

Radio Enters the Home

How to enjoy popular
Radio Broadcasting
Complete instructions and
description of apparatus



For those who desire to be entertained
with concerts, lectures, dance music -
as well as for the Radio amateur

Radio  Corporation
of America

SALES DEPARTMENT
WOOLWORTH BUILDING NEW YORK

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(4) No license under any such patent covering a combination or organization of elements is granted to replace any tubes in any set sold by the Radio Corporation of America or assembled under license from it, with other tubes not sold by the Radio Corporation of America.



June 1, 1922



SALES DEPARTMENT
233 Broadway New York City

DISTRICT OFFICE
10 South La Salle St. Chicago, Ill.

ERRATA

- Page 13—Second column, first line, should read "adjustment rotate tuning handle (7) slowly." This refers to bottom figure on diagram. Other (6) and (7) in diagram irrelative to text.
- Page 20—Second column, last two lines, "Note" refers to connection from ground clamp on pipe, to protective device.
- Page 34—Collapsible Loop Antenna Model No. should be AG-1380.
- Page 45—Caption for Fig. 3, correct as follows: (right hand column)
R1, R2, R3, R4, Standard Filament Rheostats PR-535.
R5, R6 Standard "A" Battery Potentiometer PR-536.
R7, Standard grid leak 5 to 2 Megohms UP 516, 519 or 523 with UX 543 mounting.
- Pages 52 and 112—Two stage component part audio amplifier discontinued.
- Page 53—Bakelite Socket UP-552, discontinued.
- Page 62—Ratings of Rectigon Battery Chargers should be 2 amperes and 5 amperes respectively.
- Page 73—Description of circuit No. 9 should read "Figure 9 shows a radio telegraph transmitting circuit for two Radiotrons UV-204. The energy supply for the plate circuit must be D. C. An individual transformer on A. C. for filament heating supply being used. A circuit of this character may be employed to communicate over long distances by continuous wave telegraphy."
- Page 82—Delete the words "Self-Rectifying" from caption for Fig. 9.

PRICE THIRTY-FIVE CENTS

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To meet and develop the interest of amateurs of the radio art, the purchaser of parts from us is given the privilege of assembling those various parts in the circuits shown and described in this catalogue, and covered by the patents listed below, among others, but only for his own amateur and experimental use, including broadcast reception of music and other entertainment but not broadcast transmission, and not for sale.

This license is not given to agents, jobbers, dealers, manufacturers, professional assemblers, etc., as to do so would defeat its purpose.

Nor is any license hereby granted to combine any parts purchased from the Radio Corporation of America with parts or partially assembled sets made by others.

UNITED STATES PATENTS

803,684	963,173	1,201,270	1,356,763
841,387	1,104,073	1,213,250	1,360,168
876,996	Re.14,380	1,219,215	1,375,447
879,532	1,113,149	1,219,216	1,377,405
904,222	1,137,315	1,231,764	1,384,108
924,827	1,137,714	1,282,439	Re.13,789
933,263	1,195,632	1,325,865	

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BY

RADIO CORPORATION OF AMERICA



Section of Radio Assembling Room at Immense Plant of General Electric Company, Schenectady, N. Y.



Completing Sets at the Westinghouse Electric and Manufacturing Company's Radio Works, Springfield, Massachusetts

Introduction

Radio Enters the Home RADIO has placed a new, inspiring and powerful resource at the disposal of civilization.

With magic touch it has relieved isolation and neglect on land and sea.

It has given the voice of hope and salvation to ships and passengers whose despair and tragic fate formerly were shrouded in silence.

It has brought new romance into the world to replace the exploits of Paul Revere and John Paul Jones. It travels swift as light, not through one valley, or on one lonely sea, but to the world at large on the wings of the ether.

Radio answers the call for more liberal education of nations and peoples, and permeates the remote places of the earth with the cultivating influence of music.

Radio telephony, following closely upon the heels of radio telegraphy, is sweeping the country, carrying into the homes of rich and poor alike a modern facility of pleasure and education which is binding the people together in a new and democratic brotherhood.

A richer and more complete home-life, with mental stimulus and pleasant relaxation, has been made possible through broadcasting and its receiving corollary, the radio telephone receiver.

First Taste of Broadcasting To the Westinghouse Electric & Mfg. Company is accredited the first successful attempt at organized broadcasting. This took place on November 2, 1920, at Pittsburgh, Pa., when "KDKA" broadcasted the Harding-Cox Presidential returns to thousands of expectant citizens.

Later, at the New York Electrical Show of October, 1921, a prominent artist sang to an audience of listeners in thousands of homes in and around New York. She was amazed when there came back through the ether to the concert room immediate requests for an encore. While the major-

ity, with their telephone receiving sets, merely listened, the request for the encore came from many amateurs who were equipped with sending sets.

In a like manner, nearly 200,000 radio enthusiasts, located hundreds of miles away from the ringside at Jersey City, received reports, round by round, of the Dempsey-Carpentier bout.

From a national standpoint, however, the full significance of radio telephony becomes apparent when it is possible for the President of the United States to address the people of the country clearly and impressively on special occasions. The suggestion has already been made in Congress that the debates of both upper and lower houses be broadcasted by radio.

In the great centers where broadcasting is in full swing, where theatrical stars and famous speakers have been heard by families sitting, miles away, around their own fireside, life has literally been made over for boys and girls, their fathers and mothers, the strong and well, the blind and the bedridden. Radio concerts have become the order of the evening in tens of thousands of American homes within the radius of the broadcasting stations.

Advanced scientific and engineering efforts have simplified radio receiving of concerts to the point where anyone, without experience or study, can enjoy the new national resource.

Not only have home concerts become a national pastime, but dancing to the music of famous orchestras playing in person for the benefit of radio "fans," has established itself as a permanent recreation.

From the oldest to the youngest—fathers and sons listening to baseball scores—mothers and daughters to the brief fashion talks—the whole family to some church service—farmers to the crop and weather reports—lawyers, doctors, clerks, messengers, captains of industry—all equipped for some feature of this new and amazing thing called radio broadcasting.

THE BROADCASTING STATION



A famous star singing to the "unseen audience" from radio receiving station.

AT present there are perhaps 125 to 200 radio telephone broadcasting stations in the United States which are regularly sending out news and entertainments to the hundreds of thousands of listeners who have receiving apparatus. They are located in the larger cities, which is essential for two reasons: that their programs may reach the largest number of people possible and that artists of recognized ability may be secured to join the other entertainers.

A broadcasting station is generally divided into two or more rooms. The studio, with its piano, phonograph and other equipment for the artists, resembles the music room to be found in a home, except that the ceiling and walls are generally covered with some cloth or material which will eliminate any reverberating sounds or echoes.

One or more small "pick up" instruments known as microphones, mounted on standards, are usually the only pieces of electrical apparatus to be found in this room. Wires from these convey the voice or music into another room, which in many cases is at quite a distance from the studio. The latter resembles a laboratory with its various pieces of electrical apparatus, transmitting vacuum tubes, panel boards, storage batteries, etc. Here the music or speech is put through a number of steps of amplification by means of smaller vacuum tubes which increases the volume of the sound waves thousands of times. The amplified speech currents then enter another bank of vacuum tubes, known as modulators or molders of the electric waves sent through the ether.

Vacuum tubes, made in the same manner

and containing the same number of elements as the small tubes used for receiving, but much larger and therefore capable of handling more power, usually are used for radio broadcasting.

Direct current at a high voltage is necessary for the operation of a transmitting station. To obtain this, a low voltage alternating current, such as used for lighting purposes in the home, is boosted to a high voltage by means of a motor-generator. This voltage is then applied to a number of vacuum tubes. The electric power supplied to these tubes causes electrical oscillations in the aerial wire system known as the antenna, and the antenna in turn radiates electrical waves which are molded to the form of the inflexions of the voice or of music, by other tubes termed modulators.

The power used at a broadcasting station is measured by the energy delivered to the antenna system, rather than the energy taken from the power lines. For this reason the rated power of a broadcasting station seems rather low to the uninitiated.

Many of the broadcasting stations employ 500 watts of radiated energy, which is equivalent to nearly one horsepower. However, one of the largest broadcasting stations in the United States, located in Schenectady, New York, and owned by the General Electric Company, has facilities for greater power, but this is used only for special experimental tests. The masts used to support the antenna at this station are 183 ft. high and have been erected on the roof of a five story building.

Operators at broadcasting stations must possess the faculty of clear diction; they must be able to carry on a conversation in moderate tones sufficiently modulated and at low enough speed to insure correct and faultless reception at all the receiving stations.



A corner of the Radio Corporation—Westinghouse Station "WJZ".

The average range of the several high power broadcasting stations now in existence is 100 to 500 miles, although the stations maintained by the Westinghouse Electric and Mfg. Co., the General Electric Co. and the Radio Corporation of America have been heard over several thousand miles. In one instance an operator on board a ship more than a thousand miles at sea received a complete concert from a broadcasting station near New York with great enough intensity to pass it over the ship's telephone lines to 25 different staterooms at the same time.

It is estimated there are between 500,000 and 750,000 receiving sets in use, and artists at the larger broadcasting stations have had their entertainment heard by more than one hundred thousand people simultaneously.

As previously explained, the range of a receiving station depends upon a number of variable factors and the distances pointed out here have been covered by receiving stations employing sensitive apparatus, involving several stages of vacuum tube amplification. These facts should be considered in purchasing radio receivers.

THE FIVE FUNDAMENTALS OF RADIO RECEPTION

MOST of us know that there are various types of apparatus for the reception of radio broadcasting. Some of these "sets," as they are called, are more sensitive than others. Sensitivity, in the sense we apply it to receiving sets, is a quality analogous to power in transmitting apparatus. Most receiving sets, have five distinct functions—intercepting, tuning, detecting, amplifying and reproducing. It will be helpful to us later, when we consider receiving sets as complete units, if these functions are understood.

Intercepting

"Antenna" and "Ground," the externals of a radio receiving set, intercept the broadcasted signals and lead such energy as they collect to the receiving set by means of wires. In practice the ground usually consists of a wire connecting a certain binding post or terminal connection on the set with a water pipe, or other metallic conductor which leads to the ground. The antenna, in its simplest form, may consist of a single bare wire, thoroughly insulated from adjacent objects, seventy-five to one hundred and twenty-five feet long and raised horizontally to the earth as high as possible. This also is connected with the receiving set by means of a wire called the lead-in; details for the installation of the ground and erection of antenna are furnished in printed directions which accompany every set sold by the Radio Corporation of America.

Tuning

All radio broadcasted speech or other signals arrive at the receiving antenna on a definite radio wave length, that is, the wave length to which the broadcasting station is adjusted or "tuned." Every sound we hear, therefore, is carried through space by electrical waves, but these electrical waves are not audible to the human ear until, first, they have been "tuned in" at the receiver, and second, made audible by the "detector" and the head telephone. The radio transmitting station does



Every living room of the average home becomes a radio receiving station.

not radiate a "sound wave." It radiates an electrical wave which serves to carry through space the inflexions of the human voice or of music or of telegraph signals.

Tuning, as applied to radio, means the manipulation of wave changing controls on the receiving set so that the apparatus may be adjusted for a maximum signal from the broadcasting transmitting station. Once the receiver has been tuned to the wave length of the distant station, no further tuning manipulation is necessary for the reception of the entire concert. Nor is tuning a difficult operation for the beginner; all that has to be done is to turn the controlling knobs or levers on the tuning elements until the signal is heard loudest.

Detecting

The detector rectifies or "changes" the energy received by the radio set into a form of energy which will produce an audible sound in a reproducer such as the head telephone or loud speaker. There are two classes of detectors, mineral crystals, and vacuum tube detectors. A vacuum tube detector is better

than the crystal detector because it is much easier to adjust and it performs its functions with greater efficiency as it amplifies incoming radiophone signals many times.

A receiving set equipped with a crystal detector is known as a "crystal receiver"; a receiving set which employs a vacuum tube detector is called a "vacuum tube receiver"; a receiving set using a vacuum tube detector which has special means for amplifying signals is called a "vacuum tube regenerative receiver."

Amplifying

Amplifying devices are used when the receiving set is far removed from the broadcasting station, or when it is desired to have the received signals actuate a loud speaking device.

The essential of an amplifying device is the vacuum tube. Each vacuum tube utilized in such apparatus (not to be confused with the detector tube) is known as one "step" of amplification.

Amplifier tubes operate on an electrical principle analogous to the mechanical principle of a firearm. Pulling the trigger of a gun requires very little physical energy, yet it releases a terrific energy stored in the shell in the form of powder. When energy is impressed on the amplifier tube, it "triggers off," from a battery storing electrical energy, a given signal having many times the energy of the original.

In some receiving sets, the tubes are so placed as to amplify the signal before it is fed to the detector tube. This is called "radio frequency amplification." In other sets, the tube

is made to amplify the signal after it has passed through the detector. This is known as "audio frequency amplification." Where extreme amplification is desired, the set may contain amplifier tubes in both positions.

Reproducing

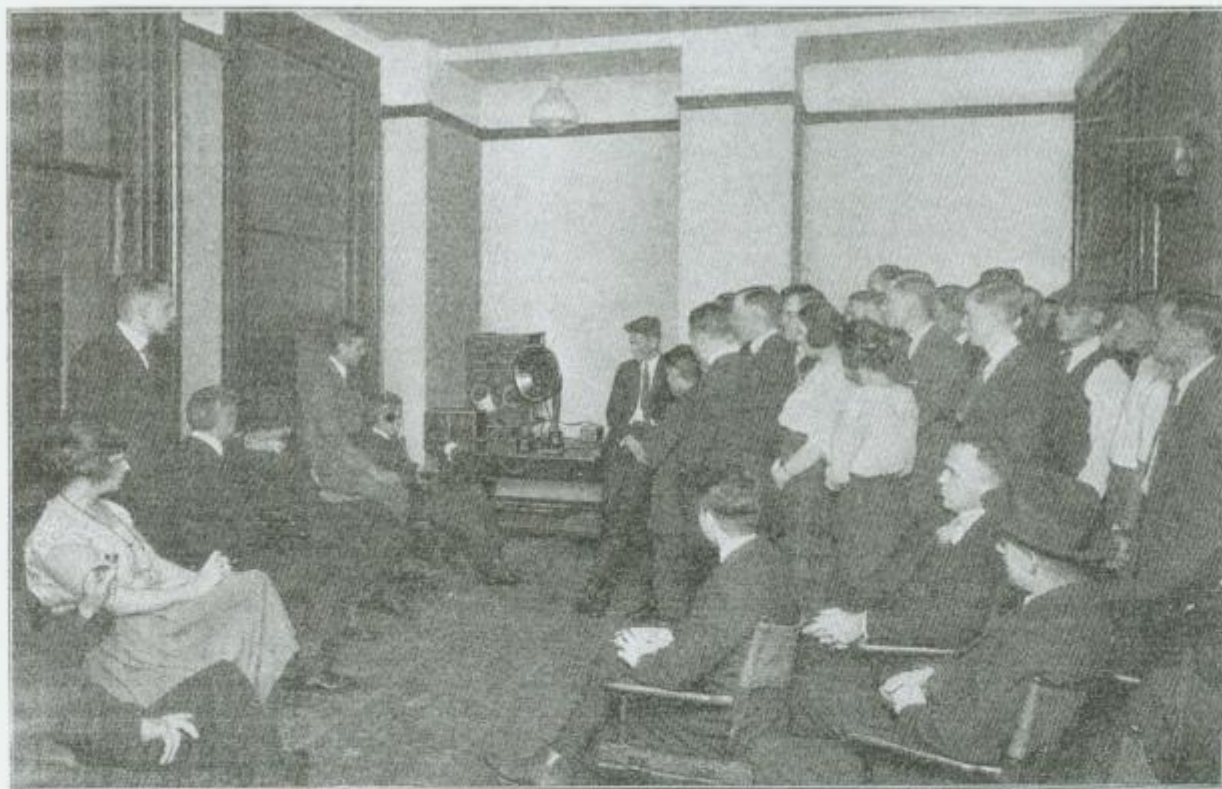
The function of the reproducer is to convert the energy which has been passed through the various apparatus described above from electrical pulsations into sound waves. A pair of head telephones constitute one type of reproducer. Another is the loud speaker, consisting of a sensitive telephonic reproducer attached to a suitable sound chamber or horn.

A very slight vibration from the head telephone will suffice to convey the sound to the ear. On the other hand, a loud speaker, to make the signal audible over an entire room, must have a diaphragm vibrating vigorously. Obviously, a loud speaker requires a signal of much greater intensity than a telephone headset, and it is one of the functions of amplification to furnish this louder signal.

General Remarks

The strength and quality of the audible sound made by the reproducer is directly dependent upon how well each of the five functions is performed by the receiving set.

Crystal receivers do not amplify signals; they simply tune, and rectify or change the energy at the detector and pass it directly to the reproducer, which is invariably a head telephone set.



The Radio Concert becomes a reality by the use of a combination receiver-amplifier unit in conjunction with a loud speaker.

CLASSES OF APPARATUS AND THEIR APPLICATION

ONCE any of the telephone receiving sets, intended for concert reception, is installed in your home, there is no need for technical knowledge. The usual questions that are asked can be briefly answered here:

"How much will it cost and what distance will it carry?" "Do city conditions differ from those of the country in regard to radio reception?"

In general it may be said that there are four classes of radio apparatus, each one designed at a specific price and for a specific use. These are:

- (1) The simple circuit crystal type receiver which may cost from \$18 to \$50, and which may receive effectively from five to twenty-five miles, according to skill in setting up antenna, and atmospheric conditions.

Crystal detector apparatus necessitates the use of an outdoor aerial, and reception is accomplished by means of head telephone receivers.

- (2) This class of apparatus may be said to be practically the same as Class 1, except in this instance we depart from the simple crystal detector to the vacuum tube detector, with an improvement in receiving qualities. The cost in this instance may range from \$65 to \$100.

It is also necessary to employ the outdoor antenna, as well as the head telephone receivers. It is not possible in this instance to make use of loud-speaking devices, for the energy received by the single vacuum tube detector is not strong enough to handle the loud speaking device unless the set is located within 2 or 3 miles of the transmitting station.



The "Man in the Moon" in action at "WDY" Broadcasting Station formerly at Roselle, N. J.



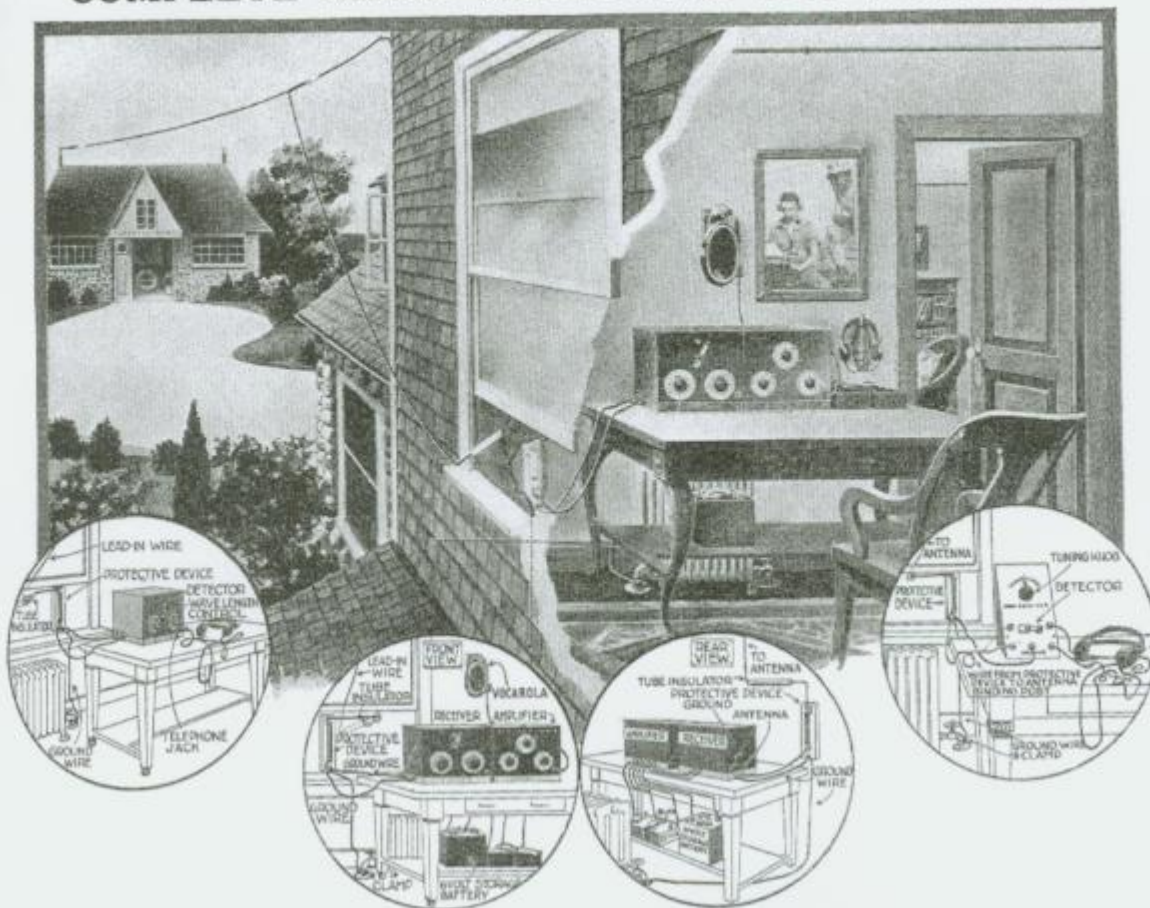
Bed time stories and music by radio have delighted thousands of little tots within a radius of several hundred miles from Newark, N. J. and New York.

- (3) In this class, it is also necessary to use the antenna and ground contact of the other systems mentioned. But much greater efficiency is obtained because vacuum tube amplification is employed. Receivers of this type usually consist of a receiving or tuning unit, a vacuum tube detector and two stages of vacuum tube amplification. This type of receiving equipment may cost from \$150 to, possibly, \$300. It has a much greater range of operation than the other types, and will function quite well up to 100 miles, although under exceptional receiving conditions, as much as 1000 miles may be obtained, employing the head telephone receivers.

It is also possible, in this instance, to employ a loud speaker and thus eliminate the head telephone receivers, thereby permitting a roomful of people to hear radio. The extra two stages of amplification permit this, for they increase the original intensity of a signal to such a point as to effectively operate the loud speaker.

- (4) This is the de luxe type of radio receiver, usually embodied in a complete cabinet, similar to that of the phonograph. All necessary instruments are enclosed in the cabinet and the tuning and adjusting devices are greatly simplified. It is designed for the use of the technically uninformed general public. A unit known as the "Aeriola Grand" is now on the market which incorporates these desirable features, and which is sold for \$350.

COMPLETE RADIO TELEPHONE RECEIVER SETS



Illustrating the general set up of receiver combinations. The extreme left hand cut show GE Receiver AR-1300 as a crystal receiver, the next cut shows GE Receiver AR-1300 in combination with Amplifier AA-1400, the next cut shows the method of battery connection when using these two units. The extreme right hand cut shows GE Crystal Receiver AR-753 in operating position.

RECOMMENDED RECEIVER COMBINATIONS

IN determining the necessary equipment for a Broadcast Receiving Station the following combinations of apparatus will be found helpful. Any unit may be bought separately. The complete combinations are indicated merely to guide those who wish to purchase a complete receiving set. Thus the technically uninformed enthusiast avoids the risk of buying unnecessary parts.

Westinghouse Aeriola Grand Combination No. 1		Westinghouse Aeriola, Sr., Combination No. 2	
RG	Aeriola Grand Receiver, with Stand, 150-550 meters, comprising one Aeriotron Detector, three Aeriotron Amplifiers, four Ballast Vacuum Tubes, and four "B" Batteries	RF	Aeriola Sr., Receiver, 190-500 meters, with Brandes Telephones and one W-D-11 Aeriotron Detector Tube
	\$350.00		65.00
6HR-9	Storage Battery, 6 volts, 100 A.H.		One Dry Cell for Aeriotron Filament
	24.00		.40
AD	Receiving Antenna Equipment	AD	One "B" Battery, 22.5 volts
	7.50		3.00
285168	Rectigon Battery Charger, 6 amperes		Receiving Antenna Equipment
	28.00		7.50
	Total		Total
	\$409.50		\$75.90
		Westinghouse Aeriola Jr., Combination No. 3	
		RE	Aeriola Jr., Receiver, 150-700 meters, with Brandes Telephones and spare crystals
			25.00
		AD	Receiving Antenna Equipment
			7.50
			Total
			\$32.50

RADIO CORPORATION OF AMERICA

Westinghouse Regenerative-Vacuum Tube Receiver Combination No. 4

RC	Short Wave Regenerative Receiver, 170-700 meters, less tubes	\$132.50
CB	Load Coil	6.00
UV-200	One Radiotron Detector	5.00
UV-201	Two Radiotron Amplifiers	13.00
6HR-9	Storage Battery, 6 volts, 100 A. H.	24.00
UD-790	Brandes Telephones	8.00
UD-824	Telephone Plug	1.75
	Two "B" Batteries	6.00
AD	Receiving Antenna Equipment	7.50
LV	Vocarola (Loud Speaker)	30.00
285168	Rectigon Battery Charger, 5 amperes	28.00
Total		\$261.75

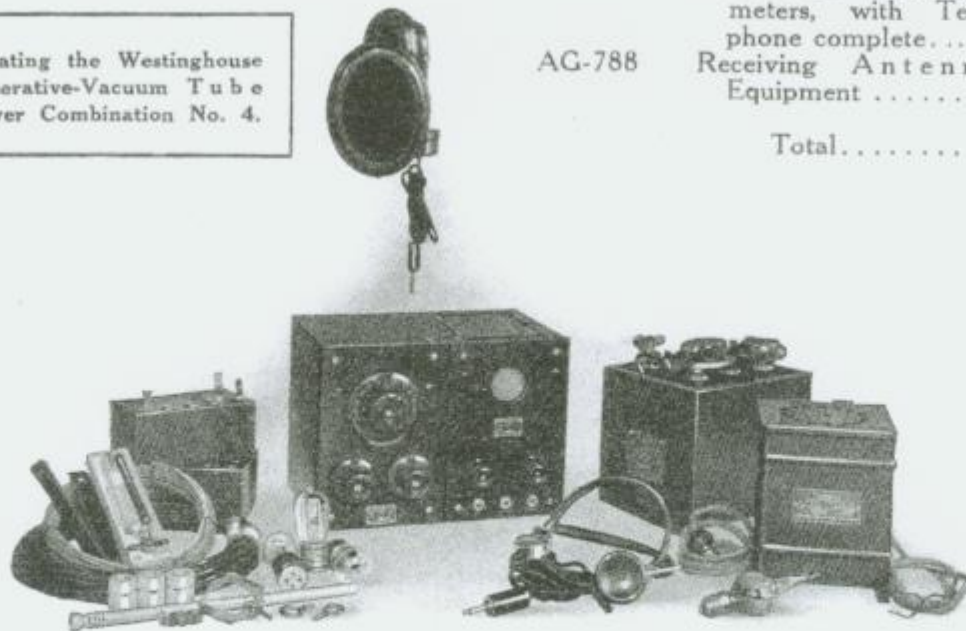
Westinghouse Crystal Receiver Combination No. 5

RA	Short Wave (Regenerative) Tuner, 170-700 meters	\$68.00
DB	Crystal Detector	6.50
UD-790	Brandes Telephones	8.00
AD	Receiving Antenna Equipment	7.50
Total		\$90.00

General Electric Regenerative-Vacuum Tube Receiver Combination No. 1

AR-1300	Radiophone Receiver, 170-700 meters	\$50.00
AA-1400	Detector—2-step Amplifier, less Tubes	75.00
UV-200	One Radiotron Detector	5.00

Illustrating the Westinghouse Regenerative-Vacuum Tube Receiver Combination No. 4.



UV-201	Two Radiotron Amplifiers	13.00
UD-790	Brandes Telephones	8.00
3LXL-9	Storage Battery, 6 volts, 80 A. H.	23.00
2156	Three "B" Batteries, each 22.5 volts	9.00
LV	Vocarola (Loud Speaker)	30.00
219865	Tungar Battery Charger, 5 amperes	28.00
UD-824	One Telephone Plug	1.75
AG-788	Receiving Antenna Equipment	7.50
Total		\$250.25

General Electric Crystal Receiver Combination No. 2

AR-1300	Crystal Radiophone Receiver, 170-700 meters, complete	\$50.00
UD-790	Brandes Telephones	8.00
AG-788	Receiving Antenna Equipment	7.50
Total		\$65.50

General Electric Crystal Receiver Combination No. 3

ER-753	Crystal Radiophone Receiver, 300-700 meters, with Murdock Telephone Receivers	\$18.00
AG-788	Receiving Antenna Equipment	7.50
Total		\$25.50

Wireless Specialty Crystal Receiver Combination No. 1

AR-1375	Crystal Radiophone Receiver, 170-2650 meters, with Telephone complete	\$40.00
AG-788	Receiving Antenna Equipment	7.50
Total		\$47.50