

A BRIEF HISTORY OF THE NATIONAL COMPANY, INC.

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THE EARLY YEARS

The story of how a small manufacturer of power plant specialty items, and later toys and household items, became one of the leading manufacturers of amateur, commercial and military short-wave communications equipment is interesting and fascinating. As we will see, it was not planned that way; it just happened!

In 1879 Edison invented the electric light bulb. This created a large demand for electrical energy. Charles Steinmetz and George Westinghouse solved the mysteries of alternating current which permitted large amounts of electrical energy to be transmitted over long distances. This, in turn, created a need for large power generating stations. By the early 1900s the design and construction of power generating stations was, in today's terminology, an emerging industry.

At the turn of the century, one of the leading power plant construction companies was, and still is, the Stone and Webster Co. who then had their headquarters in the Boston, Massachusetts area.

Power plants required many hardware specialty items which were new and unique and for which no regular suppliers had yet established themselves. Three mechanical engineers from Stone and Webster recognized this market and set up a company on a part-time basis to design and manufacture these hardware items.

A material called transite was widely used at that time to make switching and transformer vaults for power plants. Transite is a sheet material, similar to plywood except that the base material is asbestos which is noncombustible and a nonconductor of electricity.

The power plant specialty business had one serious drawback; while the market with Stone and Webster was guaranteed, it was sporadic. Stone and Webster did not receive new construction contracts every day and there were long gaps between contracts when there was no demand for these specialty items. A search was therefore made for products which they could manufacture using the production tools they had and for which a steady demand existed.

One of the three knew a toy buyer for the F.W. Woolworth Company; so they went into the toy business as well as the power plant specialty business.

I have not been able to pinpoint the date when the three actually began manufacturing power plant items or when they began manufacturing toys but

it was in the 1910-14 period. On October 23, 1914 they incorporated in Massachusetts as the National Toy Company. The initial capitalization was \$1,000; \$700 in cash and \$300, which was the evaluation placed on a patent for "talking machine toys." The incorporators were Warren Hopkins, Walter Balke, and Rosewell Douglass. Hopkins had the most money and the controlling interest in the company and always "called the shots" until his death in the early 1940s, even though he retained his position at Stone and Webster; in fact, Hopkins later became president of Stone and Webster Engineering Co. In the early toy days the company was run by Roswell Douglass; he died in the late 'teens and William Ready became the chief operating officer. He also took Douglass' place as a stock holder.

The toy business was highly successful; in June 1916, sixteen months after incorporating, the company had grossed over \$33,000 and paid over \$8,000 to Balke, Hopkins and Douglass. This is better than a ten-to-one return on their \$700 cash investment in sixteen months and would be considered good even today, but these were pre-WWI dollars. The toys were sold through such well-known stores as F.A.O. Schwarz, Jordan Marsh, Wm. Filene, John Wanamaker, and Gimbel Bros., as well as through Victor and Columbia Talking Machine dealers. Over 8,800 of these toys were sold between January and June of 1916 and the company planned to make 16,000 more during the remainder of 1916. The early talking machine (phonograph) toys were designed by Walter Balke, who was very ingenious mechanically; the toys would be considered high technology for their day. All of the toys were attached to the turntable of a phonograph and were activated by the record being played on the phonograph. For example, 'REX the Magnetic Dog' was controlled by a resonant reed. When this reed was activated by the proper note on the record, REX would jump out of his kennel. 'The Magnetic Dancers' were small figures of dancers with steel bases that would glide on an opaque glass plate over a



Fig. 1. The Magnetic Dancers.

Photo credit: John Nagle

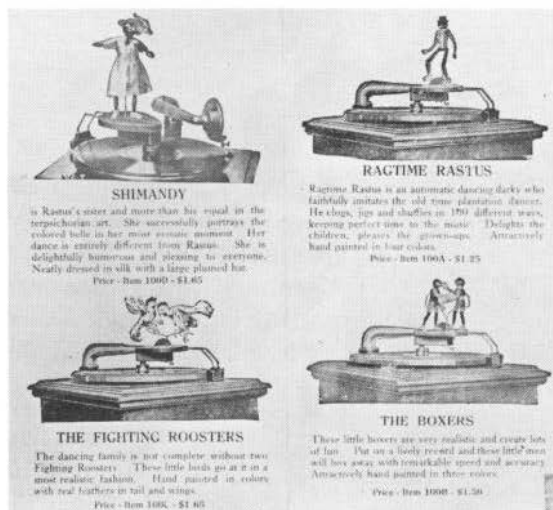


Fig. 2. The Rastus Family. Promotional flyer for the dancing phonograph figures.

Photo credit: John Nagle

special record on the phonograph containing small cobalt magnetics. These would cause the dancers to glide around the 'dance floor.' Another series were the 'Wireless Pups' which I have not seen described. There was also an entire family of 'Ragtime Rastus' dancers including Boxers and Uncle Sam and Mex. These were loose jointed wooden figures that would dance or box on top of a revolving turntable. By choosing a record with the proper beat, a very entertaining effect could be obtained:

This success apparently created the need for additional working capital and it was proposed to issue \$5,000 worth of preferred stock to be purchased by the present stock holders. The reasons for this are interesting:

"New things are constantly being brought to us, many of them specialties not in the toy line (for instance a mattress for children's cribs and hospitals which can be readily taken apart, washed and aired, as well as other household specialties). In order that we may take up the manufacture of any profitable specialty, we shall probably when increasing the capital stock change the name to The National Company or other suitable name that will not limit us to toys."

I have not been able to determine when that was written or when the name was actually changed but I believe it was in late 1916. On February 16, 1932 the corporation charter was further amended to formally change the company name to the National Company, Inc., by which name the company is generally remembered. Note that the word "Company" is a part of the name and should be spelled out as is the word National. The expression National Co., Inc. is incorrect.

When the United States entered World War I, the company made airplane parts and thread gauges for the war effort. At the conclusion of the war National went back to making power plant items, toys and as an added line, household items.

Thermal Pan Protector

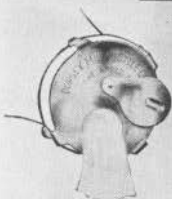
Wherever agate or aluminum pans are used there is always danger of overheating and consequent destruction. The Thermal Pan Protector placed between the flame and the pan protects the pan from the direct heat of the flame.

Made of sheet steel 8 $\frac{1}{2}$ " diameter by $\frac{1}{16}$ " thick.

LIST PRICE, 15 cents each

Standard package, 3 dozen

Weight 20 lbs.



Dorsey Milk Bottle Cover

Keeps milk free from dust, dirt, flies and odors. A sanitary necessity that has had a wide sale.

Made of aluminum.

LIST PRICE, 10 cents each

Standard package, 1 gross

Weight 7 lbs.



Roberts Lightning Mixer

For eggs, cream and mixed drinks. Over one million in use. Described fully in our Bulletin No. 105.

Made in two sizes—quart and pint

LIST PRICES
PINT, 75 cents
QUART, \$1.00

Approved by Good Housekeeping and Modern Piville

Made by NATIONAL COMPANY, Inc.

Cambridge 39, Boston, Mass.

DISTRIBUTED BY

Fig. 3. An assortment of early National Company products. The Roberts Lightning Mixer was especially noteworthy.

Photo credit: John Nagle

By the end of March 1923 the National inventory included fourteen items: T.M. Toys, Magnetic Dancers, Roberts Mixers, DMB Covers, Victrolene, Wall Rack and Plan Holders, Radio Components, S. Santry, Holophane, Thompson Spa, Portalite, H. Electric Lt, Co. Doble and Miscellaneous. I can only identify about three of them.

Fig. 4. Another National product - National Sports Skates.

Photo credit: John Nagle

NATIONAL SPORTS SKATES

NATIONAL Sport Skates
SWIFT-SILENT-SAFE

[The speed sensation of the age. Boys and girls everywhere are speeding it up on NATIONAL SPORTS SKATES which are capable of 25 miles or more an hour. Oh Boy! Can they get!]

NATIONAL SPORTS SKATES are silent, swift, safe—permitting boys and girls who need new thrills to travel many miles faster than ever before. They simply glide along on special rubber cushion tires that eliminate strain and give a sensation of speed that is absolutely new in every way. NATIONAL SPORTS SKATES are adaptable to any size or type of shoes from 4 to 12. They are strong, light, easy on the ankles, and require practically no care at all. If you want to keep pace with other boys and girls in America, if you always wish to be no time and way ahead of your friends, then speed ahead on NATIONAL SPORTS SKATES just as soon as you can.

Here are a few reasons why these skates are so popular:

- 1. The wheels are located before and behind the shoes. No skater can ever fall backward or forward.
- 2. Larger wheels on special roller bearings give increased speed.

3. Special rubber tires prevent noise even on wood.
4. Made with telescopic, non-type pressed steel frames and light disc steel wheels.
5. These skates glide easily over practically any surface.
6. Single skate can be used as a speed canoe.
7. They are manufactured and guaranteed by the National Company Inc., of Malden, Mass., Manufacturers since 1914 of precision mechanical specialties.

ENTERING RADIO - THE EARLY YEARS

In the early 1920s several radio stations began regularly scheduled broadcasting and the public craze was to build radio receivers. The leading variable capacitor (condenser in those days) manufacturer at the time was Allen D. Cardwell, and Cardwell was not able to keep up with the demand. Cardwell's representative in the Boston area — George Q. Hill — was unhappy since he worked on commission and his income was limited by Cardwell's deliveries. Hill recognized the demand for variable capacitors and looked around for alternate sources. The management of National was always interested in new products and were eager to profit from the new radio craze. In 1922 they began supplying variable capacitors to Hill who sold them as fast as National could make them. When National later entered the radio business, Hill became the sales manager for radio products.

In 1924, two engineers from Harvard University, Fred H. Drake and Glenn Browning, developed the Browning Drake tuner which was "guaranteed" to improve radio reception; Browning and Drake approached National to manufacture the tuner. The radio editor of the *Christian Science Monitor*, Vulney Hurd, liked the Browning Drake tuner and gave it extensive publicity in his weekly newspaper column, so that the tuner soon became a very popular item. The National Company decided to make the design, manufacture and sales of radio equipment and components their principal line of business, and began looking around for someone knowledgeable in the fledging radio field to join the company and lead them.

In 1924 Hopkins, Ready and Balke were on a business trip to Garden City, Long Island where they were introduced to James Millen. Millen's father had recently died while the younger Millen was a mechanical engineering student at the Stevens Institute of Technology in Hoboken, N.J. In order to finish college, Millen began writing magazine articles on radio topics. For example, a "Dear Abbey" type column on radio topics regularly appeared in Doubleday's *Radio Broadcast* magazine in which Millen answered questions from readers on their radio problems.

Millen had begun writing at an early age. He had his first item published when he was 15 in the October 1916 issue of *Popular Science Monthly*; it showed how any home work shop could have a small anvil. Staple an old fashioned flat-iron upside down to the edge of the work bench. It sounds like a good idea, even today, if you can find an old fashioned flat iron!

Because of his writing, Millen had acquired a considerable reputation in radio and had built up an extensive consulting practice which included CECO in Providence, R.I. and the Spencer brothers in the Boston area who had just established the American Appliance Co., which was later to become Raytheon. When Millen graduated in 1926 he began working for National on a consulting basis and in 1927 dropped his other consulting contracts and began working for them full time as Chief Engineer and General Manager. His goal was to firmly establish the National Company in the radio business.

In 1926 the National Company needed to expand its manufacturing facilities



Fig. 5. The National Regenaformer Kit for home construction of the Browning-Drake receiver. The company address is given as 110 Brookline St., Cambridge, Mass. List price was \$22.00.

Photo credit: John Nagle

and acquired the factory building at 61 Sherman Street, Malden, Massachusetts, formerly owned by the Cub Knitting Mills. Cub had gone bankrupt and their factory had been put on the auction block. The attorney who was supposed to appear at the auction to set the minimum acceptable bid did not show up so the building went to National for about ten cents on the dollar.

National's first offerings under Millen's guidance included a Type L-3 two-stage audio power amplifier and battery eliminator which was developed in collaboration with Arthur Lynch, a Model E-1 single stage audio amplifier and battery eliminator, and a model M battery eliminator. These were announced late in 1927.

In 1929, in collaboration with Glenn Browning, National announced the MB-29 broadcast band tuner which consisted of three stages of rf amplification and bandpass tuning. In 1930 an improved model, the MB-30, consisting of four stages of rf amplification, was advertised. These were both TRF models.

THE REGENERATIVE RECEIVERS

National's first short wave receiver was the SW-2 (stands for Short-Wave, 2 tubes) consisting of an untuned rf amplifier and a regenerative detector. The basic design was obtained from the RCA Communications Laboratory, then located at Van Cordtland Park, New York City. Several of Millen's college classmates had gone to work for RCA and he had extensive contacts there. The SW-2 was based on a receiver design RCA developed for an "export receiver" sold by the General Electric Co. in South America. This receiver became known as the SW-4 when it was later manufactured by National.

The SW-2 was the only receiver National made without sheet metal or production tooling; for example, all drilled holes were laid out by hand instead of using fixtures. The SW-2 was extensively advertised as a TV receiver and Millen wrote an article in the November 1928 issue of Radio News describing his TV experiments. The SW-2 appeared in late 1927 or early 1928. A three-



Fig. 6. The National Company at 61 Sherman St., Malden, Mass., about 1930.
Photo credit: James Millen



Fig. 7. An interior view of the National Company, in the early '30s, showing assembly of SW-3 receivers.
Photo Credit: James Millen

tube version of the SW-2 appeared in 1929; the third tube was an voltage amplifier and apparently was added to provide additional amplification for TV work.

In 1929 the company produced the four-tube SW-4, the fourth tube being an audio power output tube. A sheet metal cabinet was also provided.

As new and improved vacuum tubes were developed, National improved its receivers. In 1930 Millen and Kruse, who was a former technical editor of QST, designed the SW-5 receiver. The fifth tube was added to provide a push-pull output stage for loud speaker operation. This was one of the first short-wave receivers specifically designed for operation from AC power lines. The receiver was completely hum-free and had no dead spots which was quite an accomplishment at that time. A "high fidelity" version of the same receiver — the SW-45 — was also sold which used type 45 tubes for the audio output stage instead of the type 27 used in the SW-5.

As the country was in the midst of the great depression, a low-cost version of the SW-5 was soon developed — the now venerable SW-3. The push-pull audio output stage of the SW-5 was eliminated — which meant headphone operation only — and a wrap-around sheet metal cabinet was substituted to further reduce costs. Both AC and battery powered models of the SW-3 were marketed and two upgrades made; the last right after WWII to use octal tubes. This receiver was in production almost 15 years, from 1933 to 1948, the longest production run of any receiver except the HRO which was in production for almost 30 years. The SW-3 has become a "must" for any collector of early short-wave receivers.

One last regenerative receiver deserves mention, the SW-58C. This receiver was designed as a companion receiver for the AGS superheterodyne receiver to cover the 200 to 400 KHz frequency range used by the airlines that the AGS



Fig. 8. The famous SW-3 receiver, with a set of coils in the NCC-10 National Coil Cabinet.

Photo credit: John Nagle



Fig. 9. Early television experiments at National, about 1927. Shown is a National SW-2 with TV scanning disc. In the background is a National RF oscillator and a Western Electric 540 A.W. speaker.

Photo credit: National Radio Co., Inc.

receiver would not cover. The receiver is basically the SW-58 except for the plug-in coils. These coils look like the coils used for the AGS/FB-7 receivers but they are longer and smaller in diameter. They are NOT interchangeable with the AGS/FB-7 coils. The SW-58C had a National type N dial, as did the AGS; the SW-58C is generally seen in AGS advertisements as the 'other' receiver in the relay rack.

THE EARLY SUPERHETERODYNES

In 1932 the General Electric Co. was awarded a contract by the recently established Civil Aeronautics Authority (known as the FAA today) to provide short-wave (HF in today's terminology) transmitters and receivers to the Government for air safety use in the fledgling airline industry. GE had developed a transmitter but they did not have a receiver. The Western Electric Company had a receiver, but for competitive reasons GE did not want to team with Western Electric and instead approached Millen to have National design and manufacture a suitable receiver. The result was the AGS (for Aeronautical Ground Station). This was the first high performance short-wave receiver made by National and one of the first high performance receivers commercially available. Most of the receivers were sold to the CAA through the General Electric Co. A few went into the amateur market along with amateur band-spread coils.

Again the depression reared its head and in order to make the receiver more marketable a reduced version was made available; this was called the FB-7. The rf preselector was eliminated and a more economical wrap-around sheet metal cabinet was provided; only one set of coils was included so that the cost was reduced to where many amateurs could afford what was probably the first medium performance amateur superhet receiver. The receiver became very popular among amateurs and is among collectors, too.

THE HRO AND ITS DESCENDENTS

After the introduction of the AGS by the Government, the airline industry itself began to recognize the importance of reliable radio communication and urged National to develop a receiver for their use. Herbert Hoover, Jr. was then in charge of radio communications for Western Airlines (which later became a part of TWA); he acted as an informal spokesman for the airlines. The main airline requirements were that if plug-in coils were necessary to obtain the desired performance, then all coils must be plugged in simultaneously. A second requirement was two stages of preselection. As these requirements, plus a crystal filter, closely matched those desired by the amateur community for their dream receiver, the two markets could be combined into one receiver which became known as the HRO. By the way, HRO stands for Helluva Rush Order, honestly! How it got that name is part of the HRO story which is too long to include here.

The HRO was first announced in the October 1934 issue of QST and delivery was promised for December 1934 in time for the Christmas trade. The photograph shown in that announcement is the prototype model which did not

go into production. However, technical problems delayed deliveries until March 1935; the photograph shown in the January issue of QST is that of the first production model. The same basic receiver stayed in continuous production almost thirty years until October 1964 when the HRO-500 was announced. This is a remarkable life span for any piece of electronic equipment, especially one that was designed so early in the electronics age.

In February 1936 National announced the HRO Jr., a scaled down version of the HRO, at a cost of just under \$100. The advertised economies were effected by removing the crystal filter, the S-meter and by supplying only one coil set, without bandspread, to cover any two contiguous amateur bands. One further economy was not advertised; with the HRO Sr. each coil set was aligned in the receiver with which it was sold. This, of course, gave an exact alignment of each coil set for each receiver. The complete alignment of an HRO Sr. required about four hours. With the HRO Jr. the coils were aligned to an average receiver and the receivers were aligned with an average coil set so that one did not have the precision alignment that was obtained with the more expensive receiver.

In August 1936, Millen announced a new receiver designed for both amateurs and short-wave listeners, the NC-100X. This basic design would be carried through in many more receiver designs, the 100XA, the NC-101 series, the NC-200 family that came out just before WWII, to mention a few. Unfortunately, time and space do not permit a detailed examination of these and many other receivers that National engineers developed. Suffice to say, that by the middle 1930s the design of high performance receivers had advanced from an art to a science and National built up a very competent engineering staff that kept National products up to date and in high demand.

MILLEN LEAVES NATIONAL

In 1939 lightning struck! The June 1939 issue of QST carried an announcement that as of May first, 1939, James Millen had "completely withdrawn from the National Company." What had happened to end such a successful collaboration of almost 15 years?

The immediate reason occurred early in 1939. According to Millen, Warren Hopkins, who held the controlling interest in National, told Millen that he (Hopkins) wanted Millen to switch the emphasis of the company from making short-wave radios for a very limited sector of the country to making broadcast type radios to be marketed by the retail giants as Sears Roebuck, Montgomery Ward and the many large and well known department stores around the country. The purpose of the drastic change was to make the National Company a "household name" in the radio business.

Millen was flabbergasted!

National had been highly successful in designing and manufacturing short-wave radios; in fact, they were the recognized leader in the receiver field and more recently in transmitters and accessory items, too. Equally important, the company was profitable!

Why? Hopkins would give no definite reasons, saying only that he wanted to change the direction of the company, and the company needed products where it would have more exposure.

Millen wanted no part of it; he was dedicated to building the best receivers that he could build regardless of price. The consumer radio business was completely alien to him. So he left National and formed his own business.

From a historical point of view it is interesting to pause a moment and look back and examine what Millen had contributed to the National Company, Inc. in its transformation from a toy maker to a leadership role in short-wave communications receivers.

First, I have heard it said by people who were closely associated with National, but not employed by National, that, in the 1930s National was run by Jim Millen and his secretary Frances Bearse. Miss Bearse held the formal title of Office Manager but was apparently more of Millen's right-hand "man."

Second, Millen traveled extensively in those days visiting suppliers, dealers, and most important, individual amateurs and amateurs radio clubs throughout the country. When he returned to Malden, he knew what the amateur community needed and wanted. He also knew what new materials and components were available. He would sit down with his designers and sketch out new products. In short, Millen was an "idea man."

The third role Millen played was as a publicist. As noted earlier, Millen had a flair for writing and he used this ability well. He usually wrote a magazine article describing each new product, but more than that, he would explain in simple technical terms why it was built the way it was. By the end of the article most readers would agree that the way National designed the equipment was the "only way" to do it and nobody could improve upon it.

In the March 1934 issue of QST Millen inaugurated what is probably the longest running and most successful series of technical advertisements. These were always the first advertising page in QST and consisted of a single page write-up on some technical topic of interest at the time: a description of a new receiver, a new circuit or component of something similar. This page was known as "page 73" at National regardless of the magazine page on which it was printed. This series continued through number 243 which appeared in the July 1954 QST, a run of over 20 years.

In retrospect, Millen believes Warren Hopkins' desire to change direction was based on another consideration; Hopkins died of cancer in the early 1940s and Millen feels that Hopkins was told he had cancer in early 1939 and had only a few years to live. Hopkins wanted to convert his assets into the maximum amount of cash possible. This would be a natural reaction for any business man in Hopkins' situation. National had a good reputation in amateur and Government circles but was virtually unknown by the general public or, equally important, by the financial community which would ultimately set the value of his holdings. This lack of recognition would tend to hold down the price of National stock.

As it turned out, Hopkins got his wish of increased value for his stock but from an entirely different direction.

In the summer of 1939 war broke out in Europe; representatives of Allied governments, particularly the Royal Navy, visited National and ordered large numbers of receivers, particularly HROs. When the United States entered the war some two years later, the word was "Start building HROs; we'll tell you when to stop."

Needless to say, National began producing for the war effort, The number of employees went from the 200-300 range to about 2500 during the war. The war effort brought increased recognition and profits to National and after the war, in the late forties, National went public.

NATIONAL'S POST-WAR YEARS

National built extensively on its war-time expansion and developed an impressive array of military, industrial, and consumer as well as amateur products and appeared to have a very promising future.

Effective June 1, 1953 William A. Ready retired, after almost forty years as president of National, and Charles C. Hornbostel became president. Hornbostel graduated from the Harvard School of Business specializing in accounting.

William A. Ready is remembered as a kindly person by his fellow employees at National. He knew most employees on a first name basis as well as their wife's and children's names. He was always available and often stopped to talk with employees on his tours through the plant. No special introductions were needed.

Ready began the tradition of holding employee Christmas parties. Former National employees still gather at Christmas to renew old friendships and memories. I have been privileged to attend several of these reunions and have found the employees treasure their memories there. National must have been an interesting place to work!

After the company went public, a controlling interest was acquired by Louis C. Learner, an investment company, and the Learner interests took control. Legal technicalities tend to obscure the facts and I have not been able to determine all the details to my satisfaction.

The new management apparently set up a second company called National Radio Company, Inc.; all Government work continued to be charged to the National Company, but now all commercial and amateur work was charged to the National Radio Company. Press releases were made detailing plans for rejuvenation of the company and the price of the stock went up. At that point the Learner interests sold their stock. Several component product lines were sold to Japanese interests as was the production machinery and the name National Company, Inc. The National Radio Company went into bankruptcy and that name was sold to the bankrupt's principal creditor, who in turn sold it to the FAN-WEL Corp., who purchased the remaining assets as well. In June 1974,

FAN-WEL changed its name to National Radio Company, Inc. and is still doing business under that name.

The Japanese-held National Company, Inc. makes consumer type radios but, to the best of my knowledge, they are not sold in this country. Warren Hopkins had his wish come true after all.

ACKNOWLEDGEMENTS

I would like to acknowledge the extensive help I have received from many sources. First, James Millen has spent many hours reviewing the early days of National with me as well as the early history of the radio industry in which he played an important part. He has provided me with many technical data sheets and magazine tear sheets on the early equipment built by National and copies of his own extensive writings. I must also recognize the cooperation of the former employees of National who welcomed me into their group; particularly Vincent and Edith Messina, Conrad Espinola, Jack Ivers and Gene Simms. It has been a real pleasure meeting these people. I would like to also thank the management and employees of the present National Radio Company for letting me browse through their files of the old National Company.

Last, but certainly not least, my wife Martha has spent a lot of time correcting and revising my manuscript and turned it into something readable.

I can not conceive that this document is free of errors, although it is based on the best evidence available to me. I will be happy to hear from anyone having more accurate information.

LIST OF EQUIPMENT

The following table lists most of the amateur and commercial radio equipment manufactured by National from 1929 to 1960 in chronological order. To save space, only the basic version of most models is listed. Some of the lesser known models as well as some of the consumer products manufactured immediately following WWII, such as TV and HiFi equipment, have also been omitted.

DATE	MODEL	DESCRIPTION
1927(late)	Type M	B Power-Unit
1927(late)	Type E-1	One stage audio amplifier
1927(late)	Type L-3	Power amplifier and B power pack
1928(late)	NJ-30	BC band tuner without cabinet for custom installations.
1929	MB-29	Broadcast tuner, three stages TRF
1929	SW-4	The G.E. "export" receiver
1930	LC-3	Short-wave converter
1930	MB-30	Broadcast tuner, four stages, TRF
1930	SW-5	Regenerative receiver (Thrill-Box) 5-tubes
1930	SW-45	Similar to SW-5 but used type 45 tubes for audio output stage

1931	SW-3	Three-tube regenerative receiver
1932	SW-58	Up-dated version of SW-5 using type 58 tubes
1932	SW-34	Battery operation version of SW-58
1932	MB-32	Broadcast tuner
1932	AGS	High performance superheterodyne communications receiver
1932	SW-58C	Companion receiver to AGS for low frequency operation, rack mounted, type-N dial
1932	NC-5	Converter, 15 to 185 meters to the broadcast band, coil change switch
1933	SRR	Super-regenerative receiver Coils available 5-80 meters
1933	TRM	Transceiver, regenerative detector 56-60 mc/s. battery power, metal case
1933	TRW	Same as TRM only wooden case
1933	HFC	High-frequency converter, 5 and 10 meter amateur bands to broadcast band
1933	FB-7	Receiver, short-wave, superheterodyne "single-signal", plug-in coils
1935	HRO	High-performance superheterodyne communications receiver
1936	NC-100X	Short-wave receiver designed for SWLs and amateurs, used PW type dial
1936	HRO, Jr	Scaled-down version of HRO
1937	NC-101X	Same basic receiver as NC-100X for amateur bands only
1937	NC-80X	General coverage receiver for amateurs, ac/dc power, replacement for FB-7
1937	NC-81X	Same receiver as NC-80X but covered amateur bands only
1938	NC-100AX	Same receiver as NC-100X but with directly calibrated dial
1938	NC-101AX	Same as NC-101X except directly calibrated tuning dial
1938	1-10	Super-regenerative receiver, tuned 28-300 mc/s, plug-in coils.
1938	None	Meteorological receiver build for U.S. Weather Service, Radio-Sonde reception Based on 1-10 design, 56-85 mc/s
1938	NC-510	Superheterodyne receiver, 28-60 mc/s Apparently very few made
1938	NHU	Superheterodyne receiver, 28-60 mc/s Apparently superseded the NC-510.
1938	NHU-B	Same as NHU but for 6 volt operation
1938	NHU-20	Same as NHU but included 20 meter band
1938	NSA	Audio speech amplifier, 15 watts output

1938	NT-100PC	Final amplifier for 600 watt transmitter
1938	NT-300PC	Modulator for 600 watt transmitter
1938	NT-1200PC	1250 volt power supply for 600 watt transmitter
1938	NT-2000PC	2000 volt power supply for 600 watt transmitter
1938	NT-APW	Pi Network antenna coupler for 600 watt transmitter
1938	NT-RPW	Relay control panel for 600 watt transmitter



Fig. 10. The 1932 AGS-X in a custom walnut cabinet for table mounting. The Lamb type mechanical quartz filter provided single-signal operation. Another version, the AGU, had the three coils assembled into a single unit for ease of handling.

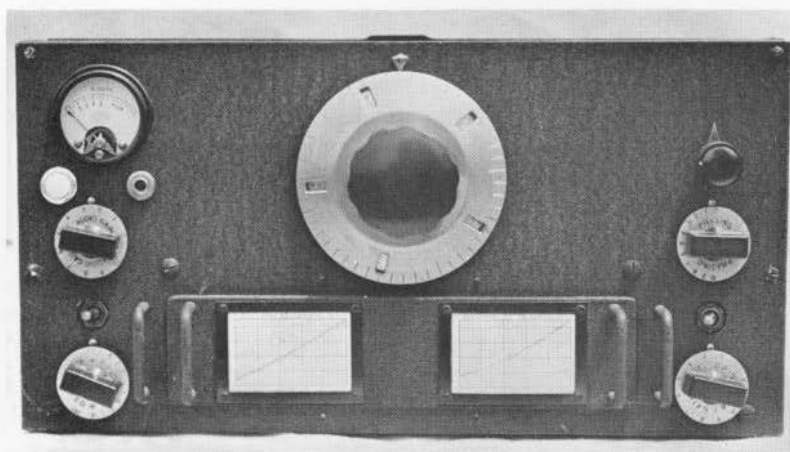


Fig. 11. The first production version of the remarkable HRO high-frequency communications receiver. The white S-meter button was quickly supplanted by the pull switch. This model is quite rare.

1939	NSM	Modulator, 30 watts output, automatic volume compression
1939	NTE	RF exciter and speech amplifier covered 5, 10, 20, and 80 meter bands
1939	NTE-A	Same as NTE but covered 10, 20, 40, and 80 meter amateur bands
1939	NTE-B	RF exciter only, no speech amplifier
1940	NTX-30	4-band 30 watt CW transmitter
1940	NC-44	Superheterodyne receiver, ac/dc power
1940	NC-44A	Same as NC-44 but ac operation only B-minus return grounded to chassis
1940	NC-44B	Same as NC-44 except ac/dc or external 6 volt vibrator supply
1940	NC-44BV	Same as NC-44B but 6 volt vibrator power supply built-in
1940	NC-200	Up-date of NC-100 family, general coverage and amateur bandspread
1941	NC-45	Same as NC-44 but with noise limiter
1944	HRO-5	First model to use metal tubes
1945	HRO-5A1	Post-war amateur model, noise limiter
1945	NC-2-40	Post-war up-date of the NC-200 family, Tuning range .49-30 mc/s
1945	NC-2-40S	Same as NC-2-40 except tuning range 200-400 kc/s and .49-18 mc/s
1946	NC-46	Post-war up-date of NC-45 series
1947	HRO-7	HRO in new cabinet design
1947	NC-173	Amateur receiver, .54-31 mc/s and 48-56 mc/s
1947	NC-108	87-108 mc/s FM tuner consumer product
1947	NC-57	Low cost communication receiver
1947	NCTV7	Television receiver 7 inch tube
1947	NC-TV7	Same as NCTV7 but added "S" meter for measurement of signal strength
1948	NC-183	Amateur communication receiver .54-31 mc/s and 48-56 mc/s
1948	NC-183DT	Same as NC-183 except dual conversion above 4.3 mc/s
1950	HRO-50	Built-in power supply, slide-rule dial push-pull audio
1951	HRO-50-1	Same as HRO-50 only 12 tuned circuits in i.f. amplifier
1954	HRO-60	Similar to HRO-50-1 but dual conversion above 8 mc/s
1958	NC-300	Receiver for amateur bands only
1959	NC-303	Same as NC-300 only dual conversion
1960	NC-400	General coverage receiver. Very few sold, probably overpriced, .54-30 mc/s