

# Charles Williams Jr.

## Part One: *Experimental Apparatus Made to Order*

Charles Williams Jr.'s place in American telegraph history would be significant alone as an important manufacturer of telegraph instruments during the 19th century. But, it was the services he offered through his Boston machine shop to experimenters and inventors that were historic for the American telecommunication industry. Williams started out offering these services just to earn a living for himself and his machinists. Ultimately, though, it led to him becoming a pioneer in the manufacturing of telephones and one of the first telephone millionaires in the United States.

Charles Williams Jr. was born in Chelmsford, Massachusetts on March 2, 1830. Early in his life his parents moved to Claremont, New Hampshire where he spent most of his school days. His father, Charles Senior, was a prominent citizen in Claremont, a staunch supporter of the Universalist Church and was sent to the New Hampshire State Legislature.

The Williams family moved to Somerville, Massachusetts in 1846 when Charles Junior was 16. He received only an elementary education at both Claremont and Somerville. As a teenager he had the aptitude and an interest in the fields of mechanics, electricity and magnetism.

Williams went to work for the telegraph and philosophical instrument manufacturing firm of Palmer and Hall. Thomas Hall had purchased the firm of Daniel Davis Jr. in 1849 and formed a partnership with G.W. Palmer. In 1850, when Williams was only twenty, he teamed up with



**Charles Williams Jr.**



Justin Hinds, who was the same age as Williams and also working at Palmer and Hall. They had similar interests and put together their individual specialties of what they were working on at that time and formed a business partnership as Hinds and Williams. They established their business at 313 Washington Street in Boston. Their early ads stated they were manufacturers of both telegraph instruments and magnetical apparatus. They also advertised they were available to build models of machines and experimental apparatus.



A Hinds and Williams telegraph key and an advertisement from 1856. (Key courtesy of Gil Schlehman, K9WDY)

In 1856, Williams became the sole proprietor of the firm and continued to operate from 313 Washington Street for a number of years as the "successor to Hinds and Williams." Justin Hinds maintained his interests in the mechanical and electromechanical fields and continued to utilize the Williams' machine shop for his own work. Hinds later received patents in steam engine pistons and railroad signaling as a co-inventor. He also gave lectures in the 1860s on electricity and the telegraph. As late as 1874, Hinds was still advertising his services in the telegraph field and operated alone from 130 Washington Street.

Charles Williams moved his machine shop on Washington Street to a larger building on 109 Court Street in Boston around 1862. Other businesses also operated at this address including a battery manufacturer, periodical dealer, clothing wholesaler and paper box manufacturer.

Williams occupied the attic and a large third floor loft that was directly above a billiard hall. The main shop, located in the loft, was small and crude in all its arrangements. The interior brick walls were of a faded, dust-covered whitewash. Set up near the front and back row of windows, were 12 to 20 hand powered, metal-working lathes. There were also two small engine powered lathes. The ceiling and beams of the shop were mostly hidden by the leather belts and pulleys of the machinery. In the center of room there were wooden racks holding steel, iron and brass sheets and rods all used as raw material. On the floor, there were piles of rough castings. There was a sink where men washed up and a small forge for annealing and tempering. One corner of the loft was partitioned off for Williams' office and a salesroom where the finished instruments were on display in glass cases.

During the 1860s Boston was considered second only to New York City as an established telegraph "Hub" and a magnet for telegraph inventors. Some of the telegraph shops in Boston had been involved in the manufacturing of instruments since the 1840s. These specialized shops attracted would-be telegraph inventors with hopes that their designs could be turned into successful models.

The telegraph shops of this era were divided into two categories: shops owned by the large telegraph companies and the independent shops. The company owned shops, besides building telegraph equipment for their offices, also built experimental equipment and models for inventors. But usually they were only built for inventors with inventions that would directly benefit the company. Other inventors, smaller telegraph companies, and most railroads sought out the independent shops, like the Charles Williams Jr. shop that also had the specialized machinery and skilled electro-mechanicians.

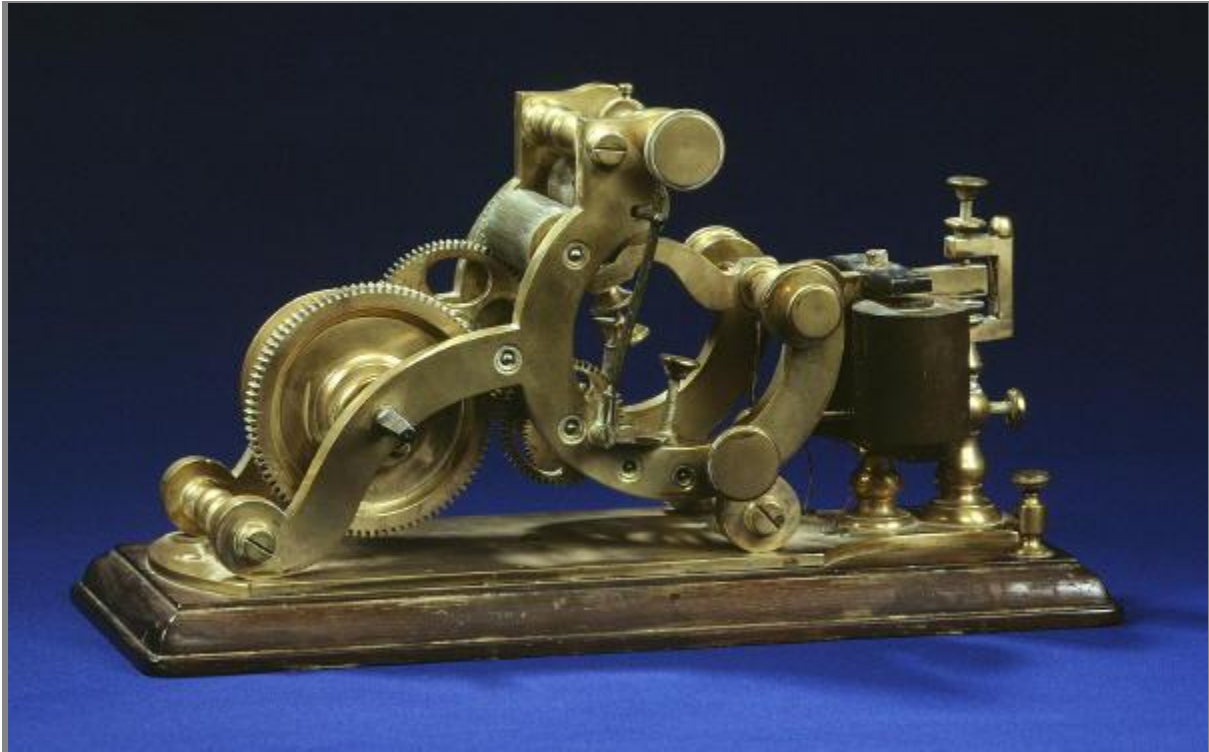
There were two telegraph companies operating in Boston at this time - Western Union with four offices and the new Franklin Telegraph Co. with three. By the mid 1860s, the Western Union offices were supplied with instruments from their main shop in New York City.

The Franklin Telegraph Company's president, Joseph Stearns, was a recognized Boston



109 Court Street, Boston, Massachusetts

telegraph inventor. Stearns improved a design of a duplex telegraph system and put it to use on his lines between Boston and New York. Stearns and the Franklin Telegraph Co. relied on the specialized independent manufacturers in Boston for their equipment. The two largest at that time were Charles Williams Jr. and Edmands and Hamblet.

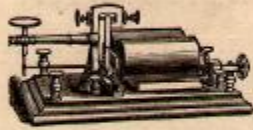


**A weight-driven telegraph register by Charles Williams Jr.**

*From the collection of the [Samuel F.B. Morse Locust Grove Estate](#)*

CHARLES WILLIAMS, JR.,

109 COURT STREET,  
BOSTON, MASS.,



MANUFACTURER OF

TELEGRAPH INSTRUMENTS,

BATTERIES AND MATERIALS,

SOLE MANUFACTURER OF

THE ORIGINAL CELEBRATED

“BOSTON RELAY.”

All Instruments and Materials used in furnishing and working

TELEGRAPH LINES,

including Registers, Relays, Main Sounders, Local Sounders, Keys, Switches, Cut-outs, Galvanometers, Repeaters, Arresters, Rheostats, Resistance Coils, Bell Calls, Dial Telegraphs, Gongs, Batteries, Porous Cups, Zincs, Coppers, Blue Vitriol, Acid, Insulators, Line Wire, Insulated Wire, Cables, &c., constantly on hand and for sale at the lowest prices. Also, Electro-Medical Instruments and Magnetical Apparatus of every description.

**Charles Williams Jr Ad from:  
*The Modern Practice of the Electric Telegraph,*  
Franklin Pope, 1869**

There were several unsuccessful inventors, experimenters and entrepreneurs who walked into the Williams shop to have their experimental designs built. Sometimes there were two or three in the shop at a time supervising the construction of their projects. But, there were a few of them that were successful and became prominent inventors of this era.

#### **Edwin Holmes**

One of Williams' first customers during the Hinds and Williams days was Edwin Holmes. Holmes purchased a patent from Augustus Pope who was living in Williams' home town of Somerville. The patent was for a simple electromagnetic burglar alarm design where if a door or window were to open, a bell rang in the owner's bedroom. Holmes originally went to Hinds and Williams with his newly purchased patent to have all the electrical bells and necessary equipment built. The Holmes' Burglar Alarm Company grew out of it and soon expanded to New York City, where Holmes felt there were more burglaries. Williams continued to supply equipment to Holmes for both cities for several years. Edwin Holmes' design of a central office to handle his burglar alarm monitors circuits in Boston would later be adapted as a telephone central office during early experiments with the telephone.

#### **Moses G. Farmer**

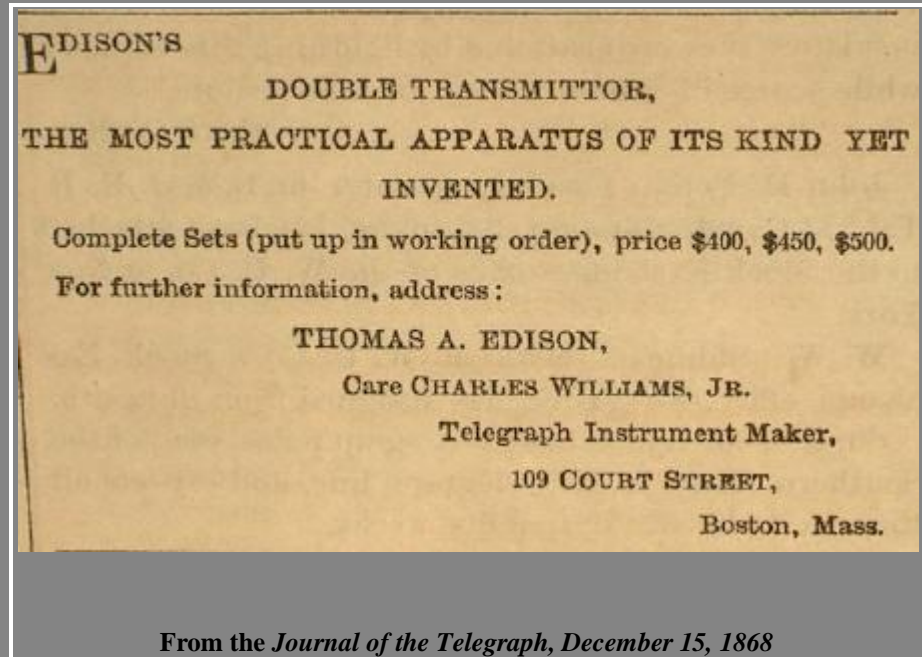
Moses Gerrish Farmer was one of the prominent inventors and leading "electricians" of this era. A Dartmouth College graduate, Farmer conducted many experiments with electro magnetism and was involved with some of the early telegraph offices and lines in New England since the 1840s. During the 1850s, he and Dr. W. F. Channing were pioneers in developing and installing a fire alarm telegraph system for the City of Boston. During the 1860s, Farmer conducted experiments in a corner of Charles Williams' shop. He had Williams build some his experiments and Farmer educated Williams' machinists about electricity. Moses Farmer's, "Thermo-Electric Battery" was being manufactured by W.H. Remington in the same building as the Williams shop.

## Thomas A. Edison

In March of 1868, when Edison was only 21, he moved from Port Huron, Michigan to Boston. He was hired by George Milliken who was the manager of Western Union's main office in Boston. Milliken was another accomplished Boston telegraph inventor with several patents, most importantly his design of a telegraph repeater. It was during this year while in Boston that Edison made the transition from being a telegrapher to a full time inventor.

Edison worked on a press wire at night at Western Union and during his off hours, worked on his projects at the Williams shop. Williams gave him the space he needed and extended Edison credit for materials and work performed by his machinists. He sometimes worked after Williams went home. While in Boston, Edison worked on a number of projects including a self

adjusting relay, stock printer, and his own fire alarm telegraph. In October of 1868, Edison filed for his first patent, a vote recorder for legislative bodies. In December of 1868, he placed his first advertisement for one of his inventions and listed the Williams shop as his address. The ad was for his double transmitter, used in duplex telegraphy. There is no evidence, though, that he ever sold either a vote recorder or a double transmitter.



In June of 1868, while Edison's was in Boston, the 109 Court Street building was badly damaged in a fire. It was estimated that the damage to Williams' shop and inventory alone was \$3000 to \$5000. The damage to Moses Farmer's expensive experimental apparatus and the battery business of W.H. Remington was estimated at \$2000 each. Williams was covered by insurance, but Farmer and Remington were not. Williams and his machinists cleaned up the shop, made repairs to their machinery, and with new tools and equipment, were back in business by August.

During Edison's time in Boston, he submitted articles to leading telegraph publications of the day. He signed his articles with the initials, "TAE" or simply with an "E." In one of his articles, published on August 15, 1868, he wrote about the manufacturing that was going on in Boston and gave first hand details about the Williams shop.



**Charles Williams Jr. Pocket Set.**  
A complete telegraph set with key and sounder  
measuring only 5"L 3"W 1.75"H.  
(Courtesy of Douglas Palmer, K4KEY)

*..The establishment of Mr. Williams is located at 109 Court Street, and though but a short time since damaged by fire, is again in full blast. Very little apparatus, except that used for Telegraphic purposes, is manufactured here, and in this particular branch the work is of a most excellent character, consisting of Repeaters, Switch-boards, Relays, Registers, Sounders, Keys, Rheostats, Galvanometers and batteries, all of which are made in large quantities. The most noticeable instrument manufactured here is the well known "Boston Relay," of which a large number are turned out weekly, mostly for use on railroad wires. Ten men are employed here. The office of the well known electrician and telegraph inventor, Moses G. Farmer, is also at this establishment.*

By January of 1869, Edison resigned his position as telegrapher to work full time experimenting and seeking

backers for his inventions. In the spring of 1869, Edison moved to New York City.

Another interesting insight during this period was by telegraph engineer and author Franklin Pope with his report of October 23, 1869 on the exhibits of The American Institute Fair in New York City: *..Mr. Williams exhibits two relays, two sounders and a register, as well as half a dozen keys of different patterns. There is, of course, nothing especially new in principle about these instruments; but in point of elegance of design, and beautiful and accurate workmanship, they cannot be surpassed by the productions of the best European workshops. These are, beyond question, the finest instruments which have ever been publicly exhibited here.*



**A Charles Williams Jr. version (front) of a Phelps/Western Union pattern camelback key.**

One of the popular key patterns of this era was the Phelps or Western Union pattern camelback key. They would have of been in use at the Western Union offices in Boston at this time. Several makers had their own interpretation of this key and Williams was no exception. You can see in the photo of the two keys, the strong similarities of the Williams key to the Phelps.

In Part Two of this article, *Human Voice sent via Telegraph*, the activities of Charles Williams Jr. and his shop after 1870 are covered.

**[To Part Two--](#)**

**[Charles Williams Jr.: Human Voice sent via Telegraph](#)**

**Part Two: *Human Voice sent via Telegraph***



Probably the most famous of Charles Williams' workers was Thomas Watson.

Watson was a son of a Salem Massachusetts livery stable foreman. He had drifted from jobs for four years until July of 1872, at age 18, he was hired by Charles Williams. He started out turning binding posts on a hand lathe for \$5.00 a week. By 1874, Watson was considered one of the shop's best men out of the 25 employees working there at that time. Watson studied the scientific principles behind his work and was educated about electricity by Moses Farmer. Williams provided a small library of books on electricity for his employees that were read during lunch time. Watson was assigned almost exclusively to do custom work of inventors.



Thomas A. Watson



Early in 1874, while working on an apparatus of Farmer's, Alexander Graham Bell came into Williams' shop and went directly over to Watson. He was looking for Watson to make modifications to a transmitter and receiver of his harmonic telegraph. His design was to send 6 to 8 messages at different pitches simultaneously over one wire and receiving them on tuned receivers. Bell was 27, and a Professor in Vocal Physiology and Elocution at Boston University. By January of 1875, Watson was assigned to Bell in addition

to doing work of other inventors.

By the spring of 1875, after months of discouraging results with the harmonic telegraph, Bell attempted to cheer up Watson one night by letting him know of another plan. He said to Watson, *If I can get a mechanism which will make a current of electricity vary in its intensity, as the air varies in density when a sound is passing through it, I can telegraph any sound, even the sound of speech.*

### Telephone Discovery

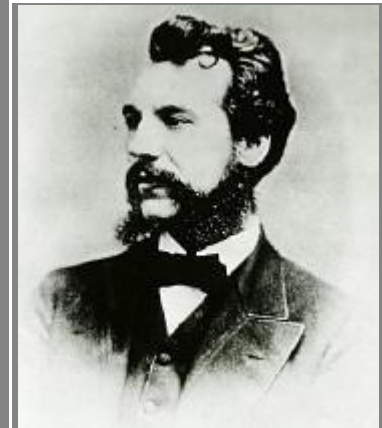
In the attic of Williams' shop, on June 2, 1875, Bell and Watson were continuing with their weeks of experiments with tuned transmitters and receivers as a means of sending several simultaneous telegraph messages over a single line. Bell had two stations set up in his room. One station consisted of a number of transmitters (interrupters) with telegraph keys and a second station consisting of receivers made with horseshoe electromagnets, and the corresponding reeds of the transmitters. A third station was set up in Watson's room with a duplicate set of receivers. All three stations were connected in series.

Each of the transmitters and receivers had a reed made from a strip of spring steel, positioned over an electromagnet and clamped at one end so that the pitch of its natural vibration could be adjusted by changing the clamping point. The instruments were adjusted to various pitches. Each transmitter was fitted with a pair of interrupter contacts, similar to those used in an electric bell. When a transmitter was keyed, the steel strip, or reed, would vibrate at its natural pitch and

only the corresponding receiver with the matching reed would respond--vibrating at the same pitch.

On this day, when Bell keyed all his transmitters in succession, the corresponding receivers responded with the exception of one located in Watson's room. With the transmitters and battery off the circuit, Bell connected the two stations of receivers together in a closed circuit and noticed while Watson was trying to pluck the reed free on the non responding receiver, that the reed on his receiver started to vibrate evidently by only some residual magnetism. Bell also noticed he could faintly hear the specific tone of Watson's reed on every one of his receivers.

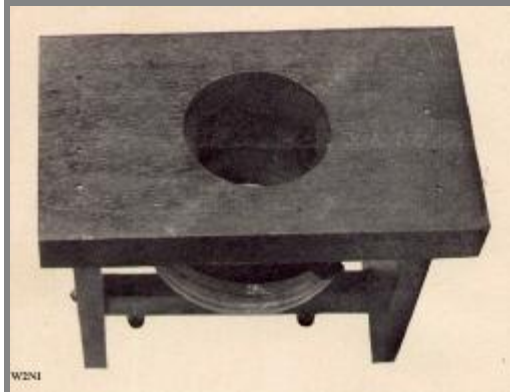
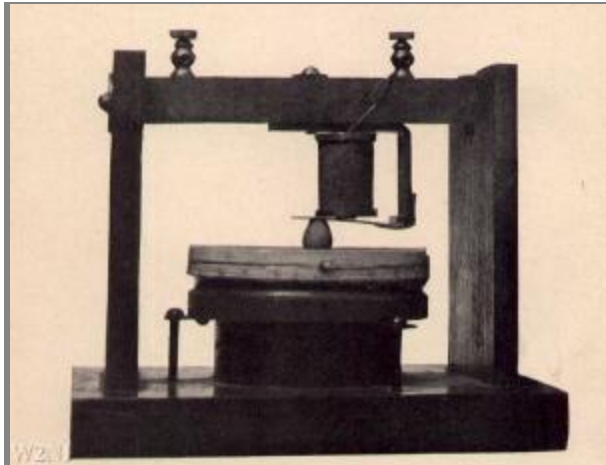
It was this discovery of a means of producing a varying electromagnetic current that led to Bell's development of the telephone--which is essentially a device for converting voice into a continuously varying electric current and using it to actuate an electromagnet acting against a diaphragm.



**Alexander Graham Bell**  
1876  
*Smithsonian Institution Archives*  
*Image # SIA2012-1090*

#### **5 Exeter Place**

In January of 1876, Bell decided to keep his experimental apparatus out of sight until he secured patents, something that was not possible at Williams' shop. He was worried about possible spies of Elisha Gray of the Western Electric Mfg. Co. who was also working in this field. Bell rented two rooms a half mile away from Williams' shop in the attic of 5 Exeter Place. Bell slept in one and Watson set up a lab in the other. Most experiments for the next two years were done there until the telephone went into full production. Watson made modifications to the instruments in Williams' shop and then carried them over to Exeter Place. Williams' men erected an outdoor line between the Williams Shop and Exeter Place soon after the experimental work began there. It was a no. 12 galvanized wire, a half mile long and run over house tops. It remained in constant use until it was abandoned in July of 1877. Watson spent hours at night listening to stray currents on this line with his primitive receivers.



**A side and bottom view of what is considered one of Alexander Graham Bell's first telephones. Speaking into the opening causes a diaphragm to act against an electromagnet. Two of Williams' distinctive binding posts are shown.**

Bell was granted his telephone patent (Improvement in Telegraphy) on March 7, 1876. On March 10, with the addition of a membrane that varied the resistance of a battery powered, liquid transmitter, Bell was able send a complete sentence to Watson's reed receiver between the two rooms at Exeter Place, "Mr. Watson, come here, I want to see you."

In the summer of 1876, Bell decided to exhibit his telephone in the Centennial Exposition at Philadelphia. Watson built a set of instruments at Williams' shop using bronze instead of wood and polished them like mirrors. Because Bell decided to exhibit them late, his telephones were not put with other electrical instruments but with the educational section. Bell received high marks from Sir William Thompson who stated *...This, perhaps the greatest marvel hitherto achieved by the electric telegraph, has been obtained by appliances of quite a homespun and rudimentary character.*

That summer, two of Bell's supporters, Gardiner G. Hubbard, who later became his father-in-law, and Thomas Sanders, a financial backer and the father of one of Bell's visible speech pupils, offered Watson a full time job for the development of the harmonic telegraph and speaking telephone. Urged by Bell, Hubbard offered Watson the same pay he was earning at the Williams shop, free room and board, and a tenth interest in Bell's patents. At that time Watson was earning journeymen's wages of \$3.00 a day and was in line to become a foreman. Watson thought about it for a couple of weeks before signing a contract.

#### **A.G. Bell Co. Formation**



**Charles Williams Jr.'s former home today. The first practical telephone line in the U.S. was installed between Williams' home in Somerville, Massachusetts and his factory.**  
*Courtesy of the Somerville, MA Public Library*

Early in 1877, Watson gave Williams the first production order of 25 box and 50 hand telephones. Up until this time, Watson had built all the phones. On April 4, the first private phone line for practical use was installed between the Williams shop and his home in Somerville. Bell said *I went into his office this afternoon, and found him (Williams) talking to his wife by telephone.* The reported success in the press stirred public interest. Inquiries and orders started to pour in and within a month a leasing plan became practice.

The first customer was a friend of Williams, Roswell C. Downer. On May 1, 1877, Downer rented two phones that were put on a private line between his State St. office and Downer's home in Somerville. The first paying customer was James Emery who on May 30, paid Williams 20 dollars for a year lease. Williams carried it around in his pocket for awhile until he



**An artist sketch of Charles Williams Jr.'s private office and salesroom in his factory at 109 Court Street in Boston, Mass. In this scene, E.T. Holmes watches as Williams "shouts" into his phone.**  
*From: A Wonderful Fifty Years, E.T. Holmes, 1917*

could ask Gardiner Hubbard what to do with it. At that time, only a "patent association" of Bell, Sanders, Hubbard and Watson existed. On July 9, 1877, the Bell Telephone Company was organized as an unincorporated "voluntary association" without any capitalization. Watson became a superintendent in charge of manufacturing and Bell was the "Electrician," although

Watson also filled this role. A strict policy of leasing instead of selling phones was adopted. On July 8, 1877, Watson dismantled the Exeter Place lab and moved it back to the Williams shop.

#### **Sale to Western Electric**

By August 1, 1877, 778 phones were in operation without failure. Williams was manufacturing phones at the rate of 25 a day. That month, Williams promised to increase his production from 25 to 50 daily, although he was incurring significant production expenses. The Bell Company, short of capital, relied heavily on the credit extended by Williams.

The manufacturing arrangement between the patent holders and Williams had been informal to this point. A formal agreement was not drawn up until August 1, 1878 giving Williams exclusive rights of manufacture. It consisted of a three page hand written contract. The Bell Telephone Company agreed to purchase all their telephones from Williams, paying him \$1.60 for each hand telephone, and \$2.45 for each box telephone. Each was subject to inspection by the company's superintendent, Watson. Williams numbered the instruments in series, the leases were closely monitored, and Watson personally shipped all the instruments.

From 1877 to the spring of 1879 the Bell Company relied exclusively on Williams' shop for telephones and associated apparatus. By early 1879, Williams could not keep up with the demand. Williams' machinists were not used to being strictly production workers, they were considered craftsmen, used to making modifications on the fly for inventors. Additionally, Williams stated, *...Almost every batch we turned out was an improvement over the preceding ones...* By February 7, 1879 Williams' employees were working 11 hours a day but production was up to only 35 phones per day.

The Bell Company began to seek other manufacturers to build the associated telephone equipment, such as call bells and exchange apparatus, to help free up Williams so he could focus on telephones. In the spring of 1879, a newly formed "National" Bell Telephone Company made agreements with four other geographically located manufacturers for telephone equipment. The Electric Merchandising Co. of Chicago, Davis and Watts of Baltimore, Post and Company of Cincinnati, and the Indianapolis Telephone Company. (A recent Bell licensee run by E.T Gilliland) Williams was still the sole producer of receivers and transmitters but now free to focus on them only, although he did make some apparatus for the New England and New York markets. By the end of the year, Williams invested \$2000.00 on new machinery and increased his work force to 60. His production went to 670 phones a week and by 1880, a 1000 per week, but it was still not enough.

During this period Bell faced heavy competition from Western Union. Back in 1877, Gardiner Hubbard offered Western Union Bell's rights for \$100,000, but he was turned down. Western Union decided later to get into the telephone business themselves and operated under the patents of Elisha Gray, Thomas Edison, George Phelps and others. A patent infringement suit took place which was settled in November of 1879 in favor of Bell. Western Union had been supplied telephone instruments from the Western Electric Mfg. Co. factories in both Chicago and New York. This settlement put Western Union out of the telephone business and left the Western Electric Mfg. Co. with no telephone work.



**The "Coffin" was probably the most famous telephone produced by Williams. A single magneto hand telephone could serve as both a receiver and transmitter. Some models came with two, one for each hand.**  
*Coffin images courtesy of Tom Adams*



A close-up view of the "Coffin's" markings.  
The two plates also served as a lightning arrester.

Soon after this, the Western Electric Mfg. Co. started to warm its relationship with E.T. Gilliland, a Bell licensee and in March of 1881, purchased a 61 percent share in his company allowing for a back door re-entry into the telephone business. A proposal was then made for the creation of a Consolidated Mfg. Co., formed by a merger of the Gilliland Co. and Charles Williams' factory into the Western Electric Mfg. Co. On July 5 1881, Western Union, who was under a hostile take-over at that time, sold its one third interest in the W.E. Mfg. Co. to the American Bell Telephone Co. American Bell had

succeeded National Bell in May of 1880 with even greater capitalization. Over the next few months, American Bell was able to obtain a majority control of the Western Electric Mfg. Co.

On a side note during this month, on July 2, 1881, President James A. Garfield was shot in the back while walking through a Washington railroad station. It was suggested that the bullet could be located by some sort of electromagnetic device. Bell and Charles Sumner Tainter, a former machinist of Williams, worked on an induction balance device to help locate the bullet. Bell's experiments for this were done at Williams' shop in Boston and at a small lab in Washington. Bell personally tried his apparatus twice on the President but was unsuccessful in locating the bullet. Bell made additional modifications to his device at Williams' shop but the President passed away before he could try it again. Bell's improved apparatus was later widely adopted as a bullet probe before the use of the X-ray.

On July 23, 1881, Charles Williams offered to sell his firm to the American Bell Co for \$120,000 in return for cash or stock of the new Consolidated Mfg Co. A contract was signed on February 6, 1882 along with a complex series of stock transfers. Out of this the Western Electric Company was formed receiving permanent and exclusive rights to manufacture telephones and apparatus for American Bell. By April of 1882, Bell owned 53 percent of Western Electric's stock. Williams' now expanded shop on 109 and 115 Court Street became a Western Electric factory, with Charles Williams staying on as its manager

**Western Electric Company,**  
Successor (at Boston) to CHARLES  
WILLIAMS, JR.,  
Authorized Manufacturer for  
AMERICAN BELL TELEPHONE COMPANY.  
Telephone and Telegraphic Apparatus.  
109 & 115 Court Street, Boston, Mass.  
CHARLES WILLIAMS, JR., Manager.

In 1884, a year after the completion of the consolidation, Williams began to transfer his operations to the Western Electric shops in New York and Chicago.

Williams' Court Street factory and what remained in machinery was sold to Albert L. Russell, one of Williams' machinists who continued there as a manufacturer of telegraph and electrical instruments.

Charles Williams Jr. officially retired in 1886, remaining a director and heavy stock holder in Western Electric. Williams had a very quiet disposition, he was fond of books and reading and spent several years in retirement traveling the world and the U.S. with his family until 10 years prior to his death. He passed away in Somerville on April 14, 1908 of bronchial pneumonia.

**Charles Williams Jr. sold his factory to the Western Electric Co. in 1882. He continued as the manager of the firm and served on Western Electric's board of directors.**

*The Electrician and Electrical Engineer, January, 1884*

[Click here to view some early ads of Charles Williams Jr.](#)



## Patents

The following patents are associated with Charles Williams Jr. Some are with his machinists and foremen.

Design #12179,  
February 22, 1881, [Charles Williams Jr. & Thomas W. Lane, Design for Telephonic Apparatus](#)

Patent #108743,  
October 25, 1870, [Charles Williams Jr. & Jerome Redding, Improvement in Electro-Magnetic Alarm-Congs](#)

Patent #217849,  
July 29, 1879, [George L. Anders, Assignor to Charles Williams Jr., Improvement in Magneteto-Electrical Call Apparatus](#)

Patent #226528,  
April 13, 1880, [Edward N. Lord, Assignor of one half to Charles Williams Jr., Telephone Switch](#)

Patent #240492,  
April 19, 1881, [J. Oscar Ziegler, Assignor of one half to Charles Williams Jr., Electric Switch](#)

Patent #248821,  
October 25, 1881, [Charles Williams Jr., Thomas W. Lane & Frank W. Harrington, Telephone Switch-Board](#)

Patent #250081,  
November 29, 1881, [Thomas W. lane, Assignor to himself & Charles Williams Jr., Electrical Switch-Board](#)

Patent #259558,  
June 13, 1882, [Thomas W. Lane Assignor to Charles Williams Jr., Electric Switch-Board](#)

Patent #259644,  
June 13, 1882, [Thomas W. Lane Assignor to Charles Williams Jr., Magneto Generator](#)

Patent #262059,  
August 1, 1882, [Thomas W. Lane & Frank W. Harrington, Assignor to Charles Williams Jr., Electrical Switch-Board and Signaling Apparatus](#)

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A version of this article was originally  
published in the July 2010 and  
January 2011  
issues of "The AWA Journal," the  
quarterly  
journal of [The Antique Wireless  
Association.](#)  
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