

Radiola 24

Portable Super-Heterodyne

Second Harmonic



Instructions 86979

Radio Corporation of America
233 Broadway 10 South La Salle Street 28 Geary Street
New York City Chicago, Illinois San Francisco, California

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PORTABLE SUPER-HETERODYNE SECOND HARMONIC

INTRODUCTION

RADIOLA 24 is a radio broadcast receiving instrument, utilizing the super-heterodyne principle, which provides unusual simplicity of operation, selectivity and sensitivity. The leather covered suit-case, which contains the operating mechanism and loud speaker, provides space for the portable battery equipment, and also for the loop antenna, which is carried inside the cover when not in use. A plug and cord is furnished for making connection to an external set of larger capacity, longer-life batteries, when desired. The receiver is designed for reception over the broadcast, frequency band 550 to 1350 kilocycles (approximately 220 to 550 meters).

ADDITIONAL EQUIPMENT INCLUDED

The 6 Radiotrons, Model UV-199, are furnished with the set.

ADDITIONAL EQUIPMENT REQUIRED

1 Set of "A," "B" and "C" batteries as follows:

BATTERIES REQUIRED

I. For Portable Use.

A—Three standard dry cells, connected in series, 1 ½-volts each, such as those listed below, for lighting the filaments.

3 Eveready Dry Cell Radio "A" Batteries.....	2 ½ by 6 ½ in.	or
3 Manhattan Red Seal Dry Cells.....	2 ½ by 6 ½ in.	or
3 Burgess No. 6 Dry Cells.....	2 ½ by 6 in.	or
3 Burgess Super Six Dry Cells.....	2 ½ by 6 in.	or
3 Ray-0-Vac No. 1214 Dry Cells.....	2 ½ by 6 ½ in.	or
3 Ace No. 6 Dry Cells.....	2 ½ by 6 ½ in.	or
3 Columbia Igniter No. 6 Dry Cells.....	2 ½ by 6 ½ in.	or

OR EQUIVALENT

B—Four 22 ½-volt plate batteries connected in series, such as:

4Eveready No. 768Plate Batteries.....	4 1/8 by 2 9/16 by 2 ¾	or
4Burgess No. 5156BP Plate Batteries.....	4 1/8 by 2 9/16 by 2 ¾	or
4 Rav-0-Vac No. 5156BP Plate Batteries.....	4 1/8 by 2 11/16 by 2 ¼	or

OR EQUIVALENT

- C—One 4 ½-volt negative grid bias or "C" Battery, such as:
- 1 Eveready No. 771 Negative **Grid Bias** Battery. 4 by 3 by 13/8 in. **or**
 - 1 Ray-0-Lite No. 231-R Negative Grid Bias Battery. . . . 4 by 3 by 1 7/16 in. **or**
 - 1 Burgess No. 2370 Negative Grid Bias Battery..... 4 by 3 by 1 3/8 in. **or**
 - 1 Vale No. 313 Negative Grid Bias Battery. 4 by 3 by 15s in. **or**
 - 1 Bright Star No. B-34-17 Negative Grid Bias Battery. . 4 by 3 by 1³/₈ in. **or**
 - 1 Novo No. 288 Negative Grid Bias Battery.....'... 4 by 3 by 1³/₈ s in. **or**

OR EQUIVALENT

II. For Non-Portable Use.

For general non-portable use, it is recommended that additional larger capacity batteries, such as those listed below, be secured, in order to obtain better battery operating life.

A—Six standard dry cells, 1 ½ volts each, such as those listed below, for lighting the filaments. These are connected in two groups, each of three cells in series, both groups being connected in parallel.

- 6 Eveready Dry Cell Radio " A " Batteries..... 2 ½ by 6 ½ in. **or**
- 6 Manhattan Red Seal Dry Cells..... 2 ½ by 6 ½ in. **or**
- 6 Burgess No. 6 Dry Cells..... 2 ½ by 6 in. **or**
- 6 Burgess Super Six Dry Cells. 2 ½ by 6 in. **or**
- 6 Ray-0-Vac No. 1211 Dry Cells..... 2 ½ by 6 ½ in. **or**
- 6 Ace No. 6 Dry Cells... . 2 ½ by 6 ½ in. **or**
- 6 Columbia Ignitor No. 6 Dry Cells..... 2 ½ by 6 ½ in. **or**

OR EQUIVALENT

B—Four 22 ½-volt plate batteries connected in series, such as:

- 4 Eveready No. 766 Plate Batteries..... 6 5/8 by 4 by 3 in. **or**
- 4 Burgess No. 2156 Plate Batteries. 6 5/8 by 4 by 3 in. **or**
- 4 Ray-0-Vac No. 2156 Plate Batteries..... 6 5/8 by 4 by 3 in. **or**
- 4 Kwik-Lite No. 255 Plate Batteries..... 6 ¾ by 4 by 3 in. **or**
- 4 Ace No. 115 Plate Batteries..... 6 5/8 by 4 by 3 in. **or**
- 4 Yale No. 1512-V Plate Batteries..... 6 ½ by 4 by 3 in. **or**
- 4 Bright Star No. 15-90 Plate Batteries. 6 ½ by 4 by 3 in. **or**
- 4 Novo No. 268 Plate Batteries..... 6 ½ by 4 by 3 in. **or**

OR EQUIVALENT

Two 45-volt plate batteries may **be used instead of four** 22 ½ -volt blocks if desired, such as:

- 2 Eveready No. 772 Plate Batteries (45 Volts). 8 3/16 by 7 1/8 by 3 ¼ in. **or**
- 2 Burgess No. 2308 Plate **Batteries** (45 Volts)..... 8 1/16 by 7 **by 3 1/8 in.** **or**
- 2 Burgess No. 2306 Plate Batteries (45 Volts)..... 7 7/8 by 6 5/8 by 3 in. **or**
- 2 Novo No. 276 **Plate** Batteries (45 Volts)..... .8 by 6 ½ by 3 in. **or**
- 2 **Kwik-Lite** No. 245 Plate Batteries (45 Volts)..... 8 ¼ by 6 ¾ by **3 in.** **or**
- 2 Yale No. 3045-V Plate Batteries (45 Volts)..... 8 by 6 5/8 by 3 in. **or**

OR EQUIVALENT

INSTALLATION

Installing Batteries for Portable Use. Remove the cover by laying the suit-case on its back, pull the cover *up* to and past the vertical position, then lift it off its hinges. Replace the set in the vertical position, turn the latch V and pull the panel

forward to the horizontal position. An envelope containing six short and two long yellow jumper connectors and three long red juniper connectors will be found inside the case.

Place the "C" battery in the right hand rear corner of the battery space, just in front of the condenser, as shown in Fig. 1. Connect the lead marked "+C" (green with yellow tracer) to the terminal of the battery marked "+." Connect the lead marked "-C" (black with blue and green tracer) to the battery terminal marked "-4.5."

Place the four "B" batteries along the back of the battery space, to the left of the "C" battery, carefully noting that the side which has the lead terminal (+22 1/2 V) is toward your left hand, and that the side with the binding post terminal (—)

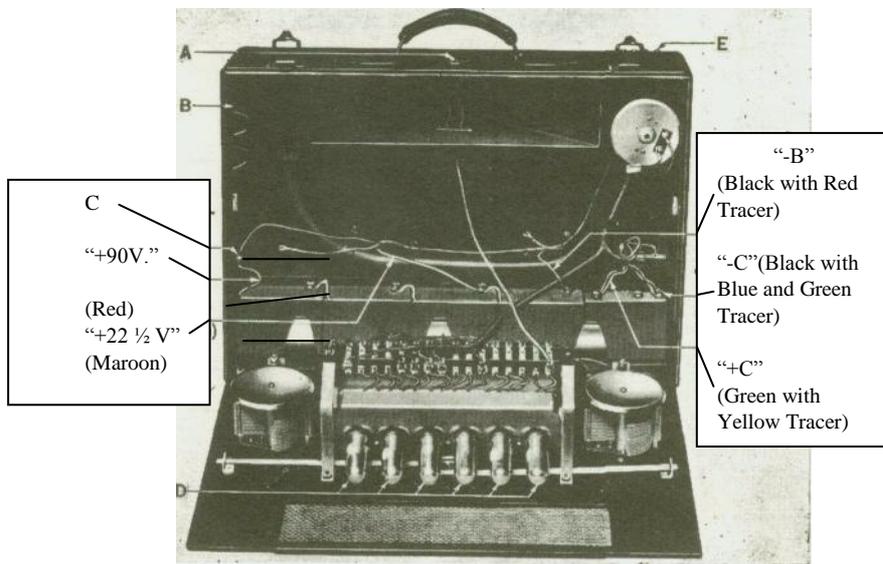


Fig. 1 Connections of the "C" and "B" Batteries for Portable Use

- A—Loop Socket.
- B - - Pockets for Spare Radiotrons.
- C'—Binding Posts for +90 Volts.
- D—Six Radiotrons UV-199 in Sockets.
- E—External Battery Socket.

is toward your right hand. Connect the red lead on the left hand "B" battery underneath the binding post nut C; and also connect the lead marked "+90 V" (red) to this same post. Connect the red lead on the second battery to the binding post terminal (—) of the left hand battery. Connect the remaining "B" batteries in series in the same manner. Also connect the lead marked "+22 ½ V" (maroon) to the binding post terminal (—) of the battery third from the left; and connect the lead marked "— B" (black with red tracer) to the binding post terminal (—) of the right hand "B" battery.

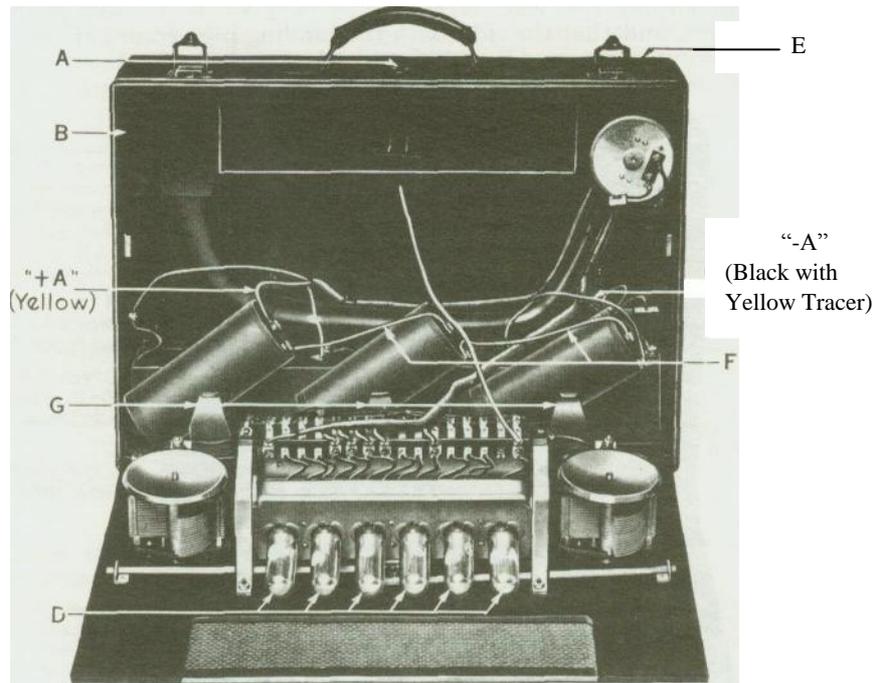


Fig. 2. Connections of "A" Batteries for Portable Use

- A—Loop Socket
- B—Pockets for Spare Radiotrons.
- D**—Six Radiotrons UV-199 in Sockets.
- E—External Battery Socket.
- F—Two Long "A" Battery Connectors (yellow).
- G—Three "A" Battery Clamps.

Connect the three "A" dry cells in series, using the two long jumper connectors F, by connecting the outside binding post of the left hand "A" battery to the center binding post of the middle "A" battery; and by connecting the outside binding post of the middle "A" battery to the center binding post of the right hand "A" battery. Connect the lead marked "+A" (yellow) to the center binding post of the left hand "A" battery; and connect the lead marked "—A" (black with yellow tracer) to the outside binding post of the right hand "A" battery. Now place the three batteries in the set, laying them on their sides, and with the terminal end toward your right hand as shown in Fig. 2. The batteries are placed behind the battery clamps G and these clamps press them against the "B" batteries holding them all in place securely.

When connecting the batteries, do not permit the metal terminals on any lead to come into contact with other battery terminals, or with lead terminals connected to them, even for a short time. Such connection causes rapid reduction in the useful life of the batteries. Make and keep all connections to the batteries as tight as possible, for doing otherwise will cause objectionable noises or complete inoperativeness of the receiver.

Installing Batteries for Van-Portable Use. If it is desired to use large capacity batteries for non-portable use, they should be connected as shown in Fig. 3.

The six "A" batteries are connected in two parallel groups of three each, the three batteries in series being connected in the same manner as was described for portable use. The six short yellow jumpers AA (Fig. 3) are used for making these connections. The four "I}" batteries are connected in series in the same manner as those for portable use, using the three long red jumper connectors BB. The lead marked "—A" (black with yellow tracer) is connected to the outside terminal of the "A" batteries. Connect the lead marked "+A" (yellow with red tracer) to the center terminals of the "A" battery. Connect the lead marked "—B" (black with red tracer) to the "—" terminal of the first "B" battery. Connect the lead marked "+22 ½ V" (maroon) to the "+22 ½ V" terminal of the first "B" battery. Connect the lead marked "+90V" (red) to the "+22 ½ V" terminal of the fourth "B" battery.

When using these batteries the plug H on the end of the cable is plugged into the socket E (shown in Figs. 1 and 2), making certain that it is facing in the right direction, that is, with the cable coming from the rear of the plug. Use the same

precautions when connecting batteries as previously described about making' tight connections and about preventing the same lead from coming into contact with other battery terminals.

Placing Radiotrons in Sockets. Radiola 24 utilizes six Radiotrons, Model UV-199, which should be handled with due care. To install the Radiotrons, the panel should be opened to the position shown in Fig. 1.

Before inserting the Radiotrons, turn the "BATTERY SETTING" knob to "OFF," or push in the filament switch Z in the lower

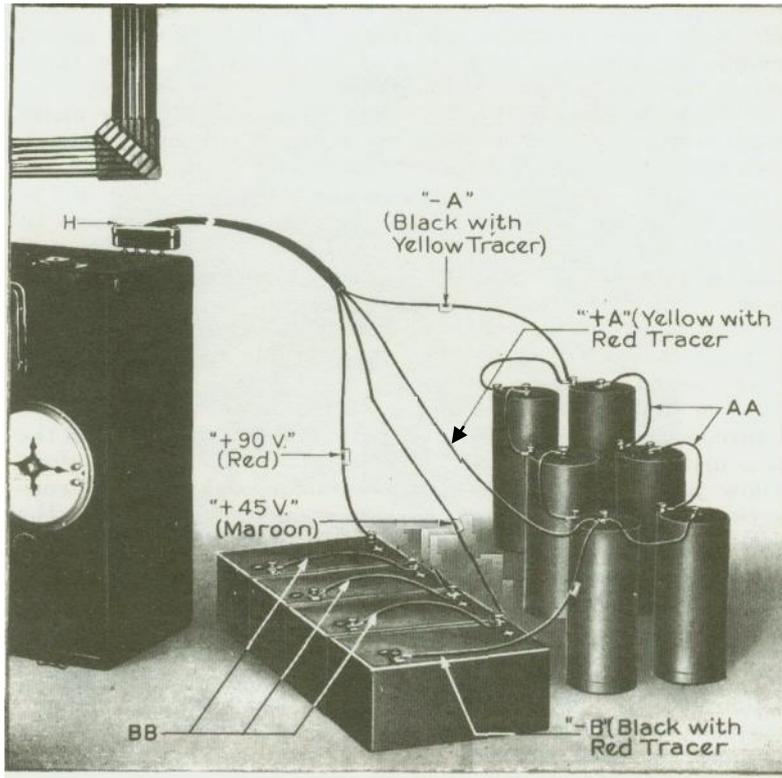


Fig. 3. Connections of Batteries for Non-Portable Use

AA—Six Short "A" Battery Connectors (Yellow).

BB—Three "B" Battery Connectors (Red).

H—External Battery Plug.

center of the panel. Remove the six Radiotrons from their individual cartons. Insert one in each of the six tube sockets **D**, by placing it in the socket, turning the tube until the pin in the base drops into the slot, and then turning slightly to the right. Swing the panel back in place and lock it, using the latch **U**.

Installing Loop. Remove the loop from the inside of the cover, and pull the loop plug **K** from the inside of the loop. Reverse its position, and place it on the outside of the loop, making the wide spaced prongs enter the holes provided in the loop. Push the loop in place in its socket **A**, on the top of the case.

Location of Set. With the batteries and radiotrons installed and connected, Radiola 24 is ready for operation. It may be located at any place convenient and desirable to its user.

OPERATION

Filaments. Pull out the filament switch **Z**. Turn the "VOLUME CONTROL" knob **Y** (Fig. 4) clockwise to 100. Turn the "BATTERY SETTING" knob **T** clockwise to the arrow mark on the dial. WITH FRESH BATTERIES, DO NOT TURN THE POINTER PAST THE ARROW MARK. THIS IS EXTREMELY IMPORTANT as you will otherwise shorten the useful life of the radiotrons and batteries, and little will be gained in ease of tuning, signal strength or otherwise. As the batteries grow older with use, this setting should be gradually advanced from week to week toward "100." Push in the amplifier switch **S**, which gives the full amplification of the receiver. Head telephones may be plugged into the telephone jack **X** when the user desires.

Tuning. The tuning of Radiola 24 involves only the manipulation of the two "STATION SELECTOR" knobs **R** and **W**— a simple operation if the principle described below becomes thoroughly understood.

The two gold-tipped pointers have approximately the same settings, i.e., if one is set at 10 or 30, etc., the other is at or near 10 or 30, etc.

When searching for stations, the settings of which are not known, proceed as follows: Set "STATION SELECTOR I" gold-tipped pointer **N** at, say, 10 (referring to the metal dial scale under the paper scale). Move "STATION SELECTOR II" gold-tipped pointer **V** slowly over the scale near 10, say from 5 to 15. If no signals are heard, there is no station working on that wavelength. Then set "STATION SELECTOR I" pointer at say 12, and slowly

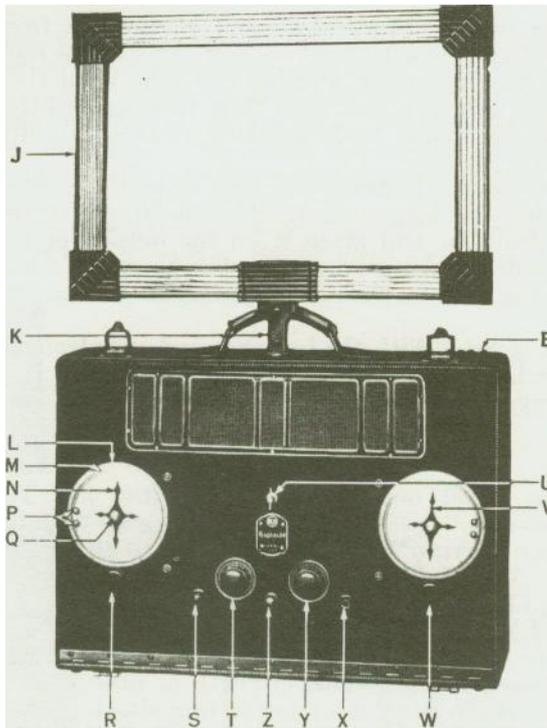


Fig. 4. Radiola 24 Ready for Operation

- E—External Battery Socket.
- J—Loop.
- K—Loop Plug.
- L—Retaining Ring for "STATION SELECTOR I" Dial
- M—Clamp Wire.
- N—"STATION SELECTOR I" Pointer.
- P—Knobs on Clamp Wire.
- Q—Thumb Nut for Pointer.
- R—"STATION SELECTOR I" **Knob.**
- S—Amplifier Switch.
- T—"BATTERY SETTING" **Knob.**
- U—Latch
- V—"STATION SELECTOR II" Pointer.
- W—"STATION SELECTOR II" **Knob.**
- X—Telephone Jack.
- Y—"VOLUME CONTROL" Knob.
- Z—Filament Switch.

move "STATION SELECTOR II" from about 7 to 17. If again no signals are heard, set, "STATION SELECTOR I" gold-tipped pointer at say 14, and move "STATION SELECTOR II" slowly from about 9 to 19. If still no signals, repeat this process, increasing the setting of "STATION SELECTOR I" in small steps until the whole scale has been covered. It will be noted after the first few trials that when "STATION SELECTORS I AND II" are in resonance, a slight breathing sound is heard indicating that the set is working properly and in resonance.

After hearing a signal, carefully adjust both "STATION SELECTORS I AND II" for the clearest reproduction. To decrease the volume of signal, turn the "VOLUME CONTBOL" knob **Y**, toward the "SOFT" position.

If no stations are heard, the loop on Radiola 24 should be turned 90 degrees from where it was during the preceding adjustments, and the tuning process just described should be repeated.

Control of Volume. As Radiola 24 is a very sensitive receiver, it is often found advisable to reduce the loud speaker volume. This may be accomplished by employing one or all of the following methods:

- (1) Turn the "VOLUME CONTROL" knob **Y** away from "100" toward "SOFT."
- (2) Pull out the amplifier switch **S**.
- (3) Rotate the loop **J** until best position is found.

Interference. Signals from an interfering radio station may be eliminated or at least minimized by either of the following methods:

- (1) Turn "STATION SELECTOR II" pointer **V**, either to the right or left, by approximately $\frac{3}{4}$ inch to 1 inch, to find another position of this control, where the desired station will be again heard. The setting of "STATION SELECTOR II" nearer the left end of the scale is technically called the "lower wavelength peak," and the other the "upper wavelength peak." Two settings of this nature will be found for all broadcast stations, and the separation between them becomes greater and greater for the higher end of the scale, i.e., nearer the right hand end. It is recommended that "STATION SELECTOR II" be consistently set on the "upper peak" in the usual manipulation of the set. When interference is encountered, shift to the "lower peak," and use whichever one at which minimum interference occurs.

There are certain wavelengths (greater than 440 meters) where four tuning positions, instead of the usual two positions, can be found on "STATION SELECTOR II," when the receiver is located close to a powerful broadcasting station. This does

not, however, interfere with reception either from the local station or from a distant one. In the case of the local station, the user should, under such circumstances, turn "STATION SELECTOR II" to either of the two positions which correspond most nearly to the setting of "STATION SELECTOR I" for the local station. In the case of the distant station, shift "STATION SELECTOR II" to the other "wavelength peak," either "upper" or "lower," as the case may be, where interference (if present) will probably not be encountered.

(2) Rotate the loop. For every transmitting station, there are two positions at which the signal strength will rise to a maximum, and two others at right angles where it is at a minimum. Set the loop on Radiola 24 where best results are secured, trying to locate the position where the interference does not come in, but the desired signals do.

GENERAL INFORMATION

Paper Dials. Four paper dials for each of the "STATION SELECTORS" will be found with the set, three each in the envelope for the Instruction Hook, and one each in place on the panel. To put another "STATION SELECTOR I" dial in place, grasp pointer N with the left hand, turn and remove the knurled nut Q which holds it in place. Grasp the two knobs P on the end of the clamp wire M, pinch the knobs together, and pull the clamp wire free from its retaining ring L. Remove the old dial, and place a "STATION SELECTOR I" dial on the panel, taking care to locate properly the central hole and the notch on the left hand side. Replace clamp wire M, pointer N, and knurled nut Q in the order mentioned.

Follow the same process for "STATION SELECTOR II" dial.

Calibration of Set. The paper dials provide a means of recording the settings of the "SELECTORS" for the various stations. Once recorded, the pointers may be reset at any later time to these positions, and if the station is broadcasting, it will be heard. After a station is tuned in as above, mark the positions of one of the tips of each of the "STATION SELECTORS" as well as the call letters of the station. It is suggested that only the "upper peak" of "STATION SELECTOR II" be recorded.

Note that in a few places throughout the country, particularly in the metropolitan areas, there may be two or more stations assigned to the same wavelength or frequency, but apportioned different hours of the day so that they will not be "on the air" at the same time. For example, Philadelphia, Pa., has two stations WOO and WIP working on the same wavelength,

but dividing time. Other examples will be found in the "Partial List of Class **"B"** Broadcasting Stations" in the rear pages of this booklet. Under such conditions, the "STATION SELECTOR" settings should be the same for both stations.

Each of the "STATION SELECTORS" is provided with four pointers, in order that stations of nearly the same setting may be recorded on the dials without crowding the markings. It is suggested that the gold-tipped pointers be reserved for wavelength or frequency markings, and that the station settings be recorded on the three remaining pointers in the following order:

long black pointer, right short pointer and left short pointer. Mark as many stations as possible on the long black pointer. When a new station is tuned in, quite close to one already recorded, then use the short pointers for the markings.

The recording of these markings and the resetting of the pointers for these positions should be made with great care, particularly the markings for "STATION SELECTOR II." This is highly important because under some conditions a slight motion of only one-thirty-second of an inch is sufficient to cut out or bring in a station at full volume.

The only precaution to be observed when making these markings is to see that the set is not located near any large metal objects, such as directly against the metal side of an automobile, or against a steam radiator. Such positions may cause changes in the settings of "STATION SELECTOR I."

In order to facilitate the tuning process, and to give an approximate idea of where stations should come in, Fig. 5 shows a reproduction of both dials, with the average markings of the principal broadcasting stations, marked in accordance with the method described.

The Log Sheets. The log sheets in the back of the book will serve as a permanent record of stations heard.

Batteries and Radiotrons. The only parts ordinarily needing replacements will be the batteries and Radiotrons.

It is important to adjust the "BATTERY SETTING" and "VOLUME CONTROL" knobs properly. With fresh batteries, turn the "BATTERY SETTING" knob to the arrow mark on the dial, but no farther. Turn the "VOLUME CONTROL" to 100. Then search for stations as described on page 9. Having located a station, turn the "VOLUME CONTROL" knob to the left, if it is desired to decrease the volume of signal.

The accuracy of the setting of the filament voltage may be checked by a good filament voltmeter (of the high resistance type). Turn the "VOLUME CONTROL" to 100. Turn the

"BATTERY SETTING" to the arrow. Touch the positive (+) voltmeter terminal to the case of the tube socket unit which holds the tube sockets D, and touch the negative (—) terminal to the movable blade of the "VOLUME CONTROL" on the rear of the panel. If the voltmeter reads greater or less than 3 volts, adjust the "BATTERY SETTING" knob until a reading of 3 volts is obtained.

With the filaments burning too brightly ("BATTERY SETTING" knob too close to 100), the active material in the filaments is rapidly driven off, and the useful life of the Radiotrons and batteries is shortened. Should this occur, the Radiotron life may be restored, provided they have not been too seriously abused.

This process of "reactivation" as it is called, may be accomplished by turning the "VOLUME CONTROL" knob to 100, and the "BATTERY SETTING" knob to the arrow (or to 3 volts), and by disconnecting the "B" batteries, either those installed in the set, or the large capacity batteries for non-portable use. This may be done conveniently by disconnecting any two or all three of the three "B" battery leads marked "—B" (black with red tracer), "+45V" (maroon), and "+90V" (red), respectively. Keep the radiotrons lighted for about 30 minutes, remake the connections, and then try tuning.

Maintenance. Very little maintenance will be required on Radiola 24, outside of an occasional oiling of a few of the parts. The oiling operation is important, and should be done about once every six months. To oil the moving parts, turn both "STATION SELECTOR" pointers as far right as possible, and open the panel of the set to the horizontal as in Fig. 1. Then place one drop of good grade oil, such as typewriter oil, on each of the following parts of both "STATION SELECTORS":

(1) On the front and rear bearings of the shafts, where the shafts pass through the black molded sub-panels.

(2) On the bushings in the panel which hold the "SELECTOR" knobs.

(3) **On the universal or ball joint just back of the "SELECTOR" knob shaft.**

(4) On the spring bearing of the slanting knob shaft (which spring bearing presses against the black insulation collar).

Cleaning the Exterior. If the case becomes dirty from handling or rough usage, it may be cleaned by rubbing with a damp sponge or soft cloth. After it is thoroughly dry, apply a coat of black leather dressing, rubbing it well into the leather. The brand chosen should preferably be of the type which dries quickly.

Storage Battery. If the user desires to use a 4-volt storage battery for non-portable use, it should be connected to the battery cable in the following manner. Connect the "+A" lead (yellow with red tracer) to the "+" battery terminal (red), and connect the "—A" lead (black with yellow tracer) to the "—" battery terminal (black). When operating the set with storage batteries, turn the "BATTERY SETTING" knob to 65 but no farther. It will be possible to leave this knob set at this point when operating the receiver. The battery should be kept well charged, and it is recommended that the instructions accompanying the battery be carefully followed. The battery should preferably be clamped or blocked in suitable manner to prevent spilling its contents and damaging the furniture or floor of the home.

POSSIBLE DIFFICULTIES

Should any trouble develop in the use of Radiola 24, it will in all probability be due to loss of life of the Radiotrons or to the exhaustion of the batteries. As the batteries grow old, they decrease in voltage, and increase in resistance. After the Radiotrons have been used for a long time, their filaments tend to lose emission. If the difficulty appears to be elsewhere, it is recommended that the services of the dealer from whom the set was purchased, be enlisted.

If the set becomes inoperative, try interchanging the Radiotrons. The second tube from the right (when facing the front of the set) is the important one and it is well to determine first whether this tube is working properly. This may be done by touching the moistened finger to the stationary condenser plates of "STATION SELECTOR II," on the rear of the panel. A sharp click should be heard in the loud speaker. If none is heard, try interchanging this tube with either the third, fourth, or fifth Radiotrons, applying the click test each time. Use for the second Radiotron from the right (when facing the front of the set), the one which gives the sharpest click in the loud speaker. If the set is still not operative, push in the amplifier switch S, and remove the Radiotron on the extreme left-hand end, from its socket. Try substituting this tube for the first, third, fourth and fifth Radiotrons, operating the set each time, to ascertain if the reception has been improved. If no improvement is noted an examination of the batteries and their connections should be made. It is of advantage to keep a spare Radiotron UV-199 on hand, to meet emergencies. Pockets B (Fig. 1) are provided on the inside of the suit-case to carry spare tubes.

There are several indications by which the user may determine that the filament or "A" batteries are becoming exhausted. These are low filament brilliancy, weak signals, and distortion, the signals becoming less and less recognizable. When it is found necessary to turn the "BATTERY SETTING" knob up to "100," and the operation of the set is still unsatisfactory (or when it is necessary to turn the "BATTERY SETTING" knob to 100 to get 3 volts on the filament, if a voltmeter is used), it is a definite indication that the filament batteries are exhausted. When fresh batteries are installed for the first time, listen to the loud speaker, while pushing the amplifier switch S in and out. Sharp "clicks" will be heard in the loud speaker. Do this sufficiently to learn just how loud the click should be. If the "B" batteries have become fairly well exhausted, these clicks will become practically imperceptible—an indication that they need replenishing. A better method of test is, of course, to use a voltmeter of suitable range (100 to 150 volts scale, preferably of the high resistance type), for measuring the "B" battery voltage. Connect the positive (+) voltmeter terminal to the "+90 Volt" binding post C (Fig. 1), and the negative (—) terminal to the "—" terminal of the right-hand "B" battery. When the voltage has dropped to 68 volts total, or to 17 volts per battery, the batteries should be replaced.

An indication of exhausted "C" batteries may be had by listening to the loud speaker with no stations tuned in. If the loud speaker gives forth a continuous noise, the battery needs renewal. The noise may be either a high pitched whistle, a high cackling sound or a low gurgling murmur. Frequently the whistle is so high as to be above the range of audibility for some persons, but, in any case, the noise becomes more audible as the batteries age. It is quite difficult to determine when the "C" battery is exhausted, except by measuring its voltage with a high resistance voltmeter. A safe plan, in lack of a voltmeter, is to renew the " C " battery each time the " B " batteries are replaced.

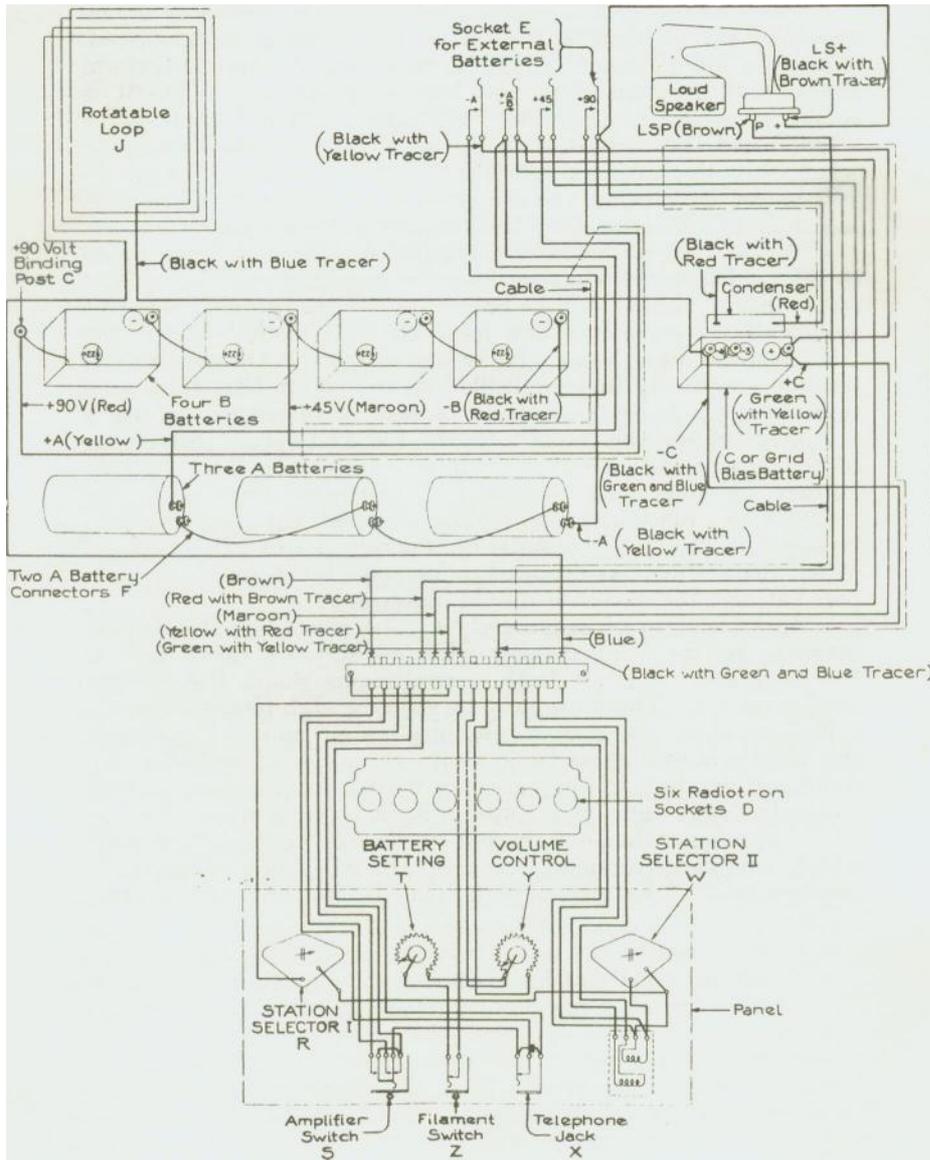


Fig. 6. Connection Diagram of Radiola 24

NOTICE

The apparatus and devices which, or the use of which, are covered by patents, are sold only under certain specified licenses set forth in a notice attached permanently to the said apparatus and devices, or if this is impracticable on account of size, then on tags or wrappers attached to the said apparatus and devices or on the cartons containing the same. This license notice is as follows:

"In connection with devices it sells, Radio Corporation of America has rights under patents having claims: (a) on the devices themselves and (b) on combinations of the devices with other devices or elements, as, for example, in various circuits and hook-ups.

"The sale of this device carries a license under the patent claims of (a), but only for amateur, experimental and entertainment radio uses where no business features are involved.

"The sale does not carry a license under patent claims of (b) except only (1) for legitimate renewals and repairs in apparatus and systems already licensed for use under such patent claims on combinations, and (2) for assembling by amateurs and experimenters, and not by others, with other licensed parts or devices, or with parts or devices made by themselves, but only for their own amateur, experimental, and entertainment radio uses where no business features are involved, and not for sale to or for use by others."

RADIO CORPORATION OF AMERICA

PARTIAL LIST OF CLASS "B" BROADCASTING STATIONS

WAVE-LENGTH (METERS)	FREQUENCY (KILOCYCLES)	CALL LETTERS		
299.8	1000	WPG	Atlantic City. . . . N. J.	Municipality of Atlantic City
		WTAS	Elgin I.L.L.	Charles E. Erbstein
302.8	990	WJJD	Mooseheart I.L.L..	Loyal Order of Moose
305.9	980	WJAR	Providence. R. I.	Outlet Company
		KDKA	East Pittsburgh... Pa.	Westinghouse Elec. & Mfg. Co.
309.1	970	WAHG	Richmond Hill... N. Y.	A. H. Grebe & Co.
		WGBS	New York..... N. Y.	Gimbel Brothers
315.6	950	KFDM	Beaumont..... Texas	Magnolia Petroleum Co.
		WGR	Buffalo..... N. Y.	Federal Telephone & Telegraph Co.
319.0	940	KOA	Denver..... Coin.	General Electric Co.
322.4	930	WSAI	Cincinnati..... Ohio	United States Playing Card Co.
		WMH	Cincinnati Ohio	Ainsworth-Gates Radio Co.
325.9	920	KFAE	Pullman Wash.	State College of Washington
329.4	910	WBZ	Springfield..... Mass.	Westinghouse Elec. & Mfg. Co.
333.1	900	KNX	Los Angeles. Calif.	Los Angeles Express
		WSAC	Clemson College.. S. C.	Clemson College
		WCAL	Northfield Minn.	St. Olaf College
336.9	890	KFMX	Northfield Minn.	Carleton College
		KSAC	Manhattan. Kan.	Kansas State Agricultural College
340.7	880	WLS	Chicago..... I.L.L..	Sears, Roebuck & Co.
344.6	870	WCBD	Zion. I.L.L..	Wilbur G. Voliva
		KOB	State College. . . . N. M.	State College
348.6	860	WTIC	Hartford Conn.	Travelers Insurance Co.
		WWJ	Detroit..... Mich. I	Detroit News
352.7	850	WJAD	Waco Texas	Jackson's Radio Laboratories
361.2	830	KGO	Oakland..... Calif.	General Electric Co.
		WDAF	Kansas City. Mo.	Kansas City Star
365.6	820	WHB	Kansas City. Mo.	Sweeney School Co.
370.2	810	WEBH	Chicago. Ill.	Edgewater Beach Hotel
374.8	800	WGN	Chicago..... Ill.	Drake Hotel
		KTHS	Hot Springs Ark	New Arlington Hotel Co.
379.5	790	WGY	Schenectady. N. Y.	General Electric Co.
384.4	780	WHAZ	Troy..... N. Y.	Bensselaer Polytechnic Institute
389.4	770	WMBF	Miami Beach. . . . Fla.	Fleetwood Hotel
		WEAR	Cleveland. Ohio	Goodyear Tire & Rubber Co.
		WTAM	Cleveland. Ohio	Willard Storage Battery Co.

394.5	760	WLIT	Philadelphia. Pa.	Lit Brothers
		W FI	Philadelphia. Pa.	Straw -bridge & Clothier
399.8	750	KHJ	Los Angeles. Calif.	Times Mirror Co.
		WOAI	San Antonio. Texas	Southern Equipment C
405.2	740	WHAS	Louisville. Kv.	Courier Journal & Times
		WJY	New York. N. Y.	Radio Corporation of America
416.4	720	WOR	Newark. N. J.	L. Iiimberger Co.
		WCCO	Minneapolis. Minn.	Washliirm-('rosbv Co.
422.3	710	KPO	San Francisco... . Calif.	Hale Brothers
		WLW	Cincinnati..... Ohio	Crosley Mtg. Co
428.3	700	WMH	Cincinnati..... Ohio	Ain.swortli-dates Radio Co.
		WSB	Atlanta..... Ga.	Atlanta Journal
440.9	680	WOS	Jefferson City..... Mo.	Missouri State Market Bureau
		WDWF	Cranston R. I.	Dutee W. Flint
447.5	670	WMAQ	Chicago..... Ill.	Chicago Daily News
		WQJ	Chicago..... Ill.	Calumet Baking Powder Co.
454.3	060	WJZ	New York..... N. Y.	Radio Corporation of America
		KFOA	Seattle..... Wash.	Rhodes Department Store
468.5	640	WCAE	Pittsburgh..... Pa.	Kaufman & Baer Co.
		WRC	Washington. D. C.	Chesapeake & Potonmc Telephone Co.
475.9	630	WCAP	Washington. D. C.	Radio Corporation of America
		WFOA	Los Angeles..... Calif.	E.C. Anthony. Inc.
483.6	620	W BAP	Dallas Texas	News & Journal
		WEE1	Fort Worth..... Texas	Star-Telegram
491.5	610	WOC	Hoston..... Mass.	Edison Electric Illuminatim; Co.
		WSUI	Davenport. Iowa	Palnier School of Chiropractic
499.7	600	WEAF	Iowa City. Iowa	State University of Iowa
		WMC	New York. Y.	American Telephone & Telegraph Co.
508.2	390	KGW	Portland. Ore.	Portland Morning Oregonian
		WIP	Memphis..... Tenn.	Commercial Appeal
516.9	580	WOO	Philadelphia. Pa.	Gimbel Brothers
		WNYC	Philadelphia. Pa.	John Wanamaker
526.0	570	KLX	Oakland..... Ca.	Tribune Publishing Co.
		WHA	Detroit. Midt.	Detroit Free Press
535.4	560	WAW	Oinaha..... Neb.	Woodmen of the World
		WNYC	Des Moines..... Iowa	Bankers Life Co.
545.1	550	WNYC	New York City. ... N. Y.	City of New York Westinghouse Elec. &
		KYW	Chicago..... Ill.	Mfg. Co. University of W isconsin Post
		WHA	Madison..... Wis.	Dispatch Concordia College
		KSD	St. Louis. Mo.	
		KFUO	St. Louis..... Mo.	