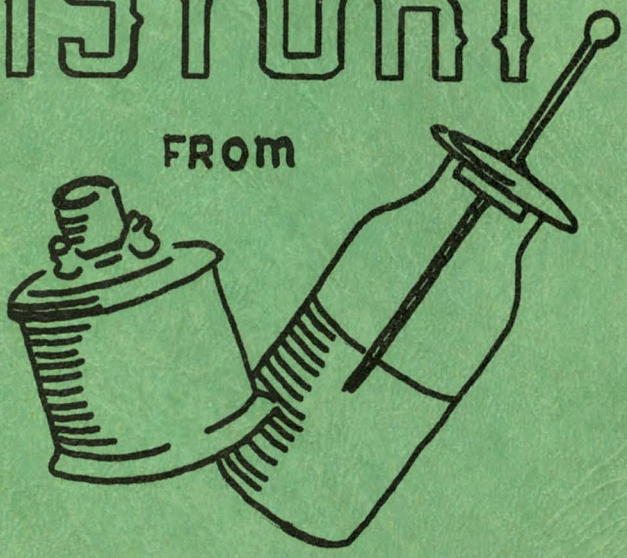
BITS OF WIRELESS HISTORY

FROM



GRAY HISTORY OF WIRELESS MUSEUM

Bits of WIRELESS History

BY

G. J. GRAY

FOREWORD

This book was written primarily to supply the visitor to The Gray History of Wireless Museum with pictures and descriptions of items in the Museum. It is hoped that my many friends who are historians and collectors of antique radio equipment will find it useful.

The original idea came from a suggestion to do some historical sketches for The Greater Cincinnati Amateur Radio Association "Mike & Key" magazine. Encouragement has come from many visitors to the Museum and from fellow members of The Antique Wireless Association.

Sources of material have been early radio magazines, books, catalogues, interviews and over fifty years in the radio field.

G.J.Gray
January 1969

First Edition

This book

is affectionately dedicated

te my wife

Ruth

BITS OF WIRELESS HISTORY

1-Bergman Direct Current Meter
2-The Condenser is Born
3-1906 Clark Wireless Receiver
4-The Electrolytic Detector
5-Massie Oscillaphone Detector
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THE GRAY HISTORY OF WIRELESS MUSEUM

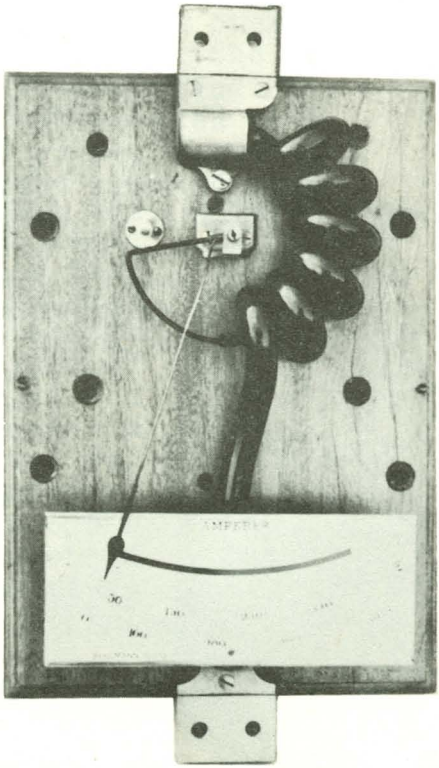
The Gray History of Wireless Museum is located near corner of Church and Frank Streets in Mason, Ohio, twenty five miles North of Cincinnati.

BERGMANN DIRECT CURRENT METER

In 1879, Thomas Edison built a meter for measuring electric current. Called an "Electro-meter", it was based on Faraday's discovery that the transfer of metal from one plate to another in an electrolytic bath was proportional to the current. The increase in weight of the removable plate indicated the total current used.

Early electric meters were large, cumbersome affairs. This 400 Ampere D.C. ammeter, built by Bergmann in New York City around 1890, was 10½" x 15" x 4" deep. The case was made of mahogany with a glass window in the cover.

It was a simple solenoid type with a 3/4" copper rod twisted into six turns and curved to permit the small curved rod mounted on the indicating hand to move in and out of the center. As the current increased, the curved plunger rod moved deeper into the coil and indicated the value of the current on the scale at the bottom of the instrument. Heavy brass connection blocks at top and bottom provided for heavy connections.



THE CONDENSER IS BORN

The advances in electricity around 1745 led to the conviction that electricity was a fluid and could be stored in a bottle. Professor Pieter Musschenbrook, of the University of Leyden,accidentally discovered the principle of the condenser. Using à glass jar filled with water and a wire thrust through the cork to the bottom,with a couple inches of wire protruding from the cork. He was trying to "pour the electric charge" from the static machine into the jar.

While grasping the jar with one hand, he accidentally touched the top wire with the other hand. Unknowingly, he had formed one plate of a condenser with one hand grasping the jar,while the water acted as the other plate. He wrote, "I received a shock of such violence that my whole body was shaken as if by a lightning stroke. I thought I was done for."

A Dr.Bevis later made a Leyden jar condenser with inner and outer coatings of thin sheet lead with a rod running through the cork,a brass ball at the top with a brass chain running from the bottom of the rod to the inner coating for a connection. Volta called the Leyden jar a condenser as he thought the electric fluid was condensed in the jar.Later condensers were made with flat glass having metal foil coating on both sides.

1906 CLARK WIRELESS RECEIVER

The Clark receiver was designed by Thomas E. Clark and manufactured by Clark Engineering Co. of Detroit.Clark sold several contracts to the U.S. government for Army and Navy wireless equipment. He was usually in financial difficulties and often could not meet his payroll.

The large semicircular potentiometer controlled the critical "B" battery voltage across the electrolytic detector. The knob and pointer behind the potentiometer tuned the variable condenser, a unique device with sheets of mica insulation between the plates.Behind the front electrolytic detector was a spare with the control switch mounted on the side of the cabinet.

The transmit-receive switch operated spring loaded push rods to open the receive circuits when transmitting. A two slide tuning coil was mounted back of the condenser. Hard rubber insulation was used in the equipment mounted on a heavy ,varnished oak base with heavy brass binding posts. The dark spots on the top of the base were caused by spilling acid from the dropper when filling the glass acid container on the electrolytic detector.
The etched brass name-plate reads:

CLARK WIRELESS
TELEGRAPH SYSTEM

DETROIT , MICH. USA.

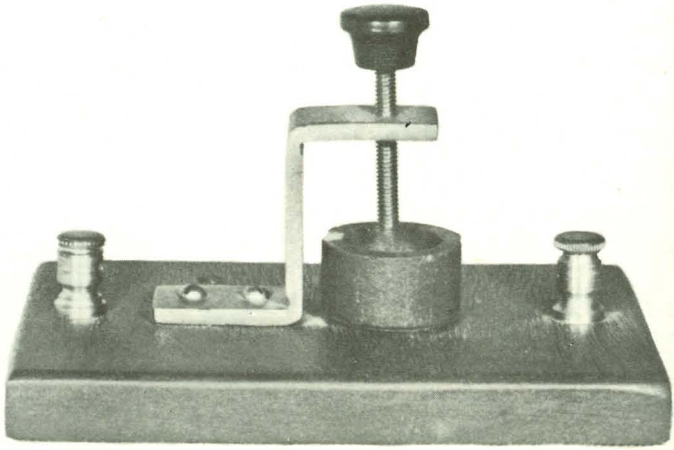
THE ELECTROLYTIC DETECTOR

The Electrolytic Detector was invented by Prof. Pupin in 1898 and improved by Prof. Fessenden in 1907. This model used a carbon cup to hold the 20% nitric acid electrolyte.

A local electric current was led into the electrolyte by a section of very fine platinun wire mounted at the end of a threaded brass rod. The platinun wire was adjusted with the knob at top of rod to barely touch the surface of the electrolyte. A potentiometer adjusted the battery voltage just below the point where the oxygen bubbles were destroyed.

When a radio signal was introduced into the circuit, the oxygen bubbles broke down and a signal was heard in the headphones following the dots and dashes of the transmitted signal.

The trade name of the very fine (0.0001 inch in diameter) platinun wire is Wollaston named after W.H.Wollaston.

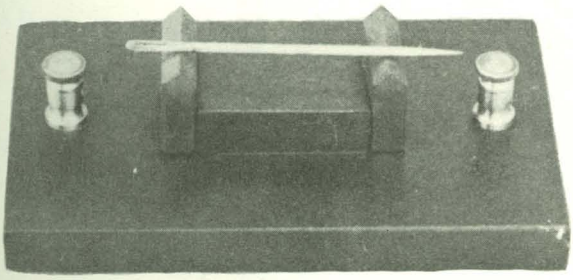


MASSIE OSCILLAPHONE DETECTOR

This simple type of detector was used by Walter W.Massie in wireless stations around 1908. It was the imperfect contact type with a sewing needle resting on the sharp edges of two pieces of carbon. Headphones in series with a battery connected to the two pieces of carbon with the aerial to one side and ground to the other side made a very simple receiver. A roaring noise was heard from the battery until a wireless signal flowed in the circuit,lowered the resistance of the imperfect contact, allowed more current to flow in the phones and caused a buzzing sound corresponding to the wireless signal dots and dashes. If the needle pressure was too light the roaring sound would drown out the signals.

The original Massie detector used a horseshoe magnet to increase or decrease the downward pull on the needle and vary the sensitivity.

This steel/carbon contact detector took many forms. Amateurs mounted two double binding posts on a base, took two pieces of lead from a pencil, inserted in one hole of the double binding post and laid a needle across the leads. The phones ,battery, aerial and ground connections went to the other hole in the binding post. Many early amateurs, low in funds, got on the air with this low cost detector.

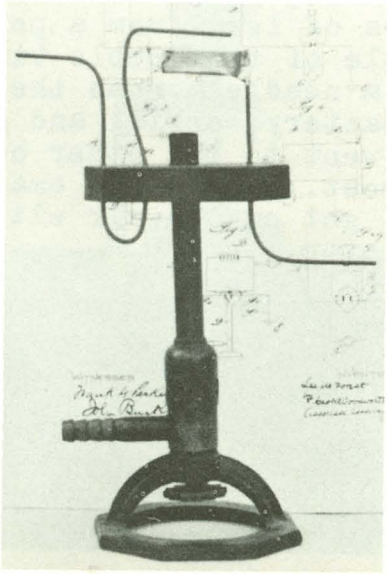


DEFOREST GAS FLAME DETECTOR

Lee deForest noticed , in 1900 ,a phenomenon in which the light in a Welsbach gas burner was affected by the operation of an induction coil nearby. This led him to an interest in the influence of electromagnetic waves on heated gas.

In 1903 he rigged up a Bunsen burner with two platinum electrodes in the flame. A telephone receiver and battery in series were connected to one electrode and the other electrode grounded to a water pipe. This crude gas flame detector actually brought in wireless signals.

DeForest applied for a patent which was granted in 1910. The application of the principle of heated gases in the detection of wireless signals eventually led to the dicovery of the three element vacuum tube. Shown here is an improved model of the flame detector with a platinum container for using salt to improve the ionized space between the electrodes.

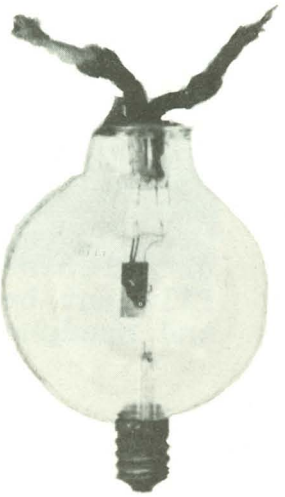


DE FOREST SPHERICAL TYPE AUDION

Lee de Forest announced the spherical type audion in 1908. For a short time he sold the tubular Audions but his manufacturer, The H.W. McCandless Co. of New York City was primarily a producer of Christmas tree bulbs so was better equipped to make round bulbs. This may account for the use of the candelabra screw base on the early tubes.

The Grid and Wing (plate) insulated connections came out of the top of the bulb. The double filament had the center connection to the center of the screw base. The outside lead of one filament connected to the shell of the base. The other outside lead was connected to a wire, insulated from the shell, wound around the neck of the bulb. When the first filament failed this wire was connected to the shell and the spare filament was in service.

These early tubes were poorly evacuated or "soft" tubes. Ionization occurred whenever the "B" voltage was raised too high. A potentiometer was connected across the "B" battery with a sliding contact for fine adjustment of the critical voltage. The most sensitive spot was just below the ionization point or when a blue glow showed inside the bulb.



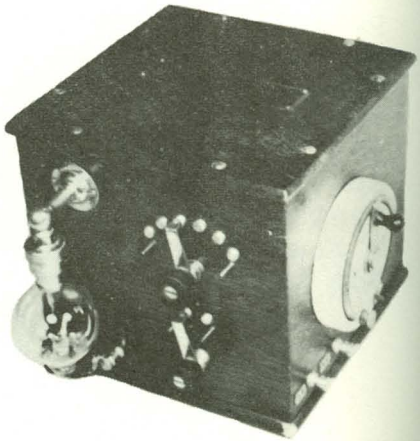
DEFOREST RJ-5 AUDION DETECTOR

For a long time after the Audion was put on sale it could be obtained from The Radio Telephone Co. (deForest) only by the purchase of a complete detector unit such as the RJ-4 or RJ-5 or by sending in the old tube. The RJ-4 unit cost $18 and the RJ-5 cost $25. The RJ stood for Radio Junior , indicating for amateur use.

The RJ-5 was in an oak box, with dark finish, in which were placed flashlight cells connected in series. Taps came out to the six point switch to get the proper "B" battery voltage.

The two point switch turned on the filament which was adjusted to normal brightness by the porcelain rheostat. A final adjustment was made for greatest sensitivity. Once adjusted the filament was turned on and off with the switch.

The spherical Audion was mounted as shown with the green wire to binding post marked G (Grid) and the red wire to binding post marked W (Wing).The plate was called "Wing" in early days. Binding post connections were provided for Input, usually secondary of a loose coupler, Filament battery and headphone.

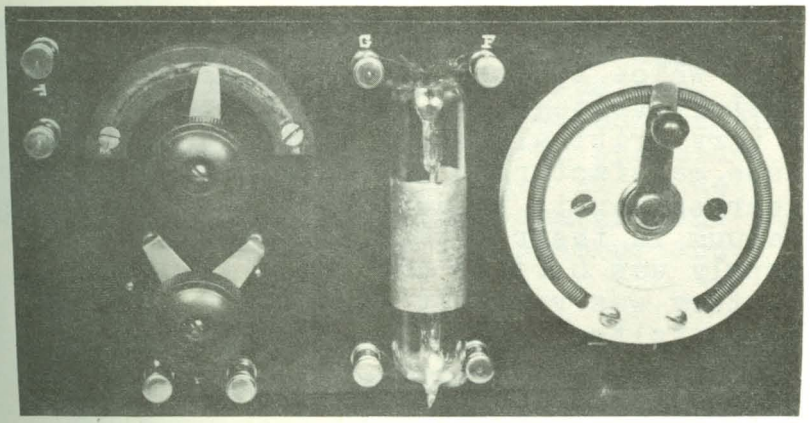


AUDIOTRON DETECTOR PANEL

This detector panel provided a convenient method for mounting the Audiotron tube , connecting the tube to the batteries and tuning circuit. This unit was manufactured by Audio Tron Sales Co. in San Francisco.

The OFF-ON switch opened the filament and "B" battery circuits. A porcelain rheostat adjusted the filament and the carbon potentiometer adjusted the critical "B" battery voltage This unit sold for $12.50 in 1916 complete with Audio Tron tube.

A more elaborate detector panel was built by the Radio Apparatus Co. and sold for $20 with a Liberty Audiotron type tube.

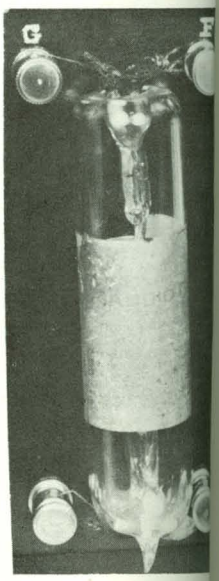


AUDIOTRON TUBE

In 1915 a west coast concern sold a cylindrical three element detector tube called the Audiotron. To meet this competition de Forest manufactured, in 1916, a tubular Audion designated as type "T". This tube, with a single filament, sold for about the same price as the Audiotron with two filaments. When one filament failed the other one was connected in service.

After World War 1, 1920, the Audiotron, licensed by de Forest, was sold by Audiotron Sales Co. of San Francisco for $6. This cylindrical tube had Grid and Wing (plate) wires sealed in the top. The three filament wires came out of the bottom with one wire as a center tap. From the center tap to one wire was the regular filament. From the center tap to the other wire was a spare filament.

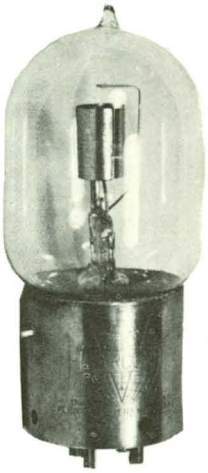
The Audiotron was a "soft" tube which ionized when the "B" battery voltage was raised above a very critical value. Early tube manufacturers had not learned how to produce a high vacuum in their tubes. Filament supply was 6 volts and "B" battery was variable from 15 to 40 volts.



Some experimenters used horse shoe magnets placed near the tube to increase the sensitivity

MARCONI de FOREST TUBE LITIGATION

The American Marconi Co. in 1914 obtained an injunction under the basic Marconi tuning patent to prevent the de Forest Co. from marketing complete radio transmitting and receiving sets using four circuit tuning. The Marconi Co. then filed suit against the de Forest Co. alleging that the three element Audion was an infringement on the two element Fleming valve.



De Forest filed a counter claim and in September 1916 the court issued injuctions preventing both companies from manufacturing tubes. During World War 1 there was a patent truce to fulfill war tube contracts.

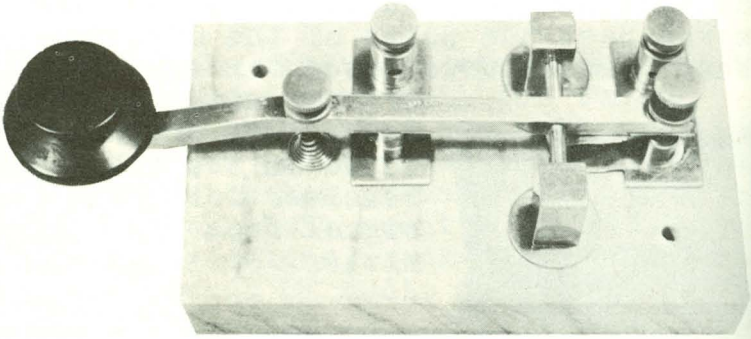
In 1919, the Marconi Co. licensed a San Francisco lamp manufacturer named Moorhead to make Fleming valves and de Forest licensed him to make Audions. The result was a tube with the Marconi emblem and Fleming patent numbers on one side of the base and on the other side, de Forest Audion with patent numbers and the statement, "Sold only for amateur and experimental use".

Here is an historic tube with a legal as well as an engineering background. As a result of these odd court descisions the radio tube industry was a hopeless tangled mess until the Fleming two elemnet valve patent expired in 1922.

THE "BOSTON" TRANSMITTING KEY

The wireless station of 1910 was a thing of beauty with green silk covered wire,polished black hard rubber panels, shiny nickle plating and polished marble bases.The "Boston" key got it's name from being manufactured in Boston by the Clapp Eastham Co. Eastham left the company in 1915 to start The General Radio Co. to supply the radio industry with high grade test equipment.

This key was made of nickle plated brass except the steel pins of the center bearings. The base was 3½" x 6" x 1", made of polished Italian dove marble. Connections to carry the heavy currents were made direct to the bottom contact through a wide piece of nickled brass strip bolted to the arm of the key. The amateur fortunate enough to own a "Boston" key gained both prestige and smooth telegraphy operation.

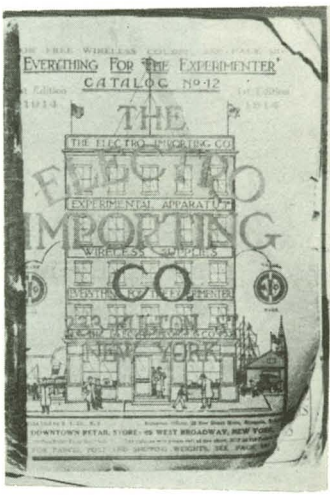


ELECTRO IMPORTING COMPANY

Hugo Gernsback came to New York City from Luxembourg in 1904 with an idea for an improved dry battery. He started The Electro Importing Co. in 1905 and founded The Wireless League of America to crusade for the rights of early Amateurs. Later he sponsored The Institute of Radio Engineers.

The E.I.Co. name is magic to the old time wireless man. Gernsback provided a most comphrehensive catalogue and stock of early wireless equipment. He published early wireless magazines, Modern Electrics, Radio News, and The Electrical Experimenter. The E.I.Co. catalogue was a "Treatise on Wireless Telegraphy" to show the young experimenter how to operate a wireless station. This catalogue was divided into three parts, 1-Wireless, 2- Apparatus and instruments, 3- Raw Materials,Parts, Tools and Supplies. Coupons in back of the catalogue could be used, one with each $1 order to get a Wireless Course in Twenty Lessons.

Hugo Gernsback started with a coherer receiver and 1" spark coil claiming a range of one mile. The next item was a tuning coil followed by a different type of detector. He kept adding new items at reasonable prices until E.I.Co. carried the largest stock of wireless items available to the Amateur.He died in 1967.

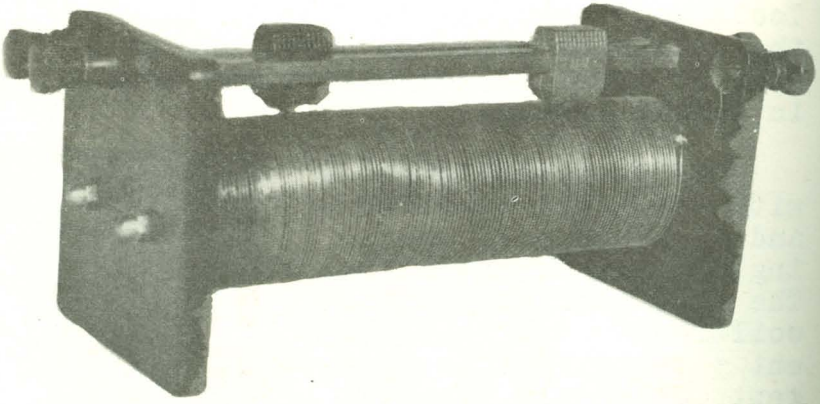


TWO SLIDE TUNING COIL

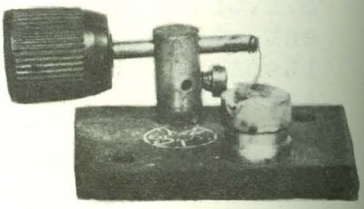
Marconi was granted patent #7777 in 1900. This patent covered four circuit tuning: the primary and secondary circuits of a transmitter and receiver. The inductance used for tuning was called a "Jigger". Early Marconi tuners were coils mounted in fine mahogany cabinets with slots for the sliders.

Hugo Gernsback received patents for loose couplers and double slide tuners in 1910. The "Electro Tuner Jr." was listed in the Electro Importing Co. 1913 catalogue for $2.

It was space wound with 300 turns of #24 bare copper wire and used the famous Gernsback Rolling Ball Slider. This slider was a spring activated rolling ball in contact with a single wire.



This small galena detector was sold by Electro Importing Co. for 10¢ and started many of us in radio.



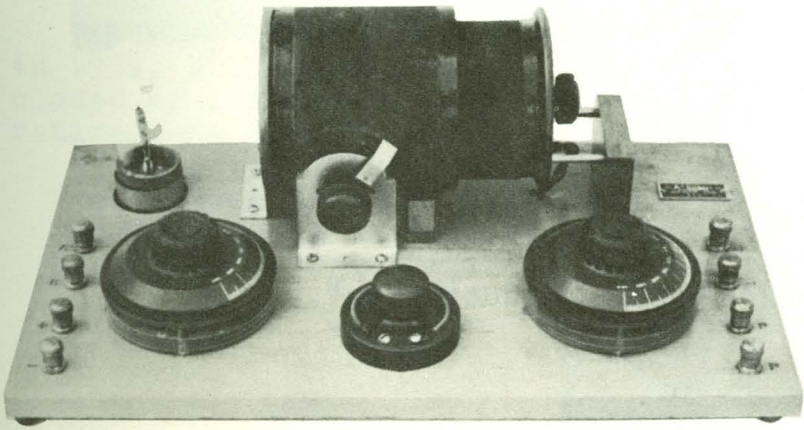
A.C. GILBERT ONE TUBE RECEIVER

The name Gilbert brings back memories of Erector sets, toys designed to develope a youngster's mechanical and electrical ability.

Gilbert started building crystal sets in the early days then went on to build radio parts, tube receivers, transmitters and antenna kits. When RCA sued him for patent infringements he quit radio and devoted all his time to the toy business.

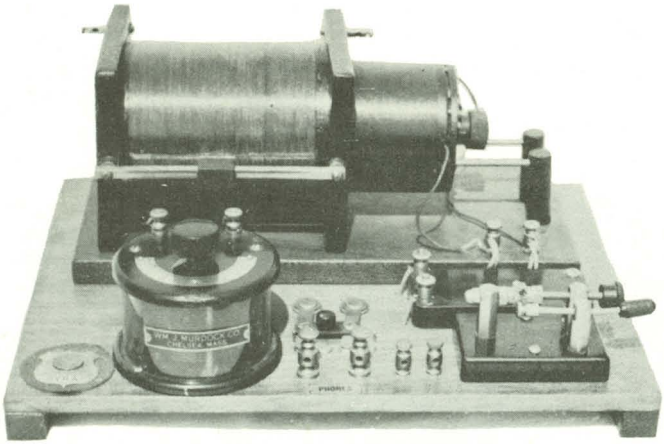
This one tube Gilbert set used a loose coupler and two small variable condensers. The condensers had a small number of plates and used insulating paper between the plates to increase the capacity. A WD12 tube with 1½ volt battery for filament and a 22½ volt "B" battery, headphones and antenna completed the installation.

The A.C. Gilbert Company was located in New Haven , Connecticut.



1915 LOOSE COUPLER RECEIVER

This early amateur receiver was made up of a Doron Brothers loose coupler,Murdock variable condenser,Murdock phone condenser and Doron Brothers galena detector. The tuning was accomplished by the slider and taps on the loose coupler.The variable condenser provided fine tuning.The galena detector required careful adjustment to find a sensitive spot on the crystal.This receiver was usually used with a spark coil transmitter.Normal range was across town and intercity operation was considered DX.



This receiver was built and used in 1915 by J.F.Riehle in Cincinnati. The badge in left corner was for "Licensed Radio Operator, Official Call 8VD, Ohio Valley Radio Association".

WILLIAM B. DUCK COMPANY CATALOGUE

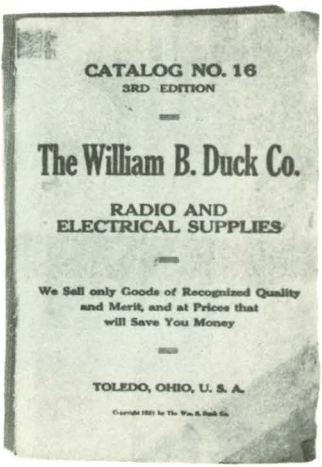
Another famous amateur wireless supply company was The William B.Duck Co. in Toledo, Ohio.This company started issuing catalogues in 1909 as The J.J.Duck Co.

In 1914 a brother, William took over and the company was changed to The William B.Duck Co.

A novel electric sign in front of the store featured a duck which periodically dipped his head in the water.Duck stocked a large supply of deForest,RCA, Murdock, Remler and other popular brands of wireless equipment.Duck manufactured a line of quality loose couplers, breadboard and panel receivers,spark coil transmitters, tuning coils and other wireless items. Like other wireless catalogues of this time the Duck catalogue carried much useful information for the amateur.

The 1911 catalogue listed ¼KW. to 25 KW. spark transmitters. A 2 KW. installation on the 90 ft.gasoline cruiser Teknla 11 was shown. A range of 250 miles per kilowatt was claimed.

During the depression in 1932, William B. Duck closed up , sold out and retired. He died in 1952.


CATALOG NO. 16
3RD EDITION

The William B. Duck Co.

RADIO AND
ELECTRICAL SUPPLIES

We Sell only Goods of Recognized Quality and Merit, and at Prices that will Save You Money

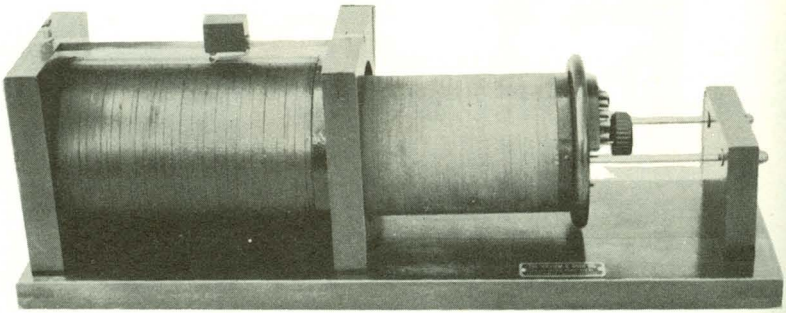
TOLEDO, OHIO, U. S. A.

DUCK ARLINGTON TYPE LOOSE COUPLER

The loose coupler came into general use around 1912. Consisting of a primary coil tuned with a slider and secondary coil tuned with a multipoint tap switch. Coupling with the primary was accomplished by sliding the secondary coil in and out of the primary on two brass rods.

A more elaborate model called the "Navy Type" had the primary coil enclosed in a hard rubber box with a coaxial double multipoint switch for tuning. Antenna and ground were connected to the primary, with galena crystal or other detector and headphones connected across the secondary coil. Variable condensers in the antenna circuit and across the primary were used for finer tuning.

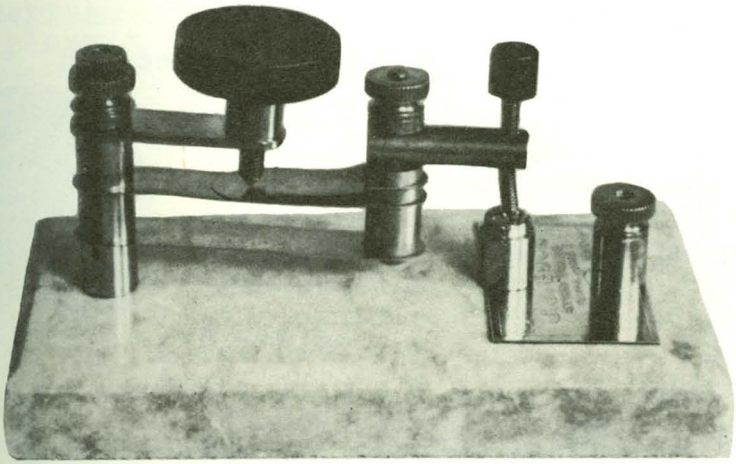
The loose coupler was modified into the variocoupler used in early broadcast receivers.The loose coupler shown was built by William B. Duck Co. in Toledo,Ohio in 1915 and sold for $9.

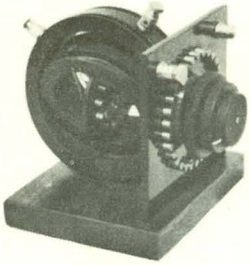


FERRON CRYSTAL DETECTOR STAND

The improved Ferron detector stand was manufactured by J.J.Duck Co. of Toledo,Ohio in 1910.It was listed in 1911 Duck catalogue for $8.50 but later sold for $5. At that time replacement crystals could be had for return of old crystal and $1.The base was polished Italian dove marble and measured 5½" x 3" x 1"thick. All metal parts were nickle plated brass. Ferron was the trade name for silicon crystal mounted in a nickle plated cup mounted on the base.

This detector was used with a loose coupler or tuning coil,variable condenser, fixed condenser and headphones. A wireless operator on a ship lying at the dock in Port Arthur ,Texas reported that he copied spark signals from New York, 1056 miles away.





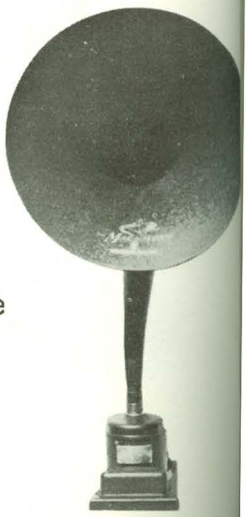
BLITZEN RECEIVING TUNER

The Blitzen receiving tuner was a compact , improved version of the older loose coupler. The primary and secondary coils were wound on grooved hard rubber rings. Tuning was accomplished by three knobs on the front mounted to operate concentrically. The large knob mounted close to the panel operated the 30 point tap switch. The middle knob changed coupling between the primary and secondary windings. The outside knob operated the 12 point secondary tap switch mounted inside the secondary coil. Range was 1500 meters on average antenna. Manufactured by Clapp Eastham and sold for $15 in 1920.

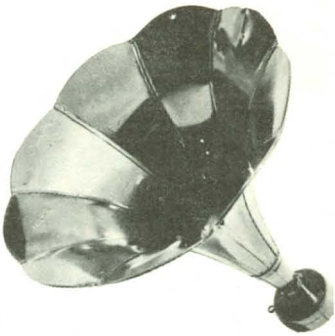
MAGNAVOX HORN

E.S.Pridham and Peter Jensen started The Magnavox Company near San Francisco in 1910. In 1913 they patented the basic, "moving coil"speaker design, still used today.

Later they moved to Oakland and built a line of horns,audio amplifiers,receivers and other radio equipment. Magnavox built several models of horns in different sizes with 6 volt magnetic fields.This design produced more volume and came into wide use. One large model with an 18" bell was used for dancing and speakers with large groups. The Magnavox R-3 with 15" bell sold for $35 in 1924.



PHONOGRAPH HORN WITH MICROPHONE



Early radio broadcasting had to use crude,insenitive,poor quality telephone dispatcher's microphones.To make up for low sensitivity someone mounted a telephone microphone on the small end of a phonograph horn.In the early 1920's, it was a common sight to see a broadcast performer with his head part way in the bell of a large phonograph horn.

BURNS RADIO SPEAKER

Along with the idea of using a phono horn with a microphone, the idea of attaching a radio headphone unit to the end of a phonograph horn came into use. Later, special loud speaker units were designed to carry more volume .

The Burns speaker,manufactured by American Electric Co. in Chicago, used a plastic "morning glory" shape with an adjustable speaker unit mounted at the end of the curved section.

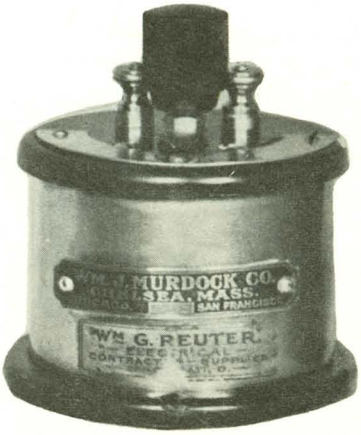
MURDOCK VARIABLE CONDENSER

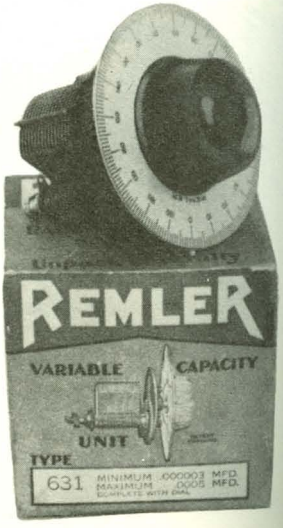
After the Leyden Jar, a Dr.Bevis mounted sheets of conducting material on flat plates of glass. Then came the vertical plate, air dielectric condenser with the movable plates sliding in and out of the fixed plates

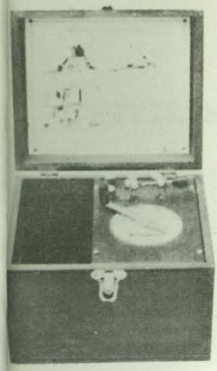
William J. Murdock built a condenser with curved vertical plates arranged with a dial and knob at the top.

REMLER VARIABLE CONDENSER

The Remler low loss condenser unit was new in desing with twin rotor sections made of embossed brass plates. It had full 360 degree rotation witha 4" vernier dial control. Paper log charts were furnished to fit over the regular dial and provided space for logging stations. This condenser was made in two capacities: .00035 and .0005 mfd. Manufactured by Remler Radio Manufacturing Co. in Chicago and sold for $5 for either unit. Two of the units could be ganged for single dial control.





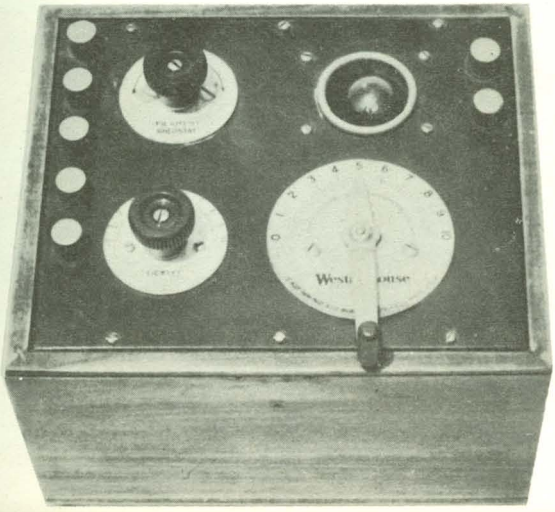


AERIOLA JR. RECEIVER

The model RE receiver was built by Westinghouse in 1922. It was a simple galena crystal with tuning inductance built in a box with a compartment for the headphones. Operating this receiver required only to find a sensitive spot on the crystal and tune the inductance for the loudest signal.Broadcast range was 190 to 500 meters and reliable reception was 10 to 20 miles from the broadcast station. Sold for $32.50 for receiver ,antenna and headphones.

AERIOLA SR. RECEIVER

The model RF receiver was a westinghouse product designed as an inexpensive set for broadcast reception.The Aeriola Sr. used a WD11 tube in a regenerative circuit.This receiver found use as a portable outdoor set. Farmers used it for the daily reception of U.S. Government market reports on 485 meters or 1579 kc. to 600 kc. A complete station with WD11 tube, 1½ volt dry cell,22½ volt "B" battery, antenna and phones sold for $75.90 in 1922.

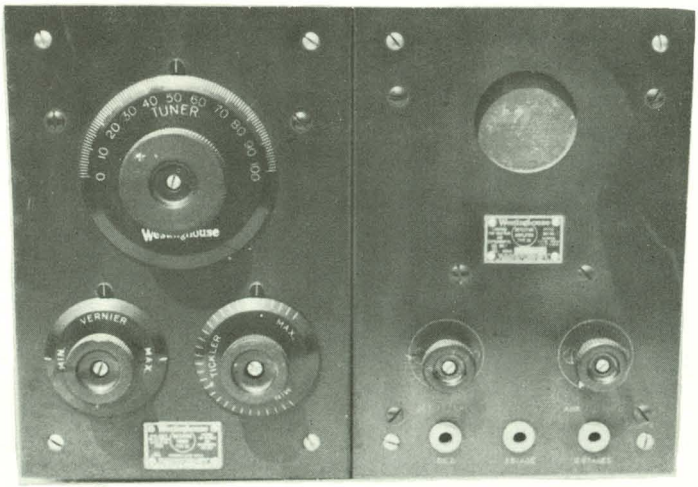


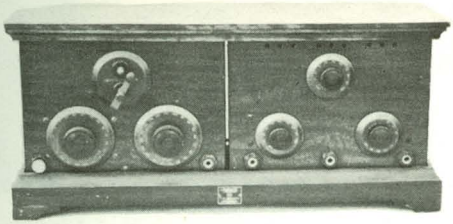
WESTINGHOUSE "RC" REGENERATIVE RECEIVER

The model "RC" was made up of model "RA" tuner and model "DA" detector/amplifier in one cabinet with a range of 180 to 700 meters or 1667 to 429 kilocycles. The addition of a loading coil,model CB, provided a range of 1800 to 2800 meters or 166.7 kc. to 107.1 kc.

Housed in a mahogany cabinet with polished Micarta panels and dials,this receiver combined rugged design with fine workmanship.

The tickler coil wound on the same tube as the stationary coil of the variometer had 31 taps for smooth regeneration control. The model "RC" retained the rugged workmanship and parts of earlier Westinghouse and Wireless Specialty equipment. The model "RC" used a UV200 detector and UV201A audio amplifier tubes. It sold for $132.50 plus accessories.





RADIOLA V -AR- 885 RECEIVER

The Radiola V receiver was built by General Electric Co. for Radio Corporation of America. It was a combination of model AR-1300 radio receiver and model AA-1400 with a mahogany base and top cover. The model AR-1300 receiver provided operation on 180 to 700 meters.The crystal detector made a complete receiver unit.The variable condenser operated an automatic switch to change inductance and provided 360 degree rotation. The Intensity knob controlled the regeneration for tube operation. The addition of the AR-1400 unit provided a detector and two stage audio amplifier. The parts were all heavy ,durable construction and the cases were heavy brass.The complete model V came in mahogany finish, and the separate units in green finish.

RADIOLA RS RECEIVER

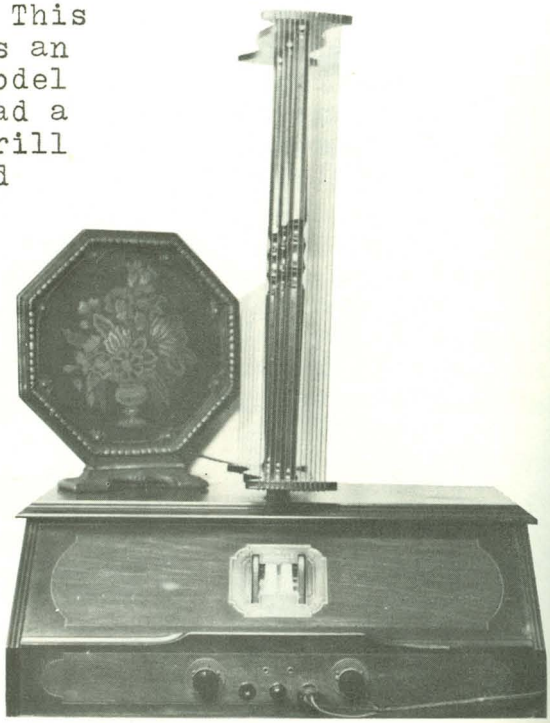
The Radiola RS receiver was manufactured by Westinghouse and sold by RCA in 1923.It used the same basic variometer circuit with tickler regeneration as the Aeriola SR. plus one stage audio amplifier similiar to Radiola 111.WD11 tubes were used. It was a deluxe receiver housed in a polished mahogany box with moulded bakelite panel.A matching unit ,the Radiola AC, provided an additional two stage audio amplifier with jacks in each stage.

RADIOLA 25 RECEIVER

Radiola 25 was a superheterodyne receiver using two dials for tuning. One dial tuned the loop antenna and the other dial tuned the oscillator condenser. Five UV199 tubes and one UX120 tube were used in sockets mounted on top of a sealed catacomb housing the IF, RF, and AF transformers. The catacomb was sealed with lead seals. RCA dealers carried spare catacombs and in case of trouble replaced the defective catacomb and returned it to an RCA Service Station.

Battery connections were through a cable to a terminal strip on rear of the catacomb. The 4½ volt "A", 4½ volt "C", and 135 volt "B" batteries were all installed in the cabinet.

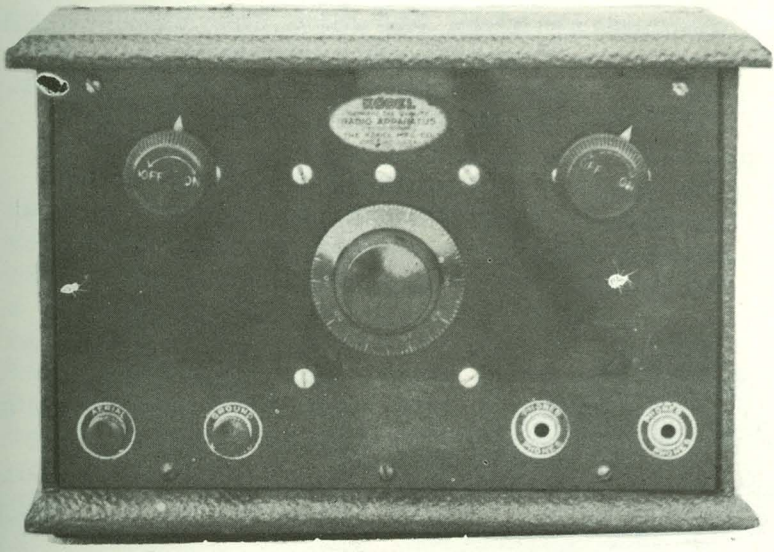
The RCA model 103 loud speaker was used with the Radiola 25 and other receivers. This speaker was an improved model 100A and had a tapestry grill and moulded frame.



KODEL RECEIVER

The Kodel Company was operated in Cincinnati by Clarence Odgen. His first receiver was made to look like a Kodak camera. The name came from "Ko" from Kodak and "Del" from his wife's name Della.

Kodel first built a line of low priced, leatherette covered, crystal, one, two and three tube receivers. The one tube receiver was advertised as the smallest on the market. Cheap, compression type condensers were used. The company name was later changed to the Kodel Radio Corporation and when broadcast station WMH was purchased the call letters were changed to WKRC.



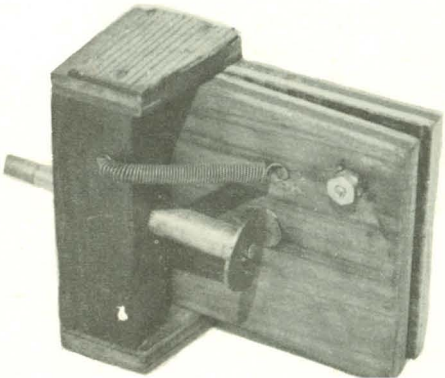
CROSLEY TUBE SOCKET

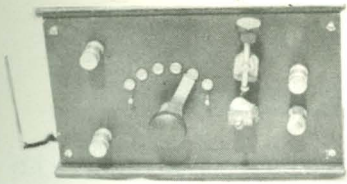
One of the first radio parts made by Crosley was the porcelain moulded tube socket which sold for 60¢ when others were selling for $1 and up.The porcelain was moulded by a supplier and assembled in the Crosley plant.In 1923 it was redesigned to be mounted on metal rods in the current Crosley receivers. Moulded asphalt compound replaced the porcelain.

CROSLEY "BOOK" CONDENSER

Powel Crosley,in 1921, was convinced that there was a market for cheaper radio parts.Working with Dorman Isreal,he designed a new,cheaper variable condenser. At this time other condensers were selling from $3.50 to $6.

Using his woodworking plant, he made the condenser of thin plywood.The two plates were plywood surfaced with shim copper sheet and sheet mica between the plates. A cam on a shaft turned by the dial operated the movable plate. A piece of light spring maintained tension on the plate so it would open and close like a book and vary the capacity.The first model sold for $1.25. Four models were produced showing constant improvement.The last, model D was made of asphalt compound moulded insulation and sold for $2.25





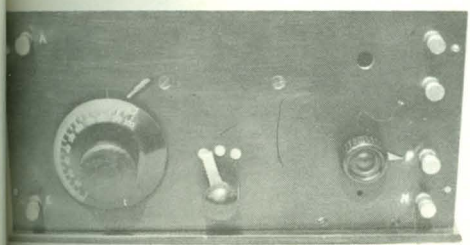
CROSLEY HARKO JR. CRYSTAL RECEIVER

The first radio receiver built by Crosley in 1921,used a galena crystal detector and coil with switch taps.It included a unique buzzer for adjusting the crystal. A 4½ volt "C" battery was connected to a piece of hacksaw blade, mounted on the edge of the cabinet, through a winding of enameled wire wound on a small nail. The other side of the battery went to a short length of #12 copper wire to scrape along the rough saw edge to produce sparking and noise in the phones when a sensitive spot on the galena crystal is found.

These receivers were produced in the woodworking plant using the regular male help at first.There was so much trouble with poor assembly and soldering that girls were hired and trained.

CROSLEY HARKO SR.ONE TUBE RECEIVER

One day Powel Crosley realized that he was making rheostats,tube sockets, variable condensers,tap switches and cabinets so had Dorman Isreal wind up a tapped coil to build a one tube receiver. They tried it out at Crosley's home and heard stations in New Jersey, Pittsburg, Hamilton and Cincinnati.The next day production started on the Harko Sr.,later called the model V.This was the first of a long line Crosley Fivers.



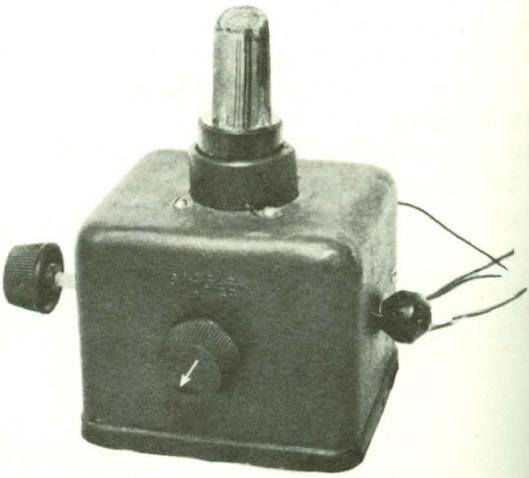
THE CROSLEY PUP RECEIVER

Working toward a low cost market in 1925, Crosley produced the famous Crosley "PUP" receiver.

The one tube regenerative circuit of the Crosley model 50 receiver was redesigned to fit in a 4 inch square metal box with the tube socket mounted on top. The "book" condenser was redesigned with the control knob mounted on a threaded shaft to actuate the moving plate.

A small Formica panel mounted in an opening in the back carried grid leak and binding posts for phones, ground and antenna. Battery connections were marked flexible leads . The Pup was usually operated with a WD12 tube, 22½ volt "B" battery and 1½ volt dry cell.

The Pup sold for $9.75 plus tube batteries, phones and antenna. This was first cheap, practical regenerative receiver on the market and provided radio entertainment for many low income people. Two singers on WLW sang "we are the Crosley Pups" to promote sales.



CROSLEY MUSICONE SPEAKER

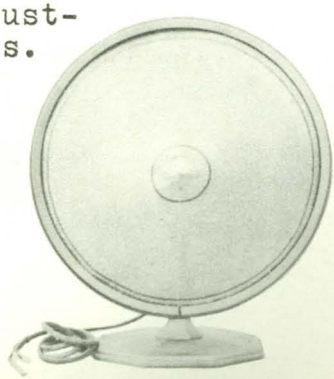
Charles Peterson came in to Powel Crosley's office one day in 1924 with a model of a new idea in cone speakers. A demonstration convinced Crosley and his engineers that the speaker was practical so a manufacturing contract was signed giving Peterson a royalty on every Musicone sold to Crosley Distributors.

Selling for $17.50, the Musicone was the first inexpensive cone speaker on the market. The demand grew until the production was 3000 per day and prices were reduced to $9.75 for the 12" model and $14.75 for the 16" model.

The driving unit employed a new principle invented by Peterson and made practical for production by Crosley engineers. The driver consisted of two magnets with two armateur coils mounted with the armature moving between the pole pieces.

An adjustment screw centered the armature. This adjustment was made by turning the screw one way until the armature rattled against the pole pieces, then counting the screw driver turns until the armature rattled against the other side. Turning back half way provided the proper adjustment.
The Musicone had to be adjusted for different type tubes.

The Model D with a new design case came later.



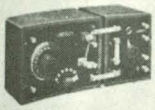
Radio News for September, 1922

CROSLEY

Radio Apparatus

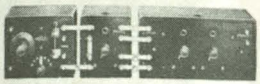
BETTER—COSTS LESS

This page illustrates the flexibility of the small unit idea, and the combinations that can be built up with Crosley apparatus.

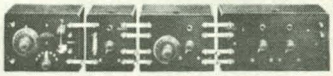


This illustration shows how it is possible to start with a Crosley Crystal Receiver No. 1, and add the Audion Detector Unit at a later time, making in effect the Harko Senior.

This shows how the R. F. T. A. can be added. The combination shown in the second illustration is equivalent to the Crosley Receiver No. 6.

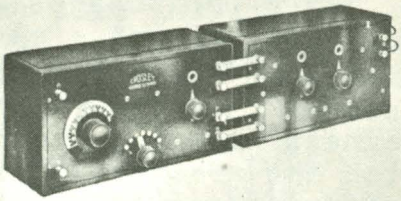


This illustration shows combination of the Crosley Receiver No. 1, Audion Detector and Two-Stage Audio Frequency Amplifier, if same is preferred to the Radio Frequency Tuned Amplifier.



Later, when desired, all four units can be combined as shown in the illustration, of the Crystal Receiving set, Audion Detector, Radio Frequency Tuned Amplifier and Two-Stage Audio Frequency Amplifier, making in effect, the Crosley Model No. X, illustrated on the opposite page.

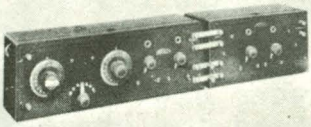
Now if the purchaser wishes to start with the Harko Senior, he can add the Radio Frequency Tuned Amplifier as illustrated, or if he prefers, he can combine the Harko Senior with the Two-Stage Audio Frequency Amplifier.



The next illustration shows the combination of all three units, which again are equivalent to the model X illustrated on the opposite page.

If the purchaser wishes to start with the Model 6, illustrated on the opposite page, he can add the Two-Stage Audio Frequency Amplifier at a later date, making a Model X. This combination is pictured below.

We believe that the unit idea has been worked out in the Crosley apparatus in a very effective manner. Efforts along this line have been made before, but never so thoroughly or completely. The idea has met with instant enthusiasm wherever shown; its popularity is already assured. The price of all units of Crosley apparatus are way below all competition. Their efficiency is unquestioned, remarkable results having been reported continually of even the simpler units. The low prices are made possible by quantity production in Crosley factories, where practically every piece and part is made, not merely assembled.



The CROSLEY MANUFACTURING CO.

CINCINNATI, O.

Dept. R. N. 1

Crosley ad in Radio News for September 1922

WLW FARM "CORN COB" MIKE

Lewis Crosley purchased a farm near the WLW transmitter in Mason,Ohio in 1941 to set up a working farm operated by farm people who talked on WLW Farm programs. Called "Everybody's Farm", it served as the center of WLW Rural programming.

The "Little White Studio" hosted countless farm programs and thousands of rural visitors over the years.This special microphone became a famous part of the WLW Farm activities.

When the need for a distinctive mike arose, R.J.Rockwell, Technical Director, asked Earl Neal, the tenant at Everybody"s Farm, to bring him the largest ear of corn that he could find. An aluminum casting was moulded and machined out to hold an RCA "Salt-shaker" type mike. After painting to look like an ear of corn it was put in service.

The Little White Studio, the old farmhouse, the farm tenants, all have passed from the scene and Everybody's Farm is just a pleasant bit of nostalgia.

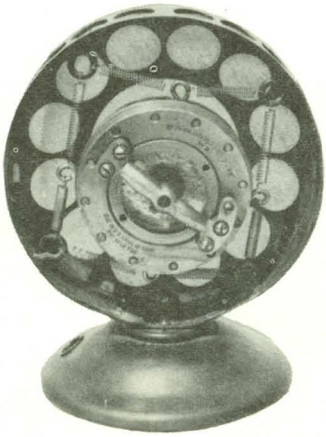
WESTERN ELECTRIC MICROPHONE

In 1877, Emile Berliner applied for a patent on a hard carbon, loose contact telephone transmitter. This instrument was later improved with a cup of carbon granules and called a single button carbon microphone.

An adaptation of this crude telephone microphone was used in early radio telephony. The first single button carbon microphone was used by station WEAF in early 1920's. Soon afterward the double button carbon mike appeared mounted on springs in a ring. Later a bronze case was added for protection.

Quality microphones for broadcast use were difficult to buy in 1922. Western Electric Co. held patents on the double button carbon microphone and sold only to purchasers of their transmitters.

Powel Crosley bought a 500 watt broadcast transmitter in early 1923 to obtain this type of microphone. The double button carbon, suspended on springs, mounted in a bronze metal case became the standard broadcast microphone of the time.



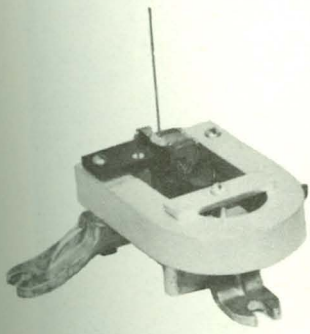
WESTERN ELECTRIC CONE SPEAKER

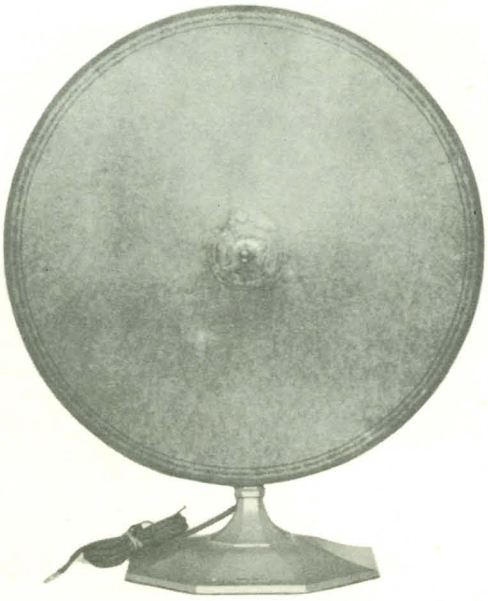
Loud speaker design evolved through many stages. The early horn type grew out of a single watch case receiver mounted on the end of a phonograph horn.

Nearly all loudspeakers used an electromagnet to cause a diaphram to vibrate with the audio currents flowing through the electromagnet windings. A metal rod extended from the armature and was rigidly fastened to the center of the cone.

The Western Electric 540 AW speaker was of the double cone type and considered good enough to use as a monitor speaker in a broadcast station. Western Electric built 18, 24 and 36 inch models.

Cone speakers were quite fragile, easily knocked over and the cone damaged. All of the WE cone speakers in the museum came in damaged and were repaired by R.J.Rockwell.

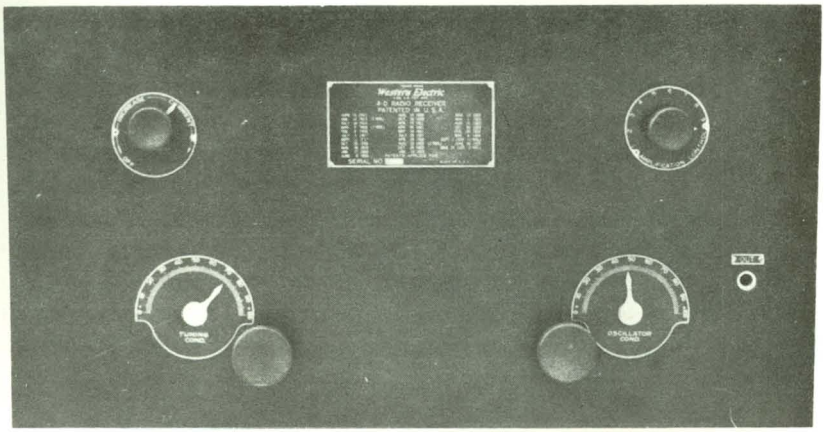




WESTERN ELECTRIC 4D RECEIVER

The Western Electric 4D receiver was designed to operate on a 600 meter antenna at a broadcast transmitter installation. In the early days of broadcasting every station was required to continuously monitor 600 meters for SOS distress calls. The law required that when an SOS was heard, the broadcast transmitter was shut down immediately.

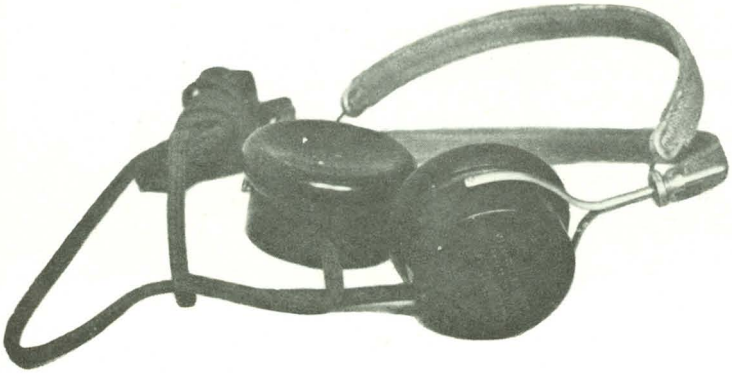
The WE 4D receiver used six WE 215A tubes in a superheterodyne circuit with one stage audio for headphone or speaker output. It could be used with a center tapped loop or a Western Electric 2A Tuning unit and 600 meter antenna. The Western Electric 20L Filter unit could be connected between the antenna and tuning unit to filter out reception on the broadcast transmitter frequency.



BALDWIN HEADPHONES

Nathaniel Baldwin designed and built the first Baldwin headphones on his kitchen table. He sent a sample pair, packed in a large baking powder can, to the Navy for test which proved them to be twice as sensitive as any other make.The headband was made of a piece of clock spring fastened to each phone and the two pieces bound together with hemp twine.Baldwin, without any test equipment, had wound his phones to within 100 ohms of the Navy standard of 2000 ohms.He had discovered an entirely new method of moving the diaphram with a driving rod.He made the diaphrams of mica.

The first contracts,all built on his kitchen table, were in quantities of 10. Baldwin, a devout Mormon, would not move to Washington for domestic reasons so John Firth , of Wireless Specialty Apparatus Co., went to Salt Lake City and arranged with Baldwin to set up a factory to supply the tremendous demand for his phones in large quantities.The type "C" "Baldies" sold for $16.50 in the 1920's.

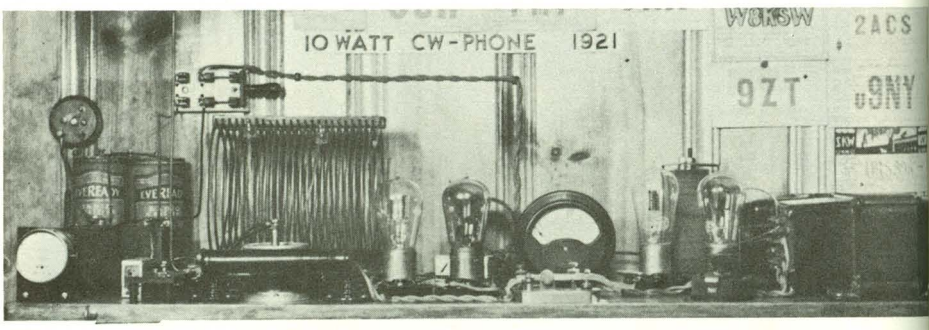


CW PHONE TRANSMITTER

In September 1921, Radio Corporation of America, following the trend in the developement of radio communication to continuous wave transmission, issued a catalogue of CW apparatus. Listed were transmitting tubes, rectifiers, chokes, hot wire ammeters, condensers, oscillation transformers, all the parts needed to build high class amateur CW and phone tramsmitters.

The 10 watt CW Phone transmitter shown,used a magnetic modulator in the ground lead for phone and a telegraph key in series with the grid leak for CW operation. A hot wire ammeter in the ground lead measured the antenna current. Two UV 216 tubes were used as rectifiers.

This transmitter was a step in the transition from the old, ineffecient spark transmitter to the new tube transmitter.



THE GREBE COMPANY

Old time radio men fondly recall the picture and musings of that venerable Chinese gentleman, Dr.Mu. A Grebe ad was not complete without Dr. Mu,his wise sayings and quotations from Confuscious.

The Grebe Co. located at Richmond Hill, Long Island built high quality equipment in the 1920's. An outstanding example of fine Grebe workmanship was the model CR-5.

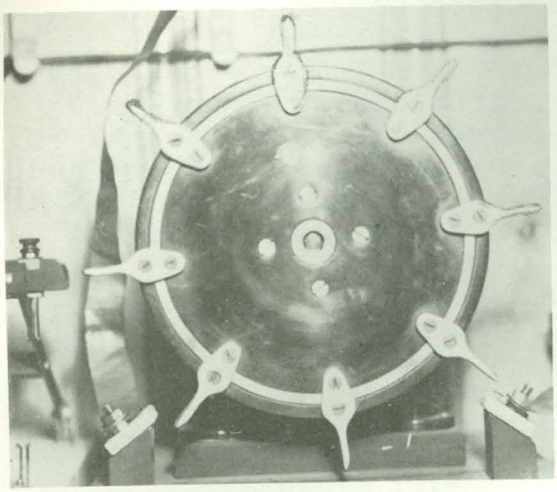
This was the first single circuit, regenerative receiver with a range of 150 to 3000 meters and two dial control. It was designed by the operator who wanted simple control and wide range.

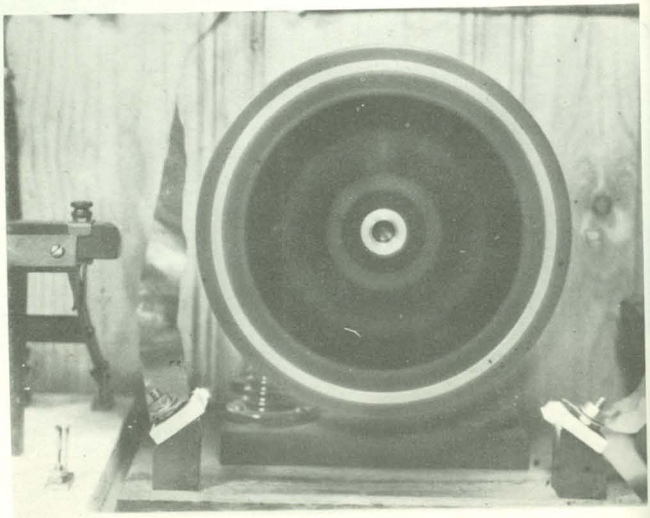
The CR-5 was tuned by an antenna series variable condenser and a ten section triple bank wound inductance in series with the stator winding of a variometer. The rotor was in the plate circuit to provide smooth regeneration control. The Grebe CR-9 added a two stage audio amplifier to the CR-5 circuit.

ROTARY SPARK GAP

In 1920, A.H.Grebe Co. produced an excellent synchronous rotary spark gap selling for $140. This rotary gap produced higher effeciency and higher spark tone which made the signals easier to read through interference.

This is a homemade rotary spark gap using a Grebe wheel originally used by Ted Ostman, 20M, in 1920



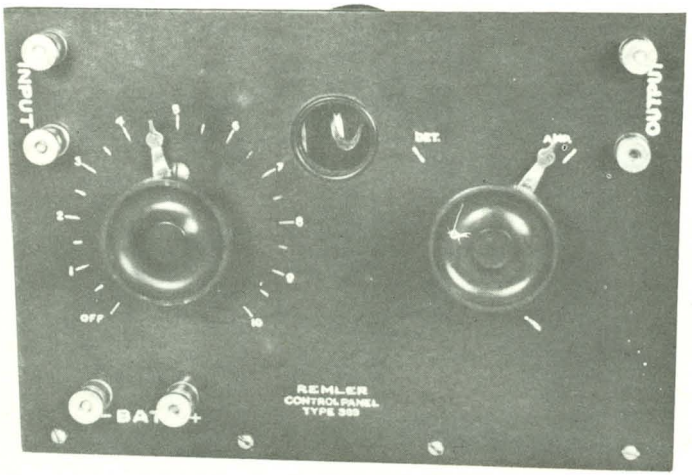


REMLER TYPE 333 AMPLIFIER PANEL

The Remler Radio Mfg. Co. of Chicago, Ill. manufactured radio parts and panel assemblies. These units consisted of Detector, Variometer, Variocoupler and Audio Amplifier panels. A wide range of radio circuits could be made up. Two variometer, variocoupler, detector and audio amplifier panels made up a three circuit regenerative receiver with two stage audio amplifier.

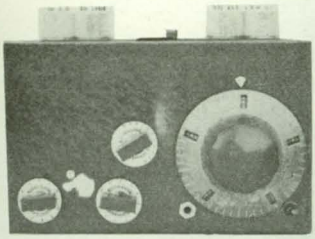
The detector unit provided filament rheostat, plate control potentiometer, grid leak, grid condenser and tube socket. Audio amplifier panels mounted filament rheostat, tube socket and audio transformer. Binding posts provided battery and interpanel connections.

The type 333 Amplifier used a rotary cam switch which had self cleaning wiping contacts and low capacity. This switch did the work of two jacks, switching the phones from detector put to amplifier output. The phones remained connected to the binding posts.



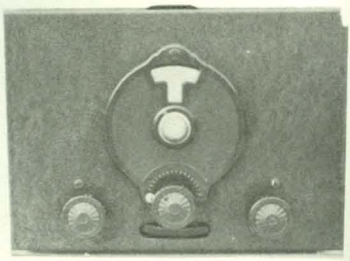
NATIONAL ONE-TEN RECEIVER

The National One-Ten receiver fulfilled a need of the radio amateur for a good receiver in the range covering one to ten meters.The circuit used a 954 tuned R.F. stage, a 955 self quenching super regenerative detector, 6C5 transformer coupled first audio and 6F6 resistance coupled output stage.Six pairs of plug-in coils covered the range.The main tuning control was the popular National Micrometer dial which revolved ten times to cover the tuning range of 0 to 500 degrees.The three small dials controlled the Detector Regeneration -Audio Gain- and R.F.Circuit Alignment. A "B" plus switch and headphone jack were mounted below the main tuning dial.This receiver could be operated from AC power pack or batteries. It sold for $85, less tubes and power pack in 1936.



NATIONAL SW-3 SHORT WAVE RECEIVER

The National Co.designed a new short wave receiver called the SW-3 in 1931. The AC-DC model could be operated with AC power pack or batteries.The RF and detector stages were gang tuned. Coils covered a range of 33MC to 1500 Kc. A 500,000 ohm potentiometer in the grid circuit of the 37' audio tube acted as a volume control and calibrated attenuation control.



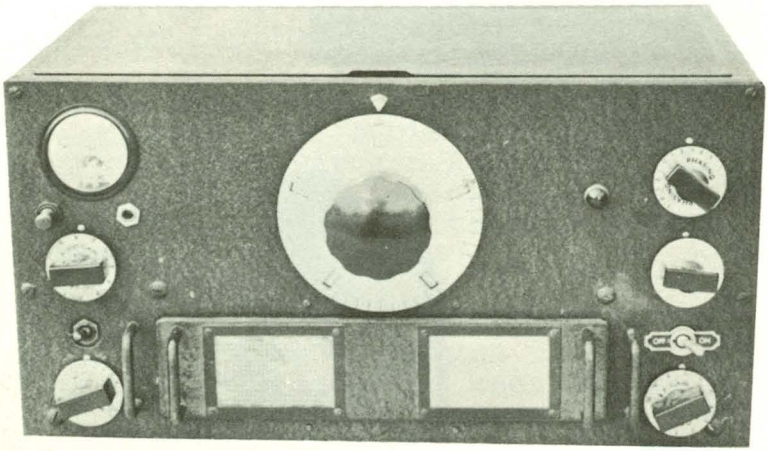
NATIONAL HRO-M RECEIVER

The National HRO-M was a short wave superhetrodyne receiver with a frequency range of 50 to 430 kcs and 480 to 30,000 kcs. This wide range was covered by nine plug in coil units. An external power supply was used.

The HRO family, starting in 1933, continued many years, going through many changes as the state of the art in tubes and circuitry improved.

The HRO-M provided adjustable selectivity in a crystal filter controlled by Selectivity and Phasing kobs. Other controls were RF Gain ,CW Osc. and Audio Gain. Switches controlled AVC-MVC,"B" Plus and "S" Meter. A phone jack for headphones automatically switched off the speaker. The "S" Meter indicated signal strength.

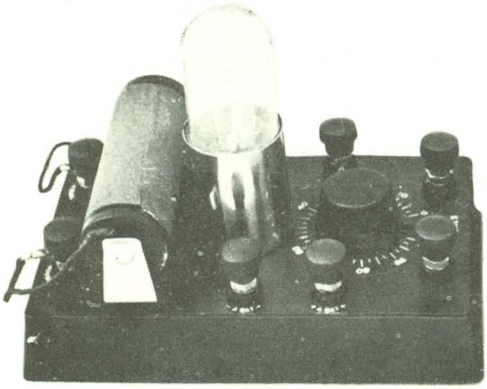
This receiver was rugged, sensitive, selective and was a popular amateur receiver for many years.

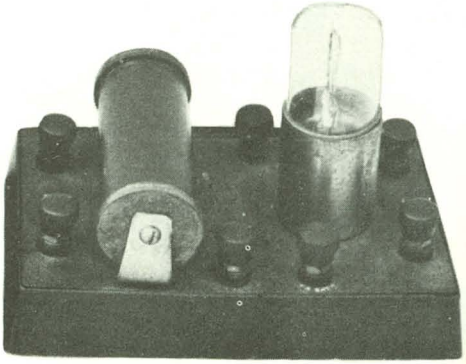


MONODYNE RECEIVER AND AUDIO AMPLIFIER

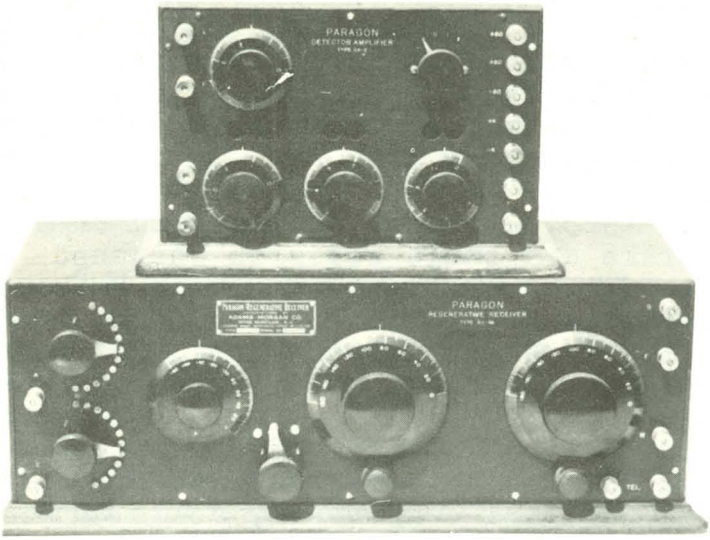
The Monodyne one tube receiver was manufactured by National Airphone Corporation in 1923. It was a simple receiver with two interchangeable inductance coils to cover a range of 200 to 600 meters, using a built in compression type variable condenser for tuning.

Accessories were WD12 tube , 1½ volt and 22½ volt batteries, headphones and antenna to make-up a complete receiver. The Monodyne receiver alone sold for $10 by mail. The one stage audio amplifier followed the same construction and sold for $8.50.





PARAGON RA-10 AND DA-2DETECTOR AMPLIFIER



The Paragon regenerative receiver was designed by "Paragon Paul" Godley. It became historic when it was used by Godley in Ardrossan, Scotland to copy the first short wave trans-Atlantic signals from amateur station 1BCG in Connecticut on Dec.12 1921.Marconi had received his famous England to Newfoundland letter "S" signals just 20 years before on Dec.12 1901.

Tom Birch used the receiver shown here to copy 1BCG's historic signals in Cincinnati.The Paragon RA-10 was built by Adams Morgan Co. and sold for $85 in 1920.The range was 150 to 1000 meters. The DA-2 sold for $65.

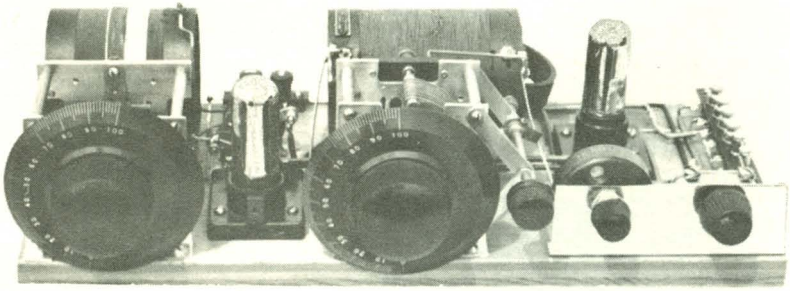
The first regenerative receiver manufactured was a Paragon in 1915. A Paragon transmitter was used on the first transcontinental contact.

BROWNING DRAKE KIT RECEIVER

During the mid 1920's every radio magazine had it's own special radio receiver circuit which was improved with every issue. The very popular Browning Drake receiver was a well engineered receiver

In 1923, Glenn H. Browing and Fred H. Drake did basic research on tuned radio frequency transformers at Harvard University Cruft's Laboratory. The result was a special tuned,neutralized, RF stage with regenerative detector.

The National Company designed and built the Regeneformer and Antenna units using National condensers, coils and National Velvet Vernier dials for the basic kits. In 1929 National produced the MB-29 and MB-30 kits. MB stood for Millen-Browning. James Millen was president of the National Company.



SODIUM TUBE RECEIVER

The Sodium tube was unique in design with a "C" terminal in place of a grid. It was designed by Harold P. Donle, Chief Engineer of Connecticut Telephone and Electric Co. and manufactured in 1923. Another Sodium tube was on the market earlier, manufactured by Electro Chemical Laboratories.

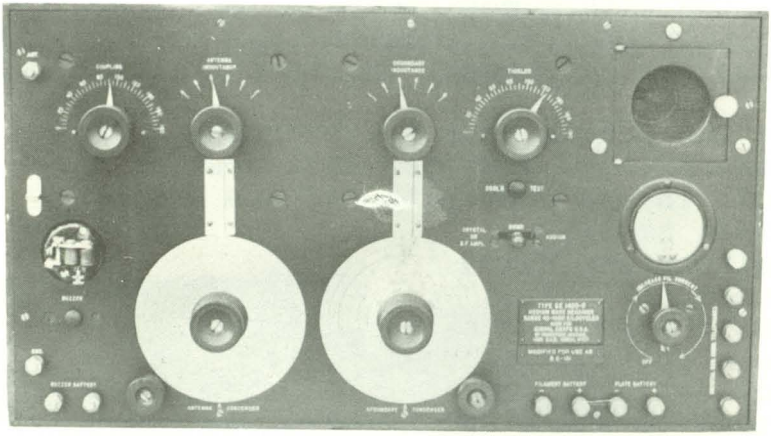
A small amount of metallic sodium was placed in the tube at time of exhaust. A heater wire in series with the filament heated the sodium and produced sodium vapor in the tube. The "C" terminal was a collector replacing the grid. This was a ½" cylinder placed very close to the filament. To keep the collector current down, a neutralizing voltage was supplied from the slider on a potentiometer in series with a resistance across the filament. The glass envelope was frosted, possibly to conceal the inside structure.

The Sodium Tube Receiver was a non-regenerative detector in a special circuit in one unit with two one stage audio amplifier units using UV199 tubes. All three units were housed in a polished mahogany cabinet. This receiver was manufactured by Connecticut Telephone and Electric Company.

NAVY SE 1420 RECEIVER

Prof. L.A.Hazeltine developed the SE 1420 at the Washington Navy Yard in 1918. It was built by the Radio Test Shop in 1919 and covered a range of 250 to 8000 meters. The design emphasized the necessity of preventing interference from short waves when receiving long wave signals. Hazeltine found that the short waves were coming through by capacity coupling between coils. By the application of neutralizing condensers shielding and proper design of the inductance the short wave interference was eliminated.

This principle of neutralizing capacity coupling was later applied by Hazeltine to the design of the Neutrodyne circuit.



The SE 1420 was designed to use a crystal detector for reception of spark signals with an anticapacity switch to change to regenerative detector for CW signals.

The condenser dials were engraved from 0 to 180 degrees on one half and rows of concentric circles on the other half. Dials were mounted flush with the panel. This feature appeared on the first Hallicrafter receivers. Bill Halligan got the idea from his Navy Radio experience. The inductance switches moved pointers to the successive circles on the dials on which could be logged the station calibrations.

Mounted on left side of the panel between Antenna and Ground posts was a static discharge gap. A buzzer with a push button was included for crystal detector testing and adjudting. A filament ammeter was mounted below the door to the detector tube for setting proper value of filament current.

The SE 1420 receiver was used in Navy service for many years and went through several minor modifications. It became the Navy standard medium wave receiver.

To avoid use of term "feedback", George H. Clark called the regeneration winding a "tickler" because "it tickles the Audion and makes it quiver".

Washington Navy Yard -1915

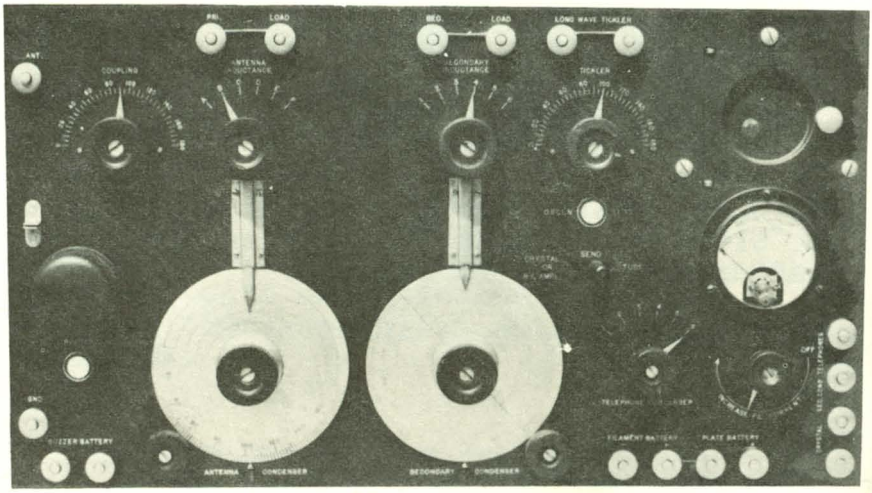
IP 501 RECEIVER

The IP 501 receiver was manufactured by Wireless Specialty Apparatus Co. in 1922 and was similiar to the Navy designed SE 1420.

The coils were bank wound of high frequency cable on threaded Bakelite tubing, impregnated and baked. This receiver covered a range of 300 to 7500 meters or 1000 to 40 kilocycles. The range could be increased to 21000 meters or 14.3 kc when a loading coil unit was added.

A detector tube was mounted behind the small door in the upper right hand corner. The unit was well shielded with a heavy copper box inside the oak cabinet. A two stage audio matching unit was available. The IP501 sold for $550 and the two stage audio amplifier sold for $95 in 1922.

The IP501 was used on all the United Fruit Co.ships and shore stations.



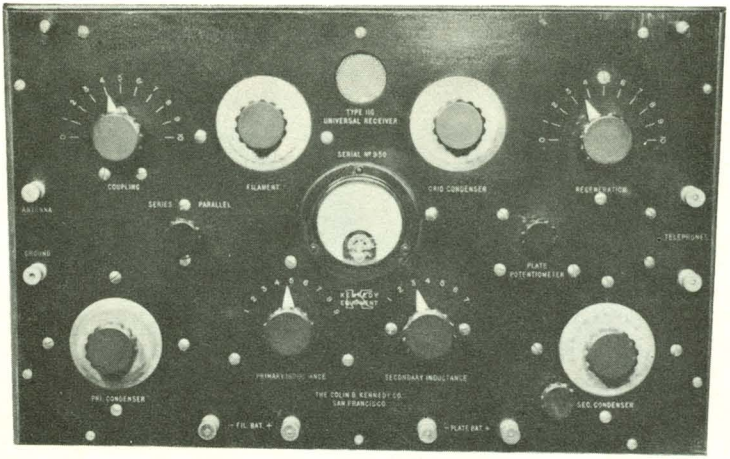
KENNEDY 110 UNIVERSAL RECEIVER

The Kennedy 110 receiver was manufactured by The Colin B. Kennedy Co. in San Francisco. Like all Kennedy equipment the model 110 was a well engineered beautifully built receiver with a range of 175 to 2500 meters or 1714 kc. to 12 kc. The polished Bakelite panel with satin silver dials and filament voltmeter was mounted in a piano finish mahogany cabinet.

Inside the cabinet connected with bus wire was a regenerative circuit with special bank wound coils,variable condensers and tap switches on the coils.

Kennedy was not a "parts assembler" but desinged and manufactured all his own parts. The bezel above the voltmeter was for checking the filament brilliancy.

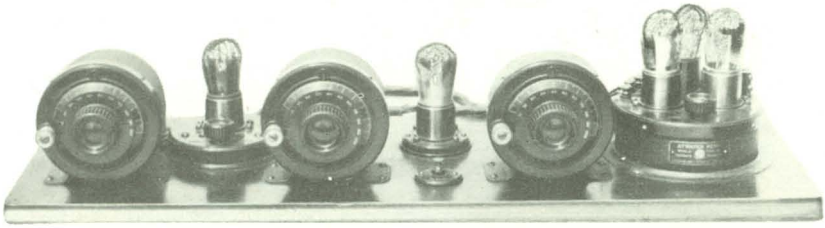
The type 110 receiver sold for $250 in 1922.When the demand for broadcast receivers started a second factory in St. Louis, Missouri was built.



ATWATER KENT BREADBOARD RECEIVER

The Atwater Kent Manufacturing Co. was founded by A. Atwater Kent in 1902 to build small electrical equipment.The business expanded rapidly and by 1912 he was making electrical parts for automobiles. Using his background in manufacturing electrical products, he began making radio parts in 1919. By 1923 he was building a complete line of quality moulded Bakelite parts including variocouplers,variometers,sockets,one two and three tube units, transformers, variable condensers and other parts.

In late 1923 he announced the model 10: a 5 tube unit receiver mounted on a polished mahogany board. The model 9,a 4 tube unit, came out in early 1924.The model 10 B and model 12, a 6 tube unit followed. All were distinguished by beautiful appearance and high quality workmanship. Cabinet models in battery, and later AC models, were produced. In 1936 A.Atwater Kent closed his plant, liquidated his business in Philadelphia and moved to California. He spent his remaining years living in a palatial home and entertaining lavishly. He died in 1949.



Model 10, sold for $80 in 1922

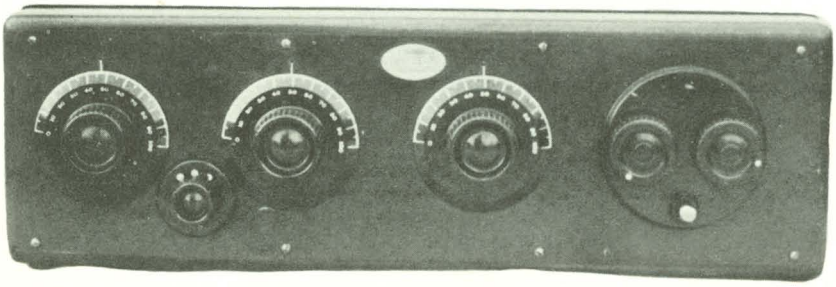
ATWATER KENT MODEL 20 COMPACT RECEIVER

The large Atwater Kent model 20 was A. Atwater Kent's answer to Hazeltine's popular Neutrodyne circuit. Atwater Kent would not pay royalties and got around the neutralized circuit by use of "losser" resistors in series with the grids of the RF tubes. Several other manufacturers used the same system.

The model 20 was housed in a fine polished mahogany cabinet with two stages Tuned RF, Detector and two stage Audio Frequency amplifier. It had three dials, 3 point antenna tap switch, two rheostats and filament switch.

The model 20 Compact receiver used the same circuit as the larger model 20 and was built in two models.The 7570 was similiar to the larger model except smaller cabinet, coils and front panel. Connections were made through a battery cable. The 7960 had UX type sockets, a center tap resistor across the detector filament and binding post connections. The model 21 was same as 7570 except it had sockets and rheostats for 3 volt tubes.

The A-K model 30 had an extra untuned stage of RF and single dial control using pulley wheels and flat copper belts on the tuning condensers. Model 48 was identical except for gold panel.



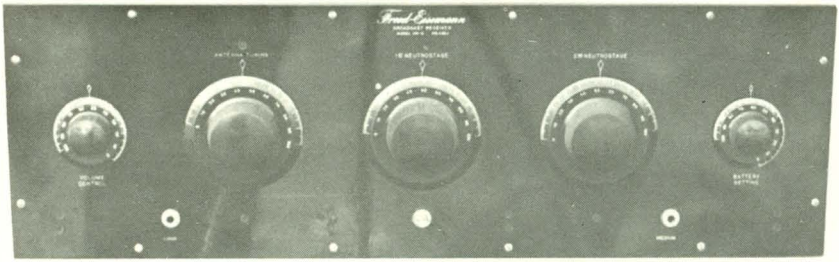
FREED EISEMANN NEUTRODYNE RECEIVER

The basic ideas for the Neutrodyne circuit occured to Prof.Louis A. Hazeltine while he was designing the Navy SE 1420 receiver in 1918. He found that capacity coupling between primary and secondary RF. circuits was the main source of interference from short wave stations when operating on long waves.

While working on receiver design in 1922, Hazeltine realized the immense possibilites of a receiver using tuned radio frequency amplification. His solution was the application of the neutralizing principle that he used in the SE 1420 design to balance out the grid/plate tube capacity.

A prototype model was built to Hazeltine's specifications and called the Neutrodyne.This original receiver model is now at The Smithsonian Institute. I.P.Rodman, of Garod Corporation had much to do with the early developement of the Neutrodyne receiver.

Hazeltine found that inductive coupling between the RF. coils was minimized when the coils were mounted at an angle of 54.7 degrees with respect to the horizontal. The Freed Eisemann NR-6 was a very popular broadcast receiver in 1924.



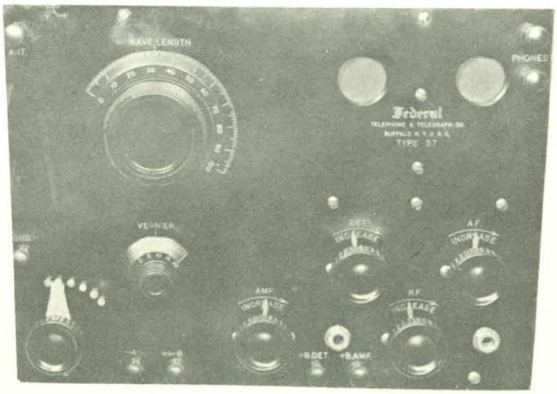
FEDERAL MODEL 57 RECEIVER

The Federal Telephone and Telegraph Company started manufacturing telephone and telegraph equipment around 1900. In 1916 they started manufacturing radio parts.

Using their early manufacturing experience they produced rheostats, sockets, audio transformers, headphones, variable condensers, switches, jacks, plugs, fixed condensers and microphones.

In 1922, Federal was operating radio broadcasting station WGR in Buffalo and producing a line of battery receivers. They designed and built a radio frequency transformer to fit a plug-in mounting. Three models were produced covering a range of 220 to 3000 meters for use with 201A tubes. A special model covering 220 to 550 meters was made for use with UV 199 tubes.

The 1924 catalogue listed a large line of parts and receivers, including the model 61, 6 tube selling for $223. The model 57 receiver had 4 tubes: one stage radio frequency, detector and two stages audio frequency. It used all Federal parts and was housed in a brass case finished in dull black enamel.



COMMUNICATION-1969

The electric waves of Maxwell and Hertz have carried communications to the moon and back. Impulses from space ships circling the moon, over 200,000 miles distant, have been transmitted to earth and translated into pictures. Cloud pictures of the earth predicting weather are sent back daily from weather satellites.

Perfect color pictures of astronauts returning to the Pacific, Peace Conference in Paris and other current events are bounced off of a communication satellite high above the world.

Technological communication has made tremenduous advances in the 74 years since Guglielmo Marconi sent and received his first wireless signals on his father's estate near Bologna, Italy.

It is unfortunate that our communication between fellow humans is so deficient. The year 1968 brought some improvement along this line. It is our hope that the goal of complete communication between people can be accomlished very soon.

NOTES