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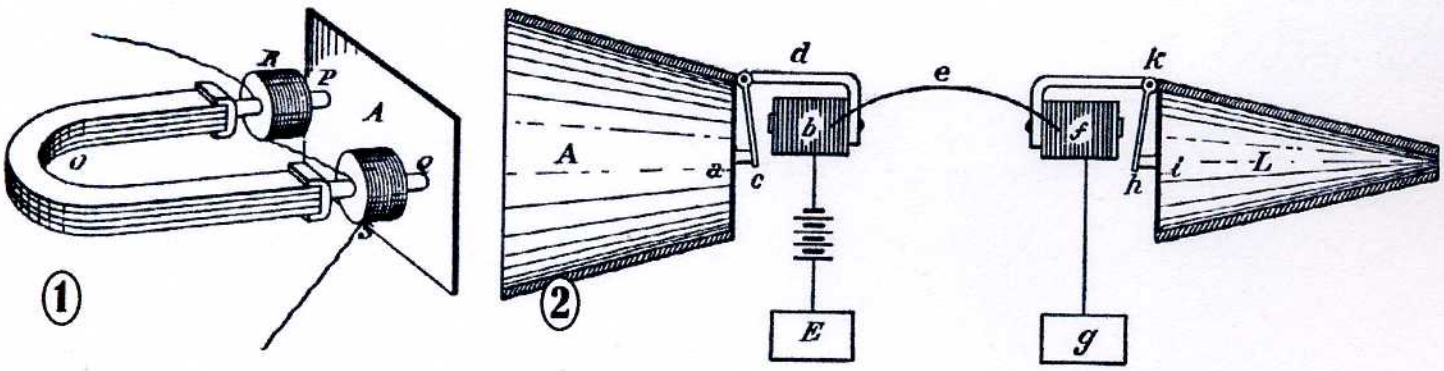
DID BELL STEAL THE TELEPHONE INVENTION FROM GRAY?

by Ralph Meyer



(From left:) Figure 1: Drawing of the improved permanent-magnet "telephone" from Bell's patent, applied for on January 15, 1877. Figure 2: Diagram of inductive transmitter (left) and receiver (right) from Bell's patent, applied for on February 14, 1876.

This is a question that ought to go away. Most recently, however, this question was raised again by Seth Shulman in a book called The Telephone Gambit, which was favorably reviewed by George Howard in the December 2008 issue of *Singing Wires*. Shulman's main claims are as follows:

• Shulman alone has discovered a revealing diagram in Bell's notebook that was not released for public viewing until 1976 ["Or that I, in a relatively casual reading of Bell's notebook, might have discovered something that had eluded generations of historians." p. 36].

• After seeing Gray's caveat [redacted] Bell added a description of a variable resistance transmitter to his patent application ["The question goes to the heart of the central mystery: namely, how much did Bell independently know about variable resistance and how much did he actually learn from Gray's caveat?" p. 151].

• Bell stole the key idea for the telephone from Gray ["... Bell did not invent the telephone transmitter he so famously used to call to Watson." p. 200. "... he stole the key idea behind the invention of the telephone." dust jacket. "The Bell and Watson 'eureka moment' ...." p. 13].

The diagram that Shulman claims to have discovered (shown on p. 36 of his book) was in fact shown on p. 180 of Robert Bruce's acclaimed 1973 book, Bell: Alexander Graham Bell and the Conquest of Solitude, so this diagram was hardly unknown to modern day historians. This claim is easy to dismiss, yet to the average reader it suggests undeserved credibility for Shulman.

Whether or not Bell copied information from Gray's caveat is more difficult to determine. You have, on one hand, extensive litigation on this question in the closing years of the 19th century, all of which was decided in Bell's favor. Bell's side of the story is described succinctly in Bruce's book. Yet, on the other hand, there are nagging questions and persistent uncertainty in the minds of some modern historians. I have no opinion about Bell's and his lawyers' integrity or their behavior just prior to and just after the date on which Bell and Gray filed their papers. But the invention of

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It's Membership Renewal Time!

See page 10 for details!

Bell versus Gray

Continued from page 1.

the telephone did not depend on these events as I hope to demonstrate in the following paragraphs.

Two standards can be used in determining who should get credit for an invention. One is conception of the idea and the other is reduction of the idea to practice. We will use both of these standards, but first we will need to have three physical principles in mind to adequately discuss the issues.

1. In 1819, Oersted discovered that an electric current in a wire would create a magnetic field around the wire.

2. In 1827, Ohm discovered that the current (I) in an electrical circuit would increase if the voltage (V) were increased or the resistance (R) were decreased. Conversely, the current would decrease if the voltage were decreased or the resistance were increased. Ohm's law is usually written as V = R x I.

3. In 1831, both Faraday and Henry independently discovered that a varying magnetic field would cause (induce) a varying current to flow in a nearby wire, in a complete circuit of course.

The first of these, Oersted's principle, was used in the receiver design. Bell used metallic reed receivers in his early work on both telegraph and speech transmission. In these receivers, an electric current flowed through a coil of wire (an electromagnet) and produced a magnetic field that attracted (vibrated) a metal reed. Within a year, Bell replaced the reed with a metallic diaphragm and patented a receiver design that telephone collectors would recognize today because it looks just like the hand-held receivers that were used up through the 1930s (see Figure 1). The receiver design is credited to Bell and does not seem to be controversial.

For a transmitter, a means is needed to generate a current that varies along with the sound vibrations. One way to do this is to use a battery to generate a steady current and then employ Ohm's relationship to vary it. This could be done by either varying the resistance in the circuit or by varying the voltage.

Shulman suggests, and others believe, that Bell did not understand that a variable resistance could be used as a transmitter until he stole the concept from Gray. But Shulman really doesn't believe this as you can see on p. 158 of his book, where he acknowledges that Bell experimented with a resistance transmitter a year earlier and documented his efforts. Bell's experiments were unsuccessful, but he clearly understood the principle.

Figure 3: Williams' coffin telephone of 1878 with Bell's butter-stamp telephones and Watson's ringer.

You can also tell from Bell's patent that he had a full understanding of Ohm's law as applied to transmitters. Bell not only described the contentious liquid resistance transmitter but also described one in which the voltage could be varied by means of "vertical vibrations of the elements of a battery in a liquid in which they are immersed" (batteries were liquid at that time before the advent of dry cells). Words like this appear nowhere in Gray's patent caveat and, therefore, could not have been copied.

If you read Shulman carefully, you will see that the only claim he really makes is that Bell stole the idea for a particular resistance transmitter, the liquid resistance transmitter. But he then illogically equates that to stealing the key idea of the telephone. Now we all know the importance of resistance transmitters in the eventual development of the telephone. But these were of the Blake type or the carbon-granule type, and neither of these designs was mentioned by Gray or Bell. Further, we also know that a liquid transmitter was never used in a commercial telephone. Therefore, if knowledge of the liquid transmitter did not reveal the resistance concept to Bell and if the liquid transmitter did not play a role in the commercial development of the telephone, you should conclude that it was an unimportant sidetrack that led nowhere.

Although a resistance-type transmitter would have been a logical extension of the make-and-break circuits already used by Reis, Gray, and Bell, Bell stumbled onto something completely different. On June 2, 1875, Bell and Watson were testing their multiple telegraph arrangement. The batteries were disconnected from the circuit when Watson plucked one of the reeds. Bell at the other end heard the sound of the vibrating reed and recognized immediately what was going on. Watson had set into vibration a metal reed that was positioned near the coil of an electromagnet. The vibrating metal reed had induced a current in the coil wire according to the third principle described above. This was an astounding observation. From the sounds he heard, Bell was sure he had discovered a way to transmit sound – and he was right.

The following day, Watson constructed the so-called gallows telephone using this principle. It transmitted vocal sounds, but was not good enough to transmit intelligible speech. Some improvements were made in July, including use of a second gallows telephone as the receiver. But then no more testing was done until after the patent had been granted. You can read Bruce's book to find out about the other things in Bell's life that intervened

if you are interested in the big delay.

It is hard to understate the significance and beauty of this new scheme. From Bell's patent drawing (Figure 2), you can see that the very same device could be used as a transmitter and receiver, yet the operating principles are entirely different in each case. When used as a transmitter, you speak into cone "A," across the back of which is stretched a diaphragm "a." The diaphragm vibrates the metal piece "c" near the coil of wire "b" and induces a varying current that goes through the wire "e" to the receiver (see #3 above).

When used as a receiver, the varying current going through the coil of wire "f" produces a magnetic field (see #1 above) that pulls on the metal piece "h." The metal piece in turn causes the diaphragm "i" to vibrate and you listen at the end of cone "L."

In Figure 2, "E" and "g" are just connections to ground, which acts like a wire between those connections. The battery in this circuit is used only to create steady magnetic fields in the coils (electromagnets) "b" and "f." In the later modification (see Figure 1), a permanent magnet was used and the battery was eliminated altogether.

Less than a year after Bell's patent was applied for, the first telephone was placed in commercial service using this induction design housed in a simple box. The next year, 1878, the Williams' coffin phone (Figure 3) was placed into service with two of Bell's induction "telephones" attached (see Figure 1; Bell called them telephones rather than transmitters or receivers because they were used for both purposes). It wasn't until 1882, six years after Bell's famous patent, that a resistance-type transmitter was introduced by the Bell Company in its Western Electric 3-box phone with a Blake transmitter.

Using the double test for an invention, we can conclude that both Bell and Gray had conceived ideas for a workable telephone, but only one of them was put into commercial service (i.e., reduced to practice). Bell's induction transmitter was truly unique and it ushered in the age of the telephone. He deserves full credit for this. Whether Bell peeked or copied anything about a liquid transmitter doesn't matter because the liquid transmitter was never used in practice and its design revealed no principles that weren't already known.

The complete citation for Bruce's book and additional information on the development of transmitters and other telephone components can be found in my book, Old-Time Telephones, from which the above figures are taken. ☎

EARLY LOS ANGELES TELEPHONE SERVICE

Los Angeles, at the beginning of the twentieth century, was served by a number of telephone companies. One of the very interesting pieces of this history was the acquisition of independent companies by the Bell System where Bell was required to maintain the same level of automatic service provided by the independents as well as offer automatic service (dials) to those who didn't have it. The equipment used and the modification of that equipment to meet installed switching systems and Bell System requirements makes for very interesting reading. Watch for this article, complete with some equipment photographs and a unique Bell publication for customers that has been reproduced and will be available to our readers. ☎