



# THE AWA REVIEW



*Powell Crosley Jr.  
Founder of Crosley Radio Company*

# **THE A.W.A. REVIEW**

**Volume XVI  
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## **THE A.W.A. REVIEW**

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### **THE COVER:**

Powel Crosley Jr. founded and developed many businesses during his lifetime. In this issue, Charles J. Stinger, a long-time employee of the Crosley Radio Company, chronicles Crosley's life, his companies, his successes, and his failures. The author also presents many never-before-seen photographs of Crosley's business endeavors.

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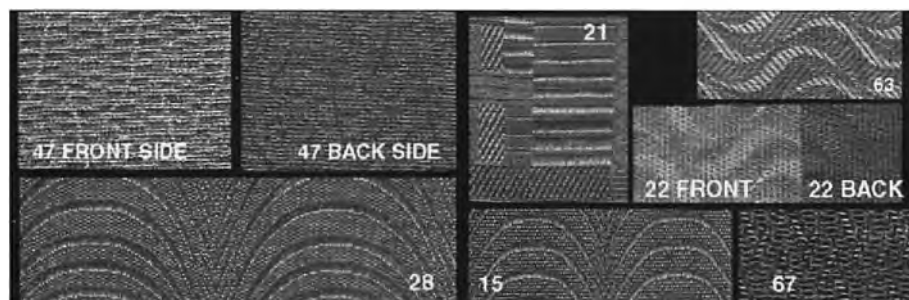
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*Three men demonstrate the operation of a pack set with a hand generator. The photograph, probably dating to 1916, is from the Radioana Collection, Archives Center, National Museum of American History, Smithsonian Institute. This is one of the many rare photographs which trace the evolution of wireless pack sets in the article in this issue by Russ Kleinman and his coauthors.*



*This photograph, from the [www.grillecloth.com](http://www.grillecloth.com) website, shows some of the many variations in the radio grille cloth patterns used by radio manufacturers from the early days of radio to the present. Barbara Havranek describes the evolution of grille cloths and their technical and design characteristics in her article on the history of radio grille cloth. A special page, showing her illustrations in full color is located at the beginning of her article.*

## FOREWORD

This year marks the 50th anniversary of the founding of the Antique Wireless Association. The tireless efforts of the authors of the scholarly papers in the AWA Review and the editors who have helped bring these articles to publication have made the Review a respected and widely cited professional journal. We constantly strive to present exceptionally well-researched and carefully documented articles relevant to the history of wireless communication and we make a particular effort to include papers that describe the scholarly presentations and historic displays at our annual conference.

We are particularly proud to be able to present Volume 16 of the AWA Review which contains four outstanding articles that delve into the history of the Crosley Radio Company, The development of portable military wireless 'pack sets,' the history of the development of the widely-used Rider's radio service manuals, and the history of radio grille cloth. Each of our authors has carefully researched the material in their papers and we hope that this volume will be a valuable technical resource for collectors and historians.

The lead article was written by Charles J. Stinger, a long-time employee of the Crosley Radio Company. It describes in well-illustrated and documented form, the many business endeavors of Powel Crosley Jr. It focusses particular attention on the radio manufacturing and broadcasting aspects of Crosley's company and it presents many never-before-seen photographs which enhance the historical material in the article. This is a particularly detailed and complete paper and it is based, in part, on the materials and displays which the author brought to the 2000 Conference of the AWA in Rochester NY. It is entitled: THE EMINENT YEARS OF POWEL CROSLY JR., HIS TRANSMITTERS, RECEIVERS, PRODUCTS, AND BROADCAST STATION WLW, 1921-1940.

The second article was written by Russ Kleinman, Karen Blisard, James Kreuzer, Felicia Kreuzer, and August Link. It traces the development of portable spark transmitter-receiver 'pack sets' which were made for the U.S. Navy and Army Signal Corps. The authors have searched the archives of the National Museum of American History and other sources and included many early photographs of this equipment which have never been seen in print. This article is entitled: EARLY WIRELESS PACK SETS: SPARK HITS THE BEACH.

The third article was written by Charles C. Kirsten, and it traces the development of the widely-used Rider's Manuals of radio repair. Certainly anyone who has been involved in the repair of radio receivers has used these Rider's Manuals but few realize the complex stages of development

that went into the creation of these books and the influence of major characters and personalities in the radio service field on the ultimate form of the books. It is entitled: **JOHN F. RIDER, HUGO GERNSBACH, AND RCA RADIOTRON: THE SAGA OF RIDER'S EARLY RADIO MANUALS**

The final article was written by Professor Barbara Havranek and it addresses an often overlooked aspect of the development and manufacture of early radios; the grille cloths that decorated and enhanced their appearance and protected their speakers. Barbara is an expert on industrial design and writes about the aesthetic characteristics of different cloths as well as the technical details of how well they performed their job of protecting the speaker while allowing unimpeded transmission of sound. Her article is entitled: **THE HISTORY OF THE DEVELOPMENT OF RADIO GRILLE CLOTH**

The CUMULATIVE TABLE OF CONTENTS at the end of this volume allows readers to see the title of every article in every volume of the AWA Review since it began publication in 1986. This makes it easier for historians and collectors to search for relevant articles and to order copies of the back issues from AWA.

Since some of the back issues of the Review are out of print, AWA offers the out-of-print volumes on CD's. Only the out-of-print issues are available on CD's at present but future plans call for all volumes to be made available in this format. Storage of the printed versions of the early volumes is a problem for AWA and CD's are much easier to store and ship. Future plans call for allowing the printed volumes to gradually become exhausted and replacing them with the CD's. For information about these CD's please visit the AWA website at: <http://www.antiquewireless.org>

I would like to thank all of the authors who worked with me to try to make their papers as complete and accurate as possible and I also want to thank Bill Fizette who helped me to edit this volume. We have jointly tried to present the material in a logical and readable format and your comments are welcome.

**Tom Perera: Editor**

# **The Eminent Years of Powel Crosley Jr., His Transmitters, Receivers, Products, and Broadcast Station WLW, 1921-1940**

**By Charles J. Stinger, W8GFA**

**With Editorial and Computer Assistance from David B. Snyder**

## **Chapter One The Early Years**

Born September 18, 1886 to a prosperous family in the Walnut Hills area of Cincinnati, Ohio, Powel Crosley Jr. became well known during his lifetime for his radios, automobiles, refrigerators, and numerous other products [48]. At the early age of 34, he courageously diverted his energy and sales experience from various other business ventures to the development of radio reception and radio transmission as a commercial enterprise. He expanded this enterprise to include an exceptionally wide range of products. This is the story of his most productive years.

His father, Powel Crosley, Sr. was a prominent lawyer who invested in real estate. He was a millionaire until the financial panic of 1893, when he lost nearly everything. Shortly thereafter, the Crosley family moved to a modest home in the College Hill area of Cincinnati, Ohio. Powel and his younger brother Lewis spent their early years in a country setting [6]. Powel Jr. soon became interested in farming, and both boys worked at odd jobs. Powel spent his earnings quickly but Lewis was more frugal. It was from Lewis that Powel borrowed eight dollars to buy the parts for his first automobile adventure, a battery-powered motorized wagon. Their father bet Powel Jr. ten dollars that he could not get the vehicle to operate. Powel Jr. was successful and repaid his brother the borrowed eight dollars and then split the remaining two dollars in profit with him. This early partnership was to last a lifetime. Later Lewis demonstrated that he had the education, patience, steadiness, and ability to guide the day-to-day operations that kept the Crosley Company running at top efficiency.

The early years of Powel Crosley are very interesting [94]. His academic education consisted of public school and the Ohio Military Institute that was located near his home in College Hill. His early interest in mechanics and automobiles led him to enter the University of Cincinnati as an engineering student in 1906. He lasted two years and then, to please his father, he began to study law. After a short time, he left school, to the great disappointment

of his parents. He had a short attention span and was too restless to be a good student but he was very ambitious, with lots of energy and ideas. Powel Jr. decided that there were more opportunities for a quick financial gain than he could find in law. He was fascinated with anything mechanical, especially automobiles [94]. After his abbreviated college days, he had numerous jobs, mostly involving automobiles. He was a bond salesman, chauffeur, lineman, and owner of an automobile agency. He built and raced his own gas-driven car. He organized his own advertising agency [83]. This was followed by the organization of a company that was to manufacture low-priced six-cylinder automobiles. At this time, there were not more than two or three makers of six-cylinder automobiles in the market. His six-cylinder automobile was built and operated successfully but it was never put into production because of lack of funds. He again returned to advertising and sales. In a short time, he organized two automobile manufacturing companies to build four- and six-cylinder lightweight automobiles. However, the two companies never went into business because of financial difficulties.

For a period of approximately six years, 1908-1914, Powel Jr. decided to make advertising his career. He had never lasted very long in any job but he thought he might do better in the advertising field. In 1910 he married his childhood sweetheart Gwendolyn Bakewell Aiken, against the wishes of her parents who probably felt that he had changed jobs too often. In 1914 Powel Jr. began to work for an advertising agency, earning twenty dollars a week. A short time later, he joined another advertising agency and by 1916 he had built up a large and profitable clientele. Powel Jr. had finally settled down, much to the amazement of his parents, in-laws, and close friends [87, 99].

One of his advertising clients asked him if he would be interested in helping to form a company that would sell automotive specialties. He knew he could progress more rapidly working for himself so he helped organize the company, gave up his advertising job, and, with some financial help, bought the automotive specialties company outright in the spring of 1917. The name he chose for his new business was The American Automotive Accessories Company, and it was located at 1601 Blue Rock Street on the north side of Cincinnati. It

**Tire Costs Reduced ONE HALF**

**NO PUNCTURES NO BLOWOUTS**

**INSYDE TYRES?** — and Double Your Tire Mileage

You can easily DOUBLE YOUR TIRE MILEAGE with Insyde Tyres. Easily fitted around the inner tube. You are not bothered with punctures and blowouts and your tire costs are cut in half.

H. K. & B. McIntosh, writes: "Have now got in my new 14 months without getting a blowout." Have to guess you had 14 thousands of other motorists are so fit to say so.

**WE WANT DISTRIBUTORS EVERYWHERE**  
DEVOTE ALL — OR YOUR SPARE TIME

**FREE** No Obligation Free

Write your name plainly on this coupon and send today for full particulars. They will be sent you by return mail.

**THE AMERICAN AUTOMOBILE ACCESSORIES CO.**  
1601 Blue Rock Street, Cincinnati, Ohio

Enclosed is a coupon to send to our office and have details about Insyde Tyres explained to you. We will send you a sample of Insyde Tyre. When you receive it, please return it to our office. If you are not interested, please return it to our office. If you are interested, please return it to our office. If you are interested, please return it to our office.

Figure 1. American Automobile Accessories advertisement, still in business in 1923.

was incorporated on December 13, 1917. (Figure 1) His resources were limited, but his ambitions and abilities were unlimited. During the first year that he was engaged in the mail order automotive accessory trade his business amounted to more than \$1,000,000. The most popular accessories for automobiles were tire liners and an inside starter. During World War I, flag holders, which could be mounted on the hood of a car, were popular since people wanted to be patriotic.

**\$1 DOWN**  
a year to pay



This  
Beautiful  
Cabinet  
Phono-  
graph  
Balance  
**\$48**  
On Easy  
Monthly  
Payments

Look at the picture of this 35-inch mahogany finished MARION Phonograph, the phonograph you have been waiting for. Double spring motor. Wonderful tone qualities. Cabinet for records. Two double records free. The MARION was designed to sell for \$75. Large production in our own plant enables us to make this wonderful introductory offer for a limited time only.

We will send the MARION to any responsible person on approval for \$1 with the privilege of trying it out five days for \$1.00. If you decide to keep it at the end of that time pay us \$4.00 per month for twelve (12) months and the MARION is your property. Total price, \$48.00 f. o. b. Cincinnati.

Send one dollar with your name and shipping address to

**MARION PHONOGRAPH CO.**

Department "A"

1625 Vandalla Street Cincinnati, O

Figure 2. Marion Phonograph Company advertisement.

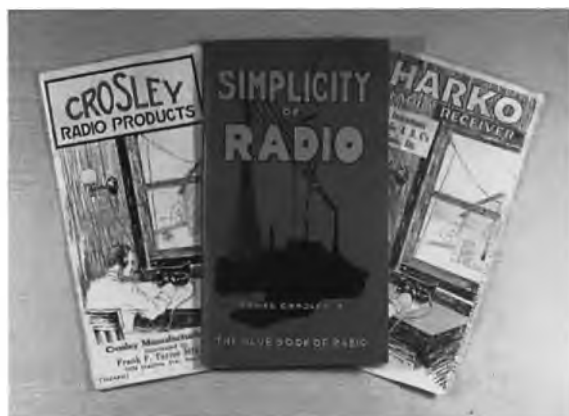
In the wintertime the sales of his automobile accessories were slow, so the company built wood cabinets and a phonograph which he called "The Marion" [94]. He manufactured them in his "Marion Phonograph Company." (Figure 2) His business expanded rapidly. In a few years he not only owned one of the leading automotive accessory companies in the United States, but he was also the owner of a large woodworking plant, a phonograph plant, a printing plant, and other businesses [99].

## Chapter Two

### The 20-Watt Transmitter

On Washington's birthday in 1921, Powel Crosley III (Crosley Jr's son) expressed a desire to own a radio set [75]. His companions had been "tinkering" with radio for some time. The boy's father, always an obliging parent, began that afternoon with his son to learn anything they could about radio. They went to the Precision Equipment Company on Gilbert Avenue to buy a radio set and were amazed at the cost— \$130. Powel thought that this was much too high a price to pay for those materials and that workmanship, since it was just to be a present for his nine-year old son. Instead, he bought

**Figure 3.** *Crosley radio booklets.*



the parts for the crystal set along with a small book called *The ABC's of Radio* for \$35. Father and son cooperated in building the crystal set. Similar booklets would later be given out to promote Crosley radios. (Figure 3)

Crosley knew merchandising values and quickly realized that the price asked for a radio was not in proportion to the cost of labor, materials, advertising, and sales. The cost was too high, and he began to think of the great number of people who would be interested in buying a radio set at a reasonable price. He wondered: "Why couldn't I manufacture such a set and sell it at a low price - so that everyone could afford a radio?" He then inspected the set carefully and immediately knew he could manufacture similar sets that would sell for considerably less. With the production and engineering assistance of his woodworking plant he could produce better and cheaper sets.

After considering the situation for a few days, he hired Dorman Israel and Elmer Hentz, two co-op students from the University of Cincinnati. They would work out plans and design the parts for his first radio, a crystal set. Powel Jr. assisted in the engineering but spent most of his time carefully surveying the radio field. He then decided the time was right to enter into the radio business, and he quickly became obsessed with radio.

The remaining months of 1921 were busily devoted to the

 This is a detailed product catalog page from 1922 for Crosley Manufacturing Company. It features several sections with photographs of products and descriptive text:
 

- The New CROSLY Variable Condenser:** Described as "Better - Costs Less" and "MODEL - C". It includes a photograph of the condenser and a list of prices for different models.
- CROSLY V-T Socket - 60c:** Described as "Better - Costs Less". It includes a photograph of the socket.
- Harko Radio Receiver:** Includes a photograph of the receiver and a list of prices.
- Harko Senior Radio Receiver:** Includes a photograph of the receiver and a list of prices.
- Crosley Cabinets:** Includes a photograph of a cabinet and a list of prices.
- Crosley Variometer Parts:** Includes a photograph of the parts and a list of prices.
- Crosley Detector Units:** Includes a photograph of the unit and a list of prices.
- Crosley Rheostats:** Includes a photograph of the rheostat and a list of prices.
- Crosley Two Step Amplifier:** Includes a photograph of the amplifier and a list of prices.
- Crosley Vario-Couplers:** Includes a photograph of the coupler and a list of prices.

 At the bottom of the page, it says "CROSLY MFG. CO. Radio Dept. 8-7 CINCINNATI, O."

**Figure 4.** *Crosley products in 1922.*

**Figure 5.** *The Crosley Harko crystal receiver, showing the "poor man's buzzer" on the left side, 1921.*



startup of the Powel Crosley Manufacturing Co., which produced the Harko Radio Receiver, porcelain tube sockets, variable condensers, variometers, vario-couplers, tap switches, rheostats and wooden cabinets.

(Figure 4) These were all sold as radio accessories. When it was time for testing of the new Harko radio, interest at the factory was intense. Employees gathered around the little box and they were delighted and amazed when they heard music coming from station WRK, in Hamilton, Ohio, a few miles away. Crosley immediately started an advertising campaign by placing ads in radio magazines and newspapers to promote his new radio and radio parts business. He now began using the same building on Blue Rock Street to manufacture radio sets and radio parts that he had been using for his automotive, phonograph and woodworking businesses.

The first radio receiver to be marketed under the Crosley name was a crystal set called "Harko." (Figure 5) Its name came from the word "hark" or "listen" [6, 92, 106]. The radio came with a galena crystal detector, a coil with switch taps, headphones, and wire for an aerial and ground. Built into the set was a unique "poor man's buzzer." This buzzer used a "C" battery connected through a choke coil made of enameled wire wound on a nail and then connected to a short piece of a hacksaw blade mounted on one edge of the front panel. The sharp teeth of the saw blade protruded from the corner of the cabinet. The other side went to a short length of bare copper wire. By scratching the wire along the saw blade you produced a "buzzer effect" which helped you adjust the cat whisker to find the most sensitive spot on the crystal.

These receivers were produced in the wood-working plant using the regular male help. There was so much trouble with poor soldering and sloppy assembly of the radios by men, that girls were soon hired and trained. This was the start of the practice of hiring large numbers of women to work in the Crosley factories for years to come. The Harko crystal set was first sold in November 1921 just prior to the Christmas season. They were marketed largely through the Milner Electric Company of Cincinnati. The price of just the radio was \$9, or, if it was sold complete with headphones, 125 feet of antenna wire, and insulators it cost \$15.

The first accessory Crosley offered was a molded white porcelain tube socket called the V-T that sold for sixty cents [76]. (Figure 6) This socket had the advantage of being either base- or panel-mounted and it was cheaper than any other socket being sold. The Crosley socket was first advertised as "A Smashing Hit." (Figure 7) The socket was made of porcelain and would indeed be a smashing hit if dropped! Crosley was informed of this



**Figure 6. (Right) Crosley's VT porcelain tube socket, 1921.**



**Figure 7. (Left) Crosley's "A Smashing Hit" advertisement, 1921.**

**A SMASHING HIT**  
**The CROSLY**  
**V-T SOCKET 60c**  
**"BETTER—COSTS LESS"**



This Socket is made of porcelain—the ideal material for the purpose. Our own special design makes possible the use of this material. Has many advantages over other types of sockets in addition to moderate price. Suitable for either panel or base mounting. If your dealer does not handle them, order direct and send us his name.

Watch for our announcement of new \$1.00 variable Condenser. We are also manufacturers of cabinets, CROSLY MAG-FON, and other radio apparatus. Write for circular matter.

**DEALERS—It will pay you to handle our line. Write for full particulars.**

**CROSLY MANUFACTURING CO.**  
 Dept. R.N. No. 2 CINCINNATI, OHIO

**Figure 8. (Right) Crosley's "Announcing" advertisement, 1921.**

**ANNOUNCING**  
**The CROSLY**  
**V-T SOCKET 60c**  
**"BETTER—COSTS LESS"**



This Socket is made of porcelain—the ideal material for the purpose. Our own special design makes possible the use of this material. Has many advantages over other types of sockets in addition to moderate price. Suitable for either panel or base mounting. If your dealer does not handle them, order direct and send us his name.

Watch for our announcement of new \$1.00 variable Condenser. We are also manufacturers of cabinets, CROSLY MAG-FON, and other radio apparatus. Write for circular matter.

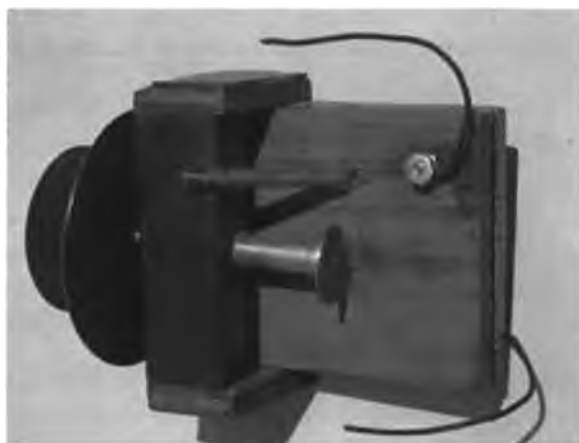
**DEALERS—It will pay you to handle our line. Write for full particulars.**

**CROSLY MANUFACTURING CO.**  
 Dept. R.N. No. 2 CINCINNATI, OHIO

aspect of the advertisement and it was immediately changed to "Announcing" the new socket. (Figure 8) The later tube sockets were made of different materials.

The first Crosley motto: "BETTER COSTS LESS" had begun to be used at this time.

Another interesting accessory was the Crosley variable condenser [77, 78]. (Figure 9) These condensers were advertised to withstand one thousand volts. Three models were made; "A" had plywood plates, "B" had molded plates, and "C" had ceramic plates. The plates were surfaced with a thin sheet of copper, and the insulating material between the plates was mica. A cam on a shaft turned by a dial knob on the front panel of the radio varied the spacing between the plates to form a variable condenser. A light spring maintained tension on the moving plate as the dial was turned to minimum



**Figure 9.** *Crosley "Book" or "Barn Door" variable condenser, 1921.*

capacity. These condensers are often referred to as the Crosley "book" or "barn door" condensers.

Realizing there was a great demand for various units that could be used by the experimenter, the TUNO, CONDENSO,

DETECTO, De-AMPLO, and DUO-AMPLO UNITS were introduced in 1922. These small units were built from standard Crosley parts and were sold in the price range of \$4.00 to \$14.00.

The first transmitter that Powel Crosley Jr. owned was a 20-W, grid modulated, amateur transmitter which he purchased from The Precision Equipment Company in Cincinnati, Ohio. With his amateur radio call sign, 8CR, he began to broadcast from his College Hill home in Cincinnati in April of 1921 [92, 100]. (Figure10)

He broadcast phonograph records using one of his Marion phonograph machines playing "Song of India" and "Dardinella" over and over. (Amateurs were permitted to broadcast phonograph music at that time.) When the records were not playing, Powel Jr. could be heard requesting mail or telephone reports from listeners.

Powel Jr. was inspired by the reception reports that he received from as far away as Troy, Ohio, a distance of 70 miles. He now realized that radio listeners must have quality programming and scheduled broadcast times if radio was to find a place in



**Figure 10.** *Amateur radio station 8CR at the Crosley home, 1921.*

the daily lives of people. To sell more radios and accessories, he needed more coverage. Therefore, a transmitter with more power output was needed.

### **Chapter Three** **The 50-Watt Transmitter**

Since Crosley's radio broadcasts had received such positive responses, the 20-W transmitter was moved to the Blue Rock Street plant of the Crosley Manufacturing Company. Shortly after the move, Dorman Israel, now an undergraduate engineering student at the University of Cincinnati, was given the task of designing and helping to install a composite 50-W transmitter at the Blue Rock Street address. (Figure 11)

This transmitter was to become the first licensed WLW transmitter [100]. The license reads: "March 22, 1922; License issued to the Crosley Manufacturing Company, Baltimore and Ohio Railroad and Blue Rock Street, Cincinnati, Ohio; WLW 360 meters; Every evening, but no fixed time, music, lectures, news, and information."

This 50-W transmitter would only have one ten-thousandth of the power of the eventual 500,000 W WLW of 1934 but it was a step forward. Four UV 203 tubes were used; two as oscillators and two in the Heising modulator circuit [92]. The transmission frequency wandered and the sound quality was poor, but the growing number of radio listeners were astounded to be able to hear voices and music, and consequently they were not too critical. A dispatcher microphone mounted at the small end of a phonograph horn was used to modulate the transmitter. A specially designed motor generator, made by Robbins and Meyers of Cincinnati, supplied the 1,000 VDC needed for the transmitter operation. The antenna, mounted on the roof, consisted of a four-wire flat top suspended between two forty-foot downspout masts.

Just before the start of the first WLW broadcast on March 22, 1922, Powel Jr. told his brother, Lewis, he would like to have the antenna raised to sixty feet. There was a quick rush to the roof where two ten-foot downspout sections were added to each mast. In addition, a counterpoise was added six feet above the roof to improve the rather poor ground system. The studio was a small, heavily-curtained, upstairs room in which there were only two windows and plenty of heat coming from the transmitter in the same room. This location next to the B & O Railroad was interesting because



**Figure 11.** *Powel Crosley Jr. and Dorman Israel, his assistant, testing the 50-W transmitter, 1922.*

**Figure 12.** *The Crosley Harko Senior receiver, 1922.*



the locomotive engineers delighted in making the sounds of their bells and whistles a part of the WLW programs [92].

Broadcasters in the early days of radio were required to share frequencies and to cease broadcasting for three minutes out of every fifteen minutes in order to listen for distress calls from ships at sea. There was also a fifteen-minute period of silence at the end of each hour of night programming. This allowed both the announcer and transmitter to recuperate. The announcer was usually Powel Crosley Jr., and the programming was usually phonograph records with some announcements. Within a short time the WLW programming became somewhat more varied and the hours increased to include morning, afternoon, and evening broadcasts. Broadcasting times varied from fifteen to twenty-five hours a week. Radio advertising, as we know it today, was not done; but Crosley was always thinking of other sources of revenue and he came to embrace radio advertising at a later date.

The Harko crystal set proved to be a great success. It was followed by the Harko Senior which was developed shortly thereafter. (Figure 12) This was a one-tube vacuum tube detector receiver and, with its companion two-stage audio amplifier, it became a very popular radio because of its superior performance. Immediately after Christmas, real volume production began on the Harko Senior. The Harko Senior sold for \$16, the companion two-stage amplifier sold for \$25, and it quickly became the best selling radio set in the world, with five hundred produced each day. Crosley was manufacturing more than ten models of radio receivers in 1922 and all were sold for under \$70, except for the Console XX, which sold for \$100. (Figure 13)

Competitors rushed to meet the challenge, but Crosley had stolen the low-priced market. His initiative had brought radio within the reach of the average American family. His next goals were to give radio listeners better programming and more coverage for the WLW transmitter. He also wanted to produce and sell better radio receivers.

The Crosley Manufacturing Company had outgrown its location on Blue Rock Street. In May 1922 it was moved to a new home on Colerain and Alfred Streets in the Camp Washington area of Cincinnati [80]. (Figure 14) Most of the large building with its 30,000 square feet of space was devoted to the manufacturing of radio apparatus. Offices and the WLW

[illegible]

**Figure 13.** *Crosley receivers of 1922.*

operation occupied much of the third floor. With the increased floor space, the manufacturing of Crosley radios and accessories became a major factor in the radio-related business of this country. (Figure 15)

Soon Powel Crosley Jr. became known as the "Henry Ford of Radio." Hundreds of women and men were employed at the factory, working under a system designed by Crosley himself. This system was actually an assembly line similar to Henry Ford's automobile assembly line. It may have been the first time that an assembly line

was needed in order to produce such large numbers of radios. Sales of radios and accessories had grown to make Powel Jr. one of the leading radio manufacturers in this country.

## Chapter Four

### The 500-Watt Transmitter

Crosley was never satisfied with the power level and programming of his WLW station. He applied to the Department of Commerce, Bureau of Navigation and was granted a power increase to 500 Watts (W) on September 22, 1922 [74, 92]. The license allowed operation on 360 and 485 meters. Again Dorman Israel was asked to design and help to assemble the 500-W transmitter. The circuitry was the same as the 50-W transmitter but used UV 204 tubes in place of the UV 203s.

Finding a 2,000-V plate power supply presented a real problem but it also created a situation which was amusing for the next six months. The Glow Electric Company of



**Figure 14. Crosley's first factory at Colerain and Alfred Streets, 1922**



**Figure 15.** *Crosley Manufacturing Company radio laboratories.*

Cincinnati designed an elaborate system that used a 440-V, 3 phase AC streetcar motor. Two 500-VDC double commutator generators were coupled to each end of this motor. This made four generators with a combined output of 2,000 V for the plate supply. However, the ripple output of the power supply modulated the transmitter about 2% and this unique sound automatically identified the station. This transmitter, with its inherent hum, was used until the Western Electric transmitter replaced it in April of 1923 [13]. Indications are that the transmitter had an output of 300 W instead of the desired 500 W. The antenna had an unorthodox design. It used a multiple-tuned 12-wire, 140-foot flat top, supported by a 100-foot guyed mast at each end.

Powel Jr. was amazed by all the reception reports that were mailed from many distant locations. Reports came from the east and west coasts and foreign countries. He was especially pleased by the many reports which told of the use of Crosley receivers to listen to his station.

At this time, his morning and afternoon programs consisted of weather reports, the opening and closing of the New York Stock Exchange, bond reports, grain and livestock quotations, and general financial conditions. Evening programming was broadcast on Tuesday, Thursday, and Friday beginning at 8 P.M. Central Standard Time. These evening broadcasts included music, lectures, news, and local interest information.



**Figure 16.** *Crosley Crystal receiver Model I, 1922.*

In less than two years, the Crosley Manufacturing Company had demonstrated tremendous growth and was producing several different models of radio receivers. These included crystal radios, 1½-V tube radios, tuned radio frequency (TRF) radios, audio amplifiers, and experimental units, along with accessories which included tube sockets, condensers, switches, rheostats, binding posts, couplers and transformers of various types, and radio cabinets. (Figure 17)

The "Henry Ford of Radio" [35, 45, 84, 85] was building and selling radios which the average family could afford. However, in the fall of 1922, Powel Crosley Jr. realized that in order for him to be competitive in radio receiver sales, he had to produce more sensitive radio receivers by using the Armstrong regenerative circuit. (The Armstrong regenerative patent 1,113,149 had been issued in 1914.)

In November 1922, Crosley considered entering into an agreement with the Pennsylvania Wireless Company of New Castle, Pennsylvania, which had the Armstrong patent rights to manufacture regenerative radio receivers. Instead of this agreement, Crosley announced in late December 1922 that a partnership had been formed with the Tri-City Electrical Supply Company located in Davenport, Iowa. They also had the Armstrong patent rights. The basic agreement with Tri-City was to manufacture the Harko Senior regenerative receivers in sufficient numbers to permit their sale at a cost which would be within the financial reach of everyone. (Figure 18) Advertisements in several publications

indicated that Tri-City Radio Electrical Supply Company would manufacture the Harko Senior regenerative receiver for The Crosley Manufacturing Company. Just three weeks later, on January 15, 1923, the Crosley Manufacturing Company announced that it had purchased the Precision Equipment Company, 2437 Gilbert Avenue, Cincinnati, for \$40,000 [81]. His new company retained the Armstrong regeneration patents rights. It also operated radio station WMH and manufactured radio receivers and accessories

# 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. was added. The combination shown in the second illustration is equivalent to the Crosley Receiver No. 2.**



**This illustration shows combination of the Crosley Receiver No. 1, Audion Detector and Two-Stage Audio Frequency Amplifier. It was a preferred to the Radio Frequency Tuned Amplifier.**



**Later, when desired, all four units can be combined as shown in the illustration of the Crosley Receiver No. 3. Audion Detector, Radio Frequency Tuned Amplifier and Two-Stage Audio Frequency Amplifier, making in effect the Crosley Model No. 3, also mentioned in the opposite page.**



**Now if the purchaser desires to start with the Harko Senior, he can add the Radio Frequency Tuned Amplifier as shown (which, as you know, is the basis of the Harko Senior system) and the Two-Stage Audio Frequency Amplifier.**



**The next illustration shows the combination of all these units, which enable one to construct in the most & illustrated on the opposite page.**



**If the purchaser wishes to start with the Model 4, illustrated on the opposite page, he can add the Two-Stage Audio Frequency Amplifier at a later date, making a Model 5. This combination is shown below.**



**We believe that the unit idea has been carried out in the Crosley apparatus in a very effective manner. Every step that has been taken, before, but never so thoroughly as completely. The idea has been with instant customer service shown, the possibility is already shown. The price of all units of Crosley apparatus are very below all competitors. Their efficiency is unquestioned, regenerative circuits having been reported consistently as being the most sensitive. The low prices are made possible by quality production of Crosley electronic tubes, practically every part and part is made, not purchased.**









**The CROSLEY MANUFACTURING CO.**  
 Dept. R. N. 1 CINCINNATI, O.

**Figure 17. Crosley Manufacturing products of 1922.**



**Figure 18.** Crosley Model V built by Tri-City Electrical Supply. (Courtesy of Robert White)

under the name “ACE.” Until now, WLW and WMH had shared program time. Now WLW programming could be increased. Although WMH was one of the first radio stations in this country, Powel Crosley Jr. decided to return the license back to the Department of Commerce. Later WMH became a part of WKRC in Cincinnati.

The identification tag on the Tri-City sets included the Armstrong patent number and the phrase: “manufactured exclusively for the Crosley Manufacturing Co., Cincinnati by Tri-City Radio Electrical Supply Co.” (Figure 19 and 20)

The Precision Equipment Company’s “ACE” advertisements appeared in publications for the next year. Sometimes they even appeared on pages opposite the Crosley advertisements. In January 1924, the Precision Equipment Company and The Crosley Manufacturing Company merged into the Crosley Radio Corporation. (Figure 21)

By 1923 the words, “Better Costs Less,” had become internationally known as the motto for The Crosley Manufacturing Company, manufacturers of radio equipment and operators of WLW. This motto was not only used in advertisements and publicity, but was the motivational slogan instilled in new employees. This slogan impressed every member of the Crosley organization.

Lewis Crosley convinced his brother Powel Jr. that the composite transmitter installed in September 1922 needed to be replaced as soon as possible. The sound quality was very poor in comparison to other transmitters in use at that time because of the noisy plate power supply. On the advice of Lewis, Powel Jr. ordered a new Western Electric Type 101A 500-W transmitter, [82] which used low level modulation with linear operation of the radio frequency amplifier stages. (Figure 23) The high-power tube complement consisted of four type 212s and one type 211. The modulation system was designed by Heising and called either “constant current” or “plate current” modulation. This transmitter was in service for 20 months beginning in April of 1923.

WSAI, a local radio broadcasting station in Cincinnati, also had ordered one of the same models of transmitter. Now there was a local race to get the transmitters on the air. Crosley won the race.





**Figure 19.** (Above)  
Crosley Model V  
Tri-City nameplate.  
(Courtesy of Robert  
White)



**Figure 20.** (Right)  
Crosley Model V Tri-City  
inside cabinet.  
(Courtesy of Robert  
White)

Headlines soon followed; "*World's Most Powerful Broadcasting Station Being Installed by Crosley Manufacturing Company To Replace Old Equipment.*" They also proclaimed: "*The new transmitter, which has all of the new refinements and improvements in radio broadcasting, when put into operation, will give WLW greater coverage and more power than any station in the United States.*"

The inauguration of the new station was a local and national affair. Messages from President Harding, governors, and national and local leaders were broadcast. There was also a musical concert with performances by the best musical artists of Cincinnati.

WLW was honored in June, 1923, for becoming a Class B station. With this new classification, the station's frequency of operation was changed from 360 meters to 309 meters (833 kHz to 970 kHz). All "canned music" was barred; therefore, all programming on WLW had to be live.


These changes caused some confusion; however, listeners soon adjusted to the new frequency. They were glad when the interference caused by so many stations operating on or near the same frequencies was eliminated.

One day in November of 1923, as the clock was striking six and most employees had gone home, a few had gathered in the office of the advertising manager to talk over the events of the day. Powel Crosley Jr., president of the company, walked in, democratically sat on the advertising manager's desk, crossed his legs, lit a cigarette and proceeded to ask a few questions. When he was finished, one of the fellows said, "Well, Mr. Crosley, are you satisfied with the way the company is growing?"


# CROSLLEY Model X

## \$55


*14 tube  
Radio  
Frequency Set*



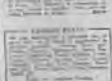
750-4400  
14-40000  
40-400000



750-4400  
14-40000  
40-400000



750-4400  
14-40000  
40-400000




750-4400  
14-40000  
40-400000

# CROSLLEY Model Vc

## \$20

*Regenerative Receiver Set*

*Licensed  
under Armstrong  
U.S. Patent No. 1113,149*



750-4400  
14-40000  
40-400000

The *Victory* regenerative receiver, this model is your finest selection in the *Crosley Model X* line. It gives you the maximum of listening pleasure with its wide frequency range and dynamic sound.

This *Crosley Model X* radio set is the most powerful radio set in the line. It is a 14 tube set, with a 14 tube frequency range, and a 14 tube frequency range. It is the most powerful radio set in the line. It is the most powerful radio set in the line. It is the most powerful radio set in the line.

Look for the *Crosley Model X* line. It is the most powerful radio set in the line. It is the most powerful radio set in the line. It is the most powerful radio set in the line.

Model *Vc* with regenerative receiver, this model is your finest selection in the *Crosley Model Vc* line. It gives you the maximum of listening pleasure with its wide frequency range and dynamic sound.

This *Crosley Model Vc* radio set is the most powerful radio set in the line. It is a 14 tube set, with a 14 tube frequency range, and a 14 tube frequency range. It is the most powerful radio set in the line. It is the most powerful radio set in the line.

Look for the *Crosley Model Vc* line. It is the most powerful radio set in the line. It is the most powerful radio set in the line. It is the most powerful radio set in the line.

## CROSLLEY MANUFACTURING COMPANY

Butler - Out Last Radio

CINCINNATI, OHIO

822 ALBANY STREET

## THE PRECISION EQUIPMENT CO.

"Ruecel Crosley Jr. President"

CINCINNATI, OHIO

122 GILBERT AVENUE

**Figure 21. Crosley and Precision Equipment advertisements side-by-side.**

The reply was lengthy, but in part it follows: "It was just about two years ago that I built my first radio set for my son. We sort of built it together. When I realized I had paid something over \$130 for a few parts with which the thing was constructed, I realized there must be a lot of people, who, like myself wanted a radio set but were not willing to pay that amount for it. We were making phonograph cabinets at our woodworking plant and had the necessary machinery to make some radio parts.

"We started by making a little crystal set that sold for a few dollars, but really my aim was to sell a complete set for about \$5. Our first effort for a vacuum tube set was the old Harko Senior. When I see how that set has been supplanted by those in front you, I can only marvel at the rapid strides of this business. From that one set a day, a few years ago, we have grown until now our factory is making 1,000 radio receivers a day. They range in price from \$20 for a single-tube receiver to \$150 for a four-tube receiver with a self-contained loudspeaker.

[illegible]

**Figure 22. Precision Equipment Company advertisement, 1922.**



This means that six men are kept busy bending 500 pounds of cut bus wire every day. 12,000 binding posts are used daily and 3,000 pounds of Formica (500,000 square inches) are used each week. 10,000 book-type condensers are made each week. 1,500 multistats, 15,000 sockets, and 15,000 coils of the basket-weave type for our Varind inductors are used each week. The Varinds use a ton of double cotton-covered wire a month and hundreds of pounds of insulated material are also used for forms upon which wire is wound. It might be interesting to note that 6,000 audio transformers are made each week and that 60,000 silicon steel laminations, each about three inches long, are used in their construction. This would be about 1.5 million laminations per month. 1,100 coils are used to go inside of these audio transformers, and there are 20,000 turns of fine wire on each coil or about 22,000,000 turns a day. Five punch presses are used to make the laminations, and five extra dies are kept around at all times.

"The factory is paid on piece-work time basis and could keep going all day and night if we wanted to, but I do not believe in night work.

"We send out 2,000,000 sales letters annually and tons and tons of printed matter. *The Crosley Weekly* is sent to 25,000 persons each week.

"With such tremendous business, I cannot help but to be pleased with the growth of our company."

The "Henry Ford of Radio" had spoken.

Another Crosley motto was: "Crosley apparatus is cheap because it is good."

One of the questions, often asked was, "How can it be so good at that price?" Powel Jr. replied, "We purchase in large quantities, purchase raw materials by the carload, make our own parts, own a large fully-equipped woodworking plant, use efficient production, and keep the overhead expenses low." It is clear that Powel Jr. was an excellent businessman.

Judging from the many reception reports, 1923 was a very successful year with at least fifteen different models of radio receivers being manufactured and sold. This was the only year that The Precision Equipment Company radio receivers and accessories were manufactured and sold under the Crosley name. (Figure 24) The Precision Equipment Company had two

addresses during this year: 2500 Gilbert Avenue, and Blue Rock and B. & O. Railroad. (Figure 25) The highest priced Crosley receiver in 1923 was the Model XXV, which sold for \$150. (Figure 26) This price did not include the tubes, batteries, headphones, or a Magnavox speaker. This radio

Crosley Manufacturing February 19, 1923	CROSLY MANUFACTURING COMPANY Powel Crosley, Jr., President 200 Alfred Street Cincinnati, Ohio  BETTER . . . COST LESS AND CROSLY HOW TO <b>Crosley Manufacturing Co.</b> CINCINNATI 200 ALFRED STREET CINCINNATI
First Precision ad February 19, 1923	<b>The Precision Equipment Company</b> POWEL CROSLY, JR., President 2500 GILBERT AVENUE CINCINNATI, OHIO
First ad for Precision on Blue Rock August 20, 1923	<b>THE PRECISION EQUIPMENT COMPANY</b> POWEL CROSLY, JR., President 2500 GILBERT AVENUE CINCINNATI, OHIO
Last Precision ad April 28, 1924	<b>THE CROSLY RADIO CORPORATION</b> POWEL CROSLY, JR., President Formerly The Precision Equipment Company and Crosley Mfg. Co. 200 ALFRED STREET CINCINNATI, O.
First ad without Precision May 5, 1924	<b>THE CROSLY RADIO CORPORATION</b> Powel Crosley, Jr., President 200 ALFRED STREET CINCINNATI, OHIO
First ad for Saverbas July 28, 1924	<b>THE CROSLY RADIO CORPORATION</b> POWEL CROSLY, JR., President 200 SAYERBAS STREET CINCINNATI, OHIO

Figure 25. Various business names and addresses used by Crosley.

## MODEL XXV

UNIT  
COST  
\$150.00COMPLETE  
COST  
\$271.00

This beautiful model is a radio in the modern sense. It is a combination of radio receiver, amplifier, and speaker.

It is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

It is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

It is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

It is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

It is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

The set is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

The set is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

The set is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

The set is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

The set is designed to be used in homes, clubs, schools, and other places where a complete, reliable, and beautiful radio receiver is needed. It is a combination of radio receiver, amplifier, and speaker.

Figure 26. Crosley Model XXV receiver, 1922.

receiver was designed so that it would match the finest piece of furniture in any home. All the other radio receivers were priced under \$65, except for the Ace 3C which was priced at \$125. Crosley prices were very competitive. (Figure 27)

## Chapter Five

## The 5,000-Watt Transmitter

The radio industry had grown rapidly in 1921 and 1922 and it now compared very favorably with many of the long established industries. It was reported

that the American people would spend approximately \$350,000,000 for radio equipment in 1924.

Powell Jr. once said, "A home is not a home without a radio." Now that radio sales had increased so dramatically, what would Crosley do next?

In January of 1924, in response to the increasing demand for Crosley radios, Powell Crosley Jr. decided to purchase a larger manufacturing plant [46]. He eventually wanted to have the capability to produce 5,000 sets a day. To accomplish this, he was compelled to seek a much larger factory. The Thomas Corcoran Lamp Company had formerly occupied the building that he purchased at the corner of Colerain Avenue and Sassafras Street in

the Camp Washington area of Cincinnati [105]. The building had 100,000 square feet of floor space compared to the 30,000 at the Colerain and Alfred street plant. The cost of the Corcoran building was \$150,000. It was estimated that another \$150,000 would be needed to make the plant the finest radio manufacturing plant in the Midwest. With plants such as this, the radio industry could no longer be considered just a passing fad. After renovation, the plant opened for production in the summer of

# CROSLEY

## JUNIOR

### CRYSTAL RECEIVER



This is the new Crosley Junior Crystal Receiver, the ideal radio set for use in listening to local broadcasting stations and those within a radius of about 25 miles. Clear, undistorted reception is assured, this new set providing perfect reproduction of radio signals. No batteries or tubes are required, nothing to become disconnected, nothing to be damaged by the children.

With the advent of summer, the demand for crystal sets has increased tremendously. Crosley dealers and jobbers will find that this new set will meet immediate approval, and we suggest that you get your orders to us as soon as possible.

Price, without phones or aerial equipment, .....\$4.00

## THE CROSLEY RADIO CORPORATION

Powell Crosley, Jr., President  
200 ALFRED STREET CINCINNATI, OHIO

Figure 27. Crosley Junior crystal receiver, 1923.



**Figure 28.** *Crosley's third factory at Colerain and Sassafra Streets, 1924.*

1924 and was known as Plant No. 1. (Figure 28) This was now the third facility that Crosley used in the production of radio receivers. This plant had the advantage of a railroad siding to facilitate reception of raw materials and delivery of finished products.

The entire top floor was devoted to office space and the new WLW studio with its engineering, and experimental departments. The assembly of receiving sets was done on the second and third floors while the first floor contained the stock rooms, shipping and receiving departments, etc. Additional buildings were added in the general area as needed.

New studios and an auditorium were built late in 1924. They were very beautiful and surpassed anything of their kind in radio broadcasting. The solo studio and office of the director was large enough to hold a small group of musicians and an announcer. The studio even contained a Baldwin piano and xylophone. The walls were covered with tapestries and the hardwood floors were covered with oriental rugs. The woodwork was mahogany. Swinging doors led to the large studio, the auditorium and the control room.



**Figure 29.** *A studio at Crosley's broadcast station WLW in 1924.*

No other broadcasting studios could compare with the arrangement of his ensemble studio. This large room could accommodate a military band or large orchestra. (Figure 29) Large divans with soft, springy cushions lined the walls. Several antique chairs with high backs gave a touch of elegance to the draped walls. A large chime clock was both useful and ornamental. A Baldwin concert grand piano was located in one corner of the room and tapestries were used as part of the decorative scheme.

Monk's cloth covered the walls of this studio and a deep fringe at the bottom of the cloth reached to the floor. These wall draperies were designed to eliminate reverberation but the monk's cloth could be drawn back in places when certain types of voices required a different acoustical quality. The ceiling was covered with a specially treated membrane material to minimize reverberation. The microphones in both studios were controlled from a triangular-shaped room located between the studios. Special telephone lines carried the programs to the station and relayed the incoming broadcasts from remote places such as churches, dance halls, sporting events, and other special events.

The familiar red studio "ON THE AIR" signal light was replaced by a new microphone stand developed by Crosley engineers. (Figure 30) There was a system of illuminated words in the stand which informed the artist when to "PREPARE" and when to "BROADCAST." This was part of a system that also allowed rapid microphone switching between the two studios.

With the completion of these new studios, WLW was now ready to become a super-power station, with an increase in power to 5,000 W.

By late 1924, Western Electric had developed a new 5,000-W transmitter. Powel Jr., following his policy of increasing power as the state of the art advanced, ordered one of these new 5,000-W transmitters. Several smaller broadcast stations set up a loud clamor about the coming "Super Power"

competition and mournfully cried that they would be forced off the air by the higher-powered stations.

A new license was granted by the Department of Commerce in January, 1925. The license read, "WLW Crosley Radio Corporation, 500 W regular and 5,000 W experimental, 422.3 meters." The license application for renewal, filed in 1927, indicated that this was the first remotely-controlled station in America.



**Figure 30.** The WLW double-button carbon microphone in 1924.

Another Crosley motto was: "Doing it first, that's Crosley." and his remotely-controlled station lived up to this motto.

*The Crosley Radio Weekly* had this as a headline on September 22, 1924: "New Super Power Station soon to be in operation; Beautiful studios planned. Five-kilowatt transmitter to be the latest radio achievement and may send Yuletide greetings around the world. Station to be miles from studio." [49, 50, 53, 54, 57, 60].

After a careful survey of the topography of the area surrounding Cincinnati, WLW engineers selected a site for the transmitter. (Figure 31) The new site was near Harrison, Ohio, about 25 miles from the studios in Cincinnati. The site selected was out in the country on a high hill.

Powel Jr. was a firm believer that broadcast transmitters should be located as high as possible and in remote areas. He believed that this kind of location would eliminate local interference and absorption of the transmitted signal by electrical wires, steel structures, buildings, and trees.

Plans for the construction of the new transmitter building and antenna system were completed and construction began in the early fall of 1924. The original design of the transmitter building changed drastically and it was eventually designed to have the appearance of a farmhouse. The first floor was used for the transmitter operation, while the second floor contained the living quarters for the resident operator.

**Figure 31.** Site of 5-kW transmitter for Crosley radio station WLW at Harrison, Ohio, 1925.



Two 200-foot towers were erected to support the 300-foot long six-wire flat-top antenna at one of the highest points around the Cincinnati area. From the 30-foot wide square base, the tower width decreased to 14 inches at the top, forming a massive pyramid of fabricated steel. The towers rested upon four concrete supports that were embedded seven feet into the ground. Only one of these towers' eight concrete supports can be seen today. It is at the intersection of Carolina Trace and Marvin Road near Harrison, Ohio.

The first remotely-controlled, super powered broadcast station was officially opened by Powel Crosley Jr. at 8 PM on Tuesday evening, January 27, 1925 [55, 56]. The broadcast was controlled from the WLW studios on Colerain Avenue in Cincinnati.



Many prominent men and women in the radio industry were present at the dedication, and telegrams and letters were received from numerous noteworthy people who could not attend.

Herbert Hoover, Secretary of Commerce and chief government supervisor of radio, sent the following telegram: *"I extend to you my heartiest congratulations upon the opening of your new station. Experiments which you and others are conducting are of the greatest interest. If successful, it will mean high efficiency in service to the listening public - and this must be the final purpose of all broadcasting. You have my very best wishes for your success."*

Edwin H. Armstrong, whose regenerative circuit was used in the Crosley radios, sent the following message: *"Believe that the higher the power of WLW, the greater will be its success. Best wishes and success."*

From William Dubilier, a radio pioneer came this message: *"Again you have placed radio science and invention under obligation to you by your commercial genius and success. You are making it possible for the public to get the benefit of research and the engineer and inventor to be properly compensated. It is through men like you, that they get together, thus rendering a much needed service. You certainly deserve the title 'The Henry Ford of Radio'."*

E. F. McDonald, president of the National Association of Broadcasters, sent this message: *"Most sincere congratulations to 'The Henry Ford of Radio' on his latest accomplishment. Here's to continued prosperity for WLW, The Crosley Radio Corporation and yourself."*

Colin B. Kennedy wrote: *"As a staunch admirer of your past achievements, it is my most sincere wish that this new station may be the means of still further spreading your good name."*

The new 5,000-W transmitter was the first of the Western Electric 5 series [101] to incorporate major refinements in circuitry that performed automatic sequencing on startup. (Figure 32) Serial number 101, which indicated that this was the first transmitter of this type made by Western Electric, was located on one of the six cabinet panels. Even though it was better than any other transmitters available at the time, it still used low-

**Figure 32.** The Western Electric 5-kW transmitter for Crosley radio station WLW at Harrison, Ohio, 1925.



level Heising modulation with linear operation of the radio-frequency amplifier stages. The tube complement consisted of a 211, 212s, 220Bs and 222s. The final linear amplifier used two 220B tubes in parallel, and the high voltage rectifier tubes were 222s. Motor-generators were used to supply the filament voltages for all the tubes except the rectifiers and to supply plate voltage for the low power stages. The high-voltage rectifier filaments were transformer powered. The rectifier and the power amplifier tubes were water-cooled. The water used for cooling the tubes was run through cast iron steam radiators with electric fans to help dissipate the heat. One feature of this transmitter was the ability to put it in operation by activating a single switch which started various motor generators, lighted tube filaments and started the water cooling system. After a time delay, the plate voltages were automatically applied to the various stages of the transmitter.

After a few years, a new 50,000-W transmitter began operation at Mason, Ohio, and this "old" 5,000-W transmitter at Harrison was sold to a company in Mexico. The transmitter building was also sold and the following winter it burned to the ground [92].

From the time Crosley began to manufacture radio equipment until the end of 1924, fifty-four different models of receivers had been built. Nearly half of these were built in 1924. The Super VI, XJ and XL models were all tuned radio frequency (TRF) receivers. The XL was the most costly at

\$140. The popular 50 series were all regenerative receivers with the Model 52SD Special Deluxe selling for \$37.50, and the Model 50 selling for \$14.50. There were twelve models for the public to select from in the lower price range. The 50P, 51P, and 52P portable receivers, which had become very popular, were also included in this price level. The 50P was the first to be built and



**Figure 33.** The Crosley 50P portable receiver, 1924. (Courtesy of Robert Sands.)

it sold for \$18.50. (Figure 33) A short time later the price was reduced to \$14.50.

Eight models of the Trirdyn [59] with the reflex-regenerative circuit were introduced that year. (Figure 34) These receivers, with only three tubes, had the efficiency and volume of a five-tube receiver. They were priced from \$50 for the panel model 3R3, to \$110 for either the Newport or Biltmore models. All receivers manufactured in 1924 used batteries as the power source.

Crosley radios were very competitive in price compared to other manufacturers, and Crosley offered a large selection of models. Sears Roebuck had an agreement with Crosley to supply radio receivers and accessories with Sears model numbers such as the Model SR2. Several models were built, but this association did not last very long because Sears Roebuck found another supplier for their radio sets.

In late 1924, Crosley acquired a large interest in the Canadian-Deforest Radio Corporation to help him expand the distribution of his Crosley radio receivers. This was a step in the fulfillment of his plan to have "A Radio in every American Home" including those in Canada, Mexico, and Central and South America. The Deforest-Crosley receiving equipment was the same type as the receivers being sold in the United States and the sets were constructed with standard Crosley parts. The receivers produced in Canada were advertised as the Deforest-Crosley Models 50, 51, and 52. In August of 1924, production also began on an audio amplifier. In July of 1925, the Canadian-Deforest advertisements no longer included the standard Crosley radio receivers, so, apparently, the Deforest-Crosley Company had started to manufacture its own radio receiver models.

Powel Crosley Jr. made a special request to the Department of Commerce to allow him to change of the wavelength of WLW broadcasting to 423 meters, (710 kHz). The wavelength change solved the problem of shared program times with WSAI, a local station which broadcast on 309 meters, (970 kHz). Starting on June 30, 1924, WLW would share program times on the new frequency with two other stations; WBAV in Columbus, Ohio and KPO in Oakland, California. Friday nights were silent. KPO would not be an interference problem because of the time difference and the distance separating the two stations. This was the third wavelength change since the beginning of the WLW programming on March 22, 1922.

During 1924, programs were broadcast for approximately sixty hours each week. In addition to the usual programming there were special programs



**Figure 34.** *The Crosley Trirdyn receiver, 1924.*

such as election results, sports (including the opening game of the Cincinnati Reds), zoo broadcasts, local concerts, orchestras, plays, and educational activities.

1924 was certainly a challenging year for Powel Jr. He changed the company name, purchased a new plant, and increased production to his goal of 5,000 radios per day. He also constructed new studios, purchased a 5,000-W Western Electric transmitter, produced 24 models of radios and numerous radio accessories, and made plans for the new 5,000-W Super-Power station. He was also successful in employing high quality management and engineering people who made 1924 such a successful year. The company ended the year with a profit of nearly \$2,000,000.

Another Crosley motto was: "Tomorrow may come -What are you going to sell today?"

From the beginning, the idea of radio broadcast advertising was opposed by some broadcasters, receiver manufacturers, wholesalers, and retailers. Radio was in its infancy and most on-air entertainment was done without pay. Therefore, it did not seem to be fitting for any commercial intrusions to interfere with the pleasure of the listener.

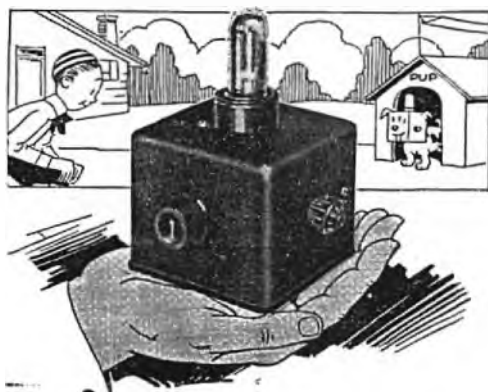
From 1922 to 1925, WLW did not sell commercial advertising. Powel Crosley Jr. was the only sponsor of his station. He wanted it to succeed because it would help him sell more radio products. Westheimer and Company received on-the-air credit for supplying the stock market reports. Baldwin was mentioned for supplying the piano. Drama schools that provided talented performers received credit. Any individual or group that performed on WLW received free advertising for their efforts. WLW listeners heard the Crosley name mentioned frequently in such contexts as the Crosley program schedule, the Crosley orchestra, and, information about Crosley products. So, when it came time to buy a new radio, the Crosley name had already become very familiar. Radio advertising became a nationwide phenomenon in 1925. By 1926, Crosley believed it was time for him to enter the radio advertising business. Cincinnati, with all its manufacturers and businesses, was ready for radio advertising on WLW because of the wide coverage and variety of programming.

### **The Crosley Pup has a Pedigree**

"Radio for the Millions" had always been the motto of the Crosley Radio Corporation. In July 1925, the Crosley Pup was introduced and immediately became one of the most popular receivers ever manufactured by Crosley [65, 66, 67, 68, 69, 70, 71, 72]. (Figure 35) It sold for the ridiculously low price of \$9.75. The receiver was a redesigned Model 50 in a small metal cabinet.

A contest was held from September 1, 1925 to March 1, 1926. A \$1,000 grand prize was offered to the owner of the "Pup" with the best reception results. The same contest also offered six pedigrees of live pups as prizes for reception reports. Another part of the advertising for the Crosley Pup featured the famous cartoon dog Bonzo wearing a pair of Crosley headphones [40]. (Figure 36) Five weeks after production started on September 1,

## WORLD'S SMALLEST RADIO SET UTILIZING VACUUM TUBE



THE life ambition of Powel Crosley, Jr., is about to be realized. Four years ago, before he was referred to as "the Henry Ford of Radio," he wanted to buy a one-tube radio receiver for his son to play with. He was informed it would cost \$130.00. Feeling that was entirely too much money to spend for a boy's toy and also realizing there must be other fathers who would like to give radio sets to their children, he made up his mind to someday build a radio set which would be within the pocket-book reach of everybody.

Success has crowned the efforts of the inventor of the new single-tube regenerative receiver

which he has called the "pup" because it is the smallest real radio set in the world. The tremendous production facilities in his Cincinnati plants makes it possible to sell the set for \$9.75. A radio of this kind makes it possible to "take your entertainment with you." It weighs about a pound and is only 3 1/4 by 4 1/2 by 4 1/2 inches.

Experiments have demonstrated this single-tube receiver will pick-up signals from distant broadcasting stations with excellent volume and the super-power stations "pound right in." Its inventor believes that it will not be long until foreign high-power stations will be heard with a one-tube receiver

Figure 35. Crosley Pup receiver advertisement from 1925.

1925, 14,000 "Pups" had been made and delivered. Sales of the popular Crosley Pup and the Trirdyn were the main factors that allowed Crosley to stay in business in the hard times of 1925 [73].

After a careful survey and study of various methods of merchandising, Crosley announced a new sales plan. Authorized Crosley sales and service stations were established throughout the country. This created a very profitable source of increased sales and income for the distributors and dealers who held a Crosley franchise. Crosley limited his

dealer outlets to the "higher end" merchants, thus improving service to the buying public and inspiring confidence in the Crosley products. The new sales plans were praised by all of the distributors and dealers who said, "This will be the salvation of radio." [62].

Powel Crosley Jr. was always enthusiastic about the development of high-powered broadcasting stations which he thought would be beneficial to people who lived in small towns and rural areas. As a member of the Hoover Commission, he attended a radio conference in Washington and fought strenuously for what he believed to be in the best interest of radio listeners. Thus he became known as "High Power Crosley." This name stayed with him because of his attitude



Figure 36. Powel Crosley Jr., Bonzo, and the Crosley Pup, 1925.

about broadcasting, and also because of his great mental powers and his ability to reach the very pinnacle of fame. In 1924 he predicted power levels of broadcast transmitters would eventually reach 200,000 W.

Powel Crosley Jr. was a very active member of the Hoover Commission and other organizations. He was past president of the National Association of Broadcasters and the National Association of Manufacturers. He had always been very concerned about the regulation of broadcasting, including wavelength assignments, receiver radiation, interference between stations, licensing of broadcasters, programming, etc.

In December, 1925, Powel Jr. attended the fourth National Radio Conference and was elated when Herbert Hoover, Secretary of Commerce, was designated the "czar of the radio industry." This complete transfer of power to the Secretary of Commerce was approved by Congress and Herbert Hoover eventually served as President of the United States from 1928 to 1932. Needless to say, Powel Jr. had considerable influence with President Hoover.

The Crosley receiver models of 1924 were in such demand that only the Crosley Pup and three new models of the Trirdyn receivers were introduced in 1925 [64].

The radio world had been waiting for a reasonably-priced loudspeaker to replace the uncomfortable head phones and hollow-sounding horn speakers. Crosley introduced the Musicone speaker [41] and it quickly became popular with the rapidly increasing number of radio listeners. (Figure 37) The Musicone speakers were attractive [16, 61]. Batteries were not needed for their operation, and they were easy to connect to most radio receivers. "Good broadcasting and a good receiving set were worthless without a good reproducer." The Musicone sold for \$17.50, and the Musicone Deluxe in a mahogany case sold for \$27.50. This was a very competitive price compared to other available loudspeakers.

In June of 1925, a baseball game between the Cincinnati Reds and the Chicago Cubs [63] was interrupted by the sale of a Trirdyn Special Receiver. (Figure 38) Tommy Griffith, a player for the Cincinnati Reds and a Crosley dealer, sold the radio and a Musicone speaker to Cliff Heathcote, a player for the Cubs. The sale was completed between the second and third innings. The crowd watched in astonishment but realized later that it was a great way to advertise Crosley radios.



**Figure 37.** *Crosley Musicone loudspeakers, 1925.*



**Figure 38.** *Crosley Trirdyn / Musicone special, 1925.*

Amrad, the American Radio and Research Corporation, was purchased by Powel Crosley Jr. in December of 1925. Amrad had been a pioneer in the radio industry dating back to before World War I. Amrad had always been foremost among radio manufacturers in fostering research. They developed such products as the "S" tube, used extensively for rectification of alternating currents.

Amrad was licensed under the basic patents for Mershow electrolytic condensers and the Hazeltine Neutrodyne circuits. Overproduction during the broadcast craze caused some financial difficulties for Amrad during the succeeding years. The operation of Amrad was entirely separate from the Crosley Radio Corporation. With the purchase of Amrad, Powel Crosley Jr., president and owner of The Crosley Radio Corporation and controller of the Canadian - Deforest Corporation, became an even more prominent figure in the radio industry [51].

## **Chapter Six**

### **The 50,000-Watt Transmitter**

Cincinnati had been referred to as "The Radio City" [98] and this title was well earned. More radio receivers were manufactured in Cincinnati than any other place in the world. Not only was there a tremendous output of receivers, but broadcasting was done from the first remotely- controlled, super-power broadcast station in this country. Powel Crosley Jr. had become the leader in producing low priced receivers and was widely referred to as "The Henry Ford of Radio."

In 1926 Crosley was producing approximately 5,000 radio receivers per day and this provided employment for 3,800 women and men in the Crosley factories. His operation also provided employment for numerous suppliers locally, as well as worldwide. As an example, lumbermen from as far away as South America and Africa supplied the solid mahogany for the radio cabinets.

Crosley always had confidence in the growing radio industry and in 1926 a six-story addition to Plant No. 1 at Colerain and Alfred Streets was completed. The studios remained in the original building which had been purchased in February, 1924.

Several of the nine receivers introduced in 1926 had the "Crescendon" or regeneration tickler control and another control called the "Accuminator," which consisted of switchable auxiliary condensers for sharp tuning. Some of these sets had six controls and this made adjustment and operation difficult.

However, in one month in 1926, 2,200 of the Model 5-50 sets were manufactured each day.

There was a period between 1926 and 1927 when many consumers were waiting for radios that did not require batteries. Crosley officials realized that there was a demand for batteryless radio receivers, but they refused to enter the field until they could sell those receivers at reasonable prices. (Figure 39) In 1927 Crosley introduced models AC-7 and AC-7C, which used the Crosley alternating current supply unit [17, 43]. This battery eliminator was designed to operate on ordinary 110-V 60 Hz lighting or power circuits [42].

By late 1926, Crosley believed that 85 percent of the six million radio receivers in use around the world were obsolete and would be replaced in the near future. Again, he believed that he had to be ready to meet the demand. Therefore, new radios were designed which used the neutrodyne circuit in a metal cabinet with an illuminated dial and other innovative features. Nine of the twelve new models were AC operated and used new AC tubes such as the UX226 and UY227. These receivers included various models such as the Bandbox, Gembox, Jewelbox, and the Showbox.

Crosley spent one-half million dollars in just a few months on advertisements for these new models. To meet production demands, another half million dollars was invested in machinery, equipment, and tools. These receivers proved to be very popular and sales and profits in 1928 were the highest in company history.

A Crosley motto at that time was: "You're there with a Bandbox and then some."

Prior to the organization of the National Broadcasting Company (NBC) in November, 1926, WLW presented a series of Sunday afternoon musical

broadcasts sponsored by Powel Crosley Jr. They were aired over radio station WEAf's network from the Crosley studios in Cincinnati. The WEAf network consisted of 20 stations, including WSAI in Cincinnati [97]. This became the new NBC network, with WEAf in New York City as the key station. There were 19 affiliated stations that used more than 3,500 miles of special telephone lines for programming

**CROSLY** Six Tube... BATTERYLESS RADIO

First radio can direct from light socket without batteries for less than \$150  
Nothing extra needed... except tubes and aerial...

**The Crosley 6 tube AC-7**  
\$70  
ABC Power Unit

**The Crosley 6 tube AC-7C Console**  
\$95  
ABC Power Unit

**A-B and C POWER**  
Nothing extra needed...

**H...**

Radio designed by J. E. Thompson

501. Bandbox, Aug. 1927, \$35  
502. Bandbox, \$40 (see note)  
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860. Bandbox, \$1830 (see note)  
861. Bandbox, \$1835 (see note)  
862. Bandbox, \$1840 (see note)  
863. Bandbox, \$1845 (see note)  
864. Bandbox, \$1850 (see note)  
865. Bandbox, \$1855 (see note)  
866. Bandbox, \$1860 (see note)  
867. Bandbox, \$1865 (see note)  
868. Bandbox, \$1870 (see note)  
869. Bandbox, \$1875 (see note)  
870. Bandbox, \$1880 (see note)  
871. Bandbox, \$1885 (see note)  
872. Bandbox, \$1890 (see note)  
873. Bandbox, \$1895 (see note)  
874. Bandbox, \$1900 (see note)  
875. Bandbox, \$1905 (see note)  
876. Bandbox, \$1910 (see note)  
877. Bandbox, \$1915 (see note)  
878. Bandbox, \$1920 (see note)  
879. Bandbox, \$1925 (see note)  
880. Bandbox, \$1930 (see note)  
881. Bandbox, \$1935 (see note)  
882. Bandbox, \$1940 (see note)  
883. Bandbox, \$1945 (see note)  
884. Bandbox, \$1950 (see note)  
885. Bandbox, \$1955 (see note)  
886. Bandbox, \$1960 (see note)  
887. Bandbox, \$1965 (see note)  
888. Bandbox, \$1970 (see note)  
889. Bandbox, \$1975 (see note)  
890. Bandbox, \$1980 (see note)  
891. Bandbox, \$1985 (see note)  
892. Bandbox, \$1990 (see note)  
893. Bandbox, \$1995 (see note)  
894. Bandbox, \$2000 (see note)  
895. Bandbox, \$2005 (see note)  
896. Bandbox, \$2010 (see note)  
897. Bandbox, \$2015 (see note)  
898. Bandbox, \$2020 (see note)  
899. Bandbox, \$2025 (see note)  
900. Bandbox, \$2030 (see note)  
901. Bandbox, \$2035 (see note)  
902. Bandbox, \$2040 (see note)  
903. Bandbox, \$2045 (see note)  
904. Bandbox, \$2050 (see note)  
905. Bandbox, \$2055 (see note)  
906. Bandbox, \$2060 (see note)  
907. Bandbox, \$2065 (see note)  
908. Bandbox, \$2070 (see note)  
909. Bandbox, \$2075 (see note)  
910. Bandbox, \$2080 (see note)  
911. Bandbox, \$2085 (see note)  
912. Bandbox, \$2090 (see note)  
913. Bandbox, \$2095 (see note)  
914. Bandbox, \$2100 (see note)  
915. Bandbox, \$2105 (see note)  
916. Bandbox, \$2110 (see note)  
917. Bandbox, \$2115 (see note)  
918. Bandbox, \$2120 (see note)  
919. Bandbox, \$2125 (see note)  
920. Bandbox, \$2130 (see note)  
921. Bandbox, \$2135 (see note)  
922. Bandbox, \$2140 (see note)  
923. Bandbox, \$2145 (see note)  
924. Bandbox, \$2150 (see note)  
925. Bandbox, \$2155 (see note)  
926. Bandbox, \$2160 (see note)  
927. Bandbox, \$2165 (see note)  
928. Bandbox, \$2170 (see note)  
929. Bandbox, \$2175 (see note)  
930. Bandbox, \$2180 (see note)  
931. Bandbox, \$2185 (see note)  
932. Bandbox, \$2190 (see note)  
933. Bandbox, \$2195 (see note)  
934. Bandbox, \$2200 (see note)  
935. Bandbox, \$2205 (see note)  
936. Bandbox, \$2210 (see note)  
937. Bandbox, \$2215 (see note)  
938. Bandbox, \$2220 (see note)  
939. Bandbox, \$2225 (see note)  
940. Bandbox, \$2230 (see note)  
941. Bandbox, \$2235 (see note)  
942. Bandbox, \$2240 (see note)  
943. Bandbox, \$2245 (see note)  
944. Bandbox, \$2250 (see note)  
945. Bandbox, \$2255 (see note)  
946. Bandbox, \$2260 (see note)  
947. Bandbox, \$2265 (see note)  
948. Bandbox, \$2270 (see note)  
949. Bandbox, \$2275 (see note)  
950. Bandbox, \$2280 (see note)  
951. Bandbox, \$2285 (see note)  
952. Bandbox, \$2290 (see note)  
953. Bandbox, \$2295 (see note)  
954. Bandbox, \$2300 (see note)  
955. Bandbox, \$2305 (see note)  
956. Bandbox, \$2310 (see note)  
957. Bandbox, \$2315 (see note)  
958. Bandbox, \$2320 (see note)  
959. Bandbox, \$2325 (see note)  
960. Bandbox, \$2330 (see note)  
961. Bandbox, \$2335 (see note)  
962. Bandbox, \$2340 (see note)  
963. Bandbox, \$2345 (see note)  
964. Bandbox, \$2350 (see note)  
965. Bandbox, \$2355 (see note)  
966. Bandbox, \$2360 (see note)  
967. Bandbox, \$2365 (see note)  
968. Bandbox, \$2370 (see note)  
969. Bandbox, \$2375 (see note)  
970. Bandbox, \$2380 (see note)  
971. Bandbox, \$2385 (see note)  
972. Bandbox, \$2390 (see note)  
973. Bandbox, \$2395 (see note)  
974. Bandbox, \$2400 (see note)  
975. Bandbox, \$2405 (see note)  
976. Bandbox, \$2410 (see note)  
977. Bandbox, \$2415 (see note)  
978. Bandbox, \$2420 (see note)  
979. Bandbox, \$2425 (see note)  
980. Bandbox, \$2430 (see note)  
981. Bandbox, \$2435 (see note)  
982. Bandbox, \$2440 (see note)  
983. Bandbox, \$2445 (see note)  
984. Bandbox, \$2450 (see note)  
985. Bandbox, \$2455 (see note)  
986. Bandbox, \$2460 (see note)  
987. Bandbox, \$2465 (see note)  
988. Bandbox, \$2470 (see note)  
989. Bandbox, \$2475 (see note)  
990. Bandbox, \$2480 (see note)  
991. Bandbox, \$2485 (see note)  
992. Bandbox, \$2490 (see note)  
993. Bandbox, \$2495 (see note)  
994. Bandbox, \$2500 (see note)  
995. Bandbox, \$2505 (see note)  
996. Bandbox, \$2510 (see note)  
997. Bandbox, \$2515 (see note)  
998. Bandbox, \$2520 (see note)  
999. Bandbox, \$2525 (see note)  
1000. Bandbox, \$2530 (see note)

Figure 39. Crosley AC-powered receivers in 1927.



The "Crosley Hour" over the Red network of NBC was among the first of the many programs that Crosley fed to NBC [20] over the coming years. Later on, many other stations became affiliated with NBC [97].

Powel Crosley Jr. was very successful in the radio business. After just four years of manufacturing radio receivers and broadcasting on WLW, he was offered six and one half million dollars for his business but he refused to sell. He was just 38 years old and certainly not ready to give up his future opportunities in radio. At that time he had already become one of the wealthiest men in Cincinnati.

A new act of Congress established the Federal Radio Commission and gave it the authority to allocate commercial frequencies and hours of operation as well as to prescribe and supervise radio discipline. The bill was passed by Congress and signed by President Coolidge on February 27, 1927.

After the Federal Radio Commission was established, Congress immediately proceeded to make it a political football. Broadcasters who wanted better frequencies and other favors began to ask their Congressmen and their listeners for support. Listeners were asked to write letters to the Federal Radio Commission and their Congressmen requesting favorable consideration for their favorite stations.

Soon after the Federal Radio Commission was established, Powel Jr. submitted an application to have WLW's operating frequency moved to 700 kHz. This frequency change was granted on June 1, 1927, but WLW had to share the frequency with WMAF in Massachusetts and KFBU in Wyoming. Later, WMAF stopped broadcasting and KFBU moved to another frequency, leaving WLW with a clear channel. This led to more programming and less interference for the WLW signal.

The time of transition had ended. Powel Jr. believed that a new period of radio growth had begun, with the addition of network programming and hopefully better regulation of the radio industry. To be a success in radio broadcasting, Powel Jr. believed it was important to have broad coverage, listener loyalty, good programming and sales power coupled with product integrity. He felt that broadcasting that was poorly handled was a liability rather than an asset. If a station maintained a high quality of service and gained the approval of the listening public, the goodwill would be commercially valuable.



**Figure 40.** WSAI at Mason, Ohio was purchased by Crosley in 1928.

To keep up with the growing radio industry, Powel Jr. believed that higher power was the answer. He applied to the Federal Radio Commission to increase the WLW power to 50,000 W.

Powel Jr. began to look closely at radio station WSAI which had a proven transmitter location at Mason, Ohio. (Figure 40) The station was owned by the U.S. Playing Card Company in Norwood, a Cincinnati suburb, and had begun broadcasting in June of 1923. WSAI had moved to a new building in Mason in February of 1925, with a new Western Electric 5,000-W transmitter, Model 5C. WLW had made a similar move to a new building in Harrison, Ohio in January of 1925, with the same model transmitter.

On May 8, 1928, *The Cincinnati Enquirer* published the news that station WSAI, operated by the U.S. Playing Card Company, had been acquired by the Crosley Radio Corporation, under the terms of a lease with privilege to purchase [18]. Twenty days later, on May 28, 1928, the Crosley Radio Corporation was authorized to build a 50,000-W transmitter. "Here we go again!" Construction of a new building adjacent to the WSAI building, a new antenna, and the installation of a new 50,000-W transmitter had to be completed. (Figure 41) Powel Jr. was always ready for a power increase, so installing and putting the 50,000-W transmitter on the air as soon as possible was nothing new for the WLW engineers [19].

Excavations for the new building and antenna tower foundations were begun in June with a goal of making the new WLW 50,000-W transmitter operational by early fall of 1928. (Figure 42 and 43)

A newly designed 50,000-W transmitter, the Western Electric Model 7A, [90, 101] was ordered. (Figure 44) This was a crystal-controlled, low power

**Figure 41.** (Below) WLW building, rear view, during construction for installation of the 50-kW transmitter, 1928. Notice horse and wagon.



**Figure 42.** (Above) 300 foot self-supporting tower under construction.

oscillator/modulator transmitter with its output driving three stages of power amplification. The 700-kHz crystal oscillator used a WE-248A tube. That tube was followed by another WE-248A buffer amplifier driving a modulated WE-248A amplifier. The modulated radio signal at 700 kHz, was amplified in three successive stages to the final output power. The first power amplifier consisted of two radiation-cooled WE-212D tubes connected in push pull with an output of 500 W. The second power amplifier had two WE-232A water-cooled tubes connected in push pull with a power output of 10,000 W. The third power amplifier had six WE-232A water-cooled tubes, connected in push pull parallel, with a final output of 50,000 W and a peak power of 200,000 W. The transmitter output could be switched to either the antenna coupling unit or to the artificial antenna.

Seven panel units were needed with a screen enclosure at the rear of the units for the transmitter and an artificial antenna. The power supplies for the transmitter required three panel units. One of these units had the necessary power distribution and control facilities. The model 7A transmitter required a three-phase input of approximately 250 kW at 440 V. Voltage for the air-cooled tubes was supplied from a 1,600-V, three phase, half-wave rectifier which used three WE-234A tubes in another panel unit. This unit also had the necessary metering, filament rheostat controls, and switching and overload protection for the equipment. Another panel unit contained the high-voltage rectifiers that supplied the 17,000 VDC for the water-cooled WE-232A tubes. This rectifier consisted of six tubes in a three-phase circuit. Like the 1,600 V supply, this unit also had the necessary metering, switching, filament rheostat controls, and overload protection. Some of the power and filament transformers, filter chokes and filter capacitors were located in another area along with the water cooling system and the direct current generator for the filament circuits.

The new two-story transmitter building was designed by Crosley broadcast engineers using brick, concrete, and steel construction. It included several windows and a flat gypsum roof.

Two 300-foot towers were constructed 400-feet west of the transmitter building. (Figure 45) These towers supported the "T" wire cage antenna which measured about 0.75 wavelength. The antenna was oriented in a north-south direction. Directly under the antenna, a tuning house was built. A ground system was installed which consisted of several miles of copper wire buried ten inches underground. Interestingly, the lumber which had been used to pack and crate the new transmitter was used in the construction of the tuning house.

On October 29, 1928, [20] the new 50,000-W WLW transmitter at Mason, Ohio [21] was dedicated. This was only five months after authorization for its construction was received. The new transmitter was located 25 miles away from the studio and the day of the dedication was a busy day for many of the WLW personnel. At 10 o'clock, on a Monday morning, a large group of guests gathered at the Crosley Radio Corporation office and studio and then were taken by motor bus to Mason, Ohio. There they toured the new WLW site and learned about its operation. Following a luncheon buffet, the guests returned from Mason and were given a tour of the Crosley factory.

**Figure 43.** *WLW transmitter building completed in 1928, front view.*



**Figure 44.** *Western Electric Model 7A 50-kW transmitter at Mason, 1928.*

**Figure 45.** *WLW "T" antenna west of the transmitter building, 1928.*

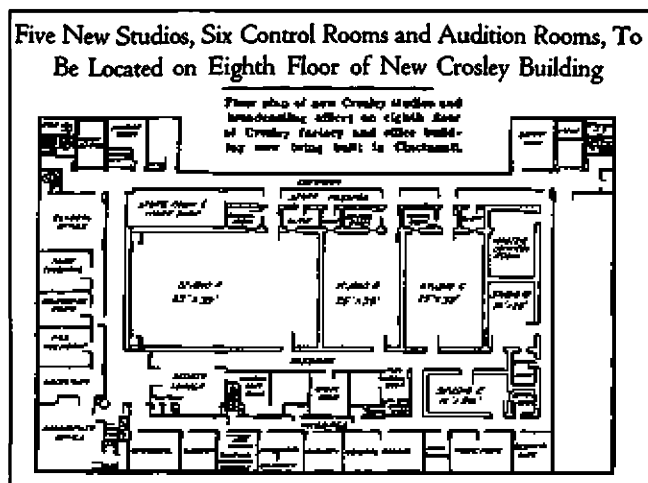


**Figure 46.** *New manufacturing facility and WLW / WSAI studio building at Gilbert and Arlington Streets, 1929.*

Charles A. Hinsch, President of the Fifth Third Union Trust Company, was the toastmaster for the dedication dinner held at the Hotel Gibson that evening. Lt. Gov. William G. Pichtel represented the Governor of Ohio, and Judge Rodney Bryson spoke on behalf of the Governor of Kentucky. Murray Seasongood, mayor of Cincinnati, praised the Crosley Radio Corporation for its effect on the local economy, its public service, entertainment, information, and the publicity the city was receiving daily from the WLW broadcasts [22].

Only a little more than seven years had passed since the first Crosley station went on the air with a power of only 20 W. From the first WLW 50-W transmitter, in March, 1922, the power had been increased to 1,000 times its 50 W level. Also in that seven-year period, Crosley had introduced and sold more than eighty different models of radio receivers.

While Crosley was moving into the new eight-story building, the economy of this country was stunned by the "Wall Street crash" of October 29, 1929, which brought on the "great depression." The depression caused a decline in sales of radio receivers because most people just could not



This was the year of another new motto: "You're there with a Crosley."

During the depression, Crosley employees, city officials, the public and friends were wondering once again, what Powel Jr. would do next. To save time at management meetings, the theme always was, "Let us find out how to do it - rather than why we can't do it." Powel Jr. felt that the length of the depression was unpredictable. Therefore, he did not wish to change his plans for the operation of the Crosley Radio Corporation because he felt that a change in plans could make the economic situation worse in Cincinnati and elsewhere. In the light of this uncertainty about the economic situation, he decided to "tinker" with some new ideas about the future operation of the corporation. One idea was to start manufacturing refrigerators.

Part of the addition to the new building included new studios on the eighth floor for both WLW and WSAI. (Figure 47) With construction completed, the new studios were opened for regular programming on Sunday, March 23, 1930 [25]. The new studios, offices, and control rooms were arranged to permit the most efficient operation of the equipment and the easiest movement of entertainers and musicians. There were five studios with different dimensions for different types of programs. The acoustics were as perfect as the most advanced sound engineering methods could make them. The walls, floors, and ceiling of the studios were completely floating in felt so that no contact was made with metal or wood. Crosley engineers made up a jingle, which sounded like a nursery rhyme: "*The top girder rests on felt, which rests on steel, which rests on felt, which rests on wood, which rests on steel, which rests on concrete.*"

There were five studios. Studio A (63 feet by 39 feet by 21 feet) contained a new organ and could accommodate a full symphony orchestra. (Figure 48) Studios B and C were smaller and were used for dance orchestras, group broadcasts, etc. The still smaller studios D and E would accommodate song teams, speakers, solo artists, etc. Each studio had its own monitoring, control, and client rooms. In conjunction with the new studios, the space included a large, luxurious lounge, rest rooms, and executive and departmental offices. To many people, these studios became known as just "Arlington Street" when speaking of WLW. The new studios, the most complete in

the world, were formally dedicated on the evening of June 24, 1930 [26]. Many guests were invited to hear the dedicatory address given



**Figure 48.** Studio A (largest) at Gilbert and Arlington Streets.

**Figure 49.** *Musicians in Studio A using Crosley condenser microphones.*



by Myers Y. Cooper, Governor of Ohio. The program also included speeches and performances by the finest artists available. It was impossible to calculate the immense number of people who listened to the dedication program over the radio.

WLW, with its midwest location, new studios, 50,000-W transmitter, and then in 1934 the 500,000-W transmitter, played a major role in the growth of radio networks in the early thirties. Through local programming and NBC network programming, WLW had a tremendous influence on the culture of its listeners during the depression years. Radio provided the same entertainment to rural listeners as to city dwellers; comedy, soap operas, news, music, drama, and market reports, etc.

The tremendous amount of programming on WLW in the early thirties required a very large number of writers and performing artists. (Figure 49) The Arlington Street studios were like a revolving door with so many entertainers, writers, and program people coming and going. Many of these radio programs were fed to NBC's Red and Blue networks.

Serialized stories were popular in newspapers and magazines so Crosley thought a weekday daily-dramatized serial on radio would appeal to housewives. "Ma Perkins," a weekday serial, began in 1930. The broadcasts were accompanied by ads for Procter and Gamble soap products. Soon, other weekday programs of this type began to be dubbed "soap operas." WLW also originated "The Mad Hatfields," and "The Life of Mary Southern," the first soap opera to appear on the Mutual network in 1934. The "soaps" were very popular, increasing from 1½ hours per day in 1934 to 4½ hours per day in 1937. Oxydol continued as a sponsor of "Ma Perkins" for 27 years.

But surely the most memorable of WLW's programs was "Moon River," a late night broadcast of romantic poetry and organ music which became legendary among lovers from coast to coast. Singers on "Moon River" included Doris Day, the Devore sisters, and later the Clooney sisters. Eddie Byron was the writer-producer on "Moon River," and the very popular program "Crosley Theater of the Air." Eddie later became the creator of "Mr. District Attorney" in New York City. Another program which originated at WLW was "Singing Sam the Lawn Mower Man." He went to New York,

where he became "Singing Sam the Barbasol Man." Jane Froeman, Little Jack Little, the Mills brothers, the Ink Spots, and Red Barber were a few of the people who got their start at WLW in the 1930s. Other radio personalities, such as Red Skelton, came to do their shows for the network but were never employed by WLW. Farm programs were very popular, with grain, cattle and hog market prices broadcast at noon on weekdays. Another popular farm program was called "Everybody's Farm" broadcasting from an actual Crosley owned and operating farm located near the WLW transmitter at Mason.

Although more than twenty-five different models of radio receivers were produced in 1929, the volume of sales was not high as expected because of the depression. Other manufacturers were starting to produce good quality radios that were both attractive in the home and relatively inexpensive. Crosley met the competition with such models as the New Buddy, (Figure 50) Playmate, Chum, Comrade, Crony, Director, (Figure 51) Pal, (Figure 52) Mate, etc. [28]. Some of the cabinets had the very ornate and exclusive Crosley-designed "Repwood" carving on the front of the radios. Crosley's production of radio receivers had declined since the beginning of the depression, and by 1932 it was fifth in the number of sets built.



**Figure 50.** (Left) *Crosley "New Buddy" receiver, \$64.50, 1930.*



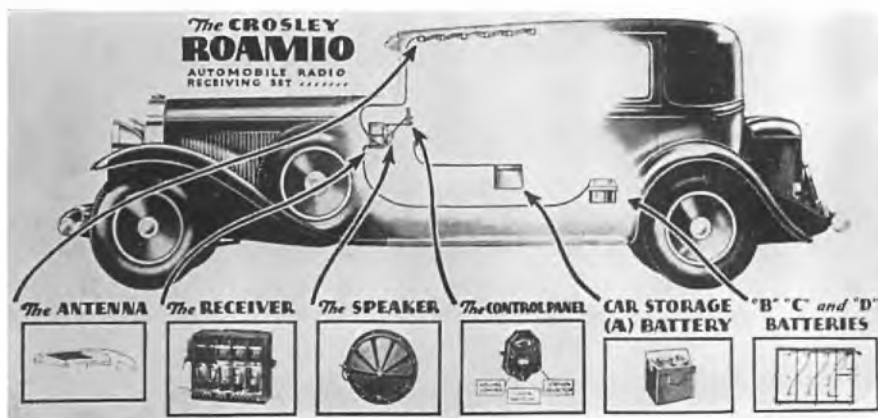
**Figure 51.** (Above) *Crosley "Director" receiver, \$107.50, 1930.*



**Figure 52.** (Left) *Crosley "Pal" receiver, \$69.50, 1930.*



To help boost the sagging sales, an automobile radio called the “Roamio” was introduced in 1930 [29, 30]. (Figure 53) The market for these sets was unlimited at the time, and Crosley made the most of it by providing at least three models of the “Roamio” with prices ranging from \$37.50 to \$75. Not only did the “Roamio” boost sales with its popularity, but it helped to create many new installation and servicing jobs for automobile radio technicians.



**Figure 53.** Crosley “Roamio” automobile radio, \$75.00, 1930.

According to Crosley advertisements, “Where There Are People In The USA, There You Will Find Crosley Radios.” In 1928, out of 3,068 counties in the United States, Crosley distributors were located in 2,550.

Powel Crosley Jr. was never satisfied with the coverage of WSAI in the Cincinnati area. He wanted to make WSAI a “true community station.” An application was submitted to the Federal Communications Commission to move the transmitter to the Clifton Heights area of Cincinnati. This location on Warner Street, between Chickasaw and Wheeler Streets, was closer to the center of the city. Authorization to relocate was granted on January 10, 1936. A building was constructed and a Western Electric 5,000-W transmitter installed. The operating power was 2,500 W during the day and 1,000 W at night. The antenna was a triangular 230-foot steel tower. Situated on a high bluff, this location of the WSAI transmitter provided excellent coverage of Cincinnati and the surrounding area. Listeners could now have an audible “picture” of the daily life of the area and hear much of the fine talent available in Cincinnati. The programming continued to originate from the WLW and WSAI Arlington Street studios.

In 1937 and 1939, the Federal Communications Commission granted permission for the power of WSAI to be increased to 5,000 W full-time. In 1939 the transmitter was moved to Mt. Healthy, a northern suburb of Cincinnati. This eliminated the interference problems in the heavily-populated Clifton Heights area. A three-tower directional antenna was designed by Crosley engineers and is still in use today.

In the summer of 1944, WSAI was sold to the Marshall Field Company of Chicago. The station is now owned by Clear Channel, and the call letters are WCKY.

## Chapter Seven

### The 831-Foot Vertical Antenna

The design of broadcast antennas was going through a change, at this time, from the flat-top and horizontal designs to the vertical antenna designs. Justification for a change from horizontal to vertical depended on the amount of money invested in the transmitter, the frequency being used, the desired coverage area, and the local ground characteristics. With the large amount of money that had been invested in the transmitter and other existing conditions at the WLW transmitter location, it was determined that a large investment in a new vertical antenna was justified. This type of vertical antenna was developed at Bell Laboratories, and the structural design was created by engineers of the Blaw-Knox Company of Pittsburgh [7]. The construction contract was given to Blaw-Knox Company to erect the 831-foot,  $5/8$  wavelength, cantilever-guyed, vertical antenna [3]. The estimated cost to build the antenna was \$50,000, and it is generally believed that no more than five antennas of this design were erected in the United States.

Since the "T" type antenna for WLW was located on the west side of the transmitter building, the location for the Blaw-Knox 831 foot antenna was to be approximately 800 feet east of the building. The base for the new antenna was put in place on March 25, 1933. Three months later in June, the new antenna was put in service and driven by the 50-kW transmitter. (Figures 54 and 62)

On the south side of the tower a neon-illuminated sign with the call letters "WLW" was installed by the Hartman Sign Company of Cincinnati. The sign was 35 feet wide and it was placed slightly above the widest point on the tower, at 350 feet. With its metal framework and the necessary electrical equipment to illuminate the ten-foot WLW letters, the weight of the sign was nearly a ton [108].

The airplane warning lights which were required on tall towers, consisted of two 1,000-W red Fresnel beacons mounted at the top of the tower, along with a number of 100-W red obstruction lights at various levels on

the tower. The Fresnel beacons and the illuminated WLW sign were flashed off and on with a control mounted at the base of the tower. In addition to the lights on the tower, a 24-inch red revolving beacon was located at the base of the tower. This was required at that time to indicate a dangerous area to airplanes. At night, the WLW tower could be seen for many miles. A small plane did hit the tower in the mid-thirties. The pilot was killed, but no damage was done to the tower.



**Figure 54.** *The WLW 831-foot vertical antenna, 1933.*

The antenna coupling house was located at the base of the 831-foot tower, and a coaxial transmission line of nearly 800 feet was custom fabricated to feed the signal to the antenna. (Figure 55) The 100-Ohm air dielectric coaxial line was ten inches in diameter, with a two-inch center conductor. Both center and outer conductors were made of ALCOA aluminum. Small openings were spaced at intervals along the bottom to permit the drainage of moisture. These openings were screened to keep out field mice and insects. The 100-Ohm transmission line was coupled through an "L" network to the 390-Ohm base impedance of the tower. Operating at 500 kW, the unmodulated radio frequency current was nearly 36 A, which produced an RF field intensity of at least 6 V per meter at a distance of one mile from the tower. The 0.5 mV/m contour was 300 miles from the transmitter site and, at night, the normal signal strength in Mexico and southern California was 0.1 mV/m.

Interesting facts concerning the antenna:

- The height was 831 feet or  $5/8$  wavelength at 700 kHz - 295 feet taller than the Washington Monument. It was later shortened to  $1/2$  wavelength. (Figure 64)
- The tower is 35 feet across at the 350-foot level.
- The antenna rests on two cup-shaped two inch thick porcelain insulators. (Figures 56 and 63)
- The insulators are not rigidly joined but are connected by a large pin to allow the antenna to sway. (Figure 57)
- The antenna can withstand a 112 mile-per-hour wind, twice the velocity of any wind ever recorded in the area.



**Figure 55. (Left)**  
*100-Ohm coaxial  
transmission line to  
vertical antenna.*

**Figure 56. (Right)**  
*Bottom half of the  
antenna base insulator  
which supported the  
vertical antenna.*



- The tower is held in place by eight 2-inch guy cables that are separated into sections by seven insulators. (Figure 58)
- The steel in the tower weighs 136 tons. The additional weight of the guy wires and wind load can produce a peak weight of 450 tons on the base insulators.
- One source indicates that there are twenty-four piles driven to a depth of seventy feet to support the foundation that spreads out under the tower. Another source indicates that there are sixteen piles driven to forty feet.
- Approximately 60,000 feet of copper radials were buried 22 inches deep around the tower to act as a ground plane. (Figure 59)
- The antenna was constructed while in a vertical position. Each piece of the structural steel was hauled up into place and bolted together. The structure was held in place by the use of guy cables that were moved upward as the work continued. When the 350-foot level of the structure was reached, the guy cables were permanently attached and the work continued piece by piece above that point [96].

After the erection of the new antenna, the efficiency of the "T" type and vertical antennas could now be compared. With all conditions (frequency, power, and location) remaining the same, field strength measurements were taken with calibrated instruments. Compared to the "T" type antenna, the use of the 831-foot vertical antenna resulted in an increase of signal strength equivalent to the doubling of the transmitter power.

Soon after the new antenna was installed and operating on the 50-kW transmitter, WLW engineers had a terrifying experience. The huge tower started to twist at the wide section in the center of the antenna, and an oscillating motion was observed in the guy cable system. A guy cable on one side would move upward, and at the same time the opposite guy cable would move downward. A hurried call to Blaw-Knox brought assurance that the antenna would stand the abuse. The only suggestion was to throw ropes across the moving guy wires to dampen the oscillations. The oscillations finally stopped but occurred again about a year later. The guy cable oscillations have not been reported since [92].

An excerpt from Lowell Thomas's broadcast on March 13, 1934, states, *"Although I am actually broadcasting from a special studio in the Netherland-Plaza Hotel, every word you are hearing jumps out at you from a metal ball eight hundred and thirty-one feet in the air atop that Mae Westian tower."* (Figure 60) Lowell Thomas was the dean of newscasters for NBC at that time and for many years afterward. He was comparing the shape of the tower to Mae West the actress who was rather well endowed in her upper sections [7].

Shortly after the 500-kW transmitter went on the air, a serious signal coverage problem existed in the surrounding areas 100 miles from the station. This included the highly populated areas of Columbus, Ohio; Indianapolis, Indiana; and Louisville and Lexington, Kentucky. Engineers determined the problem to be selective-fading, the result of a station sky wave signal interfering with its own ground wave signal. Engineering analysis of the vertical plane of a  $5/8$  wavelength antenna indicated the presence of a minor

**Figure 57.** (Right) Top half of the base insulator which supported the vertical antenna.



**Figure 58.** (Left) Guy cable installation used to support the vertical antenna.



**Figure 59.** (Left) Ground radial installation for the vertical antenna.

**Figure 60.** (Right) Announcer Lowell Thomas in 1934 using the Crosley spherical condenser microphone.



high angle lobe. The signal from this lobe could refract from the ionosphere back to earth about 100 miles from the station and cancel or interfere with the ground wave signal [93].

To correct the situation, the antenna was reduced in height to 708 feet by the removal of the 123-foot mast at the top of the antenna. The mast had sometimes been called the "flagpole." The tower became a  $1/2$  wavelength antenna. This eliminated the high-angle lobe and slightly reduced the horizontal radiation. The area of selective fading was moved out beyond the major markets and reduced in size.

A chromium-plated ball had been mounted at the very top of the mast for lightning protection. (Figure 61) When the mast was removed and the ball examined, it was noted that lightning had burned numerous holes in the lower half of the ball. This indicated that the lightning strikes approached the ball from below. Tests done by General Electric Corporation indicated that the largest hole in the ball was caused by a lightning strike with a current of approximately 40,000 A. The original lightning-scarred ball was put on display by the author at the 2000 Annual Conference of the Antique Wireless Association and it generated a great deal of interest.

After nearly 70 years, "The Big Tower" is still in use. The original WLW sign has been replaced but the tall tower is still a landmark and conversation piece for the area around Mason. The actual cost of \$46,243 is now unbelievable, and 70 years of continuous service is remarkable.

## **Chapter Eight**

### **The 500,000-Watt Transmitter**

Each time a new WLW transmitter was installed, Powel Jr. was already planning and obtaining engineering advice for the next power increase. 1930 was the first year that WLW made a profit and it amounted to \$44,000. The next year was even better, and profits increased to nearly \$150,000 [11]. In 1932 our country was in financial chaos, but Powel Jr. applied to the Federal Radio Commission for permission to use a 500-kW transmitter and a new vertical antenna.



Powel Jr. and the technical staff of WLW had been planning for the 500-kW transmitter for five years before receiving authorization in June of 1932 [32, 33]. Since it was an experimental transmitter of entirely new design, it rapidly developed into an engineers' picnic. Crosley wanted to incorporate as many new ideas as possible. New pieces of equipment were designed to make this transmitter the most sophisticated of its day, and the design incorporated many new features.

**Figure 61.** Ball removed from the top of the tower showing lightning strikes on top and bottom.



**Figure 62.** (Left) Aerial view of station WLW showing the vertical and the "T" antennas.  
**Figure 63.** (Right) Powel Crosley Jr. at the tower base insulator.

In May of 1932, an application was filed with the Federal Radio Commission for a construction permit to build a 500-kW transmitter using the 50-kW transmitter as the driver. A switching arrangement would allow either the 50-kW transmitter or the 500-kW amplifier to feed the vertical antenna. The application was granted the next month in June of 1932. This began a very busy time for Powel Jr. and his company leading up to the dedication ceremonies on May 2, 1934.

The contract for the installation of the largest broadcast transmitter in the world was awarded to the RCA Victor Company of Camden, New Jersey on February 1, 1933. (Figure 67) RCA did not build transmitters at this time, so they subcontracted the installation to General Electric, Westinghouse, and other subcontractors [93, 102].

Westinghouse was responsible for: audio frequency amplifiers, modulators, modulation transformers, filament supplies, isolation switching,



**Figure 64.** The WLW tower seen from a distance.

water pumps, motor generators for control circuits and bias, heat exchangers and the entire cooling system.

General Electric was responsible for: the radio frequency amplifiers, DC power supplies, high voltage rectifiers, harmonic filters, the RF transmission line, antenna tuning equipment, control systems and the control console.

RCA was responsible for: coordination of all the subcontractors (which numbered more than 50) and completion of the project within a year [93, 102]. After completion, the new WLW transmitter would have 10,000 times more power than the WLW transmitter of 1922.

The cost of the installation of the transmitter, the necessary addition to the building, and the vertical antenna totaled nearly \$500,000. This did not include the additional expenses incurred for the studio expansion. Design and preparation for the big transmitter began in January, 1933. Components were shipped to the WLW site near Mason in August of 1933. By December, 1933, the equipment had been installed and testing was started during the experimental hours of 1 AM through 5 AM. Shortly after the testing began, the power was increased to more than 500 kW with 100% modulation. The design of the transmitter required no major changes or additional expenditures and this was a surprise to all concerned. Installation of the transmitter progressed as scheduled, an achievement that was seldom seen in broadcasting at that time.

The following is a brief summary of the transmitter performance in typical operation [102]. With a normal power output of 525 kW, the input power to the transmitter, including all the auxiliary equipment, was 1150 kW without modulation. Input power required was 1600 kW for 100% sinusoidal modulation, and 1250 kW was necessary for the average or

normal modulation. This excluded the 50-kW driver. The audio frequency response of the transmitter varied only one decibel from 30 Hz to 8,000 Hz, and was just two decibels down at 10,000 Hz. The transmitter could achieve 100% modulation at all frequencies from 30 to 10,000 Hz. The performance characteristics of the transmitter exceeded the requirements and represented a great engineering success.

Prior to this time, WLW had always maintained its position as one of the most

## Crosley Continues To Lead The World In RADIO VALUES

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● MILLIONS of radio buyers are mindful of the Crosley policy to offer the utmost in quality and performance at the lowest possible price. Never has this policy been more clearly manifested than in the new 1934 Crosley Radios, shown below and on the two following pages. Even Crosley never before equaled these outstanding values. Measure these receivers by any standard and you will find they offer such great value that they are beyond all competition.



**4-TUBE ... A-C-C SUPERHETERODYNE**  
**CROSLLEY TRAVO & DUAL CANA**  
Operates on any 110 Volt circuit. Complete Two Double-Range Tuning, Full Floating Moving Coil Electro-Magnet Speaker. Price Right, You Get More as THE DUAL CANA HAS GREAT RANGE FEATURES.  
Dimensions of Travo: 14 1/2" high, 9 1/2" wide, 8 1/2" deep. Dimensions of Dual: 14 1/2" high, 9 1/2" wide, 10 1/2" deep. **\$16.00** deep. **\$18.00** deep.



**4-TUBE SUPERHETERODYNE**  
**CROSLLEY DUAL FOUR**  
5 Tube Dual Range AC Superheterodyne incorporating Full Floating Moving Coil Electro-Magnet Speaker. 17 1/2" high, 10 1/2" wide, 10 1/2" deep. **\$17.50** deep.

**DUAL RANGE**  
\$6 to 200 Waves. \$20 to 530 Waves.  
\$200 to 1,500 Kilocycles. \$400 to \$499 Kilocycles.  
In addition to the range of frequencies being, prices include complete and tested vacuum pentodes and other latest tested tubes, a new condenser and much available by a turn of the switch through dual range feature.



**5-TUBE ... A-C-C SUPERHETERODYNE**  
**DUAL TRAVETTE & DUAL COMPANION**  
Operates on any 110 Volt Circuit. Incorporates Dual Range, External Speaker Jack, Full Light, Removable Antenna, Full Floating Moving Coil Electro-Magnet Speaker.  
Dimensions of Dual Travette: 16 1/2" high, 10 1/2" wide, 10 1/2" deep. Dimensions of Dual Companion: 16 1/2" high, 10 1/2" wide, 11 1/2" deep. **\$25.00** deep. **\$25.00** deep.



**5-TUBE ... A-C-C SUPERHETERODYNE**  
**DUAL FIVE & DUAL FIVE LOWBOY**  
Dual Range Superheterodyne. New Standard, Complete External Removable and Dual Range Tuning. Full Floating Moving Coil Electro-Magnet Speaker.  
Dimensions of Dual Five: 16 1/2" high, 11 1/2" wide, 8 1/2" deep. Dimensions of Dual Five Lowboy: 16 1/2" high, 11 1/2" wide, 12 1/2" deep. **\$22.00** deep. **\$36.00** deep.

Figure 65. New Crosley receivers introduced in 1934.



**14-TUBES... DUAL RANGE SUPERHETERODYNE**  
**THE CROSLY DEAL FOURTEEN**  
 Dual Range, Automatic Volume Control, Class "A" Fanciful Peak-Pull Output, Master Tuning, Static Control, Auto Control, Audiotone Type Full Floating Moving Coil Electro-Dynamic Speaker. This is the finest radio receiver that can be built, incorporating every available development for excellent performance.  
 Dimensions: 41 1/2" high, 26" wide, 15" deep.  
**\$100.00**

**REMOTE SPEAKER... A.C.D.C. 6-TUBE**  
**THE CROSLY REPOSE, JR.**  
 A remote speaker designed for use only with the Crosley Repose, Jr., receiver. Large size Electro-Dynamic Speaker, features operation on any 110 Volt A.C. or D.C. supplies. Dual Range, 20 Foot Extension Cord, Attached Antenna.  
 Dimensions of Speaker cabinet: 31" high, 17 1/2" wide, 11" deep. Dimensions of Receptor cabinet: 7 1/2" high, 10 1/2" wide, 7" deep. Price includes both Speaker and Receptor. Complete with Table.  
**\$27.50**

**REMOTE POWER SPEAKER... ELECTRO-DYNAMIC**  
**CROSLY REPOSE & REPOSE FIRE SCREEN**  
 Large Size Throat Type Electro-Dynamic Speaker. For use with Dual Voltage, Dual Continuum or Dual Six... Employs Automatic Peak-Pull, 20 Foot Extension Cord. Two 250 member tubes in a power pack (standard 20 watts - 1 DC for the speaker).  
 Dimensions of Receptor: 22 1/2" high, 21 1/2" wide, 17 1/2" deep. Dimensions of Fire Screen: 31" high, 31 1/2" wide, 15 1/2" deep.  
**\$50.00** (For Screen) **\$50.00**  
 Complete with Table.

**5-TUBES... SYNCHRONOUS POWER**  
**CROSLY THIRTY-TWO D. C. & LOWBOY**  
 Synchronous, All-Grids, New 6.3 Volt Throat Type Tubes, Transistorized Dual Full Floating Moving Coil Dynamic Speaker. Designed for use with 110 Volt D.C. supply.  
 Dimensions of Thirty-Two D. C.: 31 1/2" high, 17 1/2" wide, 17 1/2" deep. Dimensions of Power Pack: 17 1/2" high, 17 1/2" wide, 17 1/2" deep.  
**\$39.95** **\$49.95**  
 Complete with Table.

**5-TUBES... CLASS "B" AMPLIFICATION**  
**CROSLY BATTERY "B" & "B" LOWBOY**  
 Synchronous, Continuous (Throat) Type and 6.3 Volt Throat Type Tubes, Transistorized Dual Full Floating Moving Coil Dynamic Speaker, Dynamic Speaker Low Battery Drain.  
 Dimensions of Battery "B": 17 1/2" high, 17 1/2" wide, 17 1/2" deep. Dimensions of Battery "B": 17 1/2" high, 17 1/2" wide, 17 1/2" deep.  
**\$39.95** **\$49.95**  
 Complete with Table.

**5-TUBES... OPERATED ON ANY 110 VOLT CIRCUIT**  
**CROSLY SHORT WAVE CONVERTER**  
 Single Dual Control, Dual Calibrated in Megacycles (range of 1.5 to 22), Two Speed Dual, Three Position Band Selector Switch. Can be used in connection with any radio receiver not equipped with dual range.  
 Dimensions: 7 1/2" high, 10 1/2" wide, 5" deep.  
**\$20.00**

**WESTERN PRICES SLIGHTLY HIGHER**

August 15, 1932

Figure 66. More new Crosley receivers introduced in 1934.

powerful broadcast stations in the United States. It had been the first station to utilize successive stages of increased power levels at 50, 500, 5,000, 50,000 and now 500,000 W. Powel Jr. believed that increasing the power of a broadcast transmitter was the most effective way to reduce receiver static. The transmitter became a high-power "Static Eliminator."

By the 1930s, radio listeners had changed their listening standards. They now wanted high quality, strong, easy-listening

signals rather than stations from a great distance. With improved receiver designs, adjacent-channel interference was reduced by making receivers more selective. (Figures 65 and 66) Fading of the transmitter signal was reduced through the addition of automatic volume controls in receivers. Therefore, an increase in transmitter power could now improve the coverage area and reduce fading without creating appreciable interference.

To accommodate the space required for the new transmitter, the length of the building and basement that housed the WLW 50-kW transmitter was extended by 36 feet. (Figure 68) This addition matched the appearance of the existing building and increased it to 80 feet long by 63 feet wide. This building is still in use for the current 50,000-W WLW transmitters. Physically, the 500-kW transmitter on the first floor is still in place, but some tubes and parts have been removed. Most of the supporting equipment necessary for its operation that was located in the basement has been removed.



Figure 67. Nameplate from the front of the 500-KW transmitter, 1934.

## Transmitter Physical Layout and General Design

The new 500-kW transmitter contained a radio frequency amplifier capable of 2,000,000-W of peak power output [104]. The audio frequency amplifier was large enough to modulate the radio frequency amplifier to 100 percent.

This transmitter was certainly unusual because of its size. (Figure 69) It actually became an integral part of the building since the steel uprights in the cabinets supported the building roof. Most of the metal in the transmitter cabinets was ALCOA [5] aluminum and the power amplifier plate tuning capacitors were also made of aluminum tubing [9].

Additional space on the first floor was necessary to allow the installation of three power amplifier cabinets, two modulator cabinets, and one rectifier cabinet. (Figure 70) The transmitter was 54 feet 7 inches wide, 13 feet 2 inches high, and 17 feet deep. This powerful transmitter required a total of nearly 935 square feet of space.

To make the transmitter more reliable, the power amplifier was divided into three cabinets and the modulator was divided into two cabinets [102]. With this design, a cabinet could be automatically isolated by a switching arrangement when a tube or any component in that cabinet became defective. This allowed the transmitter to continue in operation at reduced power and modulation capabilities. The motor-driven "isolation switch" was nearly 44 feet long and it was located directly below each radio frequency amplifier and modulator cabinet at the basement ceiling level. This kept the connecting leads as short as possible.

A platform, sometimes called the "catwalk," 4-feet above the transmitter floor and with covers 3 feet wide, ran the entire length of the front of the transmitter assembly. (Figure 72) These easily-removable platform covers provided access to parts such as internal water piping, hose reels, water



**Figure 69.** (Above)  
*Front of the 500-KW  
transmitter during  
construction, 1933.*

**Figure 68.** (Below)  
*Building the addition  
on the north side of the  
50-kW transmitter  
building for the 500-kW  
transmitter, 1933.*



flow instruments, and mechanical tuning adjustments, etc. This water piping arrangement provided a degree of accessibility that was heretofore unknown in most broadcast transmitters. A platform 22 inches wide and at the same level as the catwalk was installed inside each cabinet to facilitate tube changes and other necessary maintenance.

Fitted plate glass windows at eye level, and entrance doors at the platform level, were a major part of the frontal surface of the transmitter. Pairs of metal-lined wooden doors provided access to the back of each cabinet.

Each cabinet was entirely shielded and electrically bonded at numerous locations to the other cabinets. For safety purposes, all audio and radio frequency amplifiers and the high voltage rectifier were located behind interlocked doors and panels. A safety switch was provided at each cabinet entrance to ground all high voltage leads and condensers. The opening of any door to the power amplifier or modulator cabinets would also isolate that cabinet permanently. Low power audio stages were located in the rear of the modulator cabinets. All of the power amplifier main tuning controls, water valves, flow meters, thermometers, emergency shut down switches, tube hour and overload indicators were located on the front of each cabinet where needed.

The control console, located to the front right of the transmitter, was the first one of its kind [102, 107]. (Figure 71) The console contained control switches, indicator lights, relays, and other devices associated with the automatic sequence and protective control circuits. Various voltmeters, an antenna ammeter, and an over-modulation indicator were also centralized at the console. Relays and contactors located on a control panel directly behind the main rectifier 870 tubes were also associated with the console and its operation. During transmitter operation, the control panel and its equipment were completely accessible since this area was not interlocked. Normal operation was indicated by a red light above the corresponding control switch for each unit. If any light went out or did not light on start-up, it was an indication of a problem. Voltage for the operation of the control circuit was 100 VDC, which was supplied by a motor generator located in the basement. The generator was called the "Shop Machine."



**Figure 70.** RF power amplifiers for the 50-kW transmitter prior to the installation of the UV-862 tubes, 1934.



**Figure 71.** Control console for the 50-kW and 500-kW transmitters, 1934.

All of the rotating equipment, heat exchangers, two large modulation transformers, filter capacitors, oil circuit breakers, the isolation switch, harmonic filter, and electrical input and switching panels, etc., were also located in the

basement area of nearly 2200 square feet. Three transformers and a filter reactor for the high voltage rectifier were located outside at the rear of the building in a fenced-in area.

To operate the 500-kW transmitter, it was necessary to operate two change-over switches. One switch dissipated the Western Electric 50-kW transmitter output into a load resistance. (Figure 73) This excited the grids of the tubes in the three radio frequency amplifiers of the 500-kW amplifier. The other change-over switch allowed the output of either the 50- or the 500-kW transmitter to be switched to the input of the harmonic filter, with its output going to the coaxial transmission line and the antenna.

RCA was the first supplier of UV-862 tubes with pure tungsten filaments [107]. Twelve were required in the radio frequency amplifiers and eight in the modulators. These tubes were water and air-cooled and had a plate dissipation of 100 kW each. Each tube was rated at 90-A of peak emission with an amplification factor of 45. The filament voltage was 33 V with a

**Figure 72.** These five stars of radio were heard on the dedication broadcast for the new 500-kW transmitter. Each is holding one of the twenty 100-kW tubes used in the transmitter. Left to right are Margaret Carlisle (Chicago) who starred in "Showboat," "Bittersweet," and in London in "Words and Music," Mary Alcott (Chicago) Paul Whitman discovery; Ethel and Dorthea Ponce (New York) harmony duet; and Flo Golden, actress.





**Figure 73.** (Left) Another view of the Western Electric 7A 50-kW transmitter used as the exciter for the 500-kW transmitter. Engineer Dick Walker is seated at the console which controlled the operation of both transmitters, 1934.

**Figure 74.** (Right) The three 1500-Ampere DC motor/generators for the UV-862 tube filaments, 1934.



current of 207 A. Total filament current for the twenty tubes was approximately 4150 A or about 137 kW just to light the filaments. The tubes were 5 feet in length and each weighed 30 pounds, for a total weight of 600 pounds. The cost for each tube was \$1625, and the total cost for the twenty tubes was \$32,500. Three 1,500-A motor generators connected in parallel provided the necessary 33 V for the filaments. (Figure 74) They were driven by three 75 horsepower, 2,300-V motors. Normally these motor generators were controlled individually or as a unit from the control console.

To eliminate the three 1,500-A motor generators for the UV-862 filament power, the tubes were eventually replaced by the more modern 898A tubes [86, 93]. The filaments of the 898A tubes were multi-strands of tungsten, consisting of three sections that could be operated on DC or single, or three phase AC. The filament voltage and current for each section required 33 V at 70 A. Other than the filament specifications, the operating and physical characteristics of the two tubes were nearly identical.

The conversion to the 898A tubes required three single-phase high reactance transformers with a primary of 240 V and a secondary of 16.5 V at 140 A for each tube. High reactance transformers were used to limit the filament surge current to 200 A. There were 60 such transformers; each was 13 inches high, 10 inches wide, and 8 inches deep, and weighed approximately 150 pounds. To support the five-ton weight of these transformers, a structural steel bridge was built in the basement. It was located directly under the transmitter cabinets to keep the filament leads as short as possible. [94].

Two cooling systems, one using water, and one using air, were required to cool the transmitter. Each UV-862 tube required 30 gallons of distilled water flow per minute. High temperature water stills were operated continuously

to maintain the necessary amount and quality of distilled water in the system. The water cooling system was also designed to be adequate for the existing 50-kW WLW transmitter. The heated distilled water was pumped at the rate of 700 gallons per minute through two Westinghouse heat exchangers. (Figure 75) The waste heat was transferred to raw water which was pumped at 1,500 gallons per minute to the 75- by 75-foot spray-cooling pond located outside the building. (Figure 76)

To isolate the nearly 12,000-V anode voltage for each of the UV-862 tubes, cooling water was circulated through special rubber hoses wound on a cylindrical form [102]. The length of the hose was sufficient for an isolation of 50,000 V. These hoses were mounted under the catwalk for each radio frequency amplifier and modulator. This hosing arrangement was eventually changed to a network of 1.5-inch Pyrex™ pipes for the inlet and outlet of each tube. Nearly 900 feet of Pyrex pipe was needed for this conversion [86].

A single, 3-horsepower centrifugal blower was used to blow air through the main air duct which had branches leading to the filament and plate seals of the twenty UV-862 tubes.

### Power Amplifiers

The three radio-frequency power amplifiers, designed by the General Electric Company, were identical. (Figure 77) Each had an output of 170 kW of carrier power and they combined to make the 500 kW. Each amplifier was complete in itself with its own radio frequency and power circuits. Another first occurred when it was decided to use the existing 50-kW transmitter, running at reduced power, to drive the 500-kW transmitter. When operating



**Figure 75.** (Left) The pumps and heat exchangers for the 500-kW transmitter were located in the basement of the transmitter building and used to cool the 862 tubes, 1934.

**Figure 76.** (Right) Heated water from the 500-kW transmitter was pumped to the outdoor spray pond to cool the 862 tubes, 1934.



the 500-kW transmitter, the output of the 50-kW transmitter was fed into a load resistance and used to drive the grids of the three radio frequency amplifiers in parallel. Approximately 20 kW of power was required to drive the 500-kW amplifier. Each amplifier had four type UV-862 triode tubes, operating in push pull parallel Class C mode. The three amplifier outputs were combined in series. The radio frequency amplifiers were high-level plate modulated. (Figure 78) The modulator of the 50-kW transmitter was disabled when operating the 500-kW transmitter.

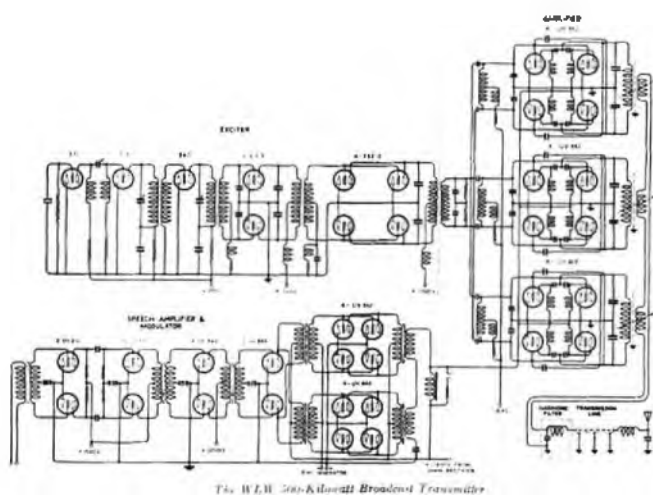
The normal operating parameters for each amplifier were: plate voltage of 11.8 kV, plate current of 20 A, bias voltage of -630 VDC, grid current of nearly 4 A, and a PA (power amplifier) tank current of nearly 95 A. The input power to the three amplifiers was nearly 700 kW and it produced 500 kW of output power. The power amplifier efficiency was slightly over 70%.

The grid circuit design was unusual [102]. Fixed mica-dielectric neutralizing capacitors were used in a conventional balanced neutralizing circuit. It is believed this was the first use of fixed neutralizing capacitors in a broadcast transmitter. With the grids driven in parallel, the balanced grid line was shielded and split into 3-equal lengths leading to the grid tank circuits. This put the grid excitation voltages in phase, which simplified tuning and loading of the amplifiers. The three grid tank circuits were permanently tuned to be resonant at 700 kHz. The total rectified grid current was measured with a General Electric meter which had a scale of 0-10 A. There was one grid current meter mounted on the front of each amplifier.

The plate voltage of 11.8 kV was applied to each tube through its associated plate choke, which was wound on a glass form. The plate current for each tube was measured by a specially-designed, highly-damped meter in the plate circuit. These meters were used for balancing the operating parameters of the four tubes in each amplifier. A General Electric DC ammeter with a scale of 0-150-A was mounted on the front panel of each amplifier and designated the plate tank ammeter. For insulating purposes, the meter was mounted behind a special glass enclosure. Under normal operation, the meter would indicate approximately 95 A. The antenna current was nearly 70 A while operating at 500 kW



**Figure 77.** Two of the twelve UV-862 tubes in the RF power amplifiers of the 500-kW transmitter, 1934.

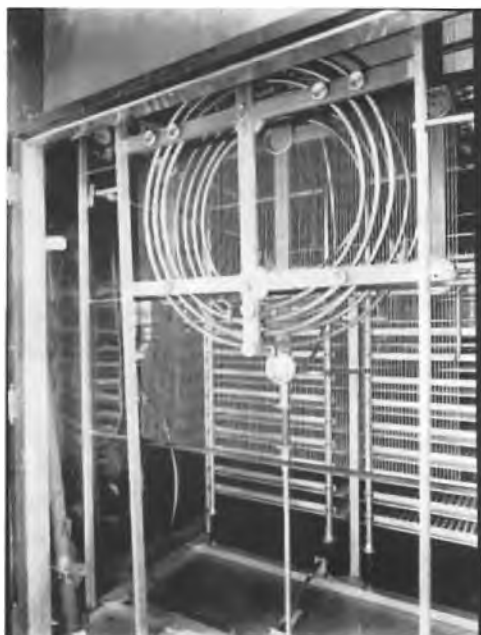


**Figure 78.** Simplified circuit diagram of the WLW 500-kW transmitter.

output power. Normal antenna current was approximately 20 A while operating at 50 kW output.

The plate tuning of each RF amplifier was accomplished by varying the inductance rather than the capacitance in the plate tank circuit [102]. (Figure 79) The plate tank inductor consisted of copper tubing bent into a spiral or “pancake” coil. It had a Q of over 1,200. For the output of each amplifier, a similarly wound spiral coil was used to couple to the plate tank circuit. An electrostatic shield (Faraday shield) was placed between the power amplifier tuning inductance and the output coupling coil to reduce electrostatic coupling between the two coils. The plate tank capacitor was fixed and had a very unusual design. The capacitor consisted of two identical air dielectric capacitors with their center points grounded. This capacitor was made of grids of aluminum tubing and was unique in broadcast transmitter practice. The capacitors were tested at voltages up to 50,000 V.

The outputs of the three radio-frequency amplifiers were connected in series, feeding the harmonic filter and transmission line to the 831-foot vertical antenna. The three radio-frequency amplifiers on the first floor required 510 square feet.



**Figure 79.** Output coupling link, Faraday screen, and plate tuning capacitor for the WLW 500-kW transmitter.



## **Low Power Audio and High Power Modulator Stages**

The design of the low-power audio stages incorporated standard audio amplifier circuits. However, the design of a modulator for the 500-kW transmitter presented a real challenge [102]. First, the audio power required from the modulator was more than ten times greater than ever before obtained from any audio amplifying system. Also, the fidelity of the modulator had to equal or surpass current standards. Furthermore, the power efficiency had to be as high as possible.

Several possible circuits were analyzed. It was decided that the use of high-level class B plate modulation could best meet the design requirement. This choice also offered important advantages such as lower initial construction and maintenance costs.

The entire low power and modulator system consisted of five stages, with the first four connected in push pull. Power for the plate circuit of the first three stages was supplied by a 3,000-V, 2.5-A rectifier which used six UV-872 tubes. This rectifier was located within one of the modulator cabinets. The audio input circuit employed two UV-211 tubes. The plate circuit was coupled by a resistance-capacity network to the grid of the second stage, which also used two UV-211 tubes.

The output of the second stage was transformer coupled to the grid circuit of the third stage, which used two UV-849 tubes. The third stage was transformer-coupled to the grids of the fourth stage, which used two water-cooled UV-848 tubes. The fifth stage, or modulator power amplifier, was divided into two cabinets. Either modulator cabinet could be isolated when necessary. Separate inter-stage transformers were used to drive the modulator grids from the output of the UV-848 tubes. These inter-stage transformers weighed at least two tons each.

The fifth stage, or modulator output, required eight UV-862 tubes. (Figure 80) These were divided into two cabinets and operated in push pull-parallel as a class B amplifier. Two identical modulation transformers were required to develop the 350 kW of audio power to modulate the 700-kW input power of the radio frequency amplifiers. The outputs of the two very large modulation transformers were connected in series to modulate the plate voltage of the three radio frequency final amplifiers. Direct current was blocked out of the modulation transformer secondaries by the use of a modulation reactor and a 50 microfarad, 15,000-V audio coupling capacitor. The reactor was rated at 4.5 Henrys of inductance at 60 ADC. The modulation reactor was similar in shape to the modulation transformers, but weighed only 12 tons.

Because of their rating and size, the two modulation transformers were of enormous interest. (Figure 81) They were rated at 180-kVA each at any frequency from 30 to 10,000 Hz. The transformers were immersed in 725 gallons of oil and, with their cases, they weighed approximately 19 tons each. The elliptical-shaped transformer cases were 11-feet high, seven-feet wide, and 5-feet deep.

A horn gap, with a series resistor, was installed across the modulation reactor. A horn gap is a spark gap designed to self extinguish a high voltage arc. This protected the modulation reactor in case of a loss of excitation [102]. Had this not been done, it was calculated that 60-80kV could appear

**Figure 80.** Three of the eight modulator tubes used in the 500-kW transmitter.

across the reactor. Other protection circuits included the addition of a surge limiting resistor in the plate circuit of each modulator tube to prevent damage to the bias rectifier. These surge-limiting resistors were bypassed with electrolytic lightning arresters.

The normal operating parameters for each modulator were: 11.8-kV of plate voltage and 1.5-A of static plate current for each of the UV-862 tubes, and a bias voltage of -1,400 V. A Westinghouse 0-50 DC Ammeter was mounted on the front of each modulator cabinet and used to monitor the total current drawn by each modulator.

One hundred percent modulation required an audio power output of 350 kW. Interestingly, however, the power input required to 100% modulate the transmitter was only 12.5 mW. In order to increase this input level to the required output level, a power amplification factor of 28,000,000 was realized. The two modulators on the first floor required a total of 238 square feet.



**Figure 81.** The lovely Honey Adams, diminutive star of the "Heatrolatown Gang" series over WLW with Lloyd Shaffer who directs the Heatrolatown Dance Orchestra, inspect the new 500-kW transmitter plant for WLW. In the photograph they are seen next to the giant audio transformers, the largest ever built at that time. Mr. Shaffer is holding in his hand the smallest audio transformer used at WLW. It is less than two inches high and weighs six ounces.



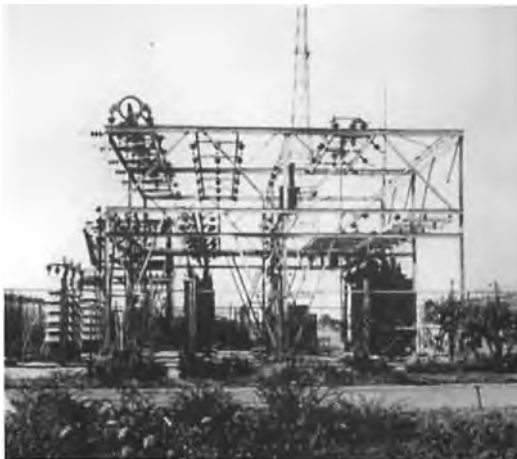
## Power Equipment

All power consumed by the transmitter was supplied from a 33,000-V substation built by the Union Gas and Electric Company of Cincinnati [107]. (Figure 82) Two 33,000-V transmission lines from Oakley and Elmwood supplied the substation with an uninterrupted power source [31]. (Figure 83) All switching was automatic; so if trouble occurred on one line, that line was automatically disconnected from the substation by an oil circuit breaker. Power entered the transmitter building through 2,300-V, 440-V and 220-V underground cables [102]. From the terminal points inside the transmitter building, each cable distributed power to the various motors, rectifiers, and transformers that were essential to the operation of the three radio stations that were located in the building.

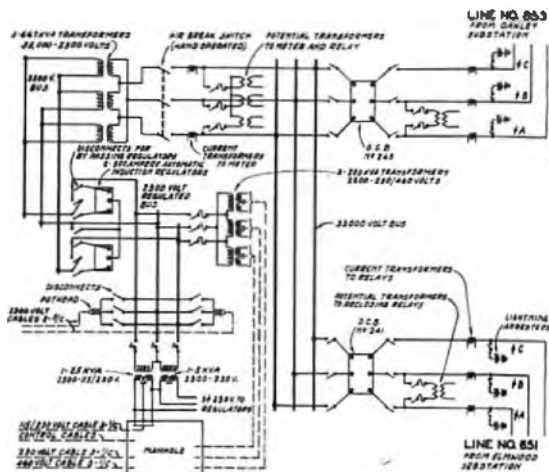
The main rectifier was of great interest and it was probably the most unique part of the entire transmitter installation. This rectifier used six RCA 870 hot-cathode, mercury vapor tubes. (Figure 84) These tubes were developed and specially built for this particular transmitter installation. They were the only tubes of their kind ever built when the transmitter was installed. These tubes were nearly 25 inches long. It was believed this rectifier could easily handle 1250 kW and they had a higher output current rating than any rectifier previously installed to operate at 12,000 V.

The 870 tubes had an indirectly heated cathode, which required 65 A at 5 V single phase. The filament had to be energized at least 30 minutes before applying the plate voltage to insure adequate cathode emission and correct operation of the mercury vapor. A time-delay relay prevented the application of plate voltage until the filaments had been heated for the full 30 minutes. Thermostatically controlled preheated air was supplied to the chamber around the base of each rectifier tube. This insured that the tube would always operate at the nearly constant temperature for which it was designed. During operation, a spare 870 tube was kept warmed up and ready for use to replace any active tube that failed [102]. The total filament power for the seven tubes was 2,275 W, and, to prevent high filament inrush current for the 870 tubes, the filament voltage was applied in two

steps. The peak inverse rating of these tubes was 16,000 V. The maximum instantaneous plate current was 450 A, with the average rating being 75 A. When they were being used as rectifiers in the 500-kW transmitter, these tubes were



**Figure 82.** Outdoor power substation for the 500-kW transmitter, 1934.



**Figure 83.** Circuit diagram of the power substation, 1934.

operating considerably under their maximum ratings.

The high voltage full-wave rectifier used three single-phase transformers. (Figure 85) Each had a rating of 430-kVA and weighed about 7,000 pounds. The 2,300-V primaries could be switched to either a "Y" or "delta" connection by the

operation of two solenoid oil circuit breakers. With the primaries connected in a "Y" configuration, the plate Voltage was 7,000 V and this was used for start-up, tuning and some maintenance periods. A reactor of 0.25 Henry at 125-A was used as a filter in the power supply. It weighed 3,190 pounds and was cooled by 160 gallons of oil. The filter capacitor was 171 microfarads rated at 15,000 V. The capacitor consisted of 114 paralleled 1.5 microfarad Pyranol™ capacitors. To absorb switching transients, a starting resistor was installed in each of the transformer's 2,300-V primaries for a short period and then automatically shorted out for normal operations [102].

Since the rectifier supplied a highly variable load, it had to be designed with a very low internal reactance to keep the plate voltage as constant as possible. This meant that if a fault such as a tube flashover or rectifier "arc back" occurred, the rectifier would supply almost unlimited power to the fault. Safety steps were taken to cut the power to the rectifier immediately after such a fault occurred. A specially developed, high speed, solenoid-operated oil circuit breaker was designed for this purpose. From the time a fault occurred, this circuit breaker would open in an average of a little over 2 cycles of the 60-Hz current.

When plate voltage was applied, all the UV-870 rectifier tubes had a very nice blue glow that would vary in intensity with modulation.



**Figure 84.** 870 mercury vapor rectifier tubes mounted in the rectifier cabinet of the 500-kW transmitter, 1934.

**Figure 85.** 500-kW transmitter plate supply single-phase transformers installed outdoors on the north side of the building. Also shown are the filter reactor and the modulation reactor.



This blue glow added attractive colors to the all black-paneled 55-foot long transmitter.

At times, the UV-870 tubes would arc back, causing a power dip. The local power company and the entire electrical network could tell when this occurred in the big transmitter at WLW. An arc-back was produced when the current in one or more of the UV-870 tubes passed in the wrong direction, causing a huge peak inverse current surge. It was estimated that the peak inverse current surge could be as high as 4,000-A at times.

With the transmitter operating at 500 kW, the normal output voltage from the main rectifier was 11.8 kVDC. The load current would vary from approximately 75 ADC to 110 ADC depending on the modulation percentage and the power drawn by the high-level class B modulator. General Electric meters mounted on the front panel of the rectifier cabinet constantly indicated the power supply voltage and load current. Approximately 175 square feet of space on the first floor was needed for the main rectifier.

*"The completion of the new 500,000-Watt WLW is a matter of great gratification to all of us of the Crosley Radio Corporation. The remarkable engineering achievement involved in the successful design and construction of a radio broadcasting station ten times more powerful than any ever built in the United States and, by far, the most powerful in the world at the present time, is in itself gratifying. But more than this is the gratification coming with the knowledge that with this tremendous increase in power, WLW multiplies many fold its service to the people of America, providing a regular uniform radio service of high quality to thousands, if not to millions, heretofore, with such service."*

The above quote is attributed to Powel Crosley, Jr., President of the Crosley Radio Corporation, April 30, 1934.

**THE CINCINNATI POST, WEDNESDAY, MAY 2, 1934**

**Giant of the Ether**

**WLW To Begin Radio Broadcasting on 500,000 Watt Power Tonight.  
Roosevelt to press key to Open Initial Program**

#### **DEDICATION**

Powel Crosley Jr. had always been a daydreamer. Unlike most daydreamers, however, Mr. Crosley's daydreams had a way of materializing into realities.



**Figure 86.** *Powel Crosley Jr., and Joseph A. Chambers, WLW Technical Supervisor, hefting one of the UV-862 triodes used in the 500-kW transmitter, 1934.*

The realization of one of these dreams came true on the evening of May 2, 1934. On that day the formal dedication exercises for the new, giant 500-kW WLW transmitter were conducted. It was the world's most powerful broadcasting station. Ever since he began experimenting with his first radio transmitter (8CR in 1921), Powell Jr. had envisioned a time of super-power broadcasting.

He slowly developed his daydream over the next 13 years. With his station WLW, he led the way toward super power through successive transmitters of 50-, 500-, 5,000-, 50,000-, and now 500,000-W.

A formal dedication program for the world's most powerful radio station was conducted on May 2, 1934. Except for a half-hour congratulatory NBC program originating from New York at 10:30 PM EST, the entire program originated from the "Hall of Mirrors" in the Netherland Plaza Hotel in downtown Cincinnati [10, 11, 14]. (Figure 86)

President Roosevelt had promised to press a telegraph key at 9:03 PM EST on May 2 to formally open WLW's new 500-kW radio broadcasting transmitter. (Figure 87 and 88)

### **May 2, 1934 The Big Night**

The 500,000-W transmitter had been tested for about an hour, starting at 6:00 PM, to make certain of its operation for the big night.

At 9:00:30 PM the studio announcer said, "This is WLW, Cincinnati, Ohio. We will now shift our transmitter to 500,000 Watts of power."

Chief Engineer Joe Whitehouse, at the control console, turned off the 50,000-W transmitter. Engineer Dick Duncan switched the audio line from the low level Heising modulation of the 50,000-W WLW transmitter to the new 350,000-W high-level modulator. Engineer Bill Schwesinger operated the transfer switch, located on the harmonic filter, to move the 50,000-W transmitter output from the antenna transmission line to the input of the 500,000-W transmitter. Engineer Fritz Leydorf checked the operation of the main line clapper switch. Joe Whitehouse turned on the 50,000-W transmitter, supplying drive to the grids of the 500,000-W transmitter. Les Petry, in the audio room at the transmitter, sent a cue signal to Washington, D.C. and President Roosevelt closed a key at the White House. By direct wire 700 miles away, in Mason, the world's largest radio station started to function. (Figure 90)

The closing of the key by the President inaugurated a six-hour program dedicating the new 500,000-W transmitter. Notables in the world of politics, business, and entertainment flooded the station with congratulatory messages as the big transmitter went into operation.

President Roosevelt, in a message to Powel, Jr., said: *"I have just pressed the key to formally open station WLW. It has been a pleasure to do this. May I take this opportunity to congratulate you and your staff upon the inauguration of this new radio service. I feel certain that WLW will give the people of our country and those of our neighboring nations a service managed and conducted for the greater good of us all."* (Figure 89)

From Rome, Guglielmo Marconi, inventor of wireless communication, cabled Mr. Crosley,

*"It affords me genuine pleasure to be present in spirit at the inauguration of your powerful broadcasting station. You may well be proud of the addition you are bringing to American broadcasting and of your own contribution to the further development of the use of the most powerful and practical means of spreading news, education and enjoyment throughout the civilized world. We cannot but feel more and more united as radio waves encircle our globe, bringing us tidings of friendship and good will."*

Other telegrams were received from John Nance Garner, Vice President; Henry T. Rainey, Speaker of the House of Representatives; Merlin H. Aylesworth, President of RCA; William S. Paley, President of CBS; Albert Einstein; and Senator Clarence C. Dill, long active in radio legislative affairs. Telegrams were also received from many other congressmen, senators, radio executives, and radio and movie stars.

Among those who spoke briefly at the ceremonies, in addition to Mr. Crosley, were Thad Brown, Vice Chairman of the Federal Radio Commission; George White, Governor of Ohio; Russell Wilson, Mayor of Cincinnati; and John L. Clark, General Manager of WLW. Charles Sawyer, Lieutenant Governor of Ohio, was supposed to be toastmaster. However, he asked to be relieved because of the death of his long time friend Colonel William Cooper Procter, former Chairman of the Board of the Procter and Gamble

CONFIDENTIAL - SECURITY INFORMATION  
 CLASSIFIED BY: [redacted]  
 REVIEWED BY: [redacted]  
 DATE: 11/11/01  
 BY: [redacted]

**FEDERAL RADIO COMMISSION**  
 WASHINGTON, D.C.

RECEIVED BY: [redacted]  
 DATE: 11/11/01  
 BY: [redacted]

April 23, 1934.

MEMORANDUM TO MR. STEPHEN EARLY:

Confirming our conversation, the Crosley Radio Corporation respectfully requests that the President press a telegraph key the evening of the 23rd, formally opening their 500 kilowatt radio broadcasting station in Cincinnati, which, incidentally, is the largest broadcasting station in operation in the world. The engineers for this corporation will, of course, make all plans for this ceremony here in Washington, and as soon as they arrive in the city I will refer them to you or any party that you designate to handle the details.

Respectfully,


  
 HERBERT L. TAYLOR  
 Secretary

Figure 87. Letter of authorization to operate the 500-kW transmitter, from the Federal Radio Commission to Mr. Early, 1934.

**Figure 88. President Roosevelt's agreement to inaugurate WLW's new transmitter. 1934.**

Co. Peter Grant, a WLW announcer, assumed the duties of toastmaster for the evening. The invocation was given by the Rev. Carl Olson, pastor of the First Universalist Church of Walnut Hills in Cincinnati.

The dedicatory banquet and ceremony is said to have been the most elaborate ever attempted in radio history. More than 200 people took part in the six-hour program, which required 28 radio engineers to complete. Several entertainers, several orchestras, and a male chorus performed at the hotel for the broadcast. The program continued into the small hours of the morning for the benefit of listeners on the Pacific coast, Hawaii, the Philippines, New Zealand, Australia, etc.

My dear Mr. Crowley:

I have just pressed the key to formally open station WLF. It has been a pleasure to do this.

And may I take this opportunity to congratulate you and your staff upon the inauguration of this new radio service.

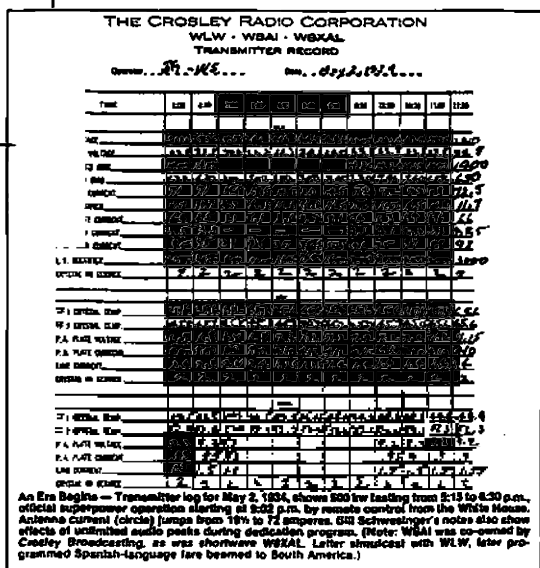
I feel certain WLF will give the people of our country and those of our neighbor nations a service unaged and conducted for the greater good of us all.

Very sincerely yours,

Mr. Powell Crowley, Jr.,  
c/o Station WLF,  
Cincinnati, Ohio

**Figure 89. (Above) President Roosevelt's letter of congratulations to Mr. Crosley, 1934.**

**Figure 90. (Right) Crosley radio station WLW transmitter log from May 2, 1934 showing 500-kW testing and operation. Note BG and WS, Bert Gregg and William Schwesinger.**





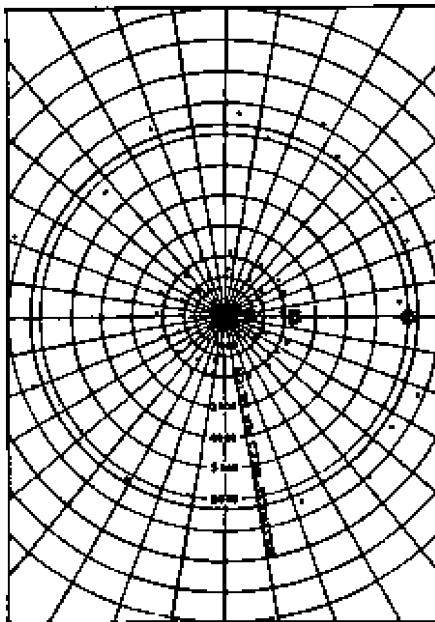
Some of the afternoon programs broadcast prior to the dedication were: Business News, Xavier Cugat, Jack Armstrong, Amos 'n' Andy, Crime Clues, Radio Court, Lowell Thomas, and Orphan Annie, etc. Listeners in rural and remote areas suddenly found these fine programs on their radio receivers and many life-styles were changed after the big transmitter went on the air.

With the arrival of the broadcasting boom, radio became a household necessity, and the commercial use of this medium outpaced its military uses. This required tighter government control, which resulted in the establishment of the Federal Communications Commission in 1934. The Communication Act of 1934 establishing the FCC was signed by President Roosevelt on June 9.

A real problem surfaced in the fall of 1934 when broadcast station CFRB in Toronto, Canada, operating on 690 kHz with a power of 10,000 W, complained about interference from WLW's strong signal at night [86]. Another complaint about interference came from WOR in New York, but eventually this complaint was dropped. (Figure 91)

The Canadian government communicated through the State Department to the Federal Communications Commission on December 13, 1934 regarding the complaint. According to an international agreement ratified by the United States and Canada, all stations must, so far as possible, be operated so as not to interfere with stations within any country subscribing to the treaty. The Federal Communications Commission on December 21, 1934, ordered a reduction in the power of WLW to 50,000 W at night. This would mean that 90% of the available power of the station would become useless during the important evening hours. This action was a terrible shock to Powel Crosley Jr., his company, and the radio world. Crosley Broadcasting resorted to legal action but the Federal Communications Commission action was

upheld in court. Crosley engineers immediately began designing and installing a revolutionary new directional antenna.



**Figure 91.** *Relative field intensities for the quarter wave antenna and vertical tower.*

*Curve A: Field intensity, 50-kW input to horizontal "T" antenna*

*Curve B: Field intensity, 50-kW input to 0.58 wavelength antenna*

*Curve C: Field intensity, 500-kW input to 0.58 wavelength antenna*

## **A Brilliant Job of Radio Engineering**

First, it was necessary to accurately determine the effective signal strength in the Toronto area with WLW operating at 50,000-W. Field strength recording equipment was set up in a cabin near Niagara Falls, New York and a series of recordings were made at all hours of the day and night while the station operated at 50,000 W. Then a second series of recordings were completed while the station operated at 500,000 W. (Figure 93)

Due to the location of WLW and the service it rendered to the community, a conventional directional antenna was deemed to be highly undesirable. A directional antenna that reduced the signal in the Toronto area would produce the same reduction over practically all of the state of Ohio. This would seriously reduce the coverage in some of WLW's most valuable service areas.

The Crosley engineers, therefore, set out to devise an antenna system that would reduce the signal in a given geographical area rather than in a certain direction. This was a distinct advance over previous methods of interference suppression using directional antennas. Due to the characteristics of the  $5/8$  wavelength vertical antenna, the radiation in the horizontal plane served the area for approximately 200 miles, but completely disappeared in Toronto, 400 miles away. [86, 89, 92]

The WLW engineering staff started with the fact that the signal that caused the interference in Toronto left the antenna at an angle of 20 degrees above the horizon. Refracted by the ionosphere, these signals were returned to the earth at approximately 400 miles from the antenna, depending upon the height and stability of the ionosphere. It was decided to suppress the signal at the vertical angle in the direction of Toronto. The engineers hoped to avoid suppressing the signal at any other angle or direction.

The problem was solved by the installation of two additional vertical suppressor antennas. They were fed with 85,000 W of power and spaced at a carefully calculated distance from the main antenna so that the signal strength was reduced at the required angle. (Figure 92)

The final design used the 831-foot main antenna and two symmetrically placed quarter wave suppressor antennas, each 326 feet high. The suppressor antennas were separated by a distance of 702 feet (one half wavelength). They were phased together so that the signal produced was a "figure eight," with its long axis pointing in the direction of Toronto. An imaginary line between these two suppressor antennas was located 1,850 feet behind the main antenna, which gave a space phase of 474 degrees. The current in the suppressors lagged the current in the main antenna by a time phase of 96 degrees.

Construction of the suppressor antenna towers was difficult and dangerous due to the induced radio frequency current from the nearby 500,000-W transmitter. For this reason, all of the steel tower sections had to be hoisted into place with rope and tackle. Members of the engineering department had to attach a flexible ground wire to each piece of steel as it was lifted into place. Without these grounding wires, the tower construction workers could not touch the steel pieces without receiving an RF burn. The cost of the suppressor array amounted to nearly \$30,000.

Field test measurements conducted within the affected area by Crosley engineers and the Federal Communications Commission indicated that the

**Figure 92.** The WLW suppressor towers in the foreground provided directivity and reduced the signal strength in areas where interference was a problem, 1934.



interference had been eliminated. The tests showed that the signal strength at 500,000 W with the suppressor array in service was nearly the same as the 50,000-W signal strength without the suppressor array. As a result, the Federal Communication Commission approved WLW's return to normal operation at 500,000 W on May 9, 1935. (Figure 94)

This pioneering step in the development of the technical science of radio broadcasting was the first successful commercial attempt to obtain both horizontal and vertical antenna directivity. It was another brilliant achievement on the part of the Crosley Radio Corporation.

With the 500,000-W transmitter now back on the air, and with its large coverage area, Crosley products became more evident throughout the United States and in some foreign countries.

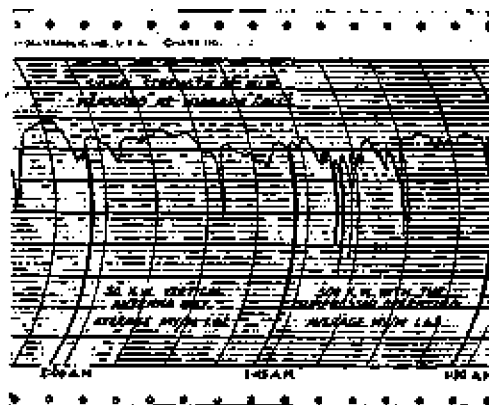
Each time there was a power increase at WLW, the number of Crosley distributors and dealers would also increase. More power led to more distributors which led to more dealers and more sales of Crosley products. Some of the local Crosley dealers had their own ideas about how to increase sales and they used them to help promote Crosley products. Dealer window displays were a very popular form of local advertising during the 1930s. (Figure 95)

Another Crosley motto was: "Make Every Day Count - Concentrate on Crosley."

*The Crosley Radio Weekly*, *The Crosley Radio Broadcaster*, and *The Crosley Broadcaster* were publications promoting Crosley radios, refrigerators and other Crosley products. Crosley distributors and dealers depended on these publications for new product descriptions, technical articles, local advertising ideas, the exchange of dealer ideas, and WLW programming, etc.

Powel Crosley, Jr. said, "It goes without saying that two legs are better than one." Crosley radios and refrigerators were ideal teammates; one helped the other in sales. Owners of Crosley radios remembered the splendid service that came with those products. Therefore, Crosley Shelvador refrigerators were chosen by many Crosley radio owners when they were purchasing a new refrigerator. Likewise, a satisfied Crosley Shelvador owner often concluded that a Crosley radio would measure up to the same standard of quality as his refrigerator [11].

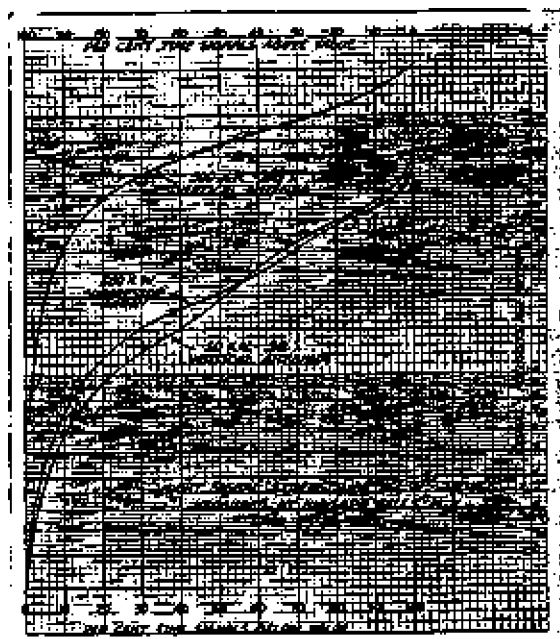
Another Crosley motto was: "Wherever there is praise, there is profit."



**Figure 93.** On this chart are successive records of the field strength measurements of WLW at Niagara Falls, New York transmitting at 50-kW power and transmitting at 500-kW using the suppressor antennas. Note the night signal strength measurements with 500-kW power using the suppressor antennas is practically the same as with 50-kW using only the vertical radiator.

Even after the stock market failure of Tuesday, October 29, 1929, competition for radio sales continued to increase through the 1930s. During this period, however, many smaller radio manufacturers went out of business. These included Doron Brothers, located in Hamilton, Ohio, and Kodel in Cincinnati. There remained more than 50 major radio manufacturers in the United States in the early 1930s. RCA, Philco, Montgomery Ward, Sear-Roebuck, Emerson, General Electric, and Zenith were Crosley's largest sales competitors.

As in the past, Crosley continued to be successful in meeting the competition during the 1930s. He manufactured radios that sold for an affordable price and many people soon came to have more than one radio in their homes. Radios were also used in automobiles, at the office, and they were even taken on vacation. Special radios, powered by wind chargers, were used on farms where there was no electricity.



In the 1930s, radios took on a more modern look and incorporated important new design features for excellent performance. Various models contained one or more of these features: a range switch for broadcast

**Figure 94.** These curves show the relative field strength measurements of the signals at Niagara Falls from WLW using 50-kW, using 500-kW, and using 500-kW as modified by the suppressor towers, as well as the range of variation of the three, 1934.

band and short wave listening from 1500 kHz to 18,000 kHz, an automatic volume control, a push-pull or triple-twin audio output, a neon tuning indicator, an airplane or other unique types of dials (some illuminated), a mystic hand for automatic tuning, various high fidelity and tone controls, remote speakers, permanent magnet and electro dynamic speakers, metal and glass tubes, static controls, and power supply noise filters, etc. The receivers in the early 1930s used the neutrodyne circuit, but after 1932 most receivers were superhetrodynes.

### **The Modern Radio is Ear Conditioned [11]**

In 1934, the price range for Crosley receivers ran from \$18.50 for the Travo model AC-DC superhetrodyne to \$120 for the Dual Fourteen, 14-tube radio. Most of the 1934 radios were sold in the price range of \$30 to \$60. This was very competitive pricing with respect to the other manufacturers.

The price range for the 1937 models ran from \$19.99 for the Crosley Fiver to \$174.50 for the Crosley model 1516 console that had 15 tubes and a 15-inch speaker. Most of the nearly 40 models of the 1937 radios were sold in the price range of \$35 to \$70. From 1921 to 1940, Crosley manufactured more than 400 different models of his receivers.

Crosley introduced the "ultimate" in radio receivers in 1936 [39]. Because of its great size and power, it was named the "WLW Super-Power Model" by Powel Crosley Jr. (Figure 96) It was a deluxe model 37-tube receiver, equipped with six speakers and other features that placed radio reception on a level never before attained. In addition to the basic radio receiver, it was also provided with a public address system. Tuning was continuous from 540 kHz to 18,300 kHz using three bands. It had an audio output power of 50 - 70 W. One speaker was 18-inches in diameter to reproduce the bass or low frequencies, two more speakers handled the middle range audio frequencies, and three more provided the high audio frequencies. Four separate chassis were required for arrangement of the circuits which used all metal tubes. The audio frequency response was from 20 Hz to 20,000 Hz. The set was crammed with features such as a bass compensation

control, a six-step tone control, and a separate volume control for each different audio range; bass, mezzo and treble. It had a 12-inch airplane type tuning dial, automatic tuning, and other features developed by Crosley engineers.



**Figure 95.** In 1929, this combination thermometer/hygrometer was sold to Crosley dealers for their showrooms. This was one of many items, such as neon signs, banners, and clocks, etc. used by dealers to display the Crosley name. This one sold for \$12.

The cabinet stood four feet ten inches high, 42 inches wide and 22 inches deep. The complete radio weighed 475 pounds. The cabinet was a masterpiece of woodwork, surpassing the capacity of words to accurately describe it. The list price was \$1,500. The order for the first WLW Super Power receiver was placed by Wheless Gambill, President of the Gambill Distributing Co. Gambill was the Crosley distributor in Nashville and Chattanooga, Tennessee.

## Chapter Nine

### The Other Crosley Products

Powel Crosley Jr. was very aware of the uncertain climate of the radio receiver business in the late 1920s. He decided to concentrate in two areas; increasing the coverage area of WLW and manufacturing refrigerators. Crosley had manufactured a refrigerator called the Icyball in 1927 [35]. (Figure 97 and 98) These thermal type units required no gas or electricity for operation. They were popular in remote areas of the United States and the world, but were impractical in areas that had electrical power due to the complex daily ritual necessary to keep them cold. The Icyball was manufactured, advertised, and sold throughout the 1930s. There was still a great potential for Icyball sales in 1936 as 10,000,000 homes in the U.S. still did not have electricity.

The freezing unit consisted of two special metal balls joined together by a strong metal tube. The smooth ball was the cold ball, and the ball with fins was the hot ball. These hermetically-sealed balls contained ammonia, a harmless liquid refrigerant. The icyball required daily regeneration. To do this, the cold ball was submerged in a tub of water while the hot ball was heated, most commonly by a kerosene heater. (Figure 100) The hot ball was "cooked" for about 1.5 hours to force the refrigerant into the cold ball, which was then placed inside the Icyball cabinet. The refrigerant gradually vaporized and returned to the hot ball while simultaneously cooling the cold ball. This action kept the inside of the Icyball cabinet uniformly cold. It was suggested that the Icyball always be heated in the morning to keep it coldest for daytime use. Heating of the hot ball required approximately a pint of kerosene at a cost of about 2-cents a day for the kerosene.

The Icyball was also made in a double unit for restaurants and stores, etc. (Figure 99) These



**Figure 96.** The Crosley "WLW Super Power" deluxe 37-tube radio receiver from 1934.

units created some humor since some law enforcement officials thought they might be used as stills to produce alcoholic liquors. A form of Icyball refrigeration is still being used in the 21st century in remote areas of the world.

Publicity in late 1931 indicated that Crosley would soon manufacture an electric refrigerator, and it was introduced just before Christmas sales began to pick up in December, 1932. (Figure 101) The advertising theme was centered around the idea that the average family could now enjoy the advantages of an electric refrigerator. Three models were introduced with prices ranging from \$89.50 to \$139.50. Crosley concentrated on the electric refrigeration market in the spring and summer when radio sales were normally down.

In January of 1933, the Crosley Shelvador refrigerator was introduced [36, 95]. This one appliance contributed greatly to the profits of the company over a period of many years. Crosley was noted for taking time to talk with any inventor, tinkerer, or gadget maker who wanted to discuss his ideas or inventions. One day in 1932, a young man who wanted to sell the rights to an idea came to see Powel Jr. He had patented the idea of placing shelves on the inside of the door of a refrigerator. Crosley liked the idea and believed it would increase sales of Crosley refrigerators. Powel Jr. offered the young man a twenty-five cent royalty on every refrigerator Crosley would make with a shelf on the inside of the door. The young inventor wanted \$15,000 and would not listen to Crosley's advice regarding the royalties (which would have made him rich). Crosley even offered the young inventor a combination of cash and royalties but again, he refused. Powel Jr. finally wrote him a check for \$15,000.

The Crosley Shelvador refrigerator was an instant success. (Figure 102) Many thousands of units were sold in the next few years. Other refrigerator manufacturers were forced to wait years until the Crosley patent rights for the shelf-in-the-door idea had expired. The Crosley Shelvador

became one of the most popular household appliances in America and increased the Crosley profits to new heights.

Other models of refrigerators that Crosley sold in 1933 for home and business use included the Kool-Rite (Figure 103) and the Kool-Draft beer dispensers. (Figure 104) A few years later the Crosley Koldrink electric bottle cooler was introduced [37]. (Figure 105)

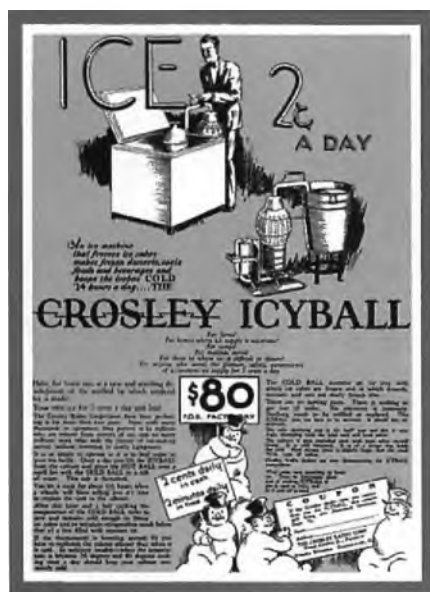


Figure 97. Crosley Icyball Refrigerator advertisement.



**Figure 98. Single unit Crosley Icyball Refrigerator, 1928-29.**



**Figure 99. Double unit Crosley Icyball Refrigerator, 1928-29.**

By 1936, Crosley was also manufacturing electric washers (Figure 106) and ironers which went by the trade name of Savamaid. (Figure 107)

In the line of least resistance, one Crosley dealer remarked, "*It is better to sell Crosley products than to compete with them.*"

At the peak of the Great Depression, Crosley was also manufacturing many other products. These included an electric bug killer, an ozone generator for use as a deodorizer, a furnace oil burner, kitchen cabinets, a physical exerciser,

(Figure 108) and a space heater that was thermostatically controlled and called the TEMPERATOR [38]. His other products included a camera, motor scooter, wind charger, head set for radio reception, ice cube generator, copper oxide rectifier, and a moisture meter, as well as antennas, wet electrolytic capacitors, and fishing tackle, etc. In the 1930s, Crosley's largest volume of business was attributed to radio broadcasting, radio receivers, and refrigerators.

### *The Ideal Stove For Heating The Crosley Icyball*

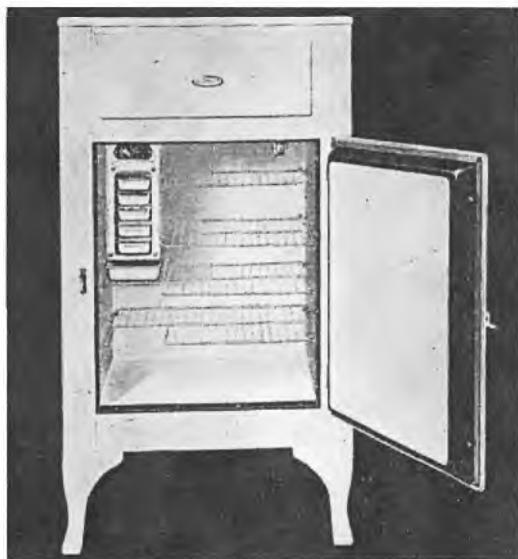


**Big Demand For Kerosene Burning Perfection Crosley Icyball Heater--Model 151**

To insure the most ideal service from the Crosley Icyball Refrigerator, it is important that the unit be heated according to directions. The ideal means of heating the Crosley Icyball unit, where gas is not available, is the kerosene burning Perfection Icyball heater shown above. This heater has been developed by the Perfection Stove Co., of Cleveland, Ohio, under the guidance of suggestions made by Crosley engineers, and is endorsed by The Crosley Radio Corporation as the most ideal kerosene heater for heating the Crosley Icyball. The Perfection stove, Model 151, is sold through your Crosley dealer. Prices are as follows:  
 Heater without stand, \$8.00  
 Heater with stand, \$10.25  
 Stand alone, priced in lots of eight \$1.97 each.

**Figure 100. Ideal Stove used to heat the icyballs to prepare them to continue cooling the Crosley Icyball refrigerators, 1928-29.**





**Figure 101.** *Crosley Model C-55 Refrigerator, 1932.*

Probably the first side product that Crosley made was the Go-bi-bi, a scooter for little tots who were too young to walk. (Figure 109) This scooter was made primarily from scrap lumber that could not be used by the woodworking shop for phonograph and radio cabinets. The Go-bi-bi was sold to a Mr. Taylor in 1925, and he eventually changed the name to Taylor Tot [47, 79].

Crosley's interest in aviation was almost as well known as his interest in broadcasting and manufacturing radios. He became president of the Crosley Aircraft Company of Cincinnati in the late 1920s. This was a private venture that concentrated on the development of radio equipment for aviation use [44].

In 1927-28, there was a flurry of activity in building airplanes [94]. Powel Jr. built a plane called the Moonbeam in one of his radio manufacturing buildings on the north side of Cincinnati. (Figure 110) Crosley eventually built five planes that were never fully certified and the selling price was never established because of the stock market failure in October of 1929. Experimental work continued for about a year, until it became evident to Crosley that he could not build airplanes as successfully as he could build radios.

By May, 1929, Crosley had acquired 193 acres in Sharonville for a flying field. It became known as the Crosley Airport and was used by private airplanes. Another airplane, called the Crosley Flea, was built at the airport by Crosley's pilot. This airplane was assembled in 1934 in a large hanger that Crosley had



**Figure 102.** *Crosley Model D-60 Shelvador Refrigerator, 1933.*



**Figure 103.** (Above) *Crosley Kool Rite Cooler, 1933.*



**Figure 104.** (Left) *Crosley Kool-Draft Cooler, 1933.*

constructed at the airport. It was supposed to be the affordable airplane for the common man. Planes of similar design experienced a series of crashes in Europe, however, and the Bureau of Commerce, forerunner of the FAA, grounded the plane. It was never flown again. From the late 1920s until 1941, Crosley traveled in at least 13 different aircraft. These included the Moonbeam, Waco, Lockheed-Vega, Sikorsky, Grumman Goose, Fairchild 45, etc.

The Crosley Airport property was sold to the Ford Motor Company in the 1950s for the construction of a transmission plant, which is still in operation in 2003.

Powel Jr. used small planes, including the Moonbeam, for short trips to his farm in Indiana and for business trips to the larger cities in the Midwest. The Grumman Albatross was a larger amphibian plane that had the capacity to carry eight passengers. This plane was used for longer trips (such as Florida and Canada) to save time. Powel Jr. had a personal rule that he would not be away from the office for more than two weeks at a time. However, he made exceptions for a houseboat trip and a family vacation to Europe which each exceeded two weeks.



**A Plus PROFIT WINNER!**

Many stores and other places in your neighborhood are in need of efficient, dependable, economical beverage dispensing equipment. Crosley leads everywhere are looking the road to extra profits by supplying the need with the new Crosley Koldrink Electric Bottle Cooler. It is used in every way by restaurants, drugstores, hotels, roadside service, summer camps, grocers and other retailers of bottled beverages. Also of particular value to the small drugstore. Get behind the Koldrink now—you will be surprised at the extra profits \$99.95 realized you.

AVAILABLE IN RED OR GREEN

**CROSLEY KOLDRINK**  
ELECTRIC BOTTLE COOLER

**Figure 105.** *Crosley Koldrink Cooler, 1933.*



**Figure 106.** (Left) *Crosley Model 63 Savamaid Washing Machine, 1936.*

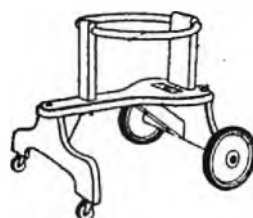


**Figure 107.** (Right) *Crosley Model 60 Savamaid ironer, 1936.*



**Figure 108.** (Left) *Crosley Autogym exerciser, 1929.*

## *The Go-bi-bi*



**PRICE, \$3.50**

Your little baby just naturally wants to "Go bye-bye". Nothing contents him like being "on the move". The GO-BI-BI gives to the child the needed exercises to teach him to walk and give him a hearty appetite and good digestion. It keeps him off the floor, clean and away from drafts. The GO-BI-BI amuses the baby by the hour and relieves the mother of much care.

The GO-BI-BI requires a floor space of only 16x18" and the seat is 8" high. It is white enameled finish with red rubber-tired wheels. Price \$3.50 postpaid anywhere. If not found in the Infants' or Toy Sections of your stores, write to

**CROSLY MFG. CO.**

**Cincinnati, Ohio**

**Figure 109.** (Right) *Crosley Go-bi-bi scooter, 1922.*

Powel Crosley Jr. never had more than a student pilot permit [94]. He took off, flew, and landed planes, but always accompanied by a licensed pilot because he did not want to spend the time to earn a pilot's license. In the late 1920s, Powel Jr. used smaller planes such as the Waco and the Moonbeam for advertising. The Crosley name, painted on the wings, could be seen from a great distance. (Figure 111) Photographs of the Crosley airplanes appeared in *The Crosley Broadcaster* as well as other radio publications, newspapers, and magazines [11]. This type of advertising was continued into the 1930s when Crosley purchased a Wasp-powered, Lockheed-Vega high wing monoplane. (Figure 112) This plane, known as the "New Cincinnati," set a round trip transcontinental record of 31 hours and 58 minutes with Captain Brock as the pilot. The plane was entered in the National Air Races and carried a receiver and a 150-W transmitter which operated on 457 kHz. The call letters of the flying transmitter were KHILO. At 6,500 feet in the air, with Robert Brown as the announcer, a half-hour program was broadcast on the local frequency. This program was picked up and rebroadcast over WLW.



**Figure 110.** *Crosley Moonbeam airplane, 1927-28.*

The Crosley airplane took part in other National Air Races. One such race between Los Angeles and Chicago was won by Wiley Post with a time of 9 hours and 9 minutes. The New Cincinnati finished in fourth place, perhaps due to carrying the additional 765 pounds for the transmitter and the announcer.

When the racing season was over, the plane took part in the National Air Tour for the Edsel B. Ford Trophy. Broadcasts were made from the plane during the International Balloon Races in Cleveland which were held to determine the winner of the Gordon Bennett Trophy. During the National Air Reliability Tour, the New Cincinnati visited more than 30 cities in the United States and Canada.

While the plane was in the air, a running account of the races, tours and special broadcasts could be picked up by radio stations along the route and rebroadcast. Thus, for the first time, it was possible for radio listeners to hear what was happening in an airplane during a record-breaking flight and other flight-related activities.

The New Cincinnati established three firsts in the records of aeronautics; the first broadcast from a racing plane, the first broadcast of an International

**Figure 111.** *Crosley advertising airplane, 1924.*

Balloon Race from the air, and the first broadcast of the National Air Reliability Tour from a flying radio station.

Unprecedented levels of publicity enhanced the prestige of the Crosley products each year that Crosley participated in these aeronautical events. Again, this was another way that Powel Jr. continued to be known as a genius in advertising. Of course, the New Cincinnati had large Crosley letters on its exterior so nobody who saw it could mistake what company was sponsoring it.

In 1928, Powel Jr. and Gwendolyn Crosley started construction on a 21-room mansion in Manatee County Florida on the pristine Sarasota Bay. (Figure 113 and 114) When it was finished in 1929, it was named "Seagate." For many years, Powel Jr. and his family, friends, and business associates traveled by airplane from Cincinnati to Sarasota Bay to vacation at the mansion. One airplane used by Powel Jr. was a Douglas Amphibian Sikorsky, which he named "Lesgo." In 1933 this plane covered the distance of 825 miles from Cincinnati to the Sarasota Bay in the record time of six hours and 40 minutes. The house was used regularly until Gwendolyn died on February 26, 1939. After her death, Powel Jr. used the house infrequently.

The Crosley boat dock which was used for the Crosley yacht named the "Sea Owl" was located near the mansion. Powel Jr. donated his luxury yacht to the Coast Guard at the beginning of World War II.

In August 1991, the Manatee County Commissioners paid \$1.57 million for the mansion, 16.2 acres of land, and the harbor. The mansion had been vacant for 15 years. The Florida Board of Regents agreed to purchase the remainder of the 44-acre estate for the University of South Florida at Sarasota. The property is on the border of Manatee and Sarasota counties and is located next to the John and Mable Ringling Museum of Art.



**Figure 112.** *Crosley "New Cincinnati" Lockheed-Vega airplane, 1930.*



**Figure 113.** *Seagate, the Crosley mansion in Manatee County, Florida, 1928.*

With the help of the Crosley Foundation and other fund raising activities, the exterior and interior of the mansion are being restored. Special

events and tours of the mansion and grounds began shortly after the county acquired Seagate.

In 1936, several other stations began applying for super-power operation, like that of WLW's 500,000-W transmitter. WHO in Des Moines, Iowa was one of the stations that applied. In 1938, the United States Senate adopted the "Wheeler" resolution which stated that it was the sense of the Senate that allowing more stations to operate with power in excess of 50,000 W was against public interest.

Since an experimental license had to be renewed every six months, the operation at 500,000 W could become a political problem. Regional and local stations protested against the super power of WLW and other super power applicants on economic grounds. They alleged that more super-power stations would result in the degradation of smaller stations to mere local status, which would eliminate their national business.

WLW, with its extended coverage provided by its exclusive 500,000-W operation, was very vulnerable. In the Federal Communications Commission hearings, accusations were made that Crosley had deleted news of Ohio valley strikes and other personally distasteful events from his broadcasts. He was also accused of denying broadcast time to certain politically active individuals. One Senator said that he "understood" WLW to be under the sway of "powerful business interests." These charges were denied.

The FCC ordered WLW to reduce power to 50,000 W after one of the hardest-fought legal battles in radio history. Crosley appealed the FCC's decision. At 5 PM, February 28, 1939, the United States Court of Appeals heard oral arguments on the plea for a restraining order to allow operation to continue with 500,000 W during the time of appeal. For an hour, the Court heard arguments between the FCC and the WLW counsel. Shortly before 7 PM it was announced that the stay was denied [6]. This was just a few hours before the FCC's order reducing the WLW power to 50,000 W was to become effective. Following the court order, WLW reduced its power to 50,000 W at 3 AM on March 1, 1939. This was only eight hours after the court ruling. WLW still had authorization to broadcast experimentally with 500,000 W during the early morning hours before dawn, using the call letters W8XO.



**Figure 114.** *The northeast corner of Seagate, the Crosley mansion in Florida.*

Shortly after the plea was denied, a simple statement was announced on WLW: "Stay Refused, WLW Returns to 50 kW." [100]. The WLW 500,000-W transmitter had been in use for nearly 4 years and

10 months before the FCC ruling went into effect. From 1939 to 1943, the transmitter was used experimentally each night after midnight with the call letters W8XO. In 1943 it was shut down permanently. One reason the transmitter was operated on the air regularly was to ensure that it would be able to inform a large part of the American population in the event of a national emergency during World War II.

When the powerful transmitter was forced to shut down, it broke Powel Crosley's heart and was a severe disappointment to him. He lost interest in broadcasting and became more active in the manufacturing of his other products, such as cars and appliances. He also took more interest in his ownership of the Cincinnati Reds.

Major league baseball was struggling to survive through the great depression. Especially hard hit were the Cincinnati Reds. With a population of only 450,000, the team was located in the smallest major league city in the country. The Reds had been purchased in September, 1929 by Sidney Weil, a Cincinnati native who had been very successful in the automotive business. One month after the purchase, he fell victim to the stock market crash of October 29, 1929. He retained control as long as possible but finally turned the operation of the team over to the Central Trust Company of Cincinnati.

Larry MacPhail, [87] an executive who had been very successful in the operation of the Columbus, Ohio American Association team, was brought to Cincinnati by Central Trust to revive the Cincinnati Reds. MacPhail convinced Powel Jr. that baseball's first professional baseball team should not be moved from Cincinnati and could be made into a very respectable and profitable team in a short time. In 1934, Powel Jr. purchased control of the Cincinnati Reds. (Figure 115) His ownership of the Cincinnati Reds was another aspect of his life that had a major impact on the city he loved. In a short time the stadium and its facilities were upgraded; and on April 16, 1934, its name was changed from Redland Field to Crosley Field [13]. Powel Jr. had joined forces with the energetic and visionary General Manager Larry MacPhail to rescue the Reds, and in the process they transformed baseball.

The Reds had averaged only 2,700 fans per game in 1934. MacPhail told Crosley that his Columbus team had higher attendance, but added "Of course we played under the lights." Always thinking about advertising, Crosley asked, "Why can't we put lights in Cincinnati?" MacPhail replied, "Oh, that's out of the question." Crosley persisted, "Is there a rule against it?" MacPhail replied, "No, but ..." Crosley immediately replied "Why don't we try?" [1] MacPhail agreed that evening, knowing that baseball could provide desperately needed revenue.

At the National League winter meetings in December 1934, Larry MacPhail presented the idea of night baseball at Crosley Field on a limited basis of seven night games a year. The dignified baseball executives opposed the idea until MacPhail promised, "*Give me seven night games a year, one with each opposing club, and I will give you seven additional Sunday crowds.*" The executives, thinking of higher profits, decided this idea would help the Reds compete with larger cities in the hiring of playing talent. The resolution was adopted unanimously. However, there was a restriction against night games on Saturdays, Sundays, and holidays. Visiting teams would also have the right to refuse to play at night, and any team that played more than seven night games would be penalized by the league office [1].

There was considerable opposition to night baseball, especially in the American League. Connie Mack, owner and manager of the Philadelphia Athletics, was very outspoken and considered "after-dark" baseball a circus. Four years later, on May 16, 1939, his team was the first American League team to have night baseball games [2]. At the end of 1940, ten of the eighteen major league teams had lights for night baseball, an innovation that increased the number of fans who could regularly enjoy the game.

The first major league night baseball game was played at Crosley Field on May 24, 1935 [2]. Prior to the game, there was a celebration which included short talks, celebrities, and fireworks that lit the sky and hurt the ears. Once again, Crosley asked his friend President Franklin D. Roosevelt to "press a button." This action turned on the lights for night baseball and launched a new chapter in baseball history. The Reds were winners over the Philadelphia Phillies 2-1 with 20,422 fans in attendance [3, 13]. The fans and players marveled at the 632 bright lights, mounted on



**Figure 115.** *Powel Crosley Jr., owner of the Cincinnati Reds, at the ballpark with Fred Hutchinson, the Cincinnati Reds' manager from 1959 to 1964.*



eight towers, which illuminated the playing field. For the next seven night games, the Reds' attendance averaged 18,000 fans, while day games averaged just 4,600 fans. Another first at Crosley Field was the installation of vertical screens attached to the left and right field foul poles. The screens helped to determine whether a batted ball was fair or foul since a ball that hit the screens was judged to be a fair ball. This reduced number of arguments and similar screens were soon installed at other major league baseball fields.

Powel Crosley Jr. became a real fan of baseball [95]. He attended games, traveled with the team, and employed management people who are now legends in baseball: Larry MacPail, Warren Giles, Chuck Dressen, Bill McKecknie, and a young announcer Red Barber. Originally, Powel Jr. had no inclination or desire to become involved in baseball other than to keep the team in Cincinnati. Later his involvement as owner grew. He attended meetings but gave his management staff a free hand and respected their judgements in the operation of the Reds. He also wanted his players to be good representatives of the city. In five years, with the addition of new players and an active farm system, the Cincinnati Reds improved from last place to winner of the National League pennant in 1939. They went on to win the World Series in 1940.

Cincinnati and Crosley Field were the hosts to the sixth annual All-Star game on July 6, 1938. The National League won 4-1. There were five Cincinnati Reds players on the team: Ernie Lombardi, Paul Derringer, Ival Goodman, Frank McCormick and Johnny Vander Meer.

Powel Crosley Jr. died in March 1961, but he will always be remembered for his determination to promote and keep major league baseball in Cincinnati.

Another Crosley motto was: *"Doing it first, that's Crosley."*

Powel Crosley Jr. was always aware of his appearance in his business and leisure time activities. The loss of his hair disturbed him. In his late

40s, he conceived the idea of a mechanical apparatus to stimulate the blood vessels of the scalp. (Figure 116) He had read in some scientific reports that cycles of alternating vacuum and pressure applied to the scalp area promoted hair growth. In November, 1936, the Xervac was introduced. It was advertised as the answer for hair loss and other abnormal conditions of the scalp, due to lack of circulation in the scalp blood vessels. These machines came with a helmet to be placed on the head to apply the alternating pressure and vacuum to the scalp. (Figure 117) The normal treatment lasted at least 30-minutes.



**Figure 116.** Crosley Xervac hair growth stimulator, 1936.

Most of the Xervacs were purchased by distributors who rented them to barber and beauty shops. At \$2.00 a treatment, these hair-growing machines became very popular and they were valuable in promoting the barber and beauty shop business. After a short time, the Xervac proved to be a failure and the most embarrassing product Crosley had ever produced. It became the object of a Federal Trade Commission lawsuit shortly after its introduction. As a result, Xervac production ceased and some Crosley credibility was lost. However, Powel Jr. had faith in the Xervac and he continued to use one every morning for a number of years as his hair loss progressed.

In 1939, Crosley introduced another product that did not sell as expected. This was a facsimile machine called the READO. (Figure 118 and 119) A complete kit to build the printer was offered for \$49.95. Crosley believed that experimenters and amateur radio operators would enjoy building the machine and then receiving printed information over the radio. The Reado printer operated under the William Finch system of facsimile. Finch had become interested in facsimile machines in 1920. By 1935, he had received 200 patents while working for William Randolph Hearst's International News Service. In 1935, Finch formed his own company to sell his facsimile system.

The Reado could receive and print information broadcast by radio stations. Crosley believed that one day the Reado could replace the daily newspaper. Crosley had a license to manufacture and sell these printers. Crosley engineers developed several additional features for the printer. In 1939 and 1940, at least 13 radio broadcast stations were equipped to transmit facsimile using the Finch system. WLW and W8XO were transmitting facsimile information during the experimental period from midnight to 6 AM. These broadcasts on, 700 kHz, also included weather forecasts, news reports, etc.

The transmission of facsimile was allowed on the normal broadcast band, 530 to 1570 kHz, from midnight to 6 AM. Some stations were also licensed to transmit facsimile during the day on frequencies from 25 to 47 MHz [4]. Crosley had an experimental facsimile transmitter, W8XUJ, on 26 MHz; but this was soon abandoned for lack of response.

Crosley manufactured and sold the Reado Printer model 118 and Reado receiver model 758-A. He also sold accessories such as a time clock and paper for the printer. The received message or picture was printed on paper 4.5-inches in width. The printing of a one-hour message required nearly three feet of paper. The Reado receiver was a Crosley design that could be used for normal broadcast reception. Special automatic features made it possible to

## XERVAC

CAN NOW BE  
RENTED

For Home or Professional Use

The Xervac has been accepted as a new pattern treatment for falling hair and other abnormal conditions of the scalp due to lack of circulation in blood vessels of scalp.

From time to time, test-treatments and before-and-after photographs come in to us. These unretouched photographs are apparently of men whose abnormal scalp conditions have resulted from the need of increased circulation of blood in the depressed blood vessels of the scalp. Some of these photographs are reproduced herewith. The originals are kept in our files.





### WHAT IS THE XERVAC?

Crosley Xervac is a mechanical apparatus employing the principle of Mechanically Controlled alternating VACUUM and PRESSURE to stimulate the blood supply in the blood vessels of the scalp. Science has shown that certain cycles of alternating vacuum and pressure are correct for range on the human scalp.

Crosley Xervac provides a scientific treatment for hastening the recuperation of the scalp and promoting hair growth in those cases which are subject to increased circulation.

If You Are Interested in Renting an XERVAC, Write to XERVAC division of The Crosley Corporation, Cincinnati, O.

Figure 117. Crosley Xervac hair growth stimulator advertisement, 1936.

use the Reado receiver with the Reado printer. The receiver would also tune from 24 to 47 MHz for facsimile and normal shortwave reception.

For years, Powel Jr. invariably used the Xervac every morning to stimulate his scalp while reading or listening to the news. He received the news and weather reports from the Reado tape or by listening to WLW with a Crosley radio. He believed in using his own products.

Powel Jr. never lost his love for automobiles, even when he was devoting much of his time to the development of radio and his other business activities. As a young man, Powel Jr. made four attempts to enter the automobile industry, with only one attempt actually producing cars. In 1907, he designed a six-cylinder car he named the Marathon Six. However, the car never sold because of the 1907 Wall Street panic [87].

In the late 1930s, following his other business successes, Powel Jr. now had the resources to again enter the automobile industry [22]. On September 18, 1938, the Crosley Radio Corporation name was changed to just the Crosley Corporation. The elimination of the word "radio" from the name was an indication of a change in focus from radio to the automobile industry. Seven months later, on April 2, 1939, Lewis Crosley announced plans for a Crosley car. The car sold for \$395, and was a two-cylinder coupe with the rear wheels spaced only eighteen inches apart. A few of the cars were built under the name "Crad" but they were not popular [15, 99]. (Figure 120)

By the end of April 1939, several of the Crosley cars were shown at the Indianapolis Speedway. These cars all had the normal wheel spacing with both rear and front wheels spaced the same distance apart. The two models included the convertible sedan and the convertible coupe. (Figure 121) They sold for \$350 and \$325 respectively. Both models were powered by a two-cylinder Waukesha engine and came in two exterior colors: Crosley blue and Crosley gray. A cream color exterior could be ordered at an additional cost. The only gauges supplied were the speedometer and the fuel gauge. The cars were displayed at the Crosley Pavilion at the New York World's Fair in 1939 along with other Crosley products. Crosley mass produced 2,017 cars in 1939 at Richmond, Indiana. These 1939 cars were known as the Crosley Model A [15].

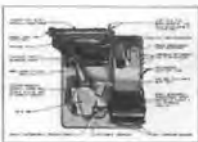
Prior to World War II, Crosley introduced three other automobile models but sales were lower than expected. Production slipped to 422 cars in 1941. The post-war models of the cars were an entirely new design and some were assembled in Marion, Indiana. The cars were very fuel efficient, and this helped them to produce a small



**Figure 118.** *Crosley Reado radio facsimile kits, 1939.*

Fully appreciative of the museum's place in the new art, Crowley now offers to the audience the *Beasts All* which, when assembled, is a complete Beasts picture worthy of joining all Beasts reunions.

Rafel first and squarely "banned" in their current va-  
cations for their development in radio, continued  
with the considerable setting in price of the Radio in  
his first, we continue to get into the income from  
radio transmission, finally. The opportunity  
of sending and receiving U.S. radio, phone, wiring  
diagrams and private messages to radio upon a new  
field of interest to the amateur from which he will  
not only receive new (He'll be well fed himself) con-  
tributing most new ideas and development in  
the very first time, just as he did in the earlier days  
of radio transmission.



EVERYTHING YOU NEED **\$49<sup>95</sup>** COMPLETE SET

**SENDING**

**THE NEW ART OF SENDING AND RECEIVING PICTURES**

Transmission of pictures on the wireless has been made possible by the National Radio Company. The new system is based on the use of the National Radio Company's "Picture Sending" apparatus, which is capable of transmitting pictures on the wireless at a distance of 25 to 50 miles. The National Radio Company's "Picture Sending" apparatus is the only one of its kind in the world. It is the only one that can be used for both sending and receiving pictures. It is the only one that can be used for both sending and receiving pictures. It is the only one that can be used for both sending and receiving pictures.

**RECEIVING**

**NATIONAL RADIO COMPANY**

1000 Broadway, New York, N.Y.

July 1918

Radio sets for sale:

- Radio set with 10 tubes, \$100.00
- Radio set with 10 tubes, \$125.00
- Radio set with 10 tubes, \$150.00
- Radio set with 10 tubes, \$175.00
- Radio set with 10 tubes, \$200.00
- Radio set with 10 tubes, \$225.00
- Radio set with 10 tubes, \$250.00
- Radio set with 10 tubes, \$275.00
- Radio set with 10 tubes, \$300.00
- Radio set with 10 tubes, \$325.00
- Radio set with 10 tubes, \$350.00
- Radio set with 10 tubes, \$375.00
- Radio set with 10 tubes, \$400.00
- Radio set with 10 tubes, \$425.00
- Radio set with 10 tubes, \$450.00
- Radio set with 10 tubes, \$475.00
- Radio set with 10 tubes, \$500.00
- Radio set with 10 tubes, \$525.00
- Radio set with 10 tubes, \$550.00
- Radio set with 10 tubes, \$575.00
- Radio set with 10 tubes, \$600.00
- Radio set with 10 tubes, \$625.00
- Radio set with 10 tubes, \$650.00
- Radio set with 10 tubes, \$675.00
- Radio set with 10 tubes, \$700.00
- Radio set with 10 tubes, \$725.00
- Radio set with 10 tubes, \$750.00
- Radio set with 10 tubes, \$775.00
- Radio set with 10 tubes, \$800.00
- Radio set with 10 tubes, \$825.00
- Radio set with 10 tubes, \$850.00
- Radio set with 10 tubes, \$875.00
- Radio set with 10 tubes, \$900.00
- Radio set with 10 tubes, \$925.00
- Radio set with 10 tubes, \$950.00
- Radio set with 10 tubes, \$975.00
- Radio set with 10 tubes, \$1000.00

Powel Crosley Jr., who firmly believed in using his own products, was a very tall gentleman. At 6' 4" in height, many people have wondered how often he actually drove his own 1939 Crosley two-cylinder compact car.

profit. Crosley also produced a small truck. However, he could not compete in the automotive industry because of the start of the Korean War which caused the price of materials and labor to increase. By 1952, the Crosley car had failed. This was another severe disappointment for Powel Jr. He had lost over \$1,000,000 per year during the final three years of automobile production. On July 17, 1952, the General Tire and Rubber Company purchased controlling interest in Crosley Motors [15, 100].



**Figure 120. (Left)**  
*Crosley Grad automobile, 1939. Note the narrow 18-inch separation between the rear tires.*



**Figure 121. (Right)**  
*Crosley convertible automobile, 1939.*

## Chapter Ten Conclusion



**Figure 122.** *Portrait of Powell Crosley Jr. by William Oberhardt, who was widely known for his portraits of national and international figures in business and politics, 1924.*

Powell Crosley Jr. lived from September 18, 1886 until March 28, 1961. He not only lived the American dream; he helped create it with his business activities, marketing, manufacturing, and technical advances that changed Americans' lifestyles. He lived nearly 75 years, but his greatest achievements were accomplished over a period of nearly 20 years starting in 1921. During these eminent years he became known worldwide as an industrialist, radio broadcaster, inventor, businessman, sportsman, and entrepreneur who made entertainment and modern day products available at affordable prices. He built a manufacturing and communication enterprise that frequently set the pace for startling developments in the radio and refrigeration industries.

Powell Jr. depended upon his brother Lewis Crosley, a college graduate, to provide management knowledge and advice in all company

activities [58]. Lewis kept the company's production lines operating at the highest efficiency. From the mid 1920s through 1940, Joseph Chambers, Joseph Whitehouse, and Ronald J. Rockwell were responsible for the operation of WLW and its associated equipment. They also maintained WSAI operations until 1936. Their responsibilities also included the construction and operation of various experimental television and shortwave transmitters and stations, such as WLWO.

During the great depression years of the 1930s, Cincinnati was very fortunate to have radios, refrigerators, and other Crosley products being manufactured in the city. Jobs were hard to find but Crosley consistently employed 3,500 to 4,000 people each week. Crosley employees may not have worked every day, but at least they had a job. Support for the Crosley manufacturing operations required the employment of several thousand more people locally and nationwide each week. The city of Cincinnati would have certainly been even more devastated by the great depression if it had not been for the operation of the Crosley plants and the opportunities for employment and even entertainment that Crosley provided.

Powell Crosley's local home was on Kipling Avenue in College Hill, a suburb of Cincinnati. (Figure 124) He had other estates and farms in South

Carolina, Georgia, Florida, Indiana, and Canada. He was a sportsman who liked to spend time with his dogs, collecting special guns, fishing, hunting, horseback riding and playing polo at his farm just south of Vernon, Indiana in Jennings County [4]. He spent much of his leisure time at his farm in Indiana where he built a fine lodge. In addition to his leisure activities, he enjoyed directing the farm operation. Powel Jr. was pleased when the farm became profitable just a short time after he purchased it. In 1958, part of the farmland was sold to the Indiana Department of Conservation for \$150,000. It was stipulated that the land be used for hunting and fishing. This area is now known as the Crosley State Fish and Wildlife Area, in his honor. Powel Crosley Jr. had started coming to this area prior to his days in radio.

He was an officer of many radio organizations and he was very proud of his city. He was a leader in several civic organizations and was known as a gracious host. (Figures 122 and 123)

On February 26, 1939, his wife of nearly 30 years died at their Florida estate, Seagate. Two days later, February 28, 1939, the order was given by the Federal Communications Commission that WLW had to reduce its power from 500,000 to 50,000 W. At the age of 53, the life of Powel Jr. dramatically changed. He lost interest in broadcasting and eventually sold his broadcast stations and manufacturing facilities to the Aviation Corporation, AVCO, in 1945. However, he continued his interest in cars and the Cincinnati Reds. Because of World War II, the Korean War, and competition in the automotive industry, he discontinued the Crosley car in 1952. The Cincinnati Reds became a big part of his life. He attended many games in Cincinnati and also traveled with the team. At the time of his death, his controlling interest in the Cincinnati Reds was willed to a foundation controlled by members of his family and one or two others. The will made it very clear that Powel Crosley Jr. wanted the team to remain in Cincinnati.

After Gwendolyn's death, Powel Jr. had several tragic times with three failed marriages and family deaths. His son, Powel III, died from a heart attack in 1948; and his grandson, Powel IV, was killed in Korea in 1950.

Mr. Crosley had several licensed experimental radio stations dating back to 1921. These stations were located at Blue Rock Street, Colerain Avenue, and Arlington Street in Cincinnati. Other locations included Harrison and Mason. Some of the call signs were 8XAT, 8XAA, 8XT, 8XAY, 8XAL, etc. In October 1928, the Federal Radio Commission ordered all licensed experimental radio station call signs to begin with the letter W. 8XAL became W8XAL, with the station operating at a power of 250 W on 5,690 kHz from Harrison. By 1931, W8XAL had been moved to the WLW transmitter building at Mason and was operating with 10,000 W on 6,060 kHz. In 1938, a construction permit was granted to increase the power to 50,000 W. Shortwave transmitters of this power, with the capability of shifting rapidly to six operating frequencies in the international bands, opened new frontiers for design and development. This represented another outstanding accomplishment for the Crosley engineering department. In July 1939, the call letters were changed to WLWO, and the new transmitter was placed into operation. (Figure 125) In April 1940, the power was increased to 75,000 W. The station was now the most powerful international shortwave

**Figure 123.** *Powel Crosley Jr. in his office on arlington Street in 1936.*

broadcast station in the Western hemisphere and was the only station in the United States to hold frequency assignments on all international broadcast bands.

During 1940, representatives of the Crosley Corporation conducted an intensive survey of the important radio receiving and transmitting facilities in Latin America. From these findings and personal observations, Crosley established a chain of stations located in 10 different countries, with a potential audience of 6,000,000 people. These stations rebroadcast WLWO programs. This Latin America network of WLWO became known as Cadena Radio Inter-Americana, and consisted of 15 stations. These stations were located in Mexico City, Guatemala City, Tegucigalpa, El Salvador, San José, Panama City, Caracas, Maracaibo, Bogota, Medellin, Cali, Guayaquil, Lima, Havana, and San Juan.

This Latin America network was short-lived because of World War II. WLWO was leased to the State Department for the Office of War Information broadcasts. Another 50,000-W shortwave transmitter, WLWK, was installed in the WLW transmitter building for the same wartime service. Directional rhombic antennas that could be switched to either transmitter were used for beaming programming to Europe or Latin America.

Shortly after the start of the war, the Crosley Corporation was contracted to build three 200,000-W shortwave transmitters at a cost of \$1,750,000. This transmitter plant, located a mile west of the WLW station in Mason, became a part of the Voice of America and was known as the Bethany Relay Station. The plant was operated by the Crosley Corporation until 1961, when the Federal Government modernized it. The government continued



**Figure 124.** *The Crosley Mansion in College Hill, a suburb of Cincinnati.*



its operation until November 14, 1994, when the plant was closed.

### **First in Ohio Television**

Crosley telecasting, the first in Ohio, started with an experimental station in 1937 using the call letters W8XCT. The first demonstration, which was open only to the press, was made on a closed circuit on April 26, 1939, from the 48th floor of the Carew Tower in downtown Cincinnati. One more demonstration was made in 1941 before Crosley engineers concentrated their efforts on World War II manufacturing projects.

### **Another First**

During its 50 years of operation, WCET-TV has received generous support from the Powel Crosley Jr. Foundation. WCET, located in Cincinnati, was the first licensed educational television station in the United States. In 1976 a substantial contribution from the Crosley Foundation provided impetus for the construction of the new home of WCET which was called the Crosley Telecommunications Center. This three-studio complex is now the center of a wide variety of community services. WCET uses not only traditional broadcast media but a plethora of new technologies like digital TV, the Internet and other broadband based programming, DVD, CD-ROM, and direct satellite transmissions [88].

Over the years, some publications have incorrectly spelled the name Powel as "Powell." The correct spelling is Powel Crosley Jr. with one "l."

### **Acknowledgements**

In 1947, when I began working for WLW, the thought that I might have an opportunity to share information concerning Powel Crosley Jr. and WLW never occurred to me. I want to express my thanks to my deceased co-workers, Ronald J. Rockwell, Floyd Lantzer, Richard Walker, George Rawlings, William Schwesinger, and Jack Gray for the many valued notes, photographs, artifacts and discussions about the history of the company.

Further assistance has been provided recently. It is with my sincere thanks and gratitude that I want to acknowledge the following: Thanks to David B. Snyder, for the many hours he has spent



**Figure 125.** George Frederick (Fritz) Leydorf, Radiation Engineer and Floyd Lantzer, Chief Engineer, standing in front of the 75-kW shortwave transmitter used for Crosley radio station WLWO. This transmitter was located in the WLW transmitter building near Mason, Ohio.



at his computer organizing the text and pictures. His suggestions, ideas, technical knowledge, knowledge of the history of Powel Crosley Jr. and his willingness to help has been invaluable. John Leming, read the original draft, suggested numerous improvements and spent time at the Cincinnati Public Library providing several references. Clyde G. Haehnle shared the history of WLW, and made suggestions, offered remembrances and edited. Clyde worked at WLW as a University of Cincinnati co-op student when the WLW 500-kW transmitter was still in operation. He was a member of the engineering department for 37 years. Ludwell A. Sibley, John Harmer, Shawn Robinson, and John Walker provided invaluable help by locating and providing references. Paul Jellison and Ted Kendrick, who are present WLW staff engineers, helped me to again inspect and review the WLW 500-kW transmitter as it exists today.

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### **Charles J. Stinger**

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Charles J. Stinger, a veteran of World War II, began his employment at Crosley Broadcasting on August 18, 1947, as a WLW transmitter staff member at Mason, Ohio. After 38 years of high power broadcasting, he retired as the plant supervisor of the Voice of America Bethany Relay Station that was built in 1944 and operated by Crosley Broadcasting for many years. The Voice of America Bethany Relay Station was located just a mile west of the WLW transmitter plant.

With the call letters of W8GFA, he has been an amateur radio operator since 1950, a member of the ARRL for more than 50 years, QCWA, OOT, and several historical and amateur radio clubs. Charles has been a member of the Antique Wireless Association, AWA, for more than 40 years and was the corresponding secretary for the third annual AWA meeting held at the Jack Gray Wireless Museum in Mason, Ohio in 1965.

His collection of radios, wireless equipment, and radio artifacts began in 1950 when a friend gave him a Crosley Model 51. While growing up, he was known as Chuck, but the name Charlie came about at the start of his broadcast career. The attached photograph shows Mr. Stinger standing by one of the tube sockets for the 898 final amplifier tubes of Crosley's 500-kW transmitter at station WLW.



### **David B. Snyder**

David Snyder was born and raised in northern Indiana. He worked for a number of small radio stations and at WOWO in Fort Wayne from 1969 to 1982. He moved to Mason, Ohio to work for the Voice of America, Bethany Relay Station starting in 1982 and working there until one year after the station closed in 1994. He was the last Plant Supervisor at the station from 1990 to 1995. He has lived in the shadow of the WLW tower for over twenty years and has known the author since 1982. The attached photo shows Mr. Snyder with a souvenir of the VOA station, a 4CV100000C tetrode and a Crosley "fiver" receiver.

## **Early Wireless Pack Sets**

### **Spark Hits the Beach!**

**by**  
**Russ Kleinman, WA5Y and Karen Blisard, N5IMW**  
**and**  
**Jim and Felicia Kreuzer, N2GHD & KA2GXL**  
**and**  
**August Link**

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### **Introduction**

Spark or 'wireless' radio developed rapidly during the early 20th century. The nearly instantaneous communication of information such as battle plans and enemy movement made the development of wireless technology a high priority for the United States Navy and the Army Signal Corps. Both services envisioned portable sets to fill this need. These took the form of pack sets, complete portable spark radio sets which were intended for quick transfer from one place to another and which could be contained within specially designed cases or trunks [1]. They were rugged and capable of sufficient power to communicate over useful distances which ranged generally up to about 30 miles. A pack set typically consisted of a transmitter, receiver, power generator, aerials, spare parts and tools, and the trunks in which to carry these components. This much equipment typically weighed 300-500 pounds, and was commonly divided into up to four trunks made of wood and fiber with brass fittings (Figure 1). Soldiers, mules or horses hauled the pack sets as necessary (Figure 2).

### **How Pack Sets Were Used**

Pack sets were adapted to many different uses by the Navy and the Signal Corps. In the Navy they were fitted onto the bridges of ships for tactical use. Landing parties used them to communicate back to the main battleship, as in Haiti in 1915 when eight Signal Corps type 1/4-kW pack sets distributed along the coast were used to maintain communication with the battleship *Washington* during an uprising [2]. Hand generators were used for power ashore at times when there was no electrical power supply for the motor generators (Figure 3).

Pack sets could also be used as auxiliary sets in case the main ship's set was disabled. They were used on docks to report submarine sightings, at target ranges, and by Fire and Rescue parties. One evening in 1913 while in Guantanamo Bay, Cuba, the battleship *Utah* sent out a rescue party in a motor launch to check out a distress signal. A pack set was used to report back to the ship from time to time in much the same manner that today's Search and Rescue teams communicate with handheld radios [3]. These pack sets often endured extremely rough use and they had to be designed to survive mechanical shock and contact with water. As they were being lowered into small boats they were often banged against the side of the battleship. When underway in a motor launch they were frequently sprayed with saltwater.

The Signal Corps used pack sets for communication along frontiers. When American troops were hastily mobilized to the Mexican border in 1911, pack mules bearing pack sets were dispatched to the frontier. The pack sets reportedly "proved so efficient that it was found unnecessary to repeat a single message [4]." In other conflicts, however, pack sets were easily targeted and taken out by enemy fire (probably because of their highly visible antenna masts) so they were quickly found to be unsuitable for use in the front lines [5].

### **The Early Development of Pack Sets**

The story of pack sets as manufactured up to 1919 for both the U.S. Navy and the U.S. Signal Corps is essentially a story of the National Electrical Supply Company (NESCO) [6]. The main reason for this monopoly was that NESCO was located in Washington DC, where the relevant officers of both the Navy and the Signal Corps were stationed. These services could therefore have direct control in all the phases of research and development of the sets [7].

NESCO began in 1880 as a small machine shop called "Royce and Marean" after its founders. Along with marine equipment, Royce and Marean also manufactured electrical devices. By 1895 the company re-organized itself as the National Electrical Supply Company. Much of the company's early business in electrical sales was with the United States Government and it included the sales of landline telegraph instruments to the government as the agent for Western Electric and as the agent for other companies [8]. It was therefore reasonable for the U.S. Navy and the Army Signal Corps to approach NESCO in 1906 or 1907 for the design and manufacture of prototypes for their portable wireless sets.

The United States was already behind in the development of wireless field equipment. Slaby-Arco in Germany had been at work since before 1901 improving upon the cumbersome portable wireless sets that the Marconi Wireless Company of London had sent to Africa for use in the Boer War. A rudimentary adjustable tuning system was employed in the Slaby-Arco system and a kite was used to elevate the antenna, thus eliminating the weight of the 80-100 foot mast that was otherwise necessary to achieve adequate antenna height [9].



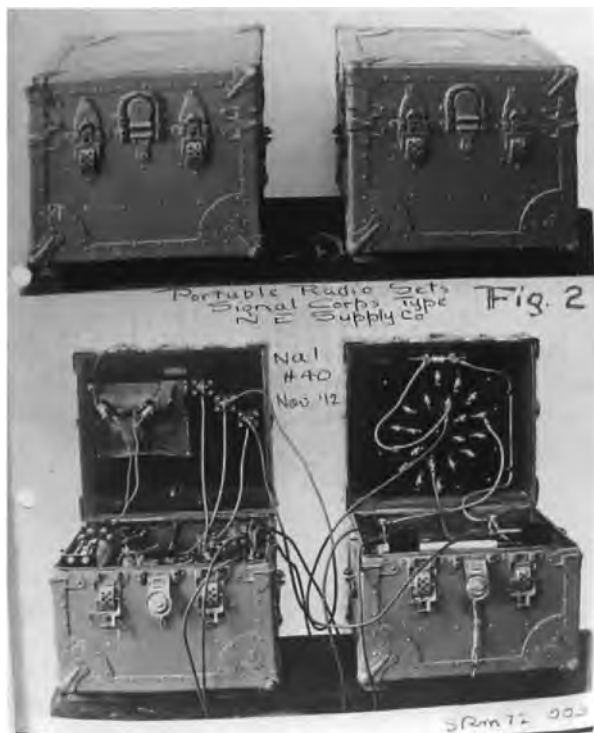
**Figure 1. (Left) Instrument Case for National Electric Supply Company Type A Pack Set, 1912.**

**Figure 2. (Right) Mule loaded and ready to move out with radio equipment, 1913. (Source: Signal Corps Bulletin No. 18 Radioana Collection, Archives Center, National Museum of American History, Smithsonian Institution.)**



**Figure 3. (Left) Three men demonstrate the operation of a pack set with a hand generator. Probably about 1916.**

When not engaged in hostilities, Navy pack sets were used during torpedo practice on small boats, which could then report results back to the battleship. These boats used battery-powered outfits because it was too difficult to grind the crank of a hand-powered generator on an unstable launch. In general, storage batteries were not included in the pack sets but were supplied by the user. The four-cell Exide battery, in which the active material was applied to the plates in the form of a paste, was frequently used with the Signal Corps sets.



**Figure 4.** Early type of pack set, made about 1908 by the National Electric Supply Co. for the U.S. Signal Corps.

### The NESCO "Sweet" Type Pack Set

NESCO designed their second Navy pack set type after Lt. G.C. Sweet had made suggestions for improvements in the initial sets. The changes were made and the new sets were available for use during the winter Fleet practice in 1910-1911. These sets became known later as the "Sweet" type sets (Figure 7). The Sweet-type sets were the first quenched-gap sets made by NESCO. The quenched-gap consisted of a number of heavy copper plates separated by a distance of about .01 inch by insulating discs and compressed by a pressure bolt. This was a significant improvement over the open gap used in the first pack sets. The advantage of the quenched-gap was its ability to prevent the oscillations induced in the aerial circuit from being fed back to the condenser circuit, even when the oscillation transformer was closely coupled. Therefore the antenna would oscillate at a single fundamental frequency and radiate a single wave. In addition, increased values of antenna current were achievable with a quenched-gap [14].

The first 500-cycle motor-driven generators made by the company were supplied with these sets [15]. The motor generators were mounted inside the chest with the transmitter and receiver. The Sweet sets also featured knobs that projected outside of the case so the generator speed and receiver tuning could be varied from the exterior (Figure 8). The sending key had a rod projecting outside the case, with the knob outside for operation. By turning the knob, it could be screwed down flush with the box surface for transportation. Extending these controls outside the case helped protect the internal components from damage from salt water.



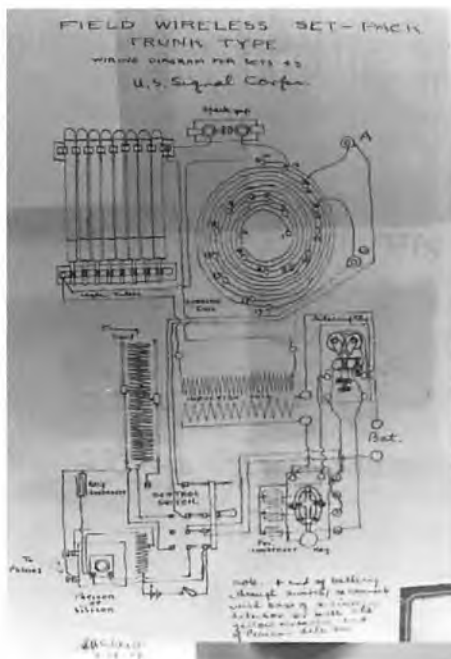
## **The NESCO "Fleet" and "Signal Corps Standard" Pack Sets**

The first Signal Corps pack set was probably designed as early as 1906 with at least one set being manufactured for the Army in 1907. The earliest Signal Corps Standard Type and Navy Fleet Type pack sets were actually delivered to the Navy about 1908, presumably so that the Navy could compare the two sets. Unlike future pack sets, these two initial NESCO pack set designs were relatively primitive open spark gap sets. The open spark gap was the simplest type of spark gap to build and consisted of two electrodes separated by an air gap. Because the use of the open spark gap resulted in a broad and harsh tone, it was replaced later by more effective but also more complicated systems.

These earliest pack sets utilized a vibrator and an induction coil. Coupling to the antenna was direct rather than inductive since a direct coupling circuit was easier to design and build [10]. Although NESCO designed and manufactured pack sets for both the Navy and the Army Signal Corps, two distinct lines of pack sets were made, based upon the specifications of each service. Yearly design improvements were made to both the Navy and the Signal Corps pack sets (see Tables 1, 2, and 7).

For the most part, the improvements were driven by the work of George H. Clark, E. R. Cram, and Albert H. Johnson. Clark was the Navy's liaison to NESCO in Washington from 1908-1919. Clark had several titles over the ten years with the Navy, but was generally known as "Chief Radio Aide." He participated in the design of the early sets and he spent time almost daily at the NESCO instrument shop [11]. Most of the information available today about the development of pack sets for the Navy comes from Clark's "Radioana" collection at the Archives Center of the National Museum of American History. The "Radioana" collection consists of about 275 shelf-feet of historical documents concerning the history of wireless collected over many years by Clark. Cram was the Radio Engineer for the Signal Corps, and Johnson was the shop foreman for NESCO. Johnson was the only civilian of the three.

The first Signal Corps Type sets (Figure 4) and the Navy Fleet Type sets (Figure 5) were experimental. The Fleet sets were supplied in large pine boxes. The Signal Corps Type Pack sets consisted of two trunks and a storage battery box. Small copper-coated Leyden tubes [12] were used for the condensers in the Signal Corps sets, and a silicon detector was employed in the receiver (Figure 6). Only two complete sets of each type were made for the Navy, and an unknown number were made for the Signal Corps. Lt. W. R. Wurtsbaugh conducted service testing of the Navy Fleet sets which were initially intended for intrafleet communications during battle. The main radio room was usually above the deck level and the antenna was lofty and exposed. During battle, the portable Fleet set could be located in a protected position away from enemy fire. Tests showed that the Fleet set could communicate successfully between ships 15 to 20 miles apart with the antennas just clear of the water at the ship's side [13]. Thus, effective communications could be maintained during battle with jury-rigged replacement antennas.



**Figure 6.** (Left) 1908 design pack set for the U.S. Signal Corps, wiring diagram by George H. Clark.



**Figure 7.** (Below) Sweet type Navy Pack Set. The first quenched gap set for the Navy made by NESCO.



**Figure 8.** (Left) Sweet type Navy Pack Set. Knobs for generator speed, receiver tuning, and the sending key protrude through the case.

Lt. Sweet reported extensively on the performance of these new sets at the end of 1910. A total of only five of the Sweet sets were made by NESCO. Each was complete in one case. The primary objective considered in the construction of these sets was to furnish vessels of war with light and easily adjustable sets which, in time of battle, could be set up in a sheltered position and which were capable of keeping the ships of a fleet in communication with each other. They also had to be capable of providing a fair degree of protection from physical damage and freedom from interference from enemy radio equipment. Lt. Sweet concluded that these goals had been accomplished, but that there were several improvements that could be made. He suggested that a spare gap be supplied so that one of the two gaps could be overhauled without disrupting service. He suggested that the fragile glass Leyden tube condensers be replaced with plate condensers made of tinfoil and paraffined paper. He also suggested improvements in the induction coil, as well as the starting rheostats [16] which had all burned out on the first models. Sweet's suggestion to make the ordinary commercial "make" type telegraph key into a "make-and-break" type key would become a hallmark of all NESCO Navy pack sets that followed. This key had a "break" or "listening in" attachment [17] which allowed the operator at the distant receiving station to interrupt the sending operator to request a repetition or to advise of interference.

Sweet noted that the sets worked up to distances of 20 miles with perfect success [18]. However, Sweet also pointed out that exact adjustment of the set for proper operation on different frequencies was difficult. Although most pack set types that followed incorporated different solutions to this tuning problem, it was never really completely solved.



**Figure 5.** "Fleet" set made by NESCO about 1909 for the U.S. Navy, drawing by George H. Clark. Made up in a large pine box with an open spark gap and zinc electrodes. Only two of these sets were made.

Two types of Battleship sets were made and delivered in 1912 at a cost of \$900 each. The first two sets were known as "short wave sets." They had a 500-cycle motor-driven generator mounted inside the case (no hand generator was supplied with Battleship sets) and they tuned from 90-210 meters. Unfortunately, this arrangement prevented receiving until the motor generator came to a rest (perhaps as a result of physical or electrical noise), so the remaining two sets were supplied with the motor generator in a separate case (Figure 11). The space that had been occupied by the motor generator was now occupied by a loading coil. These sets could now tune up to 600 meters and were therefore known as "long wave sets." Both types of Battleship sets made use of inductive coupling rather than the directly coupled antenna circuit of the earlier pack sets. The major advantage of inductive coupling was the ability to tune the transmitter more precisely so that interference to other stations was reduced [20]. The antenna intended for use with the Battleship sets was a single wire measuring 30-80 feet long.

### **The NESCO Type A Pack Set**

By the end of 1912 the Navy had a reasonably well-developed idea of what it wanted in a pack set. Experiments in the field proved that the totally enclosed Battleship sets were too "grandiose" (in Clark's words) to be practical. Johnson of NESCO felt that a more practical set was necessary and eventually Clark agreed [21]. Johnson and NESCO designed the next set to be manufactured and designated it the "Type A pack set" (Figures 12 and 13). The Type A set retained the quenched-gap and the inductive coupling of the Battleship set, but the idea of completely enclosing the working parts under a protective top was discarded. The Type A set also had an improved type of mica dielectric condenser. Better materials were used in the construction of the improved condenser, the surface areas of the conducting material and dielectric were enlarged, and the arrangement of the binding posts was improved along with many other changes. The

Type A set was intended for use with a standard portable aerial (Figure 14) and it was supplied with a hand generator (Figure 15). Five Type A pack sets were made at a cost of \$900 each. They were delivered to the Navy in late 1912.

### **The NESCO Type B Pack Set**

The Type B NESCO pack set (Figure 16) was ordered and built in 1913. Ten of these sets were made. The Type B set was of the quenched-gap design. It was inductively



**Figure 10.** Battleship set, 1912, illustrating method of mounting components and false top.

## The NESCO "Battleship" Type Pack Set

The Sweet sets were very successful but only some of the necessary adjustments could be made from the outside of the case. Clark reasoned that a pack set could be designed such that *everything* could be controlled from the outside while still keeping the set waterproof [19]. A total of four sets of this new model were made, and they were known as "Battleship" type sets (Figure 9). The specifications initially called for the paper condensers which Sweet had suggested, but the specifications were later changed and the sets were delivered with handmade mica condensers. Since the sets were required by specifications to be capable of continuous operation for six hours while delivering a maximum of 250 W at 110 VDC, mica condensers were superior to paper and paraffin because the paraffin might melt.

The sets used quenched spark gaps. A complete quenched-gap consisted of nine parallel metal plates, each separated by a short distance of air (or gap) that the spark had to bridge. As a general rule, the complete quenched-gap of a spark transmitter required one of these smaller gaps for each 1000 volts in the secondary circuit of the power transformer. Since the transformer secondary of the Battleship sets would deliver 5,000 volts, four or five individual gaps out of the nine contained in the complete quenched-gap would be required in the circuit at any given time. Since they were easily ruined by corrosion or the intrusion of moisture, twice the necessary number of individual gaps were provided so that poorly functioning ones could be excluded from the circuit. The operator selected the desired individual gaps or series of gaps from the nine individual gaps in the complete quenched-gap of the Battleship set by the placement of short-circuiting clips on flexible arms.

All of the necessary controls of the Battleship type pack sets were mounted on a false top with knobs projecting above it (Figure 10). The cover of the case in turn covered the knobs when the set was not in operation. The transmitting key was operated from the top of the case and was fitted with a rain-shedding disc over the point of entry into the case. The Battleship sets were very large and heavy, weighing about 75 pounds (not counting spare parts) and they were therefore not suitable for landing parties or for other situations that required rapid deployment.

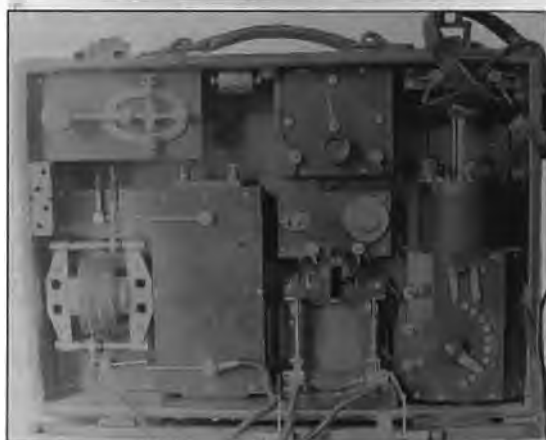


**Figure 9.** Battleship type NESCO pack set, 1912. Note that all the knobs are on top of a false top so the components remain dry underneath the real top.

**Figure 11.** (Right) *Motor Generator for long-wave Battleship type set, mounted in a separate case, perhaps to isolate its physical or electrical noise.*



**Figure 12.** (Left) *Type A pack set made for the USN by N.E. Supply Co., 1912.*



**Figure 13.** (Left) *Top view of Type A pack set made for the USN by N.E. Supply Co., 1912.*

**Figure 14.** (Right) *Standard Portable Aerial set up in front of Washington Memorial, in use with Type A pack set (serial number 100) made for the USN by N.E. Supply Co., 1912.*



coupled, and it did not differ very much from the Type A sets. The main improvement was that Type B sets were capable of operation over a wider range of wavelengths. The oscillation transformer [22] was redesigned for this purpose. The primary and secondary coupling coils were made the same diameter and hinged at the bottom so that both could open out in order to loosen the coupling. As with the Type A set, the Type B set included a hand generator (Figure 17), a motor generator (Figure 18), the antenna and mast system, and a spare parts chest (Figure 19).

### The Signal Corps Pack Sets for 1912-1914

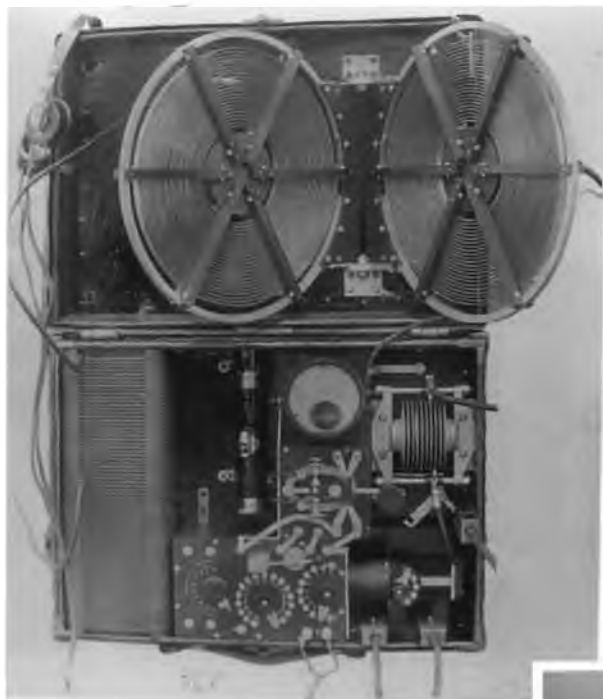
Development of the Signal Corps sets had progressed and generally paralleled the development of the Navy pack sets (Figure 20). Unfortunately, much less is currently known about the Signal Corps packs sets because E. R. Cram, who was in charge of the development of the Signal Corps pack sets, did not preserve as much of the documentation of their development as Clark did for the Navy sets. A great deal of information sharing occurred in the development of the sets for the two services. This was not surprising since NESCO was the main contractor for both of the model lines. Cram and Clark had already established a relationship while working together and developing early spark technology at the Stone Telegraph and Telephone Company in Maine as early as 1902 [23]. The "make-and-break" type of telegraph key was one distinct advantage of the Stone system of wireless telegraphy that was later incorporated into the pack set designs.

The Model 1912 Signal Corps sets and all Signal Corps sets that were made after them were of the quenched-gap type. Early Signal Corps pack set receivers from about this time period were the first to be adapted for use in aircraft by the military and they paved the way to successful communication from air to ground [24]. The Model 1913 Signal Corps pack set was similar to the Model 1912 set except that improvements were made which doubled the power output of the set and considerably increased its range of operation.

The mast which was supplied with the Model 1913 set and used for supporting the antenna wires consisted of 14 sections, each just over five feet in length (including the tube to couple one section to the next), since experimentation had shown that it was easier to erect a mast with short sections rather than with longer ones. The mast was assembled by adding sections one by one to the bottom end, while men holding the far ends of

**Figure 15.** Hand Generator (handles not attached), supplied with Type A pack set made for the USN by N.E. Supply Co., 1912.





**Figure 16.** *The NESCO Type B pack set, modified with Type C condenser.*



**Figure 18.** *Motor generator supplied with NESCO Type B, C, D and E pack sets.*

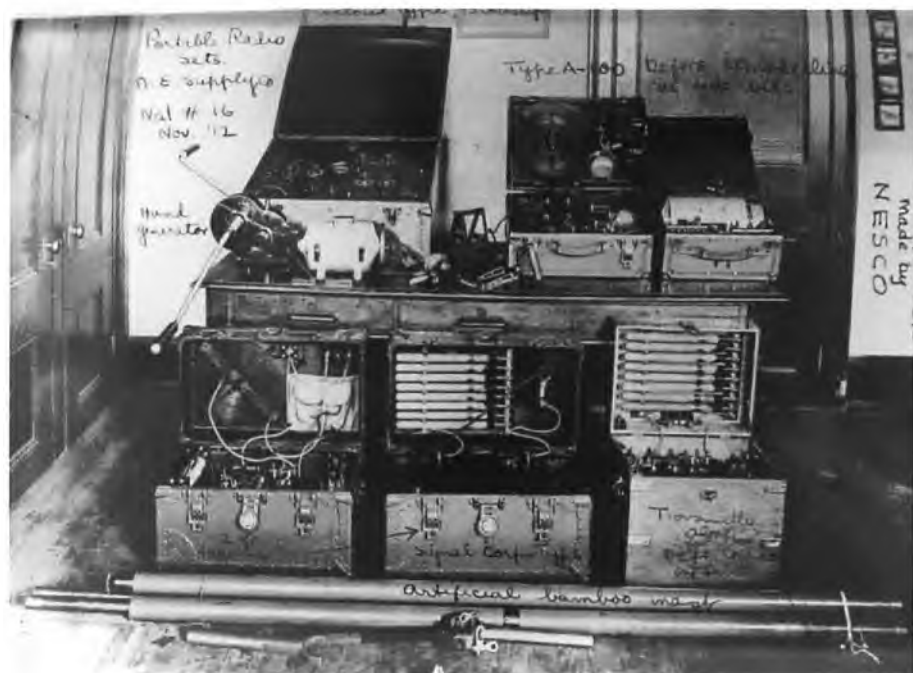


**Figure 17.** *NESCO hand generator, supplied with Type B & C pack sets.*



**Figure 19.** *(Left) Spare parts and tool kit supplied with the NESCO Type B pack set.*





**Figure 20.** Picture taken in 1912 of portable radio sets made for the U.S. Navy and the Army Signal Corps by NESCO. On the upper left, there is a Battleship set, with a hand generator and a motor generator in front of it. To the right of the Battleship set is a Type A set (Serial Number 100), with its motor generator to the right of it. The Signal Corps set is on the floor to the left. The box to the right on the floor also contains a Signal Corps transmitter. There is an "artificial bamboo" mast on the floor in front.

the antenna guy ropes kept the mast as vertical as possible during the assembly process. The standard antenna was of the umbrella type [25] with four 85-foot long wires radiating from the top of the mast. The outer ends of these wires were tied to ground pins, and four insulated 100-foot ground wires were laid out on the ground under the antenna wires for a counterpoise. The antenna and counterpoise wires were carried on hand reels so that they could be rapidly deployed.

The Model 1913 had a hand-driven 250-W generator with two handles. The handles had to be turned at 33 revolutions per minute in order to give the necessary armature speed of 3300 rpm since the combination gear had a ratio of about 100 to 1. A speed indicator was mounted on the upper part of the gear case within sight of the men who cranked it to show whether they were turning the crank at the proper speed.

As with all quenched-gap transmitters, tuning the oscillating and radiating circuits to resonance and determining the correct coupling between them were the two most important adjustments. These adjustments involved moving clips along the flat spiral coils to set the desired wavelength and to give the maximum reading on the hot-wire ammeter [26] in the antenna circuit. The correct positions of the clips on the coils were dependent on each other, so

some trial and error was involved [27]. For proper operation of the transmitter the quenched spark gaps also had to be kept cool and clean of corrosion.

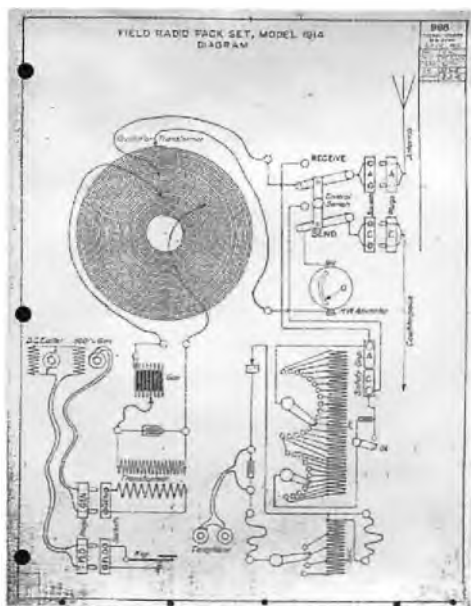
The set was normally packed on three mules, but in an emergency it could be packed on two. In normal packing, the first mule carried the generator and six sections of mast. The second mule carried the operating chest (containing the transmitter and receiver), four sections of mast, the antenna and the counterpoise. The third mule carried the shelter tent with tent pins and extension pieces folded inside, as well as four sections of the mast, the flag kit, and the lanterns.

The Signal Corps Field Radio Pack Set Model 1914 (Figure 21) was a later quenched-gap set with inductive coupling that was similar to the Model 1913 according to Clark [28]. Signal Corps training documents from 1917 mention the Model 1913 and Model 1915 pack sets but they do not mention the Model 1914 sets [29]. It is likely that few were made.

Testing was done about 1913 by the Signal Corps to determine how fast a Signal Corps detachment could set up the Radio Pack Set. At a given signal, the soldiers mounted their horses and went into formation. They galloped ahead for 100 yards and then dismounted. They unpacked the equipment from the mules, erected the 40-foot mast, and connected up the entire set. They turned the hand generator enough to send one dot, then took down the antenna and mast, and closed down the station. The whole apparatus was packed back onto the mules and the detachment remounted and galloped back 100 yards to the first position. The whole operation was performed in 2 minutes and 45 seconds [30]!

### Other Companies Force the Navy into the Competitive Bidding Process

NESCO was not the only company making pack sets. Marconi's Wireless Telegraph Company undertook testing of pack sets for military use as early as 1902 or 1903 [31]. The Marconi mule pack sets of 1915 and 1918 (Figure 22) were modern and sturdy by the standards of the time, and a knapsack set which soldiers could carry was also offered. When contracts for pack sets continued to be awarded to NESCO, the Marconi Company protested in a letter to the Navy [32]. However, the Navy had already sent a letter to all the principal radio manufacturers in 1910, including



**Figure 21.** (Left) Signal Corps Field Radio Pack Set Model 1914, wiring diagram. (Source: August Link)



**Figure 22.** *Marconi cavalry portable set. Note the shaft from the gasoline engine passing through the saddle and driving the generator, which is connected to the transmitting set by heavy leads. The saddle is equipped with a steel frame "so that it may be placed on the ground in the least amount of time." The receiving set consisted of a magnetic detector, along with headphones and a means of tuning.*

Marconi, expressing its willingness to test *any* apparatus submitted to it. In general terms, every company had offered to supply exactly the equipment necessary to meet the Navy's requirements. With the exception of NESCO, however, no manufacturer had followed up on the matter and no other suitable sets were actually offered for test. By 1913, the Navy felt that an injustice had been done to NESCO by incorporating a general description of the set NESCO had developed in the specifications that were issued to other manufacturers. The Navy felt that the other manufacturers had an advantage in that they did not have to expend the time and money to develop the technology upon which later designs were based.

The Marconi Company was awarded a very large contract for some different radio equipment in 1913 even though they were not the lowest bidder. In spite of this, the Marconi Company protested to the Navy when the specifications for other contracts did not conform to what they had to offer. This raised concerns in the Navy that Marconi interests were attempting to dictate terms and specifications to the Navy.

The Telefunken Company of Germany had designed a fully operational pack set by 1909. Telefunken made a quenched-gap pack set in trunks (Figures 23 and 24) for transportation by pack animals. It was supplied complete with a generator (Figure 25), antenna masts, and accessories and it was offered for sale by 1912 [33]. Telefunken was also interested in pack set contracts for the U.S. Navy, but they did not have a set that fulfilled the Navy requirements in spite of the fact that the company manufactured a wide range of portable sets, including a 2-kW wagon-mounted Wireless Set that was tested by the Signal Corps. Since his company did not have a pack set that fulfilled the Navy specifications, the Telefunken representative felt that NESCO should continue manufacturing the pack sets. Ultimately Telefunken declined to bid on the Navy contracts for pack sets.

A German pack set captured at Chateau Thierry, France, during World War I was similar to sets in use at the time by the Allied powers. It consisted of a quenched-gap set in a large wooden trunk.

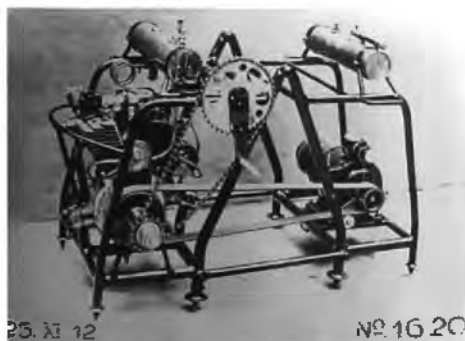
The United Wireless Telegraph Company of New York manufactured an early open spark gap, directly-coupled pack set in a large trunk in 1908. It used Leyden tubes for condensers, as had the earlier NESCO sets. It is possible that the Signal Corps purchased or tested this early unit, since



**Figure 23.** (Left) *Telefunken Pack Set for transportation by animal, packed on saddle.*



**Figure 24.** (Right) *Telefunken Pack Set for transportation by animal, quenched gap transmitter.*



**Figure 25.** (Left) *Telefunken Pack Set for transportation by animal, showing the generator ready to go.*

**Figure 26.** *Early pack set by United Wireless Telegraph Co. Note the Leyden tube condensers and the open gap.*



contemporaries referred to it as a Signal Corps outfit [34]. United Wireless itself advertised the outfit as “for Army and Navy Service, National Guard, exploring expeditions, and isolated camps [35].” (Figure 26) Other venues suggested for the set included fairs, large public works, mining camps, and any place where the construction and maintenance of telephone and telegraph lines would have been impractical or expensive. United Wireless maintained that a detail of six men could have the set ready to send and receive messages within fifteen minutes. The set was intended for communications up to a range of 25 or 30 miles. A gasoline-powered generator weighing 200 pounds

could be supplied upon request. United Wireless went on to actually manufacture a pack set for testing by the Navy in 1912. The transmitter was of the more primitive open gap type and it was disapproved by George Clark, whose job it was to evaluate the set for the Navy. Shortly after this time United Wireless succumbed to fraud, patent infringement, and bankruptcy litigation and was acquired by the Marconi companies.

In France, the Societe Francaise Radio-electrique (SFR) developed equipment remarkably similar in appearance to pack sets in use by the U.S. Signal Corps and those of Marconi [36]. The SFR supplied communications equipment to the French Army and Navy during the early part of World War I which had already broken out in Europe in 1914. One pack set with a hand generator was made by the SFR and it could be carried on the backs of two soldiers. Another set could be packed on two mules. SFR began to use tubes for amplification during the war, but SFR did not contribute to the development of pack sets used by the United States Navy or the Signal Corps.

### **Schedule 5639 and the NESCO Type C Pack Set**

Between 1910 and 1912, the U.S. Navy and Signal Corps contracts with NESCO were essentially exclusive. Bids from other companies were not solicited. As a result of complaints by other companies, beginning in mid-1913, all subsequent Navy contracts for pack sets were awarded by competitive bid. Schedule 5639 detailed the specifications for the next version of the pack set and solicited proposals. The contract called for 15 complete quenched-gap pack sets capable of 1/4 kW output. The motor generator was to deliver 500-cycle alternating current, and a hand-powered alternator with the same characteristics was also required in order to allow operation by either two or four men. Schedule 5639 required that the transmitter must be capable of "rapid and convenient adjustment to any of four different wavelengths within the range of 200 to 600 meters with the antenna supplied, and shall also be adapted to satisfactory operation at wave lengths up to 1,200 meters when used in connection with a ship's antenna having a capacity of 0.001 mfd." The transmitter and receiver were to be enclosed in one container designed to allow convenient operation of the apparatus without exposure to the weather. The weight of the container and instruments was to be less than 45 pounds, and the motor generator could not exceed 50 pounds (see Table 3). The hand alternator and accessories were to weigh no more than 80 pounds. Bidders on Schedule 5639 were required to deliver one complete sample set of the apparatus for inspection and testing to the Navy Yard, Washington, DC, prior to the time fixed for the opening of the bids.

NESCO, Marconi's Wireless Telegraph Company, and the Wireless Improvement Company were the three companies to submit bids on Schedule 5639 (see Table 4). The Wireless Improvement Company was a relative newcomer, having been founded by Colonel John Firth in 1912 [37]. George H. Clark filed a preliminary report in August 1913 on the testing of the portable radio sets submitted for Schedule 5639. He sent his final complete report to the Chief of the Bureau of Steam Engineering in May 1914. Both reports heavily favored the NESCO pack set [38]. Clark stated, "In point of over-all efficiency of transmission, compliance with specifications, design

both as to efficient working and as to durability in service, the National Electric Supply set was far superior to all others." (Figure 27) In the case of the hand generators supplied with each set, "four men were needed to turn the Marconi hand generator to give rated output, whereas two men could deliver the same output on the NESCO machine with the same muscular exertion." The NESCO set was the only one which fully complied with the specifications on Schedule 5639. The Marconi set (Figure 28) did not contain any antenna loading coil, no hand generator was supplied, and the maximum wavelength obtained was not up to the specifications.

The Wireless Improvement Company set was also very incomplete. The maximum wavelength obtainable was only 480 meters, far short of the 600 meters required. No antenna or motor generator was supplied. The complete report [39] supported Clark's preliminary findings with remarkably detailed comparisons for every component in the sets. The Wireless Improvement Company inductances were direct coupled, and this undoubtedly was a major factor weighing against its selection. Although not required by Schedule 5639, the only set to supply a key of the "make *and* break" type was NESCO (Figure 29). Clark felt that this was an important detail. Another factor favoring the NESCO sets was the fact that the individual weights of the NESCO components were almost all lighter than those of either of the other competing companies (see Table 3). Surprisingly, the Marconi receiver was rated as "poor" overall, while the NESCO receiver rated as "fair" and the Wireless Improvement Company's receiver earned an "excellent" rating.

The thorough testing of the three competitive sets included heat testing of the motor generator (Figure 30), measurement of the spark gap temperature, performance of the transmitter coils and condenser, performance of the receiving coils and condenser, overall efficiency, antenna and ground measurements, power output, signal audibility, receiver sensitivity, and damping measurements. Damping measurements were particularly important. When the current in the closed oscillating circuit died out after a few reversals, the oscillations were said to be "damped." Damping was aided by close coupling. If the coupling was too close, however, a feedback of energy to the closed oscillating circuit could occur resulting in an induced voltage sufficient to break down the spark gap. This condition was detrimental to the transmitted signal. It could be detected by its effect on the transmitted note, which became lower pitched and ragged when feedback occurred.

It is difficult to know whether this extensive testing was done purposely to give added support to the acceptance of the NESCO pack set for the Schedule 5639 contract. The contract was, in fact, awarded to NESCO. Since the testing was done by Clark, who had been involved from almost the beginning with the NESCO pack set design team, the objectivity of the tests is certainly open to question. The pack set that NESCO submitted for testing was actually a Type B set, with the understanding that the Type C pack set would be practically the same. The 15 sets for this contract were the only Type C sets made. When the Type C sets were delivered, they differed from the Type B set only in the design of the transmitting condenser which incorporated further improvements in the materials used in its manufacture.

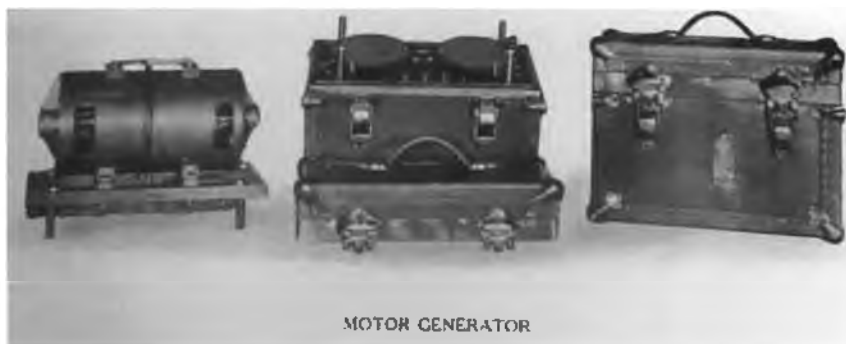


**Figure 27.** (Left) NESCO Type C transmitting and receiving chest, 1913—winner of contract under Schedule 5639.

**Figure 28.** (Right) Marconi transmitting and receiving chest, submitted under Schedule 5639.



**Figure 29.** (Left) NESCO Type C transmitting and receiving chest, detail of break type key showing connections for shorting the receiver while the transmitter was in use. This allowed for listening in between transmitting spaces.



**Figure 30.** NESCO Type C pack set, motor generator outside of case, inside case with controls on top, and with case shut.

The total weight of the Type C set as delivered was 355 pounds and the cost to the Navy was \$1000 each [40].

### Schedule 6896 and The NESCO Type D Pack Set

Schedule 6896 specified the next model of pack set for the Navy in 1914. Thirty five of these sets were required. Bidders for this contract included NESCO, the Wireless Improvement Company, and the Wireless Specialty Apparatus Company (WSA Co.) of New York City. The WSA Co. submitted the "Type No. 250-C-15" Field Radio Pack Set and Mast for testing (Figure 31). The Wireless Improvement Company's offering was the "Type 200-B-1." (Figure 32). NESCO sent the Type D Pack Set to the Navy for testing (Figure 33).

Once again, extensive testing was performed for the 1914 U.S. Navy contract. This time, however, the U.S. Navy Radio Laboratory Bureau of Standards performed the testing without the conspicuous involvement of George H. Clark [41]. As with nearly all the NESCO sets, Clark had supervised the design of the set for the U.S. Navy. Chief Electrician H.W. Kitchen, however, filed the official report to the Navy regarding testing for Schedule 6896. Both the WSA Co. and the Wireless Improvement Co. pack sets employed the Wireless Specialty IP-111 receiver. The NESCO receiver included a galena detector with a steel spring. Both receivers were found to have the same sensitivity, but the NESCO detector had a larger surface area and was very easily adjusted for sensitive points. The



**Figure 31.** (Left) *The WSA Co. "Type No. 250-C-15" Field Radio Pack Set for Schedule 6896, 1914.*



**Figure 32.** (Right) *The Wireless Improvement Company, Type 200-B-1 pack set submitted for Schedule 6896, 1914.*

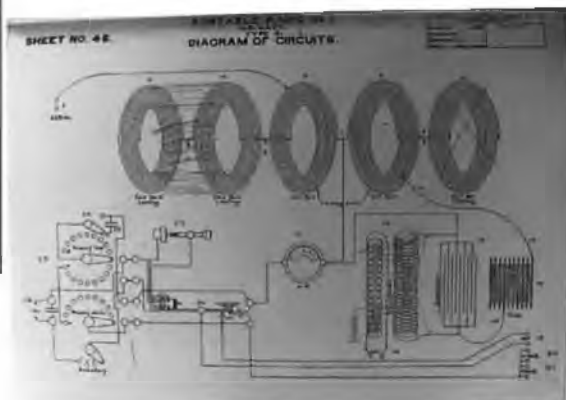




**Figure 33.** The NESCO Type D pack set submitted for Schedule 6896, 1914.

**Figure 34.** The NESCO Type D pack set for Schedule 6896, 1914.

Diagram of circuits, with added inductance to extend wavelength capability.



other detector was sensitive in only one or two spots and was very hard to adjust, both on account of poor construction and difficulty in finding the sensitive spots. It was also difficult to keep in adjustment after a sensitive spot was found (see Table 5).

The NESCO Type D pack set won the contract. The Type D quenched-gap contained a total of nine gaps, as had most of the prior sets. It differed from the Type C set mainly in that it was capable of a wider wavelength range with the standard portable antenna. In previous sets, long waves were attained by adding another condenser section to the condenser. The Type D set added inductance instead of condenser sections, and was capable of operating from 250-1380 meter wavelengths (Figure 34). The 35 Type D sets were delivered at a cost of \$1090 each.

### **Schedule 8876 and the NESCO Type E Pack Set**

Schedule 8876 called for 25 portable transmitting and receiving sets of 1/4 kW power to be delivered in 1916. It brought forth bids and sample sets from the National Electric Signalling Co., NESCO, and WSA Co. George H. Clark who was officially designated "Expert Radio Aid" conducted the testing of these sets in 1916 [42]. The NESCO set (Figure 35) was submitted complete and on time. The National Electric Signalling Co. set arrived two weeks late. The WSA Co. set lacked an antenna and mast system and the hand generator.

Overall price and total weight comparisons assumed a more prominent place than before in the final report from Clark. The NESCO set weighed a total of 391 pounds, compared to 400 pounds for the WSA Co. set and 404



**Figure 35.** NESCO Type E pack set, winner of the 1916 contract under U.S. Navy schedule 8876.

pounds for that of the National Electric Signalling Co. The total cost for the NESCO sets was \$973 each. This compared very favorably to \$1063 each for the WSA Co. sets and \$2129 for the National Electric Signalling Co. sets. The NESCO set complied with more of the specifications set forth in Schedule 8876 than did either of the other two sets, although even the NESCO set was found to be out of compliance with two of the requirements. The National Electric Signalling Co. set did not include a "make *and* break" key. In addition, the hand generator was too heavy and the inductances were found to be too fragile for pack set use. The WSA Co. set was found to be out of compliance with most of the specifications. Although the WSA Co. set earned points for neatness of design, workmanship, and finish, it was severely criticized for the manner in which all the various parts of the transmitter and receiver were enclosed. It was impossible to make repairs without taking the entire set apart. The antenna coils sparked at full power, and no antenna field rheostat was supplied. Many other deficiencies were cited. The National Electric Signalling Co. set received praise for including hinges so that many of the parts could be folded away when out of use, and for the use of springs to cushion some of the components. However, the receiver was judged "very poor," with the general workmanship and finish also being poor. Such a receiver was felt to be "entirely out of the question for field work. Interference would prevent most of the work."

The NESCO receiver showed the greatest sensitivity and by far the greatest selectivity. This meant that in the field a large number of such portable sets could be operating on slightly different wavelengths and that this receiver would copy from any of these at will with minimum interference from other undesired signals (see Table 6).

The contract was awarded to NESCO for the Type E pack set. This set had taps on the coils for the standard wavelengths to be used. These taps provided a simple and convenient means of adjusting both the open and closed circuits to any one of four desired wavelengths. All the necessary inductance for the primary was contained in one coil of the oscillation transformer. The 40-foot tall antenna mast was made in sections of hollow wood, which saved weight. The umbrella aerial consisted of a total of six wires, each 85 feet long. All in all, the NESCO Type E pack set was clearly superior to the competition.

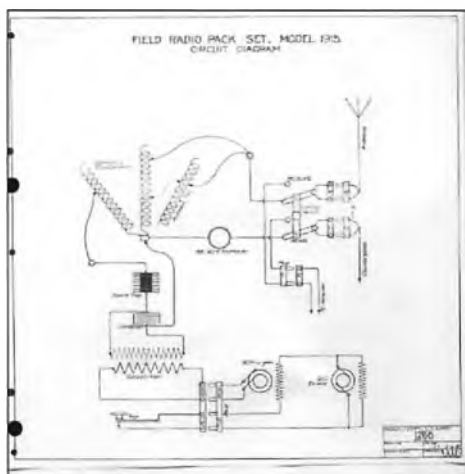
**Figure 36. Signal Corps Pack Set, Model 1915, circuit diagram.**  
(Source: August Link.)

### **The Signal Corps Model 1915 and 1916 Pack Sets**

The Signal Corps Model 1915 pack set (Figure 36) consisted of an operating chest containing the transmitter and receiver, a hand generator with two handles and a speedometer, a ten-section mast, a set of three pack frames and a tent complete with the necessary hammers, guy ropes and pins. Four legs were supplied with the chest. The entire transmitting and receiving set could be elevated on the four supporting legs to allow the operator to sit in front of it. This was a feature that would surface again as part of the SCR-49 (Figure 37) a year or so later. A toolkit and a copy of the Signal Corps circular "Radiotelegraphy" were also included [43]. How many of the Model 1915 sets were made is not known, nor is it clear whether competitive bidding for pack sets became common practice in the Signal Corps.

The required speed to turn the hand generator was raised to 50 R.P.M, instead of the 33 R.P.M. required for the 1913 machine. At the higher speed, less force was required on the handles and it was less tiring on the men.

A total of 36 pack sets were made to Signal Corps specifications in 1916. These were quenched-gap transmitting sets, with the receiver being the General Electric Company Type D [44]. The Model 1913 had included the Type B receiver, and the Model 1915 used the Type C receiver. The Type D receiver was practically the same as the Type C with the number of contact studs in the three dials increased to give finer tuning. It is not certain whether these earlier receivers were also



**Figure 37: SCR-49 on supporting structure for operation. The supporting structure is the same as the one supplied with Signal Corps Model 1915. (Source: August Link.)**

made by General Electric although it seems likely [45]. It is also not known how General Electric obtained this contract with the Signal Corps, nor why their receivers were considered the best for the Signal Corps sets while the same receivers did not gain favor with the Navy.

The Signal Corps Model 1916 pack set was the set designated the SCR-49 (Figure 38). (The "SCR" indicates that it is a complete system rather than a basic component.) Its production in 1916 and 1917 occurred at about the time that the new Signal Corps nomenclature for referencing complete radio and radio components was adopted. When the SCR-49 went into production, it made an earlier inductively coupled version called the SCR-44 (probably the Model 1915) obsolete. The SCR-49 was a 1/4-kW set which included a six-wire, 40-foot high umbrella antenna and a hand generator [46]. It also included a safety gap similar to those in previous sets which protected the receiver in case the usual connections to the key failed to short out the receiver while the transmitter was in use. There were three pancake coils in the lid of the set. The inner one was the loading coil while the outer two were the inductances for the oscillation transformer. These coils could be swiveled away from the loading coil to vary the coupling. Like prior NESCO sets, the SCR-49 was supplied with a toolbox (Figure 39), which was located directly underneath the very plain and simple transmitting key in this set [47].

#### **World War I and the CN 241-253 (NESCO Type F)**

Up to 1917, NESCO had manufactured a total of 103 pack sets of all types for the Navy. The demand for pack sets jumped dramatically between 1917 and 1919. During these war years, NESCO manufactured 325 sets for the Navy. These pack sets represented the zenith of portable set design and they were far more sophisticated than any preceding sets (Figure 40). They were the last of the line of spark pack sets made for the Navy, and included a receiver and a special wave changer designed entirely by George H. Clark. They were manufactured under Schedule 72. The only other bidder was De Forest, to whom a ten-set contract was awarded to help encourage him to develop a vacuum tube set for field use.

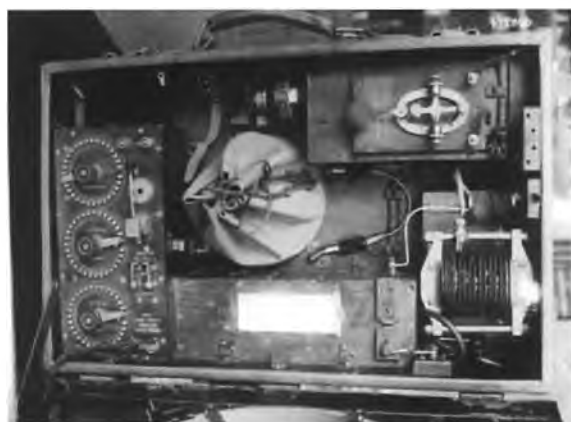


**Figure 38:** SCR-49, a 1916 model Signal Corps pack set. The receiver was the GE Type D. (Source: August Link.)

The wave changer in the set was efficient but was very difficult to adjust (Figure 41). To avoid end-turn losses, there were plug connections from coil to coil. Electrically they were excellent sets, but they were just too difficult for enlisted men to properly operate. When properly adjusted, a single setting of the mechanical coupling mechanism allowed the sets to work on several wavelengths. Unfortunately, few operators succeeded in finding this setting.

The set had a very versatile but heavy generator and gasoline engine. These were mounted on a single base along with a hand generator and direct current motor which was used for lighting and other electrical appliances (Figure 42). This made the set very heavy and hard to handle, even for four soldiers.

This same basic transmitter and receiver set, the NESCO Type F, was given several different Navy type numbers. Since "CN" was the 2-letter designator assigned by the Navy to NESCO, the Type F set was known as the CN 209, CN 241, CN 251, CN 252, and CN 253. The sets were designed to be used with several different types of power supply, and hence required different motors to function with each of them. As a result, different type numbers were given to the different sets. Occasionally there



**Figure 39:** SCR-49, note the box containing the toolkit located underneath the key. (Source: August Link.)

**Figure 40:** CN 241 by NESCO, with wavechanger and receiver designed personally by George H. Clark. Last of the NESCO spark pack sets for the Navy, made about 1917.



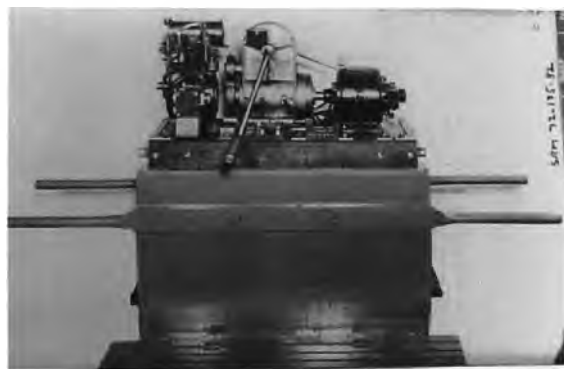


**Figure 41:** *Detail of the special wavechanger made for the CN 241-253 type NESCO pack sets circa 1917. (Source: New England Wireless and Steam Museum)*

were minor design variations, but there were no substantial differences between the various types of sets in this series. The first type was the CN 209, but the contract was cancelled and it was redesigned as the CN 241. The CN 241 used a 120-volt DC supply. The CN 251 was the same radio designed for use with a motor supplying 230 volts DC. The CN 252 was again the same radio designed for use with a motor supplying 80 volts DC. The CN 253 was also the same radio except that a different antenna and counterpoise were used. The CN 241 and CN 253 were used most frequently, because the 120-volt DC supply was the most common power source.

### Conclusion

Although the WSA Co. advertised the Q-S-250 250 W quenched-gap rig, hand generator, and accessories for commercial use in 1919 [48], there were several reasons why the NESCO 1917 sets were the last pack sets of their type made by anyone for use by the Navy. Foremost perhaps was the fact that spark transmitters were doomed to obsolescence by the growing use of tubes and continuous-wave radios. Another reason was that these “portable” radio sets had really ceased to be portable. As their complexity increased, they simply weighed too much and were too bulky to justify that name. And lastly, there were too many delicate adjustments needed, and it was beyond the ability of the ordinary Navy radioman to understand and operate the set properly.



**Figure 42:** *CN 241-253, gasoline driven generator, hand generator and DC motor all mounted on one base. This unit proved too heavy for a portable set.*

Even George H. Clark eventually admitted that the 1917 pack sets were far too elaborate for a military device which was to be used by landing parties in a hurry, and that the power plant was unnecessarily cumbersome. In his own words, Clark stated that "they were electrically darn good sets, but as military devices, they were not so hot. And they were the last of their class [49]."

**Table 1.**  
**NESCO Pack Sets for the U.S. Navy**

<i>Type of Set</i>	<i>Delivery Date</i>	<i>Contract Type</i>	<i>Competitors</i>	<i>Number Made</i>
Fleet	1909	Exclusive	_____	2
Sweet	1910	Exclusive	_____	5
Battleship	1912	Exclusive	_____	4
Type A	1912	Exclusive	_____	5
Type B	1913	Exclusive	_____	10
Type C	1913	Competitive	Marconi Wireless Improvement Co.	15
Type D	1914	Competitive	Wireless Improvement Co., WSA Co.	35
Type E	1916	Competitive	WSA Co. National Elec. Signalling Co.	25
CN 241-253 (Type F)	1917 - 1919	Competitive	DeForest (Audion test)	325

**Table 2.****Data on NESCO Pack Sets for the U.S. Navy**

<b>Type of Set</b>	<b>Number of Gaps in Quenched Gap</b>	<b>Transformer Secondary Voltage</b>	<b>Aerial to be used with set</b>	<b>Wavelength Range</b>
<b>Fleet</b>	<b>Open Gap</b>	<b>?</b>	<b>?</b>	<b>?</b>
<b>Sweet</b>	<b>10</b>	<b>10,000 V.</b>	<b>Single wire 84 feet long</b>	<b>90-210m</b>
<b>Battleship</b>	<b>9</b>	<b>5,000 V.</b>	<b>Single wire 30-80 feet long</b>	<b>90-210m for 2 sets, and 400-600m for 2 sets</b>
<b>Type A</b>	<b>9</b>	<b>9,000 V.</b>	<b>Standard Portable aerial (Umbrella type) or ship's aerial</b>	<b>no data</b>
<b>Type B</b>	<b>9</b>	<b>9,000 V.</b>	<b>Portable Aerial</b>	<b>228-870m</b>
<b>Type C</b>	<b>9</b>	<b>10,000 V.</b>	<b>Standard Portable or ship's aerial</b>	<b>200-600 with portable aerial, up to 1200m with ship's aerial</b>
<b>Type D</b>	<b>9</b>	<b>9,000 V.</b>	<b>Standard Portable or ship's aerial</b>	<b>250-1380m</b>
<b>Type E</b>	<b>20</b>	<b>11,300 V.</b>	<b>Standard Portable or ship's aerial</b>	<b>250-950m with portable aerial, up to 1200 m with ship aerial</b>
<b>CN 241 - CN 253(Type F)</b>	<b>9?</b>	<b>11,300 V.</b>	<b>Standard Portable or ship's aerial</b>	<b>300-1200m</b>



**Table 3.**  
**Weights of Components in Pounds (Schedule 5639)**

<b><i>Component</i></b>	<b><i>NESCO</i></b>	<b><i>Marconi</i></b>	<b><i>Wireless Improvement Co.</i></b>
Motor Generator	38	54	none
Motor Generator in case	48	62	none
Transmitter and Receiver in Case	52	52	47
Spare Parts and Tools	28	none	none
Hand Generator	69	88	90
Hand Generator in Case	76	no case	no case
Hand Generator Stand	63	36	none
Antenna Parts in Case	68	84	none
Antenna Pole and Parts	63	63	none

**Table 4.**  
**Competitive Testing In 1914 for Schedule 5639**

<b>Component</b>	<b>NESCO</b>	<b>Wireless Improvement</b>	<b>Marconi Co.</b>
<b>Motor Generator</b>	Slight irregularities in speed under load, heating moderate	Not supplied.	Regulation of speed good, heating excessive
<b>Hand Generator</b>	Direction of rotation indicated, stand excellent	Not supplied	Direction of rotation not indicated. Stand not rigid. Unsatisfactory base for use on soft ground
<b>Transformer</b>	Good, well protected	Good, well protected	Not well protected as only hard rubber sheet is placed around it. Did not deliver desired power
<b>Condenser</b>	Losses fairly low, mechanical vibration observed	Losses low, heated on load and sealing compound flowed out	Losses high (ebonite dielectric)
<b>Spark Gap</b>	Fair	Excellent	Good
<b>Inductances</b>	Excellent, inductive coupling supplied, method of variation of coupling excellent. Any desired wavelength obtainable, as variation not limited to any fixed amount of coil	Poor. Direct coupled	Good construction, inductively coupled. Method of variation too critical. Variation limited to whole turns. Poor.
<b>Break Key</b>	Supplied, works fairly well	Not supplied	Not supplied
<b>Receiver</b>	Fair	Excellent	Poor
<b>Detector</b>	Adjusting mechanism poor, point hard to hold	Excellent adjustment	Adjustment not easy
<b>Spare Parts and Toolkit</b>	Complete	None	None

**Table 5.**  
**Receiver Testing in 1914 for Schedule 6896**

<b><i>Test/Component Type</i></b>	<b><i>NESCO</i></b>	<b><i>WSA Co. and Wireless Improvement Co.</i></b>
Receiver Type	NESCO/no type number	IP 111 (Both companies)
Detector Type	Galena and steel spring	Pyron and steel spring (A Pyron detector is one with a metallic contact onto pyrite)
Selectivity	Good	Good
Sensitivity	Good	Good
Adjustability	Easy	Difficult

**Table 7.**

**Summary of Known Early Signal Corps Pack Set Year Models**  
(As far as known, all made by NESCO)

<i>Model Year</i>	<i>Type of Gap</i>	<i>Coupling</i>	<i>Number Made</i>	<i>Comments</i>
1906-9 (Probably in development as early as 1906 with first delivered to the Signal Corps in 1907 and the Navy in 1908)	Open	Direct	2 made for the Navy, probably another 2 for the Signal Corps, maybe more.	Leyden tube condensers, perikon or silicon detector; each consisted of 2 trunks and storage battery box.
1912 (Presumably included Type A receiver)	Quenched	Probably inductive	Unknown	No data known for models between the 1908/9 and 1912 models.
1913 (Included Type B receiver)	Quenched	Inductive	Unknown	250 watt, 500 cycle generator, more power and wavelength capability than 1912 model.
1914	Quenched—wiring diagram shows 7 gaps	Inductive	Unknown	Similar to 1913 model.
1915 (Included Type C receiver)	Quenched—wiring diagram shows 6 gaps	Inductive	Unknown	Probably later designated the SCR-44, also similar to the 1913 model.
1916 (Receiver is the GE Type D on most if not all.)	Quenched	Inductive	36 at least	Later designated the SCR-49.

**Table 6.****Competitive Testing in 1916 for Schedule 8876**

<b>Comparison</b>	<b>NESCO</b>	<b>NE Signalling Co</b>	<b>WSA Co</b>
<b>Price</b>	<b>\$973</b>	<b>\$2129</b>	<b>\$1063</b>
<b>Total Weight of set</b>	<b>391 pounds</b>	<b>404 pounds</b>	<b>400 pounds</b>
<b># of specifications in compliance (13 max)</b>	<b>11</b>	<b>10</b>	<b>5</b>
<b>Transmitter output</b>	<b>satisfactory</b>	<b>unsatisfactory</b>	<b>satisfactory</b>
<b>Note of Signal</b>	<b>Good</b>	<b>Fair</b>	<b>Excellent</b>
<b>Damping</b>	<b>fair</b>	<b>excellent</b>	<b>fair</b>
<b>Receiver Sensitivity</b>	<b>excellent</b>	<b>excellent</b>	<b>good</b>
<b>Receiver Selectivity</b>	<b>excellent</b>	<b>poor</b>	<b>poor</b>
<b>Desirable comments</b>	<b>Workmanship excellent. Excellent receiver.</b>	<b>Components hinged, folding back, or on springs. Unique antenna transfer switch.</b>	<b>Workmanship excellent. Well-ventilated gap.</b>
<b>Undesirable comments</b>	<b>No short-circuiting clips for gaps. No means provided to keep cover propped open.</b>	<b>Very poor receiver from the standpoint of selectivity. Workmanship poor. Transmitting inductance very poor.</b>	<b>Entire set must be disassembled to make repairs to any part. Sparking between coils at full power.</b>

- [13] Howeth, Captain L.S., *History of Communications-Electronics in the United States Navy*, Washington, 1963, pp. 174-6.
- [14] Bucher, E.E., *Practical Wireless Telegraphy*, Wireless Press, NY, 1921, pp. 105-6.
- [15] Almost all ships at the time had a source of direct current. The motor generator consisted of a motor driven by the ship's direct current coupled to an alternating current generator (dynamo) that converted the direct current to the alternating current required by the wireless apparatus.
- [16] Starter rheostats prevented the application of excessive current to the windings of the motor generator during starting. Without the starter rheostat, the windings could be burned out.
- [17] This could be accomplished by either shorting the receiver during sending, as originally done by Stone, or by having a quick-moving lever change the antenna from the transmitter to the receiver, this lever being moved by the keying mechanism.
- [18] Report from Lt. G.C. Sweet to The Commander, Fifth Division, U.S. Atlantic Fleet, August 2, 1910.
- [19] Clark, George H., in Radioana collection, National Museum of American History, Smithsonian Institute.
- [20] Bucher, E.E., *Practical Wireless Telegraphy*, Wireless Press, NY, 1921, pp. 93-4.
- [21] Clark, George H., in Radioana collection, National Museum of American History, Smithsonian Institute.
- [22] The oscillation transformer was the set of coils that accomplished the inductive coupling between the antenna and the transmitter.
- [23] Kleinman, R., Kreuzer, J., Blisard, K., and Kreuzer, F., "Spark Keys: The Interplay of Wireless History and Technology," *The AWA Review*, Vol. 14, 2001, p.30. The "Automatic Cram" was named after E. R. Cram.
- [24] From the program for the testimonial dinner for Major General Joseph O. Mauborgne, 1941.
- [25] The umbrella antenna was the type called the "Standard Portable Aerial". Its general shape resembled an umbrella and it consisted of a number of wires insulated at both ends (the ribs of the umbrella) and spread radially from a central mast. This type of antenna was used extensively in portable field sets, but it was not widely used in commercial stations except those designed by German engineers.
- [26] The so-called "hot-wire" ammeter depended on the principle of expansion of metals when heated. Linear expansion of a fine wire element heated by the traversing current caused movement of the indicator. See *High Frequency Apparatus* by Thomas Curtis Stanley, Everyday Mechanics Co., Inc., NY, 1916.
- [27] "Instructions for Setting up and Operating Field Radio Pack Set Model 1913," *Signal Corps Bulletin No. 18*, War Department, 1913.
- [28] Exactly which Signal Corps model year pack set became the SCR-44, and which later became the SCR-49 is not known with certainty. The SCR-49 is presumed to be the 1916 Model since the GE Type D receiver dated 1916 is one part of it.
- [29] *Radiotelegraphy*, U.S. Signal Corps, GPO, 1917
- [30] Cram, E. R., note to G.H. Clark, about 1913.
- [31] Information from Marconi Company website.
- [32] Memorandum for Chief of Bureau May 9, 1913, in Radioana, NMAH.

## Acknowledgements

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## Photo Credits

Unless otherwise noted, the source of all photos is the Radioana Collection, Archives Center, National Museum of American History, Smithsonian Institute.

## Reference Notes

- [1] For our purposes, the terms "pack set" and "trunk set" will be considered interchangeable. More precisely, this article deals only with trunk sets, since the term "pack set" can also refer to other types of portable wireless installations.
- [2] Testimony of Lt. W.A. Eaton, in US District Court, Dubilier Condenser Co. Inc. vs. Wireless Specialty Apparatus Co., 1919.
- [3] Preliminary Deposition of Lt. Commander U.W. Conway, U.S.N., Dubilier Condenser Co. Inc. vs. Wireless Specialty Apparatus Co., 1919. This suit dealt with primacy of the patent rights regarding condenser technology, and eventually resulted in WSA Co. settling with Dubilier after the war.
- [4] Collins, Francis A., *The Wireless Man*, NY, The Century Co., 1913, p. 186.
- [5] Trench and buzzer sets were developed for this purpose and performed better under fire, see Corcoran, Capt. A.P., *Wireless in the Trenches*, *Popular Science Monthly*, May, 1917, pages 795-799.
- [6] Not to be confused with the National Electric Signalling Company which was also known as NESCO. It was an entirely separate company.
- [7] Clark, George H., in Radioana collection, National Museum of American History, Smithsonian Institute.
- [8] Duvall, Edward B., "A History of the National Electric Supply Co.," originally published as *AWA Monograph No. 2*, 1961 and later expanded by David Harry and reprinted in *AWA Review #8*, 1993, pp. 117-121.
- [9] Collins, A. Frederick, "The Slaby-Arco Portable Field Equipment for Wireless Telegraphy," *Scientific American*, December 28, 1901, pp. 425-6.
- [10] For direct coupling, the oscillating circuit and the antenna circuit are connected physically to each other. In an inductively coupled circuit, the two circuits are connected by the electromagnetic field induced by the coils.
- [11] Clark, George H., in Radioana collection, National Museum of American History, Smithsonian Institute.
- [12] Leyden tubes were a test tube-shaped form of the Leyden jar, an early condenser. The inner and outer surfaces of the glass tube were coated with tin foil, and the glass acted as the dielectric.

## **Authors' Biographies**

### **Russ Kleinman - WASY**

Russ was born in Cleveland, OH, but grew up in southern California. He attended Stanford University as an undergraduate, and Case Western Reserve University in Cleveland for medical school. He did his internship and residency in General Surgery at the University of New Mexico in Albuquerque. Russ met Jim and Felicia Kreuzer at the Dayton Hamvention while he was in practice in Cincinnati. After a few years in Ohio, Russ returned to New Mexico.

Russ, WASY, received his first amateur radio license in 1971 at the age of 16. He has been active in many phases of the hobby, but telegraphy has always been a primary interest. His major passion is the history of telegraphy and he has collected telegraph keys for 20 years. Although his collection of telegraph keys is extensive and varied, spark keys are his favorite, and he has spent the last several years pursuing information on spark key history. Much of this information is organized into the Spark Key Project, which is available on his webpage: <http://www.zianet.com/sparks/index.html>



### **Karen Blisard - N5IMW**



Karen was born and raised in Lubbock, TX, where she attended Texas Tech University as an undergraduate. She received her PhD in Pharmacology and her MD from Case Western Reserve University in Cleveland. She did her residency in Pathology and fellowship in Neuropathology at the University of New Mexico in Albuquerque. She was on the faculty at the University of Cincinnati Medical Center before returning to New Mexico to go into private practice in pathology. Karen, N5IMW, was first licensed in 1984, and earned her extra class license in 1986. She concentrates on CW and DX, and enjoys operating as a DX station. Her other hobbies

include gem cutting and birdwatching. She helps with financial support of Russ's telegraph key addiction and is an excellent key-spotter.

Russ and Karen have been married for 21 years and live in beautiful southwestern New Mexico. Their home at 6,700 feet at the edge of the Gila National Forest is shared with a border collie, two shelties, elk, mountain lion, bobcat, bear, deer, javelina and various wild birds including hummingbirds in season.



- [33] Photos and company brochure given to G.H. Clark by Richard Pfund of Telefunken W.T. Co of the United States (Atlantic Comm. Co.)
- [34] Massie and Underhill, *Wireless Telegraphy and Telephony*, Van Nostrand Co., 1908, pp. 47-8.
- [35] *Portable Wireless Telegraph Sets*, company brochure, United Wireless Telegraph Company, undated.
- [36] Societe Radio-electrique, *Vingt-Cinq Annees de T.S.F.*, published by the SFR about 1935.
- [37] Douglas, A., *Radio Manufacturers of the 1920's*, vol. 3, p. 175.
- [38] Preliminary Report on test of portable radio sets, Schedule 5639, from Subinspector, Naval Radio Stations, G.H. Clark, to Chief of Bureau of Steam Engineering, August 18, 1913.
- [39] Test of Portable radio sets, from Subinspector, Naval Radio Stations, G.H. Clark, to Chief of Bureau of Steam Engineering, August 18, 1913.
- [40] Instruction booklet, *Portable Radio Set Type "C" 1913*, National Electric Supply Co., Washington, DC
- [41] Kitchen, H. W., *1914 Contract U.S. Navy Pack Sets, Receiving end test results*. U.S.N. Radio Laboratory, Bureau of Standards, 1914.
- [42] "Test of Portable radio sets submitted under Schedule 8876", from G.H. Clark to Engineer Officer, Feb. 16, 1916.
- [43] *Technical Equipment of the Signal Corps, 1916*, Washington GPO, 1917
- [44] This "type" nomenclature for the receivers used in the Signal Corps sets is completely different from the NESCO nomenclature for complete sets made for the Navy. While the presumption would be that the Type A, B, and C receivers were also made by G.E., it is not actually certain that this was the case.
- [45] Personal communication from Mike Feher. See the General Electric website for company background. G.E. began as Edison G.E. around 1890, formed by the consolidation of holdings by Thomas Alva Edison.
- [46] *Storage Catalogue*, Signal Corps, Washington GPO, 1920
- [47] *The Principles Underlying Radio Communication*, 2nd Edition, Signal Corps, U.S. Army, GPO Washington, 1922.
- [48] WSA Co. catalog, 1919. See *AWA Review #14*, 2001, pg. 58 for pictures of the WSA Q-S-250.
- [49] Clark, George H., typewritten note 9-5-1940, in Radioana collection of the National Museum of American History, Smithsonian Institute.

## August Link



August (AJ) was born in Tartu, Estonia in 1940. After the Russians invaded that country and killed his father, he and his mother fled to Germany and then Los Angeles where AJ attended high school and graduated from UCLA with a B.S.E. AJ worked as a systems engineer for Sprague Electric and North American Rockwell before starting his own company, Surcom Associates, in 1970. Surcom Associates is a major supplier of High Power RF capacitors.

From an early age AJ was interested in historical items and eventually that interest, plus years of selling military surplus while attending high school and college, led to collecting military radios. This endeavor began with a WWI Signal Corps SCR-68

aircraft transceiver. The start of his dedicated military equipment collection began with the addition of a Navy 1917 CF-99 tube type motorboat set manufactured by The de Forest Telephone and Telegraph Company.

AJ has been collecting for more than 30 years. Initially he concentrated on American World War I vintage equipment and earlier military electronic memorabilia. Later, he expanded the scope of the collection to include the period between wars and eventually to World War II equipment. His collection contains pieces dating from 1907 to 1945 and includes some representative foreign radios.

## **James H. Kreuzer - N2GHD**

James Kreuzer was born in Buffalo, New York in 1953. Jim's fascination with radio began in 1963 when he purchased his first vintage radio, a Philco 89, at a White Elephant sale for 25 cents. He collected a few battery sets from country auctions during the 1960's, but then fell out of touch with the radio scene, substituting drag racing for a few years. From 1974 -1978 he and Felicia attended auction sales and flea markets in search of battery sets of the 1920s. In a short period of time the house filled to capacity with radios, parts, tubes and literature. By 1980 Jim was specializing in Pre-1920 wireless equipment, especially Marconi apparatus.



Jim received three years schooling in technical electronics and then worked for eighteen years as a diesel mechanic for Conrail railroad before starting off on a new career. In 1985 he formed "New Wireless Pioneers" and became a seller of rare and out of print radio, telegraph, and electrical books. Jim is a member of The Radio Club of America and is respected as an authority on Marconi history and apparatus. He has acted as an appraiser for the Canadian Marconi Company and the Canadian National Museum of Science and Technology. He and Felicia own one of the most extensive wireless collections and electrical/wireless libraries in the country. Many pieces of rare wireless apparatus (including spark keys) and ephemera from their collection as well as a few duplicate items are for sale on their website: <http://marconi-wireless.com>

## **Felicia A. Kreuzer - KA2GXL**

Felicia is a native of Minneapolis, Minnesota where she was born in 1955. Felicia joins her husband as an avid collector, historian and speaker on early wireless apparatus and literature. A ham radio operator since 1979, she has recently received her Bachelor's Degree in Management and works for Moog Inc. as a Sales Administrator. She is a Charter member of the Niagara Frontier Wireless Association and served as its president since 1988.



Jim and Felicia have a 20-year-old daughter now in her 4th year of a Master's Program in Occupational Therapy and a 12-year-old son who is just beginning to search out early wireless books and apparatus on his own! Felicia enjoys collecting X-Ray apparatus and books, as well as ephemera, especially autographs: the collection now includes letters from Oersted, Morse, Faraday, Maxwell, Hertz, Tesla, Lodge and of course, Marconi!

## A Confusion of Similar Volumes

After 25 years of collecting, upon reviewing my library, I found what appeared to be **THREE** versions of the first Volume of *Rider's Perpetual Trouble Shooter's Manuals*, and **TWO** versions of Volume II, an RCA/Radiotron Riders which is titled *COMPLETE Perpetual Trouble Shooter's Manual*, as well as the set of Rider's Manuals, Volumes I to XV, and the five manuals by Hugo Gernsback. I was really surprised by the many Riders books, and I was curious enough to tabulate and compare the differences between what were apparently successive editions of these Manuals. Then I learned that John Rider was working for Hugo Gernsback as Radio Service Editor for the *Radio-Craft Magazine* when he announced the publication of his *1931 Trouble Shooter's Manual*. He did this just six months after Gernsback had published his own *Official Radio Service Manual*. Now I was really intrigued!

Gathering the facts surrounding the publication of these early Rider's radio manuals became so absorbing that I was moved to write an article on the various versions of Volume I [2]. This was edited by Dorothy Schechter, and published in the June, 1998 *Antique Radio Classified Magazine*. Interested readers wrote to me, describing two additional versions of Volume I, and two more versions of Volume II. Through collectors' good will and help, I was able to obtain copies of these other less-well-known *Rider's Manuals* to help me explore their differences and similarities. This resulted in another article on Rider's Volume IIs [3], which was also edited by Dorothy Schechter and published in the February, 2000 *Antique Radio Classified Magazine*.

Since the publication of these first two articles, a "Prototype" of Rider's first *1931 Trouble Shooter's Manual* has been discovered. I have studied this and the RCA/Radiotron *COMPLETE Perpetual Trouble Shooter's Manual* to determine their place in, and influence on, Rider's manuals.

There have been several excellent articles, such as those by Ludwell Sibley [4], and Richard Gray [5], which give descriptions of John F. Rider's manuals, his other publications, and of Rider himself, but their broad coverage of Rider's publications does not always include detailed descriptions of each publication.

This article concentrates on the first few (and lesser known) *Perpetual Trouble Shooter's Manuals*, and gives the dates and the circumstances in which Rider found himself when each volume was published. An attempt is made to tell how each manual may be uniquely identified and to bring its differences in content, appearance, and physical make-up to the attention of both radio repairers and bibliophiles.

An important aspect of Rider's circumstances is the story of John F. Rider's interactions with his employer, Hugo S. Gernsback, and his one time collaborator, RCA Radiotron/Cunningham Tube Company, and the effect they had on the timing, content, and format of Rider's publications.

There is no attempt to cover the many Riders manuals which he sold or provided to Tung Sol and National Radio School, etc. These were typically his standard manuals enclosed in special promotional or institutional binders. These "spin-off" manuals had little influence on the basic contents or organization of Rider's early manuals.

## **John F. Rider, Hugo Gernsback, and RCA Radiotron:**

### **The Saga of Rider's Early Radio Manuals**

by

**Charles C. Kirsten**

#### **The Rider's Myth**

In the summers of 1938 and 1939 while employed as a teenage tyro doing radio repair, I occasionally found the shop owner using a Riders manual that I needed. When my attempt to use an abridged manual failed to provide a full schematic, my convictions were confirmed; I "knew" that only the regular *Rider's Perpetual Trouble Shooter's Manuals* covered all the sets ever built. In those days, John F. Rider had been publishing his service manuals for seven years, so for me, Rider's manuals held the same historic credibility as a set of the *Encyclopedia Britannica*, or *Webster's Unabridged Dictionary*.

In 1975, on desk assignment to a NASA Headquarters office in Washington, D.C., The nostalgia bug bit me and I started to collect old radios. By luck, I was able to buy a set of well cared-for Riders Manuals from a meticulous retired radio repairman who, I'm sure, had carefully inserted every one of Rider's supplements into the manuals. I was comforted, knowing that the manuals contained schematics for every old pre-World War II radio made in the U.S.

Then, at the Gaithersburg flea market, I found five two-inch-thick leatherette covered *Official Radio Service Manuals* by Hugo Gernsback; one for each of the years 1931 through 1935. When I compared them to the same years of the Riders Manuals, I was dumb-founded! In addition to the information overlap, the Gernsback manuals had many schematics not contained in the Riders manuals [1]! So much for what I "knew;" the regular Riders Radio Manuals do **not** cover all of the sets ever built.

and design data to be openly published, it has been helpful to divide his struggle into four successive phases. These are summarized here, with dates, and titles of his relevant publications, which are discussed and elaborated in detail in later pages:

### **Phase 1: Summary and Publications from the mid 1920s until December, 1929**

In this period Rider was trying by personal appeals to various radio manufacturers to solicit their cooperation in providing radio schematics for use by independent radio servicemen, and for publication in his service instruction manuals. Frustration was high, and progress was made mostly with the major radio companies, who had no fear of patent suits, or circuit piracy. During this time, Rider published the following two textbooks for servicemen:

- a. *The Mathematics of Radio*, Volume I of THE SERVICE MAN'S MANUAL, a soft bound textbook on mathematics, August 11, 1929
- b. *Trouble Shooter's Manual*, Volume II of THE SERVICE MAN'S MANUAL, bound diagnosis text, (165 commercial diagrams). August 11, 1929

### **Phase 2: Summary and Publications from January, 1930 to May, 1931**

Rider was Radio Service Editor of *Radio-Craft Magazine* under Hugo Gernsback during this period. He co-authored a book on servicing sound motion picture equipment, and advertised and published two others on radio repair. Meanwhile, Rider succeeded in persuading many manufacturers to release their radio schematics to be published. Five months after he became editor, Rider had received enough schematics to advertise for sale a new group of 115 loose-leaf schematics. Viewed as a competitor by his employer, Rider's work was repressed until Gernsback could publish his own *Gernsback's Official Radio Service Manual*. Meanwhile, Rider quietly continued to collect schematics and assembled a manual (Item g) which appears to have been the prototype of his first *1931 Trouble Shooter's Manual* (Item h). Rider's publications during this period were:

- c. *Sound Pictures and Trouble Shooter's Manual*, by James R. Cameron, and John F. Rider, publ. by Cameron Press, May, 1930
- d. *Supplementary Diagrams Pkg #1*, (115 for \$2.50; offered as "Supplements to the 1929 Trouble Shooter's Manual"), May, 1930
- e. *Practical Testing Systems*, by John F. Rider, 144 page hard bound text book, January, 1931
- f. *Practical Radio Repairing Hints*, by John F. Rider 250 page hard bound book, February, 1931
- g. *Perpetual Radio Reference Data* (1st Edition Pre-release), rare Prototype Edition, unadvertised manual, circa March, 1931

### **Phase 3: Summary and Publications from May, 1931 to March, 1933**

From May, 1931, when Rider published his first *1931 Trouble Shooter's Manual* (and terminated from his position as Service Editor for *Radio-*

## **Publication Dates of the Editions**

John F. Rider was honest, idealistic, productive, and very persistent, but sadly, with the exception of his "1929" and "1931" Volumes, and a few Volume II manuals in "1932" binders, John F. Rider avoided dating any of his many insertions into his 1930s Manuals. None of the manuals show printers dates, and Rider didn't date any of the copyrights, forewords, or technical articles he wrote. That has made dating his books quite difficult. The dates given here were taken mostly from publication announcements in magazines, and from Introductions, where Rider indicates the sequence of publication of recent volumes, but few dates. In one case, a manual was not referenced, nor even advertised, so a comparison of mistakes and corrections made in Rider's Introductions was used to determine the order in which his manuals were written (Appendix A).

## **Rider's Goals**

John F. Rider was born in 1900. By the late 1920s, he had already found respect as a degreed radio engineer, and he was finding success as an author. He was a featured writer for four New York newspapers, and was associate, contributing or managing Editor for at least four recognized radio periodicals. Many of his writings were aimed at educating unschooled radio enthusiasts and showing repairmen how to analyze and repair the radios they built or fixed for profit.

In the process, Rider apparently formulated an "ideal" of what specific data was needed for each radio set, to enable a radioman to quickly diagnose, locate and repair a radio receiver problem. In his various articles and writings, he often alluded to his desire to provide all radio "trouble shooters" with this "complete" set of data for each piece of equipment in a future manual. The information he regarded as essential included, but was not limited to: an accurate schematic diagram, parts identifications, parts values, parts layouts, point-to-point resistance values, test-point voltage tables, adjustments and alignment procedures.

Having defined an "ideal," Rider seems to have made it his mission to gather this "Complete" servicing information in a manual for service men. His first efforts in 1929, showed that much of the information either didn't exist, or was deliberately withheld by manufacturers as proprietary information. When John Rider approached companies such as Ozarka, Stewart Warner, or DeForest, and proposed that he take copies of their schematics, the results of years of company research and development, and put them in a book for public sale, he must have met with varying degrees of incredulity, or even hostility. Such companies had strong franchises with their dealers and fostered "company secrecy" about their products. In most cases, he was simply shown to the door. But as his manuals attest, he was a man of great persistence, and in the end he won most of them over.

## **A Summary of the Four Phases of Rider's Success**

In trying to understand the history of Rider's efforts, and the chronology of his success in getting the radio manufacturers to allow their circuit diagrams

- p. *Perpetual Trouble Shooter's Manual, Volume II* (2nd Edition) (Volume II in manufacturers folio format), August, 1933
- q. *Perpetual Trouble Shooter's Manual, Volume I* (3rd Edition) (Volume I in manufacturers folio format), November 15, 1933
- r. *Modern Tube Index* (New) 27" by 22" wall chart of 155 tube types by 17 different manufacturers, December, 1933

## Rider's 1929 Bound Volume Trouble Shooter's Manuals

### Phase I Narrative: Mid 1920s to December, 1929

## The 1929 Service Man's Manual

In August, 1929, John Rider published *THE SERVICE MAN'S MANUAL* [6] (Figure 1). It consisted of the two separately bound, one-inch thick texts which were intended to be bought and used together by radio school students. Of these, the first volume:

*The Mathematics of Radio: THE SERVICE MAN'S MANUAL, VOLUME I, 1929*, is not included in TABLE I on page 20, because it is not a typical Rider's "Trouble Shooter's Manual." As shown in the *Radio World Magazine* advertisement [6] (Figure 1), it is in fact, a text on mathematics. The 1929 Volume I is so scarce or unrecognized, that of six people who wrote to say they had a 1929 Volume II, only one, Ray Thompson of Johns Hopkins University, actually owned a copy of the 1929 Volume I, and knew that the title was *The Mathematics of Radio*. Charles Combs, owner of a Volume II, said

RADIO WORLD

August 30, 1937

# Rider Lifts a BIG Load Off the Service Man's Chest!

In New Book Noted Radio Engineer Devotes 288 Pages to Trouble Shooting in All Receivers and Clears the Wiring Diagrams of Factory-Made Sets in 290 Illustrations—You Can Carry This Book Around With You—No More Trouble Tossing Out Circuits.

## "Trouble Shooter's Manual" By John F. Rider JUST OUT!

The first comprehensive volume devoted exclusively to the latest scientific means of service men's troubles. "The Troubleshooter's Manual" is published in its new cover a volume for service men, telling them how to find the cause of trouble in any receiver, and how to correct it. It is a book of 288 pages, with 290 illustrations, showing the cause of trouble in any receiver, and how to correct it. It is a book of 288 pages, with 290 illustrations, showing the cause of trouble in any receiver, and how to correct it.

The book is a complete guide to the service man's chest, and is a must for every service man. It is a book of 288 pages, with 290 illustrations, showing the cause of trouble in any receiver, and how to correct it.

JOHN F. RIDER  
Author, "Troubleshooter's Manual"

## Wiring Diagrams of All These Receivers!

Here are the 22 chapter headings:

- 1. THE RADIO RECEIVER
- 2. THE RADIO SET
- 3. THE RADIO SET
- 4. THE RADIO SET
- 5. THE RADIO SET
- 6. THE RADIO SET
- 7. THE RADIO SET
- 8. THE RADIO SET
- 9. THE RADIO SET
- 10. THE RADIO SET
- 11. THE RADIO SET
- 12. THE RADIO SET
- 13. THE RADIO SET
- 14. THE RADIO SET
- 15. THE RADIO SET
- 16. THE RADIO SET
- 17. THE RADIO SET
- 18. THE RADIO SET
- 19. THE RADIO SET
- 20. THE RADIO SET
- 21. THE RADIO SET
- 22. THE RADIO SET

Some of the Questions Settled in Book:

- 1. Why does my receiver not work?
- 2. Why does my receiver not work?
- 3. Why does my receiver not work?
- 4. Why does my receiver not work?
- 5. Why does my receiver not work?
- 6. Why does my receiver not work?
- 7. Why does my receiver not work?
- 8. Why does my receiver not work?
- 9. Why does my receiver not work?
- 10. Why does my receiver not work?
- 11. Why does my receiver not work?
- 12. Why does my receiver not work?
- 13. Why does my receiver not work?
- 14. Why does my receiver not work?
- 15. Why does my receiver not work?
- 16. Why does my receiver not work?
- 17. Why does my receiver not work?
- 18. Why does my receiver not work?
- 19. Why does my receiver not work?
- 20. Why does my receiver not work?
- 21. Why does my receiver not work?
- 22. Why does my receiver not work?

## "The Mathematics of Radio"

By John F. Rider, author of "Troubleshooter's Manual". This book is a complete guide to the mathematics of radio, and is a must for every service man. It is a book of 288 pages, with 290 illustrations, showing the cause of trouble in any receiver, and how to correct it.

**Figure 1.** Radio World advertis August 11, 1929, back cover.



*Craft* the same month), until March, 1933 when RCA with Rider's cooperation, published the *Radiotron COMPLETE Trouble Shooter's Manual*, John F. Rider seemed to have a difficult time coping with the task of collating literally thousands of radio schematics and data. He also failed abjectly in his attempts to devise a practical page-indexing scheme for his *Trouble Shooter's Manuals*. In what appeared to be attempts to remove the dates on his manual binders, he published two editions of Volume I with four different titles, and two versions of Volume II. All of the listed early manuals from this period were eventually replaced during Phase 4 by volumes edited and published in Rider's final format:

- h. *1931 Trouble Shooter's Manual* (1st Edition, Version 1), (Copy of Pre-release Edition in a "1931" binder), May, 1931
- i. *Perpetual Trouble Shooter's Manual* 1931 (1st Edition, Version 2), (1st Edition, in a "Perpetual/1931" binder), July, 1931
- j. *Perpetual Trouble Shooter's Manual* (1st Edition, Version 3), (1st Edition, in a "Perpetual" binder), October, 1931
- k. *Perpetual Trouble Shooter's Manual*, Volume I (2nd Edition), (1st Edition revised, in a "Volume I" binder), November, 1931
- l. *Perpetual Trouble Shooter's Manual*, Volume II (1st Edition), (Volume II, with no date in a "Step Numerical" Format), August, 1932
- m. *1932 Perpetual Trouble Shooter's Manual*, Volume II (1st Edition) (Volume II, 1st edition in a binder stamped with "1932"), September, 1932

#### **Phase 4: Summary and Publications from March, 1933 to November, 1933**

The March, 1933 publication by RCA Radiotron of the *RCA COMPLETE Perpetual Trouble Shooter's Manual* (containing Rider Volumes I, II, & III schematics), marked the turning point of Rider's efforts to bring his *Trouble Shooter's Manuals* into final form. In spite of the high quality of the RCA manual, their decision to remove all information about vacuum tubes made by companies in competition with RCA/Cunningham, seemed to anger Rider, and strengthen his determination to make his own manuals more closely meet his "ideal."

As shown in the list of publications below, one month after the RCA "COMPLETE" manual was issued by RCA Radiotron, Rider published his *Perpetual Trouble Shooter's Manual*, Volume III. In Volume III, Rider adopted every improvement offered by the RCA Manual. He upgraded the binder and printing, but most importantly, he adopted the "Manufacturers Folio" cataloging method which RCA used in their *Radio Set Catalog* to identify the pages in Volume III. This was so successful, that he rewrote his first two manuals and wrote all subsequent manuals in the new format:

- n. *RCA COMPLETE Perpetual Trouble Shooter's Manual* (Rider Volumes I, II, & III schematics), March, 1933
- o. *Perpetual Trouble Shooter's Manual*, Volume III (1st Edition) (1933 manual in manufacturers folio format), April, 1933

Volume I, with the “flexible imitation leather cover” as offered in magazine advertisements such as the one appearing in *Radio World* of January, 1930 [7].

Excerpts from John F. Rider’s preface in Volume I, 1929 best describe what he intended the 1929 Volumes to be:

“*The Mathematics of Radio* is...not intended as a textbook of fundamental principles.....our interest is the interpretation of radio theory.

“The first volume, contains the general subjects, with samples of application.

“The second volume in turn dwells upon...complete units, such as receivers, amplifiers,...testing devices, etc. The second volume further contains the diagnosis and analysis of receiver troubles, in other words, ‘trouble shooting’.”

The Volume I title page shows that *Mathematics of Radio* is Volume I of *The Serviceman’s Manual*, Copyright 1929. Since the Title Pages and Forewords are the only evidence that the two books belong together, it is likely that owners of the math book are not aware of it’s connection as Volume I of *The Serviceman’s Manual*. Since it is purely a math text, it is shown here only to dispel the speculation that it is an earlier *Rider’s Trouble Shooter’s Manual*.

The second Volume of the Service Man’s Manual: *Trouble Shooter’s Manual*: **THE SERVICE MAN’S MANUAL, VOLUME II, 1929**, was first advertised with Volume I in *Radio World*, August 11, 1930 [6](Figure 1). This is the first book by Rider to carry the “Trouble Shooter’s” title. Figs 3 and 4 show the front cover and title page of Volume II, *The Trouble Shooter’s Manual*.

From the long popularity of Rider’s manuals, the title *Trouble Shooter’s Manual* became almost synonymous with a *Rider’s Service Manual*. Rider wasn’t the first to use the term in connection with radio servicing, but he was the first to include **multiple** identified commercial radio schematics, unlike the earlier examples of similarly named publications shown below:

“The Trouble Shooter,” a monthly feature in *Radio Age Magazine*, from June, 1922 to July, 1925.

“Trouble Shooting,” a monthly feature in *Popular Radio Magazine*, from July, 1924 to July, 1925.

*Radio Trouble Shooting* by Enno R. Haan, E.E., Assoc. Editor of *Popular Mechanics Magazine*; Goodhart-Willcox Co., Chicago; 317 pgs, 1928

The title must have really appealed to John F. Rider, for after using it for Volume II of his **1929 SERVICEMAN’S MANUAL**, he used it again in the title of *Sound Pictures and Trouble Shooter’s Manual* (Figure 5), the book he co-authored with James R. Cameron in May, 1930 [8]. Later, he used the title for all his Radio and Television manuals for as long as he published them.

The 1929 Volume II, bound textbook, *Trouble Shooter’s Manual*, devoted the first hundred pages to showing how to analyze various circuit malfunctions.

## Rider's 1929 Bound Volume Trouble Shooter's Manuals



Figure 2. 1929 Edition Volume I.

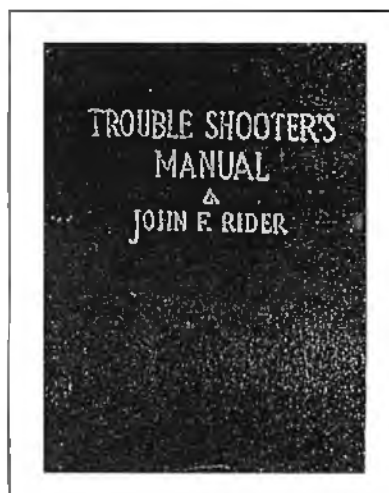


Figure 3. 1929 Edition Volume II.

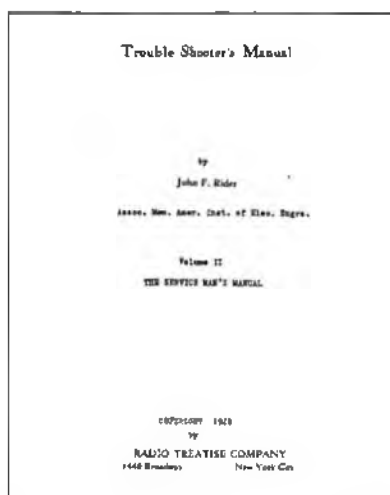


Figure 4. 1929 Volume II, Title Page.

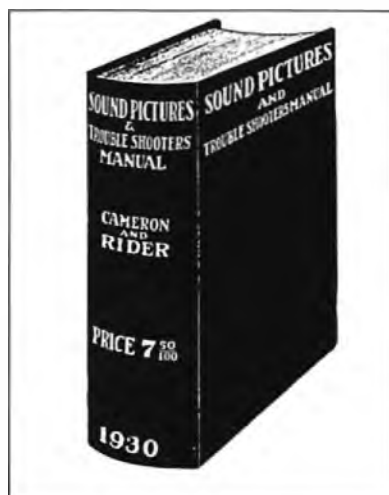


Figure 5. Manual by Cameron and Rider.

he had advertised in *Antique Radio Classified Magazine* several times for a 1929 Volume I to accompany his Volume II, with no response.

Ray Thompson's Volume I is hard-bound instead of having the "flexible imitation leather cover" offered in the magazine ads. Ray surmised that his was a Library of Congress binding.

After years of looking, only recently, did I finally spot an ARC advertisement by Dick DesJarlais, offering a good copy of the 1929 Volume I, *The Mathematics of Radio*. I was surprised and delighted at such an opportunity, and I immediately called Dick, and ordered the book. Figure 2. shows the front of the 1929

# Presenting . . .

## The New Editor of RADIO-CRAFT'S SERVICE MEN'S DEPARTMENT

Mr. John F. Rider will have editorial supervision of all material submitted to, and printed in the department of this magazine which is devoted to the special needs of the SERVICE MAN. Mr. Rider is already well known to many of our readers, as one of the best-informed and most practical authors and instructors in this phase of radio; and his appointment insures that the SERVICE MAN will find the contents of these pages worth-while reading.



JOHN F. RIDER

MR. RIDER'S active interest in radio has covered a period of some seventeen years; but in 1921, when the era of broadcasting began, he took up the subject as a profession, and applied his knowledge as an electrical engineer to both design and authorship. Throughout the period of radio development since then, he has designed commercial receivers and other apparatus, both as staff chief engineer and as consulting engineer for several manufacturers. He established his own research laboratory and has made extensive measurements on the performance of apparatus, particularly in the field of audio amplification, in which he has done much commercial work.

At the same time, Mr. Rider undertook the work of popularizing radio knowledge. The calculations of radio engineering are difficult for the most mathematical reader; but Mr. Rider possesses the happy knack

of putting difficult things in such a way that they are as easy as possible for the man who lacks formal training in the sciences. For that reason, his contributions have been continually in demand by the radio press. A weekly feature, "The Laboratory Scrapbook," was conducted by Mr. Rider in the columns of the *New York Sun Radio Section* since 1922; and has filled many a scrapbook for serious readers.

The service field, in fact, early impressed its tremendous importance on Mr. Rider, and he has devoted to it a great deal of his attention for the past three years. His latest book, "The Trouble Shooter's Manual," has received a good deal of praise from readers of *Radio-Craft*. Preceding it have been "Mathematics of Radio," "Design and Construction of B Battery Eliminators," "A.C. Tubes and How to Use Them," and "Trouble on Testing Units for Service Men." All these books are notable for their

practical nature and clear style.

Mr. Rider, with his grasp of the problems of audio amplification, was early active in the field of "tackle" engineering. He is at present associate editor of *Projection Engineering and of Radio Engineering*; and a contributing editor to *Motion Picture News*.

Mr. Rider will pass upon all the articles, submitted to this magazine, which deal with the problems of the SERVICE MAN; and we renew the invitation to all our readers to write and tell us their professional experiences, no matter in how plain a literary style. It is the endeavor of *Radio-Craft* to be a magazine BY the SERVICE MAN, as well as OF and FOR him.—Editor.

Figure 6. Radio-Craft Announcement - January, 1930, Page 295

when no schematic was available from the manufacturer. In the editorials of his new *Radio-Craft* Magazine, Gernsback stated that the magazine would be written for the benefit of the "Radio Assembler, and Radio Service Man." His editorial [11] in the September, 1929 issue, may have attracted John F. Rider to *Radio-Craft* by these words:

"There is also a demand on *Radio-Craft* to publish service data on commercial sets; not only those that have recently been put on the market, but those that have been in use for some time....heeding this demand, and beginning with the October (1929) issue, *Radio-Craft* will publish every month complete data on servicing commercial sets on which there seems to be the greatest demand."

Though John F. Rider was known as a prolific writer, it is still surprising to find that while fulfilling his duties as Service Editor for *Radio-Craft*, and assembling material for a new *Trouble Shooter's Manual*, Rider had also found time to co-author with James R. Cameron, a prominent motion picture authority and author, the book:

*Sound Pictures and Trouble Shooter's Manual*, by James R. Cameron, and John F. Rider, published by Cameron Press, May, 1930.

This is a large volume of 1200 pages and 500 illustrations, (See Figure 5) which according to the advertisement [8] in *Radio-Craft*, covered every type of projector equipment found in the U.S.A.

The remaining 101 pages show 188 commercial radio schematics which Rider obtained from 31 different manufacturers. Evidence of censorship by the manufacturers is seen all through the circuit section of the 1929 Volume II. Of the 188 circuits, only 70 have all parts and tubes marked with their values. Many circuits that appear to have values prove only to have cryptic manufacturer's part numbers or function labels such as "Grid Leak," "By-Pass," "Volume Control," etc. Many circuits have no part markings at all. One company left no room for doubt: "A Strict Observance of the Confidential Character of This Drawing is Required" streams across the top of each Freed-Eisemann drawing. Rider's Introduction to the 1929 Volume II tells more:

"Permission to publish the enclosed wiring diagrams was secured from the various manufacturers with the understanding that they would not be reproduced in magazines and newspapers without special permission and we trust that the readers of this book will cooperate with the author in this respect."

And these circuits so reluctantly offered by the manufacturers were **obsolescent!** Of the 165 indexed circuits, only three were recent 1929 models: (Majestic 180, Philco 82, and 86 and Federal K). Sixty-three were one year old 1928 models, and all the rest were two or more years old. As pointed out in an article [9] by Ed Lyon in *Radio Age*, there are only triodes (and diodes) in this 1929 Manual (except a Type 222 tetrode in a Freshman Q15 radio, and a '24 tetrode in the 1929 Federal Model K). Although fully replaced by later Riders manuals, this *1929 Riders's Manual* still holds interest from the *Trouble Shooter's Manual* viewpoint for these reasons:

1. It was the first *Trouble Shooter's Manual* issued by Rider.
2. It published a spectrum of commercial radio schematics almost two years before any other manuals, including Gernsback's *Official Radio Service Manual*.
3. It documents the severe opposition Rider faced in trying to bring commercial radio schematics to every serviceman.

**Phase 2 Narrative: January, 1930 to May, 1931**

### **Rider as *Radio-Craft* Service Editor**

From 1929 to 1931, John F. Rider was an associate editor of *Radio Engineering* Magazine, Managing Editor of *Radio Listeners Guide and Call Book*, and technical editor of *Motion Picture News*.

In January, 1930, John F. Rider took an apparently calculated step by joining the staff [10] of *Radio-Craft* Magazine (Figure 6) which Hugo Gernsback had just started in July, 1929. Ten years earlier, Hugo had started *Radio News* Magazine only to lose it to creditors after ten successful years. As owner and editor of *Radio News* Magazine, Hugo Gernsback had featured full-page diagrams, and repair instructions called "Service Notes" on one or more selected radios each month. For some schematics, presumably, Gernsback's staff must have been required to trace out the physical circuitry

from the manufacturer, they would trace the set's wiring, and publish their own version of the diagram. He might have also played on their concern about being "left out." Rider could show that RCA, Zenith, Philco, and other major companies were sending their latest schematics, so why not join these well-known companies who would be represented in service manuals used by radio repairmen all over the country?

Rider was astoundingly successful! Within five months, at an apparent average receipt rate of six schematics per week, he had gathered enough circuit diagrams to place a half-page advertisement [14] in the May, 1930 *Radio-Craft Magazine*, (Figure 7) offering:

**"Supplementary Wiring Diagram Package No. 1....** The first group numbers 115 diagrams... Approximately 20 manufacturers are represented...diagrams of 1929-1930 receivers... \$2.50"

This evidence of John F. Rider's energy and professional standing in the radio and electronics community must have added to Hugo Gernsback's concern and defensive reaction when Rider announced his supplemental radio schematics for sale in the very same *Radio-Craft* magazine of May, 1930, in which the prestigious *Sound Pictures and Trouble Shooter's Manual* was announced.

Hugo Gernsback reacted explosively!

Whatever Gernsback's attitude toward John Rider was at the beginning, he now reacted as though John Rider was a threat, and an enemy. The very next issue of *Radio-Craft* for June, 1930 contained four new initiatives by Hugo Gernsback. His first action was a full-page, pre-publication announcement [16a] stating that "Hugo Gernsback's *Official Radio Service Manual* to soon be released with several hundred pages" (Figure 8). Another full page announced Gernsback's new "National Radio Service Men's Association" [16b]. Two more pages with subscription coupons advertised two new magazines: *Short Wave Craft* [16c], "with the first two-month issue to be released May 15, 1930, (the previous month!) and *Everyday Mechanics* [16d], with the first issue to be released June 1, 1930 (the month it was being advertised).

Hugo made no immediate change in Rider's position on the magazine staff in the June, 1930 issue of *Radio-Craft*, and even allowed Rider one last small advertisement [15] of his supplemental schematics, but by the July issue, *Radio-Craft* was purged of John F. Rider: The magazine no longer carried the bold headline "Service Men's Department, Edited by John F. Rider," and no longer was Rider pictured at the beginning of this section with a summary of his qualifications. Completing the removal of Rider from the magazine, the usual feature article by John F. Rider, introducing the Service Men's Department was conspicuously missing. Gernsback did not remove the "John F. Rider, Service Editor" from the mast-head, but Rider's name was nowhere else to be found inside the magazine.

This ban on John F. Rider lasted through the July, August, and September issues of *Radio-Craft* during which time, Hugo Gernsback continued massive advertising [17] of the four initiatives he had begun in the June, 1930 issue



*Practical Testing Systems*, [21] by John F. Rider, 144 pages..January, 1931  
*Practical Radio Repairing Hints*, [22] by J Rider, 250 pages..January, 1931

At the same time, he apparently “worked under-ground” on the *Trouble Shooter’s Manual*, quietly composing his manual titled:

*Perpetual Radio Reference Data* (Volume. I, Prototype Edition.), March, ’31

### **The First Loose Leaf Manuals by Gernsback and Rider**

The *Perpetual Radio Reference Data* was the first Rider’s manual to use the big 2 1/2-inch thick, three-post “Swivelok,” loose-leaf binder. The Swivelok binder has hard black, pebble-grained covers, into which is embossed in silver, the manual title and decorative logos, and it uses a flat individual swing latch for each of the 3 posts. The upper part of each post may be ‘screwed’ up or down in the lower threaded part to change the length of the individual posts. This distinctive binder design is an immediate identifier of Rider’s early manuals from before he changed to “Slide Lock” Binders in 1933.

The *Perpetual Radio Reference Data* manual binder (Figure 10) is embossed on the right front with a “windowed” view of a single radio antenna tower, below which appears “John F. Rider” in a small font. Embossed on the upper left of the front cover is the title in four lines; *Perpetual Radio Reference Data*. The spine of the binder (Figure 11) carries just the title and “John F. Rider,” with no other decoration. The Title page (Figure 12) identifies the Radio Treatise Company as the publisher, and includes “copyright John F. Rider,” as well as the title: *Perpetual Radio Reference Data*. Although the embossed binder indicates that a number of the manuals may have been made, only one copy of the manual has surfaced during several years of buying, and corresponding about Rider’s Manuals.

This rare Rider’s manual seems to have surfaced by itself with no history. Except for the Binder design, the Title page, and a few minor differences in Rider’s Foreword, (see page 17, and Appendix A) the contents of the *Perpetual Radio Reference Data* described below is identical to the contents of the *1931 Trouble Shooter’s Manual* which is popularly known by servicemen as the first Volume I of the *Radio Trouble Shooter’s Manuals* which Rider offered for sale. There are, however, subtle differences in the *Perpetual Radio Reference Data* manual, which indicate that it was an earlier unreleased creation:

- 1) Some inserted pages were still blank on one side, indicating that advertising had not yet been subscribed for them.
- 2) The typed Introduction by Rider had not been corrected for the numerous typographical errors and misspellings.
- 3) The manual is not referenced in any of Rider’s indexes of schematics or lists of prior publications.
- 4) The embossed design on the binder is a rudimentary form of the radio tower logo adopted for the *1931 Trouble Shooter’s Manual*.

Even more compelling evidence for its earlier creation was revealed when the Introduction from the *Perpetual Radio Reference Data* manual was compared with the Introduction from the *1931 Trouble Shooter’s Manual*. Rider had promised



# ◆ ◆ Official RADIO SERVICE MANUAL



and Complete Directory of  
all Commercial Wiring  
Diagrams of Receivers

PREPARED ESPECIALLY  
FOR THE  
RADIO SERVICE MAN !

HUGO GERNSBACK  
Editor

CLYDE FITCH  
Managing Editor

\$2.50  
Special  
Pre-Publication Offer

WE ANNOUNCE the early publication of the long-awaited OFFICIAL RADIO SERVICE MANUAL. This manual is the first complete and most up-to-date book of this kind. Nothing else like it has ever appeared in print.

A tremendous amount of material has been collected, not only for the Service Man, but for everyone interested in radio. A complete directory of every radio circuit of commercial receivers is now possible, and not only to get every circuit of every set ever manufactured, of which there is any record, but in addition, an entirely new idea makes it possible to keep the manual up-to-date.

The OFFICIAL RADIO SERVICE MANUAL is made in laminated form—handily made of flexible leatherette—the entire book can be folded and slipped easily into your pocket or put in your bag.

Rarely do manufacturers supply information about receivers made before 1927—even 1930 service data are not always available because many manufacturers do not supply independent Service Men with such data. And, when you can get the material from some of the manufacturers, it is of little use to you because it is not uniform, and it is scattered in different places, difficult to get at.

Additional service data, for new receivers as they appear on the market will be published and supplied at trifling cost so that the MANUAL may be kept up-to-date at all times.

## SERVICE INFORMATION

Not only is it all. The OFFICIAL RADIO SERVICE MANUAL contains also a most comprehensive instruction

course for radio Service Men, giving practical information from every angle on how to service sets.

In short, the OFFICIAL RADIO SERVICE MANUAL is the biggest thing of its kind that ever came along in radio. It will be hailed by every radio-enthusiast and radio man throughout the entire industry.

The size of the OFFICIAL RADIO SERVICE MANUAL is 9 in. by 12 in. There are several hundred pages, printed on good paper, and the book contains hundreds of illustrations and diagrams.

## SPECIAL OFFER

The price will be \$3.50 upon publication of the book, but to our own subscribers and readers, we have a special pre-publication price of \$2.50, prepaid. This price will be withdrawn the minute the book is published, which will be during the next six weeks or so.

GERNSBACK PUBLICATIONS, INC.  
410 Park Place, New York, N. Y.

Do you prefer payment by check? Enclosed herewith \$2.50 for which you are to send no postage, one copy of the OFFICIAL RADIO SERVICE MANUAL, as soon as it is published, at the pre-publication price of \$2.50. I understand that the price will be \$3.50 as soon as the MANUAL is published.

Name \_\_\_\_\_  
Address \_\_\_\_\_  
City \_\_\_\_\_ State \_\_\_\_\_

of *Radio-Craft*, including the tantalizing full-page picture ads (Figure 8) of his (still non-existent) *Official Radio Service Manual*.

Finally, in the October, 1930, *Radio-Craft*, Hugo Gernsback and Clyde Fitch offered the "352 page soft bound *Official Radio Service Manual* with over 1000 illustrations, for \$3.50" [18] (Figures 8 and 9). Hugo was, at last, able to deliver a specific product which before, had been only a promise. In the same October issue, Rider inserted a 1/3-page advertisement [19] announcing a non-competitive "Advanced Home Study Course" for radio servicemen.

With this evidence of Rider's meekness, and having achieved the publication of his manual, Hugo Gernsback must have decided that Rider was no longer a serious threat to his *Official Radio Service Manual*, for in the same October, 1930 issue, Gernsback reinstated Rider. Once more, the magazine was Rider-friendly with Rider's picture heading the "Service Men's Department" and the service articles by Rider again became part of the magazine. In November, Gernsback announced his *Radio Service Man's Handybook* [20].

During his early employment by Hugo Gernsback, Rider had advertised for sale only several of his textbooks, the *Home Radio Service School Course*, and the package of 115 supplemental radio schematics. When Gernsback, reacting to the schematic sales, had relieved him of his duties, Rider made good use of his time, writing two more books:

Figure 8. Radio Craft Advertisement, June, 1930, Page 666

was down-graded to a 'goal,' and the term "Trouble Shooter" was brought back for the title. The following excerpt shows his original "DATA" manual Introduction, with removed words ~~struck out~~, and added words underlined for the revised "1931" Introduction:

"It is with a great deal of pleasure that we offer this work and hope that it will be the nucleus of a perpetual reference radio trouble shooter's manual ~~covering the radio receiver and associated branches of the radio industry~~. It may be of interest to the man who ~~thumps~~ thumps these pages to know that it is the fulfillment of an ideal. We had hoped for a long time to prepare a book which would contain radio ~~receiver and associated circuit~~ service data ~~in such quantity as to be a reference manual for the industry covering American and Canadian radio receivers, with completeness as a goal.~~"

With this evidence that it was a prototype version of the *1931 Trouble Shooter's Manual*, it seems clear that the *Perpetual Radio Reference Data* was a covert manual which Rider prepared during the later months of his employment at Radio-Craft. Of Rider's first five manuals in Swivelok binders, the evidence indicates that the *Perpetual Radio Reference Data* is the first version of his *Radio Manuals*. Considering Hugo Gernsback's egregious reaction when Rider sold schematics while in his employ, it is no surprise that Rider would conceal, and not offer his manual for sale until he was ready to permanently leave his position at *Radio-Craft*. Therefore, Rider may have deliberately given the manual a misleading title so as to avoid Hugo Gernsback's wrath for his having dared to work on a competitive Service Manual while employed at *Radio-Craft*. Whatever the reason for the *Perpetual Radio Reference Data* title, Rider later added the word "Perpetual" from its title to his *Trouble Shooter's Manual* titles.

Gernsback and Rider's relationship during this time is unknown, but Rider performed his editorial function for the magazine with such great competence for another six months after Gernsback reinstated him, that when Rider was ready to announce his *1931 Trouble Shooter's Manual*, four months after Gernsback published his own manual, Hugo accepted the half-page pre-publication advertisement [23] in the April, 1931 *Radio-Craft*.

Since Gernsback had already released two up-dates [24] to his first volume of the *Official Radio Service Manual*, and was preparing to release Volume 2, he probably was feeling expansive over the great success of his manual, and may even have felt that he had not treated John Rider fairly... after all, Rider had worked hard to get the manufacturers to release their schematics, and Hugo had greatly benefited from that. Rider's advance announcement proudly asserted:

"A feature of this book is that trouble *shooting data is complete* (italics mine) with electrical values, color codes, socket data and voltage data! Chassis layouts!"

## Gernsback's 1930, and Rider's Swivelok "Data" Manual

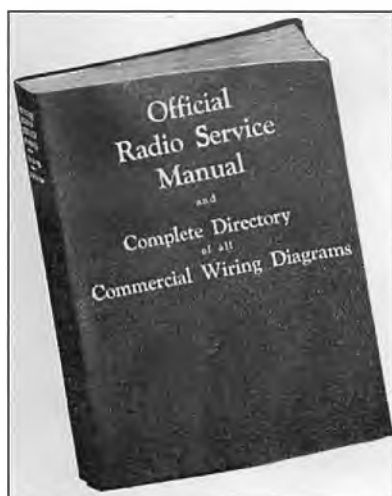


Figure 9. Gernsback's 1930 Manual



Figure 10. "Data" Manual Binder



Figure 11. "Data" Manual Spine

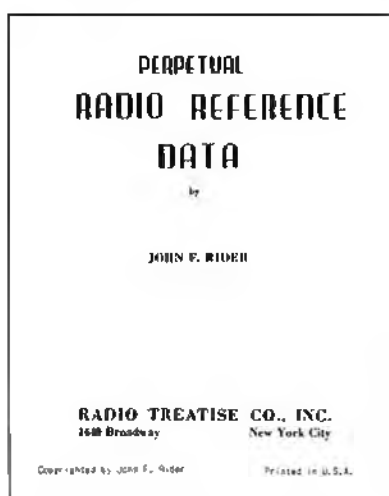


Figure 12. "Data" Manual Title Page

in his advance sales announcement [23] of the *1931 Trouble Shooter's Manual* that the manual would have "parts values, tube locations, voltage readings, etc." But when he assembled the *Perpetual Radio Reference Data* manual he included the unmarked schematics from his 1929 *Trouble Shooter's Manual*, most of which failed to meet Rider's definition for a "complete" manual.

When Rider offered the same manual for sale with the changed title of *1931 Trouble Shooter's Manual*, he rewrote and corrected the Introduction to the manual. In the "1931" rewrite, (See Appendix A), "completeness"

page count of the 1931 Manual from 800 to 950 pages, or a rate of about two schematics per day.

A page-by-page comparison of the *1931 Trouble Shooter's Manual* to the copy of the *Perpetual Radio Reference Data* in my possession confirmed my belief that Riders first release of his *1931 Trouble Shooter's Manual* was the *Perpetual Radio Reference Data* manual with a new binder design, a corrected introduction, and a new name. The front cover of the *1931 Trouble Shooter's Manual* (Figure 14) features "1931" riding atop the antenna wires between two latticed antenna towers. Below the antenna wires, between the towers are "TROUBLE SHOOTERS" and "MANUAL," below which is a radio tube attached to the antenna by wires. Below the tube is "John F. Rider." The spine of the volume has all of the information grouped at the top half of the spine, beginning with "1931" below which three successive lines show: "TROUBLE," "SHOOTER'S" and "MANUAL." Under this is a vacuum tube, below which is "RIDER." The Title page (Figure 15) shows that the book was published by John F. Rider, and The Radio Treatise Company. Note that there is no "Perpetual" on either the binder, or the Title page.

The schematics in the *1931 Trouble Shooter's Manual* are grouped in seven arbitrary sections. The "Commercial Broadcast Receivers" section makes up the bulk of the book. It is followed by a 20 page section of "Canadian Receivers," and five small sections of "Power Amplifiers," "Eliminators and Power Units," "Set Analyzers," "Short Wave and Kit Receivers," and "Midget Receivers." The schematics pages are numbered from 1 to 804, but inserted pages, with letter addenda such as 114-A, 114-B, etc., increase the schematic page count to somewhere near 1000 depending on the number of supplements. (See Table I)

Apparently, Rider, in his search for schematics had approached other magazine editors, asking to use diagrams which they printed in their magazines from time to time. Rider was then an Associate editor of both *Radio Engineering*, and *Projection Engineering*, and a contributing editor of *Motion Picture News*. As a result, Rider had some schematics which were noticeably better than he might have received from small manufacturers who had no drafting departments. In Rider's Introduction, he expresses his thanks:

"We wish to acknowledge the kindness of the editorial staffs of *Radio News*, *Radio World*, *Radio Engineering*, *Q.S.T.*, *Radio*, *Radio Citizens Call Book*, and the *General Radio Experimenter* who granted the writer the privilege of reproducing whatever material had ever been published in their periodicals."

Rider found that his manual was welcomed by radio training schools and commercial companies such as National Radio Schools, Tung Sol, and National Union, as well as by independent radio servicemen. Many of these wanted special titles or logos on the binders, so the same manual was provided in many different custom binders. No evidence was found to relate these to Rider's decisions about the development of his manuals, so there has been no attempt to include them here.



## Now Ready

### The NEW 1931 TROUBLE SHOOTER'S MANUAL

by  
**John F. Rider**

Complete with the FREE Question  
and Answer service.

This volume is the most extraordinary book  
ever prepared for the radio service man! It  
represents the data compiled during the past  
15 years and published here for use  
by the Radio Service Man in as complete and  
as comprehensive as this work by John F. Rider.

More than 850 pages!

More than 3500 diagrams!

Whatever your problems in connection with  
radio service work, the 1931 Trouble Shooter's  
Manual will supply you with the vital data con-  
cerning the circuit, the secret layout, the set  
analyzer voltage data, the color code, the in-  
ternal connections of enclosed units, chassis  
structure, peculiarities in the radio service.

If you have any special problems John F. Rider will be glad to furnish you whatever  
additional data you may require. If you purchase the manual your questions will be  
answered free.

For the first time since the existence of the radio service industry, ONE book contains  
ALL valuable data. We want you to understand that John F. Rider spent sixteen (16)  
months compiling this book. In it you will find the WHOLE line of receivers manufactured  
by the popular American and Canadian receiver manufacturers.

COMPLETE—COMPREHENSIVE—UP-TO-DATE—it covers the entire radio and public  
address field.

The book is divided into eleven (11) sections.

Section 1—A modern Radio Service and Trouble Shooting Course.

Section 2—An explanation of the principles and application of set Analyzers.

Section 3—Various Tube Tests and Tables.

Section 4—Wiring diagrams of ALL popular commercial receivers manufactured since 1928.

Section 5—Wiring diagrams of public address and power amplifiers, inclusive of the products of the most  
famous manufacturers.

Section 6—Wiring diagrams of ALL popular eliminators and power packs.

Section 7—Wiring diagrams of ALL popular short wave receivers and detectors.

Section 8—Wiring diagrams of ALL popular 30 receivers, old and new.

Section 9—Wiring diagrams of the popular set Analyzers, old and new.

Section 10—Wiring diagrams of bridge circuits.

Section 11—Possibilities in radio service, a section which you can remove from the book, bind  
separately and carry with you. This section is a distinct innovation in radio service  
literature. It will tell you of any possible trouble which may occur in the  
receiver. Every commercial receiver in the 1931 Trouble Shooter's Manual is listed  
in this section.

No matter what other books you may have, YOU NEED THE 1931 TROUBLE  
SHOOTER'S MANUAL because it includes many diagrams and details which have NEVER  
before appeared elsewhere. . . . This book contains many diagrams which are not available  
from any other source. . . . Remember that one diagram with color code may save you enough  
time and enable you to complete a successful repair in such fashion that it will repay you for  
the entire cost of this book. . . . Use it the first!

The free question and answer service personally conducted by John F. Rider will be worth  
a lot of money to you. . . . It is FREE with the 1931 Trouble Shooter's Manual. . . .

The book is large, text, beautifully bound. The pages are 8 1/2 x 11 inches. The drawings  
are large and easy to read. All of the vital data is shown upon the same page. Electrical  
constants are furnished. . . . No expense was spared to compile this book. IT WEIGHS  
6 POUNDS. . . . Every man who is doing serious work should have this book!

SOLD WITH A MONEY BACK GUARANTEE. IF YOU DON'T LIKE IT, SEND  
IT BACK AND YOUR MONEY WILL BE RETURNED. WE ARE CERTAIN THAT  
YOU WILL BE MORE THAN PLEASED.

We are in a position to supply individual diagrams of receivers and to answer questions  
for service men. Write to us.

PRICE \$5.00 Postpaid. We will send the book C.O.D.

**RADIO TREATISE CO., INC.**

1440 Broadway . . . . . New York City

Figure 13. Radio Craft  
advertisement, May, 1931,  
Page 687

## Phase 3 Narrative: May, 1931 to March, 1933

### Rider's Struggle to Organize Thousands of Schematics

In the May, 1931 *Radio-Craft* [25], with a half-page advertisement (Figure 13), Rider finally announced the sales release of the first of his now famous Radio Service Manuals:

*1931 Trouble Shooter's Manual* (Volume I, 1st Edition), May, '31

Although Gernsback accepted this and subsequent advertisements for Rider's publications, Rider was promptly severed from his staff position on the *Radio-Craft* Magazine. There was no "Good Bye," or explanation; Rider just disappeared from the staff of *Radio-Craft* in June, 1931, the month after he unveiled his manual. Since Gernsback permitted Rider to continue to advertise in the *Radio-Craft* Magazine, either he was meeting a previously made contractual agreement with Rider, or Hugo thought that Rider's *Trouble Shooter's Manuals* could never seriously threaten Gernsback's manual sales. Rider's rate of receipt of diagrams at this time may be inferred from the fact that from April to June of 1931, he had increased the advertised

## Rider's Various "1931" Swivelok Manuals



Figure 14. Rider's "1931" Binder

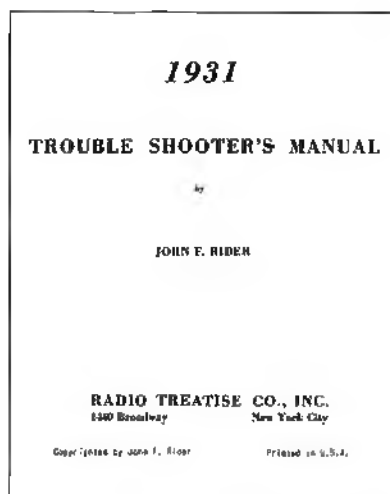


Figure 15. "1931" Title Page

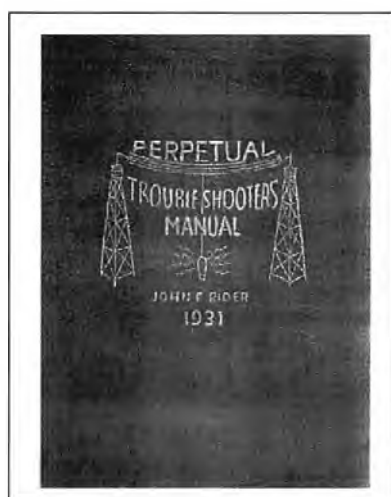


Figure 16. "Perpetual 1931" Binder

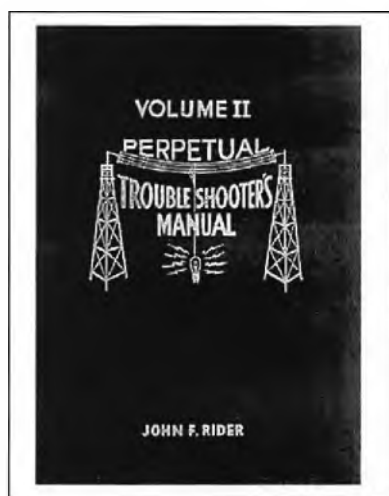


Figure 17. "Perpetual" Binder

Rider's use of "1931" on his manual seems to have been done quite innocently, since it was released in mid-1931. Unfortunately, Rider was uncommonly conscientious, and he had implied in his pre-announcement [23], and advertisement [25] that all previous schematics would be a part of the manual as they became available. John F. Rider's word was his bond. Apparently, Rider took very seriously his commitment to send out to his initial manual buyers all the circuits up to 1931, the date of the manual. Initially, the modest number of schematics for the first release of the "1931" Volume were obtained only by making appeals to the individual radio companies. Then came the floods! Major companies, such as RCA, Philco and Zenith

must have recognized the Manual as a source of free advertising for their radios, and engineering. These companies competed for maximum space in the Rider's Manual: Zenith added 14 more pages; RCA added 15 pages and six more radio models, bringing to 90 the number of RCA sets indexed in the "1931" Edition.

When the small mail-order radio companies realized they could avoid the expense and damage of shipping sets back to the factory for minor repairs by enabling local repairmen to do the work, they were eager to get their circuits and data to Rider. The resultant data flow must have exceeded John F. Rider's greatest expectations. As shown by his later supplements, radio manufacturers flooded him with schematics, wiring diagrams, tube location drawings, chassis layouts, part number lists, point-to-point resistance charts, alignments, voltage tables, and performance data.

By this time Rider must have felt like the Sorcerer's Apprentice who had started a flow he couldn't control. There was no way that the "1931" Edition was going to hold all the material he was receiving for radio sets up through 1931; the 3 post Swivelok binder had adjustable length posts, but it had a limitation of about 1300 pages, and it had been issued with 1100, so there wasn't much room for expansion. He had been "blind-sided" by his own act in titling the book "1931." Had he been unethical, he could have issued and charged for a "1930" manual, or some such scheme to wiggle out of the commitment he had made in his advertisements of the "1931" Edition. But he didn't do that. He had to keep faith with those who had trustingly bought the first issues, and at the same time maintain the \$5.00 price for later Manuals.

When John F. Rider reordered Swivelok binders he changed the title. (Figure 16) The "1931" on the front cover was taken from the antenna wires, and placed below John F. Rider's name. In its place at the top of the binder, "Perpetual" was cradled along the top of the swinging antenna wires. The new title of the volume thus became the *Perpetual Trouble Shooter's Manual* 1931. "Perpetual" was added to the top of the spine and the "1931" was put on the bottom line.

Rider didn't add the word "Perpetual" to the Title page in the "1931" manual immediately, probably because he already had a number of these pages printed ahead of time. It was now time to solicit and organize the material for the 1932 issue of the Manual. Remember that most of the schematics Rider had been receiving were for out-of-date radios, and the only companies sending him recent circuits were the giants like RCA who were so well covered by patents, that they weren't worried about anyone copying their designs. The smaller companies were in competition to improve, or innovate their way around, or ahead of their rivals' patents, and some of these were probably protective of their latest innovations. In some cases, the companies were already in violation of patents, and needed to avoid publicity about their latest circuit details. Now John had to go back and ask for their recent advances so his 1932 Manual would be up-to-date when released while he was wrestling with the problem of the ballooning "1931 Edition."

Rider again changed the binder title on his first edition, by finally removing the onerous "1931" from the manual (Figure 17) as he continued to add

**SALIENT FEATURES OF RIDER'S EARLY SWIVELOK "31" MANUALS  
THE "29," AND FOUR VERSIONS OF MANUAL I, 1st EDITION  
(IN CHRONOLOGICAL ORDER OF PUBLICATION, 1929 TO 1931)**

<b>EDITION</b>	<b>"1929"</b>	<b>1st</b>	<b>1st</b>	<b>1st</b>	<b>1st</b>
<b>VERSION NAME</b>	<b>"1929 VOLUME II"</b>	<b>"PROTO-TYPE"</b>	<b>"1931"</b>	<i>Perpetual 1931</i>	<i>Perpetual</i>
<b>PUBL. DATE</b>	Early 1929	3/1931	5/1931	7/1931	9/1931
<b>COVER LEGEND</b>	TROUBLE SHOOTER'S MANUAL	Perpetual RADIO REFERENCE DATA	1931 TROUBLE SHOOTER'S MANUAL	Perpetual TROUBLE SHOOTER'S MANUAL 1931	Perpetual TROUBLE SHOOTER'S MANUAL
<b>TITLE PAGE</b>	SERVICE MAN'S MANUAL Volume II	Perpetual RADIO REFERENCE DATA	1931 TROUBLE SHOOTER'S MANUAL	Perpetual TROUBLE SHOOTER'S MANUAL 1931	Perpetual TROUBLE SHOOTER'S MANUAL
<b>PUBLISHER</b>	Radio Treatise Co. N.Y.	Radio Treatise Co. N.Y.	Radio Treatise Co. N.Y.	Radio Treatise Co. N.Y.	Radio Treatise Co. N.Y.
<b>PAGINATION</b>	Arabic/ Numbers	Arabic/ Alphab	Arabic/ Alphab	Arabic/ Alphab	Arabic/ Alphab
<b>BINDER</b>	1.0" Flexible Bound	2.5" 3 Post Swivelok	3.0" 3 Post Swivelok	3.0" 3 Post Swivelok	3.0" 3 Post Swivelok
<b>ADVERTISING INDEX</b>	None	21 Pgs	8 Pgs	8 Pgs	8 Pgs
<b>TUTORIAL</b>	4 Pgs	20 Pgs	20 Pgs	20 Pgs	20 Pgs
<b>TUBE DATA</b>	126 Pgs	98 Pgs	98 Pgs	98 Pgs	98 Pgs
<b>PECULIARITIES*</b>	None	6 Pgs	6 Pgs	6 Pgs	6 Pgs
<b>CANADIAN RCVRs</b>	DNA	28 Pgs	—	—	—
<b>RCVR MFRS/Pgs</b>	None	21 Pgs	20 Pgs	20 Pgs	20 Pgs
<b>SUPPLEMENT/Pgs</b>	33/103	84/804	84/804	84/864	84/884
<b>POWER AMPS/Pgs</b>	DNA	8/40	8/40	8/185	8/185
<b>ELIMINATORS/Pgs</b>	1/1	15/31	15/31	15/31	15/31
<b>TEST EQUIP/Pgs</b>	1/33	30/26	30/26	30/26	30/26
<b>S.W. RCVRs/Pgs</b>	2/7	8/28	8/28	8/28	8/28
<b>MIDGET RCVRs/Pg</b>	None	31/20	31/20	31/20	31/20
	None	38/6	38/6	38/6	38/6
<b>SCHEMATIC PAGES</b>	103	1010	1010	1010	1010
<b>TOTAL PAGES</b>	234	996	968	1033	1033

\* Peculiarities In Commercial Radio Receivers..A compilation of various unique anomalies occurring in radio models listed by manufacturer, and model number, and indicating corrections. This list was sometimes included in Riders manuals as a sales incentive, or bought and placed in the manual by the owner.

**Table I**



supplemental pages. The result is that beside the "prototype," the First Edition of Rider's initial *1931 Trouble Shooter's Manual* may be found in three different versions, with various total numbers of pages, (depending upon the owners zeal in inserting new updates) and none of these are titled "Volume I."

These many versions of the 1st edition seem to reflect Rider's attempt to gradually deemphasize, and then to remove the "1931" from his manual. Table 1 shows these manuals and their salient features in the order of their approximate release dates.

The "1931" date on his *1931 Perpetual Trouble Shooter's Manual* had caused him so much grief, that John Rider must have made a vow to never again date anything. Faced with a manual binder that was bursting at the seams, and receiving far more data and schematics than it could accommodate, Rider took extraordinary steps to solve the problem. The manual was rewritten and reorganized to make better use of what little space was left, and at the same time the manual was renamed, and reissued (Figure 18) as:

*Perpetual Trouble Shooter's Manual, Volume I (2nd Edition), November, '31*

This allowed Rider to cut off further "updates" to the "1931" volume, and to start organizing material for Volume II. The rewrite was more of a repackage, than a reorganization. Rider kept all the separate sections for Canadian Radios, Power Units, Amplifiers, etc., as well as the "Modern Trouble Shooting" section at the start of the Volume. He added two pages of RCA tube tables, dropped the Cunningham table (which duplicated the Radiotron table), and expanded the Sparton data from 1/4 page to two full pages. Kellogg, Raytheon, and Amperite remained the same. Sequential page numbering was retained with A, B, C, etc., denoting added pages.

The flood of circuits coming in continued to increase as the larger manufacturers started to dig out schematics for their older radio sets. RCA, for example sent information on 30 more receivers, bringing their total to 100 radio models. Other companies responded in kind. By November of 1931, Rider must have just about reached the 1300 page limit of the Volume I Swivelok binder, and data was still coming in for 1931 and prior years.

Now came the hard decisions in the manual rewrite! It seems obvious from the crowded pages, and absent parts lists, that John Rider dealt with a firm hand as to what went into "Volume I." This resolute attitude showed up in deletions and omissions which went against many of Riders expressed convictions. Many decisions by Rider must have been very painful for him, but where a decision was made, Rider seems to have maximized utility. The "Volume I" was more crowded, often with finer print, and with fewer "full layouts" of individual sets than the 1931 Edition. A few older schematics with unmarked parts, or sets with little known trademarks were omitted. Schematics of better known, but older, obsolete sets were reduced in size, and placed with other reduced diagrams on single pages.

Resistance tables, Rider's tool of choice for diagnosis were all but eliminated. Part number tables were sharply reduced to show only the electrical component values. Often the manufacturer's part numbers were omitted, and voltage tables were edited or eliminated. Pictures of chassis top and

## Rider's "Swivelok" Volumes I and II Manuals

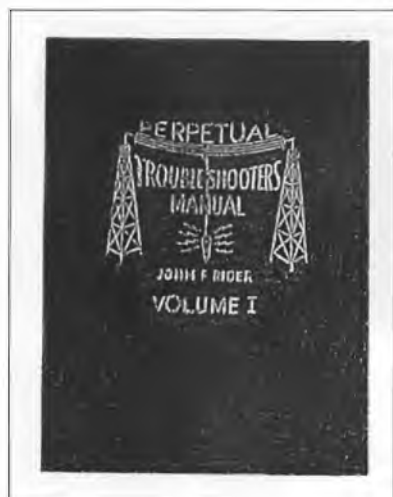


Figure 18. *Rider's First Volume I*



Figure 19. *Rider's First Volume II*

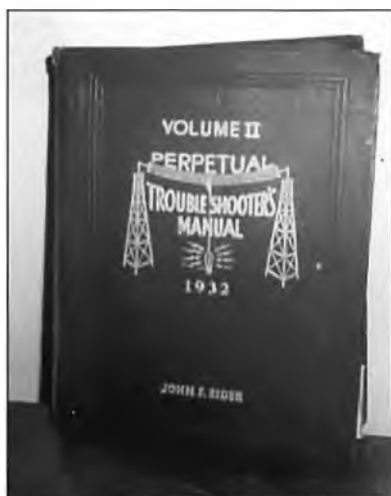


Figure 20. "1932" Volume II Binder

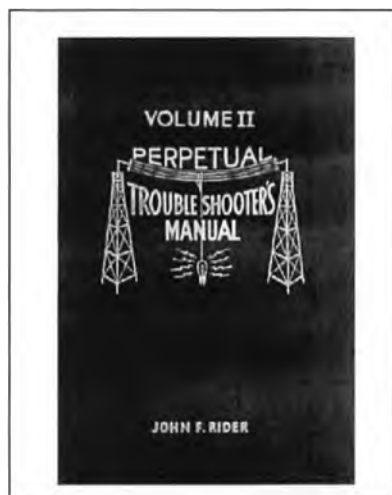


Figure 21. *Volume II*

bottom were reduced to one view, or replaced by a small sketch showing a plan view of the tube locations. Everywhere, economy of space was observed. All of this must have been hard on John F. Rider because **HE** had to make the decisions of what to leave out, and all because of a stupid "1931" on the first Volume! When Rider finally released the 2nd Edition of his first radio manual, *Perpetual Trouble Shooter's Manual*, Volume I, it wasn't the "Complete" manual he had always wanted, but it was bursting with information. This volume is readily identifiable because, like the "1931" Edition, it is in the black, 3" thick, three post, Swivelok Binder, with the

two towers and antenna motif embossed on the front, but instead of "1931" below Rider's name, it has "Volume I."

Of the versions of Riders Trouble Shooter's Manual, Volume I, this is the one that is packed with the most data. Some of the early battery sets were given less space than in the "1931" Edition, but what was lost in the rewrite, was compensated for by additions. Since he had published his 1929 hard bound *Trouble Shooter's Manual*, it had taken Rider almost two years of rewrites and organization to complete this 2nd Edition of his loose leaf *Perpetual Trouble Shooter's Manual*, Volume I which, he now had every reason to believe, was in it's final form. Alas, after comparison with his Volume III, Rider would see it's flaws so clearly that he would rewrite it once again.

Meanwhile, it was time to issue a manual for 1932; the 1st Edition of Volume II: [26]

*Perpetual Trouble Shooter's Manual*, Volume II (1st Edition), September, '32

Since most of the received schematics and data had to go into Volume II, in his Forward, Rider finally spoke about dates:

"Let it be known that Volume 2 (sic), does not supersede the first volume. It contains entirely new material. Volume I covered the period from 1919 to about October 1931, Volume 2 covers the period from October 1931 to the end of May 1932."

In Volume II, at last, Rider had space to burn! The 2-1/2 inch black, 3 Post, Swivelok binder was still adorned with the two tall antenna towers with a spread wire antenna connected to the top terminal of a vacuum tube. The *Perpetual Trouble Shooter's Manual*, Volume II (Figure 19), with the exception of the volume number, looked identical in format to the embossed cover on the Rider's Volume I, and was printed by the Radio Treatise Company.

Some Volume II binders with the date, "1932" (Figure 20) were doubtless ordered before Rider faced his date problem. These were soon replaced by a new binder with just the *Perpetual Trouble Shooter's Manual* Volume II title (Figure 21).

Now, Rider included all those things he had to leave out of Volume I, and in fact he put some of the older material in the new manual. He included the voltage tables, the chassis views, the parts tables, the resistance tables, alignment procedures, etc. Features of the early Swivelok Volumes I and II are shown in Table II.

Unfortunately, Volume II inherited a Volume I page numbering problem which became worse when extended to cover the second volume. When Rider had assembled his first manual, he arranged the pages in alphabetic order by manufacturer, and then numbered the pages in Arabic order. When additional pages were inserted, they were given the same Arabic page number as the last one in that manufacturers group, with an added "A," "B," "C," etc. Thus, Atwater Kent was numbered from 91 up to 114 in Volume I. The extra pages for Atwater Kent were inserted as 114-A, 114-B, up to 114-Z.

**SALIENT FEATURES OF RIDER'S EARLY SWIVELOK VOLUME I  
AND VOLUME II  
"VOLUME I," 2nd ED, AND FOUR VERSIONS OF SECOND  
MANUAL, 1st ED.  
(BEFORE THE RCA/CUNNINGHAM "COMPLETE" MANUAL)**

<b><u>EDITION</u></b>	<b><u>2nd</u></b>	<b><u>1st</u></b>	<b><u>1st</u></b>	<b><u>1st</u></b>	<b><u>1st</u></b>
<b>VERSION NAME</b>	<b>EARLY VOLUME I</b>	<b>Perpetual VOLUME II</b>	<b>1932</b>	<b>1932 VOLUME II</b>	<b>VOLUME II</b>
<b>COVER LEGEND</b>	<b>Perpetual TROUBLE SHOOTER'S MANUAL VOLUME I</b>	<b>Perpetual TROUBLE SHOOTER'S MANUAL VOLUME II</b>	<b>Perpetual TROUBLE SHOOTER'S MANUAL 1932</b>	<b>VOLUME II Perpetual TROUBLE SHOOTER'S MANUAL 1932</b>	<b>VOLUME II Perpetual TROUBLE SHOOTER'S MANUAL</b>
<b>PUBL. DATE</b>	<b>11/1931</b>	<b>3/1932</b>	<b>5/1932</b>	<b>7/1932</b>	<b>9/1932</b>
<b>PUBLISHER</b>	<b>Radio Treatise Co. N.Y.</b>	<b>Radio Treatise Co. N.Y.</b>	<b>Radio Treatise Co. N.Y.</b>	<b>Radio Treatise Co. N.Y.</b>	<b>Radio Treatise Co. N.Y.</b>
<b>PAGINATION</b>	<b>Arabic/ Numbers</b>	<b>Arabic/ Alphab</b>	<b>Arabic/ Alphab</b>	<b>Arabic/ Alphab</b>	<b>Arabic/ Alphab</b>
<b>BINDER</b>	<b>3.0" 3 Post Swivelok</b>	<b>2.5" 3 Post Swivelok</b>	<b>3.0" 3 Post Swivelok</b>	<b>3.0" 3 Post Swivelok</b>	<b>3.0" 3 Post Swivelok</b>
<b>ADVERTISING</b>	<b>19 Pgs</b>	<b>22 Pgs</b>	<b>22 Pgs</b>	<b>22 Pgs</b>	<b>22 Pgs</b>
<b>INDEX</b>	<b>28 Pgs</b>	<b>33 Pgs</b>	<b>20 Pgs</b>	<b>20 Pgs</b>	<b>20 Pgs</b>
<b>TUTORIAL</b>	<b>100 Pgs</b>	<b>32 Pgs</b>	<b>98 Pgs</b>	<b>98 Pgs</b>	<b>100 Pgs</b>
<b>TUBE DATA</b>	<b>7 Pgs</b>	<b>2 Pgs</b>	<b>6 Pgs</b>	<b>6 Pgs</b>	<b>7 Pgs</b>
<b>CANADIAN RCVRS</b>	<b>20 Pgs</b>	<b>20 Pgs</b>	<b>20 Pgs</b>	<b>20 Pgs</b>	<b>20 Pgs</b>
<b>RCVR MFRS/Pgs</b>	<b>91/835</b>	<b>91/695</b>	<b>84/804</b>	<b>84/884</b>	<b>84/884</b>
<b>SUPPLEMENT/Pgs</b>	<b>9/239</b>	<b>9/239</b>	<b>8/185</b>	<b>8/185</b>	<b>8/185</b>
<b>POWER AMPS/Pgs</b>	<b>15/33</b>	<b>15/33</b>	<b>15/29</b>	<b>15/29</b>	<b>15/29</b>
<b>ELIMINATORS/Pg</b>	<b>26/41</b>	<b>26/41</b>	<b>27/39</b>	<b>27/39</b>	<b>27/39</b>
<b>TEST EQUIP/Pgs</b>	<b>8/28</b>	<b>8/28</b>	<b>8/27</b>	<b>8/27</b>	<b>8/27</b>
<b>S.W. RCVRS/Pgs</b>	<b>28/30</b>	<b>28/30</b>	<b>28/26</b>	<b>28/26</b>	<b>28/26</b>
<b>MIDGET RCVRS/Ps</b>	<b>17/14</b>	<b>17/14</b>	<b>17/13</b>	<b>17/13</b>	<b>17/13</b>
<b>SCHEMATIC PAGES</b>	<b>1030</b>	<b>1100</b>	<b>1010</b>	<b>1010</b>	<b>1010</b>
<b>TOTAL PAGES</b>	<b>1147</b>	<b>1207</b>	<b>1113</b>	<b>1113</b>	<b>1115</b>

**Table II**

When Rider started his coverage of Atwater Kent in Volume II, he began with 114-ZA, 114-ZB, etc., which continued up to 114-ZP. Then came 114-P1, 114-P2, and then more strangeness; 1-114-1. and 2-114-1. It is clear that he had assigned the number 114 as the Atwater Kent identifier. In what seems like a "dumb bunny" scheme, Rider had initiated a "Step Numeric" plan for numbering the pages in his new "Volume II." This system assigned one single page number to each Manufacturer, and used "A, B, Cs" and "A-1, A-2," etc. to identify the pages within a Manufacturer's number. Thus in Volume II, the page numbers are all the same for a few pages, except for the "A, B, C" etc., and then they jump a "step" to a new number which identifies another manufacturer, the page number is repeated with A, B, C, etc. for the same company.

Rider explains in his introduction to Volume II that the page numbers will have big gaps in them, but not to worry, it was part of a grand plan. He had also stated that servicemen might eventually want to combine all the data from each manufacturer into separate manuals. Whatever the ultimate aim, I'm inclined to think Rider himself had no clear plan as to how he could resolve the page numbering mess he had made. Now he had the "1931," "Volume I," and Volume II: Three separate manuals, each requiring a separate index format, none intuitively easy to use, and supplements still came out with page "numbers" such as 438-BA-3 or similar codes.

In Volume II, Rider did some things which seemed extreme to me. He dropped his fifty page "Modern Trouble Shooting" article, which had become somewhat dated, but along with it, he dropped all the tube characteristics tables; a real loss. Rider's discussion of resistance tests in his "Modern Radio Servicing" article in the front of his *1931 Trouble Shooter's Manual* was reasonable, citing not only it's capabilities, but also it's limitations. This was replaced in Volume II by a ten-page article on "Point To Point Resistance Measurements", plus 50 pages of Point-to-Point resistance charts. In this special section, Rider promises much more data in the future:

"We are continually working upon the compilation of this point-to-point data, covering old as well as new receivers. *A great deal more of this information will be a part of Volume 3 of the Perpetual Trouble Shooter's Manual when issued.*" (my italics)

Most startling, however was the messianic stance Rider took in his preface to Volume II, extolling point-to-point resistance measurements above all other radio servicing techniques:

"The point-to-point resistance information...in this volume is the opening gun in.....a revision in service analysis methods. Resistance measurement represents the ideal method of service analysis....We feel certain....the men who have been servicing along the conventional voltage measurement lines will find this information of value...doubly so *when they are converted to resistance measurement methods of analysis, and find that they can dispense with the majority of voltage measurements.*" (The italics and emphases are mine).

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NEW JERSEY" (Figure 27). In spite of the "John F. Rider" on the cover, (and "Copyright John F. Rider" inside on the title page), the whole manual logo and cover design literally shouts "THIS IS AN RCA MANUAL!" The message is reiterated in the opened manual, as page after page shows a bold "RCA Radiotron/Cunningham" logo across the bottom of each page .... all 2,787 of them! (Figure 24) So, whose manual was this? ... Was it an RCA manual by Rider, or was it a Rider's manual by RCA? The manual's physical makeup gives conflicting clues, but the behavior of both Rider and the RCA Radiotron Company after its publication leads one to believe that it was an RCA Manual controlled by RCA Radiotron.

The RCA COMPLETE Manual is well organized for ease of use. After the title page and General Index, there is the Author's Forward by Rider, a 25 page compressed-type index of the radio schematics, and a 3 page compressed-type index of the "Set Catalog." Careful examination of the manual shows that these first seventeen sheets of paper (34 pages) in the manual don't have the RCA Radiotron/Cunningham footer at the bottom,

Set Catalog Page 31

MANUFACTURER	TYPE	MODEL NUMBER & PRICE	PRICE	TYPE	5	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100					
GUTHRIE ELECTRIC CO. (cont.)	1424	550	174.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1425	550	184.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1426	550	194.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1427	550	204.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GUTHRIE ELECTRIC CO.	1428	550	214.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1429	550	224.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1430	550	234.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1431	550	244.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GUTHRIE ELECTRIC CO.	1432	550	254.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1433	550	264.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1434	550	274.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1435	550	284.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
GUTHRIE ELECTRIC CO.	1436	550	294.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1437	550	304.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1438	550	314.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
	1439	550	324.00	C	1	2	3	4	5	6	7	8	9	10	11	12	13	14																																																																																						

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## The Complete Rider's Trouble Shooter's Manual Printed by RCA



Figure 23. "Complete" RCA Binder

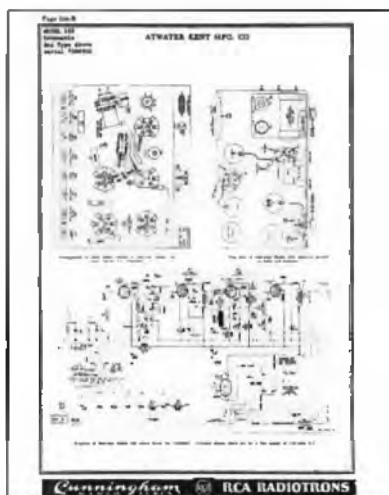


Figure 24. "Complete" typical data page

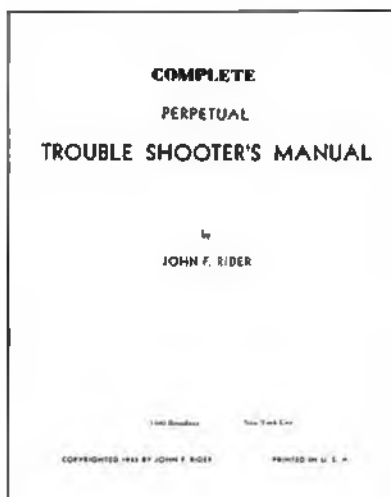


Figure 25. "Complete" Title Page



Figure 26. "Complete" Cunningham Binder

and are of a heavy, unsized, thirty-pound weight paper stock like that used in Rider's other manuals.

The first of these 'heavy' sheets in the manual is Riders usual *Perpetual Trouble Shooter's Manual* Title Page (Figure 25), with no mention of RCA/ Radiotron, but proudly wearing Rider's "COMPLETE" above the title. On the back of the title page, is typed "A General Index," which lists the page numbers for the Continuity Tests and RCA Tube Data. It also lists the "Set Catalog Index," and "Service Data Index." Sheet two in the volume is a double spaced typewritten single-sided form giving generic instructions

for inserting supplement sheets from the front of the manual into the body of the volume.

Sheet number three is the "Authors Foreword" by John F. Rider, also typed, (as evidenced by the elided "an" and "at" carriage half-skips in the 2nd and 10th paragraphs caused by too-fast key strokes). The "Service Data Index" occupies sheets 4 to 15, with the "Set Catalog Index" on sheets 16 and 17. Except for the small font used in the indices, these first 34 pages show every evidence of having been prepared by Rider's Radio Treatise Company. In these first 34 pages, (with the exception of a mention in the Author's Forward, and an index entry for the RCA Tube Data page number) there are no references, or signs by Rider that RCA Radiotron/Cunningham participated in the generation of the manual. These 34 pages seem to be the total extent of Rider's Radio Treatise Company's contributions to the RCA Manual, and from the physical evidence, it appears that Rider had compiled the indices.

All of the remaining pages in the manual are printed on thin, "bible paper," which required state-of-the-art presses to handle the tissue thin paper and to prevent "print through," i.e. the confusion of the image on one side of the paper by over-inking of the image on the opposite side of the paper. The next section on "Continuity Testing" is numbered in upper case Roman numerals from I to X, (the last two pages being RCA/Cunningham Tube Charts). Following these is the 115 page "Set Catalog" which lists the name, style, circuit type, tube complement, and retail price, of almost every commercial set manufactured in the U.S.A. from 1923 through 1931 (See Figure 22). This remarkable table of data was praised by Rider in his Foreword (see below). The remaining information in the manual's 2,787 pages of radio schematics is arranged alphabetically by manufacturer.

There is strong evidence that the first 34 pages in the RCA Manual were printed by John F. Rider on his regular paper stock, and added to the top of the filler stack after the major portion of the "COMPLETE" manual was printed and collated into the binder by RCA/Radiotron. If true, there is an implication that Rider agreed to let RCA take over the task of printing and assembling the manual without Rider's supervision, or interference, (which would explain the lack of competitors' tube data in the manual), while Rider assumed the task of putting together the Index, the Title Page, and of writing the Author's Foreword. Recently, an expert on Rider's Manuals was heard to say that "Rider did a good job in gathering the 'Set Catalog.'"

I am a fervent John F. Rider fan...but, in my opinion, there is no way that Rider could have had the resources to gather such a data base at that time. The Set Catalog can only have been an on-going market survey made by the RCA Radiotron Corporation to predict where and what their annual domestic tube market was going to be, and it served as a lure for Rider's cooperation. It is also likely that RCA Radiotron had such complete tube data on competitors' tubes that it inspired Rider's zeal.

The Author's Foreword by Rider praises the radio coverage and the extent of the "Set Catalog." It especially cites the inclusions of tube layouts,

parts values, voltages, etc. in the technical data, which make the manual "COMPLETE:"

"We feel confident..it is the most complete library of radio service information available under a single cover. While ...service information covering every radio receiver ever sold in the United States is not to be found in the volume, ...due..to the difficulty of securing such data,..."

"We further feel that this fact is substantiated by the presence in this volume of the Set Catalog pages. This tabulation, is without fear of contradiction, the only compilation of its kind, available in the world and more than 50,000 facts were collated to compile it."

"We want to call particular attention to the fact that this Complete manual is not solely a collection of wiring diagrams. Wherever available, we have published other data supplementary to the schematic, so as to make the service operation as simple as possible, and as rapid as possible. In addition to the schematic, voltage data, electrical values, and the socket layout, you will also find notes, chassis wiring diagrams, chassis layouts, chassis views, location of trimmers, adjustment frequencies, parts lists, etc.."

Many of the older schematics in the *RCA/Radiotron Manual* have very little extra information, but when the user looks up a radio set and finds full page photographs of the top and bottom of the chassis, full parts identifications, and all the other tables of voltages, resistances, etc., the "COMPLETE" in the title takes on a happy new significance. These data pages contain the information which Rider had received, but couldn't include in his previous Volumes I, and II. These layouts are numerous enough and are such a pleasure to use, they excuse Rider's use of "COMPLETE" in the title. A tabulation taken from Riders Volume I to X Index [27] indicates that 178 pictures, resistance and voltage tables, and schematics are included in the *RCA COMPLETE Perpetual Trouble Shooter's Manual* which weren't in Rider's Volumes I, II, and III. So the RCA "COMPLETE" manual contains more than just the schematics in Rider's first three Volumes [28].

Rider states that the manual does not contain schematics of sets made by companies which were out of business, or which didn't respond to his request for data. Even so, the *RCA COMPLETE Manual* was the uncontested premier, comprehensive, one volume source of radio service information for more than fifteen months. (In June, 1934, Gernsback published his *Consolidated Official Radio Service Manual* in competition.) [29]

In the body of his introduction, Rider expresses his displeasure with the RCA Radiotron/Cunningham Companies who had not included vital information on other makes of vacuum tubes which would have made the manual "Complete." The language he uses, seems to me, an open rebuke to RCA/Cunningham for their action:

"The RCA Radiotron Co. and the E. T. Cunningham Inc. organizations have found it expedient to omit all tube data other

than the tube specifications chart included. **Additional and more elaborate tube information, totaling about 40 to 60 pages will be mailed to the owners of this volume at a later date, within the next 30 to 60 days to be exact.** This additional tube information will include explanations of the application of the complete line of tubes and complete information relative to the characteristics and uses of all the tubes found in radio receivers and amplifiers."

It is credible that RCA Radiotron/Cunningham, and not John F. Rider, would have collected complete data on every competitor's tubes, and Rider may have seen or even been given a copy of this trove of information. He may have allowed himself to believe that it would be part of the "COMPLETE" manual, but since it was RCA's data, he was probably subject to RCA's proscriptions as to how the tube data was used. Certainly RCA did not want the competitor's tube data in their manual, nor would they want Rider to send sets of competitors tube data to all the RCA personnel or RCA tube users who had received the manual. Rider was probably outraged by RCA, but he was powerless to fight them.

All of the RCA "COMPLETE" manuals that I have seen had 28 pages of supplemental schematics in the front of the binder which were printed on the same paper stock as the rest of the manual. I have never heard of any other supplements offered for the RCA COMPLETE manual, nor could the manual binder have held them if they existed. No doubt Rider was persuaded to drop the tube data supplement idea by pressure from RCA, but belatedly in December, 1933, he did bring out a wall chart which covered 155 tube types from 17 different tube makers [30].

The "COMPLETE" manual was also issued with a blue binder by Cunningham [31] with a large script "C" in a circle, and the legend: "Cunningham, RADIO TUBES, Standard since 1915" (See Figure 26), but its contents were identical, so only the RCA manual is discussed here.

### **John F. Rider's "COMPLETE" Manual Motivation**

I believe that John F. Rider agreed to deliver all of the radio schematics he had received so Radiotron and Cunningham could make a "COMPLETE" Perpetual Trouble Shooter's Manual because he was discouraged with the Volumes I and II he had just published, and because RCA required little effort on his part to edit or publish the new manual.

If Rider wasn't suffering from battle fatigue, it wasn't because he hadn't been in a battle! First he had spent several years appealing to secretive manufacturers trying to secure schematics for his instruction manuals. Then, when he gained their compliance, his employer, Gernsback, used his resources to beat him to publication of a radio service manual. When he finally published his Volume I, he was first fired by Gernsback, and then he found that he had committed himself to an endless task of supplying free schematics of radios manufactured in and before the year 1931 by calling it a "1931" Manual. The final blow was to find, when he published his Volume II, that he had used a page numbering system which was incapable of future expansion.

Now, RCA offered to compile a "COMPLETE" manual, which would supersede these early manuals, and even offered a "Set Catalog" so he could check whether he had covered all radio schematics. Initially, this had been a Dream Come True for John F. Rider....to have a large well staffed corporation publish his "Complete" manual just for allowing their advertising to be on the cover!

Rider had to know that RCA made their offer out of some kind of self interest, and he may have suspected what use RCA intended for all the schematics, but he probably felt that pursuit of patent violations was merely a rightful enforcement of the law. Besides, RCA could get the diagrams simply by buying his manuals, so why not take what benefit he could from the deal?

At the time, Rider may not have recognized prestige as a reason to deal with RCA, but later he boasted in Volume IV, that his manuals were the "standard" of the radio service industry, and:

"their absolute supremacy.....is established by their use by the world famous tube manufacturing organizations, such as E. T. Cunningham, Inc., National Union Radio Corp., RCA Radiotron,..."

### **RCA Radiotron's "COMPLETE" Manual Motivation**

To have all the radio circuits of companies competing with RCA handed to them without cost in the manufacturer's own format must have been an incredible bonanza! Organizing them into one volume and distributing them throughout RCA would provide a compact, indexed, convenient guide for RCA Corporation's engineering, legal and patent review efforts. Distribution of the manual with the RCA Radiotron name on the covers, and on each page in the manual would extend tube and radio name recognition among RCA and non-RCA radiomen alike.

### **Another Wound for Rider**

What had started out as a salvation for John F. Rider was turned by RCA/Cunningham into just another hurt along the way. As unhappy as he was with the manual which RCA made so obviously for their own benefit, Rider was probably hurt even more by the apparently high handed way that RCA/Cunningham had made it impossible for him to deliver tube data to the "COMPLETE" Manual holders to fulfill a promise he had made in open print. John F. Rider had shown himself to be a man of integrity, and a man who was true to his word. To have someone else make him look to be less than that, must have hurt him deeply. For these reasons, I think Rider turned his back on the *RCA Radiotron "COMPLETE" Manual*, and resolved to continue publishing his own manuals.

### **Rider's Recovery**

Just two months after the release of the *RCA COMPLETE manual*, Rider published his newly formatted Volume III (Figure 28):

*Perpetual Trouble Shooter's Manual*, Volume III (1st Edition), May, 1933

**SALIENT FEATURES OF RIDER'S INITIAL SLIDELOCK MANUALS  
RCA "COMPLETE", AND VOLUMES I, II, & III IN MFRS FOLIO  
FORMAT  
(CONSEQUENT TO THE RCA/CUNNINGHAM "COMPLETE" MANUAL)**

EDITION	1st	1st	2nd	4th
VERSION NAME	RCA COMPLETE	VOLUME III	VOLUME II	VOLUME I
COVER LEGEND	COMPLETE PERPETUAL TROUBLE SHOOTER'S MANUAL	PERPETUAL TROUBLE SHOOTER'S MANUAL VOLUME III	PERPETUAL TROUBLE SHOOTER'S MANUAL VOLUME II	PERPETUAL TROUBLE SHOOTER'S MANUAL VOLUME I
TITLE PAGE	COMPLETE PERPETUAL TROUBLE SHOOTER'S MANUAL	PERPETUAL TROUBLE SHOOTER'S MANUAL	PERPETUAL TROUBLE SHOOTER'S MANUAL VOLUME II	PERPETUAL TROUBLE SHOOTER'S MANUAL VOLUME I
PUBL. DATE	3/1933	5/1933	8, 1933	11, 1933
PUBLISHER	John F. Rider N.Y. City	John F. Rider N.Y. City	John F. Rider N.Y. City	John F. Rider N.Y. City
PAGINATION	Numerical/ Alphabetic	Mfr. Folio Numerical	Mfr. Folio Numerical	Mfr. Folio Numerical
BINDER	4.5" 5 Post Slide Lock	3.0" 5 Post Slide Lock	3.0" 5 Post Slide Lock	3.0" 5 Post Slide Lock
ADVERTISING INDEX	RCA Binder*	None	None	None
POINT-TO-POINT	28 Pages	None	12 Pages	8 Pages
TUBE DATA	8 Pages	None	With Rcvrs	None
RCVR MFRS/Pgs	2 Pages	4 Folio	2 Folio	None
SUPPLEMENT/Pgs	172/2767	111/1032	136/757	120/962
CATALOG RCVRS/Pgs	6/20	With Rcvrs	With Rcvrs	Unknown
	855/115	—	—	—
SCHEMATIC PAGES	2787	1032	757	962
TOTAL PAGES	2940	1032	769	962

\*RCA Radiotron/Cunningham Footer on every page

**Table III**

John F. Rider gave Volume III all of the quality improvements which Radiotron had shown him. The Binder was changed to a 4 Post, (5 hole Pages) Slide Lock type, which has a slider along the full height of the binder with slots which engage and lock to the two outermost posts of the binder. The two intermediate posts are connected together by a flat metal strip which keeps them in position when the slider is closed and locked. Any center hole in the pages is not used, so the pages may be either four hole, or five hole. Instead of his traditional black, the new binder was a deep blue, with gold embossing. The John F. Rider Co. gave the "new" manual improved legibility by using engraved printing.

Most important of all, Volume III was the very first of Riders Perpetual Trouble Shooter's Manuals to be organized and printed in the "Manufacturers Folio" format that Rider took from the format used in the RCA radio "Set Catalog." The "Folio" plan treats the pages from each manufacturer as a separate group, or "Folio." Each page in the folio is imprinted with the radio company's name, or cognomen, e.g., "Philco" for all the Philadelphia Storage Battery Company pages. The "Folios" are arranged in alphabetical order in the manual. Within each "Folio," (e.g.; a group of Philco pages), each page number begins with the Arabic Volume Number in which the page belongs, followed by a dash, and then the Arabic number of the page within the "Folio," starting with page 1. Inserts are denoted by the associated page number with added "A," "B," etc. This system is easy to understand, allows easy expansion or introduction of a manufacturer's "folio," and permits quick identification of which Volume contains the page. The "folio" name identifies each page marked with the company name without need for reference charts.

The changes Rider made not only improved the appearance of the Manual, but made it much easier to locate information, and to insert and remove supplemental pages. Rider issued this manual without any articles in the front. It did not even have an Introduction. Volume III didn't contain the promised point-to-point data, (nor did Volume IV except for some fine tables in the Majestic folio). Rider was silent in these and subsequent manuals on any of these issues, so it is hard to read his feelings except by his actions. It appears as though Rider was so piqued at RCA, that he was reluctant to express any further support for point-to-point analysis. Judging from the sudden disappearance of the tube data Rider had featured in the front of the first Perpetual Trouble Shooters' Manuals, the Radiotron Tube Division of RCA managed to stop John F. Rider from giving equal space in his manuals to competing tube manufacturers like Raytheon, Sparton, and Kellogg, etc. In the "COMPLETE" manual, RCA had eliminated two pages of tube data from the Philco folio. Rider left these in the Philco folio of Volume III, but appeased RCA by inserting the Radiotron tube data in the RCA folio as pages 3-77 and 3-78.

RCA/Radiotron didn't leave it at that, however. One month after Rider announced his *Trouble Shooter's Volume III*, RCA Radiotron advertised in *Radio-Craft Magazine*; "FREE Complete Perpetual TROUBLE SHOOTER'S MANUAL By John F. Rider...Consult your RCA Radiotron or Cunningham Radio Tube Distributor" [32]. RCA was offering Rider's "COMPLETE"

## Rider's "Manufacturer's Folio" Slidelok Manuals



Figure 27. "Complete" and Vol. I Spines

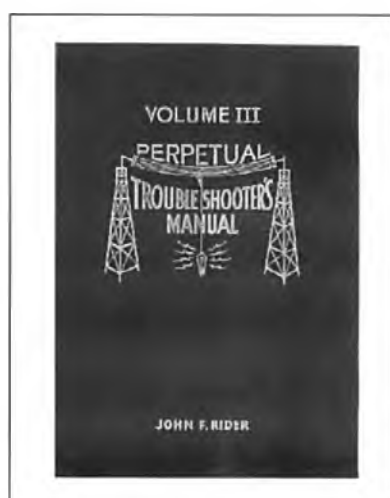


Figure 28. Volume III "Slidelok"

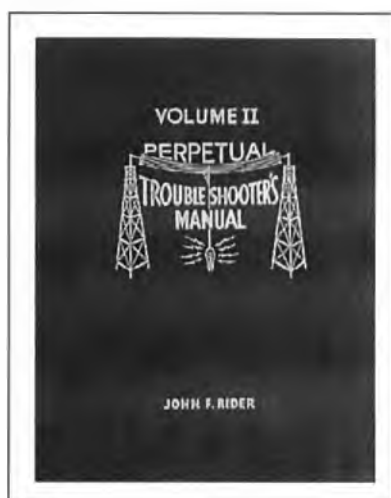


Figure 29. Volume II "Slidelok"

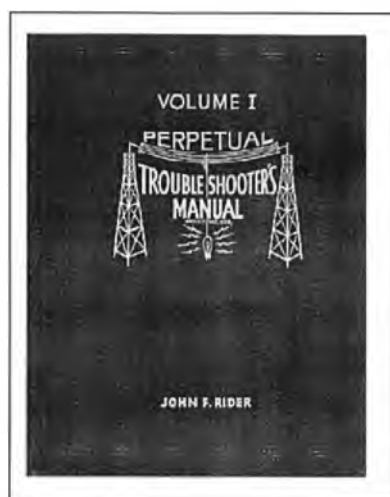


Figure 30. Volume I "Slidelok"

manual as a free premium to servicemen who would sign on for Radiotron or Cunningham tube sales franchises (See Figure 31). RCA could not have contrived a more hurtful act for Rider's manual sales. Once again, Rider was given a kick by those he had tried to deal with fairly. Again, he rose to the occasion, and in time, became a major Radio Trouble Shooter Manual supplier for the RCA Institute schools.



### ***Perpetual Trouble Shooter's, Volume II (2nd Edition)***

A Second Edition of Volume II was largely motivated by the great response given by servicemen for the Folio page identification system in Volume III, and probably by the ease of use of the binder itself which was easier to open and close for inserts.

The format and physical arrangement of the 2nd Edition of Volume II (Figure 29) was almost a clone of the new Volume III which had just been released by Rider, using the 3" wide, 4 Post, Slide Lock Binder of the new deep blue color. The outward appearance of the new edition of Volume II, except for the color, was almost identical to the previous version in the Swivelok binder. The only significant change was the adoption of the "Folio" plan introduced in Volume III.

In his new Volume II, an eight page "Point-to-Point Resistance Measurements" article was added in the front right after the index. The special sections, including the Canadian listings were all integrated into the Folios under the appropriate manufacturer's names. In his adherence to the Folio scheme, Rider took all the voltage tables which had been gathered in the front and distributed them to their related pages throughout the manual. Unfortunately, he chose to delete tube layout views to make space, and the tables were crudely typed-in on the schematic pages. The result was not neat. As shown in Table III on Page 32, the total page count is only 769.

### ***Perpetual Trouble Shooter's Manual, Volume I (3rd Edition)***

Since Rider never dated or marked his 2nd or successive editions, the only way to identify a Volume's "edition" is by its physical makeup. On this 3rd Edition, the four hole, blue Slide Lock binder is stamped with Volume I on both the front and the spine (Figure 30), but the Title Page inside does not identify the volume number, saying simply, *Perpetual Trouble Shooter's Manual*. It is likely that only the earliest releases of Volume I were issued without the up-dated Title Page, so most of the existing manuals probably have the full title as seen on the binder.

It is really helpful that in his Foreword, John F. Rider clearly states that it was published after the 2nd edition of Volume II, and even after Volume III had been published. Table III shows that Rider reissued Volume I in the Manufacturer's Folio pagination using the 4 post Slide Lock binder, with publication by the John F. Rider Company. As with Volume II, all the separate sections of Short Wave Receivers, Amplifiers, Eliminators, Etc. were integrated by manufacturer into the new Folios. In Riders Foreword, he says:

"This issue of Volume I is slightly different than earlier printings. One of the changes is to be found in the method of indexing. You will note that it is the same as used in Volume II and III as recently issued. The reason for this change is that the method of indexing as originally introduced in Volume III proved so much more popular than that previously employed in Volumes I and II, that it was deemed advantageous to establish a uniform index which would serve best over the years to come."

This 3rd Edition of Volume I was the final volume rewritten by Rider, and the "Folio" format proved to be so easy to use, and so flexible, that it was used for over 20 years in all subsequent manuals without user complaint or further modification.

Rider took advantage of this last revision of Volume I to add much of the material which previously had been left out. The 100-page article, *Modern Trouble Shooting* was removed, and many schematics of A.C. sets were added, along with additional charts for voltage and resistance. The manual gives an impression of crowding which is well earned. Many of the older pages were not changed and in some cases they had more data added. Almost 30 more set brands were added to those contained in the 2nd Edition, and yet there were 50 less pages devoted to schematics than in the "1931" version of Volume I. No wonder its pages seem crowded.

The battery set enthusiast will find only the most popular models of the largest manufacturers such as the Crosley Tridyn, and Model 51, for example, and these are reduced in size, and squeezed in between other schematics. Two and three tube battery sets are scarce. When Rider concentrated on utility in editing the 2nd Edition of Volume I, he abandoned his ideal of "Completeness" in covering the early battery sets. Apparently, very few obsolete battery set schematics were added to Volume I after the fact, since there was little need for schematics of old radios which were "not worth fixing" because they didn't work on "house current." Instead, Volume I became a manual of early A.C. sets from the late 20s, to mid 1931, with automobile and 32 volt farm sets added.

These rewritten early slide-lock manuals are shown in Figure 29 and Figure 30 along with their progenitors, the *RCA Radiotron COMPLETE Perpetual Trouble Shooter's Manual* (Figure 27), and Volume III (Figure 28).

Rider continued to include older schematics and radio data from older battery sets into his later manuals. These are readily located in the Riders Manual Indexes, and some older radio schematics were added as late as Volume VIII (1938).

751

# FREE



SIMILAR BOOK FOR CUNNINGHAM

Complete, Perpetual

## TROUBLE SHOOTER'S MANUAL

By JOHN F. RIDER

Radio Consultant • Editor of "Service"

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**RCA RADIOTRON or  
CUNNINGHAM RADIO TUBE  
Distributor**

Figure 31. Radio Craft, June '33

## Epilogue

The changes chronicled above set the standards for, and became the imprimature of, *Rider's Perpetual Trouble Shooter's Manuals* for twenty more years. The manuals are so deceptively easy to access that it never occurred to me that there was anything remarkable about the way the pages were identified. Only after tracing Rider's painful experience did I become aware of the simple elegance of his final solution. Obviously, if Rider had figured out the "Folio" pagination in the very beginning, he wouldn't have had so many manual versions.

A set of "Rider's Manuals" became the epitome of early radio schematic documentation though, as has been shown, they need to be supplemented by additional sources to approach complete coverage of the innumerable early radios which were manufactured.

If specific content is ignored, the *RCA/Radiotron Manual* stands out as a jewel among these earlier Riders manuals. It is probably the most valuable reference for material from the first three Rider's Volumes, but it must be handled with care because of its huge size, stiff spine, weight, and fragile pages. It is best as a desk reference, for it could easily be damaged in a shop environment. For example: It can't be moved with one hand. It can't be opened up so the pages lie flat enough to be easily read. The pages can't be temporarily removed (it takes two wood clamps to reclose the binder). The pages are subject to easy wrinkling or tearing. Even if removed, when a copy is made, the pages are so thin that more times than not, the diagram on the opposite side of the page "ghosts" along with the desired diagram, making the copies hard to read. With all these problems, it is still a most prized "Riders" manual for those early radios. It is truly regrettable that Radiotron chose to not include their library of information on all the tubes manufactured. Now THAT would have made a truly COMPLETE Trouble Shooter's Manual!

Starting Rider's Manual business was apparently a matter of persistence, hard work, and the pursuit of an ideal. The fact that John F. Rider outlasted a seasoned professional like Hugo Gernsback who also published Radio Service Manuals but dropped out after his seventh manual, attests to Riders energy, persistence, and willingness to work in the face of obstacles. Without Rider's tenacity, and determination, we would never have seen some of the radio schematics which he elicited from reluctant manufacturers before they went out of business, and to which he gave immortality in his "Perpetual Trouble Shooter's Manuals." Thank you John.

## Annotations

1. Kirsten, Charles C., *Hugo Gernsback's and John F. Rider's 1931 Manuals*, March, 1999. An unpublished critique and analysis of these two manuals showing that Rider had 586 schematics not shown in Gernsback's Manual, and that Hugo had 338 schematics not shown in Rider's Manual. The two manuals each had approximately 1000 schematics which were common to both manuals.
2. Kirsten, Charles C., *Three Versions of Rider's Perpetual Trouble Shooter's Manual*, Volume I. Antique Radio Classified, June, 1998, page 18.

3. Kirsten, Charles C., *The Four Versions of Rider's Perpetual Trouble Shooter's Manual* Volume II. Antique Radio Classified, February, 2000, pages 4-8.
4. Sibley, Ludwell, *John F. Rider and His Manuals*, by Ludwell Sibley. Radio Age, January, 1995, pages 1-7.
5. Gray, Richard, *Radio Diagram Sourcebook*, by Richard Gray, 1998 Rider Manuals, pages 1-4.
6. *Radio World Magazine*, Advertisement, August 11, 1929, Back Cover. *The Mathematics of Radio* by John F. Rider, Volume I of *THE SERVICEMAN'S MANUAL*, 1929, Radio Treatise Co. N.Y. *Trouble Shooter's Manual* by John F. Rider, Volume II of *THE SERVICEMAN'S MANUAL*, 1929, Radio Treatise Co. N.Y.
7. *Radio World Magazine*, Advertisement, January 4, 1930 pg 31; *THE SERVICEMAN'S MANUAL*, Volume I & Volume II, Radio Treatise Co.
8. *Radio-Craft Magazine*, Advertisement, May, 1930 page 545; Sound Pictures and Trouble Shooter's Manual, by James R. Cameron, and John F. Rider.
9. *Rider Volume Zero ?* by Ed Lyon, Editor, Radio Age, July, 1998.
10. *Radio-Craft Magazine*, Editorial, Announcement by Hugo Gernsback, of John F. Rider joining the staff, January, 1930.
11. *Radio-Craft Magazine*, Editorial Announcement by Hugo Gernsback, concerning the subject policy of the magazine, September, 1929.
12. *Frenzied Radio*, an editorial by Hugo Gernsback, Radio-Craft Magazine, February, 1930.
13. *1932 Official Radio Service Manual*, Volume II, Hugo Gernsback, Editor. Introduction, page 5, October, 1931: "It has been a source of great satisfaction to the editors to welcome the change in policy by the radio set manufacturers. Only a year ago, it was most difficult for the editors to procure all the available data on manufactured sets. This year, with practically no exception, set manufacturers have vied with each other to cooperate with the editors...." (My italics)
14. *Radio-Craft Magazine*, Advertisement, May, 1930 page 552 Supplementary Diagrams Pkg #1, (115 for \$2.50; offered as "Supplements to the 1929 Trouble Shooter's Manual")
15. *Radio-Craft Magazine*, Advertisement, June, 1930 page 650 Wiring Diagrams Package number 1 supplement to John F. Rider's Trouble Shooter's Manual (115 for \$2.50).
- 16a. *Radio-Craft Magazine*, Jun, 1930; Announcement pg. 666 Official Radio Service Manual by Hugo Gernsback, prepub. \$2.50
- 16b. *ibid*, Announcement pg. 616; National Radio Servicemen's Assoc.
- 16c. *ibid*, Announcement pg. 652; Short Wave Craft Magazine \$.50/copy
- 16d. *ibid*, Announcement pg. 669; Everyday Mechanics Magazine \$.15/copy
- 17a. 1930 *Radio-Craft Magazine*; page numbers of Advertisements for Hugo Gernsback's new publication and business initiatives:
 

	JUN	JUL	AUG	SEP	OCT	NOV	DEC	
666	6	120	170	230	314	326		<i>Off'l Radio Service Manual</i>
616	8	70	134	198	262	364		<i>Nat'l Radio Svcmen's Assoc</i>
					298	324		<i>Radio Svc Man's Handybook</i>
652	50	108	178	234	300	370		<i>Short Wave Craft Magazine</i>
669	59	123	186	246	318	380		<i>Everyday Mechanics Magazine</i>
- 17b. 1931 *Radio-Craft Magazine*; page numbers of Advertisements for Hugo Gernsback's new publication and business initiatives:
 

	JAN	FEB	MAR	APR	MAY	JUN	JUL	
390	487	553	615	677	748	56		<i>Off'l Radio Service Manual</i>
		518	627	646	748	56		<i>Radio Svc Man's Handybook</i>
431	498	566		684		82		<i>Short Wave Craft Magazine</i>
446		496						<i>Everyday Mechanics Magazine</i>

18. *Radio-Craft Magazine*, Advertisement, October, 1930, page 230; *Official Radio Service Manual*, by Hugo Gernsback, and Clyde Fitch, published by Gernsback Publ, N.Y., 352 pages, \$3.50.
19. *Radio-Craft Magazine*, Announcement, October, 1930, page 232; John F. Rider announces an "ADVANCED HOME STUDY COURSE."
20. *Radio-Craft Magazine*, Advertisement, November, 1930, page 298; *Radio Service Man's Handybook*, by C.W. Palmer, Adeleman, Freed, et al; Published by Gernsback Publ, N.Y. 200 pages.
21. *Practical Testing Systems* by John F. Rider, 144 pg. \$1.15, *Radio-Craft Magazine*, January, 1931; Advertisement pg. 433.
22. *Practical Radio Repairing Hints* by J. Rider, 250 pg. \$2.00 *Radio-Craft Magazine*, February, 1931; Advertisement pg. 491.
23. *Radio-Craft Magazine*, April, 1931, page 623; Advance Announcement of *1931 Perpetual Trouble Shooter's Manual* soon to be available with more than 800 pages, at \$5.00.
24. *Radio-Craft Magazine*, Advertisement, March, 1931, page 516; *Official Radio Service Manual*, Supplement No 2, by Gernsback and Fitch, published by Gernsback Publ, N.Y., \$3.50/Year.
25. *Radio-Craft Magazine*, Advertisement, May, 1931, page 687; *1931 Trouble Shooter's Manual* by John F. Rider, 800 pages at \$5.00.
26. *Radio News Magazine*, Advertisement, August, 1932, page 112; Announcement of publication of *Perpetual Trouble Shooter's Manual*, Volume II by John F. Rider, \$5.00.
27. COMPLETE INDEX for *Perpetual Trouble Shooter's Manuals* Volumes I, II, III, IV, V, VI, VII, VIII, IX, and X John F. Rider, Copyright 1939
28. Exceptions are the tube data sheets for Sparton, Kellogg, Amperite, Raytheon, and two pages of Philco tubes which are not strictly schematics, but were removed by RCA from the sheets for the COMPLETE Manual. One schematic of which I am aware is the schematic for the Weston Test Panel shown on page 755 in the Analyzers section of *Riders 1931 Trouble Shooter's Manual* (and may not have been given to RCA).
29. *Radio-Craft Magazine*, Advertisement, June, 1934, page 1007; *The Consolidated Official Radio Service Manual* by Gernsback, a manual of 2700 pages and over 7500 radio diagrams, is of comparable size and content to Rider's *RCA "COMPLETE" Manual*, and additionally contains 1934 schematics. It combines four unabridged Official Radio Service Manuals for 1931 through 1934 by Hugo Gernsback and an "Up-To-Date Catalog of All Commercial Radio Receivers" in a single loose leaf binder.
30. *Radio News Magazine*, Advertisement, December, 1933, page 376; Announcement of publication of a Modern Tube Index, wall chart 27" by 22" covering 155 tube types from 17 different manufacturers, by John F. Rider, \$ .25.
31. E.T. Cunningham Inc., in cooperation with RCA, published the same manual with their own cover (See Figs 15,16), but for brevity, this article refers only to the RCA version, and where "RCA" is named, you may understand it to mean "The combined RCA Radiotron/Cunningham Tube Companies."
32. *Radio-Craft Magazine*, RCA Advertisement, June, 1933, page 751; "FREE Complete Perpetual TROUBLE SHOOTER'S MANUAL by John F. Rider more than 2800 pages, more than 6000 diagrams."

## Appendix A

### Determining the Chronological Order of Rider's Manuals by Comparing his Manual Introductions

Determining the order of publication of Rider's early Radio repair manuals has proven to be somewhat daunting especially for one of his rare manuals titled *Perpetual Radio Reference Data*. With the exception of a different logo and title on the binder and on the Title Sheet inside, and a slightly different introduction by John F. Rider, it is a dead ringer for the *1931 Perpetual Trouble Shooter's Manual*. Almost all of Riders books, texts, and manuals were written to be sold, so they were widely advertised from their first release. Thus it is possible to closely identify the date of publication of most editions and volumes from the dates of advertising.. even though Rider left very few clues in the volumes themselves.

I must admit my exasperation at finding that he dated nothing among his own writings. His Introductions to the books are undated and the technical articles on radio service techniques and Trouble Shooting are undated. There are no dates of publication or printing runs in the books. Just once in his Volume II, he spoke of dates. He did not say when the book was printed but he simply mentioned what years of radio models the manual(s) covered.

When a volume of his showed up with a title quite different from his other manuals, and showing a rudimentary form of his well known two radio towers and antenna on the front, it would seem elementary that this was a precursor volume which he tried out and chose not to advertise. That would be my guess, but isn't there some way to be sure? The only differences I could detect between this manual and the *1931 Perpetual Trouble Shooter's Manual* were the title on the binder front and spine, the title page legend, and some differences in the introduction by Rider himself.

The binder is the same black Swivelok as the "1931," so, aside from the more modest logo, it doesn't give any solid proof of its priority. I finally turned to comparing the two introductions in detail. Below will be found the two introductions written in "Corrected and retained language" form, with a presumption that the "Reference" manual is the first written. The original words which were left untouched are shown untouched. The words which were deleted in the "1931" version are shown as bracketed <strike-outs>. The language which was added in the "1931" version is shown as bracketed [bold type]. With a little mental gymnastics, the piece can be read in an inverted sense, considering the bold-type to be left out of the "1931" first typing, and adding in the strike-outs.

To me, the added references to the "Trouble Shooter's" makes a lot more sense, than thinking that Rider would be striking out the title he adopted for his later manuals. There are a lot of other corrections which made the language more ingratiating to the manufacturers, and of course, the corrections of blatant misspellings.

In summary, I am convinced that the *Perpetual Radio Reference Data manual* preceded the *1931 Perpetual Trouble Shooter's Manual*, though not by much. I have guessed that it was only about a month, considering the timing of the later manual's publication dates.

# ~~INTRODUCTION~~

## INTRODUCTION

It is with a great deal of pleasure that we offer this work and hope that it will be the nucleus of a perpetual reference ~~[radio trouble shooter's] manual~~ ~~<covering the radio receiver and associated branches of the radio industry>~~. It may be of interest to the man who ~~<thumbs>~~ [thumbs] these pages to know that it is the fulfillment of an ideal. We had hoped for a long time to prepare a book which would contain radio ~~<receiver and associated circuit>~~ [service] data ~~<in such quantity as to be a reference manual for the industry>~~ [covering American and Canadian radio receivers, with completeness as a goal].

We want it known that the preparation of this work would not have been possible ~~<without>~~ [were it not for] the wholehearted cooperation of the organizations represented herein. We take this opportunity to express our sincere appreciation for the kindness shown, and the courtesies extended by the many executives, chief engineers, and service managers of the manufacturers listed herein, who have been in communication with the writer during the past two years, and who saw fit to foster ~~<the preparation of such a volume>~~ [the radio service industry by granting permission to publish their service data]. Acknowledgement is made to the tube manufacturers, meter manufacturers, and kit manufacturers ~~<mentioned>~~ [listed] in this ~~<volume>~~ [book]. Particular reference is made to E.T. Cunningham, Inc. for the socket layouts ~~<used in many instances>~~ and to the Jewell ~~<Electrical>~~ [Electrical] Instrument Co. for the ~~<many>~~ [set analyzer] voltage tables. An expression of thanks is ~~<due>~~ [accorded] the Weston Electrical Instrument Corp., Jewell Electrical Instrument Co., [and the] Supreme Instrument ~~<e>~~ Corp. ~~<, and other meter manufacturers>~~ for furnishing blue prints of their test equipment. We realize that this ~~<action>~~ [procedure] is out of the ordinary.

We wish to acknowledge the kindness of the editorial staffs of Radio News, Radio World, Radio Engineering, Q.S.T., Radio, ~~<Radio Citizens Call Book>~~ and the General Radio Experimenter, who granted ~~<the writer the privilege of reproducing>~~ [permission to use] whatever material had ever been published in their periodicals. We also wish to thank the Board of Directors, and Mr. Grover C. Kirchoff, Executive Secretary of the Radio Service Managers' Association of New York City, for their kind cooperation.

With respect to the presentation of ~~<radio service material>~~ [the trouble shooting data] we feel that ~~<such data is part and parcel of any compilation of radio circuit information>~~ [the publication of schematic wiring diagrams, and chassis layouts relieves the need for minute discussion along theoretical lines]. ~~<The engineer and technician who is not interested in such information need not pass over the pages. On the other hand, the many schools who will find this volume of interest to their practical radio students, will find there is a definite need for this data. As a matter of fact, its inclusion is an advantage to the engineer as well, because he can get an idea of the general modus operandi in this direction and thus consider the problem during the design of a radio receiver>~~ [With this information at hand, accompanied by voltage data color code the problem of locating individual units is greatly simplified, and the discussion of how to locate units need be extensive.(sic) In the event that new modes of testing are developed some time in the future, they shall be presented in the supplement sheets.]

[If this compilation of radio service data proves of aid to the radio service industry at large, the purpose of this book will have been fulfilled]  
**John F. Rider**

### **Chronology**

Rider's 1929 *The Mathematics of Radio*, The Service Man's Manual, Volume I. (1929 Math textbook)...October, 1929

Rider's 1929 *Trouble Shooter's Manual*, The Service Man's Manual, Volume II. (1929 textbook containing 100 poorly marked manufacturer's schematics) ...October, 1929

Rider, *Radio-Craft* Service Editor: Rider becomes Hugo Gernsback's Radio-Craft Magazine Service Editor...January, 1930

*Sound Pictures and Trouble Shooter's Manual*: by James R. Cameron, and John F. Rider, Cameron Press...May, 1930

Rider's 1929/30 *Supplementary Diagrams*, 115 additional manufacturer's schematics in loose leaf form...May, 1930

Gernsback's 1931 *Official Radio Service Manual*, Advance Announcement in *Radio-Craft*...June, July, 1930

Gernsback's 1931 *Official Radio Service Manual*, Volume I Advertisement in *Radio-Craft*, 352 pages, \$3.50...December, 1930

*Practical Testing Systems*, by John F. Rider 144 page hard bound text book...January, 1931

*Practical Radio Repairing Hints*, by John F. Rider 250 page hard bound book...February, 1931

*Rider's Perpetual Radio Reference Data*, (1st Ed) Unadvertised edition of Rider's Volume I...March, 1931

Gernsback's 1931 *Official Radio Service Manual*, Volume I (2nd Ed) Re-advertised page 677 of *Radio-Craft*, \$3.50...May, 1931

Rider's 1931 *Trouble Shooter's Manual*, published Advertisement page 623 of *Radio-Craft*, \$5.00...May, 1931

Rider, *Radio-Craft* Service Editor: Rider leaves...May, 1931

Gernsback's 1932 *Official Radio Service Manual*, Volume II Advertisement in *Radio-Craft*, 1000 pages, \$4.00...September, 1931

Rider's *Perpetual Trouble Shooter's Manual*, Volume I (3rd Ed) Rewrite of 1931 manual, still with bad pagination...November, 1931

Rider's *Perpetual Trouble Shooter's Manual*, Volume II (1st Ed) A manual with even worse pagination than Volume I...Jun, 1932

*RCA "COMPLETE" Trouble Shooter's Manual*, a fine manual by RCA combining contents of Volumes I, II, and III...March, 1933

Rider's Volume III *Perpetual Trouble Shooter's Manual*, the first Rider's to use the "Folio" format copying RCA's...May, 1933

Rider's Volume II *Perpetual Trouble Shooter's Manual* (2nd Ed) rewritten in "Folio" format, and copying RCA's...August, 1933

Rider's Volume I *Perpetual Trouble Shooter's Manual* (4th Ed) rewritten in "Folio" format, and copying RCA's...November, 1933

Rider's *Modern Tube Index*. Wall chart, 17" by 22" (New) data on 155 tube types from 17 manufacturers...December, 1933



**Color Photographs to accompany  
The History of the Development of Radio Grille Cloth  
by Barbara Havranek**



*The numbers on the above photos  
correspond to the Figure numbers in the  
following article by Barbara Havranek*

## Charles C. Kirsten

Charles is a retiree from over 50 years of electronic and communications engineering. His interest in radio began at the age of nine, when he was given a crystal set to occupy him during an episode of childhood illness. This led to a love of music, home radio construction, and later, radio repair as an avocation during a toolmaker's apprenticeship at Pratt & Whitney Aircraft.

Enlistment in the US Navy during WWII brought training in RADAR, SONAR, and communications, and service on Guam as an ETM/2C. Post war studies at UCLA while working at Beckman Instruments Research resulted in a BSEE and a career shift to the Telecommunications Division of Caltech's Jet Propulsion Laboratories (JPL).

The transfer of JPL from the Army to NASA came during the exciting days of transition from vacuum tube to solid state; from analog to digital; from L/C tuning to phase-locked loop signal acquisition; from carrier signal to pseudo-noise coded spread spectrum reception; from main-frame to personal computer; from battery power to solar cells and domestically, from radio to color television, and talking cars. Charles found his job as an electronic engineer designing telemetry and command systems for unmanned interplanetary spacecraft, demanding, but he still found time to earn an MSEE at UCLA. Engineers ran fast just to stand still.



Charles' interest in collecting old radios began in 1976 while he was assigned to NASA Headquarters in Washington, D. C., and shortly after several of his trips overseas to Geneva, Switzerland as a member of the Committee Consultatif Internationale Radiotelephonique (CCIR). On his trips, Charles took time to stop in Paris and peruse the stalls at the Marche aux Puces, and Les Halles Antique Center, looking for T.S.F. Recepteurs. Recently, Charles has been spending his time analyzing vintage test equipment and writing articles on the unusual and innovative approaches to test equipment design. He has written a few short articles for ARC, and the OTB, but this is his first article to appear in the AWA Review. He hopes you like it.

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Tau Beta Pi (Engineering Honorary, UCLA)  
Sigma Xi, (Science Honorary, Caltech)  
Past Member: IRE (Institute of Radio Engineers)  
IEEE (Institute of Electrical and Electronic Engineers)  
CCIR (Consultative Committee on International Radio)

waves) would produce the best sound, but speaker protection was imperative and it could not be achieved with wood or metal mesh without distorting the sound more severely than with grille cloth. The word grille is a French word that describes openwork such as metal structure or a screen covering a gate, door window or the radiator of an automobile.

Although the initial driving force behind the development of radio grille cloth was functional, the cloth soon became a decorative element that enhanced the appearance of the radio. Designers reviewed every design element to create a unified vision. The 1920s wood highboy furniture cabinet radios were an expensive investment for a family, with some costing three months pay. Radio manufacturers wanted to project the image of a solid investment in a well-crafted radio. Elements such as the addition of a visually appealing textile that complimented the warm mahogany or walnut woods of the consoles increased the marketability of the sets.

### **Types of Radio Grille Cloth Fibers**

Starting in the 1920s, radio grille cloth textiles were created using a selection of silk, cotton, rayon or a cotton/rayon blend. After World War II, grille cloths were primarily a cotton/rayon blend woven with Lurex, which is a gold, silver, or copper thread [1].

### **Silk Grille Cloths (1920s-1930s)**

Radio grille cloths made of silk were not widely used because silk is an expensive textile. Silk's characteristics of strength and fineness combined with its luxurious and aesthetic luster create a durable and beautiful radio cloth for upscale radios. One example of silk grille cloth was used on a prototype radio created in 1933 by designer Gordon Russell for the British Industrial Art Exhibition that showcased the finest in British design with the theme "Towards A Style" in British design. The radio grille cloth is a magnificent gray and blue checked silk fabric mounted in a black walnut plinth cabinet [2].



In addition to its high price, silk was not very popular with designers due to the inferior quality of silk during the 1920s. Unfortunately, the commonly available silks had become much degraded by the end of the late 19th to early 20th century. Silk, a fine, soft, strong fiber spun by silkworms to form their cocoons, was treated with a solution of tin salts to add luster and weight so that lower quality silks could mimic the very rare and expensive high quality silks. After a period of time,

**Figure 1.** *This stylish chairside radio, designed by leading industrial designer Norman Bel Geddes hides all the radio components inside a beautiful furniture cabinet. [www.grillecloth.com](http://www.grillecloth.com)*

## **The History of the Development of Radio Grille Cloth**

**by  
Barbara Havranek**

The 20th Century will be remembered, in part, as the century that gave birth to the industrial designer. With the advent of the Industrial Age and the creation of countless consumer goods, fierce competition necessitated the incorporation of creative industrial designers into the development and manufacture of most products. In order to outsell their competitors, companies hired industrial designers to artistically interpret their products while adhering to technical manufacturing requirements. The companies hoped that these artistic designs would create a desire and demand for their items, even if the consumer already owned similar products. Every minute detail of an object was examined and redesigned to create a visually appealing, updated version with increased sales potential. Due to the vast competition in the radio market, all of the radio manufacturers adopted this approach. New artistic styles of radios were designed to increase sales in an already saturated market. The goal of the radio manufacturers was to place a radio in every room in the house, and with the help of the industrial designer, that goal was attained.

Radio cabinets were created to not only enclose and unify the components but to create an artistically beautiful radio. The appearance of early breadboard radios resembled a science experiment with exposed wires and glowing tubes. The hazards of leaky batteries that left holes in the rug further reduced the aesthetic and practical appeal of these early sets. These breadboard radios, which were usually located in the living room, were unbecoming visual focal points in an otherwise unified decor. To appease the radio consumer the industrial designers unified and beautified these units by placing, and even hiding, the radio components and the speaker within a beautiful furniture cabinet. (Figure 1)

To protect the vulnerable loudspeakers from hazards such as the probing fingers of young children, the delicate speaker cone had to be covered with radio grille fabric. The development of early grille fabric was therefore initially a functional and not a decorative element of radio design. Ideally a speaker without a fabric grille cloth (which tends to mute the sound

2. Rayon could be produced in unlimited amounts in contrast to the limited supply of silk that depended upon the harvest of the silk worms and variables such as weather and disease.
3. Eliminating dependency on foreign countries such as Japan, China, France and Italy, which were the chief sources of silk during first half of the twentieth century, and the simultaneous creation of American textile jobs was appealing.
4. The interest in new technology and American ingenuity glamorized new textiles such as rayon.
5. Rayon is versatile, durable, strong, visually appealing, and easy to dye.
6. Rayon is easily manipulated, it drapes well, and has a high tenacity.
7. Rayon is hydrophobic and inherently resistant to shrinkage, making it a logical choice for radio grille fabric because it holds its shape in various humidity levels.
8. Rayon is more sturdy and non-warping than a pure cotton fabric.
9. Rayon is available in a light to heavy weave, in bright to dull finish, and it blends well with cotton, wool, silk and other fibers. Hence the large quantities of rayon/cotton blend grille cloths that were created and used throughout the decades.

The concept of the “new” textile rayon combined with the “new” industry of the radio was appealing to a public that was obsessed with having the “newest” and the “latest.” It was even more enticing to unite the “new” rayon grille cloth with the industry’s “new” Bakelite cabinets that replaced the wooden cabinets. The radio was now truly a 20th century innovation, and a Bakelite radio with rayon grille cloth was a product for the working class to be proud to own.

### **Textile Process and Designs**

Since the beginning of radio grille cloth production in the 1920s, a variety of designs from plain weaves to decorative patterns were created. The structural design is formed when the fabric is produced using either a variety of materials, a variety of methods of construction or a combination of these two factors. The yarns, which can vary in size, ply, color, and direction and amount of twist can produce a textile with a wide range of structural designs, patterns, and colors. A design can result from the use of different fibers or from combining heavy complex yarns with fine simple yarns. Patterns such as waves, leaves, blocks, swirls, lattice, and Art Deco and tapestry images were used on radios and radio speakers from 1929 through the 1940s. During the 1950s, the most popular grille cloths were simple weaves with various plies and types of fibers and metal threads which were used to create a texture and pattern. (Figure 1.) The popularity and the inspirational qualities of the plain weave radio grille cloths may have been the result of the fact that interior designers such as Russel Wright, had installed important department store window treatments with plain weave textiles and a handwoven appearance. Twentieth century mechanized woven textiles were all created at relatively similar costs so the price of the fabric was not a significant factor in its selection.

however, this alteration process chemically reacted with the textile and shattered and split the silk due to the inability of the weave structure to bear the weight over time. Silk consumption dropped from a peak of 80 million pounds in 1929 to 54 million pounds in 1937 [3]. Inferior silks and high costs led to the use of rayon as the preferred textile for radio grille cloth.

### **Rayon Grille Cloth (1925 - 1955)**

Rayon became the “silk of the working class” and it was extremely popular during the first half of the 20th century. Rayon was visually appealing and cost effective, thereby quickly replacing silk as a potential textile for radio grille cloth. The manufacturers and the public were very happy to incorporate a textile which was inexpensive and available in virtually unlimited supply, into their daily life.

Rayon was first developed and manufactured in 1910 and it is the oldest man-made fiber. Progress in the manufacture of rayon was phenomenal, breaking all previous production records of other textiles. The majority of rayon’s growth occurred from 1925 to 1955, coinciding with the explosive growth of the radio. The *Rayon Textile Monthly* reported that rayon consumption in the United States jumped from 48.5 to 285.7 millions of pounds from 1929 to 1939, vastly outselling silk which dropped from 80 to 8.9 millions of pounds during the same years [4]. In 1934, rayon accounted for 6.3% of the world production of fabric, and it climbed to 48.7% of the world production in 1938 [5].

Rayon is a generic term applied to the man-made fiber derived from regenerated cellulose such as wood pulp, an organic fibrous substance that is found in all vegetation. These raw components could be secured at much less cost than silk and obtained in sufficient quantities to allow large amounts of rayon to be produced. Cellulose fiber can be extracted from woody vegetable material such as cotton linters and wood pulp and then regenerated to form rayon. The raw material is made into a liquid that is forced through microscopic holes in a spinneret. The streams of liquid are hardened by the air into fibers of uniform size, shape, color and length. Thicker areas of a rayon thread are created by reducing the speed of the stream at regulated intervals. The liquid is hardened by the air, which transforms it into fibers, which are then spun and made into skein. The skein is then woven to form the fabric [6].

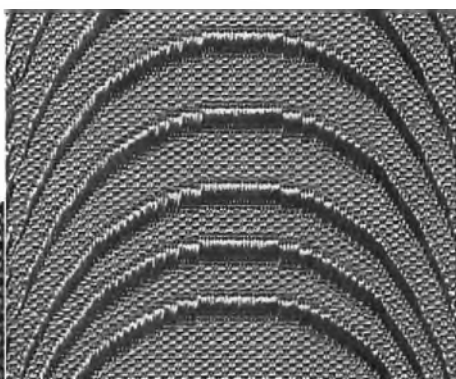
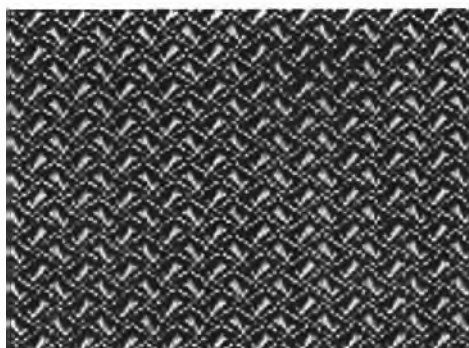
In America, the majority of 1930s radio fabrics were woven with rayon or a cotton/rayon blend. The earlier smaller radios used thinner rayon exclusively, while the larger radios used cotton with some rayon fibers to add sparkle and effect [7]. The addition of cotton to the very early form of rayon, which was extremely sensitive to changes in humidity, added the needed weight to prevent shrinkage or tightening over the radio speaker, as well as a textural appearance which complimented wood and plastic radios. Later forms of rayon did not have this problem, but cotton was still often added to enhance the appearance of the fabric.

Rayon was the most popular choice in the weaving of radio grille cloth for many reasons.

1. Rayon could be produced at a lower cost than silk and it was therefore more cost effective.

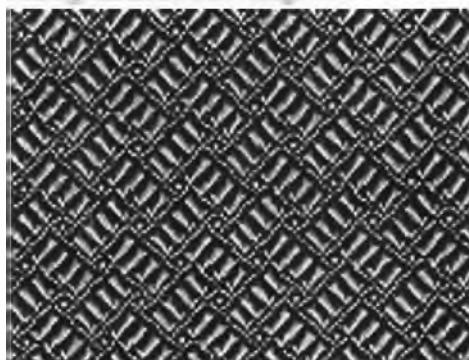


**Figure 3.** (Right) This wave pattern motif evokes images of strong pulsating radio wave signals that are racing through the air from radio stations to the waiting public to be received by the radio. [www.grillecloth.com](http://www.grillecloth.com), image 28.



**Figure 4.** (Left) This small herringbone design created a warm texture that complemented wooden radios. [www.grillecloth.com](http://www.grillecloth.com), image 10.

**Figure 5.** (Right) The Stromberg and some Philco tabletop models used similar lattice pattern textiles in a whiskey rayon color. The lattice pattern varied in size and color but its rich appearance was a popular choice for many radio manufacturers. This is a visually clean version because the decorative lines of hatching run parallel to each other. [www.grillecloth.com](http://www.grillecloth.com), image 17.



**Figure 6.** (Left) This Lattice pattern was used for Emerson and Clarion cathedrals and other small table radios. It is very busy in appearance because decorative lines within the cross hatching are perpendicular. [www.grillecloth.com](http://www.grillecloth.com), image 11.

**Figure 7.** (Right) This is the lattice pattern for the 1929 RCA 100A speaker. The textile is not as busy as that in Figure 6 so it does not compete for attention for such a large area in the speaker. Although the perpendicular cross-hatching is similar, the latticework is looser in appearance, which allows viewers to lose themselves as their eyes travel in and out of the weave pattern when listening to the radio. [www.grillecloth.com](http://www.grillecloth.com), image 35.



The fact that the material was to be used on a radio was an important design consideration among the many elements that had to be analyzed before making a final choice of fabric. Color, texture and patterns all add to the unique decorative style of a radio. The success of a specific piece of textile depends upon the careful matching of the aesthetic characteristics of the radio cabinet design with the aesthetics of the fabric. The textile should enrich, add texture, and compliment as well as decorate the cabinet. The continual and rapid growth of the radio and its technology lead to the creation of beautiful tabletop cabinets made of wood and later plastic. For example, a dark brown or tan radio grille fabric will compliment a dark brown Bakelite radio cabinet in contrast to a bold primary color that would compete with the cabinet. Fabric with dimensional depth within its composition adds texture to the warmth of wood and the smoothness of plastic cabinets thereby enhancing their own inherent qualities. The grille cloth added to the visual appeal and the staying power of the radio and justified higher prices.

### Grille Cloth Designs

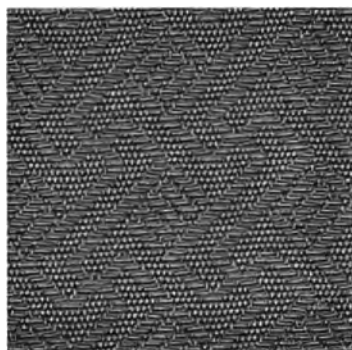
The majority of radio grille cloths are monochromatic rayon/cotton blends of medium weight with a simple weave, light threads, and an unassuming and subtle pattern. The pattern is created by varying the ply to create a random or structured weave which enhances the natural beauty and color of the fabric. Some textiles rely on the weaving to create a subtle pattern such as the ribbed textile found on mid- to late 1930 Philco tabletop models and consoles. Other textiles have an icon or pattern on a monochromatic field and some examples include the swirl pattern textile found on the Walton tombstone, (Figure 2), the wave pattern textile found on the 1939 Zenith 8-S-363 (Figure 3), a herringbone pattern found on the Philco 80B (Philco Jr.), (Figure 4), and the lattice pattern found on various Stromberg models, (Figure 5), the Emerson model 25 (Figure 6), and the 1929 RCA 100A speaker. (Figure 7)

The icon motif grille cloth found on the 1945 round British Ekco A22 radio designed by Wells Coates is more than just an attractive decorative element. I believe Coates utilized the bee motif grille cloth as a symbol of the radio itself. The bee is a communal insect that is cooperative, industrious, and diligent, since they are thought to never sleep. Bees were regarded in many cultures, such as ancient Greece, as being messengers to the gods who informed them of important events. The radio was now the diligent "bee of the 20th Century" which tirelessly brought news and events throughout the day to the modern day Zeus.



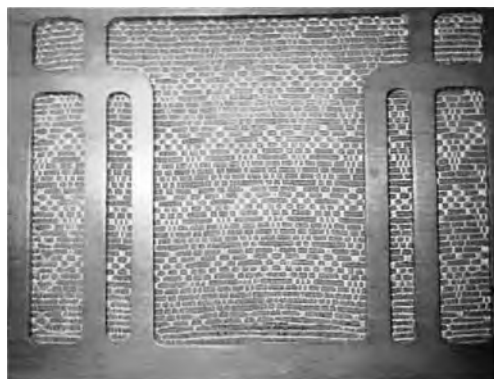
**Figure 2.** (Left) This swirl pattern motif seems to emulate the gentle sounds of the music that passes through the grille cloth. [www.grillecloth.com](http://www.grillecloth.com), image 63.





**Figure 9.** (Left) The discovery of Aztec ruins inspired Art Deco designers to create Aztec inspired patterns such as this textile used in many RCA and GE sets of the early 1930s including models 143, 111, 128, 262, 341 and others. [www.grillecloth.com](http://www.grillecloth.com), image 44.

**Figure 10.** (Right) The Crosley 8-U-19 radio with this delicate lace grille cloth evokes images of the lace and croquet tablecloths that were popular in the first half of the 20th century. (Collection: Courtesy of Stan Hywet Hall and Gardens Historic House/Museum in Akron, Ohio.) (Photograph: Barbara Havranek).



**Figure 11.** (Left) A close-up view of the Crosley 8-U-19 grille cloth shows that this appealing lace-inspired radio grille cloth complemented interior designs in houses where people placed lace doilies under their radios as well as over the armchair sleeves of the chairs in their rooms. (Collection:

Courtesy of Stan Hywet Hall and Gardens Historic House/Museum in Akron, Ohio.) (Photograph: Barbara Havranek)

Another reason smaller mills were used for making grille cloth was that the larger mills did not take orders smaller than a certain size. The amount of fabric that a typical radio company would order was not profitable from the standpoint of a larger mill. The average radio speaker required only 1/12 of a square yard. Since 1200 radios would only need about 100 square yards of material, this was a very small-volume order for a large textile manufacturer but perfect for smaller mills. Some of these small American textile manufacturers that dealt with and created textile for radio manufactures included Solar Textiles in Chicago, Illinois; Antoni Olek and Sons in Philadelphia; Pennsylvania; the Tenderly Mills in Rhode Island, and Bergen and MacIntiere Mills who specialized in tall consoles [10].

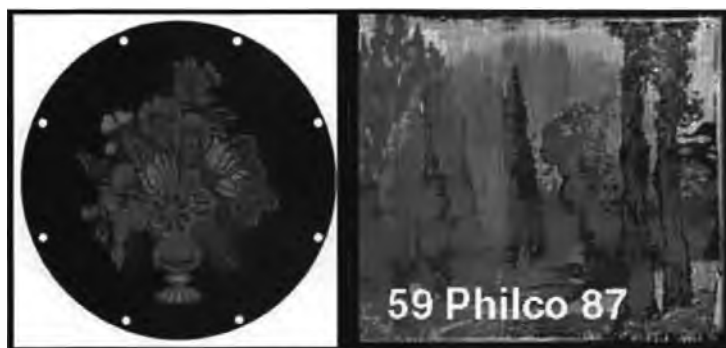
Other grille clothes have more pictorial images, which create a visual focal point. The heavier tapestry fabrics displaying this kind of image include the RCA 103 “flowers in a vase” tapestry or the Philco 87 “countryside scene” tapestry. (Figure 8). The Aztec-inspired pattern found in many of the RCA and GE sets of the 1930s reflect the geometric style recently found in Mexico, which inspired the art-deco movement. (Figure 9). The Crosley 8-U-19 grille cloth stirs memories of a crochet tablecloth with a design that hints of a pattern of tulips all in a row (Figures 10 and 11).

### Radio Grille Cloth Sound Distortion Tests

Sound distortion is one of the most important considerations in the selection of a grille cloth. The fabric must have a loose but firm weave so the sound waves can penetrate the fabric without being muffled while allowing the fabric to protect the loudspeaker. Radio manufacturers would test the fabric weave with the “muffle” test that was conducted by blowing cigarette smoke through the fabric to see how much passed to the other side. The best textiles had a loose weave to insure sound penetration without sound distortion and volume loss, and these were the ones that allowed the maximum amount of cigarette smoke to pass through [8].

### American Textiles Companies

The textile industry is one of the oldest and largest industries in the United States, with mills that range from giant corporations to small privately owned businesses. The radio industry dealt primarily with the smaller manufacturers because they could produce small runs of materials. For example, larger mills could not react quickly enough to accommodate the rapidly changing demands for the new styles that Philco required. The larger mills such as Burlington Industries needed a six-month advance notification and had a no-cancel clause in their contracts, making them impractical for companies like Philco [9].



**Figure 8.** The RCA 103 speaker tapestry with flower-in-vase image is on the left. The Philco 87 landscape tapestry is on the right. Both are a visually appealing focal point for a room. The tapestry work is associated with priceless textiles created for royalty. With the invention of the loudspeaker, people looked at the radio as if the broadcaster was in the room talking directly to them. The habit of “watching” the radio prompted radio manufacturers to create visually appealing grille cloths like these. [www.grillecloth.com](http://www.grillecloth.com), images 58 and 59.



**Figure 12.** (Above and Right) *Raymond Loewy, a prolific 20th century designer, designed everything from these Hallicrafters sets to Air Force One's interior.* [www.grillecloth.com](http://www.grillecloth.com)



**Figure 13.** (Left) *Raymond Loewy's 1933 Colonial New World Globe Radio. The speaker is in the base and it is covered with a neutral grille cloth.* (Image courtesy of Marty and Sue Bunis, *Antique Radios, Third Edition*. Paducah, Kentucky, Collector Books, 1987, page 48.)

**Figure 14.** (Right) *Norman Bel Geddes, the author of the ground breaking Industrial Design book "Horizons," created beautiful radios as well as Broadway sets.* [www.grillecloth.com](http://www.grillecloth.com)



## **Industrial Designers and the American Textile Industry**

The American textile industry and its manufacturers considered industrial design to be a low priority in their products. The American textile companies were founded during the early years of the Industrial Revolution. The textile mills were organized with the mass production of cheap, highly standardized fabrics in mind. As in any industry, the implementation of major changes, such as providing money for industrial designers and their new specially designed textiles, was unpopular since it might deplete profits [11]. The textile industry viewed the industrial designer as a necessary nuisance and industrial designers were not seen as artists as they were in France [12]. During the 1920s, few textile designers were employed, they were poorly paid, and they did not have formal artistic training.

Unlike their American textile counterparts, European companies recruited artists to design textiles. For example, the French textile industry hired many socially prominent artists such as Raoul Dufy, to design textiles that were extremely successful in Europe. The promise of increased sales prompted American textile companies to commission or purchase patterns from France and to restyle them for American tastes. In 1925, the American silk textile industry was challenged by Daphne Carr, a Paris correspondent to the *American Silk Journal*. It was also challenged by influential European artists and American Art Museums, and forced to incorporate the work of industrial designers into the American textile industry just as in Europe [13]. The new textiles created by these pioneering industrial designers merged art and industry. The original textile design sketches made their way onto the walls of New York Art Galleries and the Industrial designer became an important and respected partner in the design of objects such as the radio and its grille cloth.

### **Designers, Radios and Textiles**

Thus, the integral relationship between the industrial designers and the textile manufacturers was born. American industrial designers were now creating textiles as well as decorative objects. Designer Walter Dorwin Teague who was commissioned to create science and technology themed textiles for the Century of Progress Exposition in Chicago in 1933, created the round "Bluebird" Sparton Radio in 1934 [14]. The shiny gold grille cloth complimented the shiny chrome and blue mirror.

Raymond Loewy (Figure 12) designed the "Globe" radio in 1933 to take advantage of the current fad for using globes and radios as gifts. The radio and tuner are located in the globe and the speaker with its simple neutral grille cloth is concealed within the base (Figure 13). Norman Bel Geddes (Figure 14) created the "Patriot" radio whose face resembles an American flag, in 1940. Though I could not find any written documentation that these men actually created the grille cloth that was placed on their radios, they most probably either created or designed the textile or chose or commissioned the textile from a mill or broker.

Even though designers were commissioned to design textiles, I could not find any hard evidence of a radio grille cloth that was created by these top name designers. The majority of the designs for radios and radio grille

cloths created throughout the decades are undocumented and unsigned works, probably done by lesser-known industrial designers. Sometimes these designers created these textiles without signing the work and sometimes the documentation was lost, or it was assumed that the designer who made the radio designed all aspects of the radio.

The radio companies had the option of commissioning a smaller textile mill to create a fabric or of purchasing textiles that were already created and being sold by the fabric houses. The majority of radio companies purchased textiles from small mills with unknown designers. Solar Textiles, owned by Sal Rosen in Chicago, was the pioneer seller of radio grille cloths. It had a staff of industrial designers who created the cloth patterns that it offered to radio manufacturers such as Zenith, Belmont and Admiral. These radio companies commissioned Solar Textiles to create grille cloths which were to be used on several models for 5 years. Solar wove its own fabrics and it also operated as a so-called "Converter Company" which is a middle-man factory that purchases textiles from other companies and embosses and dyes them to the specifications of the radio companies. Solar's designers were not as famous as Bel Geddes and no records remain of their names. Their fabric colors were chosen to match consoles made of woods such as mahogany and walnut. Solar used cotton and cotton/rayon blends, and after World War II, Lurex, which came in such colors as gold, silver and copper, was added to their radio grille cloth [15].

Another source of grille cloth material was the vast quantities of fabrics that had originally been created as utility textiles for use in lampshades, drapes, furniture, and for novelty or theater use. Typically, these fabrics were not signed so there is no information about their designers. There were probably relatively few industrial designers creating radio fabric, but many designers created radio cabinets at radio factories. Industrial design was a new field that was born in the 1920s and most of these designers originally had their starts in the arts, in theater design, or in department store display design. Therefore they were familiar with the local fabric houses and mills.

For example, the pre-World War II fabric houses were located in downtown and midtown Manhattan. These companies traditionally bought job or production lots from the manufacturers in the area and sold them to the designers in New York City. Their function was to stock samples and distribute the textiles to local markets and store purchasing agents, who then sold them to people such as Broadway set designers and department store merchandise window display designers [16]. These designers with their knowledge of fabric and textile were also familiar with the textile manufacturers and their products.

The versatile industrial designer Norman Bel Geddes, who was a Broadway stage set designer as well as a merchandise display designer and radio designer, was familiar with the textile companies. While designing the merchandise windows for the Fifth Avenue store of Franklin-Simon he carefully classified textiles to be used for backgrounds in terms of their textures and colors [17]. Bel Geddes designed merchandise windows for two years. Many of the windows included fabrics or ready-made clothing and they served to

increased his exposure to the fabric houses and textile mills. Other industrial designers were influenced by his work and noted his discussion of the importance of careful observation and attention to detail as they applied to the choice of textiles and the need to design and dress up radios to look like a piece of furniture. He emphasized the importance of offering the public a straightforward and sincerely designed product in his landmark book "Horizons" [18].

Bel Geddes designed a multitude of items in his career and, in his later years, he designed radios [19]. Since many of the textile companies and fabric houses had an established rapport with these ex Broadway set designers, many of the stage-set fabrics found a new function as radio grille cloth. Salesmen from textile mills and fabric houses would bring their sample books for radio companies to review and then choose an appropriate grille cloth, based upon visual appeal, sound distortion and physical characteristics [20]. It is amusing to visualize these people sitting around and blowing smoke through the potential fabrics to test their acoustic properties.

### **European Textiles**

Meanwhile in Germany, the Bauhaus was gaining in worldwide influence. It was a new, innovative, and highly radical academy that existed from 1919 to 1933, when the Nazi Government ultimately closed it down. The Bauhaus, which literally means, "building house," created reforms in educational theory that brought unity to the arts, and brought crafts such as hand-woven textiles into mass production. It focused upon new industrial materials and mechanized production techniques to create new forms that were not dependent on, nor inspired by, the past [21]. The emphasis was on training designers who had knowledge of the materials with which they worked to create objects for industry to put into mass production. The Bauhaus textile designers explored new media and developed new prototypes, and they were encouraged to create new textiles for the modern 20th century interiors. They designed wall hangings and furnishings and the newest decorative objects, the radios.

The new functional textiles were an unexpected challenge to the weavers. The fabrics were to become an integral and subordinate part of the items into which they were incorporated. The fabric designer's role was to evaluate and work with the new criteria, which included personal expression combined with consideration of the technical attributes of the fabric [22]. The weavers created textiles that embraced the integration of all artistic disciplines within a philosophy that allowed them to develop unique textiles that utilized cotton, rayon, aluminum, metal alloys, glass and the recently developed cellophane. The use of these various fibers created textiles with new physical characteristics such as strength, elasticity, colorfastness, transparency, reflectiveness, sound absorption, light absorption, and crease-resistance. They also changed the very appearance of the new textiles by bringing out their inherent visual qualities [23].

The renowned Bauhaus fabric designer Gunta Stölzl created a cotton and rayon radio cloth in the 1930s [24]. She experimented with a variety of colors and structures but her textiles had no pattern. She used linen and

cotton, hemp, and metallic guimpe. (Guimpe is the term used to describe a lightweight cloth such as a chemise.) Experimental structures using the new rayon thread, which had revolutionized the industry in the 1930s, were woven into the Bauhaus designers' creations. As head of the Bauhaus weaving workshop, she implemented a rigorous technical and theoretical training program, which included weaving theory, material theory, fabric analysis, and the dying of fabrics [25]. These basic tools of the weaver's trade gave the students the ability to create the wide variety of textiles used for radio grille cloth, upholstery, and floor and wall coverings. The workshop in Weimar was equipped with a Jacquard loom where the pupils learned pattern and color design in classes conducted by great artists such as Paul Klee, Johannes Itten and Georg Muche. Weavers were taught the aesthetics of weaving which took into consideration the contrasts between the thick and thin or mat and glossy threads that were incorporated into textiles [26]. Many styles of American radios have glossy threads woven into their grille cloth as a result of the Bauhaus influence.

The Bauhaus was very influential and since Rayon was used in the majority of radios in America and Europe, some designers not only studied these new fibers but also wrote about their superior characteristics. For example, Anni Albers, another Bauhaus textile designer and weaver, wrote about the new developments in the world of textiles. She described the virtues of the new yarns made of rayon, and the new innovations in finishes, which included shrinkage-controlling and flame-retarding properties [27]. When Stölzl turned her attention to the design of radio grille fabric, she had to review several considerations. Rayon fiber was chosen for use in radio grille fabric because its characteristics included strength, ease of dyeing and ease of draping within the radio cabinet. Fabric performance is related to its exposure to the prevailing climate and humidity and drastic temperature changes will weaken fibers. Dimensional stability or "shape retention" is an essential requirement of hanging textiles such as those used in radio grille cloths. Some sagging or elongation can happen to all fabric, but the ideal radio grille fabric should not lengthen by more than five percent over a period of time. Rayon is hydrophobic and inherently resistant to shrinkage, with a wet strength of 300% measured in 1941 and with a high tensile strength [28]. Therefore a loosely woven Rayon fabric with a heavier warp (vertical threads) than weft (horizontal threads) was chosen.

Most radios have neutral colors such as brown and tan tones that subtly enhance the appearance of the radio. Anni Albers described and explained the woven material's aesthetic qualities such as the natural, undyed tones, which bring out the fabric's inherent visual quality [29]. An example of an Anni Albers inspired fabric can be seen on the Volksempfänger VE301, which was designed independently by the Bauhaus' Walter Maria Kersting as a prototype in 1928. Against Kersting's protests, the Nazi Government stole the prototype, slightly changed the form, and put it into subsidized mass production in 1933 [30]. The two styles of Volksempfänger radio grille cloth which I have studied are identical in weave but differ in color (Figures 15 and 16). Both textiles are made with the same twill weave that

uses interspersed threads of varying thickness to create texture and color. A subtle design is created by the use and placement of a thicker thread. This thicker decorative thread was created when the spinner was slowed and then allowed to resume the initial speed. Slowing the spinning machine creates a thicker thread by gathering more of the thread in one area.

The Volksempfänger grille fabric, though inspired by handwoven textiles, reveals its machine-made roots with its precise spacing of the thicker thread that is woven within the textile. The addition of the thicker thread woven to alternate every 1½ inches creates a subtle warp pattern, (Figures 17 and 18) and is reminiscent of Anni Alber's handwoven twill-weave prototype. (Figure 19) where contrasting thickness' of cotton guimpe and fine cotton warp thread was woven into a thinner diameter of translucent cellophane weft and fine white cotton. Visually the Volksempfänger cloth appears to be a rayon-cotton blend. The precise repeat or "placement" of the decorative thread on the warp, combined with the regulated spun diameter of this decorative thread, indicates that it was machine-made to create the appearance of a handwoven textile.

The lighter wheat-colored Volksempfänger textile is visually harmonious and uses the twill weave to create texture with only one color. The darker Volksempfänger textile has a lighter gold-thread twill weave that contrasts against the dark plain weave, to create texture and a visual type of nervous energy which makes the eye move about the cloth. The lighter wheat-color

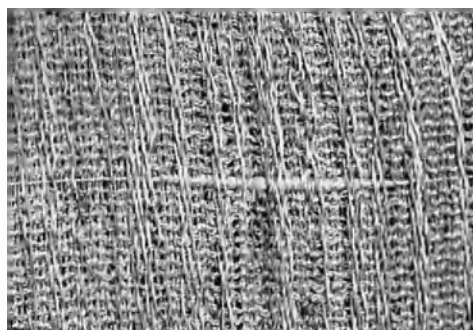


**Figure 15.** *Volksempfänger 301 grille cloth; lighter color version. Note the pattern created with the precisely placed thicker thread which is indicative of a machine-created textile emulating the popular hand made textiles created at the Bauhaus. (Collection and Photograph; Barbara Havranek)*



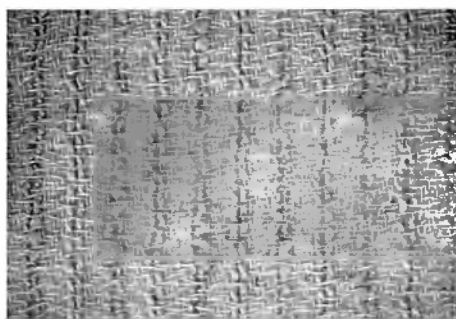
**Figure 16.** *Volksempfänger 301 grille cloth; darker color version. (Collection and Photograph; Barbara Havranek)*





**Figure 17.** (Left) Volksempfänger 301 grille cloth: lighter color version. Close-up of a thickly spun area of the spun thread. This shows experimentation with the varying sizes of threads as decorative elements. (Collection and Photograph: Barbara Havranek)

**Figure 18.** (Right) Volksempfänger 301 grille cloth: darker color version. Close up of thick spun area of the warp thread. (Collection and Photograph: Barbara Havranek)



**Figure 19.** (Left) The thick thread that seems to dance across this monochrome textile is used as decoration. This idea is carried over in a scaled down version in the careful placement of the thicker warp of the Volksempfänger 301. (Collection of the Metropolitan Museum of Art.

Accession number MMA 1970.75.56. Woven by Anni Albers, no date.) (Photograph: Barbara Havranek.)

grille cloth is woven with the all the same thread throughout the fabric. The dark brown fabric, however, has the same plain weave and thread but it has a twill weave incorporating metallic threads within the weave. The influences leading to the development of these textiles can be traced to the Bauhaus weavers who used metal threads and thicker warp threads, which incorporated thinner contrasting threads.

### **Bauhaus Textile Examples At The Metropolitan Museum of Art**

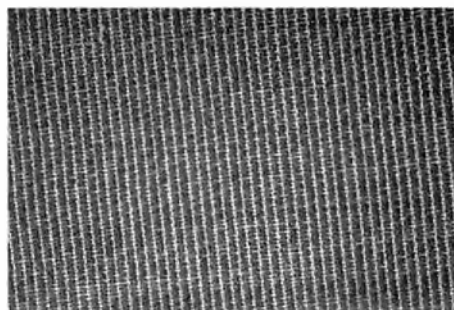
I reviewed some of the early textiles created by Gunta Stölzl and Anni Albers, at the Ratti Center's collection at the Metropolitan Museum of Art in New York City, to determine if any of the samples were radio grille cloth prototypes. I could not find any that exactly matched any of the German radio grille cloths that were produced, but it was evident that some of the prototype textiles in the collection influenced textile designers in their development of mass produced grille cloth. These textiles have the appearance, weave, color, and content that is commonly found in grille cloth from the 1930s to 1960s. The 81 textile examples at the Ratti Center

that were created by Anni Albers, incorporate fibers which include cotton, rayon, nylon, linen, silk, cellophane, fiberglass, metal foil, plastic and jute. In my opinion, these fabrics woven by the two most influential weavers of the 20th century were definitely inspirations for industrial designers working for the textile mills and radio companies.

I believe that some of these fabrics were probably grille cloth prototypes for the following reasons. First, these textiles were rayon and cotton weaves, the same blend that is found on radios. Second, the weave is loose on these fabrics so the sound would not be muffled. Third, the colors of these fabrics are shades of brown earth tones that would match beautifully with the Bakelite or natural wood cabinets. Fourth, there is no actual pattern, but simply a beautiful weave.

Gunta Stölzl's textile (Figure 20) is a wonderful example of the type of fabric used on the dark textile grille cloth of the German Volksempfänger radio. The flexibility combined with the darker color is very similar. The linen textile (Figure 21) has the tan color and earthy tonal quality of the light-tan Volksempfänger textiles (Figures 5 and 6) but not the synthetic shine or draping of polyester. A subtle design is created in this plain weave textile, with the combination of thinner threads in the warp and the thicker threads in the weft.

Gunta Stölzl's textile, (Figure 20) even though it is undated, has the appearance of a typical grille fabric that was found on 1930 table model radios. It has a brownish tone with no pattern that might compete with the



**Figure 20.** (Left) This textile has the qualities sought by radio grille cloth manufacturers such as weave, texture, appearance, and flexibility. (Collection of the Metropolitan Museum of Art. Accession number MMA 1985.198.21. Woven by Gunta Stölzl, no date. Cellophane and cotton. Handwoven. Gift of Jack Lenor Larsen Incorporated, 1985.) (Photograph: Barbara Havranek.)

**Figure 21.** (Right) This Gunta Stölzl neutral color plain weave prototype fabric is the perfect generic textile for a plain radio cloth textile that was used on many radios such as Raymond Loewy's 1933 Colonial New World Globe Radio (Figure 13) with its speaker in the base covered with a neutral grille cloth. (Collection of the Metropolitan Museum of Art. Accession number MMA



1985.198.25, woven by Gunta Stölzl, no date. Plain weave. Gift of Jack Lenor Larsen Incorporated, 1985.) (Photograph: Barbara Havranek.)

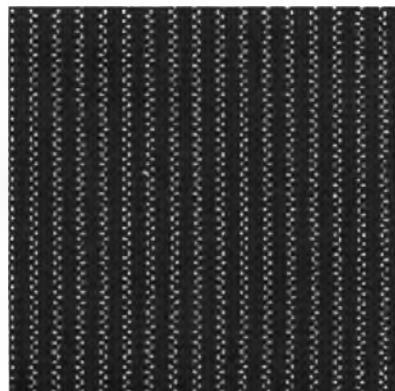


**Figure 22.** *This 1929 Anni Albers's prototype with varying thicknesses of threads can be found in radio grille cloth textiles well into the 1950s. (Collection of the Metropolitan Museum of Art. Accession number MMA 1970.75.5B. Woven by Anni Albers, 1929. Linen, raffia, cellophane. Gift of Anni Albers, 1970.) (Photograph: Barbara Havranek)*

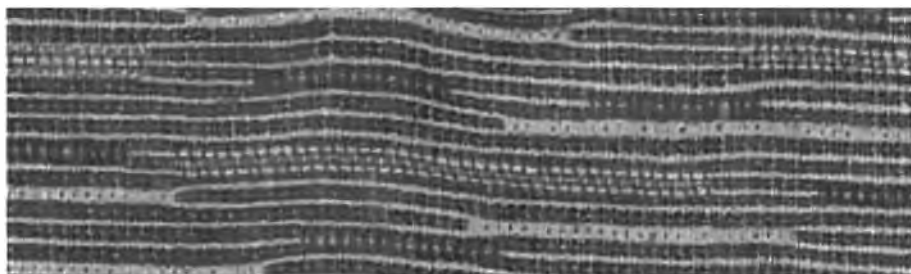
radio cabinet. The plain weave is loose enough not to muffle sound from a speaker placed behind it, but it is tight enough to hold its shape many years after it is stretched inside a radio cabinet.

Another textile sample that was probably very influential is Anni Albers' textile (Figure 22), which shows a common weave found in typical 1930 through 1950 American radios such as the Philco 37-89 (Figure 23) and the Grigsby-Grumnow #65 (Figure 24). This fabric also has a similar appearance, weave structure, and color pallet to the ribbed patterns used in many Philco tabletop radios. This handwoven textile created in 1929 has a warp of stripes of natural linen, white rayon and cellophane, and a weft of natural line woven in a tabby (plain) weave. (A tabby or plain or simple weave is produced by passing the weft (horizontal threads) across the warp (vertical threads) twice. On the outward journey the shuttle passes over the odd warps and under the even. On its return it passes over the evens and under the odds.) The variation of the thick and thin threads creates a limitless variation of visual intersections between the warp and weft, just as shown in Figure 24. There is a thick piece of cellophane woven into the fabric that is reminiscent of weaves that give grille cloths texture. This sample has a neutral color and a structure that can be found in many RCA table models of the 1950s and in the Loewe Opta Bella Luxus model 5711-W from West Germany.

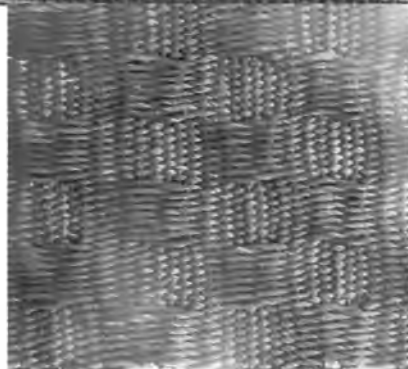
Anni Albers' 1948 Harness-maker's Thread textile (Figure 25) is very similar in hue and inspiration to the block pattern #21 (Figure 26) textile



**Figure 23.** *This ribbed textile design with its alternating thick and thin warps is evident in both the Gunta Stölzl's textile (Figure 31), and this Philco 37-89 textile pattern #14. The impact and popularity of ribbed textiles is evident in the countless varieties of widths and colors used by countless radio companies throughout the world. [www.grillecloth.com](http://www.grillecloth.com), image 14.*



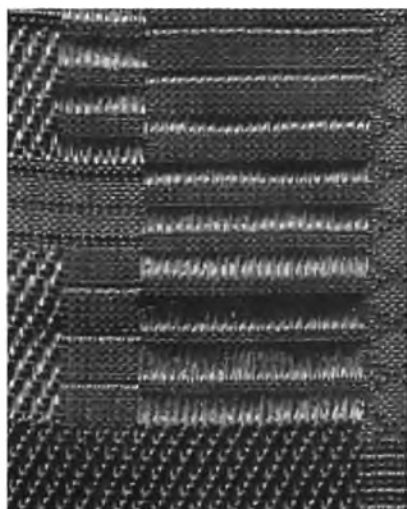
**Figure 24.** (Above) This Grigsby-Grunow textile is strikingly similar to that in the Alber's prototype shown in Figure 22. This shows the mainstream popularity of this textile. Both were created by using varying thickness of wefts to form wavy lines.  
[www.grillecloth.com](http://www.grillecloth.com), image 65.



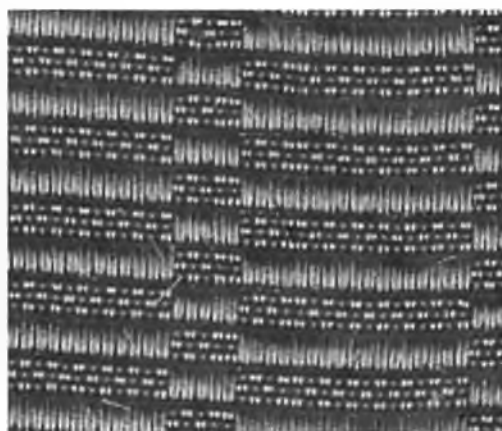
**Figure 25.** (Right) The float weave variation of this Alber's harness thread textile was an inspiration for the block pattern used in the Zenith 12-S-266 (Figure 26), and GE J-805 (Figure 27). The combination of a flatter appearing area (threads that carried over two warps) and a grainer area (one over one weave) creates a juxtapositioning of textures. (Collection of the Metropolitan Museum of Art. Accession number MMA 1970.75.77. Woven by Anni Albers, ca. 1948. Warp of waxed cotton harness-makers thread and a weft of brown cotton with a checkerboard surface texture in a warp-faced tabby with warp-float areas.) (Photograph: Barbara Havranek.)

found on the Zenith 12-S-266 and pattern # 50 (Figure 27) and #51 textile (Figure 28) found on the GE J-805 console sets from the 1940s. The fabric sample (Figure 25) is handwoven with a warp of waxed cotton harness-makers thread and a weft of brown cotton with a checkerboard surface texture in a warp-faced tabby with warp-float areas. This float-weave variation creates the pattern by not weaving one in and one out as a plain weave, but skipping three warps at a time, which creates a "flat surface." Hence the checkerboard pattern. Albers' textile sample is not precisely the same because she used a heavy and coarse Harnessmaker's thread in comparison to the lighter rayon textile used by GE.

Albers' textile (Figure 29) was handwoven in 1929 with a warp of stripes of natural linen and white rayon and a weft of natural linen, tabby weave. This fabric sample woven with linen, raffia and cellophane is similar in appearance to the RCA SHP-11 phonograph/radio combination console radio cloth from ca. 1958. (Figure 30) The raffia threads create a natural non-uniform ply which reappeared 30 years later in the RCA cloth and countless other 1950s grille cloths. The RCA SHP-11 textile is a twill weave with fat weft threads that go over five and under five thin warps



**Figure 26.** (Left) *These Zenith 12-S-266 block patterns are a more complex version of Figure 25. [www.grillecloth.com](http://www.grillecloth.com), image 21.*



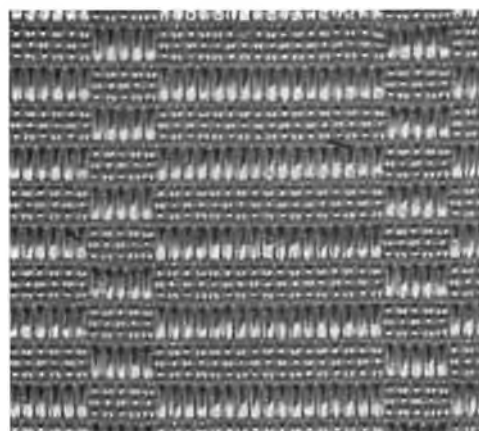
**Figure 27.** (Right) *This block pattern is similar to the pattern used for the Zenith 12-S-266 (Figure 26) but it was made in a brown color for the GE console model J-805. [www.grillecloth.com](http://www.grillecloth.com), image 50.*

threads. This resulted in a textured fabric highlighted with copper Lurex fibers that personified the 1950s grille cloth.

Gunta Stölzl's textile (Figure 31) is a plain weave variation that is similar in weave and in the use of alternating thin and thick yarns to that used on grille cloth pattern #14, found on the 1930s Philco table-top radios, cathedrals, tombstones and consoles from the mid- to late 1930s (Figure 23). It is also similar to patterns #61 (Figure 33) and #62 (Figure 34) used on table sets of the late 1930 to early 1940s, such as the 1936 Silvertone #4414. This textile has a weave that is loose enough to allow sound to pass undistorted. The weave structure, red color and the artistic design found in pattern #14 (Figure 23) reminds me of the radio grille cloth that Gunta Stölzl created between 1925 to 1932 for commercial applications at the Bauhaus in Dessau [31].

## Conclusion

Although radio grille cloth is a twentieth century technology there is little or no first hand documentation to review. For example, in 1989 a fire at the Olek Mill destroyed countless valuable sample books and lockers full of new old-stock grille cloth that would have been a key source of information for scholars [32]. Factories destroyed many of the files and few are left. Textiles were not viewed as high art forms, and unfortunately, were not documented or treated as such. Libraries that I contacted which specialize in textile history do not have information such as purchasing records from radio manufacturers, or interviews and sketches by the industrial designer who created fabrics. My research is based upon oral history interviews and the beautiful textile examples which remain a key decorative element of radios.



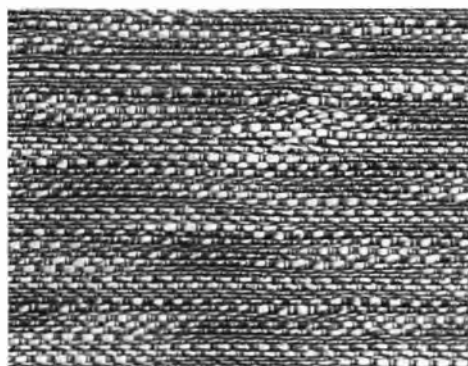
**Figure 28. (Left)**

*This is another block pattern used in the GE console model J-805 in a blond color. A mini version of the blocks are found nestled between the bands. The popularity of block patterns continued until the 1950s. [www.grillecloth.com](http://www.grillecloth.com), image 51.*

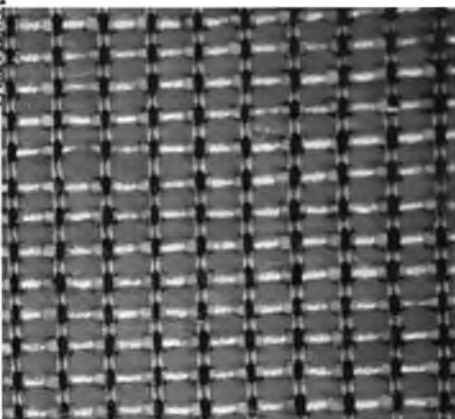


**Figure 29. (Right)** *The grille cloths of the Grigsby-Grunow (Figure 24) and RCA SHP-11 (Figure 30) both have a hand woven appearance similar to this 1929 Anni Albers textile made of stripes of natural linen and white rayon. (Collection of the Metropolitan Museum of Art.*

*Accession number MMA 1970.75.5A Woven by Anni Albers, 1929. Linen, raffia, cellophane. Gift of Anni Albers, 1970.) (Photograph: Barbara Havranek)*



**Figure 30. (Left)** *RCA SHP-11 grille cloth. Ca. 1958. Note the textured appearance created by the thicker spun threads used by Anni Albers. Notice the similarity to Figure 29. (Collection and Photograph: Barbara Havranek)*

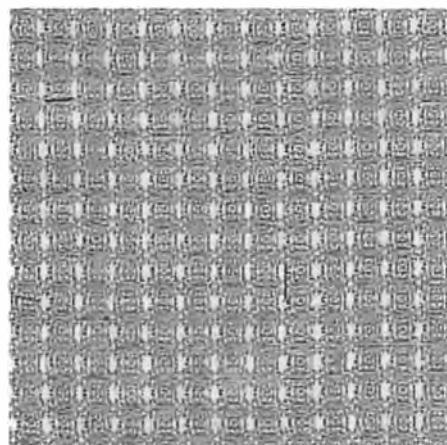
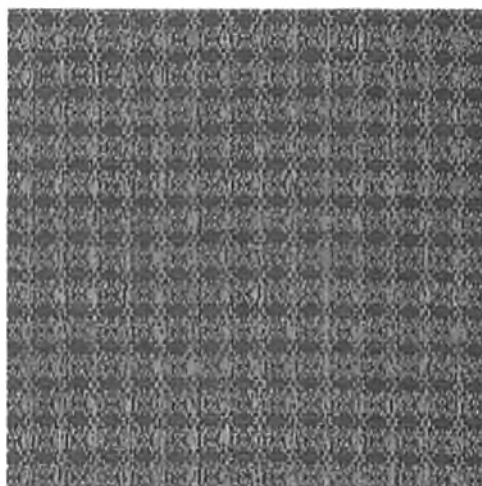


**Figure 31. (Right)** *This is reminiscent of the radio grille cloth Stölzl created at Dessau between 1925 to 1932 that used red, white and blue and did not have a pattern but relied upon the combination of color and structure. Notice the similarity to Figure 32, a pattern that was used on late 1930s Philco tabletop radios. (Collection of the Metropolitan Museum of Art. Accession number MMA 1985.198.27. Gunta Stölzl, no date, no fiber content stated. Red grid. Gift of Jack Lenor Larsen Incorporated, 1985.) (Photograph: Barbara Havranek.)*



**Figure 32.** (Left) This pattern was used on late 1930s Philco table-top radios. Notice the similarity to Figure 31 as your eye travels across the thicker wefts that are bisected by the thinner warps. This clean-appearing textile complement is one of the more user-friendly textiles. The keys to a successful radio textile are a pattern or weave that are not distracting, coupled with a color that complements cabinets created out of wood, metal or plastic. [www.grillecloth.com](http://www.grillecloth.com), image 55.

**Figure 33.** (Right) The grid like lines of this grille cloth recall the visually orderly Gunta Stölzl's textile (Figure 31). The grid pattern was a very popular textile found in many radios into the 1960s. [www.grillecloth.com](http://www.grillecloth.com), image 61.



**Figure 34.** (Left) The white threads in this grille cloth are similar to the red warp threads in Gunta Stölzl's textile that are used for decorative as well as texture purposes. A grid textile echoes the square radio cabinet design (Figure 30) and produces a geometric style that was very popular in the 1930s and 1950s. [www.grillecloth.com](http://www.grillecloth.com), image 62.



This is an ongoing research project for this author. If any reader knows of any archive or information regarding radio grille fabric, please send this information to me. Items of importance such as textile sample books from factories and sketches, notes and design books or notebooks created by artists often contain a wealth of information that would fill in the blanks about the creation and decision making processes in the design of grille cloth.

As I continue to research this topic, I remember the words that Anni Albers once wrote while teaching weaving at Black Mountain College in North Carolina:

*An elementary approach will be a playful beginning, unresponsive to any demand of usefulness, an enjoyment of colors, forms surface contrasts and harmonies, a tactile sensuousness. This first and always most important pleasure in the physical qualities of materials needs but the simplest technique and must be sustained through the most complicated one. For just this satisfaction coming from material qualities is part of the satisfaction we get from art [33].*

**Author's Note:** Thank you to John Okolowicz of *Grillecloth.com*, and Michael Katz and Sal Rosen for sharing their invaluable knowledge regarding the history of radio grille cloth. Thank you to textile historian Margot Riley, Reference Librarian at the New South Wales Library in Sydney, Australia, textile historian Mimi Sherman in New York City, colleague Sheri Guinaugh, and the staff at the Antonio Ratti Textile Center at the Metropolitan Museum of Art in New York City. Special thanks to my tireless and brilliant editor Tom Perera.

### **Interviews and Detective work....**

#### **John Okolowicz at *Grillecloth.com*:**

As I looked at countless antique radios, I began to notice the mismatched and inappropriately replaced radio grille cloths on some of them. This led me to become interested in the technical and historical aspects of radio grille cloth. It also led me to the discovery of *Grillecloth.com* as I researched radio information for my thesis. John Okolowicz, the owner of *Grillecloth.com* was kind enough to send me a copy of his Mid-Atlantic Antique Radio Club grille cloth article [9] and to allow me to use many illustrations from his website. John is a wonderful source of information regarding the fibers used in early grille cloth and the styles used on various radio models. My endless questions and countless email exchanges led me to explore several avenues of research with many dead ends. For example after I read his article I contacted several cultural and resource institutions only to discover that neither company records nor samples exist in the Philadelphia area where many textile mills had been located. But John's article prompted me to look more closely in my own back yard in New York City. I knew that radios and components were once manufactured there. I soon discovered that grille cloth textiles are still being manufactured in this area. My telephone call to John Morelli of Newcastle Fabric in Brooklyn, New York led to my fascinating contact with Sal Rosen.



## **Sal Rosen**

My extensive interviews and discussions with Sal Rosen were the highlights of my grille cloth research. Mr. Rosen has been in the business of selling radio and TV grille cloth since 1938. He is a delightful man, brimming with wonderful stories about his company Solar Textiles and about the textile business in general. I approached the subject of radio textiles with little hope of finding any specific information since so much had already been discarded or destroyed in factory accidents and fires. When Mr. Rosen recounted the "blowing the cigarette smoke through the textile" story I was just amazed. I had approached the weave and noise distortion question as if it was a scientific experiment only to find that there had been a very down to earth solution! Mr. Rosen's explanation about how the correct shade of cloth was created to match different wood cabinets by simply varying the content of Lurex was another example of a very simple solution to a complex problem. His statement regarding the use of novelty fabric as radio grille cloth during the depression was particularly interesting to me from my viewpoint as an art historian. His explanations also highlighted the importance of careful artistic design and review of all radio grille cloth. This followed the pioneering efforts of Norman Bel Geddes to ensure that all elements of a product would be designed and reviewed by an Industrial Designer.

Mr. Rosen presented a very accurate and unromanticized view of the textile industry that only a long-time worker in the field would have been able to offer. It was companies such as Solar Textiles that created the wonderful grille cloths for Belmont, Zenith and Admiral when the large textile mills would not produce the small quantities needed and could not provide a quick turn-around time when a change was needed. Though the major radio companies were big businesses, it was the small companies that added the finishing touches with their beautiful grille cloths.

## **Michael Katz**

Mr. Katz is a reproduction grille cloth dealer who patiently answered my numerous fabric content questions as well as providing countless personal insights. I found it fascinating to discover that the difficulties in obtaining historically reproduced textile furnishings for use in historic houses paralleled the difficulties in locating a textile mill that could reproduce quality radio grille cloth. The smaller textile mills that once dotted the countryside have all but faded away, forcing many dealers to seek overseas mills.

I consider myself very fortunate to have talked with each of these men. I enjoyed learning from them, as well as sharing my research on radio grille cloth during our discussions and interviews. Small textile mills have gone the way of so many other manufacturers in the United States. Despite the disappearance of these companies, we are lucky to still have physical examples of the beautiful grille cloths on surviving radios. My research started out as a response to seeing radios with incorrectly replaced grille cloths. I had no idea that my dismayed reaction would result not only in my continuing research in the area, but also in the delightful meetings and

discussions with pioneers in the industry such as these men. It is my pleasure to place their memories in this journal as an historical archive for future generations. As for myself, I will never look at radio grille cloth in quite the same way again.

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### **Barbara Havranek**

Barbara is a fashion history professor at Virginia Marti College of Art and Design. She is a board member of the Art Deco Society of New York, a web editor for *Greensward.org* - the Friends of Central and Prospect Park, and the archivist/curator for the Fairview Park Historical Society. Barbara Havranek received her Masters of Art in the Conservation of Decorative Arts at the Fashion Institute of Technology in New York City. *The Influence of Bakelite upon the Technical, Social, Political, Economic and Stylistic Development of Early Radios* was the basis of her Master's thesis which is on file in the Library at the Fashion Institute

of Technology. Her interest in radio grille cloth started while doing research for this thesis. Barbara has served as an archivist at the Metropolitan Museum of Art, the Brooklyn Historical Society, the Calvin Klein library and Leffert's Homestead Museum. She also served as a guest curator at the Scarsdale Historical Society. Her research and interview work from the past two years provided the material and motivation for this article. She has published other articles on the subject of Bakelite and plastic radios. Her passion for collecting and researching old radios was instigated by her parents, Martha and George, whose many styles of radios in every room of the house intrigued their daughter at an early age.

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