

MARCONI - THE MAN AND HIS APPARATUS

By

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INTRODUCTION

As one explores the birth of any great invention, it is often seen that many minds may have come close to the actual discovery but are never recognized by history as major contributors. Thus, the credit for the origin of wireless telegraphy, though sometimes disputed, in our eyes is without serious contention. Guglielmo Marconi had a vision unequaled by any other man, and most importantly, the exceptional fortitude to follow it through. He amazed the world, succeeding finally in his struggle to send wireless messages over long distances. This is his story.

Together let us explore the early influences on Marconi's life. We will follow the experiments which foreshadowed the use of wireless telegraphy in commercial applications, and present some little known facts pertinent to the development of the early equipment. We will also review a history and description of the three main factories where most of his apparatus was produced, complementing it with a photographic review of Marconi wireless gear. These pictures include those that are well known, but also many which are previously unpublished.

THE DAWN OF WIRELESS

On April 25, 1874, an event occurred which would change the world forever: on that day Guglielmo Marconi was born in Bologna, Italy. His first influences proved unusual. His father, Giuseppe, was an able, dignified Catholic Italian businessman. His mother, Annie Jamison, a blue-eyed Protestant Irish girl of Daphne Castle, County Wexford, was descended from a family of well-known whiskey distillers in Dublin. Their first child, Alfonso, had been born nine years before Guglielmo. Neat, tidy, studious and obedient, he was nearly the opposite of his brother.

Guglielmo's boyhood was passed in the country at his father's handsome Villa Grifone estate at Pontecchio, some eleven miles outside the city

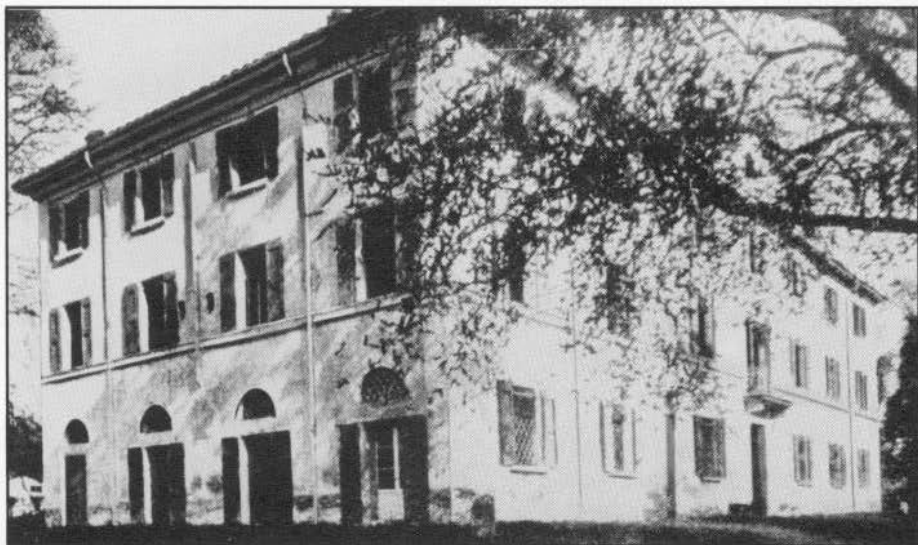


Figure 1. The Villa Grifone where Guglielmo Marconi spent much of his childhood.
Source: *Marconi-Master of Space*, Jacot & Collier, 1935

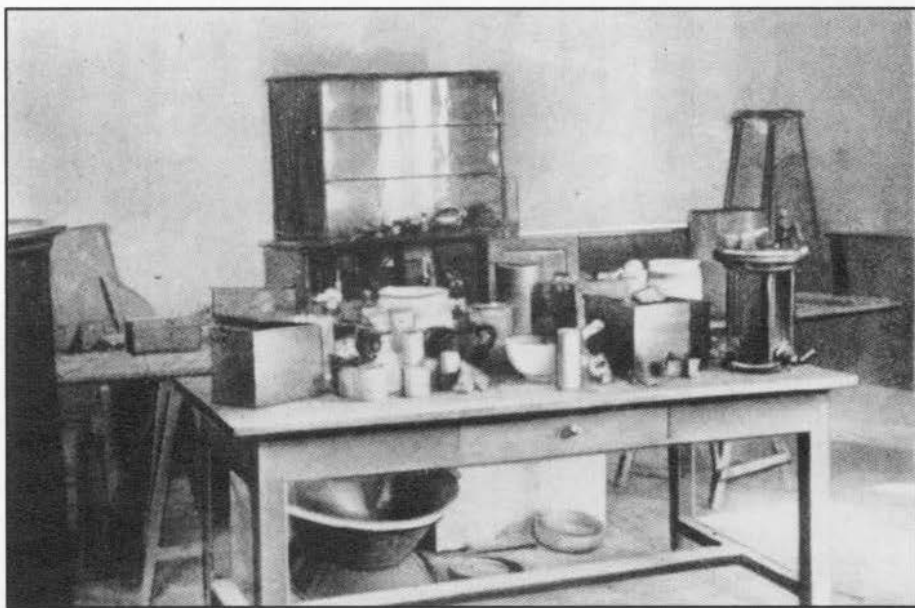


Figure 2. The first wireless laboratory in the world, situated on the third floor of the Villa Grifone. Marconi performed his initial experiments here.
Source: Marconi Company Archives

of Bologna. Guglielmo wasn't a particularly clever boy; in fact, he was a bit mischievous. He never lacked imagination, and it was his ability to focus with intense concentration which set him aside from the boys in town. He was always a favorite with his mother; his hobbies became fishing, sailing and horse-back riding, as well as traveling, an asset for the future.

While at home he preferred to spend most of his time in the family library, which concentrated on history, science and technology. In his early years Guglielmo never attended a public school, and although he was tutored in many subjects, he was largely self-taught. His mother also encouraged him to speak and write fluently in English, a decided advantage in later years.

When he was twelve years old he attended the Cavallero Institute in Florence, where he studied physics and chemistry,¹ and quickly ran into difficulties because of his poor Italian vocabulary. On a more positive note, he developed a friendship with a schoolmate, Luigi Solari. At the time he had no way of knowing that Solari would assist him in many of his early experiments, and eventually become an invaluable associate in the field of commercial wireless telegraphy.

At Leghorn the following summer Guglielmo made the acquaintance of a kindly old telegraphist, Nello Marchetti, who took a liking to Marconi and taught him the Morse code.² Over the winter, Guglielmo enrolled in the Technical Institute at Leghorn, where he was finally able to secure good grades and enjoy his studies. He was given an introduction to electro-physics by a Professor Rosa and rapidly developed an appetite for an increased knowledge of electricity and its associated areas.³

Marconi thoroughly enjoyed playing with electricity, performing "scientific" experiments whenever he could borrow the money from his critical father, who frowned upon his interests. One of his favorite experiments was to bring a wire down from a lightning arrestor on top of the house and hook it to a doorbell. When a sufficient static charge had built up during a thunderstorm, the bell would ring.

Upon noting her son's strong interest in electricity, Annie prevailed upon a neighbor to allow Guglielmo to attend some lectures at the University of Bologna. The neighbor and lecturer was Professor Augusto Righi, a noted physicist at the University. He allowed Marconi to borrow books from the university library, and even perform some experiments. While the professor believed there was nothing new and exciting in the work, he encouraged Marconi to continue.

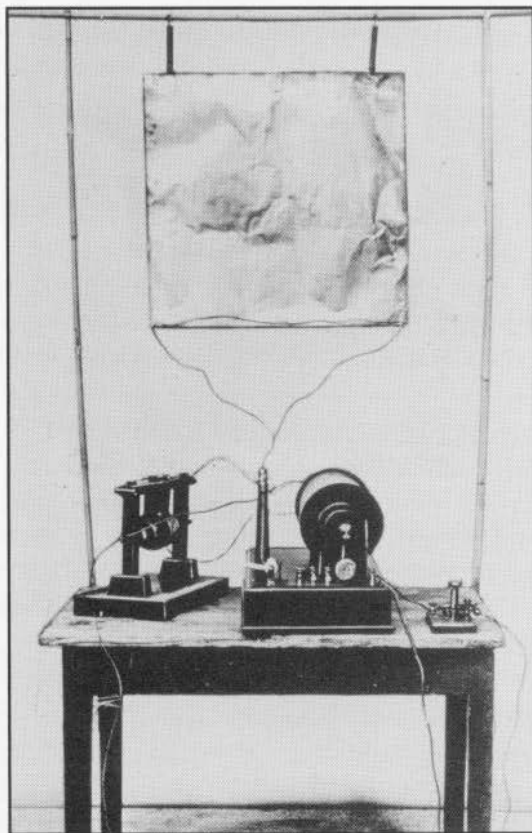


Figure 3. A replica of the first transmitter used at Villa Grifone.

Source: Marconi Company Archives

In the summer of 1894, his twentieth year, Marconi and his brother went to Biellese in the Italian Alps for a vacation. During this time Guglielmo received his inspiration for the idea of using Hertzian waves as a medium by which to communicate. Accounts vary, but several biographies mention that while vacationing Marconi read an obituary on Hertz, and that after reading this the idea of wireless telegraphy was born.⁴ Several sources state that the obituary was in an Italian journal, but, unfortunately, no specific reference was ever cited.

However, the mystery of exactly what Marconi read which inspired his life's work appears to have now been solved. In the January, 1894, issue of the Italian electrical journal *Il Nuovo Cimento* two significant articles were printed back-to-back.⁵ The first was a seven-page obituary of Hertz written by Antonio Garbasso. This was followed by a six-page article by Augusto Righi detailing

Hertz's electric wave experiments. Piecing together the various clues presented in numerous Marconi biographies indicates that it was probably this issue of *Il Nuovo Cimento* which Marconi read in the summer of 1894.

After finishing the articles by Garbasso and Righi, a revolutionary idea.....

It sparked an interest which was to occupy him day and night, so that during the remainder of his vacation he became preoccupied with sketching and designing diagrams and circuits. On his return to Villa Grifone in Pontecchio he was ready to begin a new group of experiments.

Marconi found it difficult to believe that no other scientist had grasped the commercial possibilities of wireless telegraphy, even though the foundations of the technology were present. Determined to see if his ideas had substance, he set up a primitive laboratory in two rooms on the third floor and began crude experiments with wireless, assisted by his brother, Alfonso.

All of his apparatus at the time was hand-made. This was not only through a lack of funds (he disliked having to plead with his father for lira,) but because the type of apparatus he needed hadn't yet been developed.

In many of his early experiments Marconi was complimented by his young friends and assistants on his uncanny ability to produce serviceable instruments and devices from the most primitive materials. Probably this was due to his vivid imagination, which usually enabled him to foresee the end result of a certain piece of apparatus. This ability was to serve him well throughout his career.

Inspired by Hertz, he repeated the electromagnetic wave experiments, using the adjustable spark gap as the receiver and the parabolic reflectors (Fig. 10), which directed his waves, as an antenna system. The transmitter consisted of an induction coil connected to a spark gap, designed by Professor Righi. It combined four brass balls, immersed in Vaseline and separated by small gaps. He controlled the discharge of the spark gap by means of a telegraph key placed in the primary circuit.

Guglielmo continued to consult with Prof. Righi, who had performed many experiments with Hertzian waves, but still had grave doubts that a system of wireless signaling would ever come to any worthwhile use.⁶

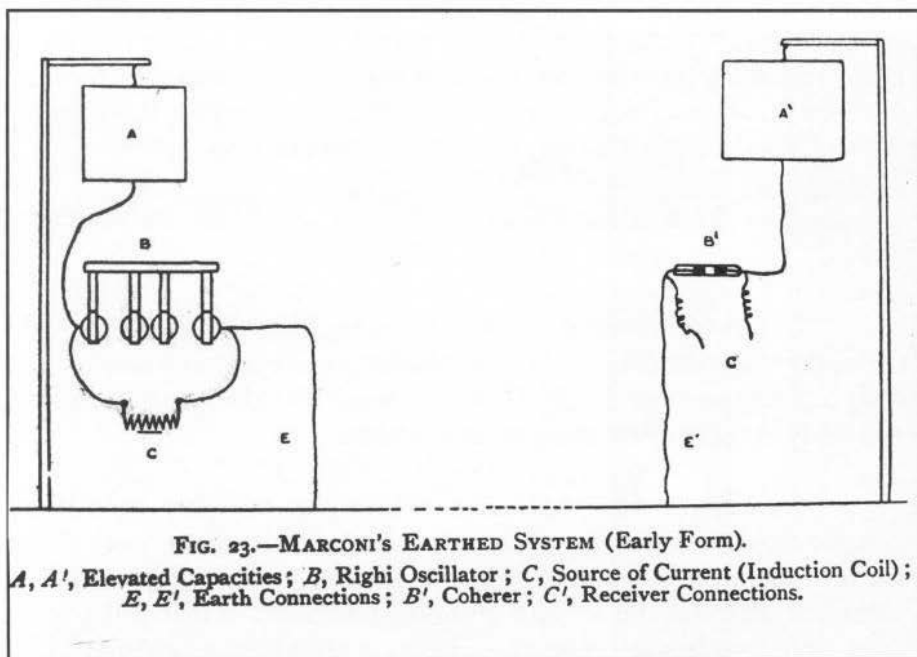


Figure 4. Marconi wireless apparatus using a grounded vertical antenna.
 Source: *Handbook of Wireless Telegraphy*, James Erskine-Murray, 1907

Towards the end of 1894 Guglielmo substituted a device known as the Branley coherer, replacing the Hertz gap as the detector. It consisted of a small glass tube with metal plugs at each end. The middle space was filled with fine metal particles which cohered, or bonded together when in the presence of electromagnetic waves. This device, when connected to a battery and a doorbell, acted as a switch in the circuit, ringing a doorbell in response to a signal. The battery circuit could also be used to operate a tapper, which, when placed close to the coherer, would strike the side of the glass and loosen up the metal granules to be ready for the next signal. (Also see Fig. 25.)

In later developments, he employed a polarized relay to activate the tapper mechanism, simultaneously operating a telegraph printing instrument (Morse inker) to record the signals received. (Also see Fig. 26.) An additional improvement in distance was obtained by connecting metal plates to the spark gap terminals of the transmitter and receiver, in the hope that the longer waves would also provide longer signaling distances.

In December, 1894, after spending countless hours constructing apparatus with no success, he was able to perform a demonstration for his

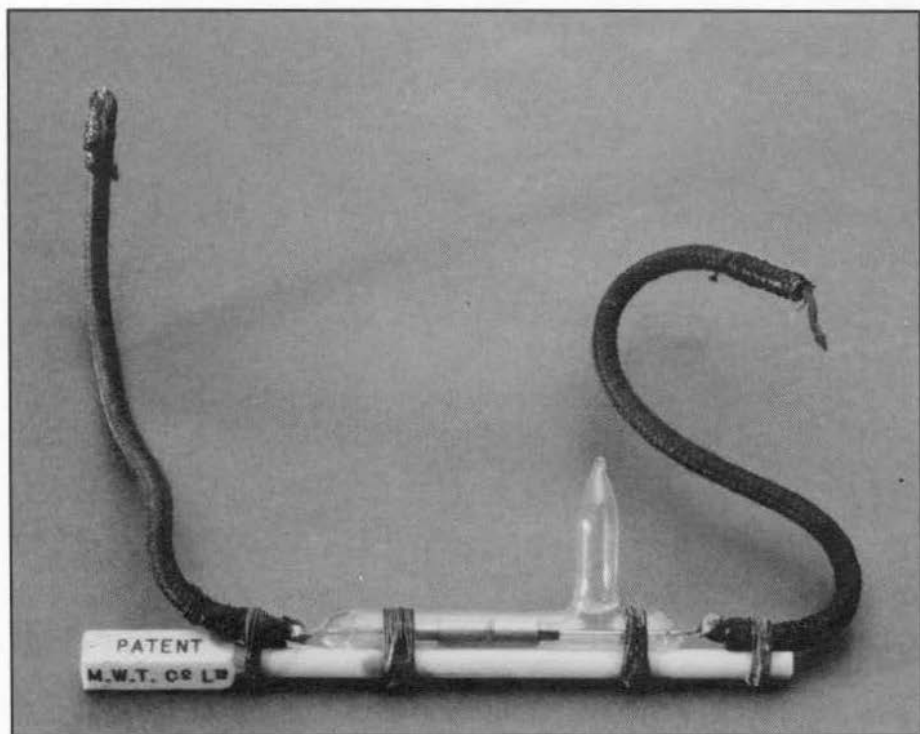


Figure 5. The Marconi Coherer and its ivory supporting rod, which Guglielmo utilized as the heart of his wireless receiver. Source: Kreuzer Collection

mother. Pressing a key in one room, he made a bell ring in another, thirty feet away. This was the beginning of wireless communication!⁷

During the spring and summer of 1895, he concentrated on improving his apparatus, most notably the coherer. Marconi tried many different kinds of metal filings, and eventually determined that a combination of 95% nickel and 5% silver produced the most sensitive device. He narrowed the space between the metal plugs and exhausted the air from the glass tube to about 1/1000th of an atmosphere, thereby increasing its reliability for signaling at greater distances. He moved his receiver to the lower floors of the house and then finally out to the garden.⁸

He was now in need of more serious funds to continue his experiments. When he approached his father for financial assistance, proof was demanded of the future possibility of signaling with his wireless. His father asked him to send an "S"; Marconi immediately did so. Suitably impressed, Giuseppe gave him 5,000 lira (\$1,000) to expand his experiments.⁹

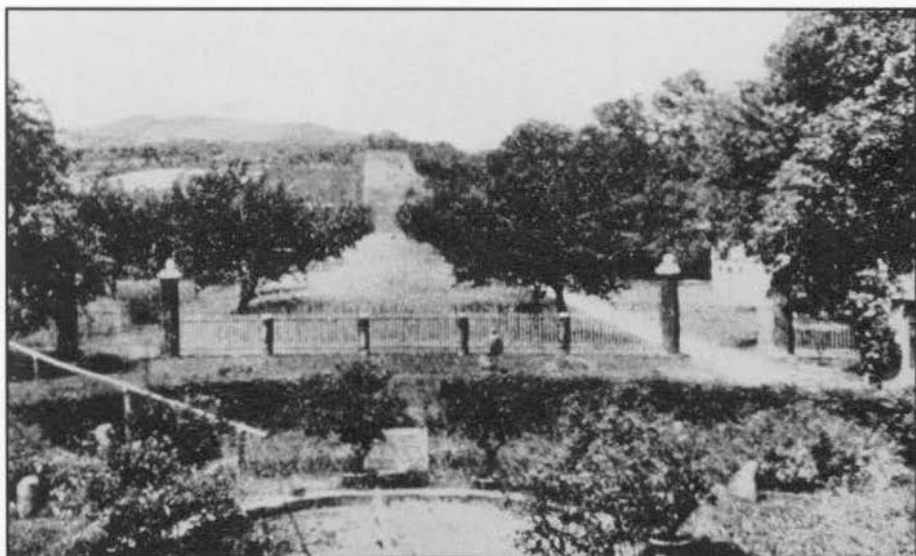


Figure 6. The grounds at the Villa Grifone at Pontecchio. Scene of the first out-doors wireless experiments.

Source: *Marconi-Master of Space*, Jacot & Collier, 1935

Guglielmo continued his experiments outside at the Villa Grifone, placing a metal plate on the ground hooked to one end of the spark coil, connecting the other to a metal cylinder on the top of a pole. The results were incredible! He could now signal for hundreds of meters with this contrivance! It was Marconi's first real antenna system. Now the electromagnetic waves could travel much further with increased signal strength.

Attempting further experiments with this grounded vertical antenna, he found that the distance over which the waves traveled was directly related to the size of the cylinder and how high it stood above the ground. For instance, if a sheet of tin one foot square was placed six feet high, he could receive signals 100 feet away. When the height was increased to twelve feet above the ground, he could receive signals 300 feet away, and finally, if he raised the height to 25 feet he received signals at 1300 feet! Marconi continued with related experiments, burying the metal plate and raising a larger metal cylinder high in the air, until he succeeded in signaling over distances of 1 1/2 miles.¹⁰

At the end of 1895 Marconi decided to offer his system to the Italian Ministry Of Posts and Telegraphs. They rejected his proposal on the basis that since wireless was allied to the sea, it would be better offered to the English who had greater shipping activity. It is interesting to surmise that had the Italian Navy been approached, the entire history of wireless telegraphy might have been rewritten.¹¹



Figure 7. Marconi, his parents and brother Alfonso at the Villa Grifone park in Bologna just prior to his 1896 trip to England. Source: Marconi Company Archives

Annie Marconi now began, in earnest, to contact her kinfolk in Ireland with the possibility of offering the system to the British government for signaling between their lightships and the shore. Finally, Annie received an invitation from Guglielmo's cousin, Henry Jameson-Davis, an experienced business man and milling engineer. He occupied a prime position to aid Marconi in furthering his interests.

On February 2nd, 1896, 21 year old Guglielmo and his mother arrived safely in England. Full of hopes and dreams, they ran into almost immediate opposition from the customs inspectors, who looked upon the Italian youth with suspicion while they examined his "black boxes," convinced the wires and apparatus inside might be a bomb! The coherer receiver and spark transmitter were rendered useless from the rough handling they received from the customs agents.¹²

Henry Jameson-Davis met them at Victoria Station and assured Guglielmo that repairs were possible. The next week Henry busied himself with acquiring the materials needed to repair the apparatus, meanwhile developing a warm personal interest in the young man.



Figure 8. Marconi and the mysterious black box which he brought to England.
Source: Marconi Company Archives

Annie and Guglielmo rented a house in Bayswater, a quiet section of London and an appropriate place in which to continue his work. Henry Jameson-Davis introduced Guglielmo to one of the foremost patent lawyers in London who would work to establish Marconi's priority with his inventions. For four months Guglielmo labored in the preparation of his patent papers, while performing further experiments.

On June 2, 1896, Marconi deposited a provisional specification of his invention in the London Patent Office. On March 2, 1897, he followed this up with a complete specification, including eleven drawings for improvements in transmitting impulses and signals. This reached acceptance on July 2, 1897, with the granting of patent #12,039.¹³

Having established his priority in the system of wireless communication, his thoughts were next directed to the task of locating the best person to further promote his interests. It was decided that the Chief Engineer of the Post Office, Mr. William Preece, would be the person to approach; he was the man in charge of all forms of communication in England. Through a

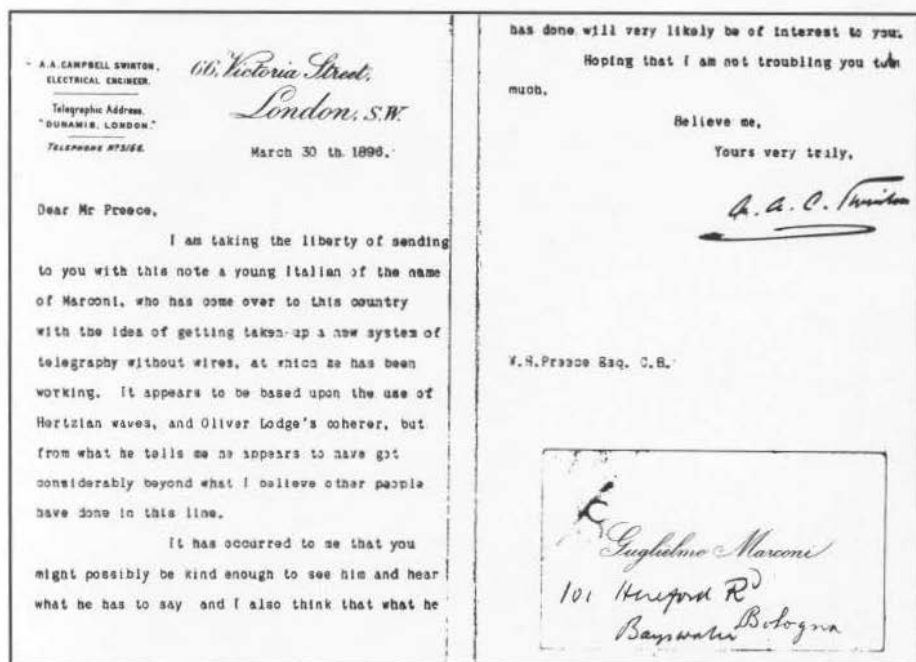


Figure 9. The letter of introduction from A.A. Campbell Swinton, which Marconi presented to Mr. W. Preece, Engineer-in-Chief of the Post Office.
Source: Marconi Company Archives

fortunate coincidence, one of Henry Jameson Davis's friends was A.A. Campbell Swinton. An electrical engineer, he had witnessed some of Guglielmo's demonstrations in London and agreed to provide him with a letter of introduction to Mr. Preece.¹⁴

On a day in July, 1896, a young Italian man called at the G.P.O. West building and presented a letter of recommendation from A. A. Campbell Swinton to Mr. William Preece. Mr. Preece brought the youth into his office and watched as he placed on a table the contents of two large bags. Among the items was an induction coil, a Righi gap, and a small glass tube containing fine silver and nickel filings—the improved Marconi coherer.

Marconi performed numerous experiments for William Preece throughout the day. Preece was impressed, and offered Guglielmo the use of his laboratory for future experiments. More important, he promised to exercise his influence in arranging a demonstration of the wireless system for the heads of the British Postal Telegraph Department.

Marconi moved into Preece's laboratory and carried on a series of more extensive tests. The first official demonstration occurred on July 27th before

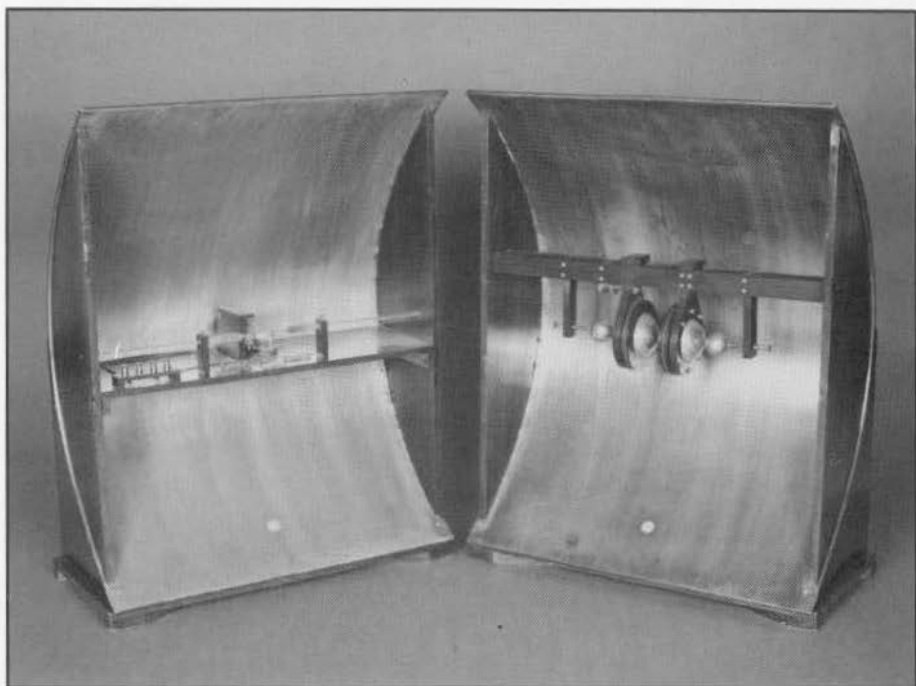


Figure 10. Parabolic transmitter and receiver at the Marconi Company Museum in Chelmsford, England. Possibly an early reproduction of Marconi's original experimental apparatus. Source: Marconi Company Archives

senior officials and engineers of the G.P.O., on the roof of the G.P.O. building in St. Martin's-le-Grand. His transmitter consisted of a Righi spark gap placed in the focal line of a parabolic reflector which was fabricated of sheet copper. His receiver combined the improved Branly coherer, a polarized relay, a Morse inker for recording, and a parabolic reflector.¹⁵

He was able to communicate with a station manned by members of Preece's staff on another G.P.O. building in Queen Victoria Street, near the Thames embankment, a distance somewhat less than a mile. An epoch-making day, not only was it an unqualified success for Marconi, but it marked the beginning of the British interest in wireless telegraphy.

With this initial accomplishment behind him, government support for further demonstrations was easily obtained. Marconi's first government demonstration was arranged on Salisbury Plain, near Stonehenge, on September 2, 1896. This sight was chosen because of the privacy needed for these clandestine tests. Officers representing both the army and navy were present, and a range of 1 3/4 miles was recorded.¹⁶

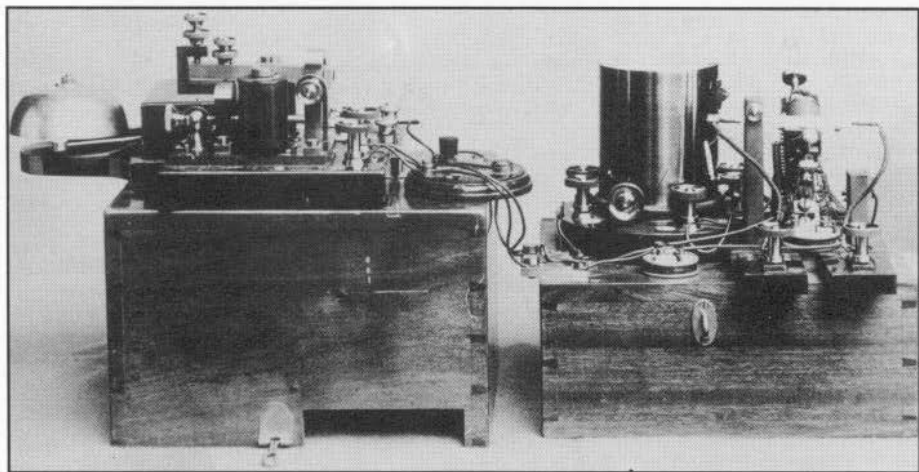


Figure 11. A detailed view inside the black box that helped make Marconi famous throughout the world. Source: Marconi Company Archives

A second series of tests was carried out in March, 1897, using the same site on Salisbury Plain, with longer antennas supported by kites. Communication was extended to distances up to 4 1/2 miles.¹⁷ A Mr. G. S. Kemp was assigned to assist Marconi with the venture, beginning an association which was to last over 35 years, until Kemp's death in 1932. This experiment attracted considerable attention from both the press and the public at home and abroad.

The first public demonstration of wireless was held at Toynbee Hall in London during a December lecture given by William Preece. This historic demonstration verified that Marconi was developing a penchant for showmanship. He moved mysteriously around the auditorium carrying a receiver, which included an electric doorbell. Whenever Preece pressed the telegraph key, activating the spark gap, the doorbell in Marconi's hand rang. Both pieces of apparatus were enclosed in black painted boxes to further mystify the public.¹⁸

Having shown that his system functioned over land, he next proceeded to attempt communications over water. Here he hoped to provide even more useful applications for his wireless signals. In the spring of 1897, Marconi moved his equipment to the Bristol Channel, setting up a receiving station at Lavernock Point in Penarth, and erecting a transmitter on the Channel island of Flatholm, 3 1/2 miles away. After a few days of antenna problems, communications were finally established.

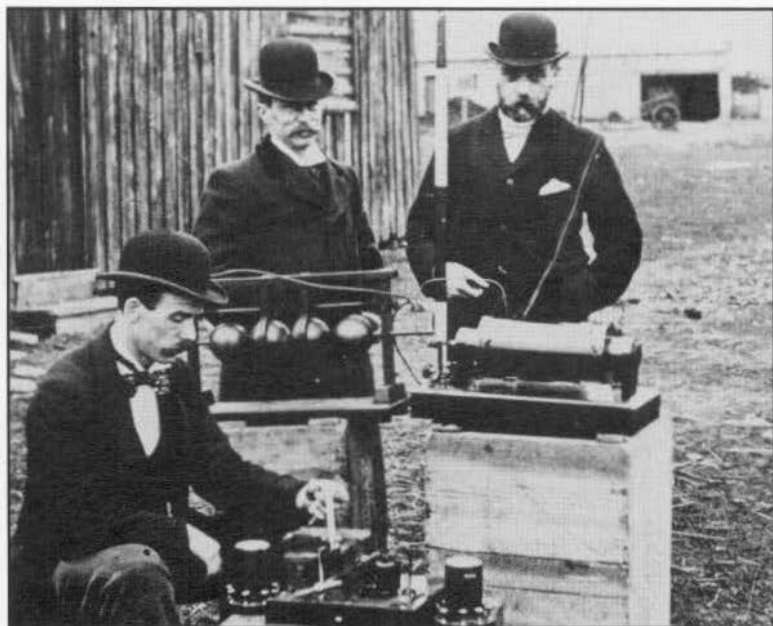


Figure 12. Post Office engineers inspecting Marconi's equipment during the Bristol Channel tests of 1897.

Source: Marconi Company Archives

On May 18 Marconi moved his transmitter to Brean Down. Using a kite to support his antenna, he was successful in signaling 8.7 miles over water.¹⁹

Professor Adolphus Slaby, a German electrical scientist, was also present at these tests. He submitted a very admirable report of Marconi's work for an article he contributed to the *Century Magazine* in April, 1898.

It is interesting to note that although Marconi was in possession of German patents covering his invention, about a year later patents were granted to Prof. Slaby. He had devised a different antenna system, and developed in collaboration with Count Arco the Slaby-Arco system of wireless telegraphy. In 1903 this company merged with Braun Company and Siemens-Halske to form the Telefunken company, a conglomerate which is still in business today.

William Preece gave a lecture at the Royal Institution of Great Britain on Friday, June 8, 1897, entitled "Signalling Through Space Without Wires". In this lecture he described his own system of wireless telegraphy using an induction method, comparing it to Marconi's use of Hertzian Wave telegraphy. He extolled Marconi's system and supported Marconi's use of Branly's coherer and Righi's spark gap, ending his lecture with this:

Lecture & Practical Demonstration

OF

MARCONI'S

WONDERFUL SYSTEM OF

WIRELESS TELEGRAPHY

BY MR.

WILLIAM LYND.



The
instruments
used are
supplied by the
WIRELESS
TELEGRAPH
SIGNAL CO..

And prepared
specially for
Mr. LYND by
Signor
MARCONI

MARCONI AND HIS MARVELLOUS APPARATUS.

How to Send Telegrams through Space and Apparent Obstacles will be demonstrated during the course of the Lecture. Mr. LYND will be assisted by Mr. W. W. BRADFELD, one of Signor Marconi's Experimental Assistants.

Figure 13. A poster of 1897 advertising a lecture by William Lynd and W. W. Bradfield demonstrating Marconi's wireless telegraph apparatus.

Source: Marconi
Company Archives

It has been said that Mr. Marconi has done nothing new. He has not discovered any new rays; his transmitter is comparatively old; his receiver is based on Branly's coherer. Columbus did not invent the egg, but he showed how to make it stand on its end, and Marconi has produced, from known means, a new electric eye, more delicate than any known electrical instrument, and a new system of telegraphy that will reach places hitherto inaccessible. There are a great many practical points connected with this system that require to be threshed out in practical manner before it can be placed on the market, but enough has been done to prove its value, and to show that for shipping and lighthouse purposes it will be a great and valuable acquisition.²⁰

In April, 1897, Marconi was approached by Henry Jameson Davis who proposed that a company be formed to develop and exploit his invention. Marconi resisted, feeling that he owed much to the G.P.O. for the valuable support given him in the early days. He had reached a point, however, where considerable capital would be necessary if he was to continue progress with wireless. Therefore, Marconi informed Preece of his requirements; he needed about £25,000 to develop and patent his system.²¹

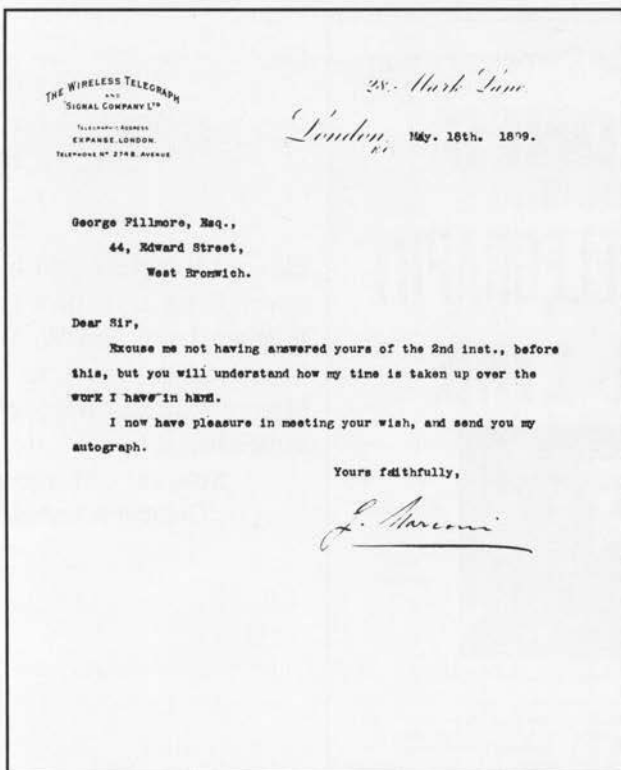


Figure 14. A letter-head from the first wireless telegraph company in the world, signed by Marconi for an autograph collector.

Source: Kreuzer Collection

Although William Preece made a recommendation to his superiors to offer Marconi £10,000 for his patent, the government refused and no offer was made. Tired of kicking his heels on the doorstep of the British Treasury, Marconi relented, and on July 20, 1897 the first wireless company was formed: The Wireless Telegraph and Signal Company, Ltd.²²

The Company paid Marconi £15,000 in cash, plus 60,000 of the 100,000 shares of £1 each. This comprised the authorized capital for his patent rights, of which all were relinquished excepting the Italian rights to his system. The balance of 40,000 shares was to be put on the market for public subscription. The cash to purchase these shares was subscribed mostly by the Jameson and Davis families, with some capital coming from family members in Scotland. Henry Jameson-Davis, representing the interests of his family, became the first managing director.²³

Guglielmo received an invitation from the Italian government to go to Spezia and Rome and give a demonstration of his wireless telegraph system. Marconi arrived during July, 1897, and immediately set about assembling his receiving apparatus on a tugboat. The transmitter was located on the inner shore of the Gulf of Spezia with a vertical antenna wire 78 feet high ending in a zinc

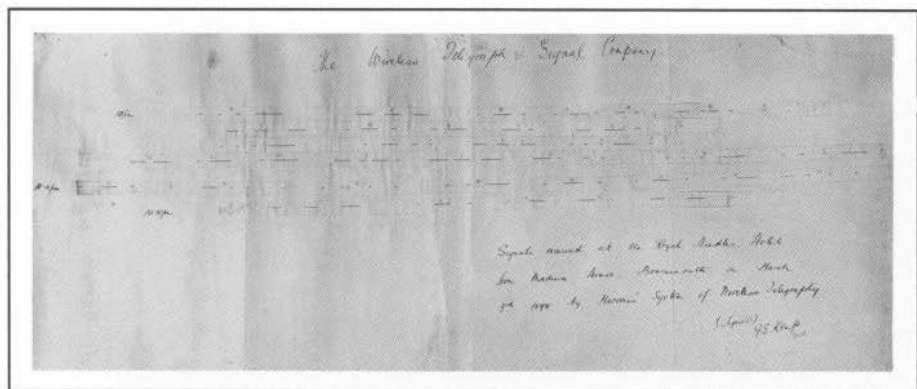


Figure 15. A record of the original signals received at the Royal Needles Hotel from the Madiera House, Bournemouth on March 3, 1898, signed by G.S. Kemp.
Source: Marconi Company Archives

plate, while the receiving antenna was 48 feet high, grounded in the water of the bay.²⁴

The first signals were received at a distance of 2 1/2 miles, but when the transmitting antenna was raised to 90 feet he extended his reception to eight miles. This was the first time a signal was received using a moving receiving set.

The receiver was then transferred to the Italian warship, and the aerial on the receiving station was raised to 90 feet, while increasing the transmitter antenna to 111 feet. With these changes Marconi was successful in achieving signals up to 11 1/2 miles from shore, the greatest distance he had ever realized.²⁵

With his work completed at Spezia, he took his apparatus to Rome and performed a successful demonstration for the king and queen of Italy. As a result, it was announced that Marconi wireless apparatus was to be adopted by the Italian Navy.

Upon Marconi's return to England he was forced to attend to the final details of his company's formation. Not only busy with his experiments, he was confronted with the rigors of establishing a commercial plan for his system of wireless telegraphy. The inception of his company marked the end of any official support from the British Post Office. Although relations were strained, he always remained close friends with William Preece.

POST OFFICE TELEGRAPHS.		No. of Telegram
NOTE.—If the accuracy of an Inland Telegram be doubted, the telegram will be repeated on payment of half the amount. If the accuracy of an Inland Telegram be doubted, the telegram will be repeated on payment of half the amount. If the accuracy of an Inland Telegram be doubted, the telegram will be repeated on payment of half the amount.		Office Stamp 700 WILLIAM PIERCE ALL 30 28 14-600
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Handed in at	Bournemouth at 2.30 p.m.	Received at 3.20 p.m.
TO { Maclean Physical Laboratory University Glasgow Tell Blith this is transmitted commercially through ether from alum bay to Bournemouth and by postal telegraph thence to Glasgow Kelvin		
N.B.—This Form must accompany any inquiry made respecting this Telegram.		

Figure 16. The first paid wireless telegram sent by Lord Kelvin to his chief assistant on June 3rd, 1898, from the Royal Needles Hotel at Alum Bay.

Source: Marconi Company Archives

In September, 1897, the British Post Office began to perform their own experiments at Dover, without informing Marconi. He was upset about not being invited to participate in the experiments, which were made using his apparatus. After the tests produced disappointing results, an attempt was made to secure Marconi's participation, but he declined.²⁶

The first goal of the new company was to establish some permanent wireless stations to be used for public demonstrations and trials. The first was constructed in November at the Needles Hotel, Alum Bay, on the Isle of Wight. The following month, tests of ship-to-shore communications were carried out using a small steamer named *The Solent*. Messages were sent at distances of 18 miles.²⁷

In February, 1898, a companion station was erected at the Madiera Hotel in Bournemouth, and on March 3, successful communication was established fourteen miles away. The antennas were 120 feet high and the standard 10" induction coil was used.²⁸

On June 3, 1898, Lord Kelvin visited the Needles station. It was then that Kelvin sent the first wireless telegram, to his chief assistant in the Physical Laboratory of the University of Glasgow. Kelvin insisted on donating a



Figure 17. An early ship-board wireless station aboard the lightship *Tongue* in 1900. It used the Marconi coherer receiver and the 10" spark coil.

Source: Marconi Company Archives

payment of one shilling for the service, giving it the distinction of being the first paid Marconigram. The station at Bournemouth was moved in September (because of trouble with the hotel management) to the Haven Hotel in Poole, where it remained a prominent experimental center until it was finally closed in 1926.

The first income the Wireless Telegraph and Signal Company was to receive came in the way of an assignment from the Dublin Daily Express newspaper. Marconi was commissioned to relay the progress of the boats in the 1898 Kingstown Regatta. This novel experiment proved a complete success. Developments were reported to a newspaper on shore during the race, and a special edition was published and sold on the streets.

Seven hundred messages were sent in all, ranging in distance from ten to 25 miles. Similar demonstrations began to be reported in newspapers all over the world, producing a profound effect on the public's perception of wireless.³⁰

Trinity House, a corporation in charge of lighthouses and lightships, commissioned Marconi to install his apparatus at the South Foreland lighthouse at Dover and on the *East Goodwin Lightship*, anchored twelve miles from shore.³¹

On Christmas eve of 1898, with George Kemp at the key, two-way communication was established. This winter was particularly severe, with many storms moving up the coast. The ship was constantly tossed about, subjected to high winds and very heavy seas. In early January a huge wave ripped away a section of the ship's bulwarks. The damage was reported immediately to the South Foreland lighthouse; wireless had finally been used to report an accident at sea.³²

Kemp instructed the lighthouse men in the operation of the transmitter and receiver, as well as Morse code. This proved a time-consuming task, but finally on January 9 he was able to leave after spending 22 days on board. On March 17, 1899, a decidedly foggy day, the steamship *Elbe* went aground on the Shoals. The East Goodwin heard the steamer's incessant whistles and summoned help by way of the wireless on board. The entire crew of the grounded steamer was rescued, as well as more than a quarter of a million dollars in goods. This was the first time wireless was used to save lives as well as property.³³

Sir Ambrose Fleming commented, "Marconi was eminently utilitarian. His predominant interest was not in purely scientific knowledge per se, but in its practical application for useful purposes."³⁴

In March, Guglielmo was anxious to establish communication between France and England, across the English Channel. He requested permission from the French government to erect a wireless station at Wimereux, France. The French consented, and on March 27, 1899, after a few weeks of construction, Marconi was ready for the test.³⁵

With French dignitaries in attendance, Marconi sent and received messages to the South Foreland Lighthouse in England immediately, and with no problems, greatly impressing his audience. The English Channel had been bridged by wireless!

Upon the completion of the tests across the English Channel, Marconi decided to turn his attention to America. He had been invited by James Gordon Bennett, owner of the New York Herald, to report the America Cup Races by wireless. On September 11, 1899, Marconi sailed from Liverpool, arriving in New York on September 21. Greeted with some fanfare due to the Herald's prior announcement, Marconi wasn't the least bit intimidated by the tall buildings. What did upset him, though, was the discovery that a trunk was missing from his many pieces of luggage—the important one containing the coherers!

After frantic searching it was found that the trunk had been loaded on the wrong ship in Liverpool, and was now in Boston. W.W. Bradfield, one of

Marconi's assistants, went to Boston and brought the vital trunk back.³⁶ On September 29, 1899, the equipment was in place and the first United States shipboard wireless message sent by Marconi was transmitted from the *S.S. Ponce* to a shore station set up on a tall building at Navesink Highlands, New Jersey.

The races began on October 16 after a few days delay owing to the light winds present along the eastern seaboard. They were relatively uneventful with the yacht *Columbia* retaining the America cup. Marconi had sent a total of 1200 messages and was considered a national hero.³⁷ The advantages of ship-to-shore communications were apparent. Many prominent New Yorkers were given an opportunity to take advantage of the wireless on board the *S.S. Ponce* to send messages back to the big city, and were also treated to the latest stock market quotations on Wall Street.

With the successful yacht races behind him, Marconi was commissioned by the U.S. Navy to perform tests for them using the same equipment installed for the races. The cruiser *New York* and the battleship *Massachusetts* were chosen for this task; a maximum distance of 36 miles was covered. During the experiment, however, another station transmitted messages at ten-minute intervals, rendering the Morse inker tapes completely unintelligible due to interference.³⁸

This was of immense importance to Marconi, as it demonstrated a main weakness in his system, the inability to separate multiple signals. He had been working on selective tuning, but was far from finished and hadn't filed any patents for his apparatus. The Navy looked upon these tests as failures, so Marconi left the U.S. without any orders for his wireless telegraph instruments.

Before he left, however, Marconi issued a prospectus to form a company for the purpose of purchasing the American patent rights held by the English company. Receiving a favorable response, the American Marconi Telegraph Company was organized on November 22, 1899, under the laws of the state of New Jersey. Its authorized capital was \$10,000,000, covered by the issuance of two million shares of stock with a par value of \$5.00 each. This company was the first of many foreign subsidiaries which Marconi was to form.³⁹

Upon completion of the U.S. Naval demonstrations, he packed up and headed back to England on the *S.S. St. Paul*. While on this return trip, when 66 miles from the Needles station, he received satisfactory signals. He was able to record the news of the day, including progress of the South African war. He authorized the captain to print the news on a single sheet, calling it the "Transatlantic Times." He sold it to the passengers at \$1 per copy, with the

Guglielmo Marconi

THE TRANSATLANTIC TIMES.

VOLUME I.

NUMBER I.

THE TRANSATLANTIC TIMES

Published on board the "St. Paul," at sea, en route for England, November 15th, 1899.

One Dollar per Copy is paid of the Seamen's Fund.

By W. W. Brashfield, Editor-in-Chief, Mr. T. Bowden, Assistant Editor, Miss J. B. E. Egan, Treasurer, Mr. H. H. McClellan, Managing Editor.

Through the courtesy of Mr. G. Marconi, the passengers on board the "St. Paul," are accorded a rare privilege, that of receiving news several hours before landing. Mr. Marconi and his assistants have arranged for work the apparatus used in reporting the Yacht Race in New York, and are now receiving dispatches from their station at the Needles. War news from South Africa and home messages from London and Paris are being received.

The most important dispatches are published on the opposite page. As all know, this is the first time that such a venture has been undertaken. A newspaper published at sea with Wireless Telegraph messages received and printed on ship going twenty knots an hour!

This is the second voyage eastward of the "St. Paul." There are 375 passengers on board, counting the children, grained and extinguished. The day runs have been as follows:—

Nov. 9th	435
" 10th	436
" 11th	435
" 12th	434
" 13th	433
" 14th	434
" 15th	432

97 miles to Needles at 11 o'clock, Nov. 15th.

BULLETINS

1:50 p.m. First Signal received, 66 miles from Needles

2:40 "Was that you 'St. Paul'?" 50 miles from Needles.

2:50 Hurrah! Welcome Home! Where are you?

2:30 47 miles. Ladies, Kimberley and Maudie, wishing out well. No big battle. 15,000 men recently landed.

2:40 "At Ladies no more killed. Commemoration at Kimberley elected the destruction of ONE TON PUFF. It was auctioned for £2.00. It is felt that period of anxiety and strain is over, and that our turn has come."

4:00 Sorry to say the U. S. A. Cruiser "Charleston" is lost. All hands saved.

The thanks of the Editors are given to Captain Jamison, who grants us the privilege of the issue.

Figure 18. An original copy of the "Transatlantic Times" signed by Marconi while on board the *S.S. St. Paul*. Source: Kreuzer Collection

proceeds going to the Seamen's Fund. This was the first time a newspaper had been printed on board a ship with the help of wireless.⁴⁰

By the end of 1899 communication between ships and land stations using distances of 80 to 100 miles had become an accomplished fact. Without contracts, however, there was no revenue for the Marconi Company. By 1900, shipping companies, realizing the value and importance of the discovery, began to install wireless on their ships.

Maclaurin records in his book, "Marconi had decided in 1900 that he would not sell apparatus outright, but only lease it. This decision covered all types of wireless equipment; when Fleming wrote Marconi to ask if his valve could be put on sale, Marconi replied; "...your valve is likely to become a very valuable receiver for long distance wireless, and I wish if possible to keep the monopoly of these experiments to ourselves." Marconi's leasing arrangements to ships provided for a certain number of messages per month without charge, plus a standard rate per word above this maximum. The company trained and furnished wireless operators who remained on the company payroll. Marconi reasoned that, if the equipment were sold outright, the price charged would not



Figure 19. A colorful British Marconi Company stock certificate issue in 1909 and signed by Alfonso Marconi, one of the directors.

Source: Kreuzer Collection

be enough to support any effective research and engineering. And he was determined to perfect his system of radio communications by continuing his experiments.”⁴¹

In the United States, however, Marconi found himself compelled to sell rather than lease wireless apparatus, but he imposed many restrictions. The U.S. Navy would have to pay a substantial flat royalty each year and equipment had to be purchased at current market prices, including duty. He also required messages to be accepted for relay from Marconi equipped merchant vessels and commercial Marconi stations. Marconi equipment was not to be used for communication with any rival system except in an emergency or when working with another naval vessel. The U. S. Navy refused to agree to these conditions, and sought to work with other companies such as Slaby-Arco and the Deforest Wireless Company. The Marconi Company lost many lucrative contracts in the U.S. because of its stance on this issue.

At the annual meeting of The Wireless Telegraph and Signal Company on February 23, 1900, a resolution was adopted which changed the name of

the company to "Marconi's Wireless Telegraph Company, Ltd.". On April 25 (Marconi's twenty-sixth birthday) The Marconi International Marine Company was formed to establish marine wireless telegraphy on a sound commercial basis throughout the world. Its main purpose was to equip and manage the maritime wireless activities across the seas.⁴²

In 1898 Marconi had introduced the "Jigger", or oscillation coil, whereby the primary was wired in the aerial circuit, with the secondary connected to the coherer circuit of the receiver. Using various taps, this coil helped match the antenna to the receiver. The first "syntonized" tuned transmitter designed by Marconi was constructed in 1899 following arduous experimentation lasting over a year. It consisted of an oscillation coil transformer using a spark gap and a Leyden jar condenser in the primary, while the secondary was connected to an adjustable inductance in the aerial circuit. (Also see Fig. 23.)

On April 26, 1900, Guglielmo Marconi filed a provisional specification for a patent on selective tuning. It incorporated tuned coupled circuits which enabled the wireless receiver to tune out unwanted stations causing interference with the reception of the intended transmitter. The Marconi "Four Sevens Patent" (#7,777) controlled the use of syntononic wireless telegraphy and was granted in 1901.⁴³ Sir Oliver Lodge had also been doing research along these lines and eventually sold his rights to the Marconi Company. This patent put the Marconi Company very close to a monopoly of syntononic wireless telegraphy in England and America.

In July, 1900, the British Admiralty contracted for the installation of the Marconi system in 26 warships and six coast stations. The financial terms were settled in November, 1901, providing the Marconi Company with £100 per set as an annual royalty for a period of ten years.⁴⁴ In September, 1901, Lloyd's of London placed an order for ten signaling stations to be fitted with wireless - primarily for maritime communication. Marconi received greater pleasure from the prestige gained by the order than any financial benefit.⁴⁵

THE ATLANTIC IS CROSSED!

Ever since Marconi bridged the English Channel linking England and Europe by wireless, his mind was occupied by a much greater challenge—to send wireless signals across the Atlantic Ocean.

For this purpose, John Ambrose Fleming was brought in to design and build the transmitter because of his skill in working with high voltage alternating current systems.⁴⁶ R.N. Vyvyan was chosen to take charge of the

construction of the station and assist Fleming in obtaining the necessary machinery. A spot near Land's End, at Poldhu, was chosen for the transmitter site, and work was begun in December, 1900. After a major setback, caused by the collapse of the immense antenna system, it was replaced by a large fan-type aerial, and the construction at Poldhu was completed by February, 1901.⁴⁷

Marconi then turned his attention to the other side of the Atlantic, and proceeded to erect a similar antenna system on Cape Cod, near South Wellfleet, Mass. The same fate awaited this mammoth structure; it too was destroyed by a storm in October, 1901, prior to Marconi's scheduled arrival for the tests. It was decided to use a balloon or kite to raise the antenna, and move the site from Cape Cod to St. John's, Newfoundland, where the distance was not so great.

Marconi and his entourage of G.S. Kemp and P.W. Paget arrived in secrecy at St. John's on December 6, 1901. Guglielmo chose to keep his tests confidential in case they weren't successful. He would not brag beforehand about what he might do - he was careful to give his best shot first, and only then announce his victory.

He chose a site next to the Cabot Memorial Tower, an unused army barracks on a high point overlooking St. John's, known as Signal Hill. The first few days were spent hauling in the shipping trunks which contained gas cylinders, balloons, kites, receiving apparatus and sheets of zinc for the earth system. The next chore was digging in the frozen earth to install the zinc-plate ground system.⁴⁸

It was a cold and damp place, so they worked in shifts, coming in frequently to warm themselves by the coal stove. It was agreed that the operators at the Poldhu station would begin sending the letter "S" during a three-hour period of transmission at 12 noon on the 11th day of December. This letter was chosen not only because it could easily be recognized, but also for the lack of a suitable sending key. They were forced to use a ponderous electrical switch to make and break the circuit. Also, the transmitter was not built to withstand the full power of the supply, and if dashes were sent, the generator and other components might have overheated excessively.⁴⁹

Early in the day they finished wiring up the receiver and then attempted to raise a balloon to lift the heavy aerial wire, but a gale force wind ripped it loose from its moorings. The wind continued the next day and it was decided to try using a kite to raise the antenna system, which now would be untuned, owing to the varying height of the kite. He was forced to use the Italian Navy coherer, developed by Luigi Solari, and abandon the Morse recorder in favor of a headphone. Marconi and his crew assembled the new apparatus, raised the cumbersome kite up about 400 feet in the air, and waited for noon.⁵⁰

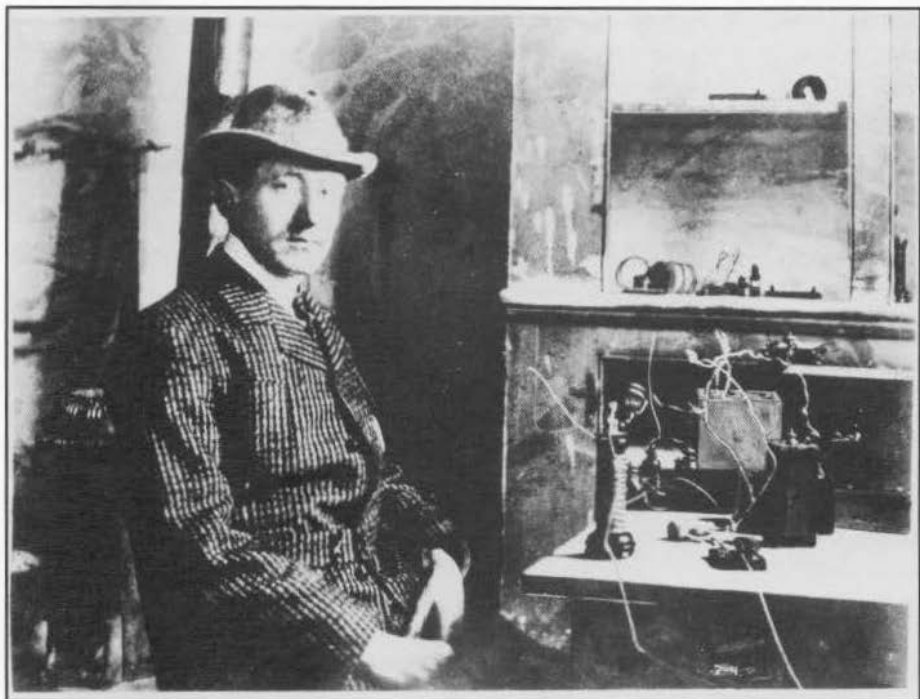


Figure 20. Guglielmo Marconi sitting with his receiving set in St. John's, Newfoundland, on December 12, 1901. Source: Marconi Company Archives

At precisely 12 noon Marconi picked up the headphone and placed it to his ear. After a few minutes he handed it to Kemp and asked if he heard anything. Kemp exclaimed that he too had heard it—the letter S—three dots! They continued to receive the signal intermittently for the rest of the day and part of the next. Kemp's diary records for history the various times of reception and signal strengths.⁵¹

The date of December 12, 1901, has become one of the major landmarks in the development of wireless communication. After much contemplation Marconi decided to release the news to the media concerning his triumph over the Atlantic—2,170 miles! The reaction of the public to the feat was enthusiastic, but there were many scientists who doubted this feat had actually occurred.⁵²

After the successful test had been made public, the Anglo-American Telegraph Company threatened legal proceedings against Marconi if he continued to receive signals in Newfoundland. Since they held the sole rights for telegraph traffic on the island, Marconi decided to request another

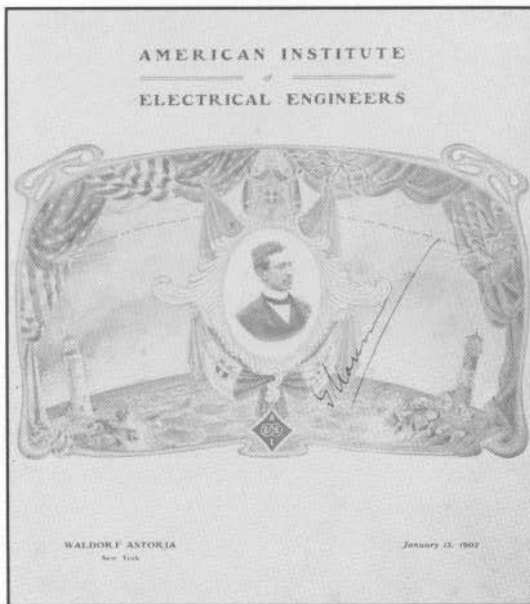


Figure 21. Cover of the menu presented at the AIEE Dinner where Marconi was the guest of honor following his successful transatlantic signal. Marconi autographed this one.

Source: Kreuzer Collection

opportunity in Ottawa. There the Canadian government offered a subsidy of £16,000 towards the erection of a wireless station on the coast of Canada, but with one condition; the rate for wireless messages could not exceed ten cents a word. Marconi gratefully accepted and began planning a high-power station to be erected near the town of Glace Bay on Cape Breton Island, Nova Scotia.⁵³

Before returning to England, Marconi was invited to be the guest of honor for the American Institute of Electrical Engineers annual dinner at New York City's Waldorf Astoria Hotel. The affair was arranged with only 48 hours notice owing to the unavoidable uncertainty of Marconi's arrival from Canada, and his intention of sailing almost immediately from New York after the dinner.⁵⁴

It was truly a gala affair, with the hall including "a tablet at each side, one labeled Poldhu and the other St. John's, with a string of fairy lights joining the two tablets, blinking on and off in the dot-dot-dot of the Morse letter "S." Marconi's name was spelled out in lights above the high table which was backed by the Stars and Stripes. More lights supplemented the floral decorations, where the final touch was the setting down of ice stuck with tiny frozen telegraph poles."⁵⁵

Such was the appropriate greeting Marconi received from the Americans after his triumph over the Atlantic. Attended by over 300 members and their wives, many dignitaries were present, including Charles Steinmetz, Elihu Thomson, Alexander Graham Bell, Mrs. Thomas Edison, Michael Pupin

and Frank Sprague. Telegrams containing congratulations were received from Nikola Tesla and Thomas Edison, who were unable to attend the hastily planned reception.

Ten days later Marconi sailed to England to confer with the board of directors concerning which direction the company should take following his great accomplishment. His initial plan was to put to rest the doubts regarding the actual reception of his transatlantic signal. A month to the day from his return to England, he again sailed for America. This time he brought his new syntonic receiver for use in receiving the signals from Poldhu.

Aboard the *S.S. Philadelphia*, equipped with an antenna 150 feet high, Marconi and his assistants, R.N. Vyvyan and C.S. Franklin, carried out their experiments. The receiving equipment included a Morse ink recorder to provide a permanent record of the messages received at the station. Complete messages were received at a distance of 1551 miles, while signals were detected up to 2,099 miles, just short of the distance from Poldhu to Newfoundland. The demonstration was witnessed by the captain and the chief officer, as well as many passengers who showed an interest. The captain signed the paper tapes as further proof that signals had indeed been received at the distance claimed!⁵⁶

When the ship docked at New York, there were hordes of reporters awaiting his arrival. He calmly handed them the signed tapes with the comment, "This merely confirms what I have previously done in Newfoundland. There is no longer any question about the ability of wireless telegraphy to transmit messages across the Atlantic."⁵⁷ Within a year he would be described as the most interviewed man in the world.

The completion of the transatlantic tests signaled an end to Marconi's early experiments. We will now examine the formation and development of the various wireless telegraph factories in the U.K. and North America.

THE MANUFACTURING PLANTS OF THE MARCONI COMPANY

THE CHELMSFORD, ENGLAND, FACTORY

Shortly after his arrival in England, Marconi began assembling apparatus for experimentation in his Bayswater residence. Later, he was to continue his work as he moved to subsequent dwellings in the London area.

Until early 1899 the ground floor room of the Haven Hotel station at Poole served as the main laboratory and manufacturing facility. W. J. Baker, in



Figure 22. The earliest known trade catalog dedicated to wireless apparatus. It promotes the Marconi system of wireless, and was donated to the Franklin Institute Library in October, 1897.

Source: Kreuzer Collection

A History of The Marconi Company writes, “A visitor to the station in 1899 records that in the main laboratory he found two of the earliest employees, the brothers Cave, at one table making coherers; at another, P.W. Paget was winding receiver chokes and at a third Marconi himself was busy fitting V-plug gaps into an experimental coherer. Outside, along the foreshore, Dr. Erskine Murray was conducting parabolic mirror reflector tests, using centimetric wavelengths.”⁵⁸

In due course Guglielmo was ready to begin commercial production of his system. Foremost, he needed to acquire a building in which to set up his own manufacturing facilities. Searching the area surrounding London, he decided on the Essex town of Chelmsford, about 35 miles away. Chelmsford had a number of advantages. Besides being close to London, cost of land was reasonable and the wide, flat, undeveloped countryside seemed highly suited for wireless experiments. It was also near the Port of London, which handled a considerable amount of shipping. This could lead to a potential source of income for the fledgling company.

In December, 1898, a former silk factory and furniture warehouse on Hall Street became the world’s first wireless factory. Although he occupied the

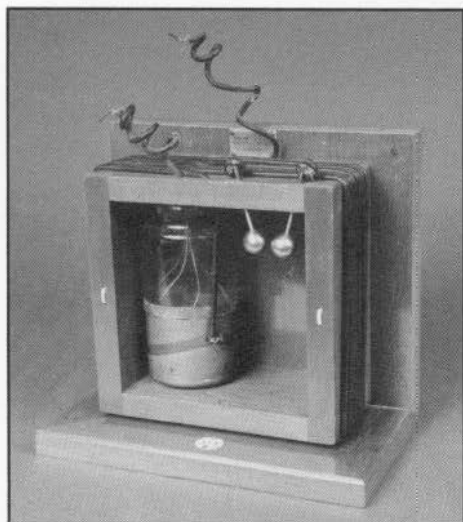


Figure 23. This is one of the original oscillating circuits employed by Marconi in 1899 which led to the introduction of tuned circuits in both transmitters and receivers. The square wood frame carries two windings. One of these is in series with the Leyden jar and spark gap, the balls of which were connected to the terminals of the induction coil. The other winding consists of a single turn connected between the aerial and ground. This arrangement provided more sustained oscillations and helped greatly to reduce the mutual interference previously experienced. It formed the basis of the famous "Four Sevens" patent (#7777) of 1900.

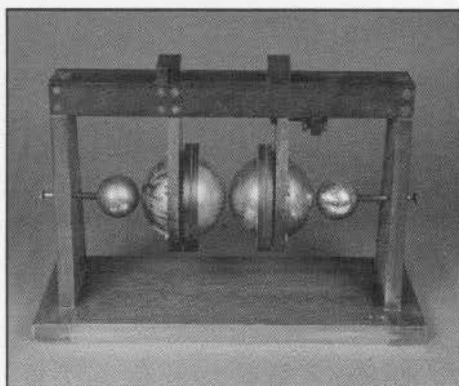
Source: Marconi Company Archives

building in November, it wasn't until January 25, 1899, that the lease was signed. The warehouse was empty and it took several months to acquire the necessary machine tools and design the manufacturing arrangement. The Directors' Report dated December 19, 1899, stated: "The machinery and plant have been installed and the works are in running order...."⁵⁹

Approximately 40-50 people were employed. The men worked on the ground floor in the machine shop and assembly area. The women were upstairs in the coil winding and condenser shop, where they insulated and lacquered the windings and assembled the induction coils. The items manufactured included the coherer, polarized relay, induction coil, Righi spark gap and tuned circuit. They were supervised by Mr. E.T. Priddle, the first Works Manager. In July

Figure 24. A Righi spark gap, developed by Augusto Righi and improved by Marconi. Dating from 1899, it was one of the first items manufactured by Marconi at Chelmsford.

Source: Marconi Company Archives



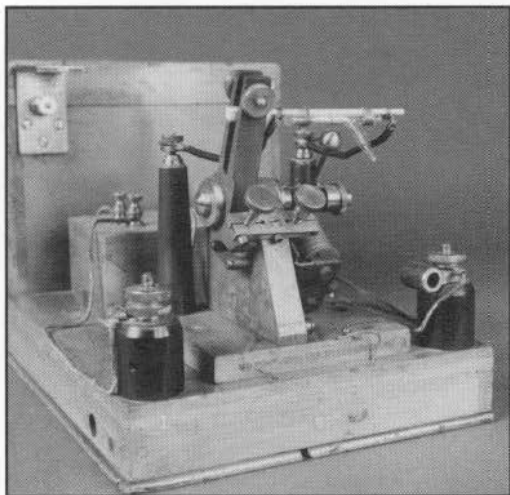


Figure 25. A detailed view of the coherer/decoherer assembly. Various styles were produced, using both wood and ebonite bases. This was standard ship's wireless equipment for the reception of telegraphic messages from 1898-1905.

Source: Marconi Company Archives

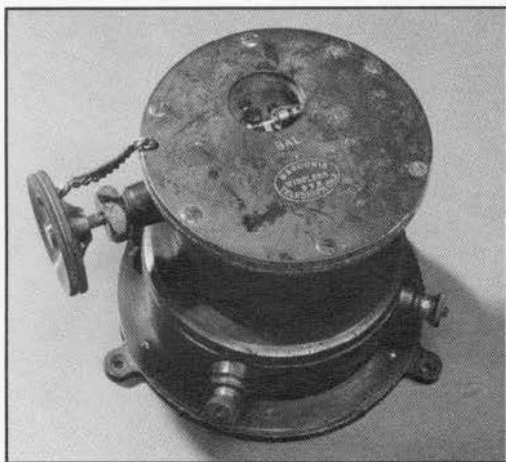
Dr. Erskine Murray left the experimental laboratory at the Haven Hotel in Poole to take charge of the technical work in Chelmsford.⁶⁰ By September, 1899, a station was in place at the factory; it was able to receive signals from the Wimereux station in France, 85 miles away.⁶¹

Although the Wireless Telegraph and Signal Company in 1900 had a technical staff of only 17 engineers, Marconi always had a way of surrounding himself with very knowledgeable men. Included among them were the famous personages W.W. Bradfield, W.H. Eccles, Andrew Gray, C.S. Franklin, J.A. Fleming, G.S. Kemp, Dr. Erskine Murray, H.M. Dowsett, H.J. Round and R.N. Vyvyan.⁶² (See Fig. 32)

The first significant order obtained by the Hall Street works was the Admiralty contract of July 4, 1900. They were requested to supply 32 sets of

Figure 26. A polarized relay, dating from about 1900 and used on the coherer receiver. With this device in the receiving circuit it was possible to record wireless signals on a Morse inker.

Source: Kreuzer Collection



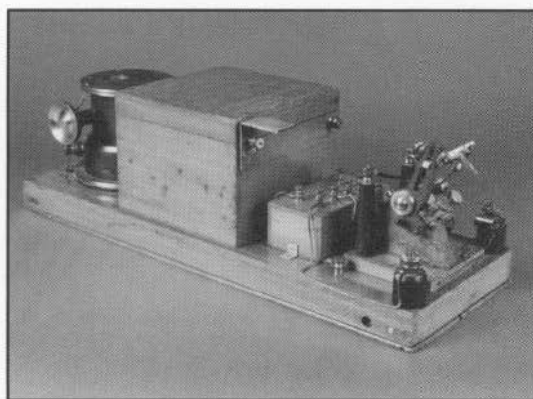


Figure 27. A complete coherer receiver, this style was used both on shipboard and in land stations, circa 1900. It was enclosed in a metal box to shield it from the station's spark transmitter.

Source: Marconi Company Archives

Figure 28. The Morse inker used with the coherer receiver to supply a permanent record of the wireless signals. Manufactured by Siemens Company, it was sold by the Marconi Wireless Company.

Source: Marconi Company Archives

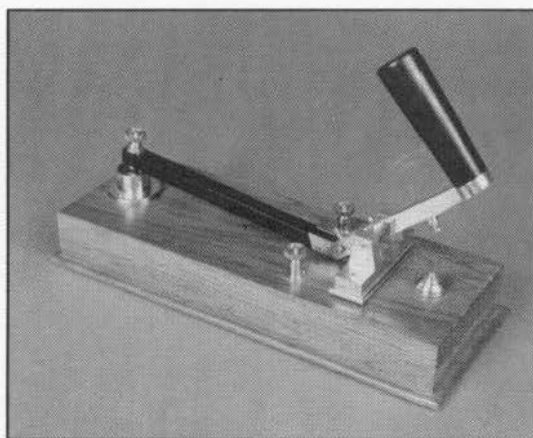
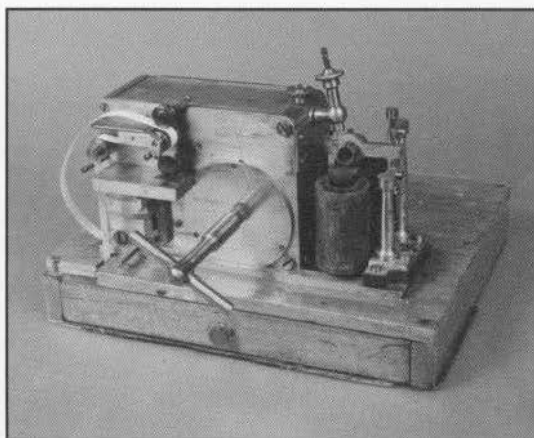


Figure 29. This is known as the "Grasshopper" key and was used in the first Marconi stations. It also served as an early form of antenna switch, for when done using the key, the arm fell back and connected the receiver with the antenna. This is a photo of a reproduction on display at the Marconi museum in Chelmsford.

Source: Marconi Company Archives

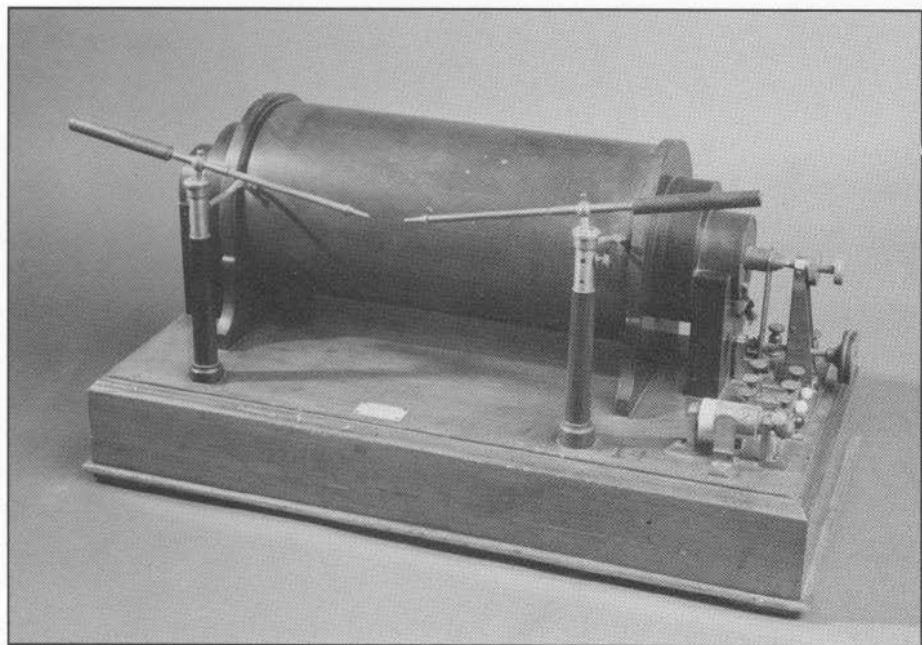


Figure 30. A 10" induction coil used in the earliest Marconi spark transmitters. The coils were wound in sections and fitted with a well-balanced condenser, a specially constructed platinum point interrupter and an adjustable spark gap.

Source: Kreuzer Collection



Figure 31. Women assembling various sections of the 10" induction coil at the Chelmsford Works. The forms for pouring the insulating wax can be seen in the background.

Source: Marconi Company Archives

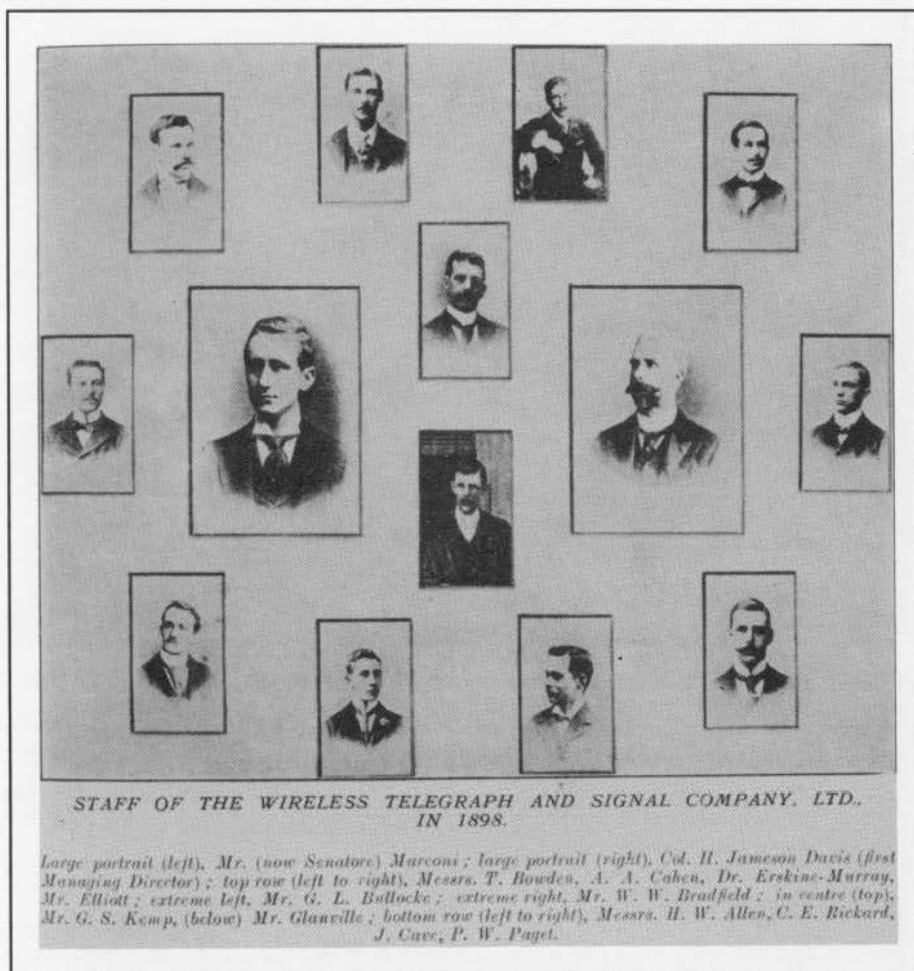


Figure 32. Staff of The Wireless Telegraph and Signal Company, Ltd. in 1898
Source: *The Wireless World*, November 1915

wireless apparatus for installation on British warships and at Admiralty land stations. The contract included spares, with an extra induction coil and an extra receiver for each installation. Deliveries began in September and were completed by November.

The Directors' Report dated December, 1900, made a short reference to the factory: "The works at Chelmsford have been improved and the plant and machinery increased, so that they can turn out all the apparatus likely to be required during the next twelve months..."

In the process of developing long distance wireless communications, many new forms of apparatus evolved. Among these, one of the most important

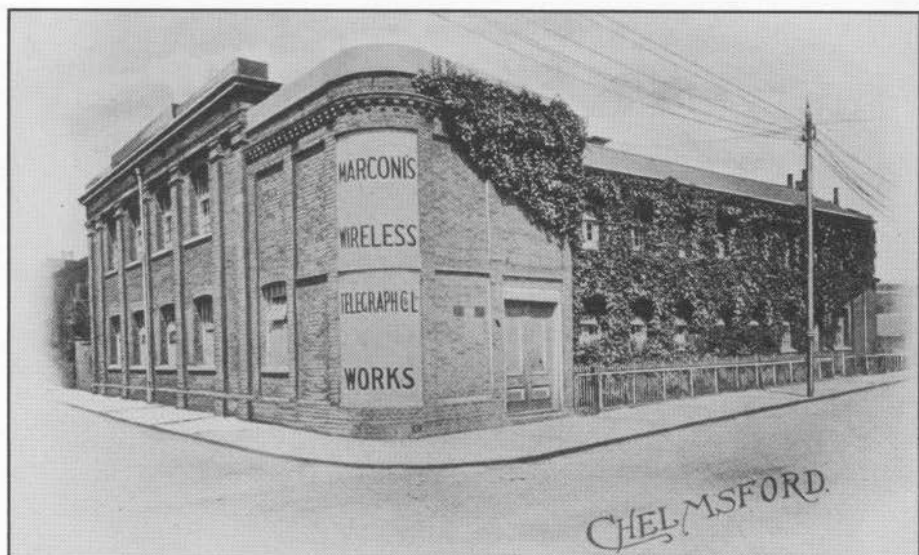


Figure 33. The Chelmsford Works as it appeared in 1900. The building is still standing, but the Marconi sign is gone.

Source: Marconi Stock Prospectus, 1903 - Kreuzer Collection



Figure 34. The mounting shop of the Chelmsford Factory, located on the 2nd floor, where the final assembly of transmitters and receivers took place.

Source: *The Marconigraph*, August 1912



Figure 35. The instrument test room at the Marconi Works in Chelmsford. Note the spacious work area available and the clean working conditions. (I wonder what's hidden in those cabinets?)

Source: *The Marconigraph*, November 1912

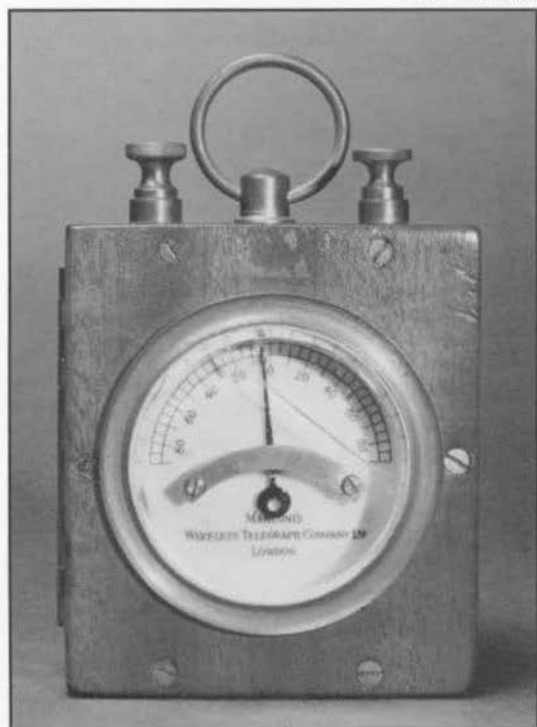


Figure 36. A galvanometer used in testing the circuits of early wireless installations, circa 1901.

Source: Kreuzer Collection

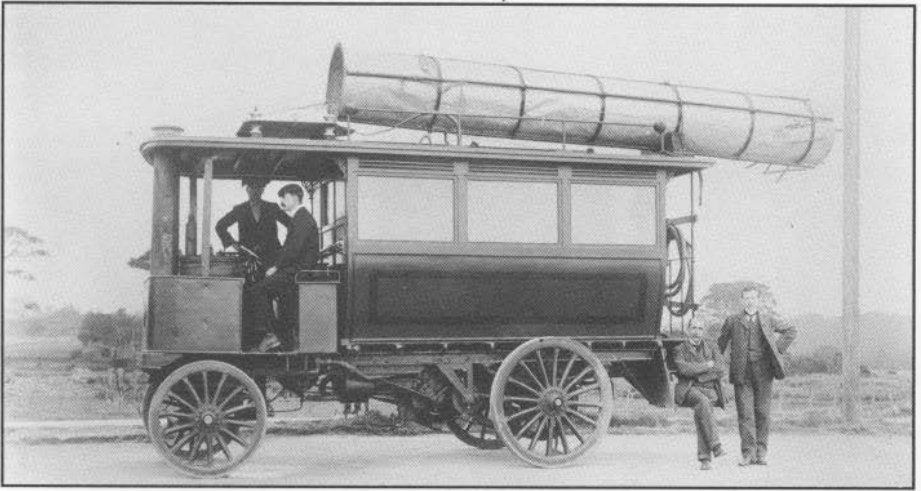


Figure 37. The first application of the Marconi system on the road. This steam motorbus includes a light zinc cylinder serving as its antenna. When stationary, the antenna was mounted vertically. Marconi can be seen standing at the rear, with John Ambrose Fleming sitting on the step. Communications were successful up to twenty miles using this outfit in 1901.

Source: Marconi Company Archives

was the magnetic detector. (Also see Fig. 112) Its development soon led to the demise of the unreliable coherer. The coherer's speed under the best of conditions was no better than ten words a minute, whereas the "Maggie" was able to match those obtained by wire telegraphy. On January 13, 1902, not long after the transatlantic test, while in New York, Marconi disclosed his idea for the magnetic detector to W.W. Bradfield. Having made a preliminary sketch in his notebook, he completed construction of the original prototype on April 20, performing his initial experiments on April 23, 1902. His first disclosure to the public was on June 12 at a meeting of the Royal Society, and he described the device in a paper released the following day.⁶³

On May 3, 1902, Marconi filed his first patent for the magnetic detector. In July, he conducted the original long distance tests aboard the Italian Navy cruiser, the *Carlo Alberto*. While sailing to the port city of Kronstadt, Russia, signals were satisfactorily received on the ship from some 1600 miles away. Marconi and his party continued on to the Mediterranean, then on to Nova Scotia where signals from the Poldhu station were received. Over the years to come, the magnetic detector was to prove invaluable for the reception of wireless signals. It remained in service up to the 1920s.⁶⁴

In 1904, the disc variable condenser was developed in Russia by C.S. Franklin while working on wireless communication during the Russo-Japanese



Figure 38. A prototype of Marconi's magnetic detector, used aboard the Italian Navy ship *Carol Alberto* in 1902. It was constructed in an ordinary cigar box.
Source: Luigi Solari, Marconi, 1940

Figure 39. An early transmitter-receiver designed for portable use in the field. Note the early variable condenser and miniature magnetic detector, circa 1908.
Source: Marconi Company Archives

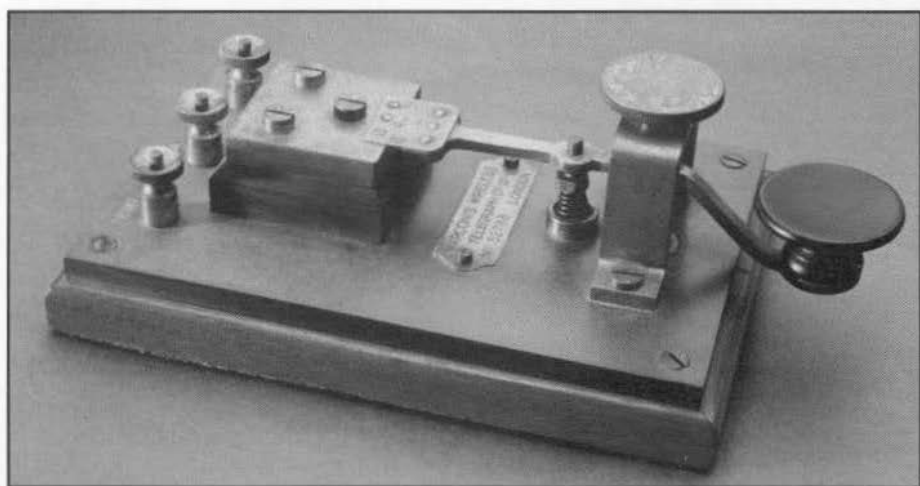


Figure 40. An unusual Marconi spark key with provisions for either normally open or normally closed contacts, circa 1907.

Source: Kreuzer Collection



Figure 41. The earliest company label used, it was pressed into wood, and appears on apparatus built from 1900 to 1904. We've never seen an example of wireless gear identified with the name of Marconi's first company, The Wireless Telegraph and Signal Company.

Source: Kreuzer Collection



Figure 42. An ivory nameplate used from about 1903 to 1907, usually found with serial numbers in the two and three digit range.

Source: Kreuzer Collection

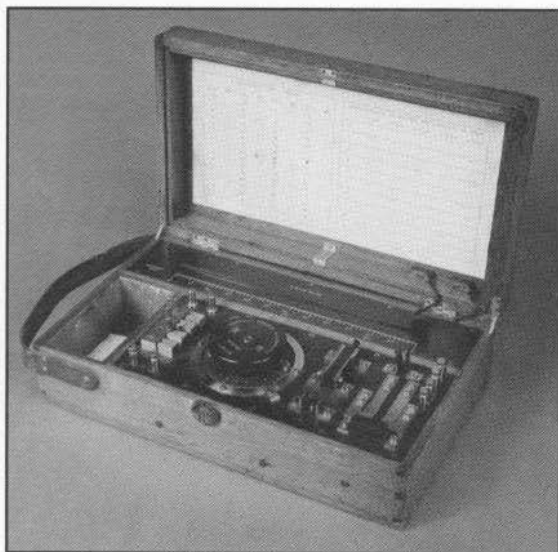


Figure 43. Made of sturdy brass, this nameplate can be found on apparatus built from about 1906 right up into the 1920s, with the serial numbers ranging from four to six digits.

Source: Kreuzer Collection

Figure 44. This instrument is known as a decremeter and dates from 1909. It was designed to measure the damping of high frequency circuits by means of simple adjustments. It could also be used for plotting tuning curves, and measuring wavelengths, capacity and inductance.

Source: Marconi Company Archives



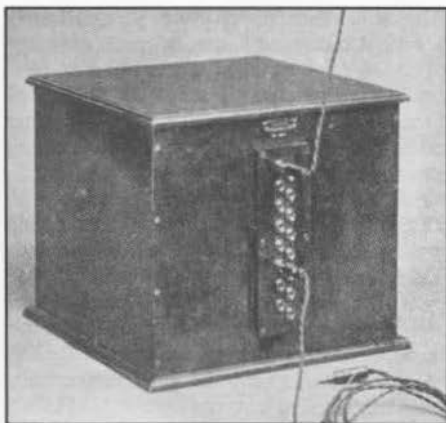
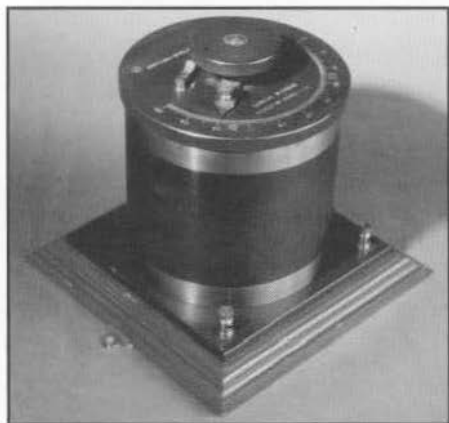


Figure 45. A large variable condenser used in laboratories where high values of capacitance were needed. Patented in 1906, the dielectric was made of ebonite. It weighs 35 pounds!
Source: Kreuzer Collection

Figure 46. This box contains a tapped coil used for tuning a receiver. Known as "The 60 foot tuning inductance," it was manufactured in 1904. It predates the Multiple Tuner.
Source: *Wireless World*, April 1917

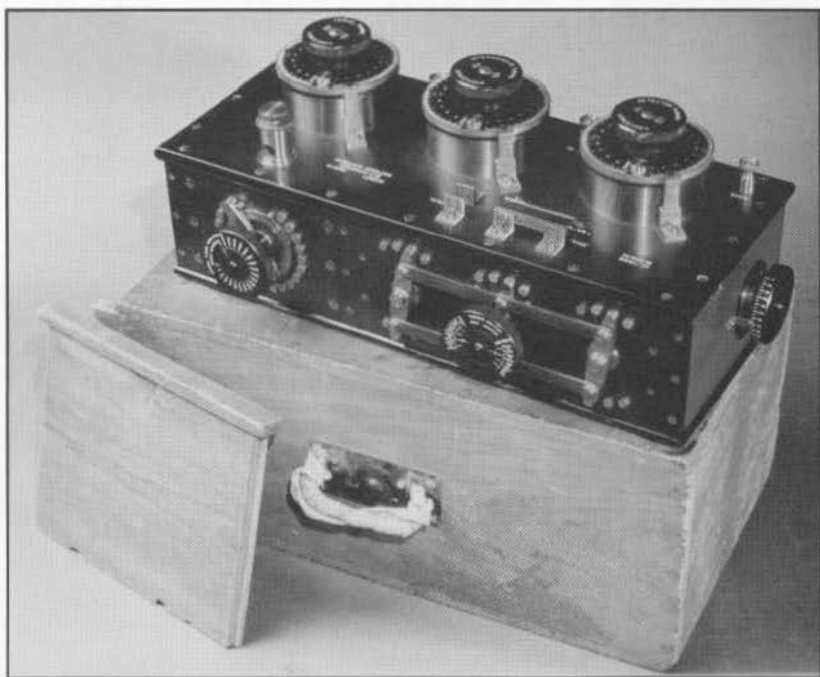


Figure 47. Marconi Multiple Tuner, patented in 1907, with the original velvet-lined shipping case. This instrument was used in the receiving circuit. Incorporating three adjustable L-C connected circuits, it was the first serious tuner ever developed. Source: Kreuzer Collection

MARCONI'S WIRELESS TELEGRAPH Co., LTD.

MULTIPLE TUNER No. 119

TABLE OF WAVE LENGTHS CORRESPONDING TO READINGS OF INTERMEDIATE CONDENSER WHEN INTENSIFIER HANDLE INDICATES AN ANGLE LESS THAN 10°

WAVE LENGTH IN METRES	TUNING SWITCH AT	INTERMEDIATE CONDENSER AT	WAVE LENGTH IN METRES	TUNING SWITCH AT	INTERMEDIATE CONDENSER AT
80.			300.	160.	0.77
80.			325.	0.85	1000.
100.			350.	0.90	1750.
110.	150.	0.29	375.	0.97	1800.
120.		0.40	400.	1.03	1350.
135.	0.50	450.	1.19	1400.	0.95
150.	0.55	500.	1.36	1500.	2.90
165.	0.66	550.	1.53	1600.	8.90
180.	0.60	600.	1.74	1700.	2.40
200.	0.64	650.	1.96	1800.	3.50
220.	0.96	700.	2.20	2000.	6.00
240.	0.62	750.	2.45	2200.	5.80
260.	0.67	800.	2.70	2400.	5.50
280.	0.72	850.	2.98	2550.	5.20

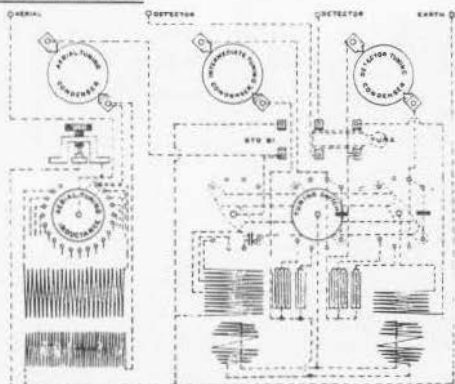


Figure 48. Schematic diagram of the Multiple Tuner and wave length chart as supplied from the factory. It accompanied the model illustrated in Figure 47.

Source: Kreuzer Collection

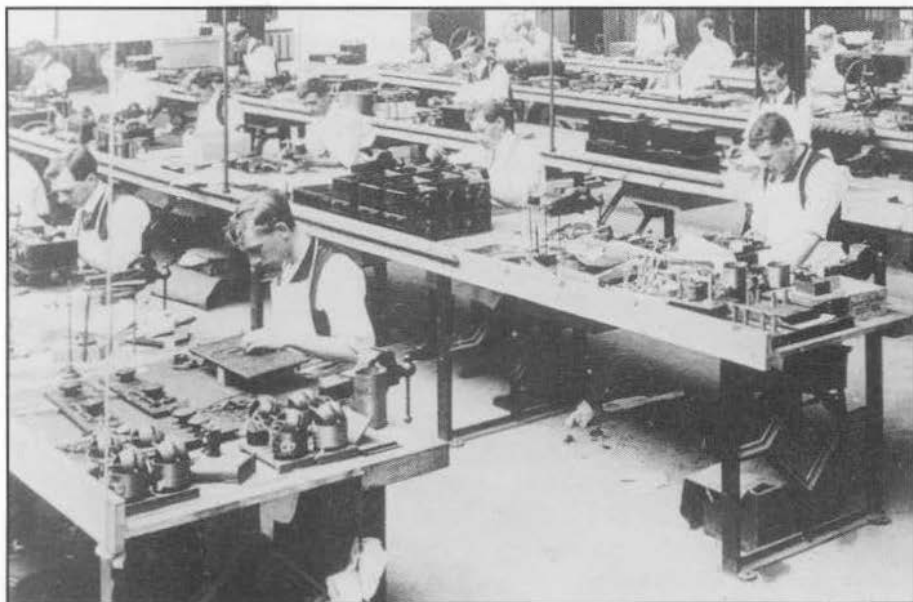


Figure 49. The assembly area at Chelmsford where the Multiple Tuners were built. Over 30 workers were employed due to the complicated assembly procedures.

Source: Marconi Company Archives

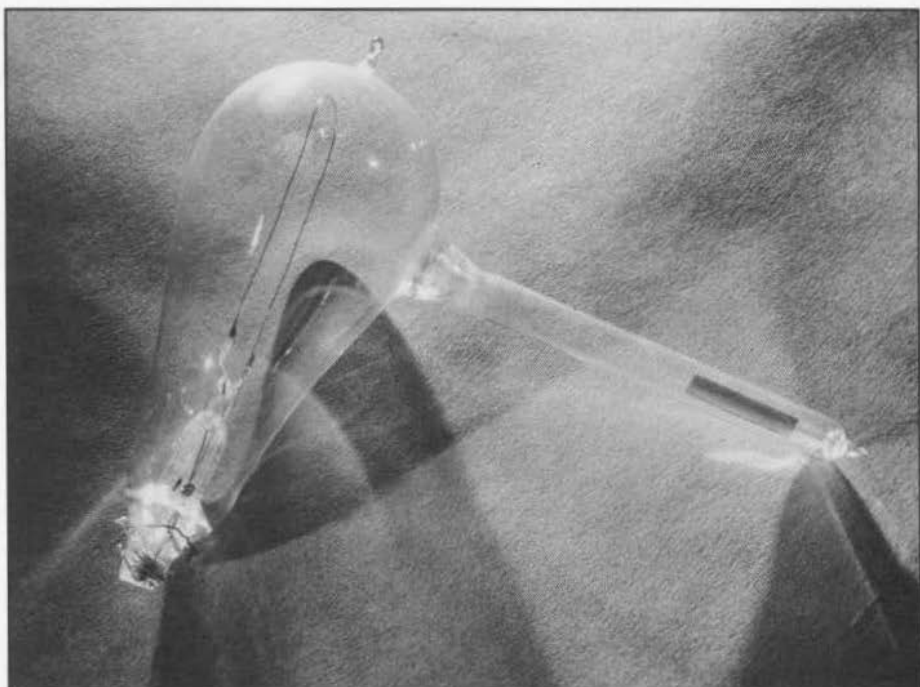


Figure 50. An 1884 Edison effect bulb, given to Sir William Preece by Thomas Edison. Note the plate at the end of the long tube on the right hand side. This diode is the grandfather of all electronic vacuum tubes.

Source: Kreuzer Collection

war. The design greatly simplified the adjustment of the receiver tuned circuit. Franklin went on to design a compact assembly of three tuned circuits, variable in wavelength and coupling. He patented this apparatus in 1907; it was known as the multiple tuner. With a tuning range of 500 to 8,000 feet, as labeled on the dial, it became a fitting companion for the famous "Maggie" or magnetic detector. Together they served to provide a true state of the art installation for shipboard and coastal stations.

One of the most important and famous of all apparatus developed at the Marconi Company was John Ambrose Fleming's diode vacuum tube. Fleming had been hired in 1899 as a technical consultant. He soon proved his value to the company by designing the first transatlantic station at Poldhu in 1901. In 1904 he began to experiment with chemical rectifiers, trying to develop a detector which would give him a visual indication of a signal. Frustrated by the absence of a breakthrough, he recalled an incident he had experienced in 1884 while working as an advisor to the Edison Electric Light Company.

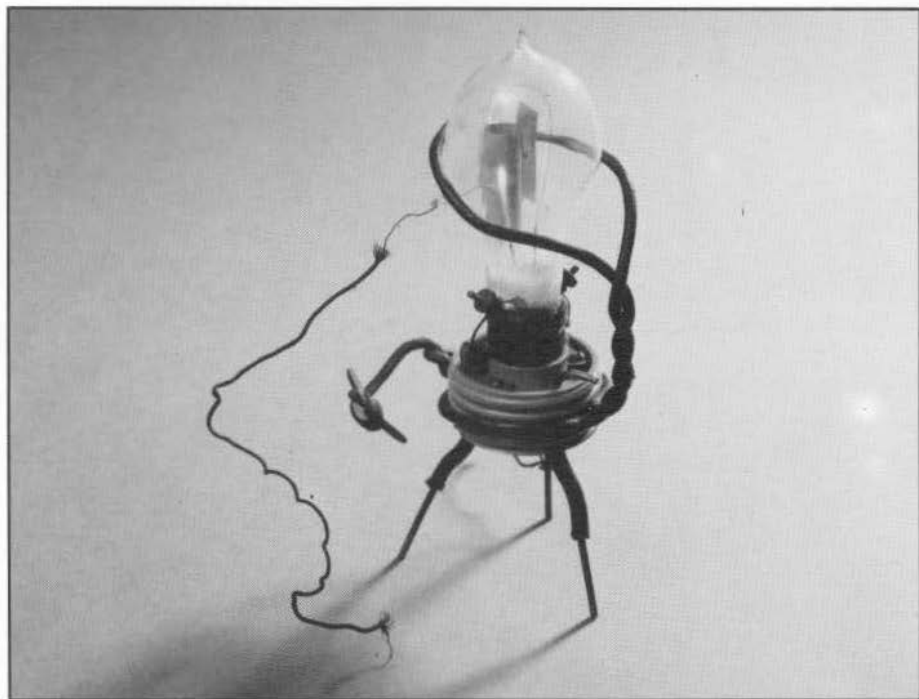


Figure 51. One of the original Fleming Valves designed and built by John Ambrose Fleming in 1904. This is the father of all electronic vacuum tubes.

Source: Marconi Company Archives

Fleming had traveled to America and visited with Thomas Edison to discuss some problems with the manufacture of light bulbs. While there Edison showed him a strange light bulb he had been working on. Edison noted a discoloration inside the glass envelope of the light bulbs due to the accumulation of carbon which had been thrown off by the filament. Hooking a galvanometer to the positive side of the D.C. supply, he discovered that a small current flowed from a piece of tinfoil placed inside the envelope. When connected to the negative side, no current flowed at all. At the time it was given the name "Edison Effect" and considered a scientific curiosity with no practical application.⁶⁵

Fleming decided to try this "valve" in a circuit. He connected the tinfoil plate to one side of the secondary of an oscillation coil through a galvanometer, with the opposite end hooked to the negative side of the filament's D.C. source. As he hoped, the signal was rectified by the Edison Effect bulb, providing a detector with the visual indication he had been looking for. Many experiments followed; even better results were obtained from a modern (1904) lamp constructed with a metal cylinder surrounding the

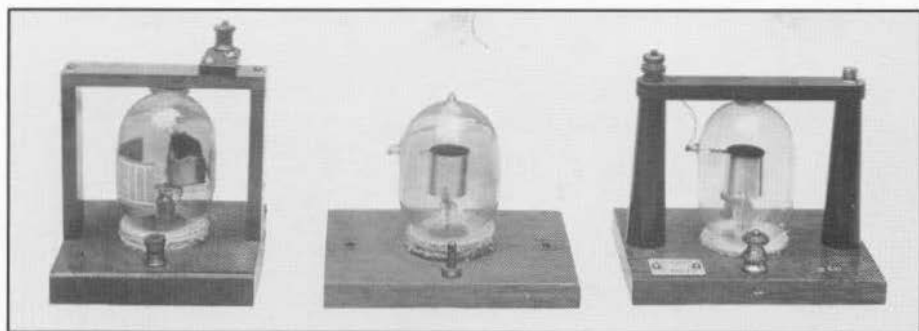


Figure 52. A group of three Fleming valves shown in various conditions. These were the first production vacuum tubes on the market. Known as "Gallows Mount" Fleming Valves, they were used as a substitute for the magnetic detector.
Source: Marconi Company Archives

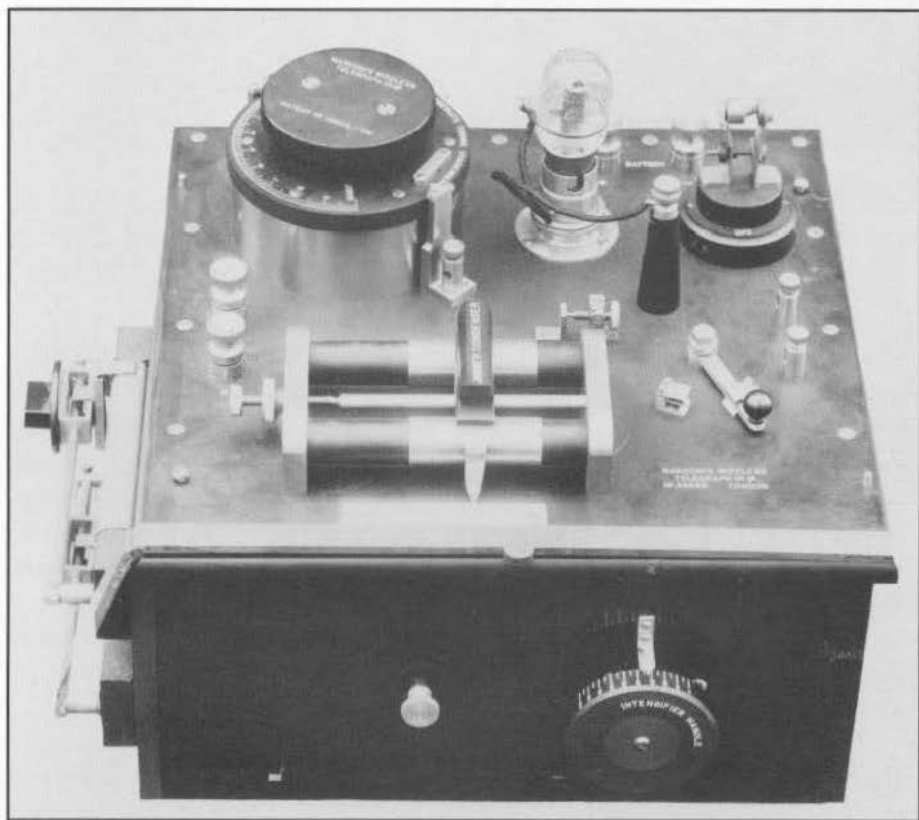


Figure 53. A Fleming Valve receiver using a crystal detector as a backup. Built around 1910, very few of these receivers are found in collections today.
Source: (Photo) Kreuzer Collection



Figure 54. A spare parts kit that includes various types of crystals as well as extra Fleming Valves. These boxes would have accompanied the tuner in Figure 53. Source: Kreuzer Collection

filament. Fleming immediately applied for a patent on November 16, 1904, a date now known as the birth of the thermionic valve.

Fleming labeled it “The Oscillation Valve.” Marconi recognized possibilities in the device and ordered it placed into production. Although not as sensitive or as sturdy as the Maggie, the new detector wasn’t as susceptible to the effects of heavy static disturbances. For this reason the Fleming valve was often used as a standby to the magnetic detector.⁶⁶ (Also see Fig. 106.)

By December 24, 1904 the Marconi Company had 69 land stations in operation and 124 ships equipped with its system of wireless telegraphy. Both commercial and military communications benefited from the new installations. One of the main selling points which the Marconi Company presented to promising clients was the number of lives and value of equipment already saved through this important medium.⁶⁷

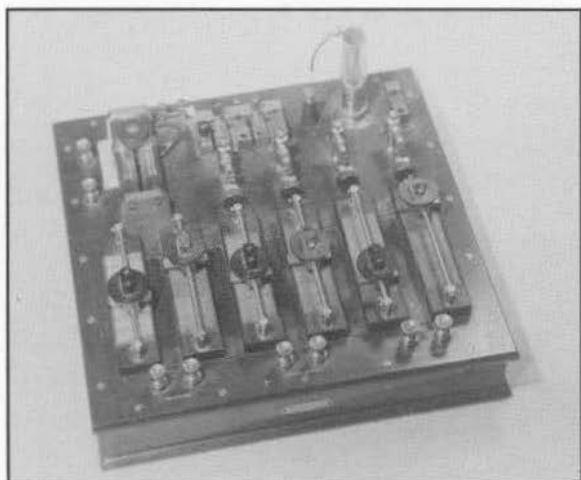
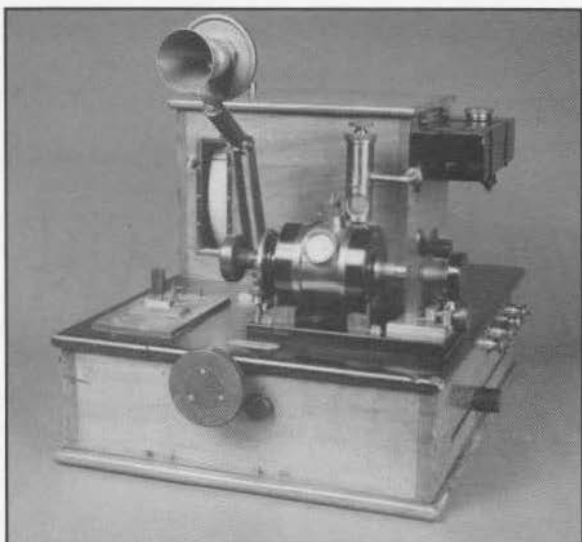


Figure 55. A British Marconi detector box, circa 1910. This unit includes provisions for switching between four different crystal detectors, as well as a Fleming Valve.

Photo: Antique Wireless Association Museum

Figure 56. Marconi radio-telephone arc transmitter, designed by Captain H.J. Round of the Marconi Company in 1910. Note the visual arrangements for burning the arc in an atmosphere of hydrocarbons, along with a clockwork mechanism to rotate the anode, thereby improving the steadiness of burning.

Source: Marconi Company Archives



By early 1905 Mr. H. Cuthbert Hall, the Managing Director, decided to move the factory from Chelmsford to Dalston in North London. A large building with four floors and three wings was procured. Here wireless equipment was manufactured, as well as a new line of spark coils for the growing automobile industry. The move worked well for a time, but the strain of having two large facilities to maintain along with the construction and operation of the Glace Bay and Clifden stations depleted the company finances.

In March, 1908, with the resignation of Mr. Cuthbert Hall, Marconi took over as Managing Director of the Company. The Dalston works had become a white elephant with an unsuitable engineering department and



Figure 57. The receiving station at Clifden, Ireland. The magnetic detector is used with early type variable condensers and a multiple-tapped tuning coil.

Source: Marconi Company Archives

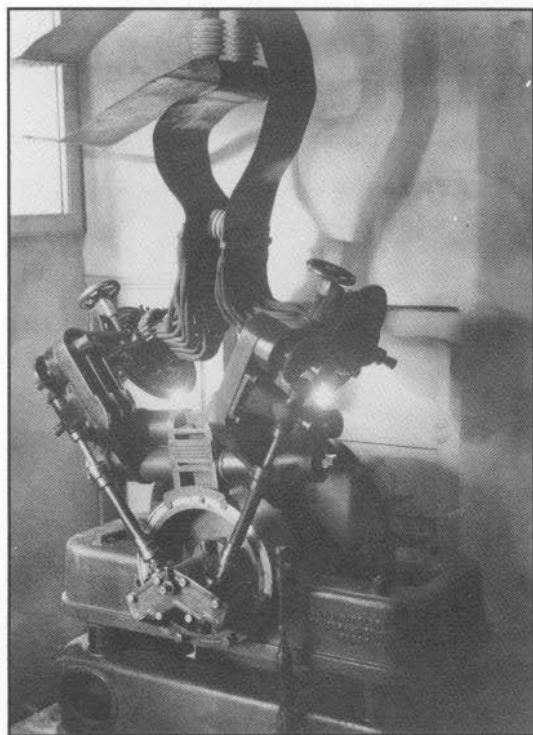


Figure 58. The rotary disc discharger transmitter in operation at the Clifden, Ireland station in 1908. Note the heavy connecting straps fed through the window.

Source: Marconi Company Archives

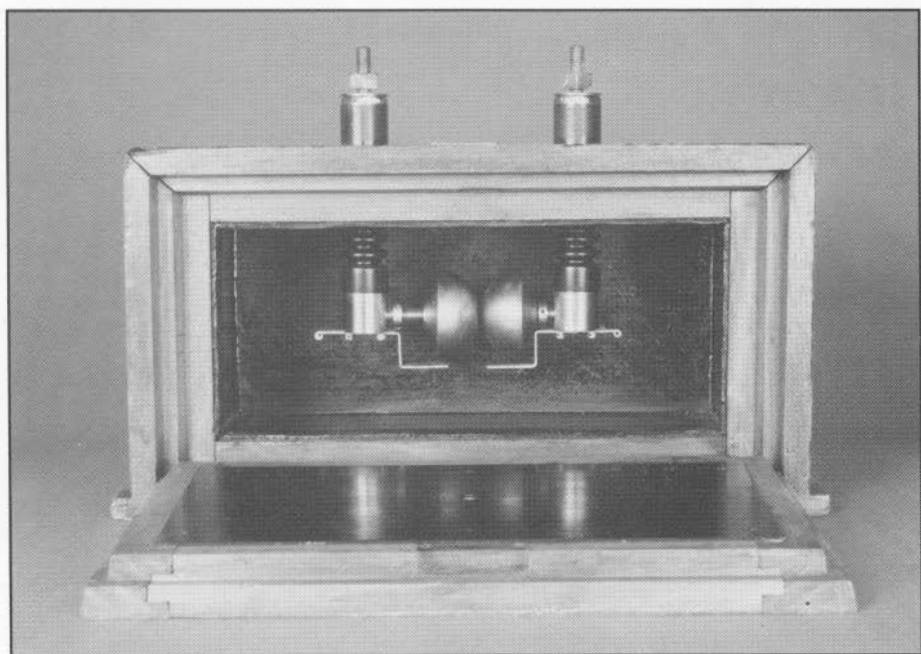


Figure 59. Enclosed spark gap used in the standard 1 1/2-kW shipboard transmitter. It consists of a pair of mushroom-shaped cast iron electrodes mounted in a 1 1/2-inch thick teak box to muffle the noise. Lime is placed in a removable zinc tray to absorb the acid produced by the spark.

Source: Marconi Company Archives

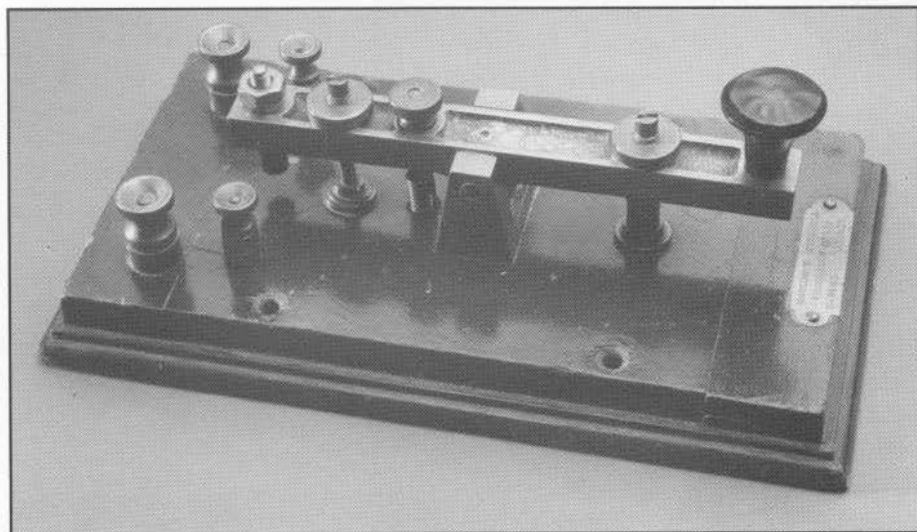


Figure 60: Marconi wireless spark key, circa 1912, used in shipboard installations.

Source: Kreuzer Collection

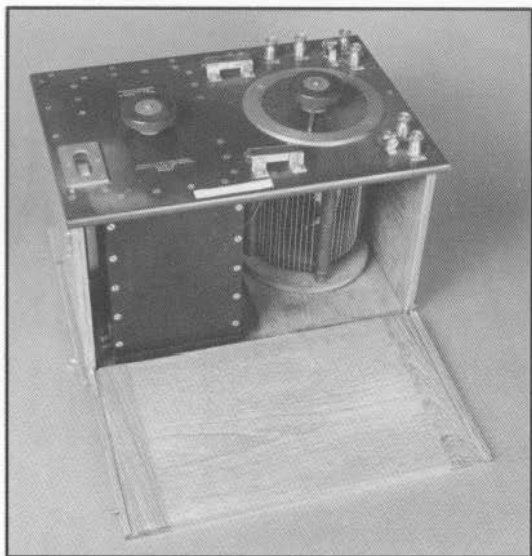


Figure 61. Marconi-Bellini-Tossi direction finder, used during World War I. This apparatus enabled the wireless operator to determine his ship's position, or the whereabouts of another wireless station.

Source: Marconi Company Archives

minimal income from the automobile ignition coil line. A decision was made to close the factory; everything was moved back to Chelmsford by mid-1908.⁶⁹

By early 1907 Marconi was testing a new type of transmitter utilizing a high speed rotary disc, moving at 600 feet per second. It produced a regular succession of quenched sparks synchronized with an alternator which supplied the charging potential. Discharges were produced at regular intervals, giving the sparks a musical tone. It was christened the "disc discharger." By October, 1907, both the Glace Bay and Clifden stations were equipped with this new design; its output was rated at 300 kW. On October 15, 1907, with many prominent people present, the two transatlantic stations exchanged messages comprising a total of 10,000 words sent and received!⁷⁰

Another important innovation fostered by the Marconi Company was the radio direction finder. Originally developed by E. Bellini and A. Tossi in 1907, their patents were purchased by the Marconi Company in February, 1912. Dr. Bellini joined the technical staff as a consultant. The first installation of the Marconi-Bellini-Tossi direction finder was in 1912 on the steamship *Mauretania*. Two large fixed triangular loop aerials were suspended by their apices at right angles to each other. The reception of the signals was by means of a crystal receiver, which unfortunately rendered the direction finder insensitive and limited its range. Later types used valve tuners which were more selective and sensitive.⁷¹

Radio direction finders revolutionized both marine and aerial navigation. In World War I, they made a tremendous difference in keeping an



Figure 62. A memorial postcard published not long after the sinking of the *Titanic*. It shows Captain E.J. Smith and John George Phillips, the chief wireless operator.
Source: Kreuzer Collection

eye on the German fleet, and, mounted in mobile trucks, they were also used on land. They recorded the movement of the Zeppelins and the changing position of the German trench stations. By 1917 a system consisting of a rotating frame direction finder was developed which enabled the British to locate wireless-equipped German aircraft as they flew over the front lines. Within one week eleven German spotting planes were brought down using the bearing information supplied.

The greatest peacetime marine disaster in history occurred on the evening of April 14, 1912, when the White Star Liner *Titanic* struck an iceberg and sank in less than three hours. Even though 712 people were saved that night through the use of wireless, 1,517 unlucky souls were lost. One hour before striking the iceberg, the *Titanic* was warned by the wireless operator on board the *Californian* that there were icebergs in the area. The *Titanic* acknowledged the report, but then rudely replied: "Shut Up I'm Busy With Cape Race"⁷² (the Newfoundland shore station – see also Figure 112.)

Although the *Titanic* was within sight of the *Californian*, her wireless operator had gone to bed and even distress flares which were sighted went unheeded. The *Carpathia* responded to the *Titanic*'s SOS call but was 58 miles away and didn't arrive until about 4:20 in the morning. By the time it had

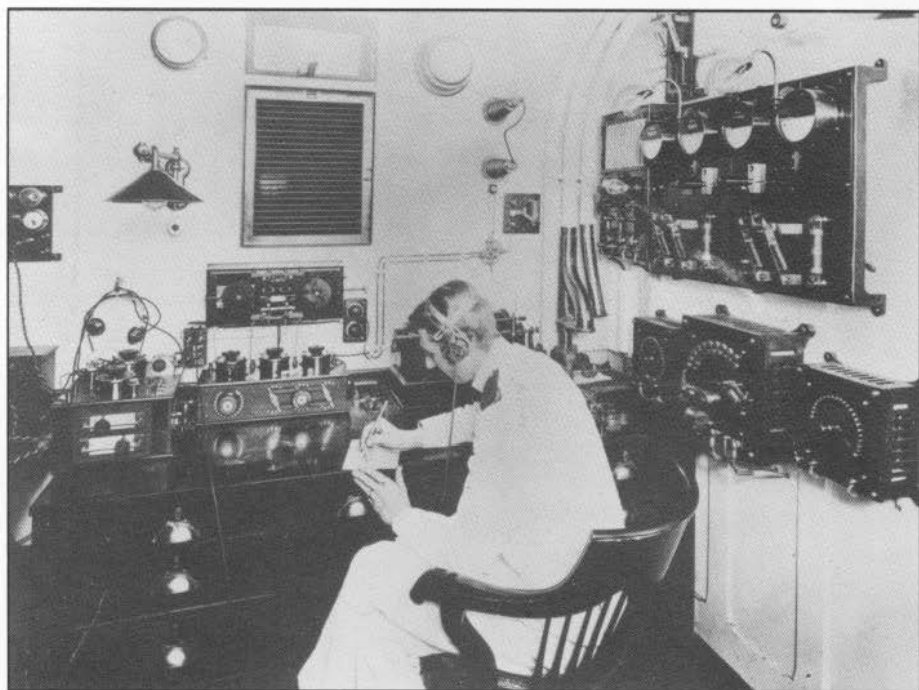


Figure 63. Wireless room of the *Olympic*, the sister ship of the *Titanic*. The apparatus included a Fleming valve receiver, as well as the magnetic detector/multiple tuner installation. Source: Marconi Company Archives

reached the scene and began picking up survivors from the lifeboats, two hours had passed since the sinking and many lives were lost. This incredible tragedy awakened the world to the importance of the use of wireless on shipboard.⁷³

Ultimately some good did emerge from the catastrophe. Two months following, on June 4, an International Radio-Telegraphic Conference was held in London. Various representatives from the countries attending proposed important legislation relating to the regulation of wireless apparatus aboard ships. On July 5 the delegates signed the charter. The International Conference on the Safety Of Life At Sea was held on January 20, 1914. Representatives from sixteen nations signed an agreement, which contained 74 articles relating to the safety of shipping, including the use of wireless aboard ships.⁷⁴

One of the articles proposed that all merchant ships carrying fifty or more passengers must be equipped with wireless. Certain classes of ships had to have a minimum of two wireless operators to keep a 24-hour continuous watch. Another article addressed the minimum range requirements, which were set for both the main wireless equipment and the auxilliary equipment. Also, an independent power source must be provided, capable of working at least six hours, in case of trouble with the primary source of power.



Figure 64. Souvenirs presented at the banquet given by the Marconi Company for the delegates of the June, 1912 International Radiotelegraphic Convention. Each male delegate received a sterling silver model of the disc discharger. The ladies were given a sterling silver perfume flask, engraved with the details of the convention. A dime is shown for size comparison.

Source: Kreuzer Collection

Figure 65. Early form of wavemeter incorporating an internal battery and wave-length chart, circa 1909.

Source: Kreuzer Collection



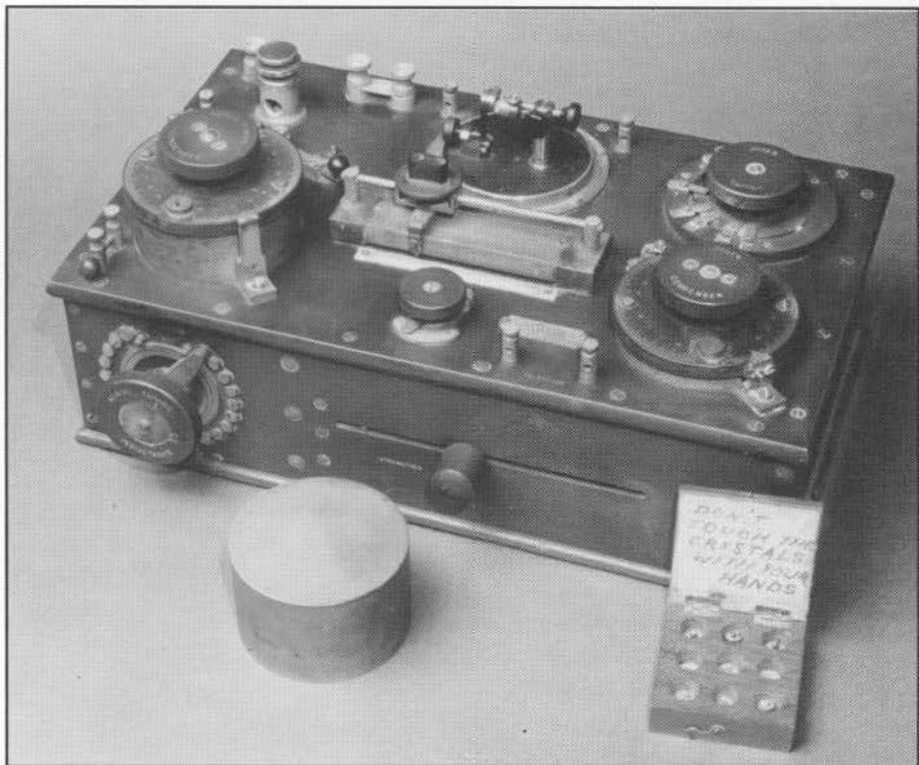


Figure 66. Marconi Universal Crystal Receiver, developed in 1912, which tuned a range of 300 to 3000 meters. This unique receiver incorporated an internal loose coupler and a crystal detector protected by a brass cover. The detector circuit is designed specially to disconnect both sides by means of internal relays when the transmitting key is depressed. This feature prevented the detector from burning out when strong currents were induced during transmission. A container of spare crystals is shown next to the set.

Source: Kreuzer Collection

Eventually the company's business completely outgrew the capacity of the Hall Street Chelmsford works. In 1911 it was decided to build a new factory at New Street on ten acres of land next to the main railway lines. The main building measured 466 feet by 150 feet deep, with excellent lighting and layout design. An extensive number of back orders had been accumulating prior to the Titanic disaster. Combined with the subsequent orders, and the impact of the long-awaited "Imperial Wireless System," which sought to connect all the British colonies by wireless, there was reason enough to complete the first radio factory in the world, built expressly for the purpose.⁷⁵

It was with great foresight that the Marconi Company constructed the factory at New Street, for on August 4, 1914, England entered the Great War

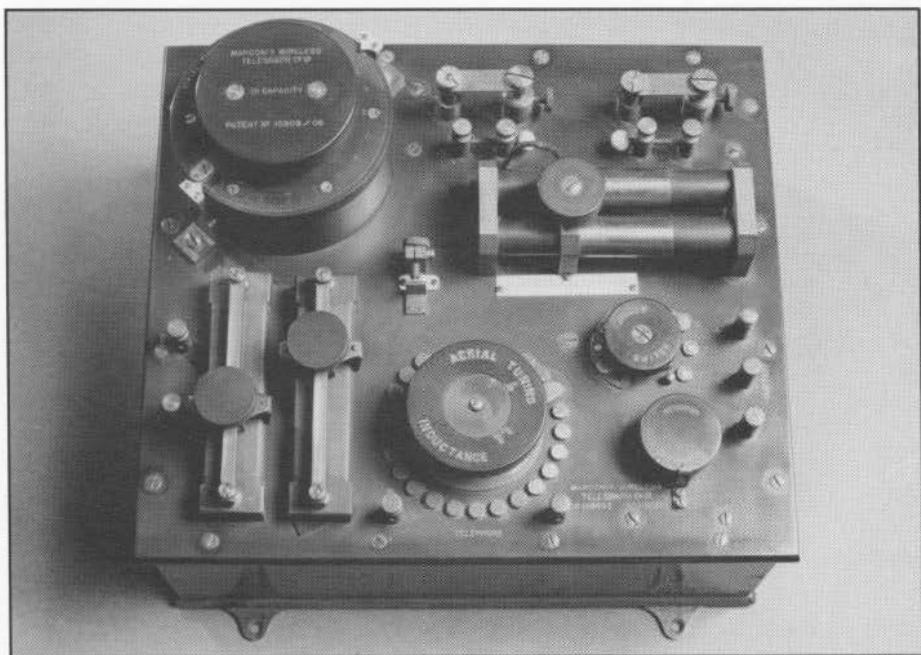


Figure 67. Type 16 Balanced Crystal Receiver, the standard receiver for the 5-KW ship and shore installations. It was designed in 1914 to tune from 250 to 3500 meters. Using two crystal detectors, this design provided the option of either working them simultaneously or independently.

Source: Kreuzer Collection

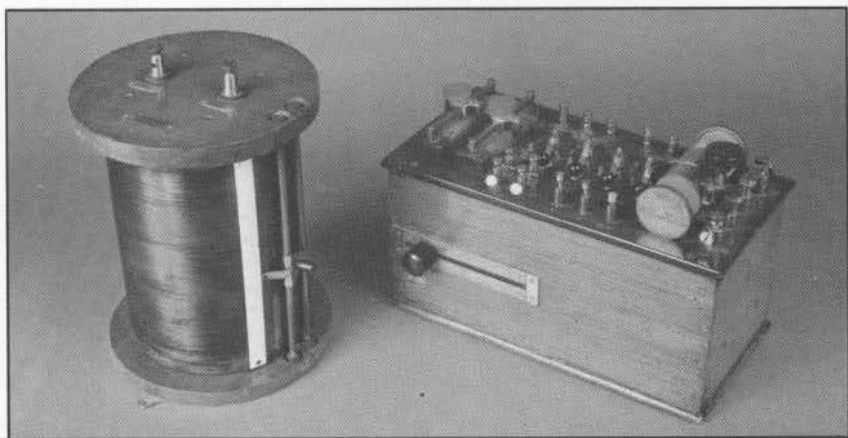


Figure 68. Marconi Type 31 shipboard receiver, covering a wavelength of 300 to 600 meters, and in use about 1916. The instrument is fitted with two crystal detectors, which may be used for independent or balanced working as desired. An advantage of the aerial tuning inductance—wavelengths of 200 to 2500 meters are possible.

Source: Marconi Company Archives

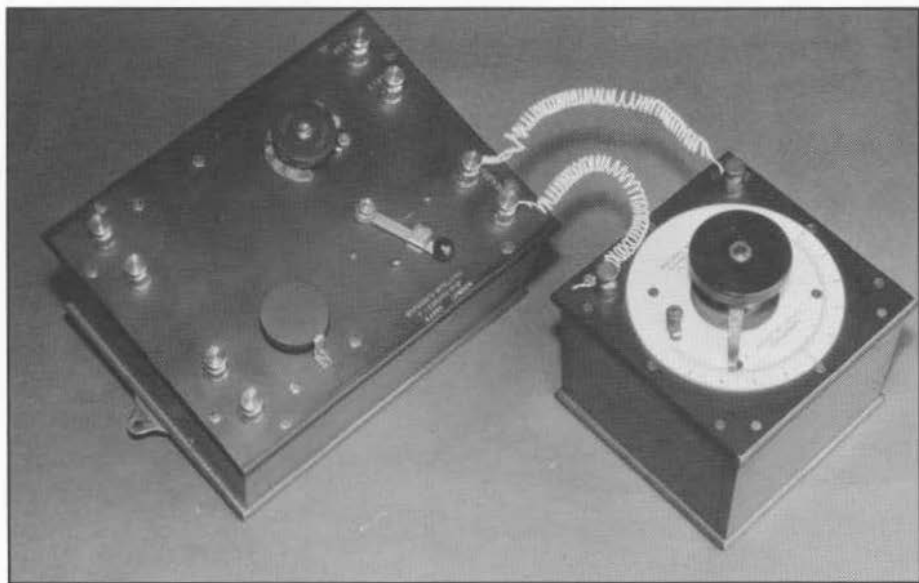


Figure 69. This tuner was designed for use by the infantry around 1917. It required the use of an external tuning condenser as well as an outboard detector unit.
Source: Kreuzer Collection

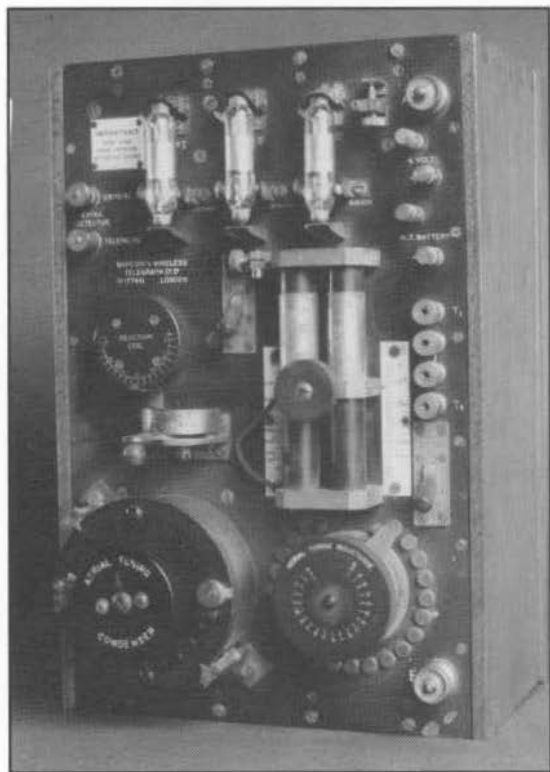


Figure 70. This unusual set is known as the Type 38 Field Station Receiver and was developed in 1917 for use in World War I. It was one of the earliest receivers to use the Type Q valve. One valve is the detector, while the other two serve as audio amplifiers. Provisions were made for an outboard crystal detector.
Source: Kreuzer Collection

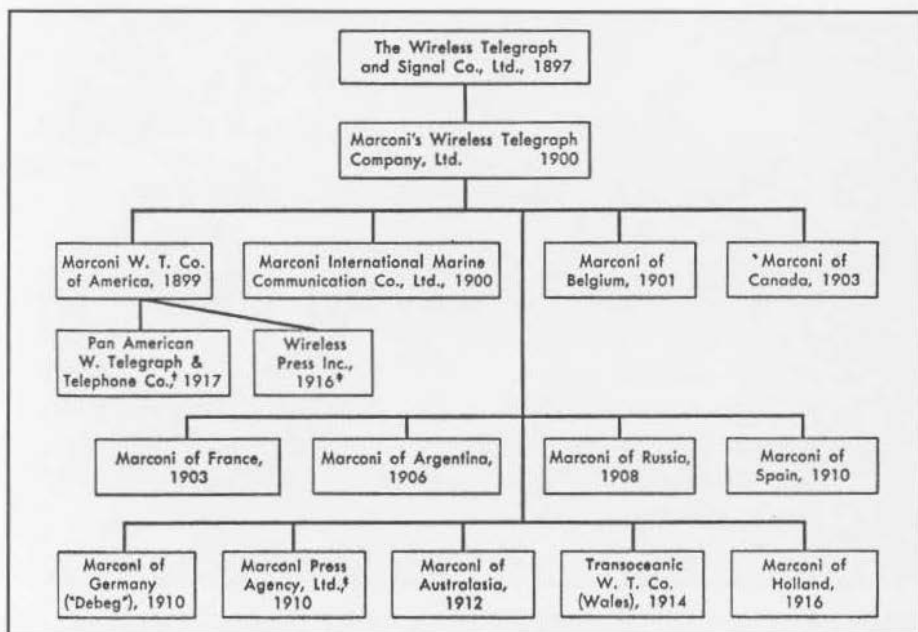


Figure 71. A chart of the principal Marconi companies from 1897 to 1917.

Source: W. Rupert Maclaurin, *Invention & Innovation In The Radio Industry*, 1943, p. 43

against Germany. Immediately the output of the Chelmsford works was directed towards the war effort. Many new types of apparatus were developed during the war, and perfected as a result of their use in the field.

THE MARCONI WIRELESS TELEGRAPH COMPANY OF AMERICA

THE ALDENE, N.J., FACTORY

It wasn't until 1912 that manufacturing facilities were finally acquired by the Marconi Company in the U.S. Previously the main purpose of the American company had been to conduct a wireless telegraph service specifically with ships along the east coast. By 1901 a few German and English transatlantic liners were equipped with wireless apparatus, making it necessary to build stations along the coast. Initially, only the Nantucket and the Babylon Long Island stations were erected. They carried on a fine business transmitting messages from passengers when ships were near shore, or with the various Marconi stations located along the transatlantic run.⁷⁶

The first Chief Engineer of the American company was W.W. Bradfield, succeeded by Frederick Sammis in 1908. By 1904 J.J. Brennan had

come to the Marconi New York shop as a machinist, and continued as head of the machine shop after the RCA merger. He personally built many items of equipment for Henry Round while a technician, as well as made-to-order apparatus for Marconi. Although the original intention was to perform all the manufacturing in England, the high import duty on complete sets persuaded them to ship finished but unassembled parts duty free, or nearly so, and assemble them in New York.⁷⁷

They needed a small New York shop to make occasional repairs to equipment on the ships and also make repairs to land stations, as well as a storeroom for parts and equipment. The Front Street attic shop and later 37 Water Street served this purpose and occasionally when Guglielmo Marconi was in this country he wanted special apparatus made, for he was continually experimenting and developing new ideas. The New York shop also built special parts for South Wellfleet for tests.⁷⁸

These shops had a small lathe and assembly benches but were essentially used for repair.

Most metal parts were imported from Chelmsford, England, using standard English Marconi style apparatus. Wood work was performed by Bubek and Guerin on 18th Street, while special metal work and castings were done by the Manufacturers and Inventors Electric Company on Gold Street near the Marconi shop. Transformer cases, square forms for early oscillation transformers, and later loading coil forms were made a few at a time in the cabinet shop and assembled at the Marconi shop.

As of 1905 there were six or eight people in the New York office, and two in the shop. With the operators at the four coast stations, there was a total of about 25 employees in New York.⁷⁹

Up until about 1910 American Marconi was a very small company, operated very economically. Some American operators used to call it 'That Cheap Dago Push Cart Wireless Company.' True, some of the shops including Seattle did have ordinary vegetable peddlers' push carts for emergency use to take parts to a ship in a hurry, and once I was glad of it when a ship about ready to sail developed trouble and I had to rush a new 10-inch induction coil several blocks down the waterfront in a hurry. Then I also heard that A.P. Gianini, founder of the Bank of America, carried a million dollars in a vegetable pushcart during the emergency following the San Francisco earthquake and fire, so the things can be very useful.⁸⁰

American Marconi's chief competitor in the wireless business was the United Wireless Company. They had been infringing on Marconi's inductive

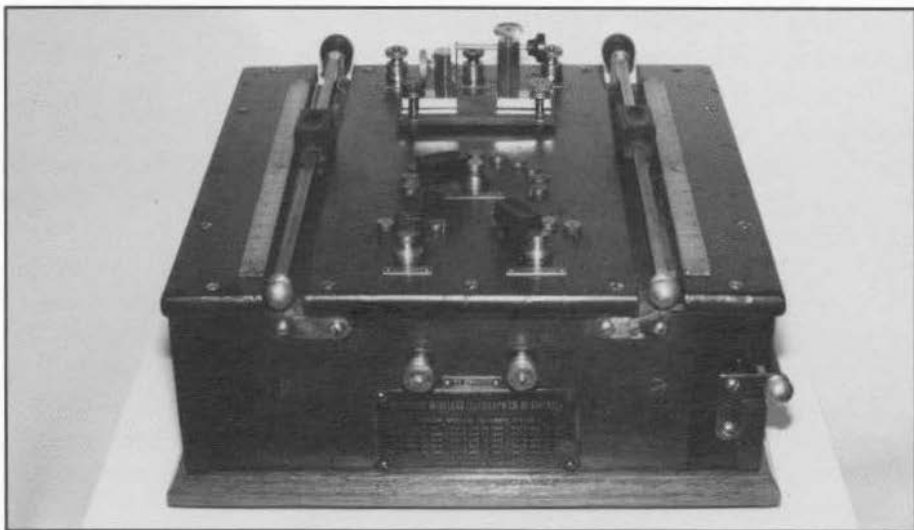


Figure 72. An updated United Wireless Type "D" tuner, with minor circuit changes and the addition of a Marconi Wireless Telegraph Company nameplate.

Source: Barry Janov Collection

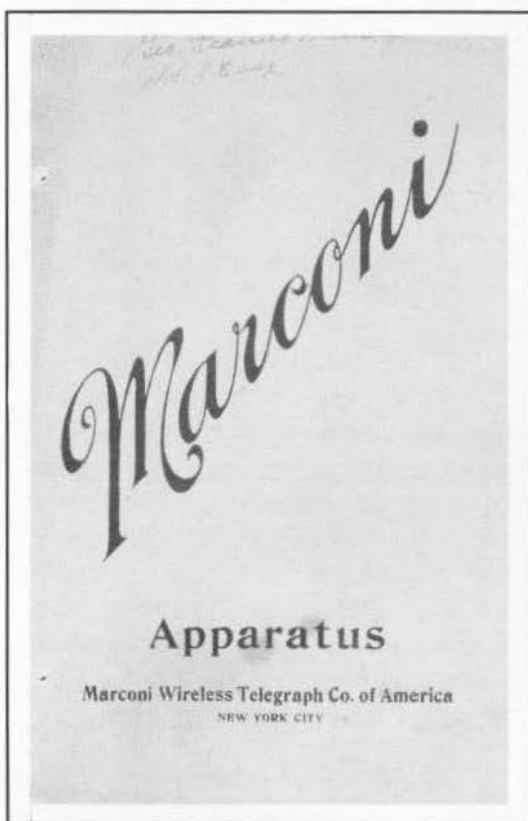
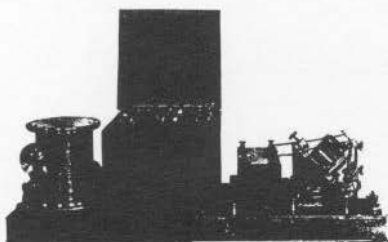


Figure 73. Probably the first American Marconi catalog, circa 1912, published before the Aldene plant was in full swing.

Source: Kreuzer Collection

COHERER SETS.



These are the Marconi commercial coherer sets which but a few years ago were in general use at ship and shore stations.

They consist of the original finely finished Marconi coherer, decoherer, air tight polarized relay, jigger and batteries mounted upon a mahogany base with binding posts for connecting to the antennae and ground and to a sounder, Morse inker, bell or other device whose operation it is desired to control by Hertzian waves.

Having a considerable stock of these admirable receivers and having discontinued their commercial use we have located the price at practical cost.

This instrument occupies a space 23 in. x 8 in. x 8 in.

Complete with one coherer and iron screening case.

Price, \$95.00 Extra Coherer, \$5.00.

KEY.



This key is small, neat, light in operation and with the knob close to the table. The base is of fireproof material and metal parts of lacquered brass. We have designed it to provide an inexpensive desirable key for the experimenter.

15 ampere A. C.	Price.....	\$5.00
30 " A. C.	"	5.75
15 " D. C.	" with condenser in case.	6.50
30 " D. C.	" with condenser in case.	7.25

Figure 75. Another page from the Marconi catalog showing a very unusual magnetic detector, complete with spring motor drive, for only \$19.50. Also listed is a Fleming valve for \$3.50.

Source: Kreuzer Collection

MAGNETIC DETECTOR.



As with the greater part of the apparatus listed in this catalog we have tried in this magnetic detector to embody all the features of the Marconi commercial apparatus that are necessary for the experimenters purpose and at the same time make a low priced instrument.

As the imported driving mechanism of a commercial instrument is necessarily expensive we have designed this detector to be driven by hand. In other respects this instrument embodies all the good qualities for which the commercial magnetic detector is justly famous.

It is the most durable wireless detector made, not damaged by static, vibration, dust, moisture, induction or kick back from transmitter. Can be used in shunt around small gap in break system. Requires no adjustment, no battery, and only 160 ohm telephones.

Price, \$10.00. Extra Bands, \$1.50 each.

With spring motor drive. Price, \$19.50.

THE FLEMING OSCILLATION VALVE.

This is the type of detector with which the Marconi Transatlantic reception is accomplished. Operates on four to six dry cells.

Detector complete with base. Price, \$3.50 each. Extra Valves, \$2.50 each. Add 10c. for postage.



TUBULAR VARIABLE CONDENSER.



This neat little instrument has a remarkably wide capacity range considering its small cost and where a less expensive instrument than the Marconi disc condenser is sought, is highly desirable for use in connection with the secondary circuit of the inductive tuner and in similar circuits.

It has a graduated scale.

Price, \$3.00.

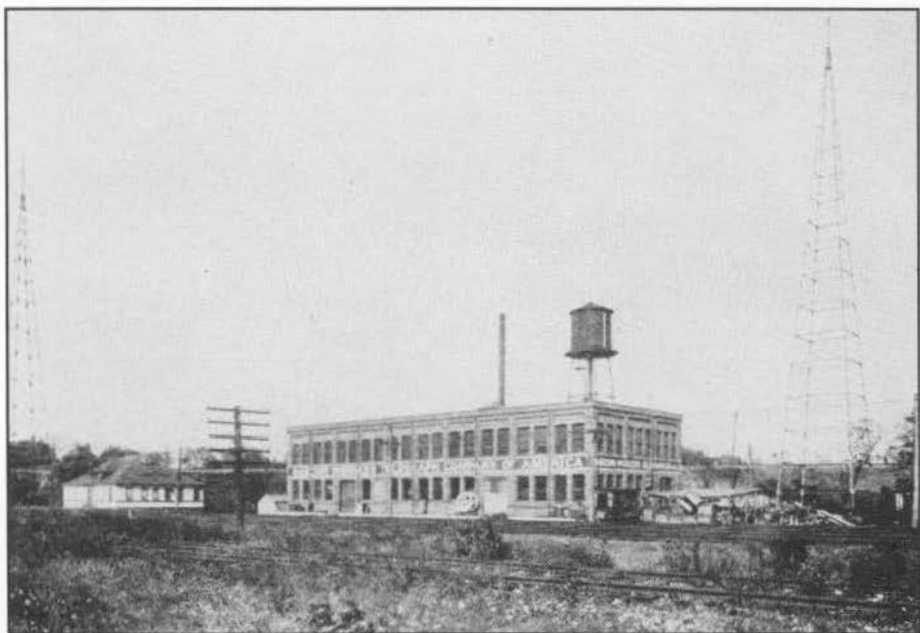


Figure 76. The Marconi plant at Aldene, New Jersey as it looked in its first year, 1913. Two additions to the plant were to follow; the first in 1917, and the last in 1918, to keep pace with the demand during wartime.

Source: 1918 Marconi Company Annual Report

coupling patent, #7777, for some time, so eventually he filed suit against them, in 1911. A notice in *Modern Electrics* on page 27 of the April, 1912, issue disclosed the following information:

As a result of a merger which has been brought about between the Marconi Wireless Telegraph Company and the United Wireless Telegraph Company, when the suit of the former against the latter corporation for alleged infringement of patent rights came up in the United States District Court on March 25th, the United Wireless entered no defense and consented to the granting of a decree in favor of the Marconi Company.

As a further result of the merger all the stations and contracts of the United Wireless will be taken over by the Marconi Company. This involves about 500 ship and 70 land stations in the United States.

The absorption of the assets of this company gave the American Marconi Company a practical monopoly of the supply of apparatus and operators for radio communication in the United States.⁸¹

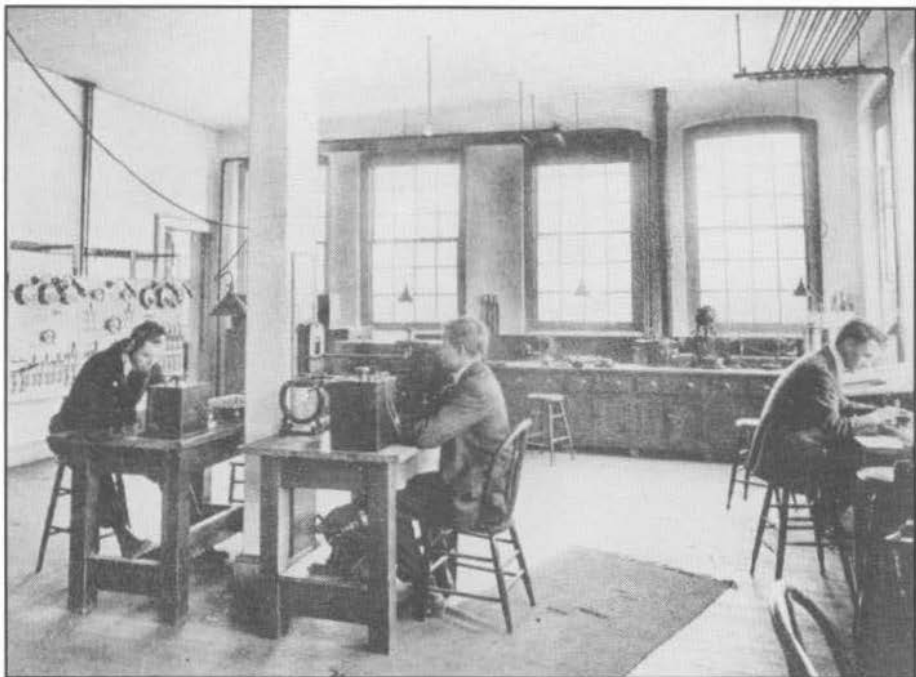


Figure 77. The research laboratory at Aldene, operated under the guidance of Marconi's research engineer, where the original investigations were made and new apparatus evolved.

Source: *Wireless Age*, February 1914

This relief from a powerful source of competition added to the business prestige of the American company, thereby providing control over about 90% of the American ship-to-shore business. Marconi also procured the engineering department from United, including Harry Shoemaker, who became Chief Development Engineer in charge of making immediate design changes.

In 1912, with a great increase in business and orders pouring in, the management decided it was time to build a larger production facility.

The company acquired land, built and equipped a 20,000 square foot factory in Aldene, New Jersey, near Roselle Park, for producing wireless equipment for its own needs and for sale.

The building was "L" shaped with the testing department, transformer room, plating room, stock rooms and the power plant located on the first floor. The second floor incorporated the machine shop, research laboratory, tool rooms and the factory offices.⁸²



Figure 78. The assembling and test department of the American Marconi factory at Aldene, New Jersey
 Source: *Manual Of The Marconi Institute*

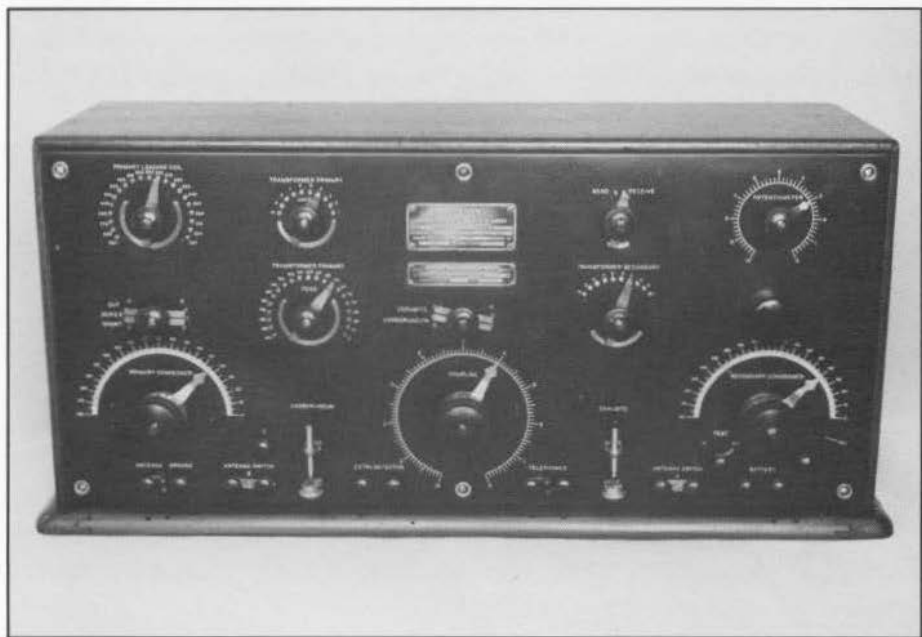


Figure 79. A very impressive receiver, this is the Marconi Type 101. It tunes from 200 to 7500 meters, and is the first receiver designed and made in its entirety at the American Marconi plant in Aldene.

Source: Richard Groshong Collection

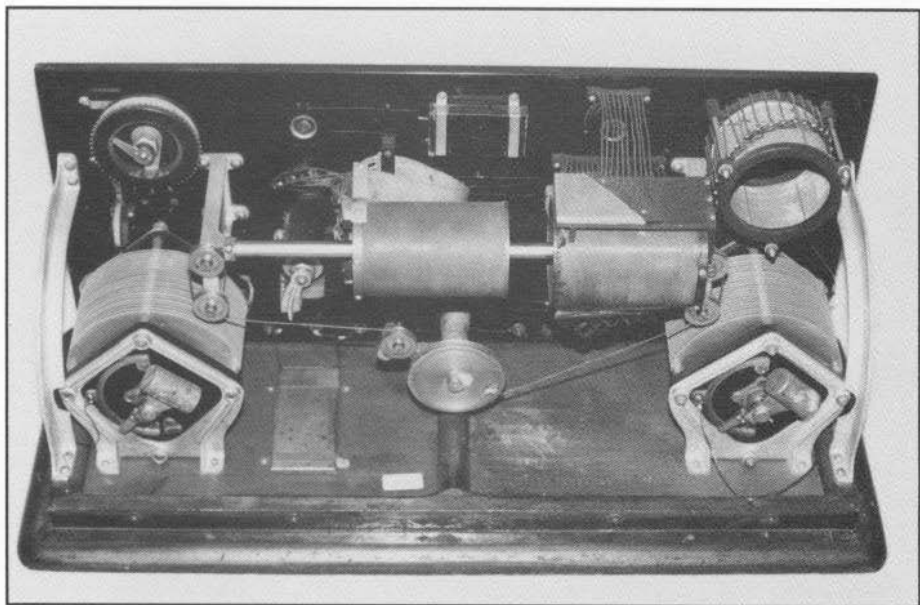


Figure 80. An internal view of the Type 101 receiver showing the large internal loose coupler which is operated by a system of pulleys and cable.

Source Richard Groshong Collection

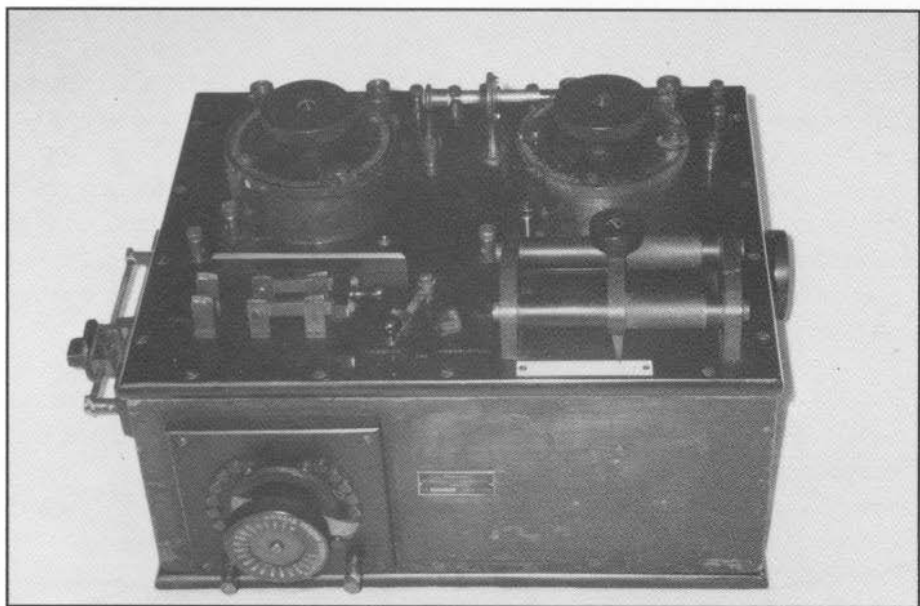


Figure 81. The Marconi Type 103 crystal receiver. It tunes from 200 to 600 meters and uses a carborundum detector. Designated primarily for marine applications, it was built entirely from English Marconi components.

Source: Jim Chew Collection



Figure 82. The external crystal detector for the Type 103 receiver. It uses a cup containing both carborundum and cerusite minerals. A brass loop is incorporated, which, when locked onto an operating table, made it difficult to put in your pocket for your own use. Source: Kreuzer Collection

To attempt to describe in detail the apparatus produced would require a large book, for it was always changing. By comparison, United Wireless had essentially the same spark transmitter and only five different receivers from 1907 to 1912, Types A, B, C, D, and E.

A policy change was now instituted by the Commercial Manager of the American Marconi Company, the young David Sarnoff. Previously the company would only lease its equipment; now it was decided to sell it outright. One of Sarnoff's many brilliant moves, the new policy resulted in a sizable number of orders being placed by the U.S. Navy in 1913.

Prior to this time, British designed and engineered equipment was being used in all the Marconi installations. Harry Shoemaker brought many designs and ideas from United Wireless, and the United Wireless "Type D" tuner was placed in service, with the addition of a Marconi Wireless Telegraph Company name tag. This receiver became part of the auxiliary equipment described in the *Instructions For Marconi Operators*, printed in June, 1913. (See Fig. 72)

Many receivers were produced from 1912 until American Marconi's absorption by RCA in 1919. They began with the Type 101 and ended with Type 122. The first receiver designed by Harry Shoemaker for Marconi was the

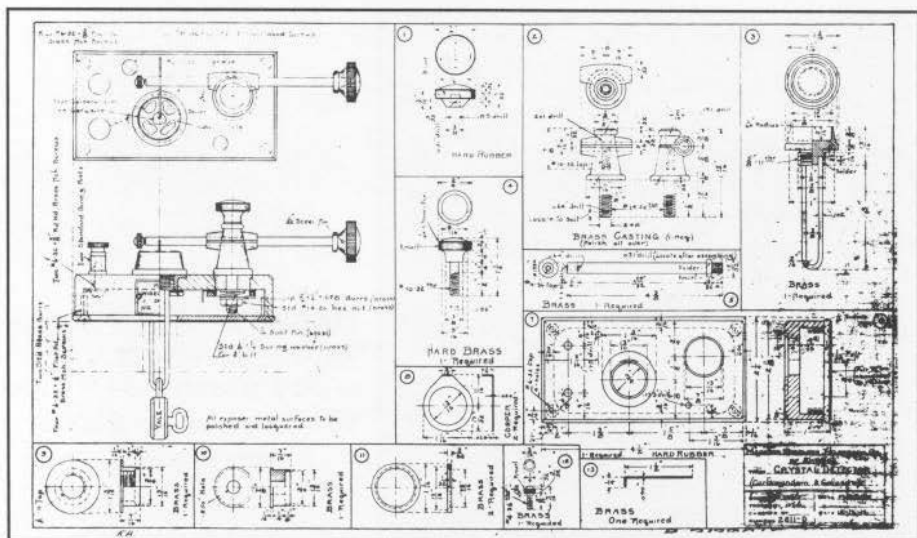


Figure 83. Original blueprint for the detector in Figure 82. It is dated December 12, 1912 and was among the first items produced at the Aldene plant.

Source: Kreuzer Collection

Type 101, intended for land stations equipped with 5-kW transmitters. Its design derived from the United Wireless Type “E” tuner, which contained a loose coupler on its panel and covered the frequency range of 200-500 meters. The 101 used a loose coupler mounted behind the front panel and incorporated two solid rectifier detectors, cerusite and carborundum, on the front panel. Less than 100 of these sets were manufactured.⁸³

A few Type 102s were produced, which tuned from from 200-4000 meters. The Type 103 was assembled from British components; patterned after the Fleming valve receiver, it covered from 200 to 600 meters. It used a carborundum detector with provision for an add-on cerusite detector. Although the carborundum detector was considerably less sensitive than the cerusite, it had an advantage of increased stability and wasn’t easily disturbed by static, loud signals or vibrations.

The 103 was a very popular receiver, but by January of 1915 instructions were sent to technicians and operators for changes in the design, resulting in a new model, the Type 107. The tuning circuits were completely overhauled, with a resulting coverage of 250 to 4,000 meters.⁸⁴ By November of 1915 new orders detailed the reconstruction of the remaining Type 103 and Fleming valve tuners to allow reception of wavelengths up to 2,800 meters. After either type was altered according to the instructions, it became known as the Type 107-A, and is easily identified by a six-point, double-throw switch

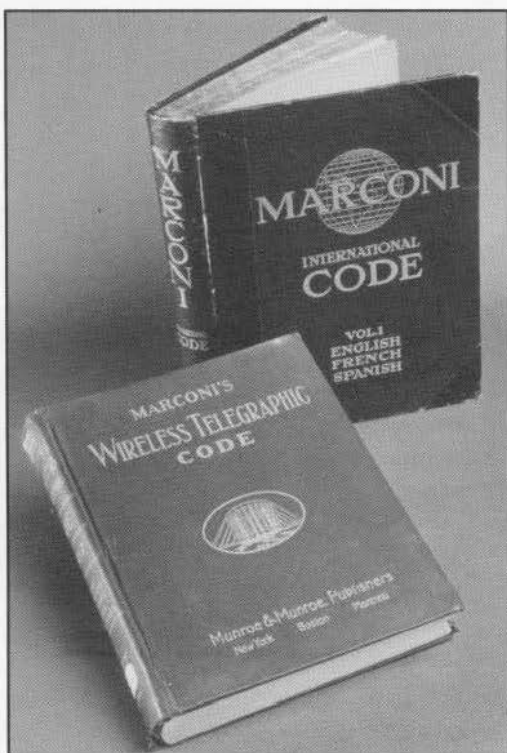


Figure 84. Marconi Type 22 wavemeter, covering from 200 to 750 meters. It is dated 5/20/14 on the nameplate.

Source: Kreuzer Collection

Figure 85. Marconi code books which were used at all wireless stations to facilitate the handling of messages. The standing book is from 1919, while the other is 1906-7.

Source: Kreuzer Collection



mounted on the top panel. As a result, unaltered Fleming valve and Type 103 receivers are very scarce.⁸⁵

While researching the George Clark *Radioana* collection at the Smithsonian archives, the authors came across an interesting box of Marconi ephemera which included details of the factory. The first report is a listing of every employee involved with the manufacturing of wireless equipment at the Aldene, New Jersey plant, including their salaries. As an interesting sidelight, listed below is a sampling from the report, which is dated June 27, 1913, and includes a total of 187 workers.⁸⁶

A.Y. FORREST	LABORATORY WORKER	\$21.92 PER WEEK
H.D. BENSON	101 RECEIVER	\$20.00 " "
S.M. BUDD	CHAUFFEUR	\$18.00 " "
P. KREISS	VALVE TUNER	\$17.00 " "
TOM WIER	TOOL ROOM	\$8.00 " "
K. ULRICH	WINDING TRANSFORMER	\$6.00 " "

The other report consists of ten pages, listing 193 employees and their duties, dated December 24, 1913. Here is one entry:⁸⁷

LATHE HAND	24 WORKMEN
101 RECEIVER	21 "
VALVE TUNER	3 "
WAVEMETER	10 "
DISC CONDENSER	4 "
KEYS	3 "
ENGRAVING	2 "
BILLI CONDENSERS	2 "
ROTARY SPARK GAP	2 "
HELIX OSC. TRANSFORMERS	3 "
HIGH POWER STATIONS	5 "
CHAUFFEUR	1 WORKMAN

Probably the first Marconi receiver to use a three-element vacuum tube was the Type 105. The tube used was a Marconi Type "D", which bore a close resemblance to a double-wing DeForest spherical audion. Needless to say, DeForest soon filed a suit against Marconi claiming infringements of his patents, but before the case ever made trial, the Marconi Company confessed its guilt in the matter. The 105 was put on the market in early 1915 for receiving long wave, from 300 to 6,000 meters.⁸⁸

During 1914 the new Marconi works at Aldene, N.J., was very busy bringing out many new designs, among them the 1/2-, 2- and 5-kW 500-cycle quenched gap transmitters. They needed a new receiver for smaller installations,

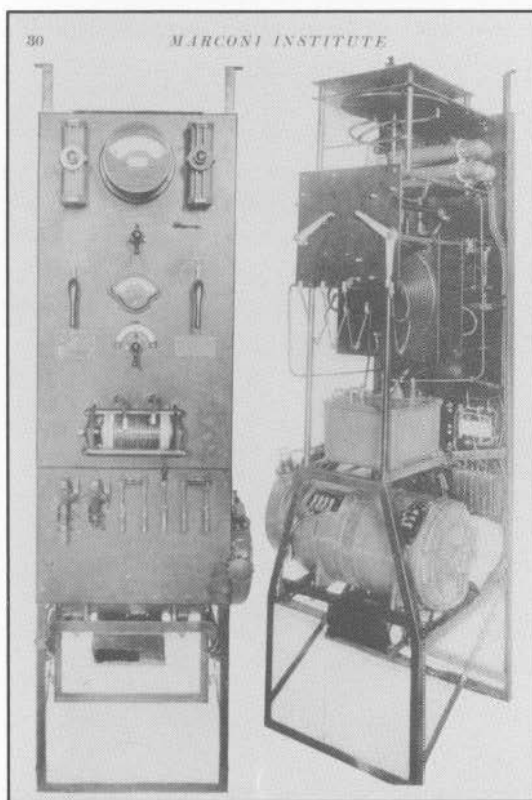


Figure 86. Marconi Type P-5 1 1/2-kW, 500-cycle quenched-gap spark transmitter. It was designed for shipboard use and covered from 300 to 600 meters.

Source: *Manual Of The Marconi Institute*

both for government orders and private rentals. (At this time Marconi did not sell apparatus to private users—most ship installations were on the basis of one thousand dollars a year rental.)⁸⁹

The new receiver was the Type 106. Of the same general appearance as the earlier 101 and 102, it was smaller and tuned from 200 to 3500 meters. Most of the design work was done by Roy Weagant, but Fred Sammis and Harry Shoemaker also had a hand in it. The earliest 106s sported an engraved panel while later models used etched metal dials and plates, the result of faster production during the war years.⁹⁰

The 106 receiver was marketed early in 1915 and used for many years, with updated versions of the 106B, the 106C and finally the RCA 106D. It was still used aboard ships until January of 1942, when they and all other regenerative receivers were outlawed for marine use for fear the radiated energy might be picked up by enemy direction finders on submarines.

By the end of March, 1915, the Marconi Company had 225 coast stations and 1,894 ships equipped with their wireless apparatus. By mid-1915 Roy Weagant had replaced Frederick Sammis as the chief engineer, and



Figure 87. Marconi Type 106 receiver, probably the most popular of all Marconi receiving sets. It lasted for many years, going through numerous changes in both design and type numbers (106B, 106C, 106D).

Source: Kreuzer Collection

Sammis returned to his homeland to be with his parent company, British Marconi.⁹¹

The Aldene plant provided all the apparatus accompanying receivers and transmitters, such as spark gaps, telegraph keys, wavemeters, antenna switches, and Leyden jars. The last series of receivers was produced for the Signal Corps in 1918 and 1919 and were designated Types 120-121-122. They are identical in appearance, differing only in wavelength. As an example, the Type 120 covered 50 to 225 meters, while the Type 122 covered 175 to 775 meters.

The American Marconi Company was nearing its heyday. Over a quarter of a million commercial messages were sent in 1915. This traffic was brought almost to an absolute standstill, however, in early 1917, when war with Germany was declared. All wireless stations were affected, either by being completely shut down or put under United States Navy control.⁹²

At the time 540 ships had Marconi apparatus. The U.S. Navy took over 370 ocean going vessels. Although the remainder were left in Marconi's control, the vast majority of the communications business was crippled.

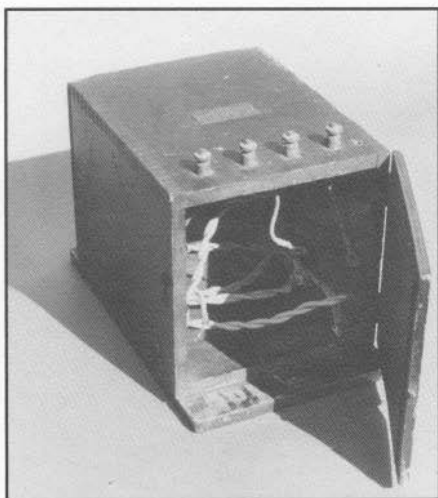


Figure 88. Marconi Type 106 battery box. The blueprint shows this to be the battery holder that was stored under the operating table.

Source: Kreuzer Collection

The Aldene factory was to take up the slack through manufacturing. It doubled in size during the summer of 1917, accommodating the orders for wireless equipment to outfit the Army and Navy. Employee growth more than tripled from 200 to 700.⁹³

The first million dollar contract was awarded for 400 1/2-kW, 500-cycle spark transmitters (Type CM 296A) to equip submarines. Larger transmitters were later ordered for battleships and destroyers, while portable units were requested for truck and field use. Equipment sales grew to an all time high of \$7,000,000 by 1918.⁹⁴

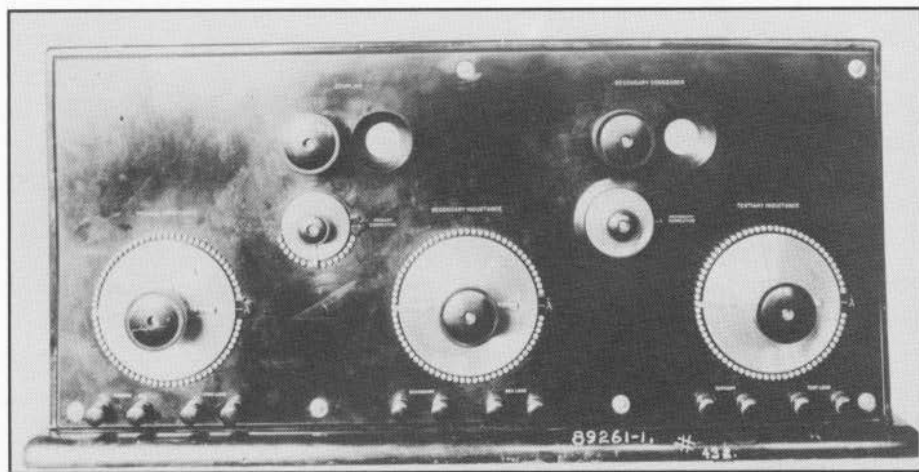


Figure 89. Marconi Type 110 receiver. A prototype built in 1917, it never went into production.

Source: George Clark *Radioana* collection

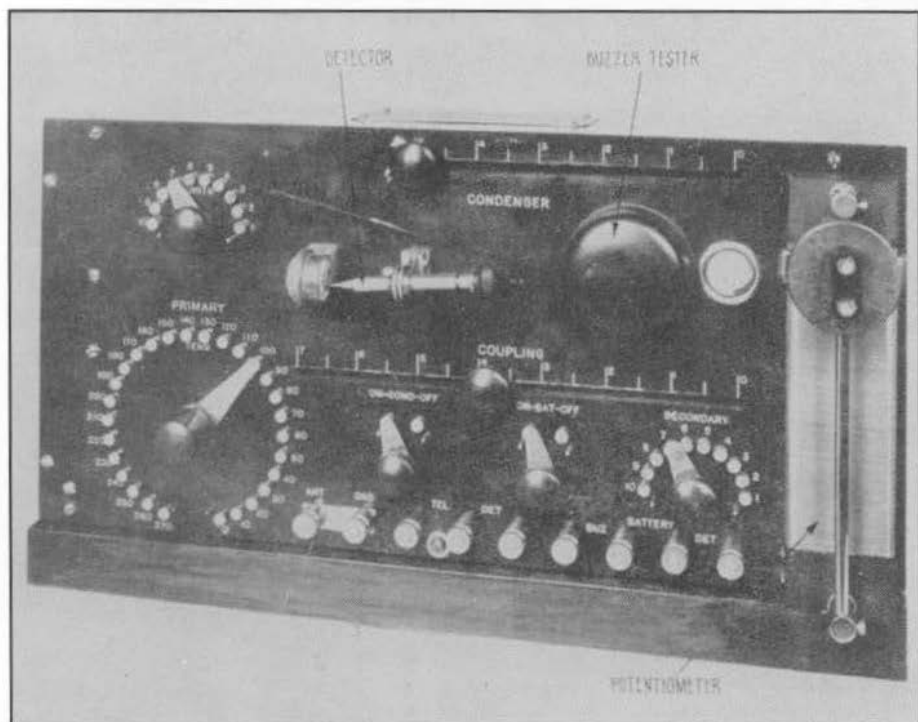


Figure 90. Marconi Type 112 receiving set. This compact set tuned from 200 to 3,000 meters and included a loose coupler behind the front panel. It was designed to be a part of a 1/4-kW installation destined for British ships in 1917.

Source: *The Wireless World*, October 1917



Figure 91. Type SE-86 flame proof 1/2-kW hand key. This well built spark key is rated at 5 amperes and was designed for use where open spark is not permitted, i.e., an airplane cockpit.

Source: Kreuzer Collection

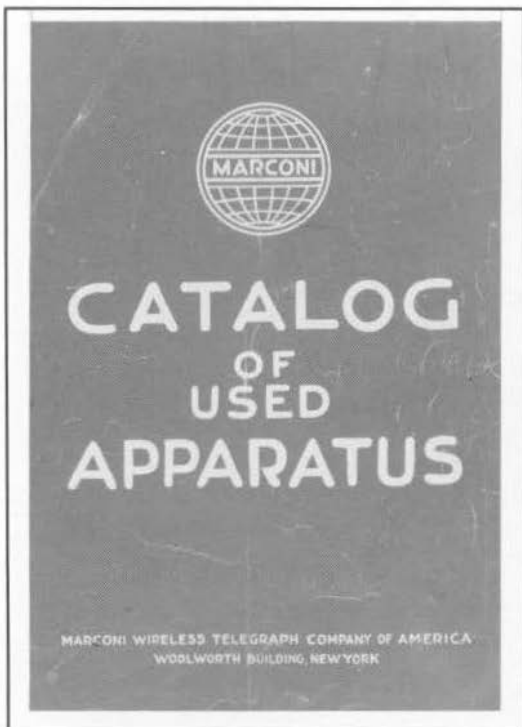


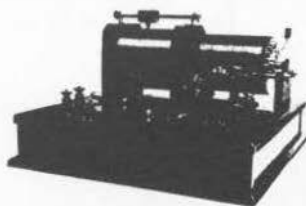
Figure 92. Published around 1916, this catalog lists the out-of-date and used Marconi equipment available at a substantial discount.

Source: Kreuzer Collection

Figure 93. A page out of the Marconi catalog showing a United Wireless Type "E" tuner for sale at \$40.00. Other items listed include a Type "D" tuner for \$6.75, a 10" spark coil for \$65.00 and a rotary spark gap for \$18.00!

Source: Kreuzer Collection

MARCONI USED APPARATUS



Type E Receiving Tuner No. 211

Excellence of mechanical construction and efficient design makes possible with this tuner the reception of wave lengths between 300 and 3000 meters. Fitted with binding posts for antenna and ground, binding posts for receiver, detector stand, variable condenser, potentiometer, battery and reversing switch. Sold complete with box-mounted crystals.

Special Sale Price \$40.00



Short Wave Condenser No. 210

Used for reducing the wave length of the antenna system to a value below the natural period. The type shown has been carefully designed to withstand considerable voltages. Condenser includes four high potential plates connected in series. Recommended to amateurs who wish to make their sets comply with Government regulations.

Capacity 2005 microfarads

Special Sale Price \$3.00



Head Telephones No. 212

Sensitive and reliable 2000-ohm receivers with adjustable headband. Equal to any on the market.

Special Sale Price \$4.50



Aerial Change-Over Switch No. 213

Substantial and complete; controls both transmitting and receiving circuits, allowing the antenna to be employed for transmitting and receiving as desired.

Special Sale Price \$3.50

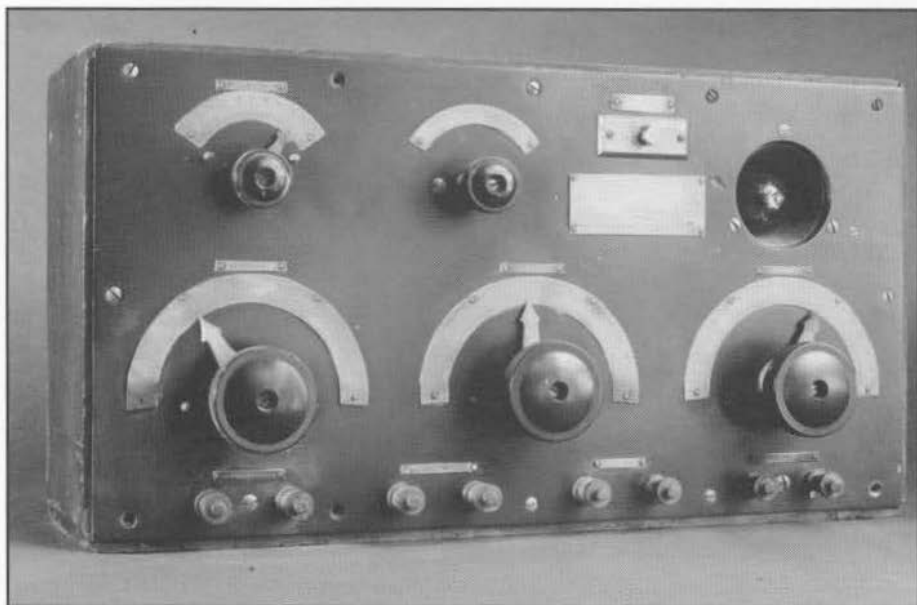


Figure 94. Type 122 receiver. Built for the War Department - Signal Corps in 1918, this was one of the last complete receivers made by American Marconi.
Source: Kreuzer Collection

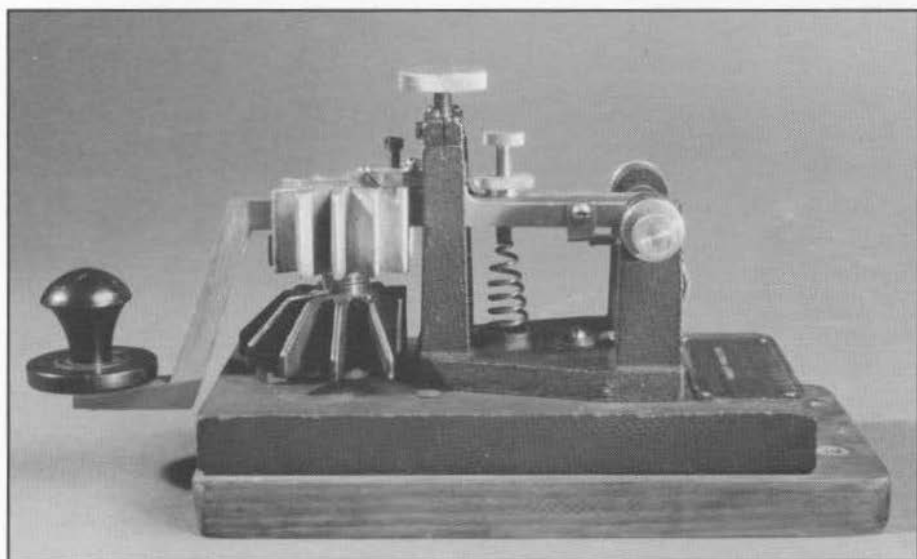


Figure 95. A 5-kW auxiliary hand sending key, rated at 50 amperes @ 250 volts. This was built for the War Department - Signal Corps in 1917. It is one of the largest and heaviest keys made by Marconi, and is mounted on a slate base.
Source: Kreuzer Collection



Figure 96. Marconi Type CM 2946C Short Wave receiver made for the Navy Department, Bureau of Steam Engineering. It covered from 250 to 3100 meters and was built in 1917. A popular battleship receiver, many were manufactured during the First World War.

Source: Kreuzer Collection



Figure 97. A jacket worn by a Marconi wireless operator during the 1910-1919 period. The wireless man must have been of a small stature, as this fits Felicia, who stands 5'6" tall!

Source: Kreuzer Collection

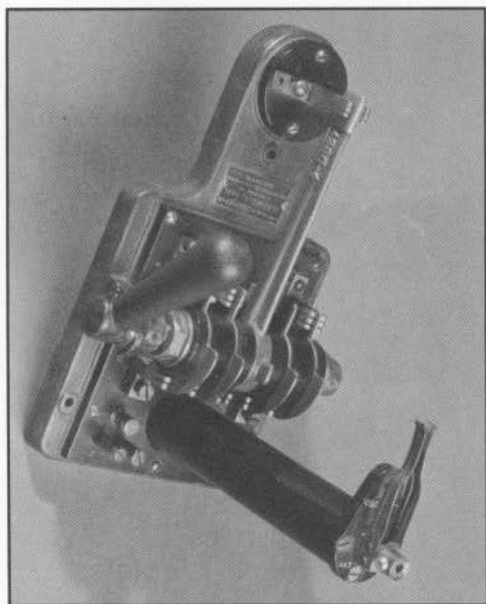


Figure 98. Type "I" antenna switch used in the 1/4- and 1/2-kW wireless stations of the WWI period.

Source: Kreuzer Collection

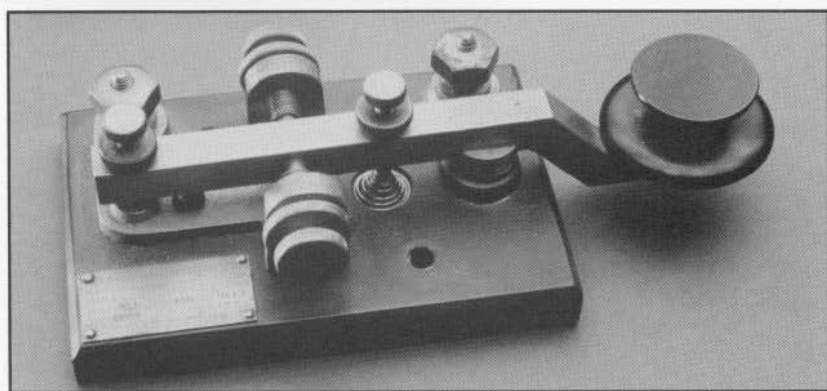


Figure 99. Type CM 425 1-kW auxiliary hand sending key, made for the Navy Department, Bureau of Steam Engineering. Dated 1917, this key is rated for 20 amperes @ 250 volts.

Source: Kreuzer Collection



Figure 100. Type SE 68 auxiliary hand key, made for the U.S. Navy. Produced in 1917, this key is rated at 20 amperes @ 250 volts.

Source: Kreuzer Collection

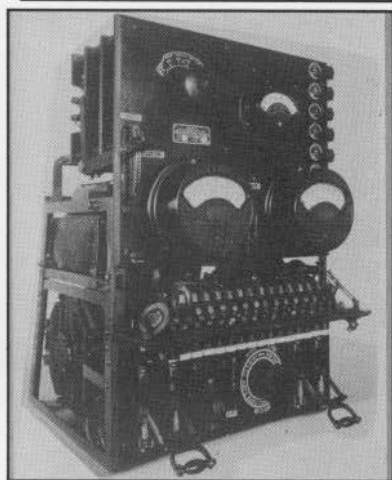
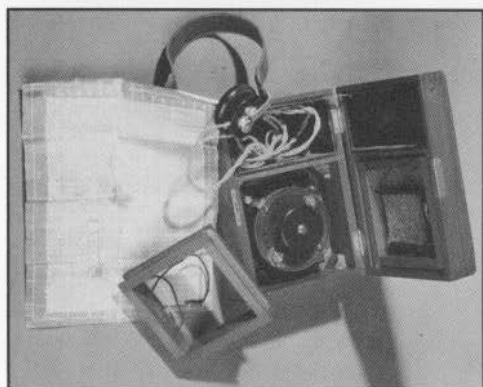
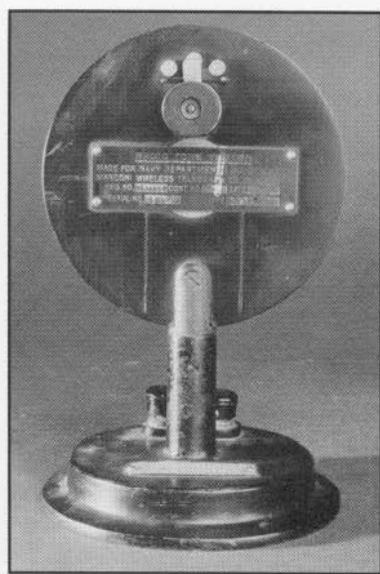
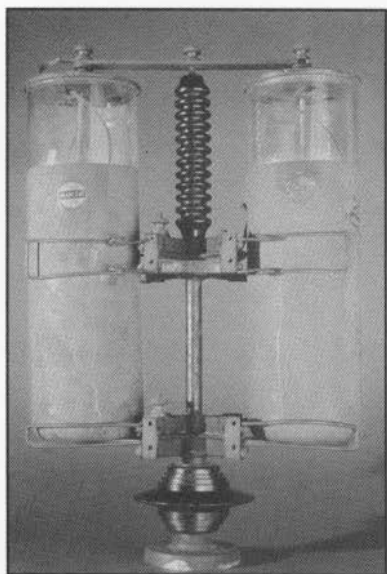


Figure 101. (Upper left) A pair of Marconi transmitter Leyden jars, each rated at 0.002 mfd. They are mounted in a Type SE 150 two-jar rack manufactured by the Machinery Division, Boston Navy Yard.

Figure 102. (Upper right) Radio Tone Tester Type SE 84, built for the Navy Department, Bureau of Steam Engineering, in 1918. This device enabled the operator to monitor the output of his spark transmitter by using a crystal detector mounted on the back.

Figure 103. (Lower left) A portable wavemeter with spare pickup coil, blueprint and original headphone. Most Marconi wireless stations had one for determining the wavelength of a circuit. Source: Kreuzer Collection

Figure 104. (Lower right) The Type CM 296A 1/2-kW, quenched-gap spark transmitter, tuning from 300 to 952 meters. Source: *Marconi Maintenance Manual*



Figure 105. A pair of American Marconi headphones, identified on the earpiece. Note the Navy type headband and the length of the phone pins. This set may have been used at the Aldene factory.

Source: Kreuzer Collection

The Armistice was signed in November, 1918, signaling a change in the wireless communication business in the United States. By November of 1919, one year after the end of the war, the American Marconi Company had reached the end of its life; the formation of RCA was imminent.

MARCONI'S WIRELESS TELEGRAPH COMPANY OF CANADA, LTD.

THE MONTREAL, CANADA, FACTORY

The first permanent wireless station in Canada was the Glace Bay transatlantic station. Completed in December, 1902, it would eventually prove to be a financial drain on the company. Successful transatlantic two-way communication with Poldhu was still a few years down the road. Progress had been made equipping ships with wireless apparatus, so the Company decided to eliminate the experiments at the Glace Bay and Poldhu stations. The time had come to develop a new transatlantic service for shipping.

Many of the various steamship lines carried Marconi apparatus, including Cunard, White Star, Red Star and the American Line. It was advantageous for ships to be able to contact a shore station and alert the home office when they were due to arrive. In the event of mechanical trouble or an accident at sea, as more ships carried wireless, the probability increased greatly of another vessel coming to their aid. By October of 1905 there were 74 passenger steamships carrying Marconi apparatus.⁹⁵

As business increased in Canada, a decision was made to create the Marconi Wireless Telegraph Company of Canada. Originally registered in Ontario on November 1, 1902, it obtained a Dominion Charter by a Special Act of Parliament on August 13, 1903.⁹⁶

The Company was originally owned almost entirely by Marconi's Wireless Telegraph Company, Limited of London, England, and under an

agreement entered into between the two companies in 1903, the Canadian Company was granted rights in perpetuity in Canada and Newfoundland under the patents of the Parent Company.⁹⁷

By May, 1904, the MWT Company of Canada received a contract from the Canadian government for the erection, installation and operation of a system of wireless telegraph stations along the St. Lawrence River and the Eastern Canada coast line. The contract called for payment on a royalty and license basis. The apparatus used by these stations was constructed in the machine shop at Glace Bay. The shop also made parts and performed repairs for the transatlantic station. It was the first to manufacture commercial radio equipment in Canada.⁹⁸

During a visit to the Glace Bay station in September, 1906 Marconi designated \$40,000 to be spent improving and enlarging the company's machine shop. He felt it would increase efficiency by having his Glace Bay technicians design and manufacture the wireless apparatus directly at the station. He was also bound by a promise made to the Canadian government to build as much apparatus in Canada as possible.⁹⁹

By early 1907 the machine shop was turning out magnetic detectors, switchboards, high frequency transformers and smaller instruments for the Canadian coastal stations. The first shop manager, Mr. Warren, was very adept at designing the unusual, welcoming every opportunity to overcome obstacles.¹⁰⁰

The orders continued to roll in over the next three years. By 1910, the Glace Bay shop had far exceeded its capacity to produce. Instead of expanding, it was decided to transfer this phase of the company's activities to the company headquarters in Montreal. It came as quite a shock to the Glace Bay community, for by 1910 there were forty men employed at the machine shop, constructing and designing wireless apparatus.¹⁰¹

A suitable plant, with space for test and draughting rooms was found on Delorimer Avenue. The regular staff at first consisted of two machinists, two assemblers and a messenger. It was operated under the supervision of the chief engineer, and any members of the engineering staff who chanced to be in Montreal were employed in testing apparatus and drafting plans for new equipment, or new stations.¹⁰²

About the middle of 1912 the company began to manufacture for itself equipment which had been previously purchased from others. Such pieces of

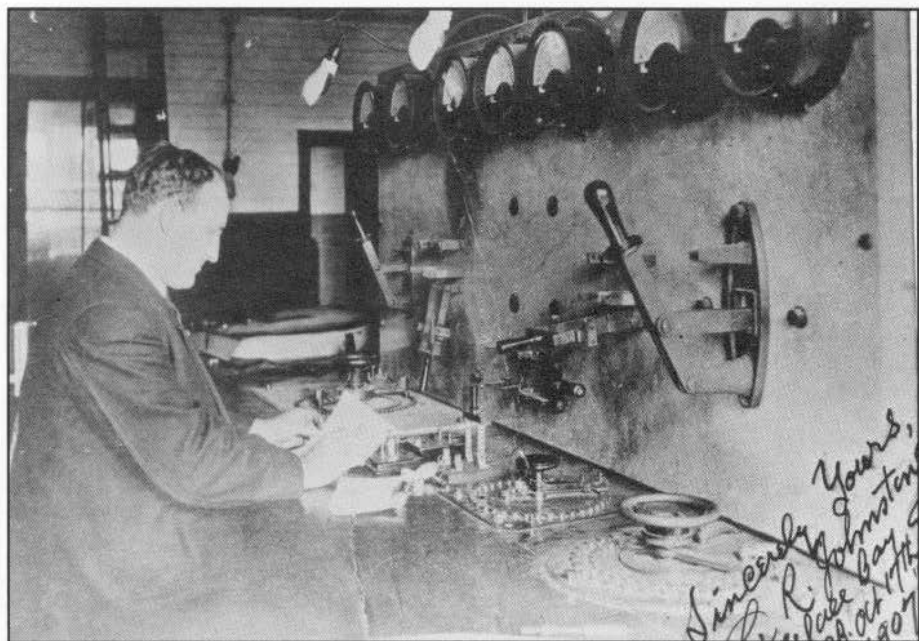


Figure 107. L.R. Johnstone transmitting the first official messages from the Glace Bay station on October 17, 1907. The front cover (Fig. 106) shows the receiving station at Glace Bay. Source: Marconi Company Archives

apparatus as switchboards and complete receivers were now being made entirely in the Montreal plant, and plans were being prepared by the local engineering staff for all new Canadian stations. The first three large stations on the Great Lakes were designed and built this year, at Tobemory, Midland and Sault Ste. Marie. The next year saw the construction of two other stations at Les Pas and Port Nelson in connection with the building of the Hudson's Bay Railway.¹⁰³

A large amount of equipment was designed and constructed at the Montreal plant, as evidenced by the numerous blueprints and line drawings which have survived. Here the first synchronous spark gap transmitter was made for the government wireless station at Grindstone, Magdalen Islands. The much-heralded Type 843 receiver was also built here. It incorporated a combination of two different circuits, short wave and long, each with its own crystal detector assembly containing multiple minerals.¹⁰⁴

By the end of 1913 the company had outgrown the Delorimer Avenue factory, and a three-story building on Rodney Street was acquired to accommodate the designing and manufacturing of wireless equipment for World War I.

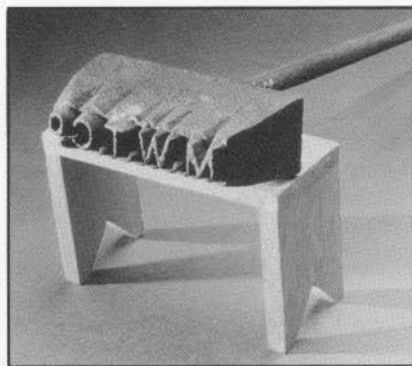


Figure 108. Marconi Wireless Telegraph Company branding iron. This was found, still in use as a stovepoker, in 1983 at the Glace Bay site. A Mr. Russell Cunningham bought the property from the Marconi Company in 1945 and was still living there, amongst all the priceless treasures!

Source: Kreuzer Collection

Figure 109. A very early kite unearthed at the Canadian Marconi Company, in storage with five others for many years. James Kreuzer is on the left, while Mr. Roger Hart, the discoverer of the kites, is on the right.

Source: Canadian Marconi Company

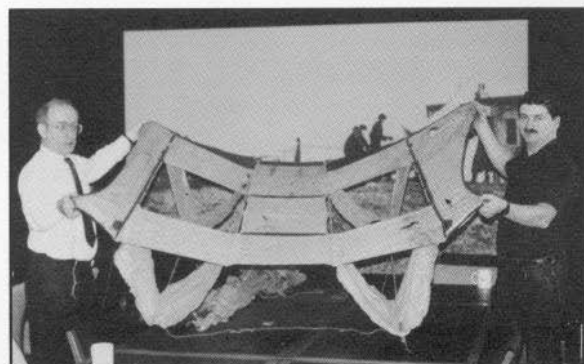
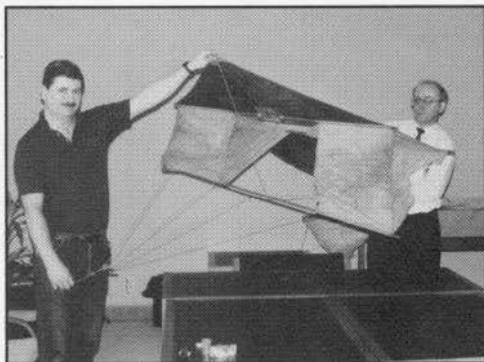
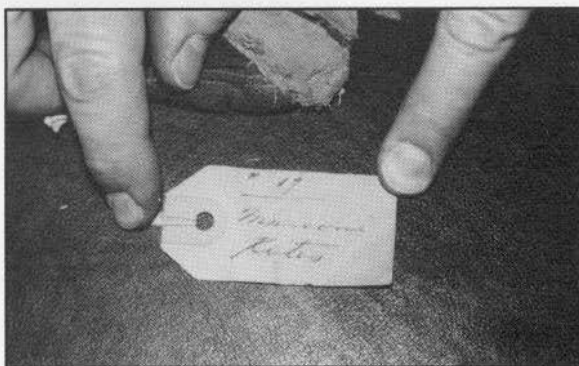


Figure 110. Another vintage kite of an entirely different design, but of the correct construction of a kite from the turn of the century. Could these be some of the kites that Marconi brought over to St. John's, Newfoundland, in December, 1901? Source: Canadian Marconi Company

Figure 111. A vintage tag attached to one of the kites; it reads "#17 Marconi Kites." Source: Canadian Marconi Company



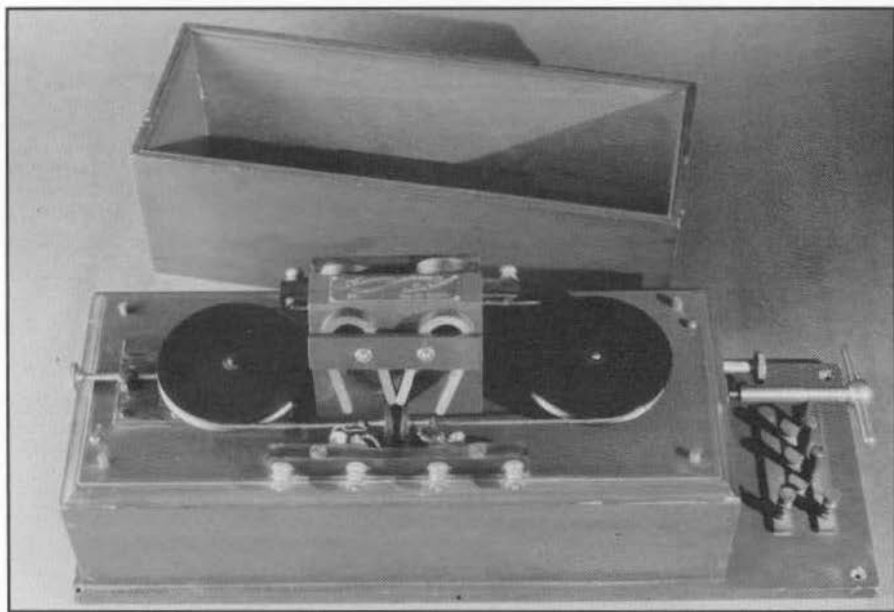


Figure 112. Marconi Wireless Telegraph Company of Canada, Ltd. magnetic detector, circa 1906. The Canadian Marconi version has the phone condenser mounted on an extension of the baseplate, as opposed to the English version which is contained in a separate box. This particular "Maggie" came from Thorn Mayes. He obtained it from a Marconi operator who worked at the Cape Race station, and who told Thorn that it was the one in use at the time of the Titanic disaster, and was in contact with the ship as it collided with the iceberg.

Source: Kreuzer Collection

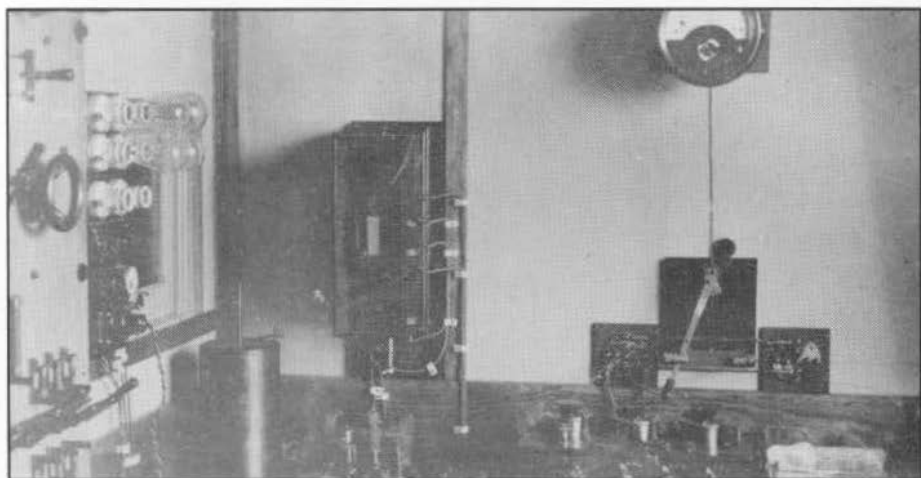


Figure 113. A photograph showing the wireless room at the Cape Race station. Notice the Maggie on the wall, and a multiple tuner on the lower right side.

Source: Roger Hart Collection

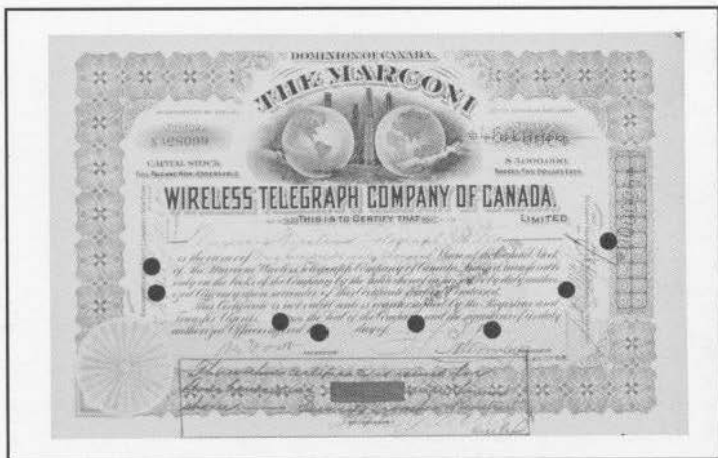


Figure 114. A Canadian Marconi stock certificate made out to Marconi's Wireless Telegraph Company for 460,000 shares! It was signed by J. Bottomley and dated April 29, 1912.

Source: Kreuzer Collection

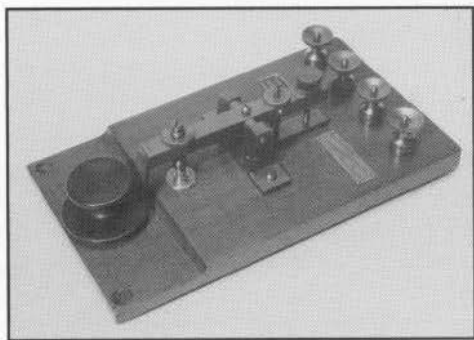


Figure 115. Type 701 Canadian Marconi spark key, circa 1913. This type was used at the wireless installations around the Great Lakes and along the Eastern Canada coastline.

Source: Murray Willer Collection

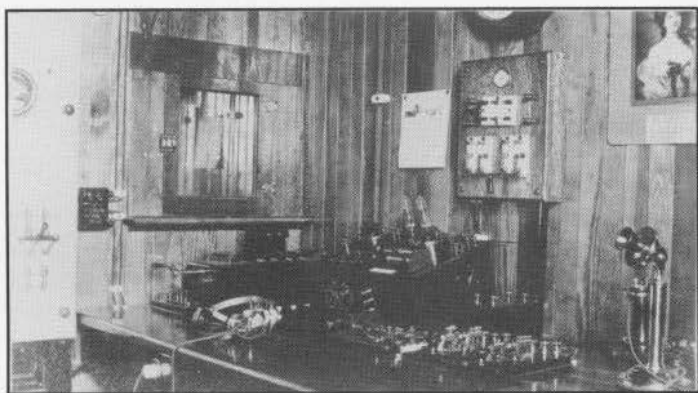


Figure 116. This is the operating room of the Marconi station at Midland, Ontario. Note the Fleming valve receiver and the "Maggie." The calendar on the wall shows October, 1912.

Source: Roger Hart Collection



Figure 117. The employees of the Marconi Wireless Telegraph Company of Canada pose for the camera on a cold winter day in Montreal. This photo was taken at the Rodney Street works in 1915.

Source: Roger Hart Collection

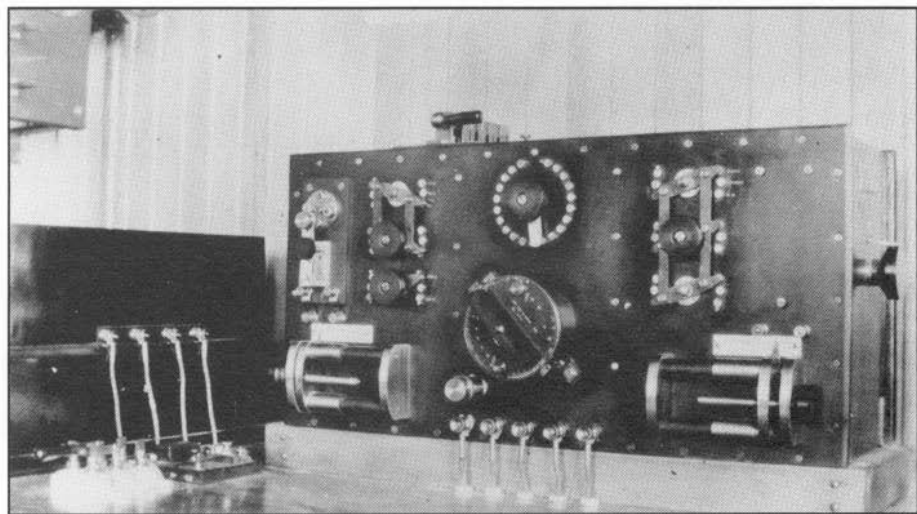


Figure 118. The Marconi station at Kingston, Ontario, circa 1914. Shown is the Canadian Marconi Type 843 crystal set and a magnetic detector.

Source: Roger Hart Collection

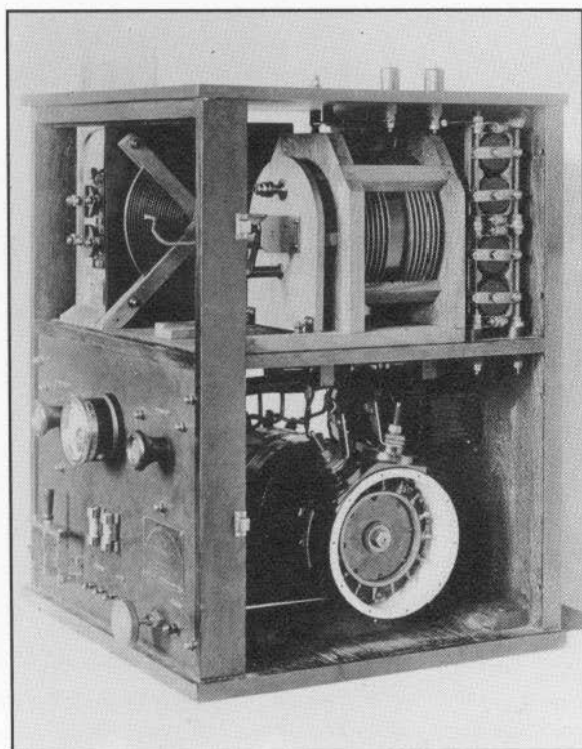


Figure 119. Canadian Marconi 1/4-kW ship-board transmitter using a rotary spark transmitter.

Source: Roger Hart Collection

Figure 120. The William Street factory in Montreal. In 1919, from the top floor, far left side, the first broadcasting station in Canada, station XWA, made its transmissions.

Source: Roger Hart Collection



The urgency was so great that the factory was operated day and night, in spite of the difficulty of securing capable employees. Finally, the receipt of large orders from the English company and through it from the United States Shipping Board left no alternative but to increase the manufacturing facilities, and in October, 1917, the plant was moved to a much larger building on William Street, which was equipped to turn out every sort of apparatus required in wireless work.¹⁰⁵

The William Street plant was where Canada claimed to have initiated the world's first broadcasting station. In early 1919, regular reports were broadcast, including weather reports and general news. With the assigned call letters XWA, the first reports were sent in telegraphic code and consisted of weather reports and some general news. Later in 1919 voice communication was used, and by 1920 the call letters were changed to CFCF.¹⁰⁶

CONCLUSION

We have traveled with Marconi from childhood experiments, when he made a bell ring to impress his mother, through the major works of his lifetime. Using the most primitive of tools and hand-made equipment, he developed a vision which culminated in possibly the most exciting discovery of the century. Among all the advantages obtained from wireless, Marconi always felt the most important was the ability to save lives.

Marconi was also a creative genius in the world of future communications. He was the forerunner in short wave with his beam system, and while experimenting in 1916, Marconi and C.S. Franklin noted, as Hertz had, the phenomenon of radar as short waves were reflected from obstacles in the signal path.

When we ponder the trials and tribulations involved in developing Marconi's system of wireless, it would seem the impossible had been achieved. He was often disregarded as a serious inventor. He fought nature while attempting to assume control over variable conditions, searching for optimum performance in communications.

His kites failed, he traveled excessively for a family man. The weather rarely cooperated. Against all these odds—and more—Marconi managed to do what no man before him could. He dreamed, then proceeded to make his dreams come true. He was forced

to demonstrate over and over the value of his equipment, often facing ridicule and disappointments. Ahead of his time, he foresaw the possibilities of television. His ideas inspired many others to future inventions. Truly he was a great man.

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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 radio, a Philco 90, 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 1974-1980 he and Felicia attended auction sales and flea markets in search of battery sets of the 1920's. 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 commercial 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 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.



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Felicia is a native of Minneapolis, Minnesota where she was born in 1955. Felicia joins her husband as an avid collector and historian of early wireless apparatus and literature. A ham radio operator since 1979, she is a Radiologic Technician and is presently training to specialize in Sonography. 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 fourteen year old daughter and a six year old son, who is always picking up transistor radios. Felicia enjoys collecting X-ray apparatus and books, as well as ephemera, especially autographs; the collection now includes letters from Oersted, Morse, Faraday, Maxwell, Hertz, Tesla, Lodge and, of course, Marconi!

