

## AMPLIFIERS

### 100-TYPE LOUDSPEAKER SETS

#### DESCRIPTION

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#### 1. GENERAL

1.01 This section describes the transmission, equipment, and circuit features of the 100-type loudspeaker sets. This section includes information formerly contained in Section AB22.334, Issue 3 and Addendum.

1.02 The 100-type loudspeaker set consists of an amplifier and a loudspeaker mounted in a small walnut-finished cabinet suitable for use on an office desk or table. The 100-type set is intended for use with key equipments and for general monitoring application. The housing is 11½ inches wide, 7½ inches high, and 5½ inches deep. The set is arranged to operate on 105- to 125-volt power supply, either dc or 25- to 60-cycle ac. A 6 foot power cord equipped with a 2-conductor nonpolarized plug is furnished for connection to a convenience outlet. A 5 foot 6 inch input cord equipped with spade tips is also provided for connection to the telephone circuit. The set weighs 11 pounds.

1.03 On the front of the cabinet is a grilled opening for the loudspeaker, a pilot light and two control knobs, that on the left controlling the loudspeaker volume and that on the right operating the power switch. The rear of the cabinet is enclosed by means of a metal back plate. A number of ventilating slots are provided in the top of the cabinet. These, together with the openings in the back plate, permit a circulation of air. This aids in carrying off the heat from the electron tubes and resistors. The slots in the top of the cabinet also provide a ready means of checking the filaments of the tubes which are connected in series.

1.04 Figs. 1 and 2 illustrate the front and rear, respectively, of the 100-type loudspeaker sets. In Fig. 2 the back plate is removed to show the internal arrangement. The 100F set is used for illustration.

1.05 The electron tubes used in the amplifier are of the heater element type and require about one minute to become heated to operating temperature when full voltage is applied.

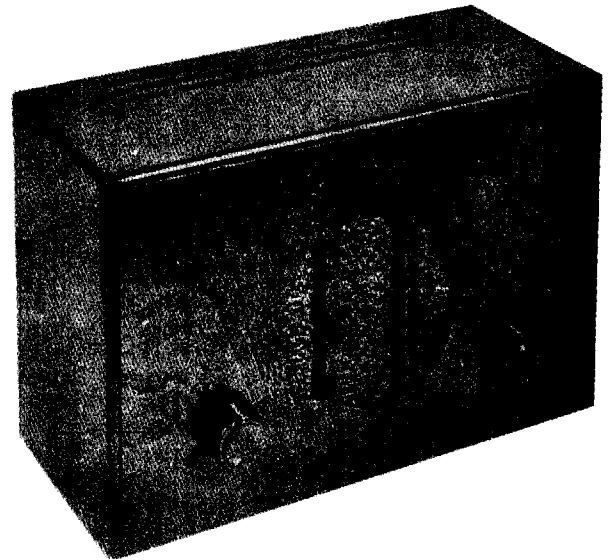


Fig. 1 — Front View

1.06 When operated on alternating current the poling of the power plug may affect the amount of noise heard when the set is operating. When operated on direct current the amplifier will operate only when the power plug is properly oriented with respect to line polarity.

#### 2. EARLY MODELS - 100A TO E, INCLUSIVE

2.01 In appearance the 100A, B, C, D, and E sets are very similar to the 100F illustrated. In the 100A, B, and C the ventilating slots in the top of the cabinet extend forward from the rear of the cabinet rather than from side to side.

2.02 In addition to the usual "Off" (left-hand) and "On" (right-hand) positions, the power switch in the early models is provided with an intermediate position which applies a reduced voltage to the electron tubes. When the switch has been in this position for two or more minutes the tubes will become fully heated within 5 seconds after the switch is turned to the "On" position. The reduced voltage arrangement is provided to conserve power consumption and electron tube life during intervals when it is desired to have the loudspeaker set ready for use at short notice. With the power switch in the intermediate position the pilot lamp glows dimly and the output of the amplifier is short-circuited.

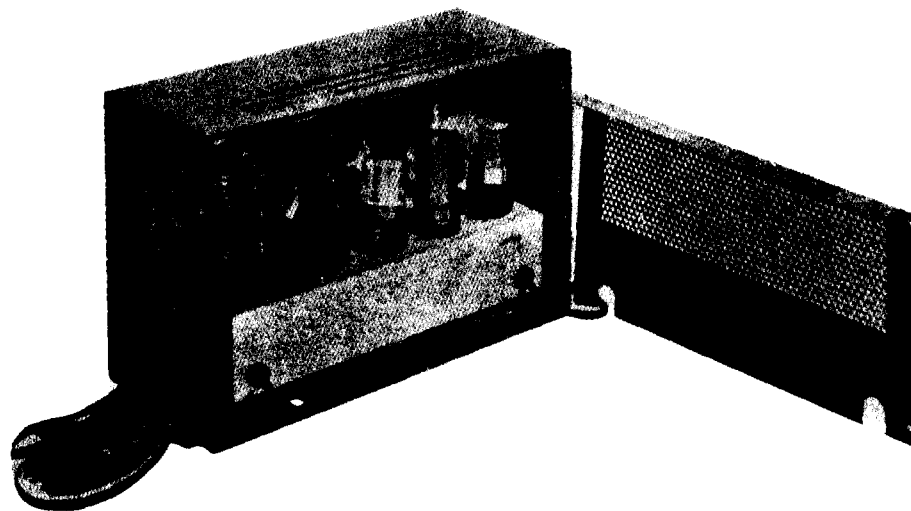


Fig. 2 — Rear View

**2.03** The rear of the loudspeaker set is closed by a brown enamel finished metal plate to prevent accidental contact with any of the parts of the amplifier. Louvers in the plate permit adequate air circulation; it is fastened by machine screws to the rear of the case and serves to hold in the operated position a safety door switch mounted on the rear of the chassis.

**2.04** Early 100-type loudspeaker sets were equipped with electron tubes as follows:

- Rectifier - RCA-25Z5
- First Stage - RCA-77 or 78
- Second Stage - RCA-43

The 77- and 78-type electron tubes used in the first stage of the older 100-type loudspeaker sets were found to be unsatisfactory in some instances because of a particular combination of circumstances involving tube, 100-type set and line voltage conditions, although each might be within allowable limits. The distortion and loss of volume was noticeable in a few cases. For these older sets a special Raytheon CK 108 tube is recommended for the first stage in cases where this trouble is noticed. Raytheon 43- and 25Z5-type tubes are also specified in place of the similar RCA tubes previously used in the sets. Although there were no indications that the previous RCA 43 and 25Z5 tubes used were unsatisfactory in any of the sets, this latter change was made to simplify the handling of the tubes.

**2.05** While the manufacture of the earlier 100-type sets has been discontinued, the existing sets may, of course, remain in service and be used interchangeably for most installations. Schematic diagrams of these sets are shown in Figs. 3, 4, and 5.

**2.06** Electrically, the 100A set differs from the later 100-type sets in that the latter have a maximum gain of 60 db as compared to 70 db for the

100A sets. This change was made because the 10 db additional gain will apparently seldom be required to obtain sufficient volume, whereas its omission reduces the possibility of subscribers hearing crosstalk, noise, or babble of objectionable magnitudes due to improper use of the higher gains. The reduction in gain was obtained by a minor change in the interstage resistance coupling.

**2.07** In 100D and later loudspeaker sets the resistance in the power supply circuit has been increased 15 ohms. This was done to extend the tube life in areas where the line voltage is above 115 volts. It may be desirable, therefore, to give preference to the use of the 100D or later sets in the higher voltage areas. This change does not affect the performance of the set for voltages below 115 except where the voltage may be as low as 95 to 100 volts, in which case, the gain and maximum undistorted output level may be reduced slightly. In areas where this is an important consideration, the 15-ohm resistance may be strapped out. This may be done by removing the back of the cabinet, unsoldering the connection to the top lug on the resistance nearer the back of the set and soldering it to the lug immediately below.

**2.08** The over-all frequency characteristics of the 100-type loudspeaker set are uniform within a range of about  $\pm 5$  db from about 300 cycles to about 3000 cycles. The input transformer is designed to be used as a termination of the telephone line. Its dc resistance is about 40 ohms which is sufficiently low to hold any supervisory relays in the telephone circuit. The transmission characteristics of this input coil are not appreciably affected by the normal amount of direct current which will flow through the line winding from the telephone line. The input impedance of the loudspeaker set is nominally 600 ohms over the voice-frequency range.

**2.09** A small metal plate bearing the following instructions is attached to the top of the cabinet of 100C, D, and E sets:

**FOR BEST RESULTS**

**USE LOWEST SETTING**

**GIVING SATISFACTORY VOLUME**

Ask Distant Person to Talk Clearly  
as Though Addressing an Audience

**BELL SYSTEM**

**2.10** In the 100E set the chassis is directly connected to one side of the power supply line cord.

**2.11** Schematic diagrams of early sets are shown in Figs. 3, 4, and 5.

**3. CURRENT MODEL - 100F**

**Transmission Features**

**3.01** The 100F set is designed to operate from a telephone line or other nominal 600 ohm source as was the case with the earlier sets. The output power capabilities have been increased, making the new set capable of an acoustic output approximately 8 db greater than that of the early sets. This will provide more satisfactory service in noisy locations. The over-all gain of the old and new sets has been kept the same (60 db), however, because of crosstalk considerations. With this amount of gain, and ambient room noise not in excess of about 70 db R.A.P., the set can produce a comfortable listening level if the electrical input is between +10 and -36 vu.

**3.02** A permanent magnet loudspeaker is used in the 100F set. Adjustment of the amplifier for optimum acoustical balance between low and high frequencies with this loudspeaker results in an electrical response approximately 5 db lower at 5000 cycles than that of the amplifier in the 100E set.

**3.03** Power supply requirement for the 100F set is approximately 50 watts at 105 to 125 volts either dc or 20 to 65 cycles ac.

**Equipment Characteristics**

**3.04** In size and general appearance the 100F set is about the same as other sets; several equipment improvements have been incorporated, however. In particular the ventilation has been improved. In the older sets ventilation is largely dependent upon the slots in the top of the cabinet. If they are obstructed, high internal temperatures may be encountered. In the 100F set, in addition to these slots in the top, the rear cover is perforated with round holes. It is spaced 3/16 inch from the top and bottom of the box for additional air circulation. This rear cover is shaped so that if the slots in the top are blocked, the cover absorbs a larger proportion of the heat and keeps the internal temperature within safe limits.

Under this condition the temperature of the cover may rise enough to be uncomfortable to touch but not enough to be hazardous. It is better to keep the top and back ventilating slots clear of obstructions.

**3.05** The 100F set has a two-position power switch with "ON" and "OFF" positions. This differs from the 100E set which has a three-position power switch with "ON," "STAND-BY," and "OFF" positions.

**Circuit Description**

**3.06** The chassis of the new set is connected to the power line through a 0.1 mf condenser instead of directly, thereby eliminating the necessity of other measures required to limit the possibility of shocks and of fire hazard from short-circuiting the chassis to ground during maintenance. Certain filament and plate circuit resistors are included in a plug-in type unit to avoid exposed line terminals. These changes permit the elimination of insulators from the chassis mounting, the door switch associated with the rear cover plate, and the perforated fibre screen which was formerly required to prevent contact with the live chassis by accidental penetration of the loudspeaker grille cloth.

**3.07** Several other minor changes involve the modification of the plate filtering circuit to a resistance-capacitance filter. The loudspeaker is mounted by fixed angle brackets instead of by springs and one of the four slots has been omitted from the top of the box. The instruction plate is decalcomania instead of metal. Newer types of pilot lamp socket and power cord are used.

**3.08** The schematic circuit is shown on the attached Fig. 6. The set contains a two-stage amplifier with an input transformer (T1) for operation from a nominal 600-ohm source and an output transformer (T2) for matching the load impedance of the self-contained loudspeaker to the plate circuit of the second stage. The input transformer primary winding is designed to allow passage of enough dc to hold supervisory or switching relays. A level control potentiometer (P1) is connected between the secondary of the input transformer and the grid circuit of the first stage electron tube (V1). This tube is a 6SL7GT dual triode with the two sections in parallel. The 15,000-ohm current limiting resistor is included in series with the grid of the second portion of V1 to comply with the requirements of the Underwriters' Laboratories, as this grid uses terminal Number 1 of the socket which terminal number is the shield of metal electron tubes. The interstage coupling circuit contains a 110,000-ohm plate resistor (R2), a .001 microfarad coupling condenser (C1), and a .62 meg-ohm grid resistor (R3).

**3.09** The second stage electron tube is a pentode-operated 25L6GT. The .04 microfarad condenser (C4) across the primary of the output transformer reduces the gain at higher frequencies relative to that at 1000 cycles per second. Each stage has an

unbypassed cathode resistor, 2400 ohms (R1) for the first stage and 240 ohms (R4) for the second stage, which provide local feedback in each stage.

**3.10** For ac operation the 25Z6GT electron tube acts as a half-wave rectifier at the output of which is a 22,000-ohm voltage-stabilizing resistor (R6). The plate and screen supplies for the amplifier stages are filtered by a resistance-capacity filter composed of R7 and R8 and a three-section electrolytic condenser (C3). The heaters of all three electron

tubes are in series. The voltage reducing series resistors are R5.1 and R5.2. The latter is in parallel with the power pilot lamp. These voltage reducing resistors together with the rectifier plate protective resistors (R5.3 and R5.4) are all contained in a plug-in unit for insertion in an electron tube socket. The 0.1 microfarad protective condenser (C2) is designed to comply with the Underwriters' Laboratories requirements for ac-dc devices of this type. The schematic circuit diagram of the 100F set is shown in Fig. 6.

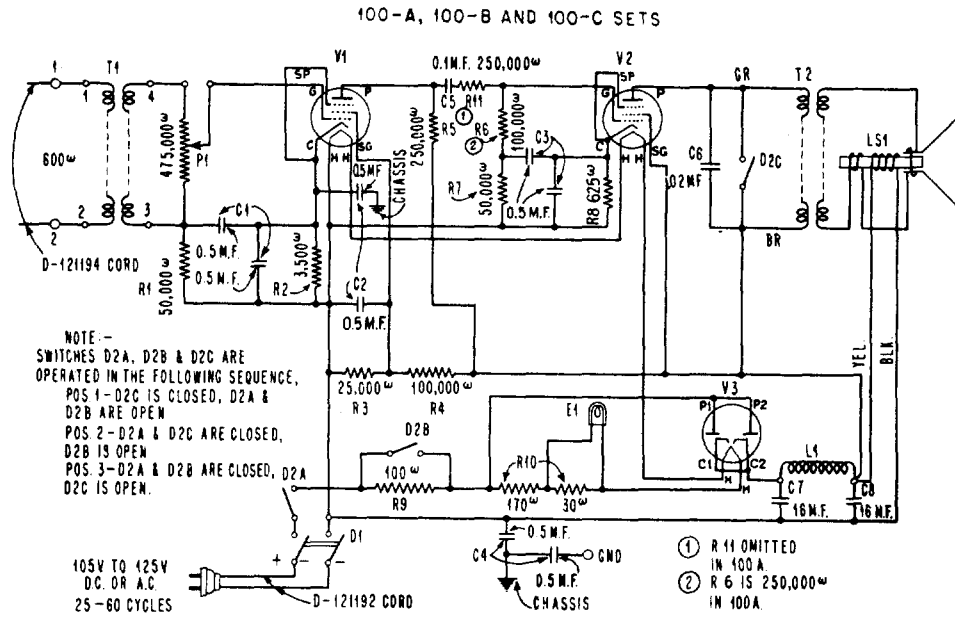


Fig. 3—100A, B, and C Schematic Diagram

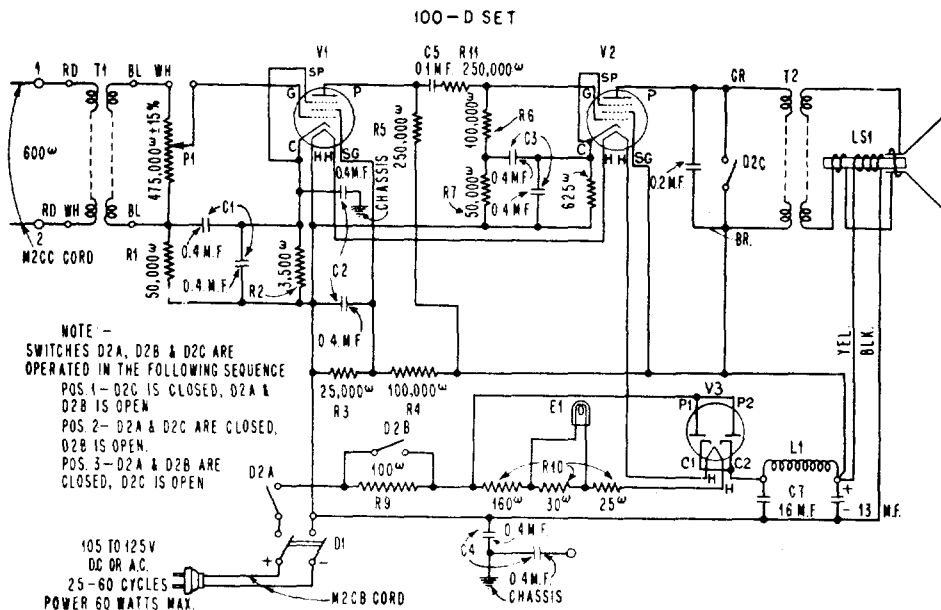


Fig. 4—100D Schematic Diagram

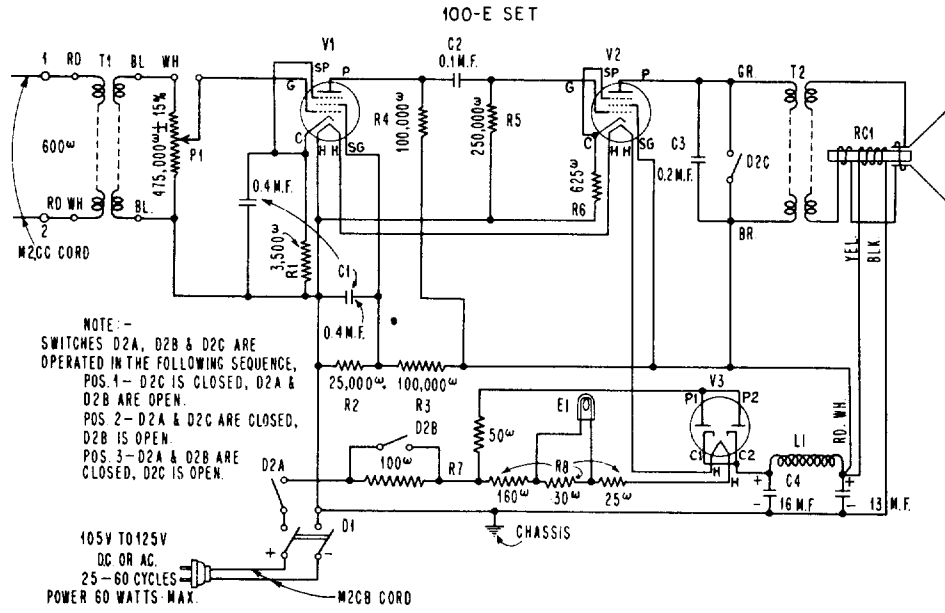


Fig. 5—100E Schematic Diagram

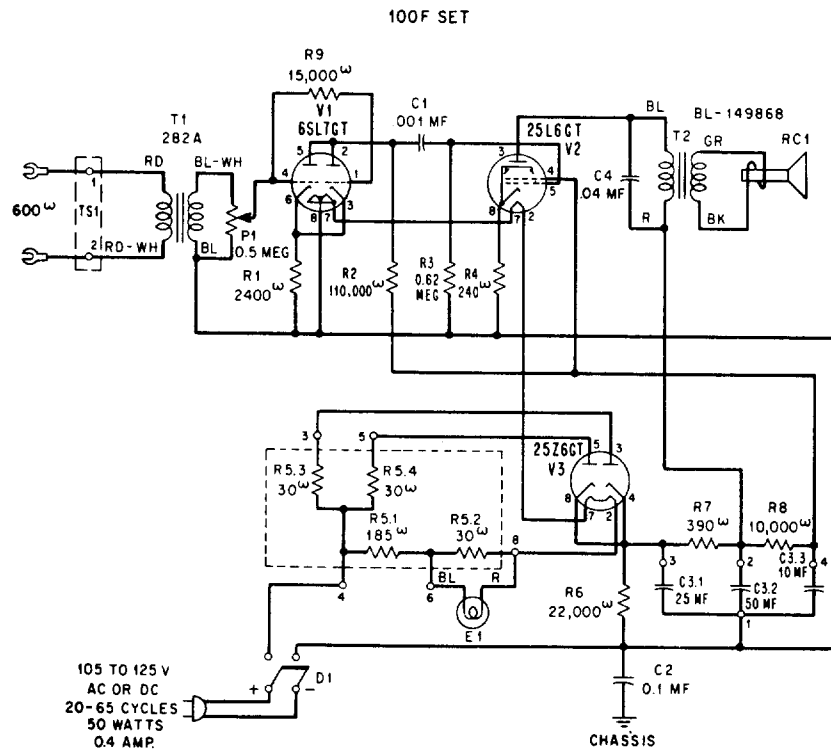


Fig. 6—100F Schematic Diagram