

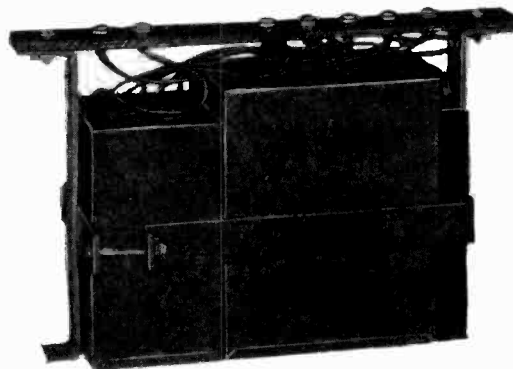
# A.C. OPERATION OF RADIOLAS 25 AND 28

Using A.C. Packages Model UP-971  
and Model UP-972

## SERVICE NOTES

A C -25-28-1

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UP-972 Condenser Bank

## RADIO CORPORATION OF AMERICA

*Prepared by*

**SERVICE DIVISION of the PRODUCTION AND  
SERVICE DEPARTMENT**  
233 Broadway, New York City

### DISTRICT SERVICE STATIONS

326 Broadway  
New York City

2001 West Pershing Road  
Chicago, Ill.

274 Brannan Street  
San Francisco, Cal.

1412 Monroe Street, N. W.  
Washington, D. C.

## A WORD OR TWO ABOUT SERVICE

Service goes hand in hand with sales. The well informed Radiola Dealer renders service at time of sale in affording information as to proper installation and upkeep. Subsequent service and repair may be required by reason of wear and tear and mishandling, to the end that Radiola owners may be entirely satisfied.

Obviously this service can best be rendered at point of contact and therefore Dealers and Distributors who are properly equipped with a knowledge of the design and operation of Radiolas occupy a favorable position to contract for this work.

To assist in promoting this phase of the Dealers business the Service Division of the RCA has prepared a series of Service Notes—of which this booklet is a part—containing technical information and practical helps in servicing Radiolas.

This information has been compiled from experience with Radiola Dealers' service problems, and presents the best practice in dealing with them. A careful reading of these Service Notes will establish their value to Dealer and Distributor, and it is suggested they be preserved for ready reference.

In addition to supplying the Service Notes the RCA, through its Service Stations, has available to Dealer and Distributor the services of engineers who are qualified to render valuable help in solving service problems.

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# CONTENTS

	<i>Page</i>
A Word or Two About Service . . . . .	2
Protective Seals and Their Use . . . . .	4
Protective Devices . . . . .	4
Introduction . . . . .	5

## PART I—PROBLEMS ARISING IN A.C. OPERATION OF RADIOLA 25

Voltage Readings . . . . .	5-7
Catacomb Tests—Coils and Connections . . . . .	7
Catacomb Tests—Condensers . . . . .	7
Continuity Test Instructions . . . . .	8
Panel Tests . . . . .	8
Resistance Strip Tests . . . . .	9
Installation Change in A.C. Package UP-971 . . . . .	10

## PART II—PROBLEMS ARISING IN A.C. OPERATION OF RADIOLA 28

Voltage Readings . . . . .	11
Catacomb Tests—Condensers . . . . .	13
Catacomb Tests—Coils and Connections . . . . .	13
Panel Tests . . . . .	13
Panel Tests—Condensers . . . . .	13
Resistance Strip Tests . . . . .	14
Changes in Factory Built A.C. Radiola 28 . . . . .	14

## PART III—PROBLEMS COMMON TO A.C. OPERATION OF RADIOLAS 25 AND 28

A. C. Packages and Cable . . . . .	15
High, Low or No Voltage Readings at Terminal Strip of Radiola . . . . .	17
No-Current Voltmeter . . . . .	17
Distortion in the Speaker . . . . .	18
Fluttering . . . . .	19
Blasting . . . . .	19
Howling . . . . .	19
Fading of Signals . . . . .	19

## ILLUSTRATIONS

UP-972 condenser bank . . . . .	1
Radiola 25 A.C. operated continuity circuit diagram . . . . .	6
Wiring diagram for resistance measurement . . . . .	9
Panel wiring change required for installation of UP-971 in some models of Radiola 25 . . . . .	10
Radiola 28 A.C. operated continuity circuit diagram . . . . .	12
Installing condenser bank of A.C. Package UP-972 . . . . .	15
Panel layout, circuit diagram and complete model of No-current Voltmeter . . . . .	16

## PROTECTIVE SEALS AND THEIR USE

The lead seals placed on various units of Radiola 25 and 28 and RCA Loudspeaker Model 104 are for the protection of the dealer. Broken seals indicate tampering.

Under no circumstances should a catacomb seal be broken. The special parts that go to make up the catacomb are impregnated in a wax compound and it is neither advisable nor practical to attempt repairs without proper equipment. If tests indicate a defective catacomb replace it with a new one, returning the defective one through the regular channels to the nearest RCA Service Station.

A service man may sometimes find it necessary to break a seal in the R. P. A. unit of the Model 104 Loudspeaker in order to make repairs. In such instances he should replace those broken by suitable substitute seals when the repair work is finished. Thus he is aided in determining whether any trouble that may develop later is due to tampering or ordinary wear and tear of assembled parts. The unit that has been tampered with will be indicated by a broken seal.

## PROTECTIVE DEVICES

In RCA Loudspeaker Model 104 there will be found two protective devices, one a safety switch and the other an interlocking device. The safety switch is designed to break the A.C. input current when the rear door is removed and make it impossible to operate the Loudspeaker unless the door is in place. The interlocking device is a small sliding door so arranged that it is impossible to open the terminal door of the R.P.A. unit unless the A.C. input plug is first removed.

It should be understood that the electrical protective devices on RCA Loudspeaker Model 104 are adjusted at the factory. If for any reason a service man finds it necessary to remove them to adjust or replace a defective part, great care should be taken in reassembling to see that they are returned to proper operation. Dealers should caution their customers not to attempt to render these protective devices inoperative or to experiment with the apparatus inside the metal cabinet or R.P.A. unit.

# SERVICE NOTES

## A.C. OPERATION *of* RADIOLAS 25 *and* 28

*Prepared by*  
RCA SERVICE DIVISION  
A C -25-28-1

### INTRODUCTION

The problems that arise in A.C. operation of Radiolas 25 and 28 driven by RCA Loudspeaker Model 104 are somewhat different from the problems encountered in battery operation of these Radiolas. The present Service Notes deal only with A.C. operation. For information on service problems encountered with battery operated Radiolas 25 and 28 consult the "Service Notes" issued on those models.

In A.C. operation with RCA Loudspeaker Model 104 A.C. Package UP-971 is used with Radiola 25 and A.C. Package UP-972 with Radiola 28. These A.C. Packages consist essentially of a special condenser bank, Catacomb resistance strip, "Volume Control" and "Battery Setting" resistances, connecting cables and other miscellaneous items. The instructions for installing the various parts are given in the "Instruction Book" accompanying the particular A.C. package.

The present notes are divided into three parts:

- I. Problems Arising in A.C. Operation of Radiola 25.
- II. Problems Arising in A.C. Operation of Radiola 28.
- III. Problems Common to A.C. Operation of Radiolas 25 and 28.

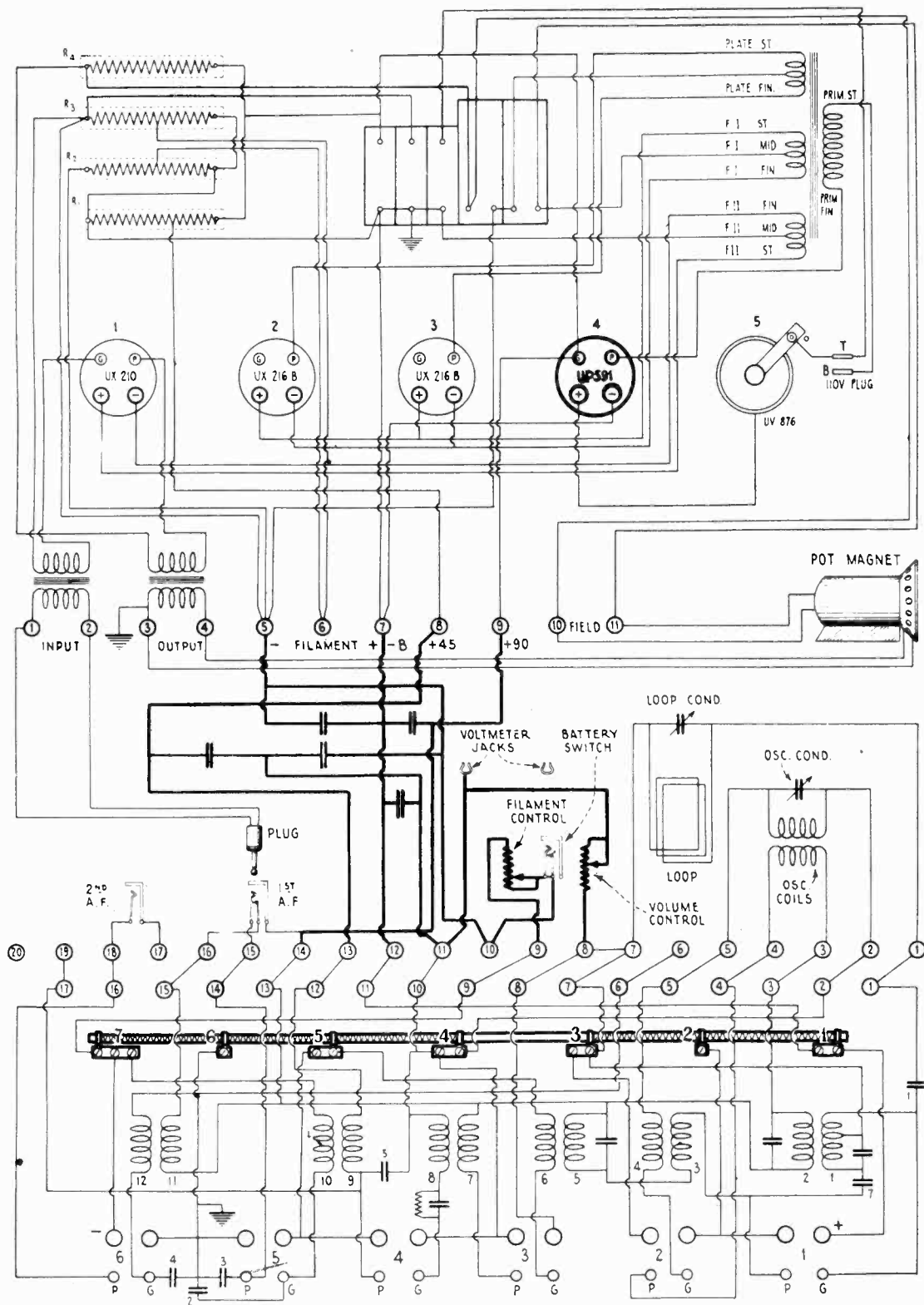
When isolating trouble each particular section should be consulted as conditions may warrant.

### PART I

#### Problems Arising in A.C. Operation of Radiola 25

##### (1) VOLTAGE READINGS

The following are the correct voltages that should be obtained at the Catacomb terminal strip across the terminals indicated in the text test table, with the power turned on at the Loudspeaker. A voltmeter with at least 600 ohms resistance per volt or the no-current voltmeter described on pages 17 and 18 of these notes should be used if true readings are to be obtained. The allowable variation is approximately 5 volts in either direction.



A.C. PACKAGE CHANGES

Figure 1—Radiola 25 A.C. operated continuity circuit diagram

## VOLTAGE READINGS OF RADIOLA 25

Taken at Catacomb Terminal Strip—Count Terminals from Right to Left When Facing the Front of Radiola 25

<i>Terminals</i>	<i>Correct Effect</i>
10 to 12	Should measure 31 volts with all Radiotrons lighted and battery setting near "Off." Positive terminal of voltmeter to be placed on No. 12.
12 to 13	Should measure 21.5 volts normally. Positive terminal of voltmeter should be placed on No. 13.
13 to 14	Should measure 41 volts normally. Positive terminal of voltmeter should be placed on No. 14.

### (2) CATACOMB AND PANEL CONTINUITY TESTS

The following tests will show complete continuity for both external and internal connections of the catacomb. See page 8 for "Continuity Test Instructions."

#### CATACOMB TESTS (Coils and Connections)

The Radiotrons, Cable and Loop Are to Be Removed

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
15 to P5	Closed	Open connection
14 to P1	Closed	Open coil No. 3 or No. 5
14 to Term. 3	Closed	Open coil No. 2
14 to P3	Closed	Open coil No. 7
14 to Term. 16	Closed	Open coil No. 11
13 to P4	Closed	Open coil No. 9
11 to G3	Closed	Open coil No. 6 or resistance strip
9 to G5	Closed	Open coil No. 10
7 to neutralizing cond. (Hole between sockets No. 1 and No. 2)	Closed	Open connection
7 to G1	Closed	Open 1/2 coil No. 1
6 to G6	Closed	Open coil No. 12
5 to G2	Closed	Open coil No. 4
4 to P2	Closed	Open connection

#### CATACOMB TESTS (Condensers)

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
15 to Terminal 9	Open	Shorted cond. No. 3
11 to P4	Open	Shorted cond. No. 5
11 to G4	Open or weak	Shorted grid condenser
9 to G6	Open	Shorted cond. No. 4
7 to P1	Open	Shorted cond. No. 7
1 to G1	Open	Shorted cond. No. 1

## CONTINUITY TEST INSTRUCTIONS

Both filament control and volume control rheostats should be adjusted so that half the resistance is in the circuit, the loop removed and the power supply cable disconnected from the terminal strip at the rear of the catacomb.

A pair of headphones with at least 4½ volts in series or a voltmeter with voltage sufficient to give full scale deflection when connected directly across battery terminals should be used. This arrangement will be found to be very sensitive in checking voltage drop in various circuits.

The contacts of the test equipment should be placed across the terminals indicated in the column titled "Terminal" in the text test table and the results should be as indicated in the column titled "Correct Effect." If the results are negative the cause of such negative effect will be found in the last column under the heading "Incorrect Effect Caused by:"

The numbers of the terminals referred to in these tests apply to the terminals on the connecting strip at the rear of the catacomb frame assembly, counting from right to left when facing the front of Radiola 25. The designation "P" and "G" refer to plate and grid contacts of the socket indicated by the number following, counting from right to left when facing Radiola 25. For example G2 would indicate the grid contact of the second socket; P5 would indicate the plate contact of the fifth tube socket. The coil numbers referred to in the right hand column will be found in Figure 1.

If the catacomb fails to pass any of the tests it should be removed from the panel and replaced by a new one. Under no circumstances should the lead seals on the cover plate be broken. No marks of any kind should be made on the catacomb. To indicate the defect in the catacomb for future reference, attach tag to catacomb and note thereon observed defect.

The various panel parts are comprised in the following tests:

### PANEL TESTS

With Radiotrons, Cable and Resistance Strip Removed

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
16 to 15 (With no telephone plug in 1st stage jack)	Closed	Defective 1st stage jack
11 to 8	Closed	Defective volume control
10 to 9	Closed	Defective filament control
4 to 3	Closed	Defective oscillator coil
5 to 2	Closed	Defective oscillator coil
1 to 7	Closed	Open loop

### PANEL TESTS (Condensers)

Loop Removed

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
7 to 1	Open	Shorted loop tuning condenser



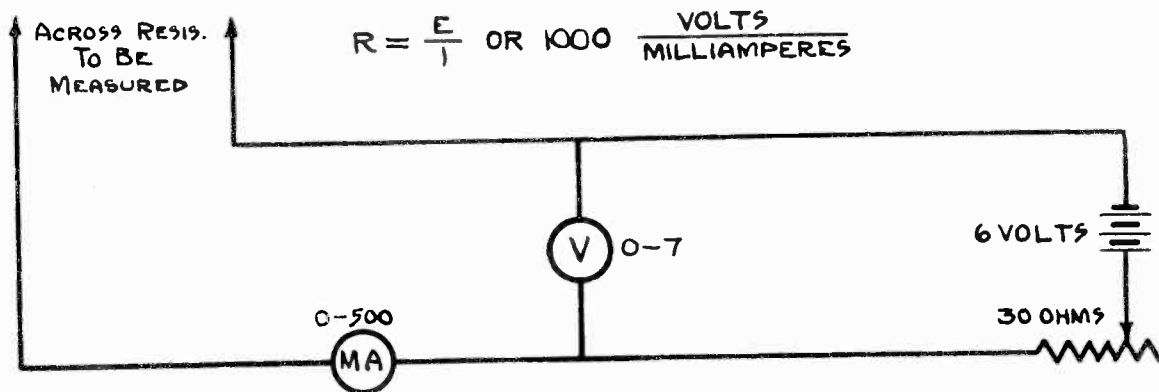


Figure 2—Wiring diagram for resistance measurement

### (3) RESISTANCE STRIP TESTS

The resistances of the strip mounted directly behind the catacomb can best be checked by a Resistance Bridge. If this is not available the voltmeter-ammeter method can be applied. A milliammeter with a scale of 0-500 should be used and a voltage applied that will give a substantial reading. A circuit diagram of this method is shown in Figure 2.

The resistance may then be calculated by the use of Ohm's law.

$$R = \frac{E}{I} \text{ where } R \text{ equals ohms, } E \text{ equals volts and } I \text{ equals amperes}$$

$$\text{or ohms} = 1000 \frac{\text{volts}}{\text{milliamperes}}$$

Since the current reading is taken in milliamperes (or  $\frac{1}{1000}$  ampere) it is necessary to multiply by 1000 to get the resistance value in ohms.

The allowable values in ohms for the different sections of the resistance strip in Radiola 25 are tabulated below:

#### RADIOLA 25 A.C. RESISTANCES

Count Terminals from Right to Left When Facing Radiola 25

Resistance Terminals	Lower Limit	Normal	Upper Limit
1-2	218.5	230	241.5
2-3	192	201	208
3-4	Open	Open	Open
4-5	151.9	155	158.1
5-6	143	150	153
6-7	44.75	50	55.25

If the values obtained do not fall within the prescribed limits the strip should be replaced.

#### (4) INSTALLATION CHANGE IN A.C. PACKAGE UP-971

Some models of Radiola 25 have panel cabling instead of the regular black wire connections. When installing A.C. Package UP-971 on these models the following instructions should be observed. (See Figure 3.)

Remove the panel cable lead (yellow with green tracers) from the left voltmeter jack and resolder it to the right voltmeter jack.

To one side of the "Volume Control" rheostat are attached two panel cable leads (each yellow with green tracer.) Disconnect these two leads and determine which one

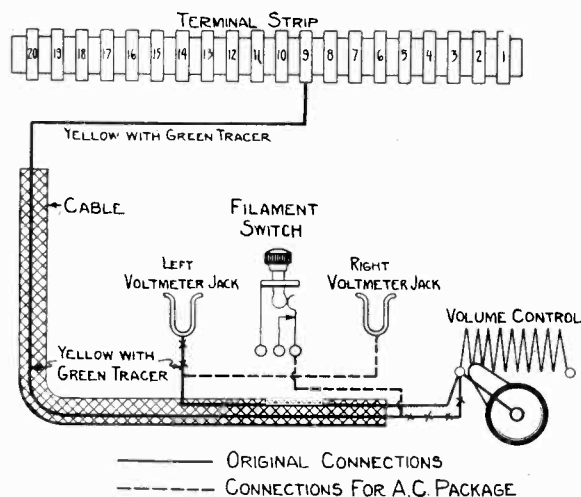


Figure 3—Panel wiring change required for installation of UP-971 in some models of Radiola 25

goes to terminal No. 9 on the terminal board. This may be done by means of a pair of telephones connected in series with a  $4\frac{1}{2}$  volt battery. One of the test points is placed on terminal No. 9 and the other tried on the two panel leads which were connected to the "Volume Control" rheostat. One of these will give a click when connection is made to the other test point. This is the one that goes to terminal No. 9.

Solder the lead which goes to terminal No. 9, as determined above, to the long prong of the filament switch. Resolder the other lead (yellow with green tracer) to the "Volume Control" rheostat, exactly as it was.

In Instruction Book No. 86997 "A" edition for A.C. Package UP-971, pages 5 and 6, the following two paragraphs are not applicable to this model of Radiola 25:

"It will be noticed that one of the wires from the 'Volume Control' rheostat runs to the right-hand voltmeter clip. Unsolder it and resolder it to the left-hand clip, as shown in Fig. 4."

"Unsolder either one of the two wires which go to the filament switch, and solder this wire so that it is on the same switch blade as the other wire, as shown in Fig. 4."

## PART II

### Problems Arising in A.C. Operation of Radiola 28

#### (1) VOLTAGE READINGS

The following are the voltages obtained at the Catacomb terminal strip, when tests are taken across the terminals indicated in the text test table. A high resistance voltmeter of at least 600 ohms resistance per volt or the No-Current Voltmeter described in Section 3, Part III, of these notes should be used. The allowable variation plus or minus is approximately 5 volts.

#### VOLTAGE READINGS OF RADIOLA 28

Taken at Catacomb Terminal Strip—Count Terminals from Left to Right When Facing Radiola 28

<i>Terminals</i>	<i>Correct Effect</i>
1 to 21	Should measure 31 volts, normally with all Radiotrons lit and battery setting near "Off." Positive terminal of voltmeter on No. 1.
1 to 10	Should measure 21.5 volts normally. Positive terminal of voltmeter to No. 10.
10 to 11	Should measure 41 volts normally. Positive terminal of voltmeter to No. 11.

#### (2) CATACOMB AND PANEL CONTINUITY TESTS

The following tests will show complete continuity for both external and internal connections of the catacomb. Terminal numbers refer to terminals on Catacomb terminal strip, counting from left to right when facing front of Radiola 28. (Figure 4.)

Both filament control and volume control rheostats should be adjusted so that half the resistance is in the circuit, the loop removed and the cable disconnected from the terminal strip at the rear of the catacomb.

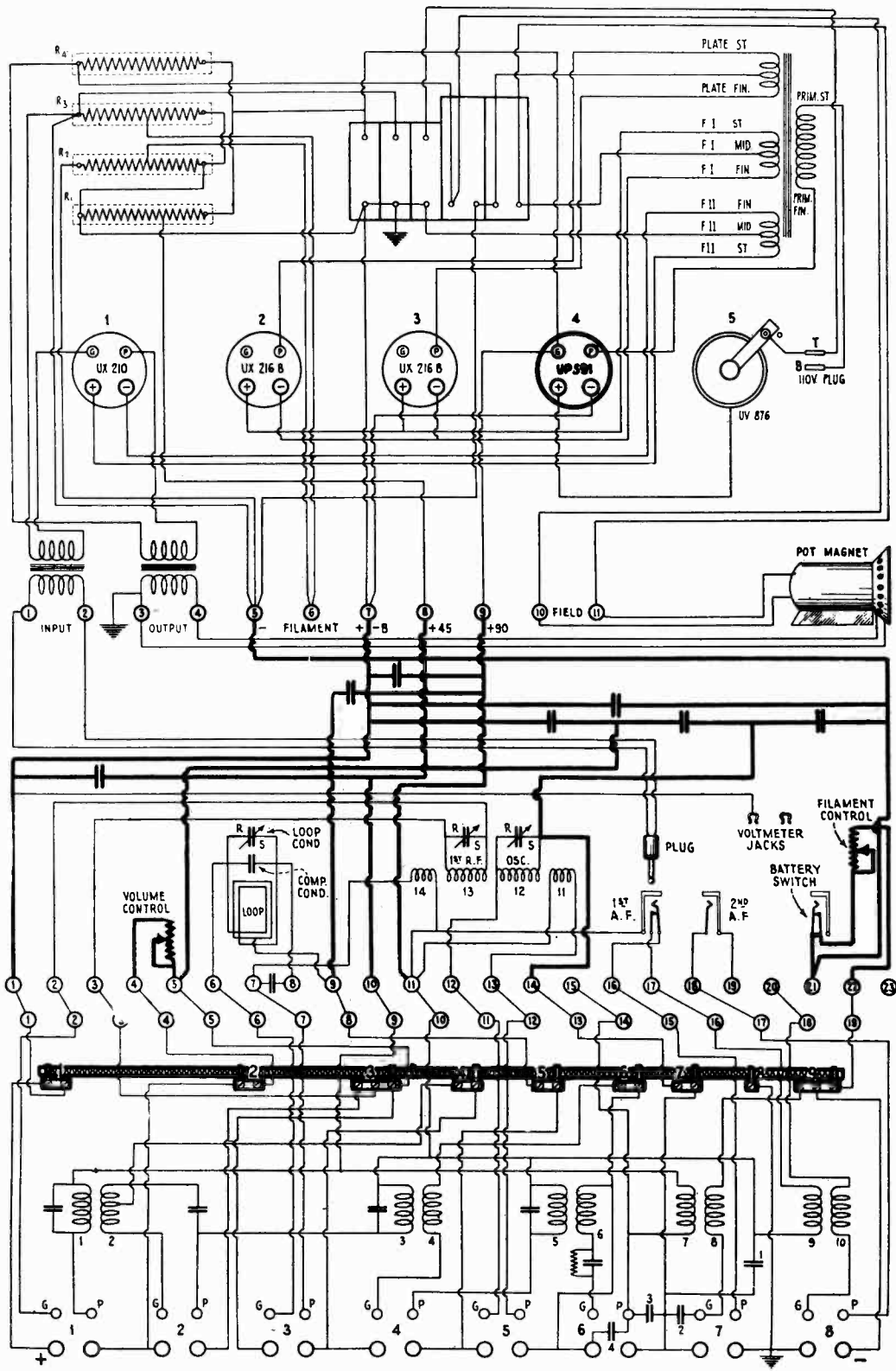
A pair of headphones with at least 4½ volts in series or a voltmeter with voltage to give full scale deflection when connected directly across battery terminals should be used in making this test. This arrangement will be found to be very sensitive in checking voltage drop in various circuits.

Any failure of a circuit to meet the above tests will indicate a defective catacomb which should be replaced with one of known operating condition.

#### CATACOMB TESTS (Condensers)

The Radiotrons, Cable and Loop Are to Be Removed

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
P6 to +6	Open	Shorted cond. No. 3 or No. 4
9 to P2	Open	Shorted catacomb neutralizing condenser
9 to G6	Open or very faint	Shorted grid condenser
14 to 11	Open	Shorted cond. No. 1



**A.C. PACKAGE CHANGES**

Figure 4—Radiola 28 A.C. operated continuity circuit diagram

**CATACOMB TESTS (Coils and Connections)**  
**The Radiotrons, Cable and Loop Are to Be Removed**

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
2 to G1	Closed	Open connection
6 to G3	Closed	Open connection
7 to P3	Closed	Open connection
9 to G2	Closed	Open 1/2 coil No. 2 or resistance strip
9 to G4	Closed	Open coil No. 4 or resistance strip
10 to P1	Closed	Open coil No. 1
10 to P6	Closed	Open coil No. 7
11 to P2	Closed	Open coil No. 3
11 to P4	Closed	Open coil No. 5
11 to Terminal No. 17	Closed	Open coil No. 9
12 to G5	Closed	Open connection
13 to P5	Closed	Open connection
16 to P7	Closed	Open connection
18 to P8	Closed	Open connection
20 to G8	Closed	Open coil No. 10
22 to G7	Closed	Open coil No. 8

**PANEL TESTS**

**With Radiotrons, Cable, Loop and Resistance Strip Removed**

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
3 to 2	Closed	Open R.F. coil
5 to 4	Closed	Open volume control
11 to 7	Closed	Open R.F. coil
13 to 11	Closed	Open oscillator coil
14 to 12	Closed	Open oscillator coil
16 to 11	Closed	Defective 1st stage jack
(With shorted telephone plug in 1st stage jack)		
17 to 16	Closed	Defective 1st stage jack
(With no telephone plug in 1st stage jack)		
22 to 21	Closed	Open filament control

**PANEL TESTS (Condensers)**

**Loop Removed**

<i>Terminals</i>	<i>Correct Effect</i>	<i>Incorrect Effect Caused by:</i>
8 to 6	Open	Shorted loop or compensating cond.
8 to 7	Open	Shorted neutralizing condenser

### (3) RESISTANCE STRIP TESTS

listed below :

#### RADIOLA 28 A.C. RESISTANCES

The method described in Section 3, Part I, of these notes should be used in checking the value of the various resistances of the resistance strip.

The values in ohms of the various resistances in the Radiola 28 resistance strip are  
**Count Terminals from Left to Right When Facing Radiola 28**

<i>Terminals</i>	<i>Lower Limit</i>	<i>Normal</i>	<i>Upper Limit</i>
1-2	185	190	195
*2-3	350	400	450
3-4	158	163	168
4-5	150	155	160
5-6	125	130	135
6-7	116	120	124
7-8	111	115	119
8-9	45	50	55

\* On some models section No. 2 of the resistance strip has been left open. When this is done the volume control is of 187.5 ohms resistance instead of 375 ohms as used when the strip is not open.

Another series of resistance values with a 250-ohm Volume Control found in some models of Radiola 28 is given below :

<i>Terminals</i>	<i>Lower Limit</i>	<i>Normal</i>	<i>Upper Limit</i>
1-2	260	271	282
2-3	Open	Open	Open
3-4	230	236.5	243
4-5	191	197	203
5-6	176	183.5	191
6-7	146	154.5	163
7-8	137	145.5	154
8-9	45	50	55

All resistance strips are interchangeable, provided the volume control has the correct value for the strip used. This is of utmost importance as the Radiola will not function properly when the volume control and resistance strip are not correct.

### (4) CHANGES IN FACTORY BUILT A.C. RADIOLA 28

The following changes in connections and parts apply to factory built A.C. Radiolas 28 as distinguished from battery operated Radiolas 28 converted to A.C. operation.

Whisker 16 is connected to terminal 19 instead of terminal 17.

The condenser cable has an additional connection.

The output of the Radiola is taken direct from the terminal strip at the rear of the catacomb and the plug is not used in the first stage jack.

The filament switch voltmeter pin jacks and second audio stage phone jack are also omitted.

The instruction book accompanying the receiver refers to these changes and should be consulted when servicing this particular model of Radiola 28.

## PART III

### Problems Common to A.C. Operation of Radiolas 25 and 28

#### (1) A.C. PACKAGES AND CABLE

When tests are made, especially voltage readings, at the terminal strip of the catacomb and trouble is found, additional tests to check the preliminary test must be made. For example, the voltage readings should be taken at the condenser bank terminal strip and terminal board of the R.P.A. unit. This will prevent a possible defective cable or condenser bank from indicating trouble elsewhere. If the various tests check and the readings at the three points are the same it may be well to assume that the trouble is in the R.P.A. unit.



*Figure 5—Installing condenser bank of A.C. Package UP-972*

The small A.C. Package cable connecting the catacomb terminal strip of the Radiola to the A.C. package condenser bank and the 30-ft. cable joining the condenser bank to the R.P.A. unit of the Loudspeaker should be carefully examined to determine if the leads at the ends of each cable are worn or the terminals soldered to each lead are corroded or loose. Worn leads should be repaired or replaced. Corroded or loose terminals should be cleaned and resoldered.

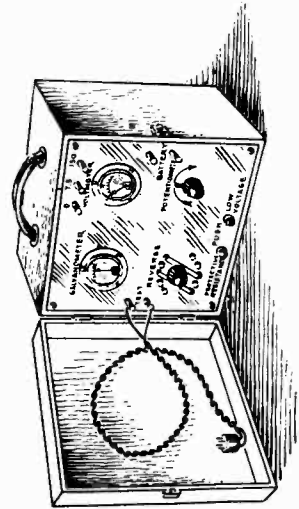
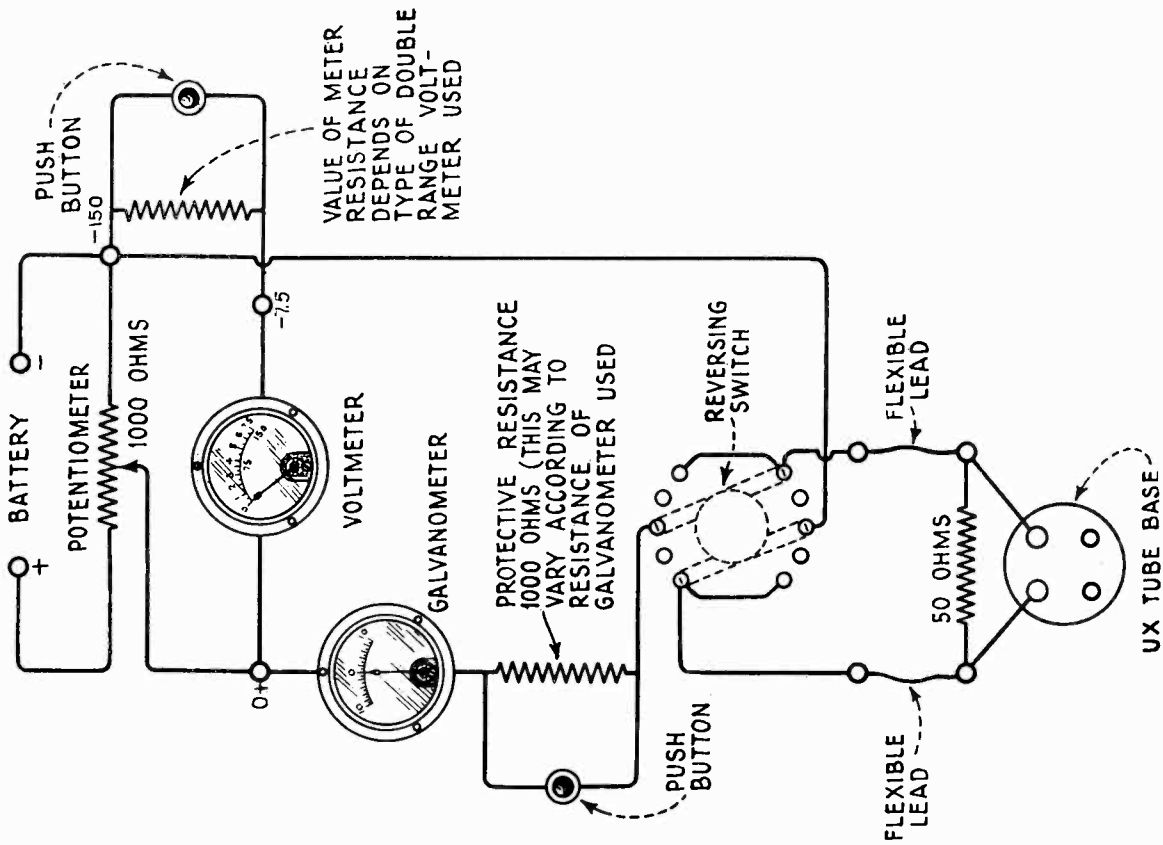
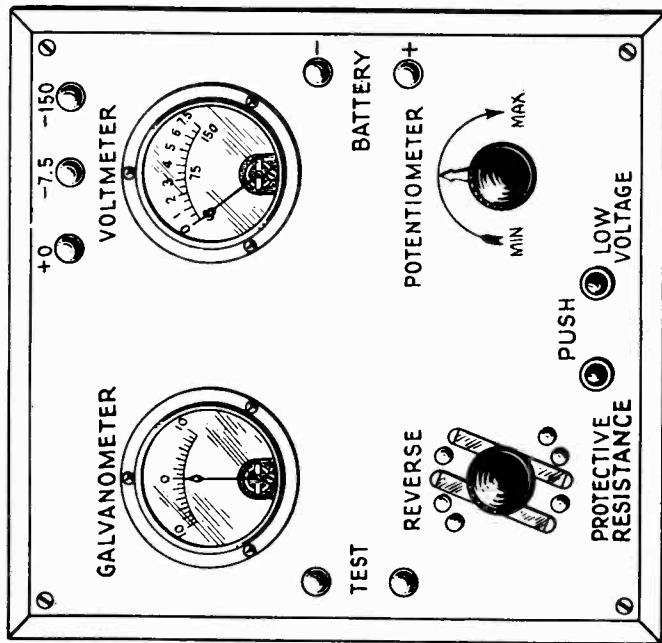


Figure 6—Panel layout, circuit diagram and complete model of the No-Current Voltmeter



## (2) HIGH, LOW OR NO VOLTAGE READINGS AT TERMINAL STRIP OF RADIOLA

This condition may be caused by a defective A.C. package or R.P.A. unit. A check at the terminal board of the R.P.A. unit will isolate the trouble to the condenser bank of the A.C. package or cable. If the condenser bank or cable tests O.K. the R.P.A. unit should be checked for the following indications. It is assumed that the Radiotrons are of known operating condition and light to normal brilliancy.

No voltage at R.P.A. unit may be due to:

- (a) Shorted Resistor UP-591. (Used in place of Radiotron UX-874.)
- (b) Open connections at R.P.A. terminal board.
- (c) Shorted 7 Mfd. or 4 Mfd. filter condenser. (This will be indicated by excessively hot plates of Rectrons UX-216-B.
- (d) Shorted 2 Mfd. condensers. (Check by means of continuity test.)

Low voltage at R.P.A. Unit may be caused by:

- (a) Shorted turns in high voltage winding of power transformer.
- (b) Low emission Rectrons UX-216-B.
- (c) Leaky 7 Mfd. or 4 Mfd. filter condensers.
- (d) Leaky 2 Mfd. condenser (located next to resistance units).
- (e) Defective Resistance Units.

High voltage in R.P.A. unit may be caused by:

- (a) Defective Pot magnet.
- (b) Defective Resistance Units.
- (c) Shorted turns in primary of power transformer.
- (d) Open Resistance Units R2 or R3.

## (3) NO-CURRENT VOLTMETER

When measuring the plate or filament voltages of an A.C. operated Radiola it is necessary to use a high resistance voltmeter if true values are to be obtained. High resistance voltmeters are expensive and scarce, consequently need exists for other means of measuring these various voltages. A method of obtaining correct voltages with any type of D.C. voltmeter is described below which may be relied on up to the accuracy of the meter itself and as being more accurate on voltages from an R.P.A. unit than most high resistance voltmeters.

The various parts and circuit diagram are shown in Figure 6. These parts consist of a 0-7.5 voltmeter with multiplier, D.C. galvanometer, potentiometer, reversing switch, safety resistance, UX-199 plug and an external voltage in excess of that to be measured. A compensating resistance of 50 ohms, shunted across the filament prongs of the "UX Tube Base" is necessary when using the "UX Tube Base" to measure the filament voltage of any Radiotron UX-199 in an A.C. operated Radiola. This will compensate for the loss of filament resistance caused by the removal of the Radiotron UX-199.

The following procedure should be used when measuring any D.C. voltage.

- (a) The voltmeter scale covering the voltage to be measured should be used.
- (b) If not using UX-plug, disconnect it and 50-ohm resistance from circuit.
- (c) Adjust potentiometer so that voltmeter reads approximately that of the voltage to be measured.
- (d) Connect external voltage to proper "Battery" binding posts.
- (e) Connect voltage to be measured to "Flexible Lead" terminals.
- (f) Set "Reversing Switch" for correct polarity (determined by experiment).
- (g) With "Protective Push Button" open, adjust potentiometer by zero reading of the galvanometer.
- (h) After obtaining zero reading close "Protective Push Button" and readjust potentiometer for zero reading.
- (i) Voltage now indicated at voltmeter is correct voltage of circuit under measurement.

When measuring filament voltage of an A.C. operated catacomb the "UX-Tube Base," with compensating resistance, is used to connect the source of voltage to be measured to the test set; otherwise the operations are the same.

The theory of the "No-Current Voltmeter" is based upon the condition that when an external voltage is applied so as to oppose the voltage of the circuit under measurement, the galvanometer will read zero when the two voltages are exactly the same. The voltmeter connected across the opposing voltage makes it a simple matter to read what external voltage is necessary to exactly balance the circuit under measurement.

#### (4) DISTORTION IN THE SPEAKER

Distortion in the Reproducer unit of the Loudspeaker may be caused by any of the following:

- (a) Poor input from Radiola. (Examine Radiola.)
- (b) Shorted 2 Mfd. condenser in R.P.A. unit (located next to 7 Mfd. condenser).
- (c) Shorting of movable coil to pole piece of pot magnet. (Replace cone.)
- (d) Defective Radiotron UX-210. (Replace Radiotron.)
- (e) Leads from movable coil broken away from cone. (Make these fast with a little shellac.)
- (f) Mis-alignment of Reproducer cone.

The reproducer cone may be readily realigned by removing the front grille and very carefully adjusting the small round head screw in the center of the cone. In making this adjustment care must be exercised to prevent damaging the cone, which may be caused by the screwdriver being pulled out of control by the strong magnetic field about the pole piece of the pot magnet behind the cone.

## (5) FLUTTERING

Fluttering sometimes is encountered when an A.C. installation is made. This is a loud hum having a 60-cycle base and occurs at the resonant point when manipulating the tuning drums.

Any means of changing the electrical constants of the audio circuits will correct this condition. The following remedies are suggested.

- (a) Change A.C. Package.
- (b) Interchange Radiotrons UX-199 of Catacomb.
- (c) Connect 30 to 50-henry choke across terminals 10 and 15 of catacomb terminal strip. (Count from left when facing front of Radiola.)
- (d) Connect 2 Mfd. condenser in series with 30-henry choke and then place combination across terminals 15 and 22 in the Radiola 28. The choke goes to 15 and condenser to 22.

## (6) BLASTING

This condition is present when the volume control is near or at maximum, and signals are being received from nearby stations. Interchanging the Radiotrons, keeping those having the least microphonic tendencies in the two detector and first audio sockets and a change of the UX-210 may help. Also the distance from the Radiola to the Loudspeaker should be increased. In some cases it may be necessary to insert a choke across terminals 10 and 16 of Radiola 28 terminal strip. The primary of a Radiola 104 Loudspeaker input transformer or the complete winding of a Radiola III-A output transformer has the correct impedance for this choke. This may be relied upon to clear up the most obstinate cases of blasting.

## (7) HOWLING

Howling may be caused by sound waves from the Loudspeaker setting the elements of Radiotron UX-199 into vibration. This vibration is amplified and reproduced in the loudspeaker. Increasing the distance from the Loudspeaker to the Radiola and interchanging the Radiotrons will usually eliminate howling. The microphonic Radiotrons should be kept in the intermediate and R.F. sockets.

## (8) FADING OF SIGNALS

Fading of signals beyond the normal slight drop after the speaker has been placed in operation may be due to any of the following causes:

- (a) Defective Radiotron UX-210. This will be accompanied by rough and unnatural reproduction.
- (b) Defective Radiotron UV-876 (or UV-886).
- (c) Defective Resistances in R.P.A. Unit. (Indicated by the defective resistance becoming excessively hot. This does not apply to unit R-4, which becomes very hot during normal operation.)

