers principally the "electrification" of the set described in the May issue of RADIO NEWS, that is, adapting it to lamp-socket operation.

The receiver itself is the same except that it contains no audio amplifier, this being combined with the socket-power unit.

The combined power amplifier and socket-power unit is of a new type and gives excellent reproduction and all the volume desired. The same unit supplies the necessary "B" voltage for the receiver.

The "A" power unit is a combination low-capacity storage battery and trickle charger controlled by an automatic relay switch. It requires practically no attention.

If you are after one of the finest receivers and power amplifiers, both operating direct from the lamp socket, we would suggest that you build this one designed by Mr. Lynch.
—EDITOR.

PERHAPS that old saying about history repeating itself wasn't quite so far wrong after all At least from some recent observations, it seems to have some slight confirmation in the radio industry. Remember the old "pre-war" two-filament Audiotrons? Just this season a new tube manufacturer placed a double-filament 201A-type tube on the market.

And then how about the old tuner "boxes" and amplifier "boxes"? Complete receivers with tuners and audio amplifiers in one cabinet were almost unheard-of contraptions in the early days of radio.

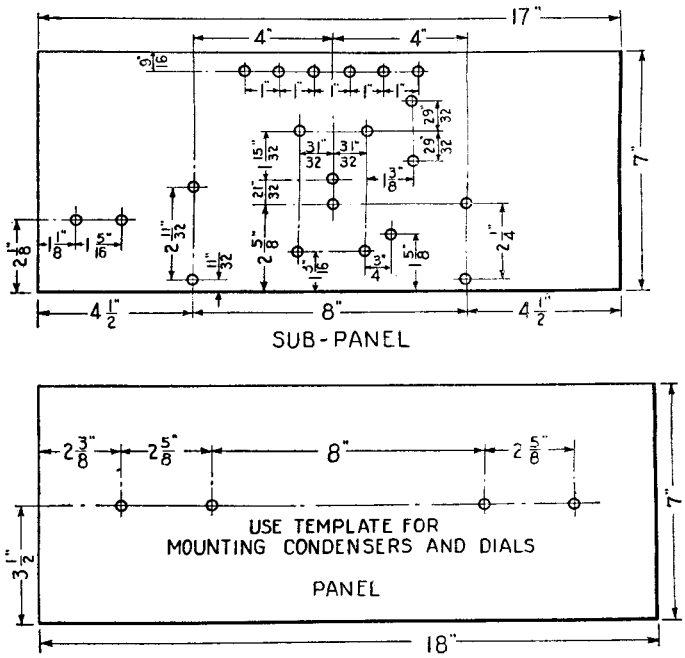
Then came broadcasting and the so-called "broadcast receivers," which for a time tried to include even the speaker and antenna as well as the batteries in the same unit as the set proper. Surely the reader hasn't already forgotten the D-10 De Forest set of only a few years ago.

But now, with well-nigh perfect audio reproduction obtained by means of the new lamp-socket-powered three-stage amplifiers, the separation of the radio and the audio amplification channels of broadcast receiving sets into at least two distinct units is apparent in some of the newer designs, such as the author's De Luxe system.

SEPARATE UNITS

The De Luxe system consists of an exceedingly efficient, selective, sensitive, easily-tuned, and reliable two-tube receiver, the output of which is fed through a new combination high-quality audio channel and lamp-socket power-supply device.

The amplifier-power unit supplies all necessary power to both the receiver and the amplifier, with the exception of the "A" power for the two tubes in the set and the first two tubes in the amplifier. "A" power for these tubes may be obtained either directly or indirectly from the lamp socket, as will be explained later in this article. The entire outfit is automatically controlled by the volume-control knob on the receiver. As this knob is turned from right to left, the volume gradually decreases from a full, life-like intensity to a mere whisper and then the entire outfit is automatically shut off. Turning the volume control to the right first turns on all the power and then gradually increases the volume.



Drilling and dimensional details of the panel and sub-panel.

FIG. 4

RADIO NO LONGER A CURIOSITY

Aside from volume, ease of control, and reliability of operation, perhaps the most desirable, and at the same time the most neglected, virtue of a modern broadcast receiver is fidelity of tone. When radio was new, it was classed as a novelty, and even a few squeaks and squawks ever so faintly resembling music were greeted with great enthusiasm. The novelty stage has now passed and perfection of performance is the paramount requisite of receiver design.

Listening to the receivers of past years may be rather accurately compared to a person's watching a ball game through a crack in the fence. There is, at first, a thrill attached to the process which tends to compensate for the inconvenience and limited vision. Soon, however, the novelty wears off and only a grandstand seat with full and undistorted vision will suffice to hold one's interest. The full, clear and undistorted tone quality, obtainable from the new-day radio receiver capable of such performance as the De Luxe system is even better than the grandstand seat. It brings the performance, the crowd, the excitement, in fact, everything, right to the listener's living room, without the inconvenience and expense of his going in person to the performance.

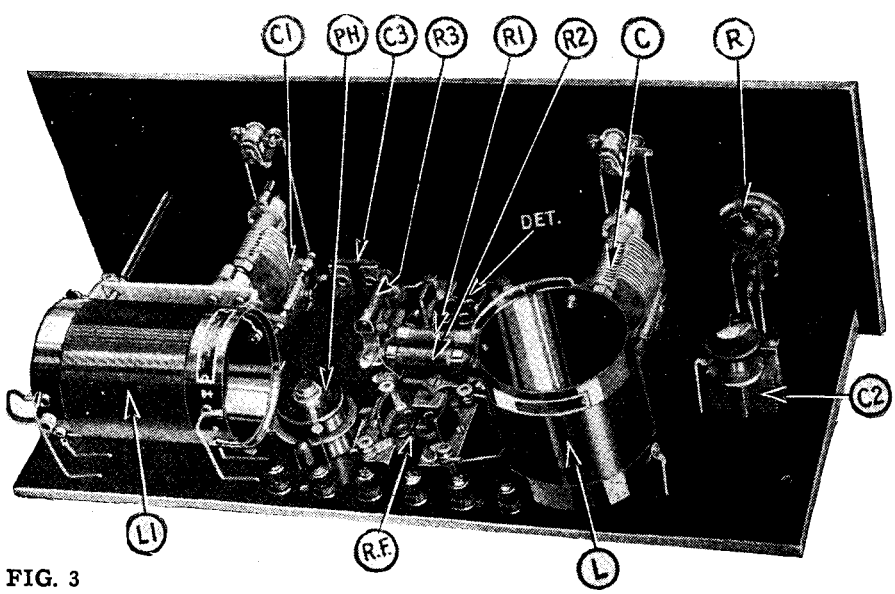


FIG. 3

A rear view of the special Browning-Drake receiver designed to operate with a separate audio amplifier and socket-power unit. The lettered parts are described in specification sheet on page 1458.

THE AMPLIFIER

As will be seen from Fig. 1, the heart of the De Luxe System is the power amplifier and "B" supply.

This unit comprises one stage of impedance-coupled and two stages of resistance-coupled audio-frequency amplification. The first two stages are used as voltage amplifiers and employ high-mu tubes; while the last stage is used as a power amplifier and employs the 171 type of tube. The remaining tube is a type "BH" Raytheon filamentless rectifier, which is used in the "B" and "C" voltage supply. A view of the unit itself is obtained from the illustration of Fig. 2.

The entire amplifier, together with its associated power supply equipment, is mounted on a sturdy cast-iron base, finished in block-crystal lacquer. Many of the small but essential parts, such as filament ballast

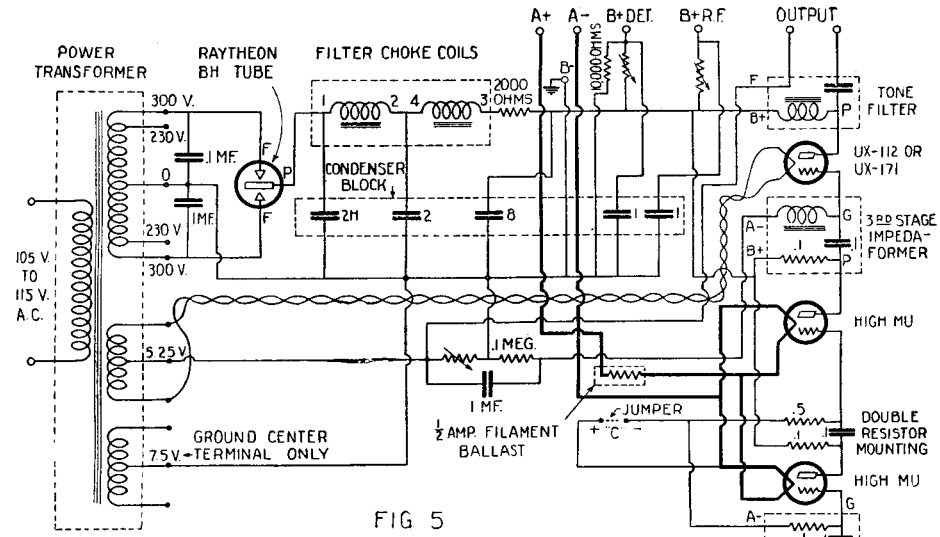


FIG. 5

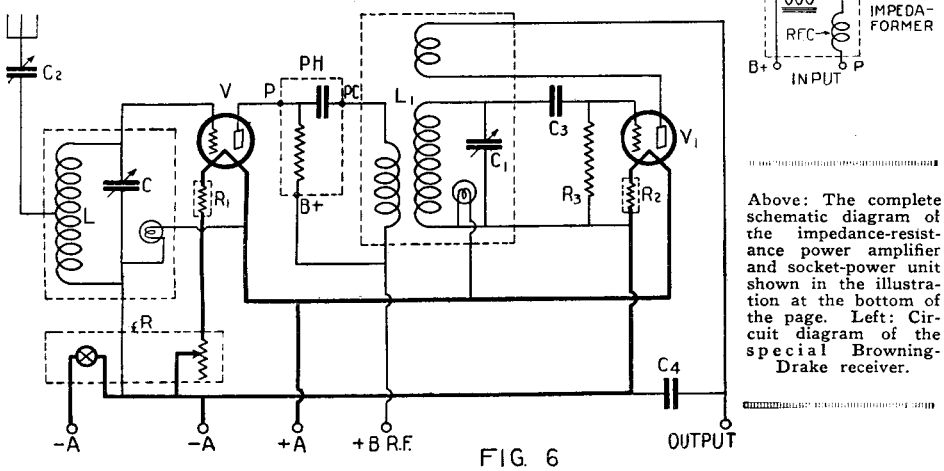


FIG. 6

Above: The complete schematic diagram of the impedance-resistance power amplifier and socket-power unit shown in the illustration at the bottom of the page. Left: Circuit diagram of the special Browning-Drake receiver.

resistors, buffer condensers, grid condensers, resistors and, of course, the wiring, are concealed within this base.

The power transformer, designed by Philip Eyrick of Cambridge, Mass., supplies, in addition to the high voltage for the Raytheon rectifier, a low voltage for use on the filament of the power tube. A noteworthy feature of the transformer is the special electrostatic shield between primary and secondaries to eliminate noise in the receiver due to line disturbances.

As a result of the use of unusually large air gaps and a generous iron core in the filter chokes, their inductance values remain unusually constant, even with heavy loads.

As the result of such design the amplifier may be used, when so desired, with superheterodyne and other multi-tube sets drawing heavy "B" current with the same excellent results as with a small two-tube set. Lower voltages, down to practically zero, are readily obtainable by means of the voltages-control knobs provided for the purpose.

The grid-bias voltage for the power tube is also variable and the control is mounted on the sloping front panel of the amplifier base, along with the two "B" voltage controls. By having this control variable either the 112 type or the 210 type tubes may be used in place of the 171, when so desired. Either the 210 or the 112 may be used, but the 171 type is the ideal tube. The volume obtainable from the amplifier when the 171 is used is greater than will ever be required in the majority of cases.

The amplifier channel itself has several unique features, of which perhaps the following are the most outstanding:

(1.) Incorporation of a radio-frequency choke in the input circuit, to keep the radio-frequency energy present in the plate circuit of the detector tube from getting into the amplifier and thus impairing the tone quality.

(2.) Use of an input impedance, rather than resistance, in order to make possible the use of the new special detector tubes with their high plate current.

(3.) The use of metallized filament, grid and plate resistors to insure permanent and noise-free results.

(4.) The use of the Millen system of amplifier stabilization and "motor-boating" prevention; a phase-shifting inductance in the power-tube grid circuit.

(5.) The use of a tone-filter in the output to prevent damage to the loud speaker and distortion due to the passing of the heavy plate current of the last or power tube through the loud-speaker windings.

(6.) The use of high voltage on all the amplifier tubes, made possible by the incorporation of the amplifier and power supply into a single unit. High "B" and "C" voltages are essential for the best tone quality.

THE TWO-TUBE SET

The radio section of the De Luxe system is identical in every way except physical layout with the radio end of the five-tube Modernized Browning-Drake receiver described by the writer in RADIO NEWS for May, 1927. In this instance, as only two tubes are incorporated in the receiver, a much smaller front panel is used. As no tubes need be placed along the back edge of the sub-panel, the standard tuning units with coils mounted directly on the backs of the variable condensers may be used without making the set more than seven inches deep. This arrangement simplifies construction to a considerable extent, as mounting the condensers automatically mounts the coils. The set is illustrated in Fig. 3. Incidentally, the variable condensers are designed to serve as mounting-brackets for carrying the sub-panel.

The coils themselves are unusually efficient, being wound with enameled wire on three-inch bakelite tubes in such a manner that each turn is spaced from the next by half the diameter of the wire. Such construction reduces electrical losses to a minimum. Another feature is the use of the new Phasatrol system of stabilization which has already been described.

As previously mentioned, a combination switch and rheostat serves as a volume control. The rheostat is employed in addition to a filament ballast resistor in the filament circuit of the R.F. tube. Such a combination prevents damage to the tube when the rheostat is turned all the way on. Another separate filament ballast is used to control the detector tube filament. The use of these insures the operation of tubes at the proper

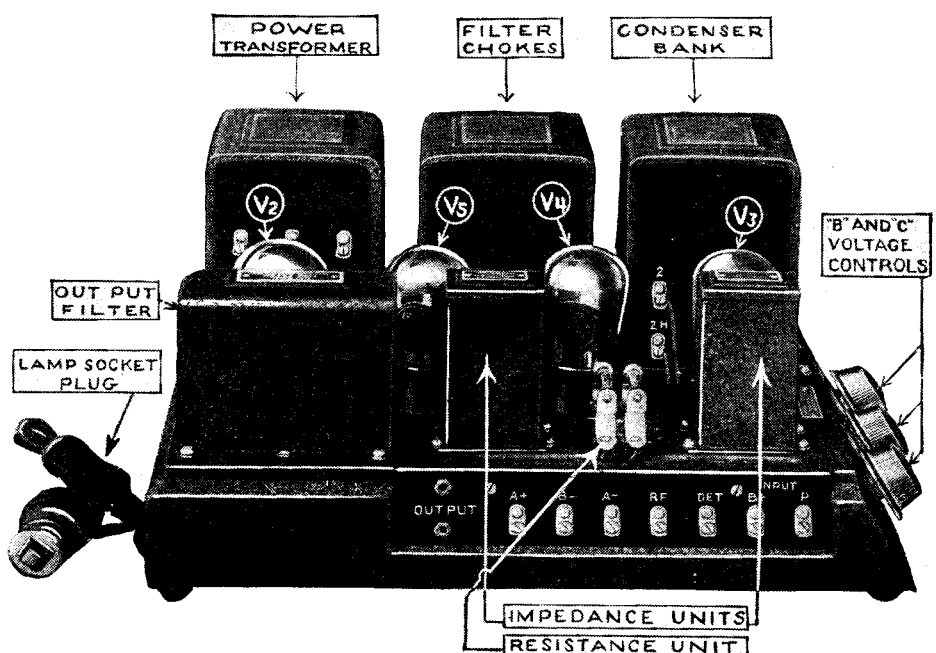


FIG. 2

The completely assembled and wired power amplifier and socket-power unit. This supplies the "B" and "C" voltages for the amplifier and the "B" voltages for the receiver.

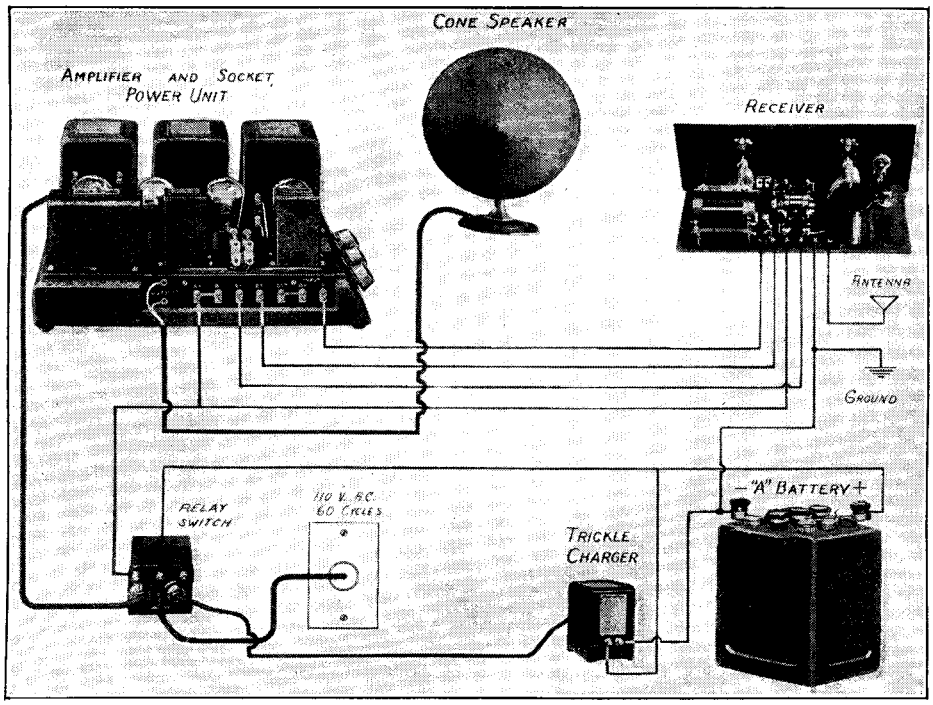


Fig. 1
A picture wiring diagram of the complete De Luxe system. The relay switch takes care of the "A" power unit, composed of the storage battery and trickle charger.

voltages without unnecessary controls and the use of an expensive voltmeter.

MOUNTING THE PARTS

In constructing the set, first prepare the front and sub-panels according to Fig. 4. The sub-panel is made half an inch shorter at each end than the front panel, so that the set will fit a standard 7x18-inch cabinet.

When the panels have been prepared, mount the tuning units in place, by means of screws through the sub-panel into the tapped holes in the bottom of the condenser frames. Then mount the two sockets, the filament ballast resistors, the grid-leak mounting, the antenna series condenser, the binding posts, and finally the Phasatrol. The "chassis" which results may then be almost completely wired before adding the front panel, which is fastened to the condensers. With the front panel in place, the dial lights and rheostat-switch may be wired, completing the set.

It is recommended that semi-flexible triple-insulated wire be used rather than bus bar. All connections must be carefully soldered, particularly those to the tuning units. The grid condenser should be mounted just as close to the grid terminal of the detector tube socket as possible.

The special "A—" filament connection is used so that the switch on the panel of the set may control the filament of the first two (the high-mu) tubes in the amplifier and, by means of a relay, the lamp-socket power, as well as the two tubes in the set.

"A" POWER FOR THE SYSTEM

There are two general forms of lamp-socket "A" power. One consists of a combination of trickle charger and small "A" battery, so arranged that the battery is automatically placed on charge whenever the set is not in operation. Such a system is economical, reliable, and exceedingly satisfactory from an engineering point of view.

The other, or true "eliminator" method, is, in its present state of development, rather expensive and more difficult to adjust.

For economy, silent performance and reliability with a minimum of care, the system illustrated in Fig. 1 is recommended. The trickle charger may be of either the bulb or chemical types; or, if preferred, one of the combination outfits, in which the battery and trickle charger are enclosed within a single case, may be employed.

OPERATING THE SYSTEM

The first step to be taken in putting the De Luxe into operation after the various units have been connected together, as shown in Fig. 1, is to insert the various tubes in their proper sockets.

Although we have a set with but one stage of radio-frequency amplification, due to the use of special R.F. and detector tubes, of a regenerative detector circuit and of extremely low-loss coils and condensers, the receiver is exceedingly sensitive to weak signals from distant stations.

Thus, through the use of only a single stage of R.F., the cost of the set is reduced, the construction and operation simplified and, most important of all, the audio quality is not jeopardized by the cutting of side-bands, which takes place in many multi-stage radio-frequency amplifiers.

In the amplifier the tubes used are two high-mu, a 171, and a Raytheon "BH," as indicated in the illustration. Tubes of the 201A type should not be used, under any condition, in the amplifiers; as the grid-biasing voltage provided for the first two tubes is correct only for high-mu tubes.

With the tubes in place, loosen all three variable voltage controls on the amplifier, insert the cord from the relay switch into a base outlet or lamp socket and turn up the volume control on the panel of the set.

Next turn in the grid-bias control on the panel of the amplifier almost as far as it will go. Do not, however, turn it all the way. Then turn in the other two controls very slightly. A local broadcast station

(*Continued on page* 1472)

SYMBOL	Quantity	NAME OF PART	REMARKS	MANUFACTURER ★	
			RECEIVER		
L	1	Antenna Coil		1	
L1	1	R. F. Transformer	With variable tickler coil	1	
C	1	Var. condenser	0.0005 mf. Attached to coil L	1	
C1	1	Var. condenser	0.00025 mf. Attached to coil L1	1	
C2	1	Var. condenser	10 to 150 mmf. Midget type	2	17
C3	1	Grid condenser	0.00025 mf.	3	4,5,7,18,19,20,21,22
C4	1	Fixed condenser	0.001 mf. By-pass	4	3,5,7,18,19,20,21,22
R	1	Rheostat	10 ohms. Combined with fil. switch	5	23,24
R1,R2	2	Fil. ballast Res.	5 v. 1/4 amp. With mountings	6	25,27,28
R3	1	Grid leak	6 megohms. With mounting	6	3,4,7,18,27,28,29
PH	1	Phasatrol	Stabilizing device	7	
	2	Sockets	UX type	8	9,26,30,31,32
	6	Binding posts		9	17,31
	1	Panel	7" X 18" X 3/16"	10	33,34,35,36
	1	Sub-base	7" X 17" X 3/16"	10	33,34,35,36
	2	Dials	Vernier, illuminated	1	37
		Hookup wire		11	38,39
V	1	Tube	5 v. 1/4 amp. R.F. amplifier	12	40,41,42,43
V1	1	Tube	5 v. 1/4 amp. Special detector	12	40,41
			AMPLIFIER and POWER UNIT		
	1	Power amplifier	Including socket-power unit	1	
	1	Relay switch		13	23,44
	1	Trickle Charger		14	15,45,46,47,48,49
	1	Storage Battery	6 v., 40-60 ampere hours	15	14,50
V2	1	Rectifier tube	Filamentless type	16	
V3,V4	2	Tubes	5 v., 1/4 amp. High-Mu	12	40,41
V5	1	Tube	5 v., 1/4 amp. Power amplifier	12	40,41,42,43
	roll	Connection wire		11	38,39

NUMBERS IN LAST COLUMN REFER TO CODE NUMBERS BELOW.

1 The National Co.	2 Precise Mfg. Co.	3 Dubilier Condenser Corp.
4 Tobe-Deutschmann Co.	5 Carter Radio Co.	6 Arthur H. Lynch, Inc.
7 Electrad, Inc.	8 Airgap Products Co.	9 H. H. Eby Mfg. Co.
10 Micarta Fabricators, Inc.	11 Belden Mfg. Co.	12 C. F. Mfg. Co. (Ceco)
13 L. S. Brach, Inc.	14 Westinghouse Elec. & Mfg. Co.	15 Electric Storage Battery Co.
16 Raytheon Mfg. Co.	17 X-L Radio Labs.	18 Aerovox Wireless Corp.
19 Wireless Specialty App. Co.	20 Potter Mfg. Co.	21 Sprague Specialty Co.
22 Sangamo Elec. Co.	23 Yaxley Mfg. Co.	24 Central Radio Labs. (Centralab)
25 The Radiall Co. (Amperite)	26 Alden Mfg. Co.	27 Daven Radio Corp.
28 Langbein & Kaufman Co. (Elkay)	29 International Rec. Co. (Durham)	30 Silver-Marshall, Inc.
31 General Radio Co.	32 Benjamin Elec. Co.	33 Amer. Hard Rubber Co. (Radion)
34 Insulating Co. of Amer. (Insuline)	35 Diamond State Fibre Co.	36 Formica Insulation Co.
37 Martin-Copeland Co. (Marco)	38 Acme Wire Co.	39 Cornish Wire Co.
40 Radio Corp. of Amer.	41 E. T. Cunningham, Inc.	42 The Van Horne Co.
43 The Magnavox Co.	44 Jewell Elec. Inst. Co.	45 Fansteel Products Co.
46 Konite Corp.	47 Kodel Radio Corp.	48 General Elec. Co.
49 Valley Elec. Co.	50 Gould Storage Battery Co.	

★ **THE FIGURES IN THE FIRST COLUMN OF MANUFACTURERS INDICATE THE MAKERS OF THE PARTS USED IN THE ORIGINAL EQUIPMENT DESCRIBED HERE.**

If you use alternate parts instead of those listed in the first column of manufacturers, be careful to allow for any possible difference in size from those originally used in laying out and drilling the panel and sub-base.

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should next be tuned in, and the three knobs readjusted for best results.

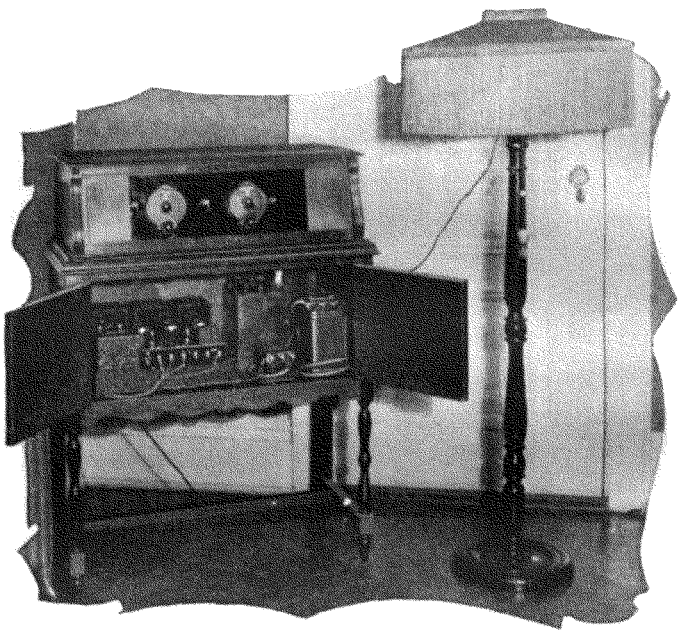
During this process the adjustment on the Phasatrol should be set halfway between the two extreme positions. With the amplifier adjusted, the Phasatrol should be readjusted, by means of a long stick sharpened at one end to resemble the point of a screwdriver.

The proper adjustment of the Phasatrol is such that both dials may be tuned to resonance without the set's oscillating. During this process the tickler coil should be turned at right angles to the large coil L1, to which it is attached.

A variation of the detector-voltage control on the amplifier will enable an adjustment to be secured such that the detector tube will go into oscillation smoothly as the tickler coil is rotated.

The antenna series condenser should be so adjusted that the two tuning dials read very nearly alike when tuned to any one station.

The call letters may be recorded directly on the dials, to facilitate the reception of the same stations at a later date.



The De Luxe system mounted in a handsome console, the amplifier unit and power supply beneath. The adjustable panel is adapted to the short chassis. The remote speaker is not shown.