

SPARK KEYS: THE INTERPLAY OF WIRELESS HISTORY AND TECHNOLOGY

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Introduction

In the short span of under 30 years, the world witnessed the evolution of wireless communications from spark telegraphy into everyday broadcast radio. Guglielmo Marconi, who received the Nobel Prize in Physics along with Carl Ferdinand Braun in 1909, is generally credited with starting this communications revolution. Using a spark gap and an induction coil, he discovered that high voltage could break down the gap and cause a train of damped waves to form.¹ This created a problem for Marconi and those who followed. The same high voltage and current necessary for the transmitter to function would melt and fuse the contacts when a landline telegraph key was used to control the circuit. This problem was overcome by manufacturing keys of heavier construction fitted with much larger contacts that could handle the higher current load. These keys are referred to as “spark keys.”

The history of the spark era has been told and retold many times. Credit for the invention of wireless has been hotly contested and the legal disputes over patent rights probably slowed the progress of radio considerably.² The technical aspects of early wireless telegraphy have been described, detailing the exact workings of each of the components of the spark transmitter.³ One component has received little attention—the spark key. In modern works as well as in textbooks from the first and second decades of this century, relatively little has been written about the spark key. Spark keys played an important role in the history of wireless communication and were made by more than 80 different manufacturers.

The early history of the spark key parallels the history of wireless communication itself. The spark key, though in reality just a simple switch, was made in quite a surprising number of shapes and forms. Many manufacturers developed spark keys using either their own designs

or Navy specifications. These various spark key designs were influenced by the conditions of their use as well as by other inventions and world events. This article will discuss spark keys and their relationship to history before, during, and after World War I.

Ultimately, transmitters using vacuum tubes replaced both the spark transmitter and the arc transmitter,⁴ which was a competing form of wireless developed to a high degree in the United States by Reginald Fessenden.

Spark Keys and the Events Prior to World War I

On August 14, 1894 Professor Oliver Lodge presented a demonstration of Hertzian waves at a meeting of the British Association for the Advancement of Science at Oxford. Dr. Alexander Muirhead, an eminent telegraph engineer, supplied Lodge with telegraphic equipment including a Kelvin galvanometer, a Morse inker, and a telegraph key. When the key in the primary circuit was depressed for a short time, a small deflection of the galvanometer took place in the lecture theater. If the key was held down longer, a larger deflection was produced. Lodge was thus able to transmit “dot and dash” signals, demonstrating for the first time the possibility of sending messages by Hertzian waves. There were still a few telegraph engineers alive in 1931 that were present at Lodge’s original demonstration. They recalled copying the Morse signals. What Lodge’s spark key looked like, however, is unknown.^{5, 6}

In December, 1894 Guglielmo Marconi successfully demonstrated for his mother the workings of his wireless apparatus while in the attic laboratory of his family’s estate in Italy. He depressed a telegraph key and made a doorbell ring 30 feet away in an adjoining room using wireless transmission.

Marconi’s earliest experiments were conducted with a tall-handled key. Rare photographs and drawings of this key exist. They show it to be a relatively small key, in many respects similar to landline keys of the time (Figure 1).^{7, 8} Two binding posts stood at the opposite end of the key from the tall straight handle that had a flared knob at the top. The base appears to have been about an inch thick. The operator grasped the flared knob at the top rather than grasping the entire length of the handle (Figure 2).⁹

A key with a thicker wooden base but missing the tall handle, also known only from photographs, was probably Marconi’s second wireless key (Figure 3).¹⁰ This key was the first to be specifically designed for wireless work. It had a thick lever arm and the standard landline knob with the pieces assembled on the base. This key is of somewhat heavier construction than the earliest model but still is not particularly heavily

Figure 1. *Marconi's first key, used in the earliest Marconi wireless experiments. Notice the tall handle.*

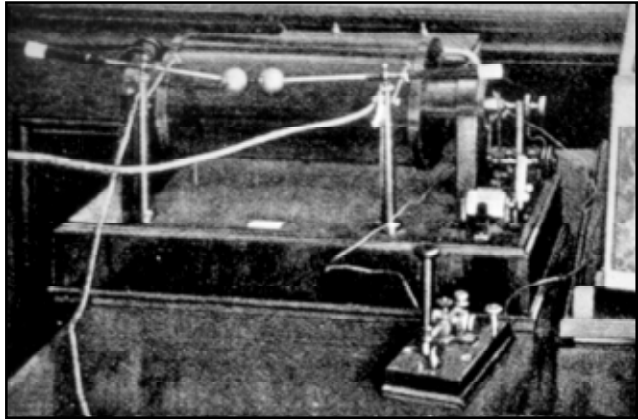
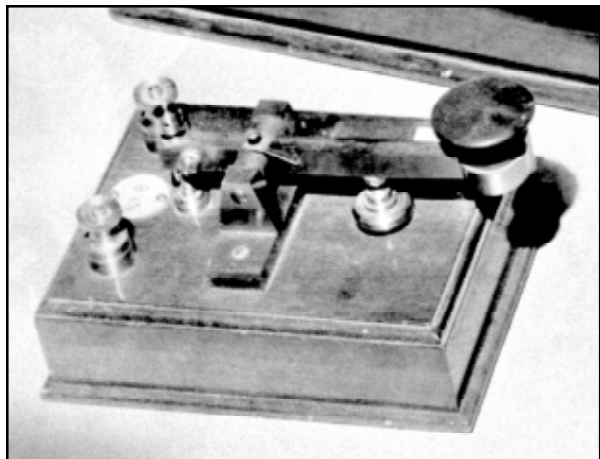


Figure 2. *Sketch showing George Kemp transmitting with Marconi's first wireless key. Notice the method by which he grasps the handle.*

Figure 3. *Marconi's second wireless key. The tall handle is gone. The frame is similar to that of many later Marconi keys.*



built. The frame style of this key became the pattern for the more familiar Marconi keys of later years.

In Marconi's early experiments, communications were carried out in one direction only. Since the receiver was located at some distance from the transmitter it could not be damaged when the transmitter was keyed. But when two-way communications began, a mechanism was needed to prevent inadvertent operation of the transmitter while the receiver was connected to the aerial. The Grasshopper key was an odd-looking affair designed to fulfill this requirement (Figure 4). This key was included as part of United States patent No. 650,109 in the year 1900.¹¹ Sewall described the Grasshopper key in 1903:

"The arm of the key is prolonged beyond its pivot, and carries an insulated contact which is permanently connected to the aerial conductor. Below this contact on the base of the instrument is the terminal of the receiver. The arm is so arranged that immediately after its release by the operator, subsequent to the sending of a message, it turns about upon its pivot, bringing the above mentioned contact and terminal together, so connecting the receiver with the aerial conductor."¹²



Figure 4. *The Marconi Grasshopper key. There was no spring. The weight of the lever arm pulled the key down.*

Just exactly who coined the name “Grasshopper key” is not known, but the term was already in use in 1925.¹³ Gravity pulled the lever back down to connect to the receiver terminal so that no spring was necessary. Marconi himself used a Grasshopper key during demonstrations as late as 1901.¹⁴ Unfortunately, very few of the original Grasshopper keys are known to exist. A reproduction has been on display at the Marconi Museum in Chelmsford, England.

The first recorded attempt to use wireless telegraphy during war took place during the Anglo-Boer War of 1899-1902.¹⁵ The British forces in South Africa did not succeed in making useful communications with their Marconi equipment, presumably due to poor ground conditions and lack of a matching system for the antennas. The Heliograph, a mirror-based light signaling device, achieved much better results.¹⁶ No photographs of the spark keys from the sets supplied to the British forces in South Africa are known to exist. At this same time Marconi radio equipment was also being installed on the *U.S.S. Massachusetts* for Navy tests in 1899.¹⁷ A diagrammatic sketch of this equipment clearly shows a Grasshopper key in place as well as its connections. It seems plausible therefore that Grasshopper keys were supplied with the transmitting sets to the troops in South Africa.

The Boer Republic placed an order for six wireless telegraphy sets from the German firm Siemens and Halske on August 24, 1899.¹⁸ Some of this original equipment is currently on display at the Military Museum in Bloemfontain, South Africa. These sets were never used, as they were confiscated by customs on arrival. However, Marconi clearly already had commercial competition from other companies developing wireless equipment. The German equipment had a guaranteed range of 15 kilometers and used antennas 36 meters high. Two German firms, Braun-Siemens-Halske and Slaby-Arco, supplied sets to the United States Navy in 1902 for comparative tests. None of the keys from these original sets are known to have survived.

Wireless quickly proved its value on the high seas. On Christmas Eve, 1898, George Kemp reported damage to the East Goodwin lightship from 12 miles offshore.¹⁹ Changes were necessary as wireless moved from land to sea. A new key was made presumably because a key which was less awkward than the Grasshopper key and capable of higher sending speed was desired. It was the fourth Marconi design. Use of the springless Grasshopper key resulted in slow transmission, but this was just what was necessary at the time as the coherer in the receiving circuit functioned sluggishly. The new key incorporated a side lever whose purpose was to open the primary circuit in emergencies.

This key was widely used in marine installations. It has become known as the “Guillotine” key (Figure 5) because of the appearance of

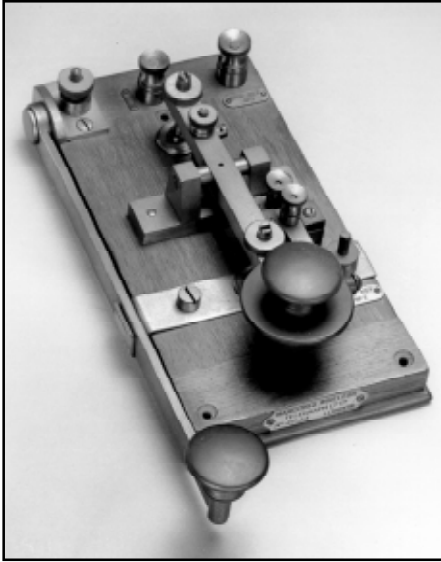


Figure 5. Marconi's fourth key design, the Guillotine Key. The lever on the side is essentially a safety switch.

the long-levered safety switch, though it is unlikely that it was known by this name during its own time.

The Guillotine key was commonly employed in tandem with the Gray Magnetic Relay Key.²⁰ The Gray Magnetic Relay Key controlled sparking at the contacts of the Guillotine key, which then was called the “manipulating key.”

The best description of the Guillotine key as well as the use of a magnetic key in association with it to reduce sparking is given by Hawkhead and Dowsett in 1915.²¹ According to Hawkhead and Dowsett, the magnetic key allowed the circuit to break only at current minimums of the wave cycle. This permitted the operator to send much more quickly. The Guillotine key can be seen on many wireless operating desks in photographs from 1900-1915. It is likely that this key was used on the lightship *Tongue* in 1900.²² A pair of Guillotine keys is in obvious view at the operating position of the *S.S. Mauritania* in 1913 (Figure 6).²³

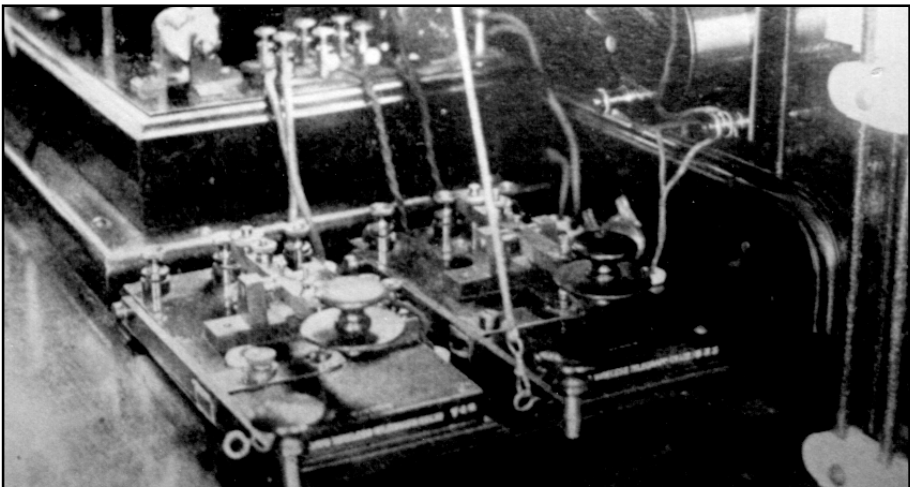


Figure 6. Marconi Guillotine keys in position in 1913 on the *Mauritania*.

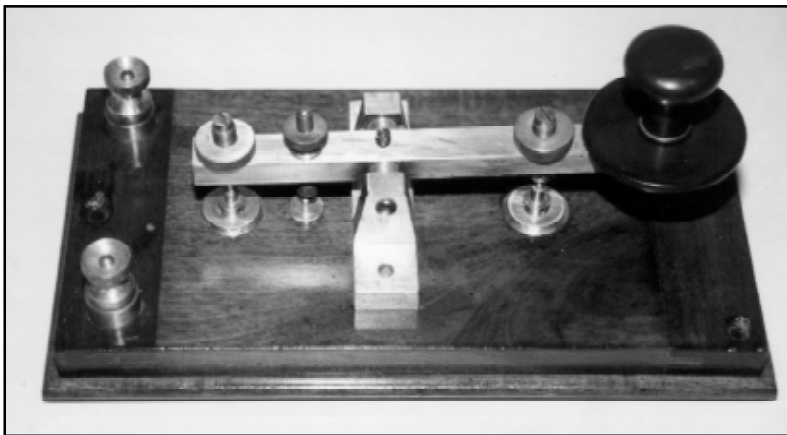


Figure 7. *Standard large Marconi wireless key on wooden base, without safety switch or connections for a magnetic relay.*

Marconi also made keys similar to the Guillotine key, but with neither the switch on the side nor connections for the magnetic relay key (Figure 7). These keys were also in use by 1913 and were used on Atlantic liners, as were the Guillotine keys. In response to maritime disasters the United States Department of Commerce, which at the time regulated wireless installations, had enacted laws in 1910 and amended them in 1912 “to require wireless apparatus and operators for radio communications on certain ocean steamers.”²⁴ Most major vessels, including the *Titanic*, were outfitted with Marconi installations which included Marconi spark keys.

Marconi companies eventually made spark keys not only in Chelmsford, England but also in Canada and in the United States. The three different companies made different styles of keys. The British Marconi Company made keys that were usually on a wooden base. An example appears in a very early British Marconi catalog from 1905 (Figures 8 and 9). The wooden base of this key was by necessity quite tall because it concealed a fixed condenser which was connected across the contacts. This would become a common strategy to reduce sparking. Marconi marketed his apparatus through his original company, The Wireless Telegraph and Signal Company, while he was at the Haven Hotel in Poole, England. The British patent for the Grasshopper key was granted to him on March 5, 1899 (No. 5,657). The name of the British Marconi company was changed to “Marconi’s Wireless Telegraph Company” in 1900. This company designed many different types of keys (Figures 10, 11, and 12). Most of them have no model numbers and their dates of manufacture are in question. Not seeming to follow any given pattern, they were probably made for specific applications by the British engineers.

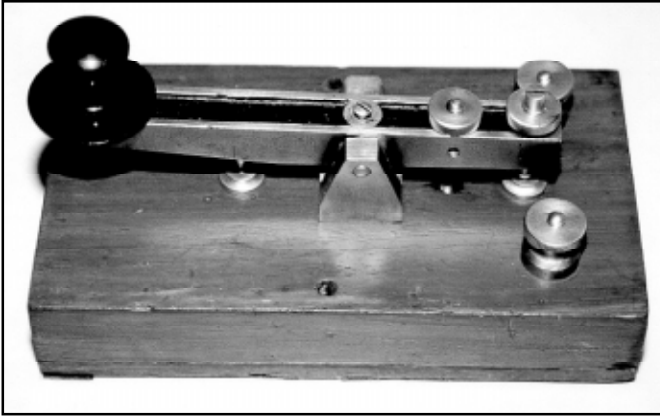


Figure 8. Marconi's Wireless Telegraph Company, Ltd., smaller key on a thick wooden base containing a condenser to reduce sparking at the contacts. Probably considerably later than the 1905 model, though similar.

Figure 9. Marconi's Wireless Telegraph Company, Ltd., same key as Figure 8 but with bottom cover open and condenser exposed.

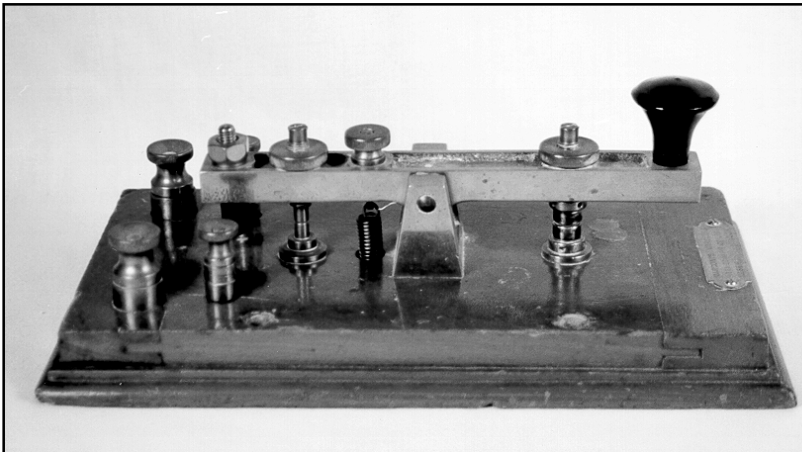
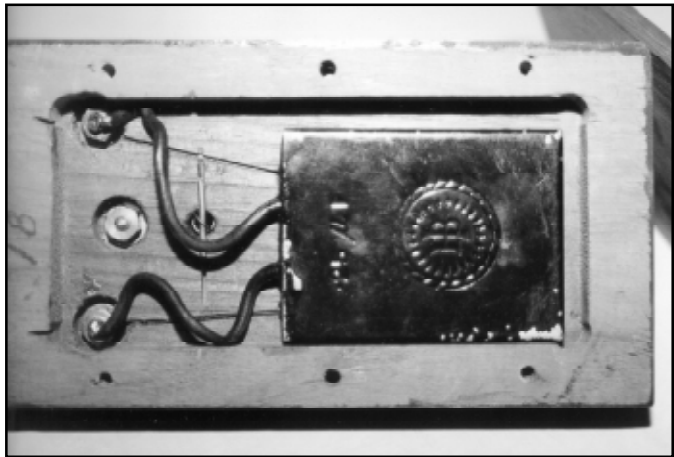


Figure 10. Marconi spark key on wooden base. Note distinctive lever style.

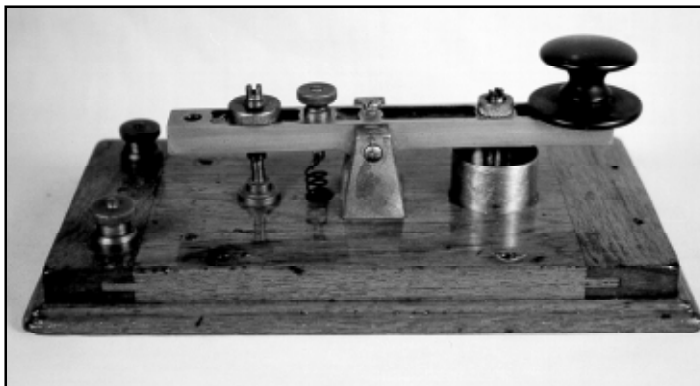


Figure 11. *Marconi, Chelmsford, England. Oil break type key on wooden base.*

The American Marconi Company was organized in 1899 in New Jersey and appears to have used British Marconi keys until the construction of the Aldene, New Jersey factory in 1912. The Preston-Lamson Terry key (Figure 13) seems to have been an exception. This key was probably made in 1910 in New York. One of the earliest keys made in the United States by the American Marconi Company was a cross-shaped key. This style was acquired as a result of the merger of the American Marconi Wireless Telegraph Company with United Wireless in 1912. A Marconi company report from December 1913 surprisingly lists only 3 workmen assigned to the manufacture of wireless telegraph keys at the Aldene plant. American Marconi made keys for the Signal Corps (Figure 14), the Navy (Figure 15), and for amateur use (Figure 16).

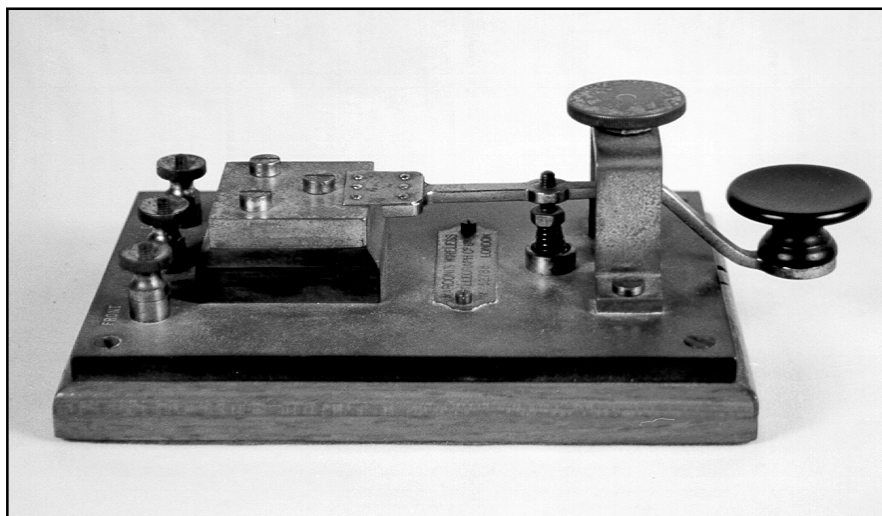


Figure 12. *Marconi key with flat spring. Note slate on wooden base. England.*

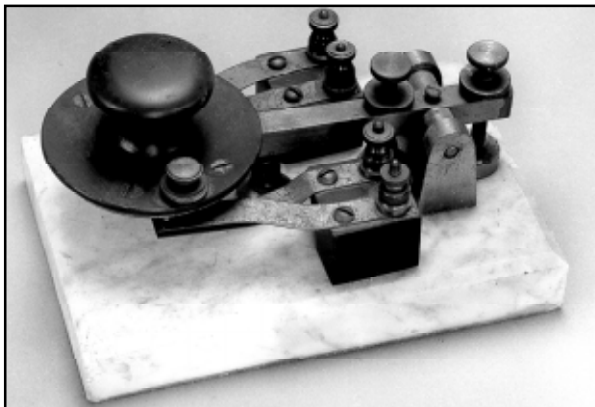


Figure 13. *Marconi's Wireless Telegraph Company, Preston – Lamson Terry key, 1910. Tested by the U.S. Navy. Too early to have been made at the Aldene, New Jersey plant, this key was probably made in New York.*

Figure 14. *Marconi's Wireless Telegraph Company of America, Relay and Hand Sending key, Signal Corps design. Improved by R.A. Weagant. Note the upright handle for hand sending in case of breakdown of the relay. About 1912.*

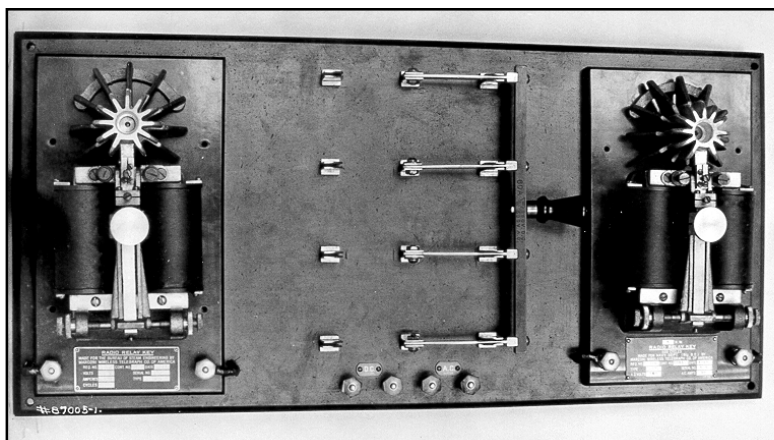
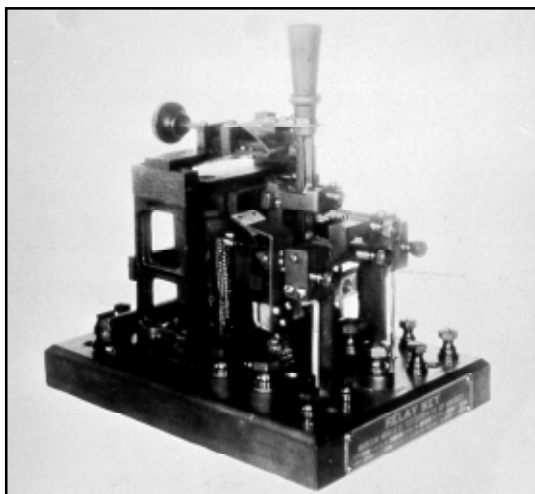


Figure 15. *Marconi's Wireless Telegraph Company of America, Relay Key Type CM 858.*

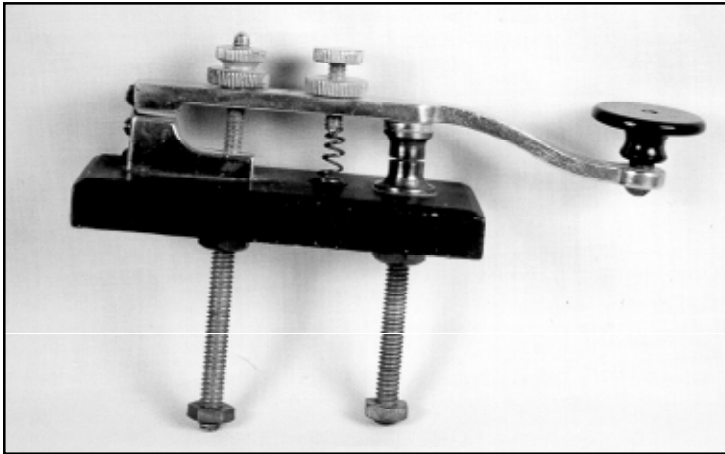


Figure 16. *Marconi's Wireless Telegraph Company of America, Type 205 key. Rated at 2- kW, it cost \$2.00 by catalog.*

The Canadian Marconi Company was registered in Ontario in 1902 and also used British Marconi keys until around 1910 when the Glace Bay Station upgraded its machine shop to manufacture equipment. The Type 701, 702 (Figure 17), and 705 keys (Figure 18) were designed and manufactured in Canada for use exclusively at Canadian Marconi stations. They are unusual in that they have two nameplates. One nameplate displays a beautifully scrolled “Canadian Marconi Company” and the other lists the key type and serial number. In addition to the fancy nameplates, Canadian Marconi keys have a distinctive lever which angles sharply down to the knob.²⁵ No examples or mention of Type 703 or 704 keys appear in the literature or blueprints.

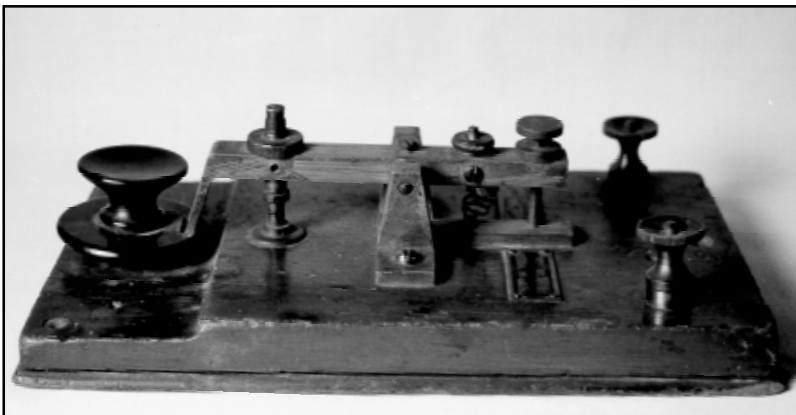


Figure 17. *Canadian Marconi Type 702 key on wooden base. Note distinctive drop of lever toward knob.*

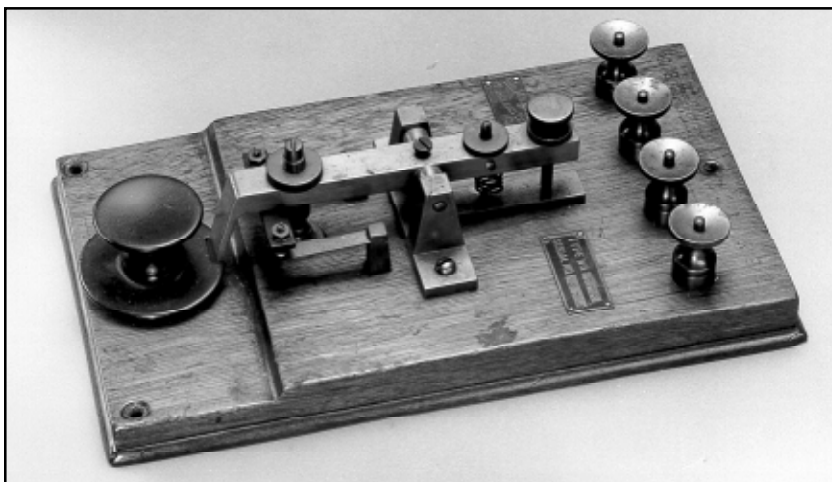


Figure 18. *Canadian Marconi, the Type 705 key. Notice the fancy labels and the four binding posts in a row.*

Marconi was negotiating with the U.S. Navy over lease agreements for his equipment around 1902, allowing other companies to gain a foothold in the American wireless market.²⁶ One such company was the Clark Wireless Telegraph Company, established by Thomas E. Clark. Clark, who began the study of electrical engineering at age 15, started manufacturing wireless telegraph instruments in 1898.²⁷ Clark boasted that he made the first saleable wireless apparatus in the U.S, and he sold wireless apparatus to Japan in 1903. The spark keys used with the Clark wireless system were mounted on a glass or marble base and used a step lever somewhat reminiscent of the Partrick and Carter landline key lever (Figure 19).



Figure 19:
View of Detroit Laboratory of Clark Wireless Telegraph Company.

Meanwhile, Ferdinand Braun was developing wireless apparatus in Germany. Funkentelegraphie GmbH of Koeln was formed in December 1898. The company became Prof. Braun's Telegraphie GmbH, then Telebraun. After joining forces with Siemens and Halske AG, the company became Braun-Siemens. Finally, after merging with AEG-Slaby-Arco, a new company was formed in 1903 that was named Gesellschaft fuer drahtlose Telegraphie mbH. The word Telefunken was born, being derived from Braun's TELEbraun and Slaby's original use of the term FUNKENtelegraphie in 1897.²⁸

The Slaby-Arco key of 1902 had a tall insulated handle made of wood. It was very similar to Marconi's first experimental key (Figure

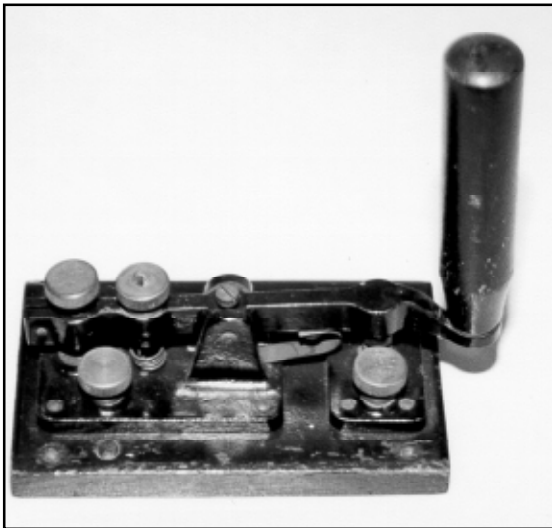


Figure 21. Left
Slaby-Arco type key, notice the tall wooden handle. This later example, probably after the formation of Telefunken, does not have the blow-out magnets. The large contacts are oval in shape. This key is light and small for the size of the contacts. It is seen in many field sets where a light key would be important. Similar keys probably also saw service in Zeppelins.

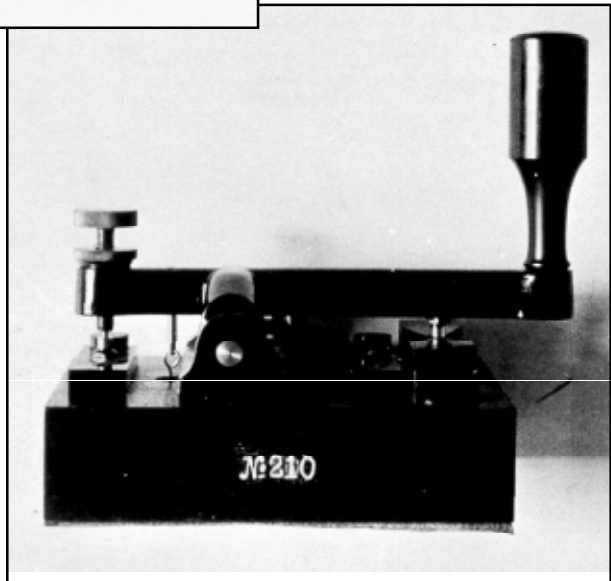


Figure 20. right
Early Slaby-Arco key, with blow-out magnets surrounding the contact point.

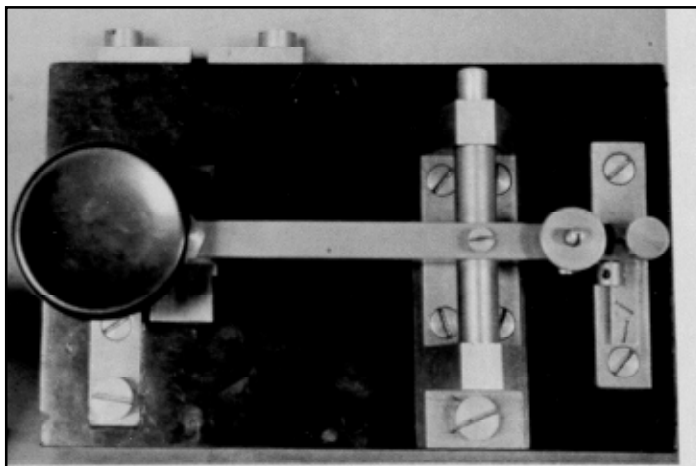


Figure 22. *Wireless key, Telefunken System, from the U.S.S. Nebraska, 1907. Type TK.*

20 and 21), but it operated by placing the entire hand around the handle. The various parts of the key were assembled on a wooden base, and a spring return was used. Two poles of a magnet were placed perpendicular to the contacts to magnetically “blow out” the arc that formed at breaking of the contact. The windings of the magnet were in series with the main circuit and were energized when a signal was sent.²⁹ It is likely that the design reflected the anticipated use in airships and stationary balloons. This key can be seen as part of a Slaby-Arco set in a picture taken in 1904.³⁰

Another Slaby-Arco key was enclosed with a Ruhmkorff coil in a box with only the knob allowed to protrude.³¹ This field set used a kite to lift the aerial.

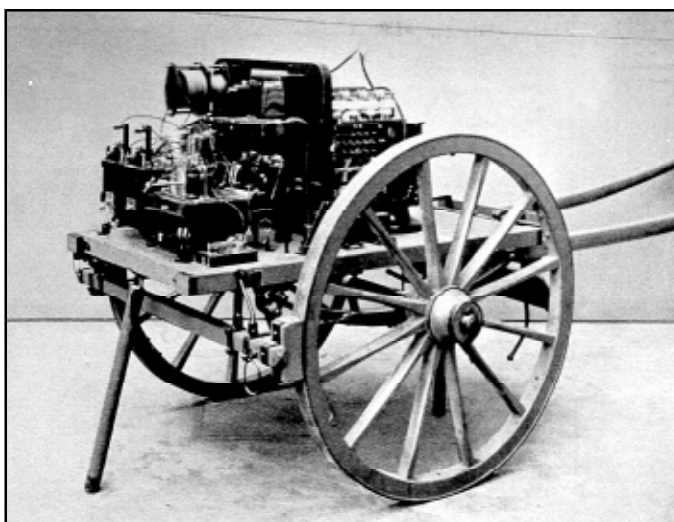


Figure 23. *Pack set with Slaby-Arco type key.*

Later Telefunken keys were bulky and solid, but otherwise similar to their Slaby-Arco predecessors. Telefunken manufactured complete ship stations and portable sets (Figure 22).³² Many of the pack sets retained the original Slaby-Arco tall handled key (Figure 23).³³

Beginning in 1901, Lee de Forest's Wireless Telegraph Company of America made spark equipment for the U.S. Navy.³⁴ Mack Horton, de Forest's assistant, designed some if not all the wireless keys.³⁵ The de Forest key on the U.S.S. Iowa is one of the earliest known examples of the "cross" design (Figure 24). The supporting frame of this form of key looks like a cross.

De Forest's company installed a large solenoid relay key at Guantanamo, Cuba in 1905 (Figure 25). This huge device was capable of keying the large 35-kW transmitter. One contact was brass, the other copper. Horton found that the combination lasted much longer than if both contacts were brass or copper. The upper contact was solid, but the lower had a cup shaped cavity. Oil was placed in the cavity. When the key was operated, the lower contact came up, carrying a small cupful of oil with it. The oil splashed over the contacts and lengthened greatly the life of the key. Without oil, the key contacts would not last 5 minutes. With oil, the contacts lasted 3 or 4 hours.

De Forest exhibited the "Wireless Auto No.1" in 1904 at the St. Louis Exposition (Figure 26). This was one of the world's first automobiles equipped with wireless.

De Forest's "cross" shape for the supporting structure of the key was adopted later by the United Wireless Company, successor to the early de Forest company. United Wireless was formed in 1906 and was a very prolific manufacturer of cross-shaped keys (Figures 27, 28, and 29) even though it did not survive long due to fraudulent stock offerings

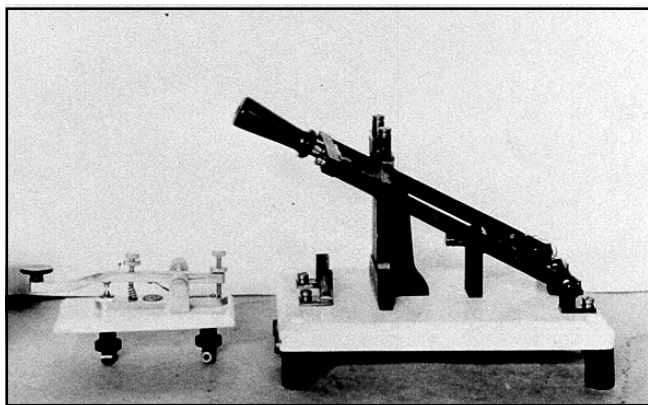


Figure 24. *Cross-shaped early de Forest key and antenna switch made for the U.S.S. Iowa made by the de Forest Co. United Wireless made this same type of key.*

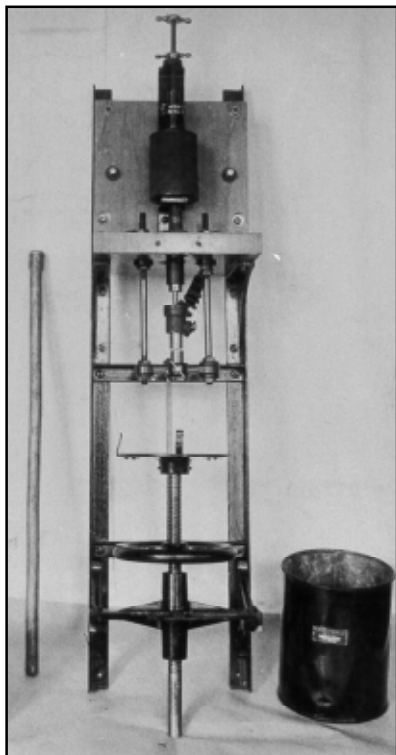


Figure 25. *Solenoid Relay Key, 35-kW from American de Forest Co. used at Guantanamo, Cuba, circa 1905. Designed by Mack Horton for the U.S. Navy.*

and the resultant legal entanglements. The cross-shaped United Wireless key can easily be recognized in a photograph of a “modern” wireless station (Figure 30).³⁶

United Wireless made at least two different kinds of relay keys (Figures 31 and 32). A relay key is a combination telegraph key and relay with large contacts. The coils of the relay can be used to close the heavy-duty spark contacts and these coils can be operated by small, light, fast hand telegraph keys. If the coils failed on the relay, the integrated hand key could still be used to complete the message. United Wireless also made a portable outfit that was

suitcase-sized and included a lightweight key. This company was based in New York and Seattle and was eventually succeeded by the Marconi Wireless Telegraph Company.

Walter Wentworth Massie made high quality spark equipment that was solidly built. Born in 1874, Massie studied mechanical engineering and became interested in wireless. The Massie Wireless Telegraph Company produced commercial equipment as well as equipment for the Navy and coastal vessels beginning about 1903.³⁷ In 1908 he co-authored a book in which three different Massie keys are illustrated.³⁸ The smallest of the three is a slate based key (Figure 33). This key is a



Figure 26. *De Forest Wireless Auto No. 1, as exhibited at the St. Louis Exposition, 1904.*

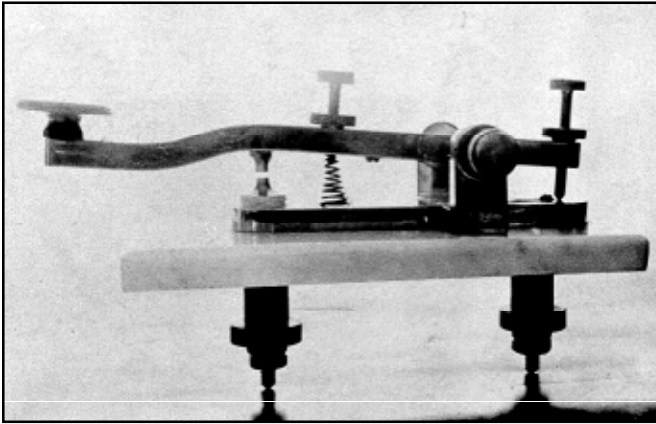


Figure 27. Hand sending key by United Wireless Telegraph Co., 1907. Cross-shaped leg key on marble base.

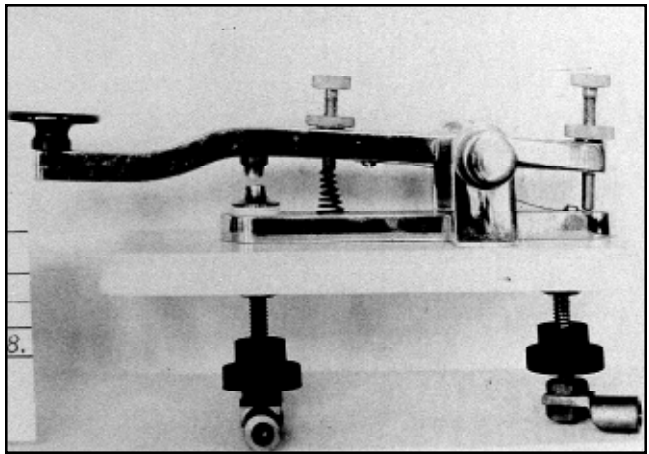


Figure 28. United Wireless Telegraph Co. leg key on marble base, 1908.

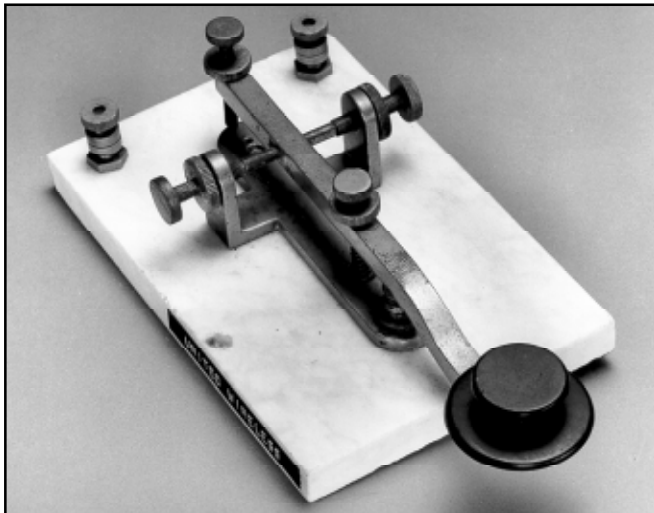


Figure 29. Detail of a cross-shaped key, possibly United Wireless. Many different companies produced this kind of key, making it difficult to reliably identify the manufacturer.



Figure 30. *“Modern” wireless station with United Wireless cross-shaped key in use. Notice early United Wireless antenna switch in foreground.*

bit of an enigma. It appears for sale in the Sears catalog of 1916, well after the Massie company had been absorbed by Marconi.³⁹ Perhaps Marconi was selling the remaining stock of Massie equipment.

Another key pictured in Massie’s book is a very large pump handle key operated by gripping the entire handle (Figure 34). This key weighed in at eighteen pounds! The base and main body of this key were made of hard rubber and the top parts were brass. The contacts were brass and $\frac{1}{2}$ ” in diameter. Due to the oxidizing qualities of brass, it was necessary to clean the contacts frequently. The operator stood at the side of the key to operate it, rather than sitting. Copies of this key have been made in the past few years. There are likely more reproductions in collections today than original keys. The label and other details of the reproductions are not exactly correct and it is possible to distinguish them from the original keys.

The third key pictured in Massie’s book is a key mounted on a wooden base with a 5-kW solenoid switch (Figure 35). The key itself

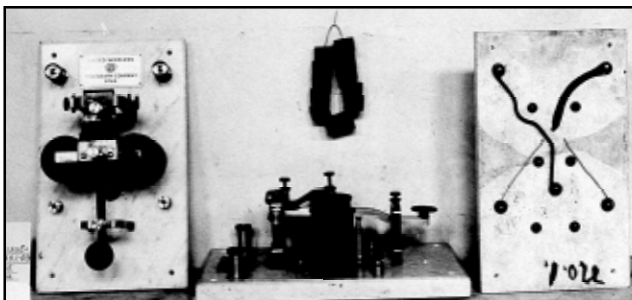


Figure 31. *United Wireless Telegraph Co., relay key for Puget Sound station, 1909.*

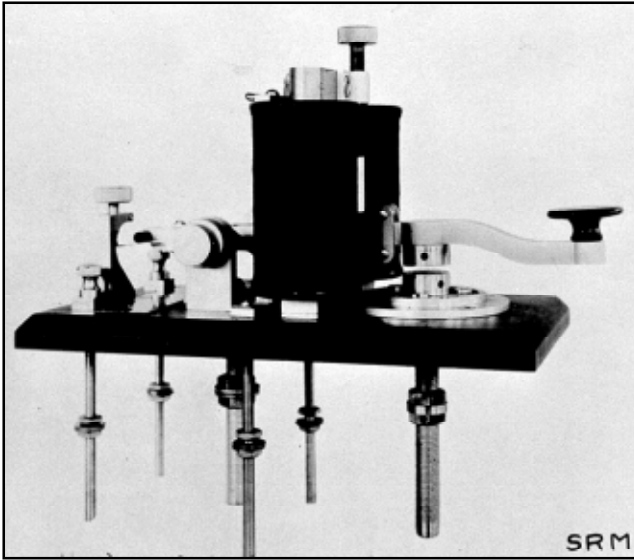


Figure 32.
*United Wireless
Telegraph Co.,
combined hand
and relay key,
1910.*

had relatively small contacts since the solenoid acted as a relay. This key and solenoid switch was made as early as 1906. A Continental Wireless Telephone and Telegraph Company catalog describes this key as an “oil brake [sic] transmitting key.”⁴⁰ It is therefore likely that the contacts operated by the solenoid were immersed in oil. Massie made pack sets and portable outfits that were equipped with the key and solenoid switch. The same key that operated with the solenoid switch was offered separately as a leg key for wireless use in 1906. (Figure 36) A leg key is a key with long legs that projected down through the operating table and to which the electrical connections were made.

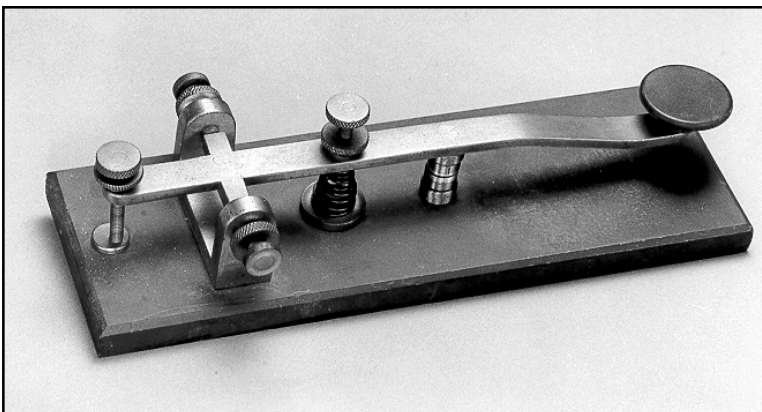


Figure 33. *Massie key on slate base with long slender lever,
ca. 1908.*

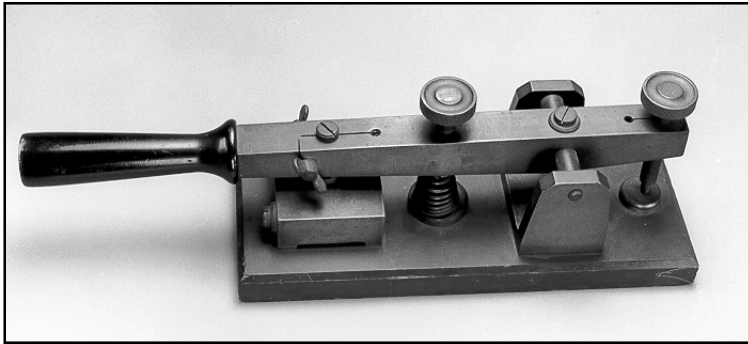


Figure 34. Large Massie pump-handle key operated by grasping the entire handle with the hand and standing next to the key.

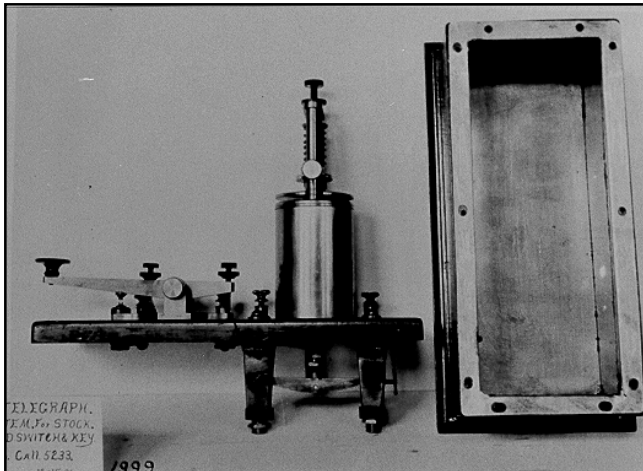


Figure 35. Massie System 5-kW Solenoid Switch and Key, ca. 1906.

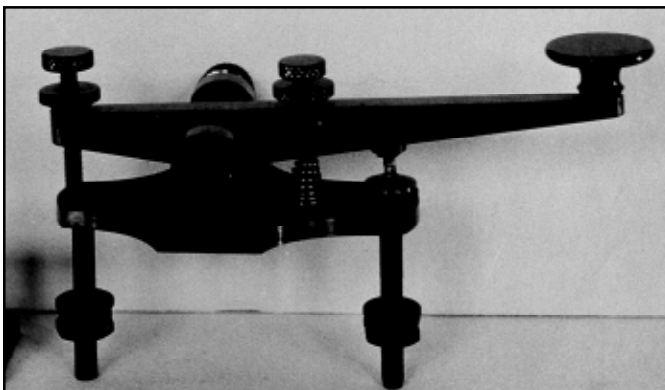


Figure 36. Massie System wireless telegraph key, ca. 1906.

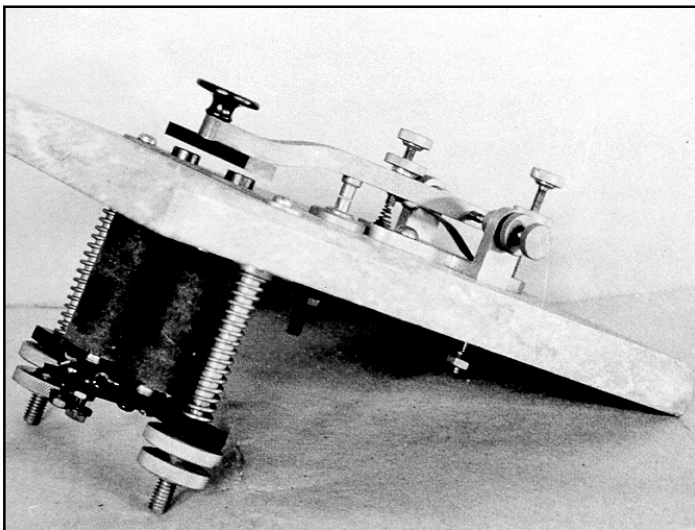


Figure 37. *Shoemaker System, 1906. High potential relay telegraph key for U.S.S. Connecticut.*

Another type of Massie key was a true oil break key. Oil break keys have a cup in which the contacts are immersed in oil. The intention was to prevent sparking which could have been disastrous in the flammable environments of early airplanes and submarines. The Massie oil break key was part of a table, with the both the oil chamber and the contacts located beneath the surface.⁴¹

Harry Shoemaker was an outstanding engineer who began his career with de Forest and later worked for the Consolidated Wireless Company. He developed a system of wireless telegraphy as early as 1901.⁴² The Shoemaker system used at least two kinds of keys.⁴³ One of these keys was an unusual relay key with a marble base (Figure 37 and 38). On top of the base was a relatively standard de Forest cross-shaped spark key. A metallic bar underneath the knob pulled the key closed when it was attracted to two contacts that protruded up through the marble base from solenoids mounted underneath.

Another version of this key had solenoids on the top and the bottom (Figure 39). The other Shoemaker system key was nothing more than a modified Greeley Victor key (Figures 40 and 41). Both keys were used on board the *U.S.S. Connecticut* in 1906.

Reginald Fessenden became widely known for his work with arc transmitters. But he and one of his companies, the National Electric Signaling Company, did make spark equipment as well. Fessenden made the 10-kW rotary spark gap system for the *U.S.S. Connecticut* in 1909. The spark keys used with the NESCO systems were sturdy but not large (Figure 42). The keys made for the Fessenden arc system can be difficult to distinguish from the spark keys.

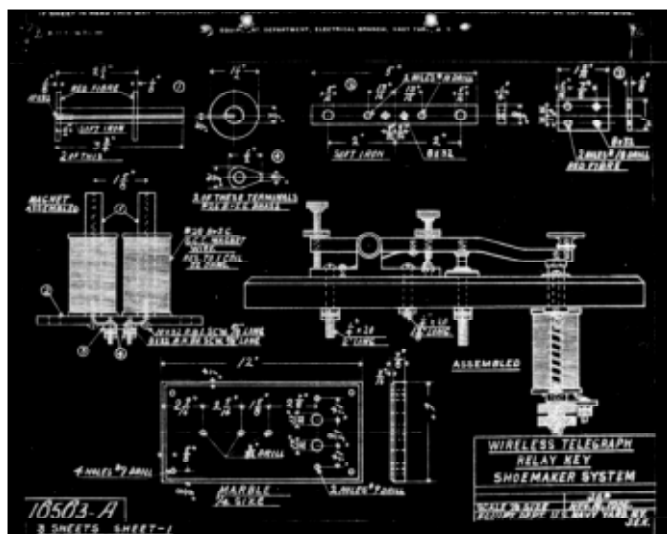


Figure 38. New York Navy Yard blueprint drawing for the Shoemaker System relay key, 1906.

Most of the early wireless companies owed their success to one or two gifted individuals. Marconi, Clark, Braun, de Forest, Massie, Shoemaker and Fessenden all were catalysts for the early development of wireless. John Stone Stone, a mathematician, inventor, and physicist, also belongs to this elite group.⁴⁴ Stone is known best for his contributions to tuning and loose coupling. The Stone Telegraph and Telephone Company was incorporated in Maine in 1902.

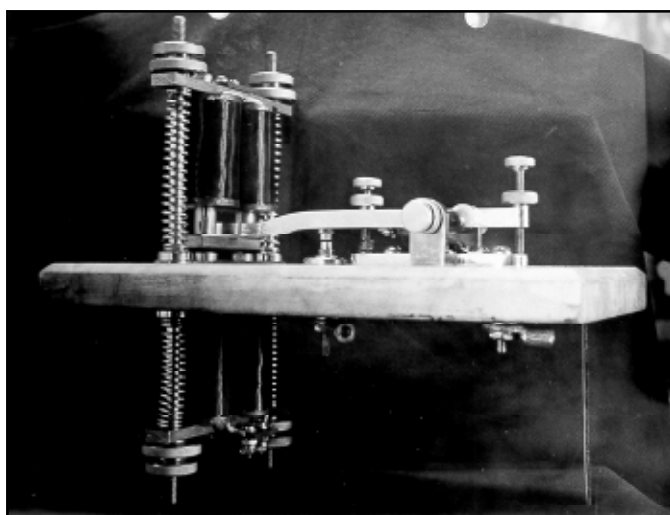


Figure 39. Shoemaker System, relay key with solenoids on top and bottom of base.

Figure 40.
*Shoemaker System,
Victor key modified
for wireless for
U.S.S. Connecticut,
1906.*

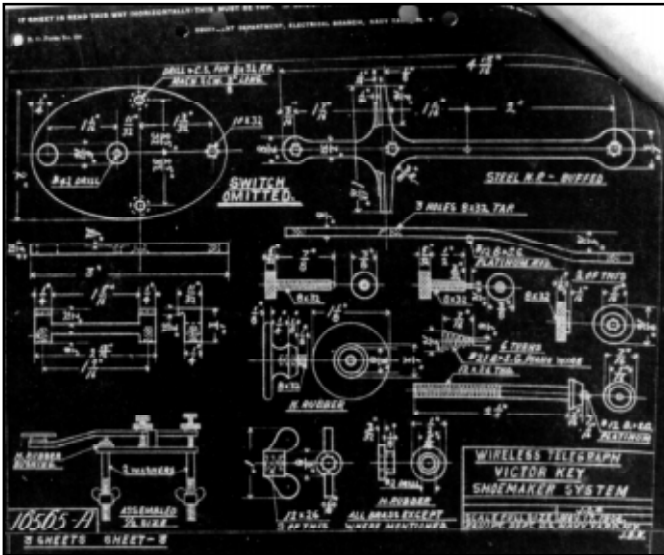
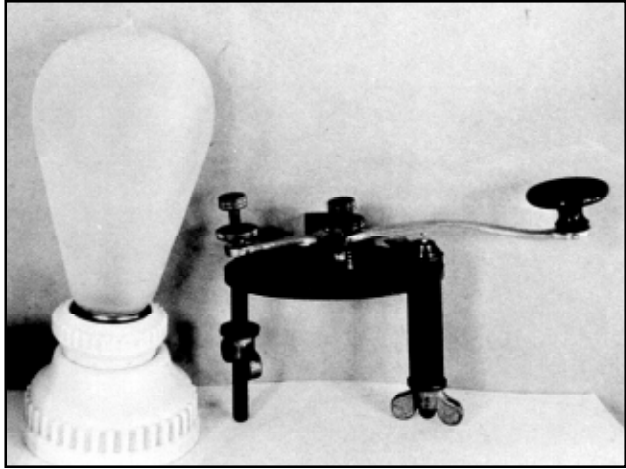
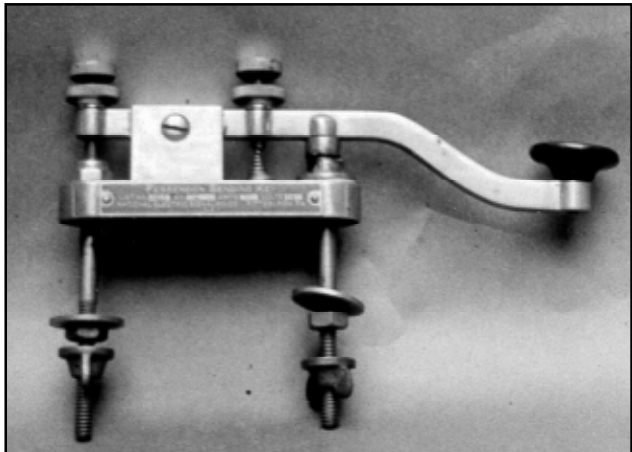


Figure 41.
*Shoemaker
System, blue-
prints for Victor
Key to be used
for wireless
telegraphy, 1906.*

Figure 42.
*Fessenden Sending
Key, National Electric
Signaling Co., for the
U.S.S. Florida. This
key was available in
2-kW and 5-kW
models.*



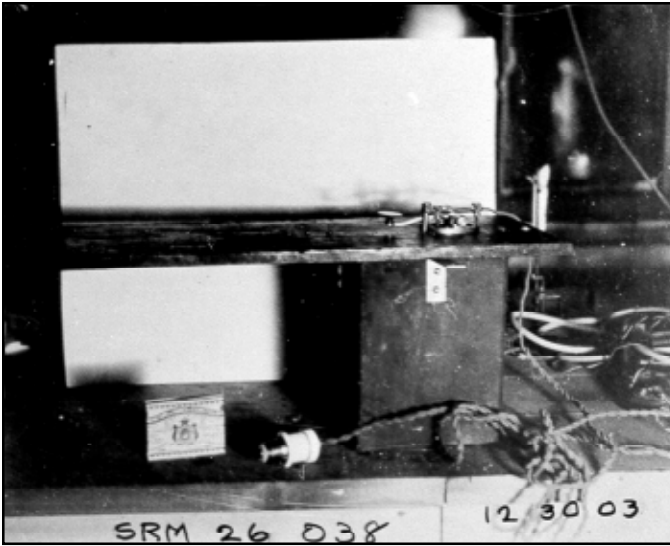


Figure 43.
Early oil break key, designed by G.H. Clark for the Stone Telegraph and Telephone Company, 1903. The contacts are within the square hard rubber jar underneath the key and wooden table.

Stone produced at least three types of spark keys. One of these was a very early oil break key designed by George H. Clark in 1903 (Figure 43). The contacts were immersed in oil contained in a hard rubber jar. Oil break keys would remain popular for some time, especially in Europe. One of the largest of the oil break keys, probably designed and made by an unknown French manufacturer, was used on the *S.S. Santa Marta* in 1915 (Figure 44). Clark also devised the first relay key for the Stone Company in the fall of 1902. For reasons known only to Clark, this key was called the “Automatic Cram.”⁴⁵

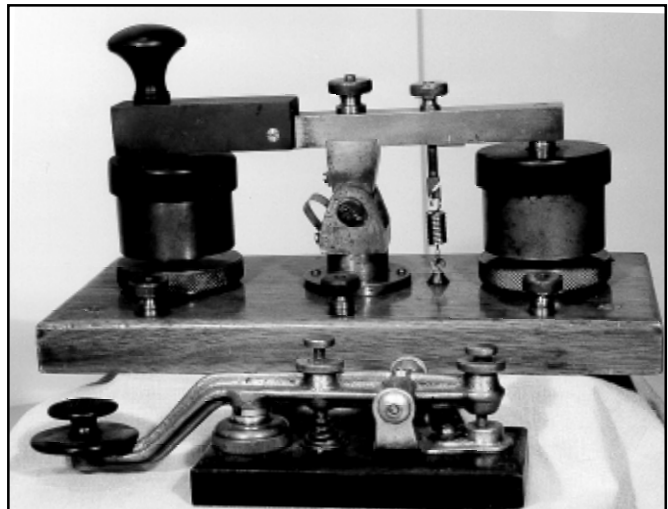


Figure 44.
Large oil break key used on the S.S. Santa Marta in 1915. Probably of French origin. Shown next to SE-68 for comparison.

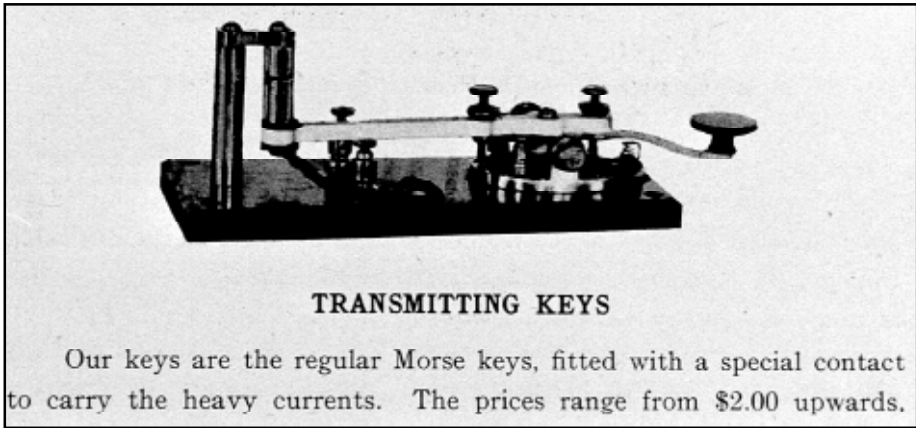


Figure 45. ACME Wireless Construction Company transmitting key, 1909. The catalog states "Our keys are the regular Morse keys, fitted with a special contact to carry the heavy currents."

The third type of key made by Stone was a very lightweight key on an oval base with $\frac{1}{2}$ " silver power contacts at the end of the key away from the knob. The key was manufactured with the minimum amount of metal consistent with carrying the required current. Stone installed this key at the Boston Navy Yard around 1905. Eventually other manufacturers also picked up this design. The ACME Wireless Construction Company of Cambridge, Massachusetts sold them for \$2.00 and up in 1909 (Figure 45).⁴⁶

In 1903 G.H. Clark made an automatic transmitter to control the sending key for the Stone Telegraph and Telephone Company (Figure 46). This device was used to send regular test signals. A clockwork

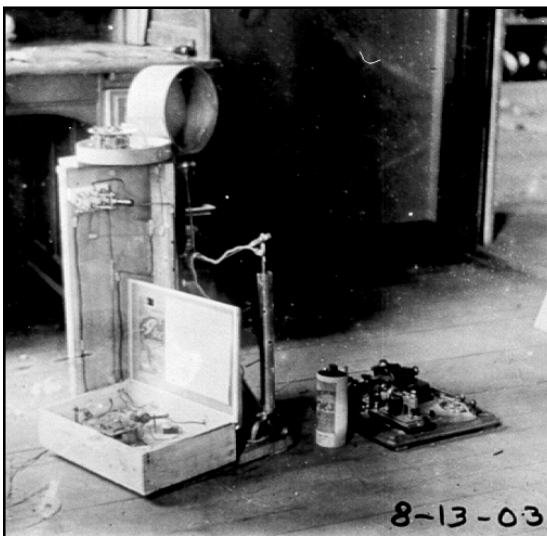


Figure 46. Automatic transmitter to control sending key. The key is in a brass case under water pressure. Built by G.H. Clark for Stone Telegraph and Telephone Co., 1903. The brass case with the key inside is the vertical tube in the center of the photograph.

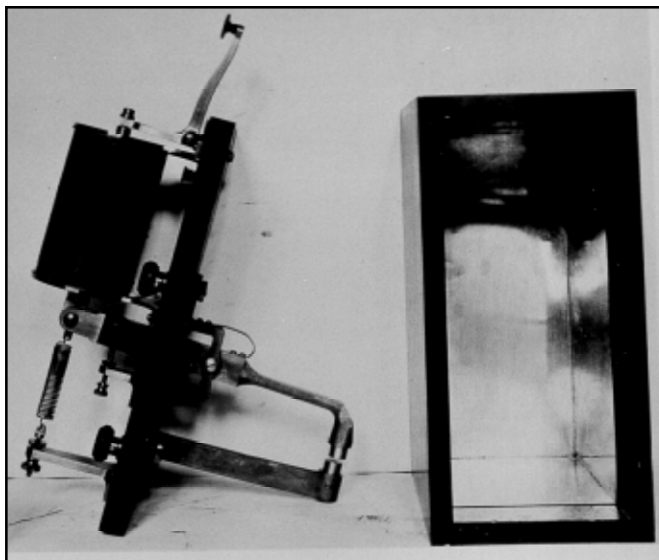


Figure 47.
*Wireless Telegraph
 Relay Key,
 Massachusetts
 Wireless Equipment
 Company, made for
 Sitka Alaska, 1908.*

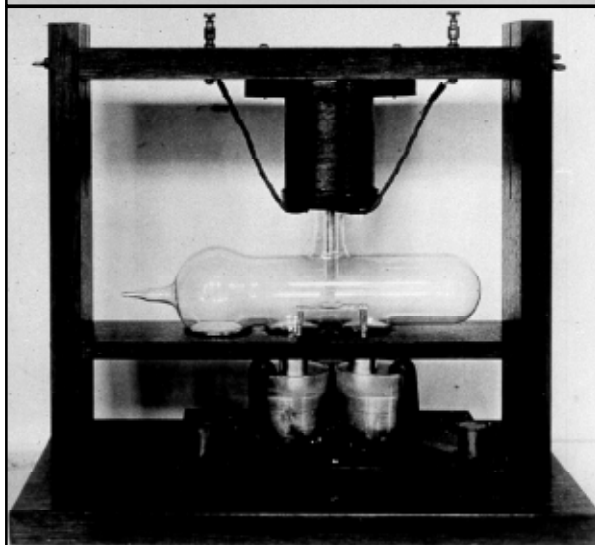


Figure 48. Above
*Massachusetts Wireless Equipment Co.,
 Mercury vacuum key for the wireless
 telegraph, for Sitka Alaska, 1908.*

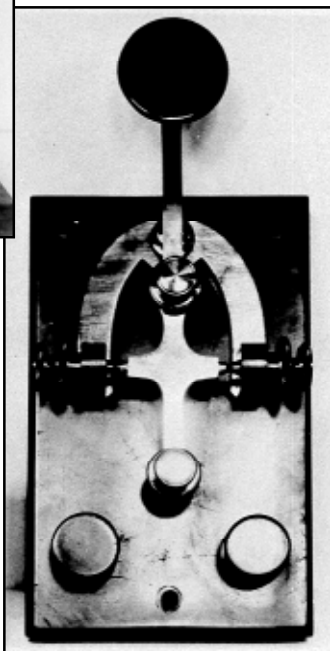


Figure 49. Right
*Wireless Telegraph Back Stroke Key,
 Massachusetts Wireless Equipment
 Co., for Sitka, Alaska, 1908.*

device controlled the mechanism. The key was in a brass case, under water pressure.

Very little has been written about the Massachusetts Wireless Equipment Company even though this company manufactured some unique telegraph keys. Keys made by this company were in use in Sitka, Alaska, in 1908. One was a large relay key, with a single coil mounted on top of a wooden box (Figure 47). The large power contacts were contained within the box. Another of these keys was called the Mercury Vacuum key (Figure 48). This was a very strange key that looked more like a piece of laboratory gear than a telegraph key. In an attempt to reduce sparking, the contacts were sealed in a glass chamber filled with mercury vapor. Ducretet in France had also experimented with keys using the Mercury Vacuum design. The most normal appearing key made by the Massachusetts Wireless Equipment Company was called the “Back Stroke” key. It resembled a standard oval brass landline key with half the oval base cut off and the remainder mounted on a slate base (Figure 49).⁴⁷

The Wireless Specialty Apparatus Company (WSA Co.) was formed by an alliance of some of the most colorful characters of early wireless. Greenleaf Whittier Pickard, who had already succeeded in improving early detector technology, joined in 1906 with a patent attorney named Philip Farnsworth. With the addition of Colonel John Firth in 1907, the WSA Co. was born. Firth was the marketing genius needed by the company to complement Pickard’s engineering ability and Farnsworth’s legal skills.

Pickard’s detector designs contributed significantly to the company’s early success. When the company began producing the IP76 crystal detector receiver, the Navy bought them in large quantities. Although the WSA Co. did not initially make transmitters because of patent difficulties, it did make spark keys. Hand key Type Q-S-5004 (Figure 50) was a very large spark key made by WSA Co. for use with transmitters up to

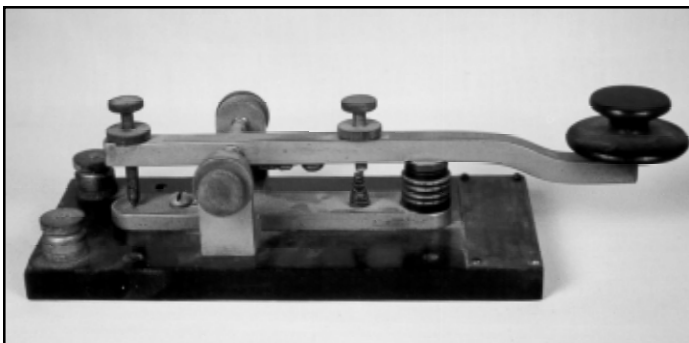


Figure 50. *Wireless Specialty Apparatus Company, Hand Key Type Q-S-5004. For use with transmitters up to 5-kW.*

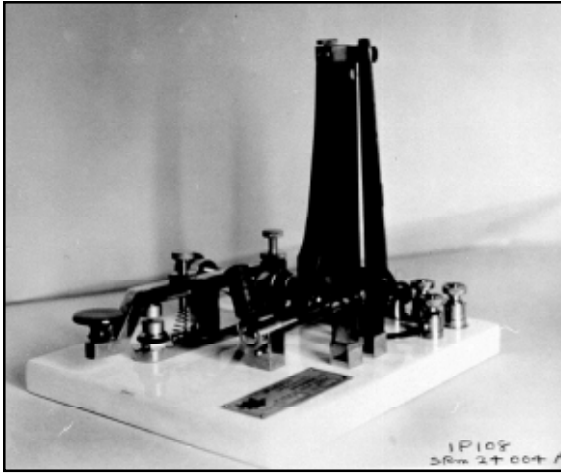


Figure 51.
*Wireless Specialty
 Apparatus Co., IP 108—
 combined key and
 antenna switch on a
 beautiful marble base.*

5-kW. It could handle up to 40 amperes without arcing. Some of these keys sported heat-radiating flanges on the contacts. The Q-S-5004, also known as the Type IP 109, was 9 inches long and weighed 1½ pounds.⁴⁸ This key was part of the QSF 2150 control panel, and was also part of the IP 108. The IP 108 was a beautiful combination unit on a marble base consisting of the large spark key and an antenna switch (Figure 51).

WSA Co. made a wide variety of spark keys. The Flame-Proof Type Q-S-505 was made for use in submarines and aircraft (Figure 52). The main parts of this key are contained within an enclosure to prevent explosions or fire.⁴⁹ The Q-S-505 was really a Navy design. It was designed by W. Chadbourne, the radio aide at the Boston Navy Yard. The Navy number for the Q-S-505 was SE-1443. The Boston Navy Yard was designated by the Bureau of Steam Engineering to conduct research and to design sending keys, because Chadbourne was a specialist on this form of apparatus. After World War I, WSA Co. appropriated the design of the SE-1443,

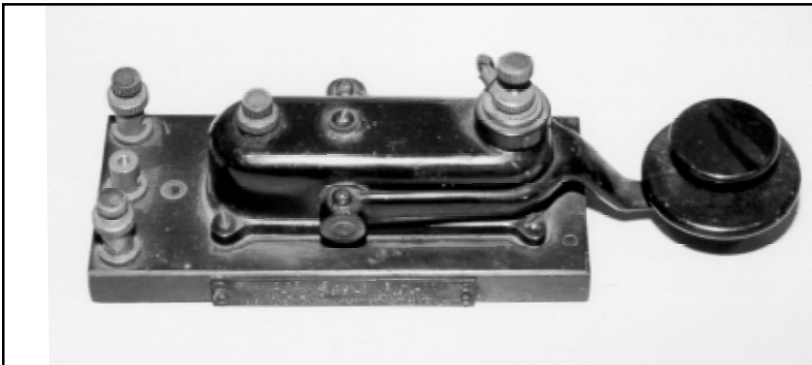


Figure 52. *Wireless Specialty Apparatus Co., Type Q-S-505 for
 use in submarines and aircraft. Rated for 10-amps at 300-volts.*

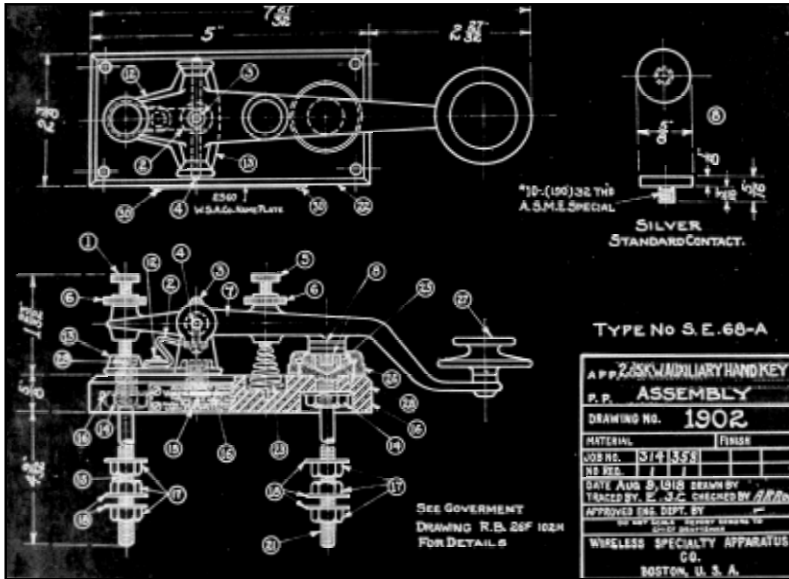


Figure 53. *Wireless Specialty Apparatus Co., drawing plans for SE-68A, 2- and 5-kW Auxiliary Hand Key. 1918.*

gave it a type number of their own, and offered it to the world, with no reference to its Navy origin.

WSA Co. was one of many companies to make the SE-68A (Figure 53) for the Navy. Other spark keys made by WSA Co. include the SE-653 (Figure 54), the Flame-Proof Type NS 1917, the CP-675, and the Q-S-504 (Figure 55). WSA Co. also produced several relay keys (Figures 56 and 57) including the Q-S-5003. This key, which was designed by W. Chadbourne, could handle up to 60 amperes while the operator maintained a safe distance.



Figure 54. *Wireless Specialty Apparatus Co., Type SE-653 for use with airplane sets. Rated at 4.5-amps at 150-volts.*

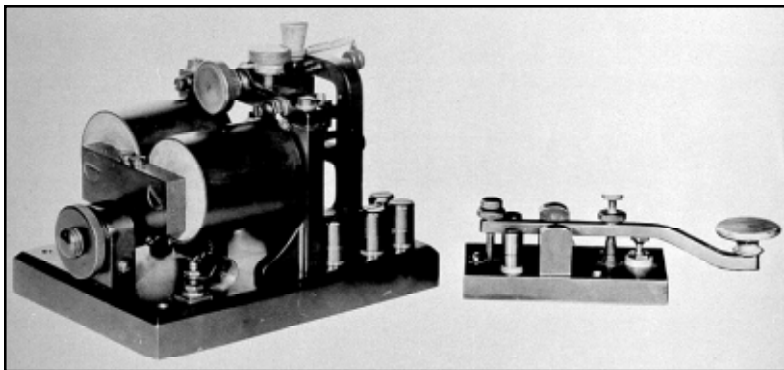


Figure 55. *Wireless Specialty Apparatus Co., Light Hand Key, Type Q-S-504. Rated up to 6-amps. Mounted on a heavy "bakelite dilecto" base. Shown with large WSA Co. relay key.*

WSA Co. is not known to have made an oil break key, but they did make a diaphragm key (Figure 58). This type of key moves the contacts underneath a hard rubber diaphragm, shielding the surroundings from the spark. The Washington Navy Yard also made a diaphragm key in 1914 (Figure 59).

Interestingly, WSA Co. manufactured a key nearly identical to the Clapp-Eastham Boston Key (Figure 60). The WSA Co. model is easy to differentiate from the Clapp-Eastham key by a large tag attached to the base in one corner, and contacts that were larger than those provided by Clapp-Eastham.

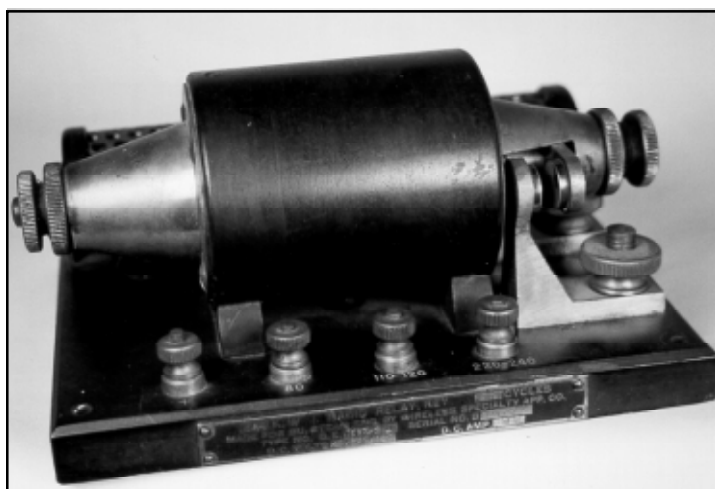


Figure 56. *Wireless Specialty Apparatus Co., SE-137. 2- and 5-kW relay key, style similar to Lowenstein design.*

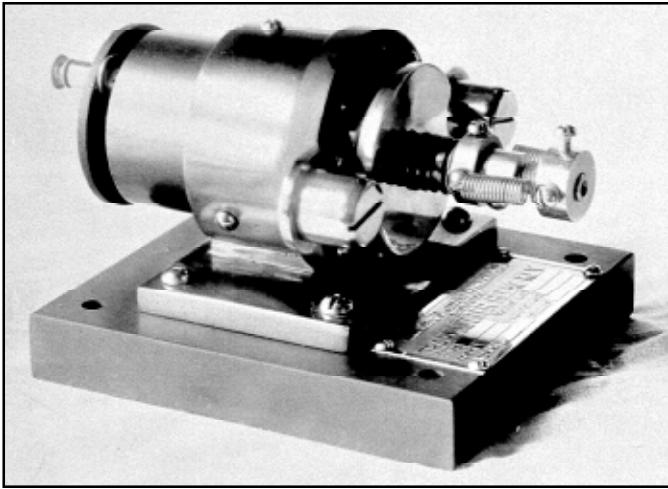


Figure 57.
*Wireless Specialty
Apparatus Co.,
5-kW relay key.
ca 1914.*

The main office of the Burlingame Telegraphing Typewriter Company, under Elmer Burlingame, was located in San Francisco, California.⁵⁰ The company began in 1906 as The United States Wireless Printing Telegraph Company before changing its name in 1908. Like Marconi, Burlingame preferred to lease his equipment. With the Burlingame device attached, messages were sent directly from an ordinary typewriter keyboard to steamships by wireless telegraphy (Figure 61). The mechanism is displayed prominently on the beautiful stock certificates sold by the company (Figure 62). The device used by this company was similar to a landline device called the Yetman typewriter. The advantage of the device was that the operator did not need to know Morse code. As the company brochure stated, “A boy or girl can send messages. No expert operator required.”⁵¹ Neither the Yetman typewriter nor the Burlingame device enjoyed widespread acceptance.

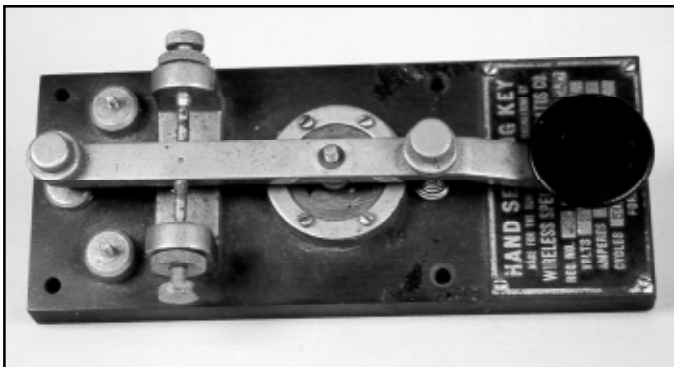


Figure 58. *Wireless Specialty Apparatus Co., diaphragm
type Hand Sending Key.*



Figure 59.
*Washington Navy Yard, Hand
 Sending Key and Spark Control,
 1914. The key is of the
 diaphragm type.*

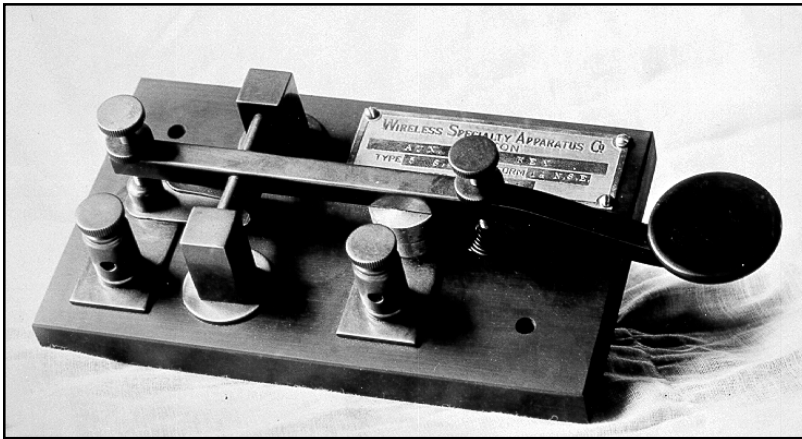


Figure 60. *Wireless Specialty Apparatus Co., Boston Pattern
 Key. Note the huge contacts and the label that was attached
 with small screws.*

Figure 61.
*Burlingame Telegraphing
 Typewriter Company,
 apparatus attached to an
 L.C. Smith Typewriter. ca
 1908.*





Figure 62. Picture from stock certificate of the United States Wireless Printing Telegraph Company, later the Burlingame Telegraphing Typewriter Company. Note the mechanism shown, with the tall antenna beaming directly to steamships.

No Burlingame Telegraphing Typewriters are known to have survived and it is doubtful that many were produced. There are no known descriptions of how the mechanism functioned.

Edward Corliss Kilbourne founded Kilbourne & Clark around 1901. Kilbourne was a Seattle dentist who lived to be over 100 years old. He was a business genius who made his fortune in real estate. He also obtained Seattle's electric power franchise in 1889 after a fire destroyed portions of the city.⁵² Walter G. Clark was Vice President and Manager

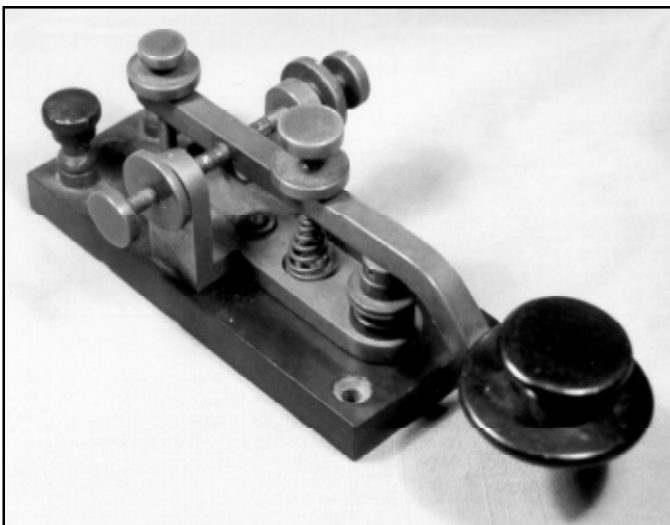


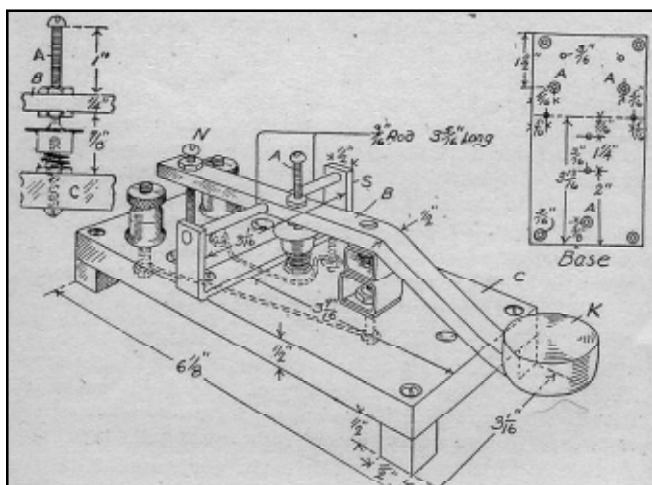
Figure 63. Kilbourne & Clark, cross-shaped key, no model number. This basic design was the same as de Forest and United Wireless.



Figure 64. A.C. Gilbert Company, the Gilbert Wireless Telegraph Outfit. ca 1917.

of the company.⁵³ No model numbers accompany many of the spark keys made by Kilbourne & Clark (Figure 63). The company did make versions of the SE-68 and the SE-1865 for the Navy. The company also made marine spark transmitters, receivers, detectors, junior radio sets, and kits. In 1920, Kilbourne & Clark was able to fend off a lawsuit brought by the Marconi Company alleging infringement on the Marconi patent of 1900. The company went out of business in 1926 or 1927. The Kilbourne & Clark factory still stood in 1978, but had been turned into a restaurant.⁵⁴

Wireless experienced a remarkable boom in growth between 1900



and 1915. In 1900, the U.S. Navy was testing wireless equipment. In 1907, the Navy declared in the annual report that “Wireless is now considered an essential part of the equipment of every naval vessel.”⁵⁵

The public also contributed to the growth of wireless. Many amateur experimenters produced spark sets at home. As early as 1898, articles were written encouraging the rise of a corps of amateur wireless experimenters.⁵⁶ Before the World War, A.C. Gilbert made a functional toy wireless set in a box for youngsters (Figure 64). The very low power buzzer transmitter was operated by a strap key.

Designs for homebrew transmitters and receivers were easy to find, as were plans for building spark keys. Plans described crude strap keys as well as more sophisticated keys that resembled those made commercially (Figure 65). It was probably recognized fairly early that a spark key could be fashioned by modifying a landline Morse key. All that was needed was to add a current strap or heavy piece of wire and a set of larger contacts (Figure 66). This is the so-called “Dime Key” that many amateurs used. Keys made by J.H. Bunnell and the Manhattan Electric Supply Company were commonly modified in this way and this probably led to the manufacture of keys by these companies specifically for spark.



Figure 66. J.H. Bunnell key modified for heavier current capacity by adding large contacts. This key was used by station 2BY in Schenectady, NY, operating with 990-Watts on spark in 1922.

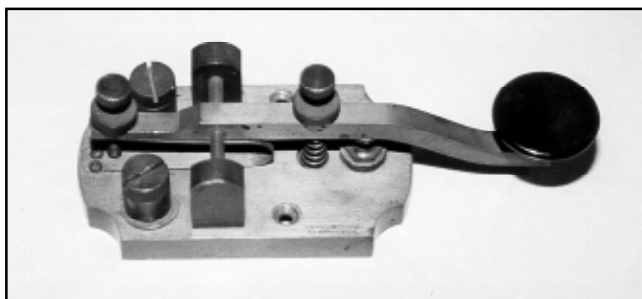


Figure 67. Bunnell spark keys were generally small, for low power sets. Brass key on base with cutout corners; notice current carrying strap. This style was manufactured as early as 1912.

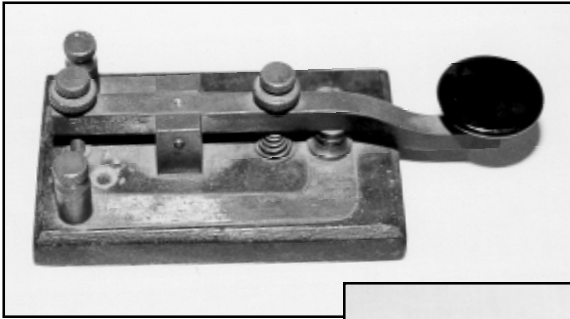
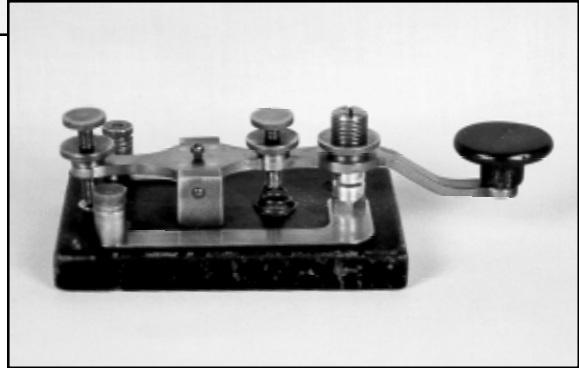


Figure 68.
*Marconi Roadmap key,
Aldene, N.J. about 1912.*

Figure 69.
*Different variation of
the Marconi Roadmap key.
Notice the different style
lever. The attachment
above the upper contact
is also seen in early
photographs of the
Roadmap key.*



The Bunnell (Figure 67) and MESCO keys were small and sometimes difficult to tell from their landline counterparts without looking carefully for the current strap, larger contacts, and other modifications. In the 1950s, Bunnell made a key with the current strap but on a plastic base that was similar to the Bunnell wireless key of 1912. This version was intended for use on landline Morse circuits.

With the boom in radio and the growth of the amateur market some companies began marketing spark keys specifically aimed toward the amateur experimenter. The Marconi Roadmap key (Figures 68 and 69) was produced in at least two variations. It was one of the first keys made at the Aldene, New Jersey factory in 1912 and was intended for both amateur and military use.⁵⁷ The Roadmap key, so named because of the unique flat-metal wiring on top of the base, was depicted in the company's initial 1912 catalog. Although Marconi keys certainly are engineering works of art, not all were aesthetically pleasing. The Marconi Roadmap key, though very sturdy and compact, was quite plain in appearance (Figure 70).

The Electro Importing Company, established in 1904 in New York and known by most as EICo, was another company that catered to the amateur experimenter.⁵⁸ EICo claimed that 90% of their customers were experimenters. Hugo Gernsback was the president of EICo and editor of "The Electrical Experimenter." He fought against restrictive laws that would have limited experimenters. The company bragged, "The first wireless outfit in America was made and sold by us." The "Telimco," a contraction of The Electro Importing Company, was offered in 1905 and

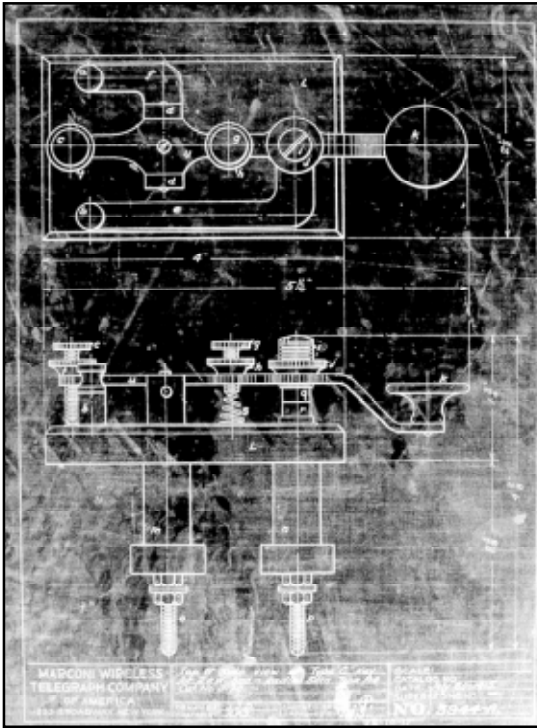


Figure 70.

Marconi Wireless Telegraph Co. of America, drawing for the Roadmap key. This version was called the "Type C" key, and was made for 2-kW radio sets in 1915.

Marconi's price to the Signal Corps for this key in 1917 was \$4.41.

may have been the first complete wireless outfit offered for sale to the general public. The Telimco had a guaranteed range of one mile and was supplied with a strap key.⁵⁹

The "Electro" Wireless Key (Figure 71) was illustrated in the 1914 EICo

catalog. The "Electro" was rated at 30 amperes and sold for \$1.75. The key was made with an "opal glass base" and had 3/8" contacts that the catalog stated "can be changed in less than two minutes." EICo also sold a heavy black strap key (Figure 72). They sold virtually anything that the experimenter might need related to wireless.

The William B. Duck Company of Toledo, Ohio also targeted the



Figure 71. *Electro Importing Company, New York. The EICo Electro, on an unusual glass base.*

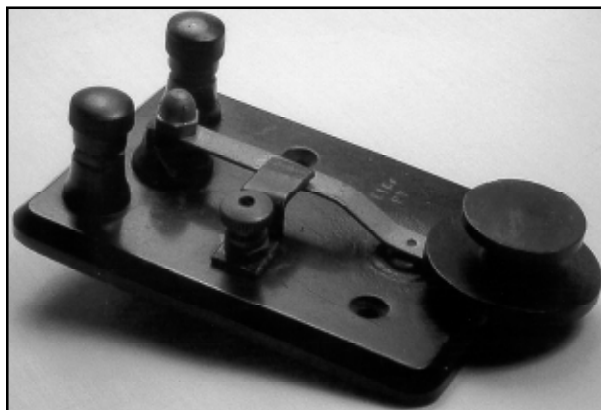


Figure 72. *EICo, New York. Heavy black strap key.*

amateur experimenter. The Overland Wireless Key was a cross-shaped key on a marble base (Figure 73). It was furnished with one of three contact sizes: 5, 10, or 20 amperes. The base was marked with the current rating of the contacts. The Overland Wireless key sold for \$4.75 to \$6.75 depending on the contact size. The William B. Duck Company produced catalogs nearly every year from 1909 to 1920. The early catalogs also carried the name “J.J. Duck.” This company advertised heavily in *QST*, the magazine of the American Radio Relay League. The William B. Duck Company survived the war years to continue supplying the experimenter in the 1920s.⁶⁰

The William J. Murdock Company of Chelsea, Massachusetts was founded in 1896 and continued making radio equipment until about 1980. Murdock made a medium-sized spark key with a marble base (Figure 74). The marble base was available in a selection of colors. It was covered underneath by a hard rubber pad with a lip to hold the marble steady. This key sold for \$8.00.⁶¹ A small key identical to landline telegraph

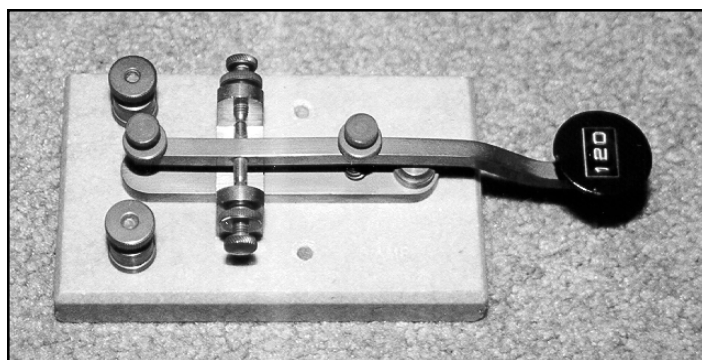


Figure 73. Wm. B. Duck Overland Wireless Key. This key was rated at 5-amps, but also was available with 10- and 20-amp ratings.



Figure 74. *Wm. J. Murdock 2-kW key on marble base with heavy nickel-plated lever. The price was \$8.00 in 1910.*

keys was also offered for use with small wireless sets for \$1.75.⁶² Both these two keys were available by catalog from Murdock in 1910. Later catalogs also list transmitting key No. 285 (Figure 75), a strap key for use with practice buzzer sets or low-power induction coil transmitting sets.⁶³ The strap key was inexpensive at 70 cents each, and available as early as 1914.

The Clapp-Eastham Company of Cambridge, Massachusetts advertised in “The Electrical Experimenter.”⁶⁴ Though perhaps best known today for its wonderful wireless receivers and transmitters (Figure 76), Clapp-Eastham also made one of the most aesthetically pleasing and sought after of the spark keys marketed to the wireless amateur. Advertised in 1916, the “Boston Key” sold for \$6.50 and was supplied on a marble (Figure 77) or Bakelite (Figure 78) base with silver contacts and nickel-plated brass parts. The Boston Keys

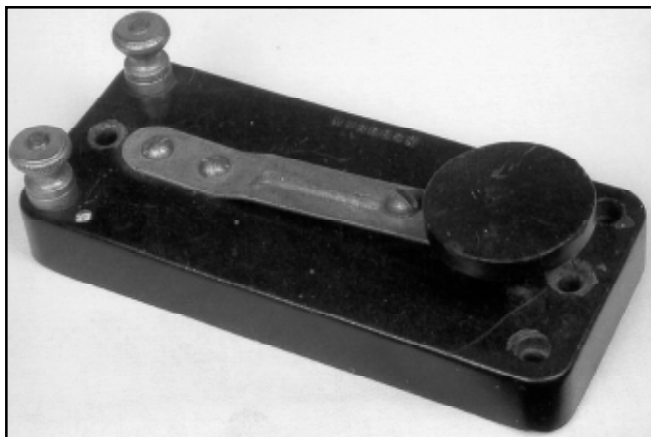


Figure 75. *Wm. J. Murdock transmitting key No. 285, an inexpensive strap key for low power sets.*

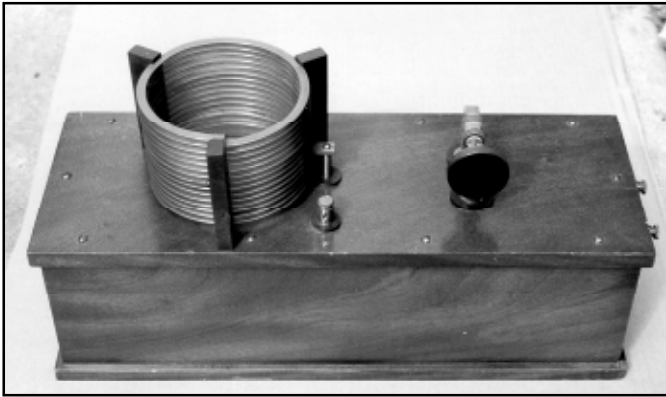


Figure 76. *Clapp-Eastham, straight spark gap transmitter.*

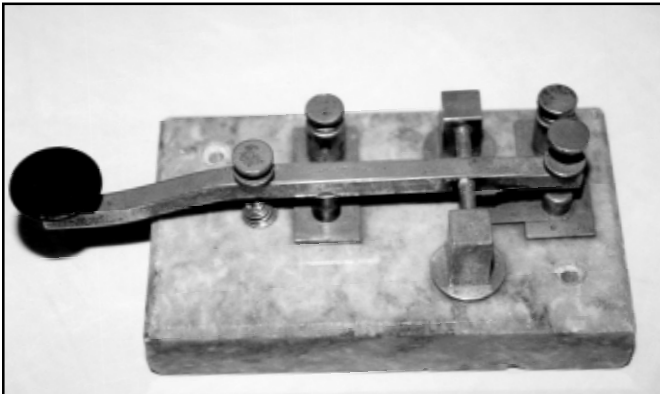


Figure 77. *Clapp-Eastham Boston Key on marble base, ca 1916.*

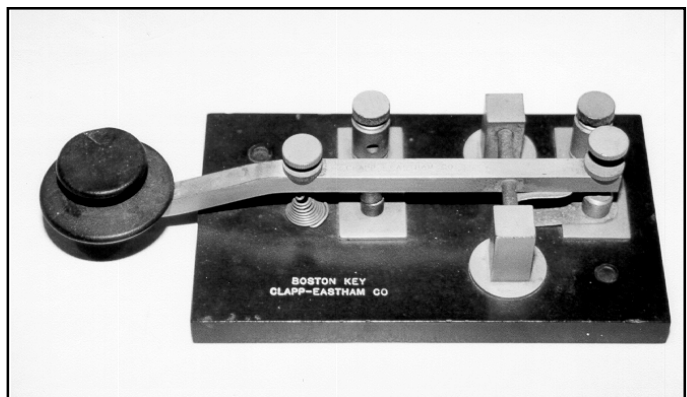


Figure 78. *Clapp-Eastham Boston Key on Bakelite base, ca 1916.*

made by Clapp-Eastham were marked on the lever arm with the name of the company in small lettering. Many keys identical to the Boston Key but missing the lettering on the lever arm are in collections today. At least two other companies made “Boston Pattern” keys, virtually identical to the Clapp-Eastham product. Central Scientific Company made a Boston Pattern key in 1917.⁶⁵ Its key was not marked. The Boston Key made by Wireless Specialty Apparatus Company carried a large identifying label. One company, the Radio Engineering Company (RECO) of Baltimore, made a slightly different key that was nonetheless similar to the Boston Pattern key (Figure 79).

In 1910 Joseph and Shuler Doron of Hamilton, Ohio pioneered a radio apparatus business that sold tuners, crystal detectors, wireless telegraph and telephone equipment, oscillation transformers and spark gaps.⁶⁶ They made a spark key with an oval frame and a thick lever arm, mounted on a marble base (Figure 80). The company operated the wireless station

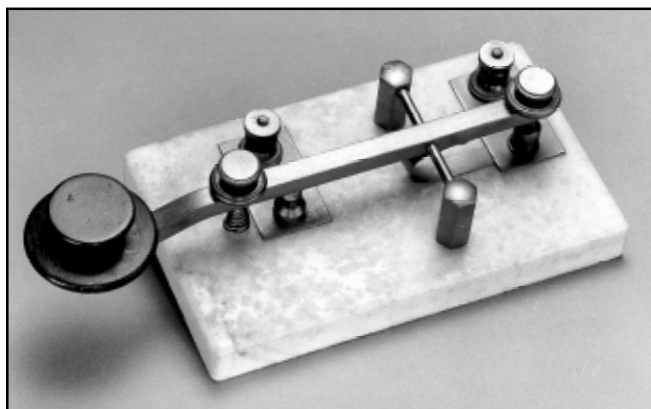
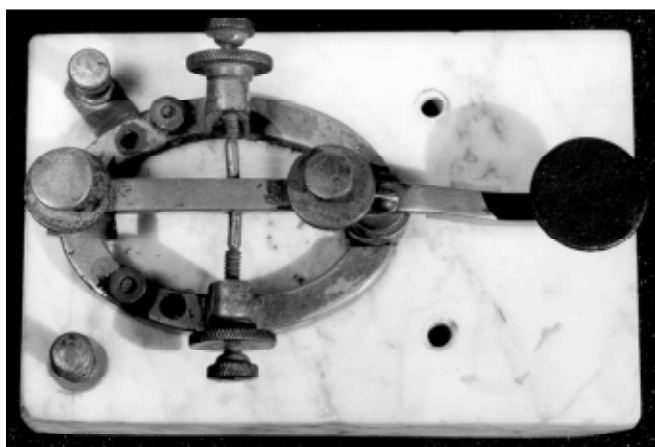


Figure 79.
Radio Engineering Company, Baltimore, MD. The RECO key was very similar to the Boston Pattern keys.

Figure 80.
Doron Brothers of Hamilton, Ohio. Spark key on marble base, ca 1910. Notice the tab from the oval brass base to the contact post and the accommodation made for the large contacts.



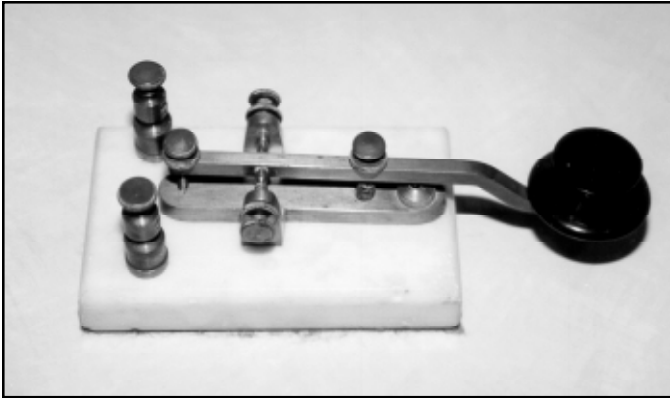


Figure 81.
*The Electro-Set
Special Wireless
Key, by the
Electro-Set
Company of
Cleveland, Ohio,
ca 1916.*

8ZU with a 5-kW spark transmitter, and also experimented with a Poulsen-type arc transmitter. Nine different complete wireless outfits were sold for \$350 to \$3,500. In 1916, the Doron Brothers started a mail order business of wireless parts and sets under the name “Dependable.” During the 1920’s they also marketed a vacuum tube receiver called the “Equidyne.”⁶⁷ The Doron Brothers Electric Company came to an end in the 1930’s because of competition, legal problems with patent rights, and the Great Depression.

The Electro-Set Company of Cleveland, Ohio made the “Electro-Set Special” wireless key (Figure 81).⁶⁸ The Electro-Set Special sold for \$3.00 and boasted a “genuine marble base.” It was rated at 1-kW and was six inches in length. The Electro-Set Company made a children’s toy practice Morse set around 1915.⁶⁹ This was nothing more than an

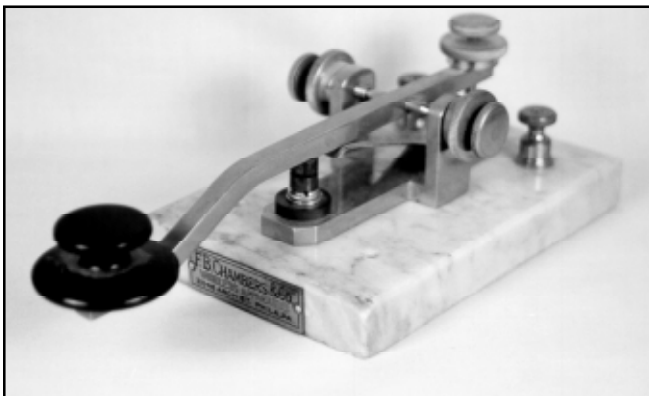


Figure 82. *F.B. Chambers of Philadelphia, 1913. Spark key on marble base. Notice the intricate label and the leaf spring. Chambers claimed that the use of the leaf rather than a coil spring made the key handle easier.*

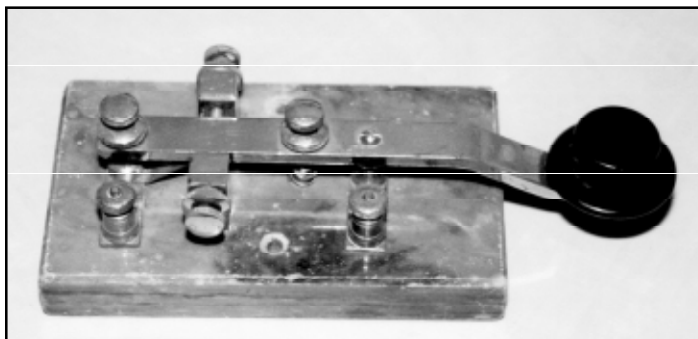


Figure 83. *A.W. Bowman key. This key was advertised by Sears & Roebuck Co. as the “Meteor Key.” It was also sold by Montgomery Ward Co. The Meteor Key was sold before and after the war.*

electromagnet and a strap key on a small wooden base. Electro-Set also manufactured condensers, detectors, spark coils, loose couplers, and storage batteries.

The number of companies offering wireless keys exploded in the years immediately preceding World War I. The “Etheric” key and a strap key were made by the Etheric Wireless Manufacturing Company of New York in 1911.⁷⁰ The International Wireless Signal Company of New Jersey made the “Inwesco Universal Sending Key” in 1912.⁷¹ It had a long 7-inch lever on a marble base and sold for \$6.50. F.B. Chambers manufactured a lovely key on a marble base in Philadelphia in 1913 (Figure 82).⁷² The Sears and Roebuck Company advertised both the Meteor Key on a thick marble base (Figure 83) that was probably made by A.W. Bowman, and a small brass spark key made by Signal Electric before the war.⁷³ The Nichols Electric Company of New York advertised the “Nichols Low Price Wireless Key” on a solid mahogany base for 70 cents in 1914.⁷⁴ In London, A.W. Gamage Ltd. sold the Type 1914 wireless key.⁷⁵ The Adams-Morgan Company of Upper Montclair, New Jersey, made the AMCO Junior Wireless Key and the AMCO “Simplex” Wireless Key⁷⁶ that was similar to a smaller key made by A.W. Bowman. Many other smaller companies also joined in the business of selling keys and wireless equipment to amateur experimenters.

In 1914, the Wireless Improvement Company made a 5-kW Relay Key that the Navy tested against similar keys made by the Wireless Specialty Apparatus Company and the Lowenstein Radio Company. In the Navy tests, all three keys performed well at 120 amperes with the sending speed of 20 words per minute. At 200 amperes, the Lowenstein relay key stuck after a few seconds of testing. The Wireless Improvement key survived for five minutes and then stuck. The WSA Co. key was still operating at twenty minutes when the test was discontinued!⁷⁷

During the boom years for wireless radio, 1900-1915, other forms of technology were also being developed. These included the dirigible, the airplane, the automobile, and more practical and deadly improvements in submarine warfare. Each of these incorporated wireless radio in their development.

The U.S. Navy had used wireless radio in airplanes by 1912.⁷⁸ It was generally expected that communication with airplanes would radically alter the conduct of war, but realization of this potential did not come quickly. There were several problems that had to be solved. First, the weight of the wireless installation was significant compared to the payload capacity of the aircraft. The wireless system had to be made as light as possible, but still had to be capable of operating at the required distance from the receiving station. Airplanes were usually loaded to near capacity with just the pilot, an observer and the fuel supply.

Another problem was that the noise and vibration of the aircraft could make it impossible for the pilot and the observer to hear their own wireless transmissions. An electric lamp was added with the airmen copying the code by sight rather than by sound.

Yet another problem was the question of how to deploy an aerial. Initially, trailing wires of 300-700 feet, which were reeled out after takeoff and reeled in before landing, provided the most satisfactory design. Incorporation of the aerial into the wing of the aircraft was another strategy.⁷⁹ Power for airplane spark rigs usually came from either the propeller shaft or a separate wing-mounted propeller-driven generator.

If it took ingenuity to fit an airplane with a wireless outfit in 1912, it was truly formidable to operate spark rigs in dirigibles. The British were experimenting with wireless in both captive and free-flying balloons by 1908.⁸⁰ British “Blimps” would be heavily involved in submarine spotting during World War I. At least one photograph exists of the telegraph key used in the British “War Balloons” in 1915. It shows a very simple key with a low power set.⁸¹

By the time the United States was placing radios in airplanes, Germany was long past the experimental radio stage with dirigibles. A spark transmitter could be considered the most dangerous piece of equipment carried by a dirigible. The rigidity of Count Zeppelin’s airships was provided by an aluminum frame, which conducted electricity very well. When charged by friction with the surrounding air the frame could arc to ground structures and explode the envelope even without an internal source of a spark. At least one Zeppelin exploded after arcing in this way. By 1915 it was noted that “the danger of operating the wireless is obvious, and it is generally believed in technical circles that the majority of the Zeppelin disasters from fire have been directly attributable to this [wireless].”⁸² Essentially a Zeppelin was an airborne piece of metal filled with flammable



Figure 84. *Ducretet and Roger of Paris, France. Oil break key made for aircraft use.*

hydrogen, carrying 800-1500 gallons of gasoline, and operating spark telegraphy. The Zeppelin was a bomb, carrying its own detonator, which was continually at risk of exploding.

Another consideration was that airborne wireless rigs were of limited range and could easily be tracked by ground stations making the aircraft vulnerable to attack. In addition, radio signals could be read by friend and foe alike, and could be jammed quite easily.

Despite all of these problems, wireless slowly took hold in aircraft. Slaby-Arco and Telefunken probably made the German Zeppelin keys. Ducretet and Roger of Paris manufactured a brass key on a wooden base in 1914 made specifically for aircraft use (Figure 84).⁸³ This was an oil break key, to reduce the risk of sparking in the explosive airplane environment. The lever arm was brass with large diameter holes in it. The holes are conjectured to have lightened the key for aircraft use,⁸⁴ but could also have been a response to a shortage of brass during wartime.

Eugene Ducretet did in France what few were able to accomplish in the U.S. He was very successful as both an early manufacturer of landline telegraph instruments and a manufacturer of wireless equipment later. The elder Ducretet had been experimenting with wireless instruments before 1899, and after his death in 1915 he left the business to his son Fernand and his business partner Ernst Roger.

In the United States, a number of manufacturers produced wireless equipment for use in the air. The Sperry Gyroscope Company made a relay key for use with a ½-kW airplane set with trailing wire.⁸⁵ This company was established in 1916 in New York, and still exists today as Sperry Marine. When America entered World War I, L.S. Brach made a combination set called the J-7 consisting of a covered key and electric

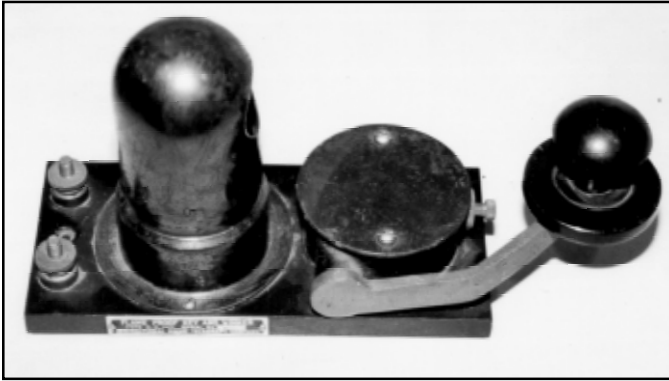


Figure 85. *The International Radio and Telegraph Company made the C.Q. 1140, for use in aircraft. The blinker light was intended to allow the airmen to copy transmissions over the noise of the wind and airplane.*

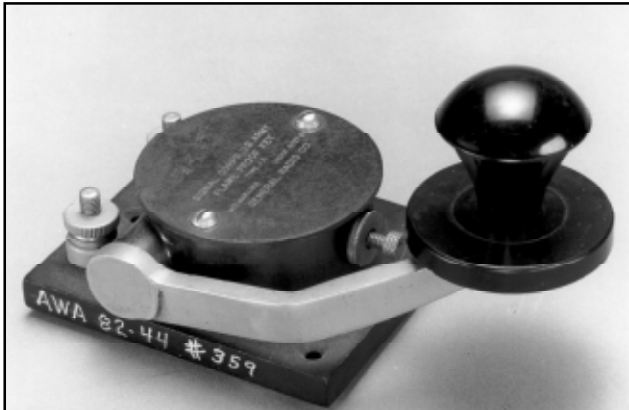


Figure 86. *General Radio Co., 1918. Flame Key Type J-5, made for use in aircraft. Also made by L.S. Brach*

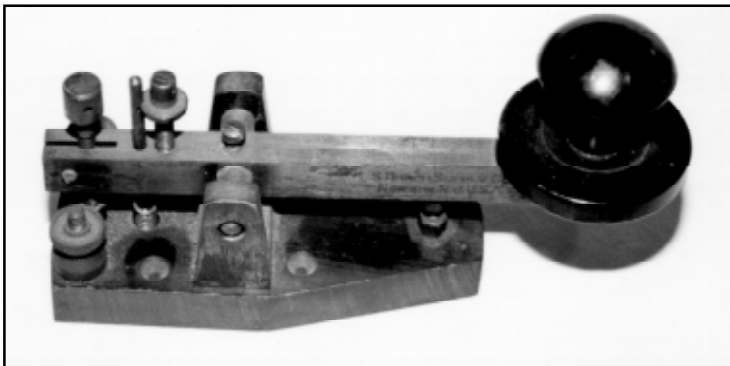


Figure 87. *L.S. Brach J-6 ca 1918. Note the unusual shape to the base. For use in aircraft.*



Figure 88.

The BC-15A aircraft transmitter made by Connecticut Tel. and Elec. Co.

light winker on a single base for aircraft use. The International Radio and Telegraph Company made a unit almost identical to the J-7, called the C.Q. 1140 (Figure 85). The J-5 and J-6 (Figures 86 and 87) were also made for use with the BC-15 airborne spark transmitter (Figure 88).⁸⁶ The J-5 was made by L.S. Brach,

Connecticut Tel. and Electric Co., General Radio, and probably others. General Radio, formed in 1915 after Melville Eastham left Clapp-Eastham, made the Type No. 151 key (Figure 89), which was similar to the J-5. General Radio also made the heavy 1-kW relay key called the Type CAG 457 (Figure 90). The CAG 457 was not for airborne use, but was part of the SE-1075 1-kW Panel type transmitter made in 1918 by the International Radio Telegraph Co. of Pittsburgh, PA.⁸⁷

The S.G. Brown Company was organized in London, England, in 1915 and began making a key for use in aircraft (Figure 91). This key has a cover with a mica viewing port. Under the viewing port is a small auxiliary spark gap that was probably supposed to prevent the received signal from reaching an inductance in the circuit. Some of these Brown

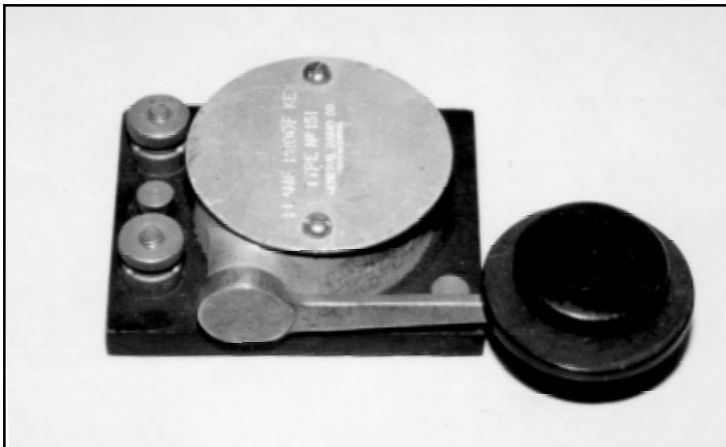


Figure 89. *General Radio Type No. 151 key, ca 1918. For use in aircraft.*

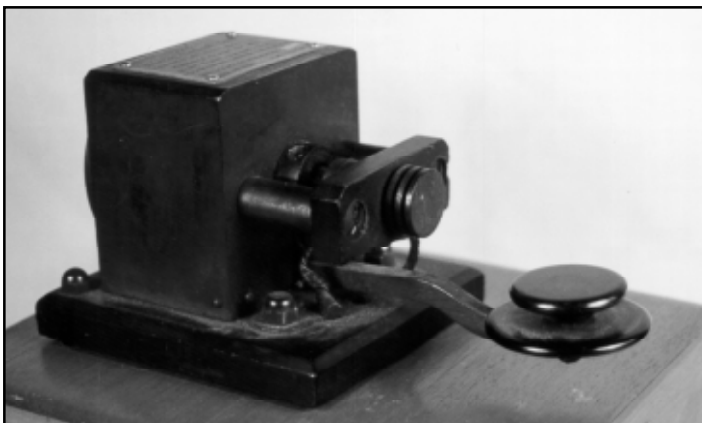


Figure 90. *General Radio Co., Type CAG 457, 1-kW relay key with 5/8" silver contacts.*

aircraft keys are marked "RAF" on the bottom. On April 1, 1918, the RAF was formed by the union of the RFC (Royal Flying Corps) and the RNAS (Royal Naval Air Service). No key marked "RAF" could have been made prior to that date.

S.G. Brown made at least one other spark key model, but not specifically for use in the air. This was a large key with a triple crystal detector on the end of the base opposite the key (Figures 92 and 93). The S.G. Brown Company still exists today as a division of Vosper Thornycroft, making gyrocompasses.⁸⁸

The early use of spark transmitters in submarines is poorly documented. The environment inside an early submarine was a horrible mixture of



Figure 91. *S.G. Brown Company, London, England. Aircraft key with mica window covering small auxiliary gap.*

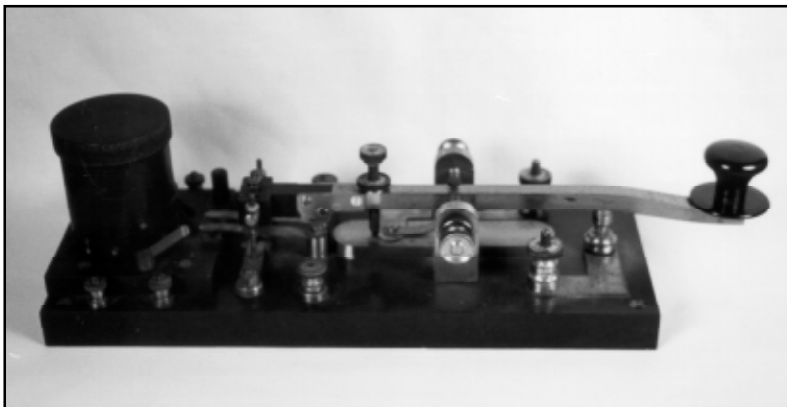


Figure 92. Above
*Large spark key with
 triple crystal detector
 on same base, S.G.
 Brown Company,
 London.*

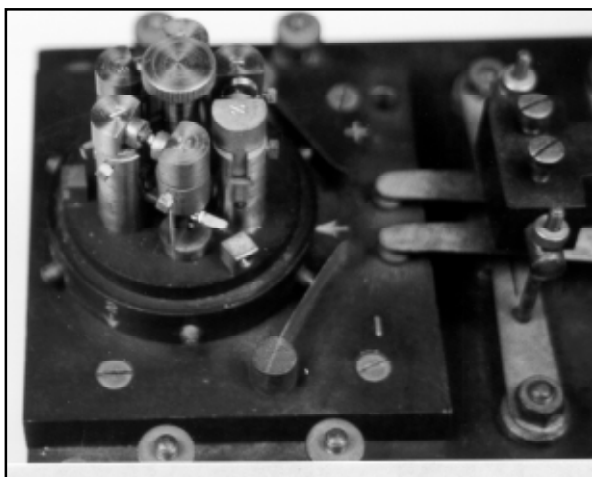


Figure 93. Right
*Detail of the triple
 detector on the large
 spark key with detector
 cover removed. S.G.
 Brown Company,
 London.*

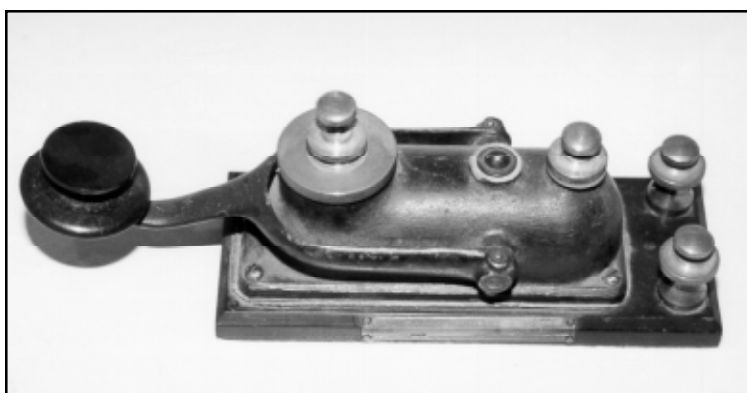


Figure 94. *Machinery Division Boston Navy Yard, SE-144,
 for use with submarine transmitters 1-2-kW.*



Figure 95. *Marconi's Wireless Telegraph Company of America, SE-86 for use on submarines. Similar to the SE-144 by the Boston Yard.*

sweat and gasoline fumes. The danger and noise increased dramatically with the addition of a spark transmitter to the already cramped quarters. In 1906, the U.S. Navy reported that experiments with wireless telegraphy were in progress. The report stated, "It is doubtful, however, if the use of wireless on submarines will be of value."⁸⁹ The Wireless Specialty Apparatus Company made the Q-S-505 for submarine use. The Machinery Division of the Boston Navy Yard made heavy enclosed keys called the SE-144 (Figure 94) and the SE-86 specifically for use with submarine spark transmitters.⁹⁰ Marconi also made the SE-86 (Figure 95). These keys were made much later than the early experiments, so that the question of which keys were used on the earlier submarine transmitters remains unanswered.

A description of a captured German U-boat Radio including the key appears in *QST* for November 1919.⁹¹ This amusing article declares "no good amateur would have such a set in his station. The material and workmanship was unexcelled. The hook-up looks like a Chinese puzzle." The author of the article, J.A. Crowdus, goes on to describe the transmitting key: "The transmitting key — well it was a crime. It weighed about 4 lbs. and the lever about 3 lbs. It was characteristically German, for it would take a big overgrown Dutchman to manipulate it. Anyone wishing to take a look at said key call around my shack — for there it will be found on exhibition." This key would have almost certainly have been made by Telefunken. A photograph of a different submarine installation from about 1908 clearly shows the Telefunken Type H.T. 3 spark key at the operating position (Figure 96).⁹²

With wireless sets being taken to sea and into the air, it was only to be expected that they would also be carried by horseback. This was more convenient than landline during times of war. The poles and wire that landline required were very vulnerable to enemy fire and sabotage.

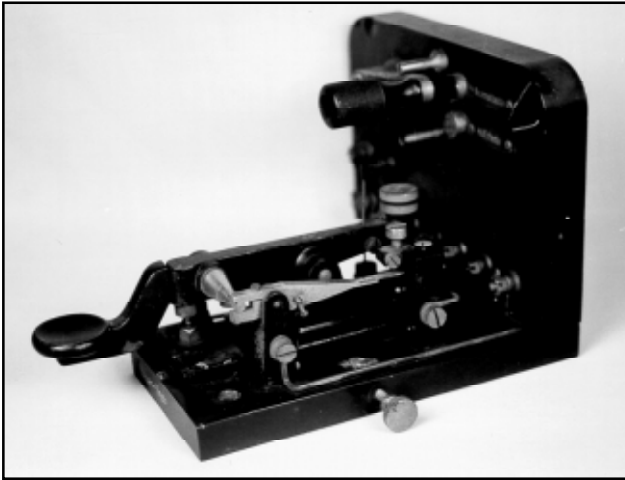


Figure 96.
*Telefunken System
key Type H.T. 3, as
used on submarines,
circa 1908. The
same basic key was
used in other
applications as well.*

Massie made “pack sets” as early as 1908.⁹³ The Massie portable sets were supplied with Massie keys. By 1914 the National Electric Supply Company produced keys and complete portable Navy outfits (Figure 97).⁹⁴ The first application of wireless on the road was in 1901, on a steam motorbus.⁹⁵ This Marconi unit had a 20-mile range. The keys supplied with pack sets in general were small and rather nondescript. They usually keyed smaller apparatus and they had to be lightweight. The U.S. wireless Signal Corps pack set was already functional by the time it was mobilized to the Mexican border in 1911. A.F. Collins described the pack set in 1913 as follows:

“The wireless field equipment of the United States Army is believed to be one of the most efficient in the world. As a result of long experiment in actual field work an ingenious portable outfit was been adopted. The apparatus necessary for establishing a field station, both for sending

Figure 97.
*National Electric
Supply Co.,
drawings for Type D
portable radio set
key for the U.S.
Navy. Dated
Sept. 11, 1914.*

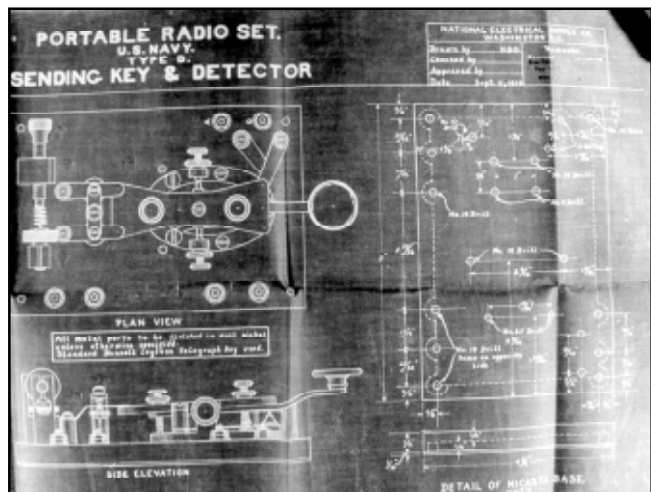




Figure 98.
Wireless Specialty Apparatus Co. field set. Note quenched gap at upper right on panel. The key is on the lower right of the panel.

and receiving wireless telegrams, with the dynamos for supplying the power, weighs less than four hundred and fifty pounds. It is designed to be packed in three packages each weighing one hundred and fifty pounds. These are usually carried on pack mules which are especially trained for the work. In a recent test in the Philippines a field station was unpacked and set up ready for operation in two minutes and ten seconds.

The entire apparatus for receiving and transmitting messages is packed in a leatheroid trunk measuring thirty inches in length and seventeen inches wide and fourteen inches in depth. The power for generating current is supplied by a hand generator which may be worked by storage batteries or in remote regions by two soldiers. There is the keenest rivalry between the various squads of the signal corps for the best time record for setting up one of these field stations. These stations work effectively over a



Figure 99.
Close-up view of the key on the Wireless Specialty Apparatus Co. field set. It is similar to the Q-S-504.

radius of thirty miles.”⁹⁶

When the United States entered World War I, several companies produced field sets in addition to the National Electric Supply Company. Wireless Specialty Apparatus Co. made a quenched gap set which fit into a suitcase, Model Q-S-A-250 (Figure 98). A light hand key was built into the panel. The key was essentially a modified version of the WSA Co. Q-S-504 (Figure 99).

A pack set with a key that folded up into the unit was made in 1918 by the Emil J. Simon Company of New York (Figure 100). This key design, possibly used both with spark and CW sets, was later copied for pack sets in Europe as well. When the Institute of Radio Engineers was formed in 1912, Emil J. Simon was the Secretary. John Stone Stone was a Manager for the IRE, and Fritz Lowenstein was the organization’s treasurer. The IRE was one of the predecessors of the Institute of Electrical and Electronics Engineers (IEEE).

Telefunken in Germany had also devised complete sets for portable use (Figure 101). A set was generally packaged into a horse-drawn cart, complete with antenna and mast (Figure 102). Pictures of these sets clearly show the Slaby-Arco style tall-handled key.^{97, 98} Slaby-Arco had experimented with portable sets as early as 1901.

In London, the Dubilier Electrical Syndicate produced a small portable wireless set around 1912 (Figure 103). The device weighed 17 pounds

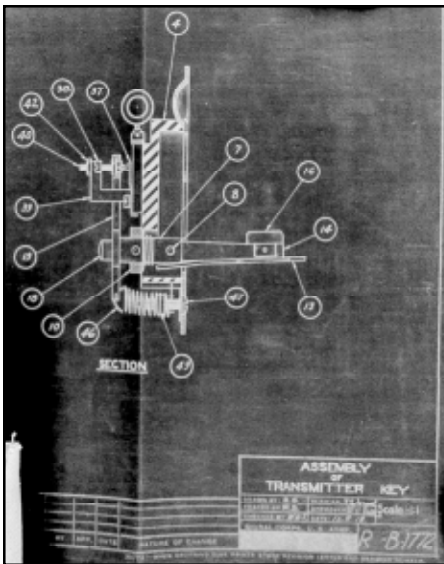


Figure 100. Emil Simon, drawing details for folding key that was part of pack set in 1918.



Figure 101. Telefunken System portable military set complete with mast, ca 1911.



Figure 102. *Early Slaby-Arco horse drawn portable set, ready to go.*

and worked from a 200-volt direct current supply. This set was proposed as a cheaper alternative for those ships that required wireless, but whose owners were unprepared to pay the prices demanded for conventional wireless equipment made by the larger wireless companies.

Spark Keys During World War I

The War in Europe had been raging for about three years when the United States declared war on Germany in 1917. The note from German Secretary of State Zimmerman to the German Minister to Mexico was one of the most compelling reasons for the United States to enter the war. In this telegram, Germany encouraged Mexico to invade the United States, with Mexico to receive New Mexico, Texas, and Arizona as spoils

of war. The British decoded this wireless intercept and delivered it to the United States.⁹⁹ With the declaration of war, amateurs in the United States were ordered to stop transmitting and receiving, and all antennas were disconnected.¹⁰⁰ Within a month, young men were being encouraged to train for wartime wireless service. Commander Todd, Director of Naval Communications, encouraged men to enroll in wireless schools.¹⁰¹

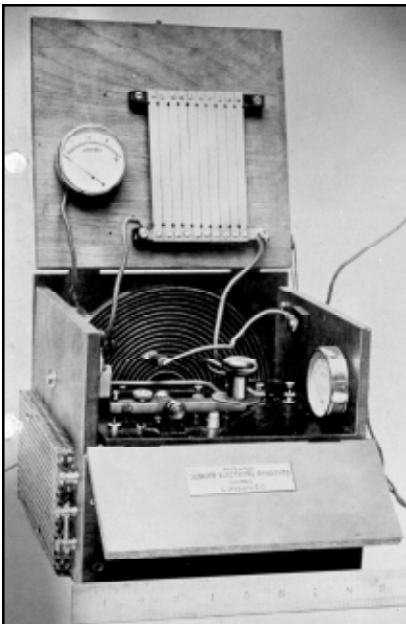


Figure 103. *Dubilier Electrical Syndicate, Ltd., London. Portable 200-volt, 100-Watt transmitter and key. ca 1912.*

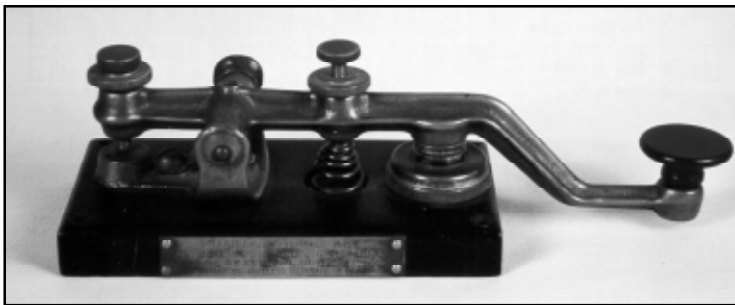


Figure 104. *Marconi's Wireless Telegraph Co. of America, SE-68. The SE-68 was made in large numbers by several companies.*

The demand for wireless equipment experienced a second boom as a result of World War I. With amateurs off the air, equipment was supplied almost exclusively by contract to the military. Most wireless communications during the war were made using spark technology. Even so, vacuum tube technology, which would eventually replace spark telegraphy, was under experimentation at this time. The de Forest Audion, the first triode tube, had been under development since about 1906.¹⁰² The National Electric Supply Co., Washington Navy Yard, de Forest Radio Tel. & Tel. Co., and Western Electric Co. supplied a selection of tube equipment to the Navy in 1917,¹⁰³ but the equipment was of limited availability. It was for this reason that spark equipment continued to play such an important role in communications during the war.

The telegraph keys made for World War I were quite different from the instruments made for amateurs. Instead of shiny brass mounted on pretty marble bases, the military keys were usually bulky, with parts painted black, and mounted on black bases. The desirability of beauty was completely replaced by the need for durability.

The perfect example of this heavy and sturdy design was the SE-68 (Figure 104). Several companies made this durable black key on its heavy black base. The contacts were replaceable and the parts were not difficult to manufacture. The SE-68 was originally designed as a leg key, though amateurs later modified many of them to sit flat on an operating table. The SE-68 was manufactured by Marconi's Wireless Telegraph Company, Wireless Specialty Apparatus Company, Machinery Division Boston Navy Yard, Liberty Electric Corp., and the Lowenstein Radio Company. The design came from the Boston Navy Yard and the key was intended for use with 2-kW and 5-kW sets.¹⁰⁴ The SE-68 and the SE-68A (Figure 105), essentially the same key with minor design modifications, are two of the most commonly found World War I vintage spark keys today.

The Boston Yard also designed the SE-86,¹⁰⁵ a heavy enclosed key manufactured specifically for submarine transmitters. The “SE” designation of this and other keys from July 1, 1910 onward reflect the nomenclature used following the organization of the Bureau of Steam Engineering within the Department of the Navy. The keys designed by the Navy begin with “SE.” Each company that designed equipment for the Navy was given a unique letter code. For instance, National Electric Supply Co. was given the code “CN.” George H. Clark, an

Type #	Designed By	Description
SE-59	Washington Yard	Combined buzzer and blinker practice set
SE-68	Boston Yard	2- and 5-kW Auxiliary Hand Key
SE-69	Washington Yard	Buzzer practice set
SE-86	Boston Yard	½-kW Flame Proof Hand Key for submarine transmitters, part of CM98 ½-kW motor boat set with gasoline engine drive (CM designates Marconi manufacture.) Also part of CM296(A) panel set. Superseded by SE-653.
CN-582	Nat. Elect. Supply	Key, part of CN100 ½-kW motor boat set
CS-491	Sperry Gyroscope	Relay Key, part of CS103 ½-kW motor boat set and ½-kW airplane set
SE-137	Boston Yard	2- and 5-kW Relay Key
SE-144	Boston Yard	Flame Proof Hand Key for 1,2, and 5-kW submarine radio transmitters
CM-394	Marconi's WTCO.	Key, part of CM295 airplane set
CM-410	Marconi's WTCO.	Key, part of CM297, 278, 279, 301 5-kW transmitting sets
CM-420	Marconi's WTCO.	Key, part of CM304 10-kW transmitting set
CL-419	Lowenstein Radio	Relay key, part of CM304 10-kW transmitting set
CM-425	Marconi's WTCO. (Figure 106)	Key, part of CM306, 307 2-kW and 309 1-kW transmitting sets
CM-408	Marconi's WTCO. (Figure 107)	Relay key, part of CM306, 307, 309 2 kW transmitting sets. Sold by MWT to Navy for \$45 each.
CL-462	Lowenstein Radio	Key, part of CL342 2-kW transmitting set
CL-830	Lowenstein Radio	Key, part of 10-kW radio transmitter

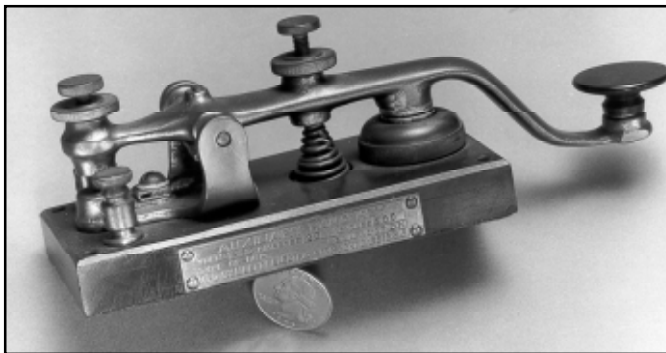


Figure 105. *Liberty Electric Corp., Port Chester, NY. SE-68A.*

expert radio aide to the Navy Department in World War I, was instrumental in devising this system. A partial listing of the letter codes for telegraph keys of the Department of the Navy, Bureau of Steam Engineering, follows: ¹⁰⁶ Please refer to *AWA Review* Volume 7, 1992 pg 69 for a 20-page listing of Naval equipment manufacturers.

Many of these keys were made to be part of a particular transmitting set. Nearly all of the transmitting sets mentioned are of the quenched gap type. The signal from a quenched gap had a musical quality and was of much narrower frequency spread than earlier gaps.

One of the keys not mentioned in the table is the Marconi SE-179, made in 1917. This huge Marconi “rockcrusher” was supplied on a thick slate base. It had large cooling flanges on both the upper and lower contacts. This Marconi key was made in a version for the Signal Corps (Figure 108) in addition to the Navy model.

Fritz Lowenstein was an Austrian immigrant who had worked with Sir William Crookes studying electrical discharges through gases. After

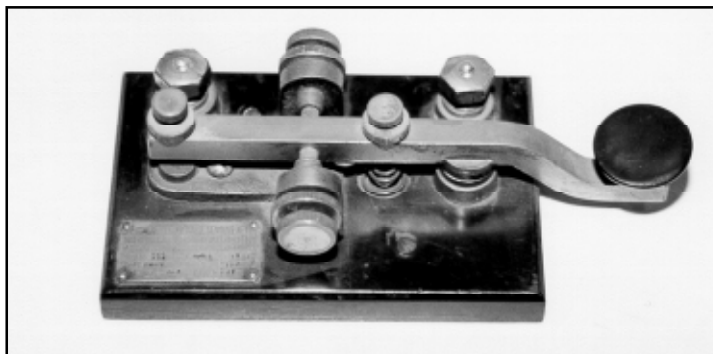


Figure 106. *Marconi's Wireless Telegraph Company of America, CM-425, supplied with 1-kW transmitting sets, ca 1918.*

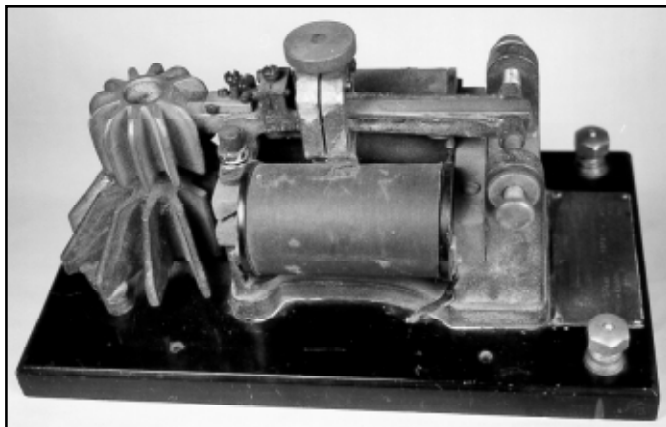


Figure 107. *Marconi's Wireless Telegraph Company of America, CM-408 relay key, ca 1918.*

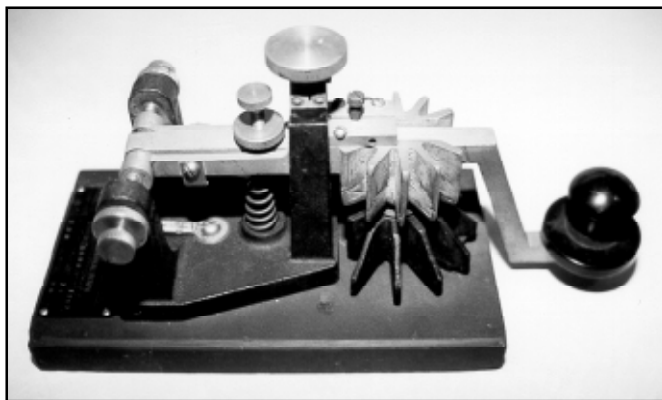


Figure 108. *Marconi's Wireless Telegraph Company of America, 5-kW Auxiliary Hand Sending Key, War Dept., U.S. Signal Corps, 1917.*



Figure 109. *Lowenstein Radio Company, SE-923 for 1/4- and 1/2-kW transmitting sets. ca 1919.*

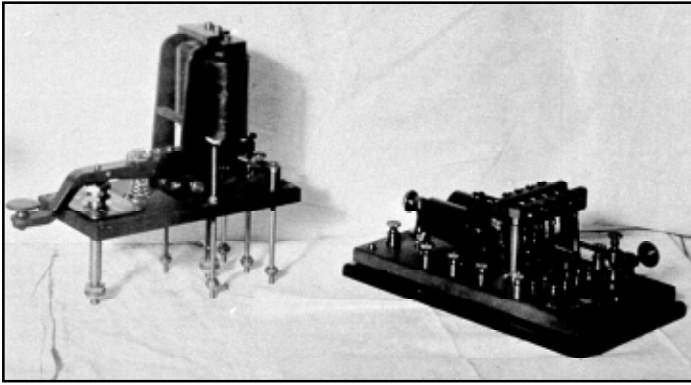


Figure 110.
*Fritz Lowenstein,
relay key and
relay, 1914.*

coming to the United States, he worked as an assistant to Nikola Tesla, and then as a consulting engineer for a de Forest company from 1909 to 1911. Lowenstein's own research later focused on vacuum tubes and audio amplifiers, and the design of radio transmitters and receivers for the Navy. He designed the CL-346 complete quenched gap spark transmitter in 1917. The Lowenstein Radio Company of New York, N.Y., was incorporated in 1918. Lowenstein is credited with discovering the use of negative grid bias as well as several other innovations. The company also made detectors and quenched gaps for the Bureau of Steam Engineering.¹⁰⁷ The spark keys made by Lowenstein also included the SE-68, the rear pivot "Type A" key, the SE-923 (Figure 109), and a large relay key (Figure 110).

One very interesting entry in the Navy catalog is the CF-118.



Figure 111.
Radiguet and Massiot,
Paris, France. Type 4
spark set with folding
key. Made in 1917.

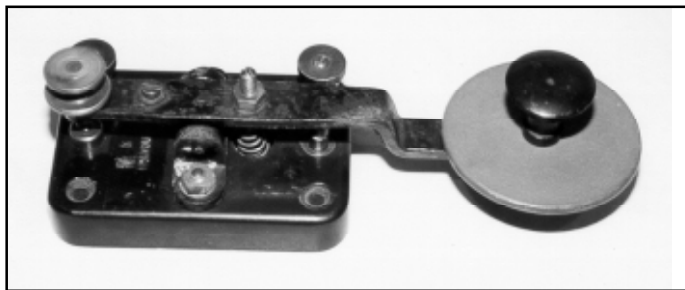


Figure 112. *M.A.E.S., Trevoux, Ain, France. Small spark key made for World War I.*

This was a ½-kW dirigible set. It was designed in 1917, and 16 such sets were made. This rig used a de Forest tube and was therefore a CW transmitter.¹⁰⁸ The United States military apparently did not make the mistake of putting spark rigs on their dirigibles, as had the Germans, at least not in 1917.

Radiguët and Massiot of Paris made the Type 4 key and portable spark set for the war in 1917 (Figure 111). The lever arm folded away into the wooden box that contained the spark gap and coil. Radiguët and Massiot also made electrostatic machines, landline equipment, wireless receivers, and other electronic equipment.

A company known today only by the letters “M.A.E.S.” of Trevoux, France made a field set nearly identical to the one by Radiguët and Massiot, as well as stand alone spark keys on a small Bakelite base (Figure 112). M.A.E.S. was a maker of condensers and small parts for wireless and high frequency applications. They were called upon to expand operations during World War I.

Spark Keys Following World War I

World War I ended toward the latter part of 1918, and all restrictions on amateurs and amateur radio stations in the United States were removed on October 1, 1919.¹⁰⁹ American amateur radio resumed its pre-war status under the Department of Commerce. The immediate post-war period in wireless was characterized by a lack of good review articles on wartime communications, probably because it was still considered secret. It was also the beginning of the third and last boom in spark key production. The amateur market was flooded with war surplus wireless apparatus. The American Sales Company of New York advertised brass wireless keys on a wooden base for ninety-five cents. These keys look identical to the J-3 trench telegraph set key used during the war. The Brach J-5, J-6, and J-7 are still commonly found today.

Many of the companies that had catered to the amateur experimenter

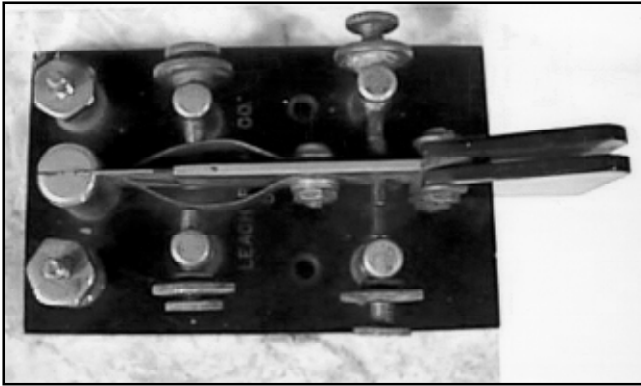


Figure 113.
*Leach Relay
Company, San
Francisco. The
Leach Cootie Key.*

before World War I also sold equipment to amateurs after the war. Such companies included Wm. J. Murdock, A.W. Bowman¹¹⁰ who sold keys through Sears and Montgomery Ward,¹¹¹ Signal Electric, and others. The Bowman spark key was available again on a marble base, a return to the more pleasing aesthetics of the pre-war amateur design. This key was advertised for use with sets up to 5-kW. Judging by the number still in existence, it was a popular key and was made in large numbers. It sold for \$4.25 in 1919. Sears called the Meteor key a “Navy Type Key,” probably more as an advertising ploy than anything else.

New companies came into existence and prospered after the war. Val Leach, a radio operator in World War I, founded the Leach Relay Company in San Francisco in 1919.¹¹² This company based its business on making relays and switching parts, but they also made a side-to-side action key, similar to the Bunnell sideswipers. These were very popular landline keys and were supposed to decrease the risk of telegrapher’s Glass Arm, a repetitive stress injury common to telegraphers. The Leach radio sideswiper had large wireless contacts and was built with heavier parts on a bulky base. This kind of key became known as the “Cootie” key (Figure 113). The origin of the name “Cootie” is

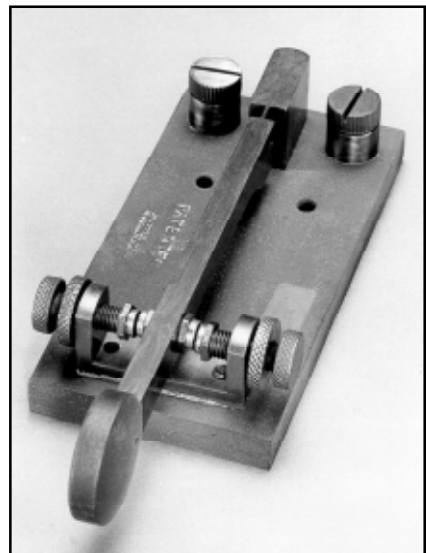


Figure 114. *J.H. Bunnell radio
sideswiper—the “Cootie” key, early
1920s.*

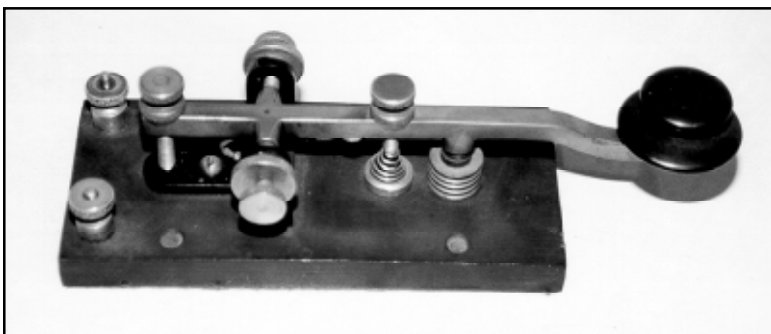


Figure 115. *J. Lehmkuhl, Oslo, Norway. Note the cooling flanges and the long lever, 1920s.*

obscure, but the Leach Cootie key was advertised as such in the 1925 edition of “The Radio Trade Directory.”¹¹³

The Leach Relay Company made the Speedoplex line of semi-automatic telegraph keys in the 1920’s and 1930’s. The company moved to Los Angeles in 1929, and Val Leach died in 1941. Cootie keys were not exclusively made by Leach, but also by Bunnell (Figure 114) and probably by Tri-City Radio Labs. The Leach Relay Company still exists as Leach International and continues to make a full line of relays and switching products.

The Lehmkuhl Company was also founded after World War I. Joakim Lehmkuhl was born in 1895 and established his own engineering company, Lehmkuhl Verksteder, in 1926 in Oslo, Norway. Lehmkuhl made three spark keys (Figure 115). If these keys were manufactured after Lehmkuhl Verksteder was formed, it would be quite a bit after the heyday of the spark transmitter. Because the two labeled models have the “Lehmkuhl” name on the key, but no mention of the company,



Figure 116. *McIntosh Electrical Corp., Chicago. Marble based key with label, ca 1922.*

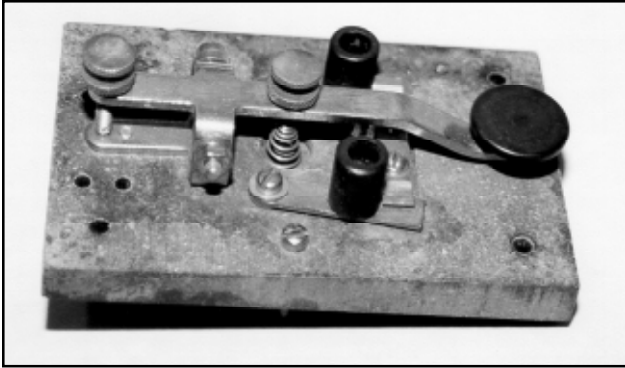


Figure 117.
McIntosh Electrical Corp., key or switch for an unknown application.

it is possible they were made by Lehmkuhl himself before the company was founded. These keys are large and have a very long and heavy lever with cooling fins on the contacts. They are very similar to the Wireless Specialty Apparatus Q-S-5004 and it is possible that Lehmkuhl copied that earlier design.

Lehmkuhl also made the Kraftsuper wireless receiver in 1926. Two triodes served as detector and amplifier in the receiver. By 1926, vacuum tubes had become much more available and were used in many commercial receivers. The Lehmkuhl Company was the Norwegian representative for the German Telefunken company in the 1960's and still existed into the late 1980s.¹¹⁴

The McIntosh Electrical Corporation of Chicago, Illinois was a company with origins before World War I. L.D. McIntosh advertised a quack medical device called the McIntosh Electrical Belt for \$10 and claimed that it could heal a multitude of medical conditions.¹¹⁵ The McIntosh Battery and Optical Company was formed around 1890 and seems to have spun off the McIntosh Electrical Corporation in 1922.¹¹⁶ McIntosh Electrical made two types of keys with heavy contacts, only one of which seems clearly to have been a spark key. This key is on a brown marble

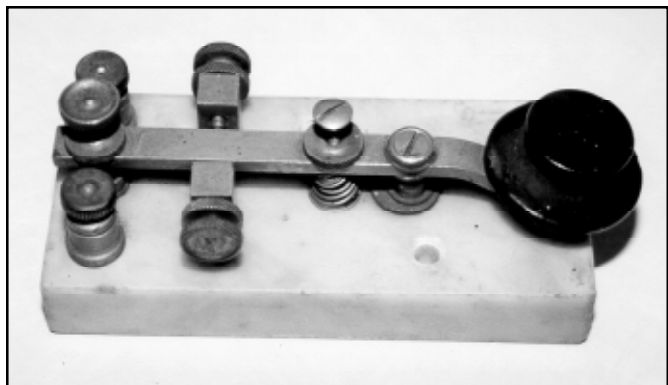


Figure 118.
Eastern Precision Electrical Co., Rockville Center, NY, ca 1921.

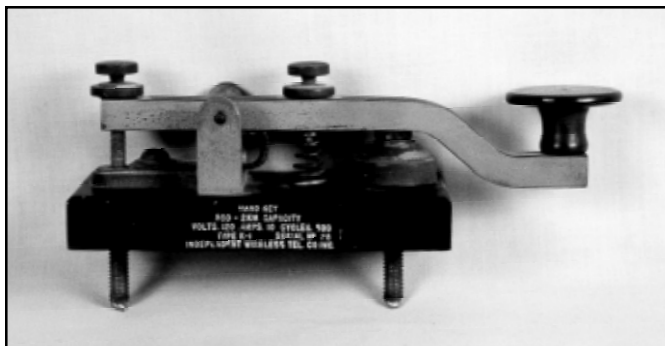


Figure 119. *Independent Wireless Telegraph Co., Inc., of New York. Type K-1, 2-kW.*

base and is labeled with the manufacturer's name (Figure 116). The other key made by McIntosh may not be a wireless key at all (Figure 117). The topside parts are similar to the ones on the wireless key, with the exception of a set of switches on either side of the lever. The key is not labeled except for "2250-L-4" on the bottom of the base. Collectors would prefer to think that this was a spark key, but given the company's otherwise interesting past, it is equally likely that this key was part of a quack medical apparatus.¹¹⁷

There were several other companies that made telegraph keys during this final period of spark key development. Eastern Precision Electrical Co. of Rockville Center, New York produced a key on a marble base in 1921 (Figure 118). This key did not bear a manufacturer's label.¹¹⁸ John H. Robertson designed and manufactured special radio apparatus to order in Detroit. His company, the Robertson Clock and Instrument Company, made an oil break key. Robertson advertised



Figure 120. *Marconi International Marine Communication Co. Ltd., London, Type 365A.*

this key in *QST* in 1921. It was available on a white or blue marble base. He promoted his CW gear in the same advertisement.^{119, 120} The Independent Wireless Telegraph Co., Inc., of New York, made a large spark key whose basic design seems to have been copied from the Boston Navy Yard's SE-68. It was called the "Type K-1" and was rated at 2-kW (Figure 119). Economic Electric Limited, of London, made a labeled spark key for amateur use in 1920.¹²¹ These companies and others continued to make spark keys well after the popular acceptance of the (undamped wave) CW transmitter.

QST ran articles describing homebrew transmitters using Audion tubes for CW well before amateurs were allowed back on the air after the war. An article entitled "Building Your Own C.W. Apparatus" appeared in the October 1919 issue of *QST*.¹²² This same month amateur transmitting privileges were restored. For quite some time, articles about CW appeared in the same issue as articles on spark transmitters with discussions about the advantages of each. H.J. Tyzzer noted in November, 1919 that: "The tube transmitters, although very effective for local work, are limited in output and hence cannot be used to any great advantage for long distance transmission."¹²³

Almost every issue of *QST* for a few years after the war contained both advertisements for spark gear and advertisements for tube equipment. The Signal Electric Company was a heavy advertiser during this time, but is likely that many of the keys were being used on CW.

There is no doubt that the lack of availability of tubes resulted in a prolongation of the spark era. Legislation curtailing the use of spark on popular frequencies was enacted in 1924. However, the use of auxiliary or emergency spark transmitters in the maritime service continued until World War II, as noted by Bob Shrader, a commercial telegrapher:

"...I was an operator on Dollar line ships from 1933, starting with the *SS Pres. Harrison*, to 1937, ending by sending SOS when we were bombed while at anchor on the Yangtze River. The spark transmitters were the stand-bys on the smaller 502' around the world ships and the 535' SF to Manila via Japan and China ships. The spark rigs were old navy ones, I think, 2- kW quenched gaps."¹²⁴

Shrader notes that the Leach relay was used with spark transmitters aboard most ships in those days, and that "with our spark sets we were handling traffic at speeds up to at least 30 wpm with no difficulty." Heavy-duty contacts on a bug, a high speed semi-automatic key designed for land-line use, could easily handle the 0.25 ampere keying current of the Leach relay.¹²⁵

There were wireless keys that were used for both spark and CW during this transition period. The Marconi International Marine 365A, which appeared in the 1930s, is one of the most notable of these (Figure 120). The 365A is a huge key that was occasionally used on spark rigs

in the maritime service well after World War I. Many 365A keys in collections today are missing the large box-like metal cover. According to collector Wyn Davies, the reason for this was that the wireless operator often used the cover as an ashtray.¹²⁶ The cover became separated from the key and was subsequently discarded.

Conclusion

The earliest wireless transmitters required heavier keys that could withstand much higher current than the landline keys of the 19th century. Spark keys quickly changed in form to match their function. They were adapted for use in submarines, airplanes, field sets, automobiles, and dirigibles. Several strategies were devised to reduce sparking at the contacts including placing a condenser across the contacts, submersing the contacts in oil, breaking the contacts in mercury vapor, placing the contacts underneath a diaphragm or within an enclosure, using blowout magnets to extinguish the arc, and using magnetic relays to break the contact at the time of minimum current.

During World War I wireless radio played an important role in communications. Spark keys were made almost exclusively for the military after amateur experimenters were ordered off the air. In 1919 amateur operators were again allowed access to the airwaves. By that time the vacuum tube was well on its way to making spark telegraphy obsolete. The use of spark telegraphy continued sporadically until the beginning of World War II.

There is still much to learn. Many spark keys bear no label and their origins remain unknown. Many companies that produced spark keys have disappeared with little trace. Photographs from the spark era need to be examined so that historians may document the type of transmitter and key at the operating position.

Spark keys and the events surrounding them are fascinating. Each key has a story, and many of them survived war to become a part of history.

The Spark Key Project

The Spark Key Project is an ongoing research tool through which collectors and historians worldwide can contribute information about the history of spark keys and telegraphy. The Internet has greatly facilitated this endeavor. The Spark Key Project is presented after this article as an aid to collectors and historians. The Spark Key Project was published in its first draft in Lynn Burlingame's Keyletter, #29, November 29, 1999. It was subsequently included in the Telegraph Collector's Reference CD by Tom Perera. You may view the latest updates of the Spark Key

Project on the internet by searching for it under that name.

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Sue J. Faulkner: 80

Thierry Ohannessian Collection: 111



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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, WA5Y, 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.

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.



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 from 1985 to 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,