

MILLENER'S PURSUIT OF SECRET OF WIRELESS WAVES

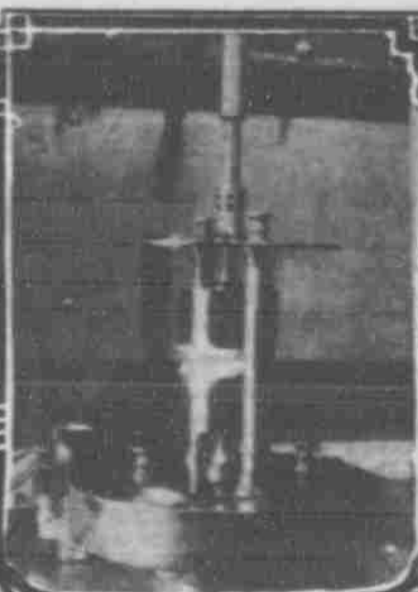
Adaptation of Electric Impulse Through Ether to Telephonic Communication Between Dispatcher and Engineer One Objective of Deep Research Now Being Made by an Expert at Union Pacific Shops



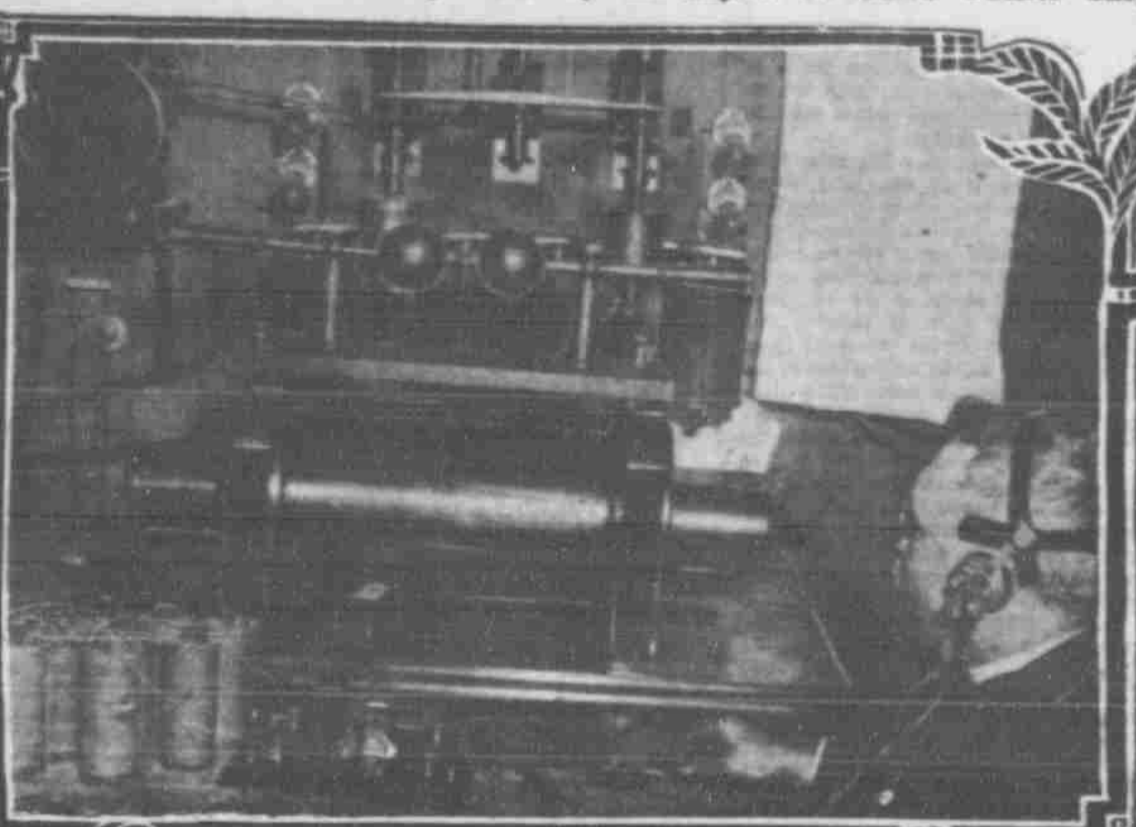
RECEIVING ON THE WIRELESS - DR. MILLER TUNING INSTRUMENTS



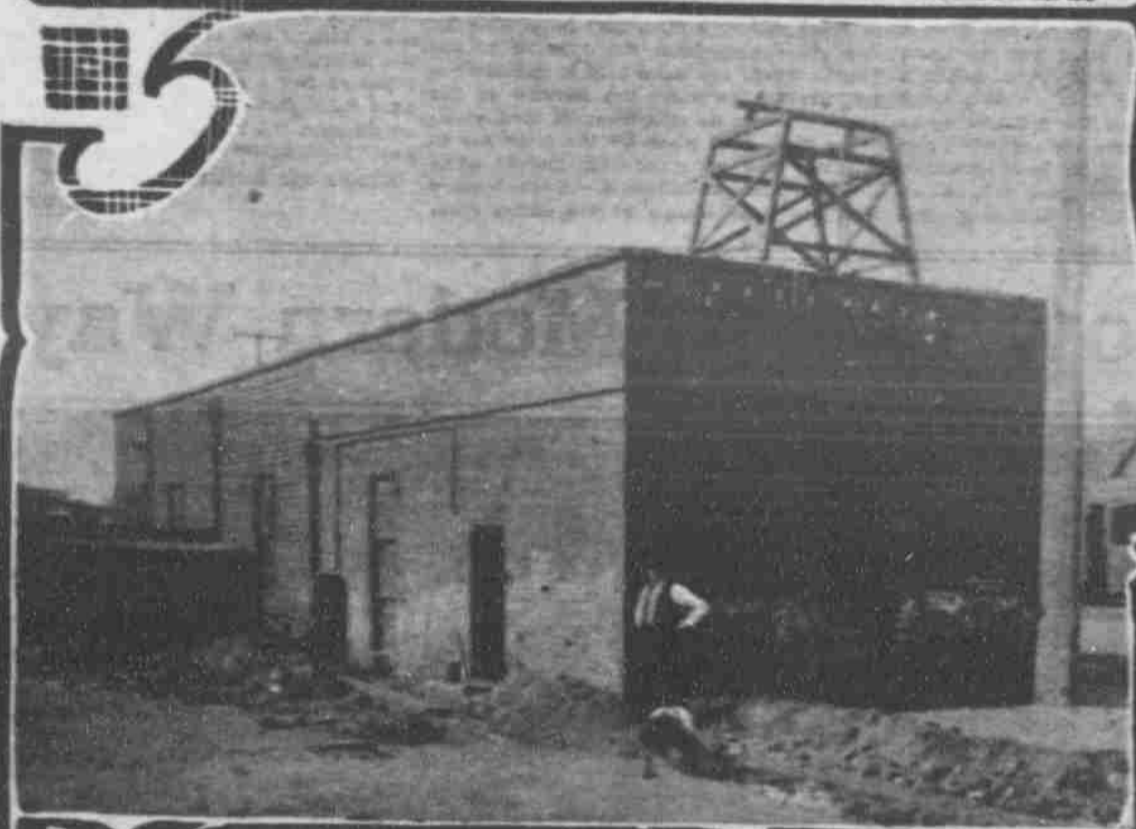
ENGINEER'S ALARM IN ENGINE CAB



HEAVY BRASS INSTRUMENT CONTAINS TERMINALS OF "SPARK GAP" FOR BIG TRANSFORMER



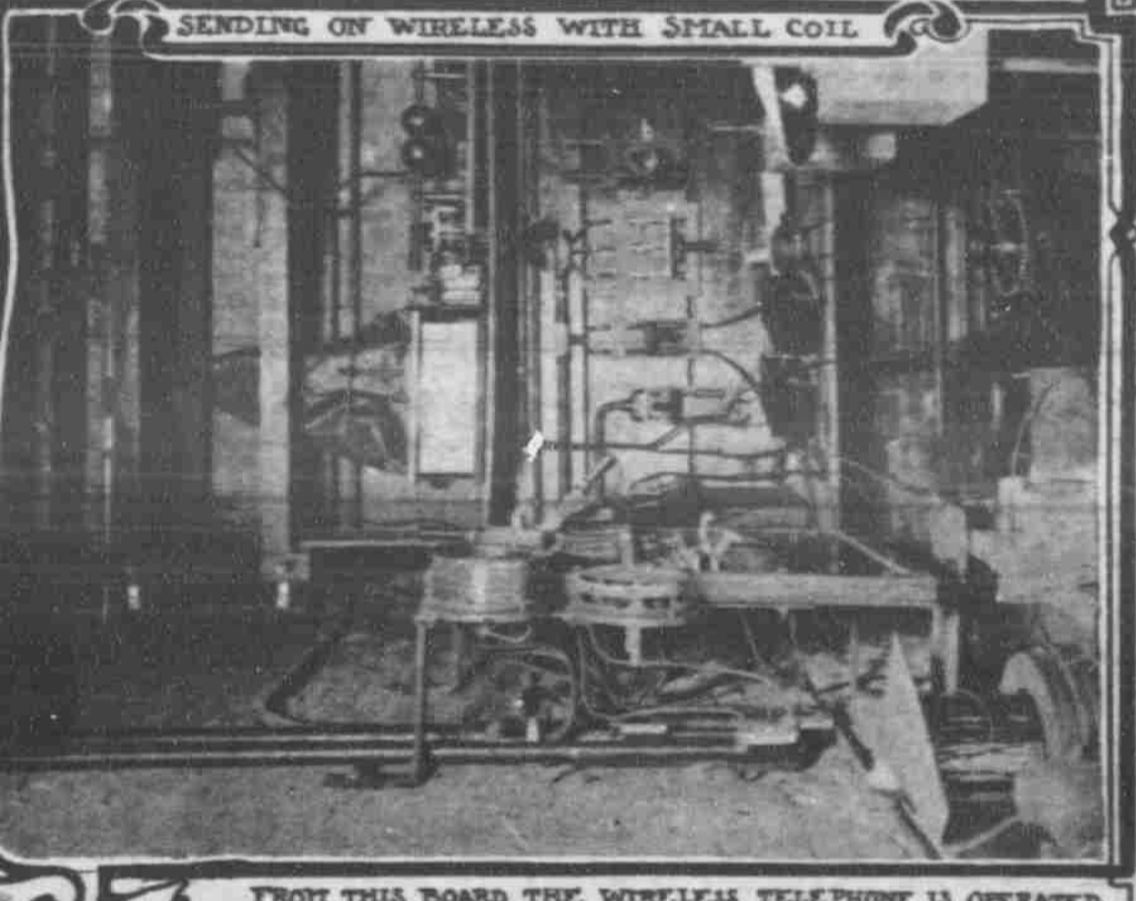
SENDING ON WIRELESS WITH SMALL COIL



MILLENER'S HOUSE OF MYSTERY



F.H. MILLER INVESTIGATOR



FROM THIS BOARD THE WIRELESS TELEPHONE IS OPERATED. GIANT TRANSFORMER IN PROCESS OF CONSTRUCTION IN LOWER HAND CORNER.

IN A TINY brick building, surrounded by whirring machine shops and acres of noisy railroad yards the creative mind of an electrical engineer is probing for the answer to a problem. When the solution is reached the Union Pacific Railroad company will have possession of a wireless telephone of working value, and Dr. Frederick H. Miller, electrical research expert, will have erected a milestone in scientific history. There are many, many days of persistent and relentless experimentation yet to come before the wireless telephone is a fact. Still that little brick shanty holds secrets even now that certain interested engineers abroad are anxious to pry into.

Dr. Miller, who is to be found over his instruments through most any of the long days, and oft times far into the night, tells a little to his visitor and then retires into modest reserve. Of what others have done he is willing to talk, of what he is doing—well wait until after awhile. There is a vast maze of instruments to be seen. One may look them over; but never mind about the circuits that lie concealed behind the switchboards.

The pursuit of the wireless telephone means far more to the Union Pacific and to the railroad world than a laboratory demonstration. The achievement of a successful wireless phone will mark the end of telegraphic train orders. It will mean that the dispatcher at his desk may hold direct converse with the man with his hand on the throttle of the big mogul that is pulling the trains over the mountains hundreds of miles away. In this lies much of the importance of the wireless to the railway company.

That the wireless telephone should replace the present day telephone in general usage is as unlikely as that the wireless telegraph should do away with the wire system. But the field of special application for the wireless telephone is as broad as that of the wireless telegraph.

Several investigators are pushing toward the wireless telephone. The experiments are going on both in America and abroad, where the Germans are particularly active. There is nothing to indicate that they are so far along or so near the goal as is Dr. Miller down there in the Union Pacific yards.

The attempts at the wireless transmission of speech have been many. Success has attended the use of several devices, but in highly limited degree. So far back as the St. Louis exposition the sensitive action of the selenium cell to a variant beam of light was utilized in the wireless transmission of speech. The limitations of such a device are obvious. It can scarcely ever be more than a lecture room curiosity.

Numerous other devices have been made to operate intermittently, and occasionally, just enough to give encouragement to the investigators. The wireless telephone will come in time. The scientists are as positive of it as the mathematician that an integration can be performed. It may take a long time to write the equation or plot the curve, but it can be done, and it will be done. In the mind of the men who are wrestling with the problem of how it is to be done doubt does not exist.

The discovery that an arc light can be made to reproduce human speech when placed in circuit with a telephone transmitter under certain conditions has placed in the hands of the experimenters a basic principle, a tangible fact to work upon. At first thought to the lay mind this perhaps seems of little significance in the attempt to gain the transmission of speech by wireless. The investigators have found, however, that the arc light produces a series of vibrations which vary from those which produce sound and light in an ascending scale far into the regions of wave activity known as the ultra violet with reference to light. They are but different manifestations of energy pitched in different keys. They are vibrations which are invisible and inaudible, simply because of the limitations of the human eye and ear. In this respect they may bear the same relation to the scope of hearing as the high pitched hum of the mosquito does to persons with a low range of hearing. There are many persons with perfectly good ears who can not hear the mosquito, and it is a demonstrated fact that cats can hear sounds high above the reach of the human ear.

The production of these higher wave vibrations which come off of the speaking arc becomes the vital function of the initial or sounding apparatus of the wireless telephone in its present state of development. These ultra violet waves are to become the instruments or vehicles of wireless speech. Their translation into sound waves be-

comes the simple function of the same receiving device which takes in the clicking of the wireless telegraph. That much of the wireless telephone was perfected with the wireless telegraph.

The problem thus resolves itself into the production in proper form of the waves which will project themselves through the ether carrying in terms of energy the impulse that can be converted back into audible human speech.

The speaking arc's efficiency in the production of those waves is directly indicated by the degree of audibility and clarity of the speaking voice that comes from the instrument. The sound waves, of course, are dead within the short distance that they can be heard, but the ultra violet waves which are coming off the arc simultaneously with the sound waves are carried through distance no one knows how far.

Dr. Miller's work in the Union Pacific research laboratory is now directed toward the perfection of the speaking arc. He is bringing the speaking arc to the point where it will deliver its words as clearly and plainly as the receiver of a telephone. When that stage of perfection is reached he will know that the arc is delivering the wireless waves which are to carry the message of the telephone in the station in the same degree of perfection.

The investigator has gone far with the speaking arc, gaining efficiency that has not been attained even in the best of the German laboratories. Just how he has done it is a matter that lies in a corner of his own brain. Parts of his apparatus have been made on special order in the east, while other parts were made in the Omaha shops, and yet others by his own hands. No one but himself is in possession of a knowledge of the whole.

A great deal is said to lie in the telephone transmitter, which is constructed to operate with a high voltage such as is necessary in producing the arc light at a high frequency for the generation of the wireless waves. With a temporary installation Dr. Miller last week gave an inkling of his progress with the wireless telephone by a demonstration of a speaking arc which gave forth every sound repeated into it with the utmost accuracy of articulation.

The arc which will eventually become a part of his wireless telephone will, however, be a much different instrument from the ordinary lamp with which the demonstration was made.

The speaking arc presents many whimsical possibilities aside from its utilization in the wireless telephone. The entire illumination system of a city could be made by its adaptation to give forth the announcement of an election in words audible at every lighted intersection of the streets. A band concert at a far away park could be audible in every part of the city. The same lamps that illuminate a showwindow could be made to talk advertising in the most eloquent terms. The campaigner could speak to his whole ward at once with-

out hiring a brass band to assemble the voters in some third-story hall.

The Miller laboratory, with its intricate maze of apparatus and mysteries, contains an entire series of inventions in the making, others complete, but yet to be adapted to operation in railway service.

A commonplace looking brass box, displaying to the eye only a dial and a gong, conceals the working economy of a wireless block signaling device, which has proven its possibilities. On the dial are displayed the arms of a miniature semaphore identical with those which stand over the tracks at the blocks. At a change in signal or as the train enters a block the dial signal before the eyes of the engineer tells him of all that is taking place without moving his hand from the throttle.

The wireless telegraph plant with which Dr. Miller is conducting experiments for the Union Pacific is one of remarkable efficiency. A new transformer now under process of construction in his plant is soon to make the Union Pacific's plant the most powerful in the world. Dr. Miller is investigating the possibilities of the wireless in inland work.

"An example of the vital importance of the wireless for continental service was shown by the recent storm, which cut off the railroads, and all the public as well, from communication with the west," said Dr. Miller. "A series of wireless plants of even ordinary efficiency could have bridged the storm-swept territory and permitted the operation of trains with the same facility that they are moved with the wire lines in perfect operation."

Miller, the man, seen outside the little room in which he wraps himself in his work, is far from the inventor of fiction and drama. Dr. Miller is to the casual acquaintance just an interesting person of professional appearance, who might be engineer, lawyer or physician. He is as much inclined to talk about the "best seller," the latest discovery of the stage or the city's water supply as of his specialty. The Miller of the laboratory, a concentrated person in shirt sleeves with a pair of pliers nestling next to his fountain pen, is another man. There he is with his pets, a wireless telephone and a big transformer.

Nobody disputes the authenticity of the fact that electricity obeys certain laws, but there is a question as to what some of those laws are. The discovery of many of these laws has led directly to their utilization through the invention of new devices. The new transformer which is now under construction in Dr. Miller's laboratory will do certain things to an absolute certainty. However, it may do a great many other things that nobody knows about. There was never such a transformer builded in the wide world before, so it may do things that no other transformer has ever done. This instrument

is the greatest ever wound for the generation of the wireless impulse. Marconi has a machine, now the largest in operation in the world, at Glace Bay, which is but 60 per cent of the size and capacity of the one under construction for the Union Pacific's experimental plant.

This great induction coil, for that is all in reality a transformer, will deliver a current of 100,000 volts at half an ampere in volume. This means nearly seventy horse-power of energy coursing over the wires that deliver the impulse to the antenna from which the wireless wave is disseminated. In frequency, rate of vibration or wave undulation, what ever one may wish to call it, the coil permits of a great range. It is capable of handling from 60 to 450 and 100 cycles, which means the current can reverse polarity that many times in a second. The sixty cycle current has a frequency about equivalent to that of the alternating current ordinarily used for commercial electric lighting purposes.

It may be an epoch-making moment when the key first closes to start the ether echoes sounding across space from the antenna connected with this giant coil.

What will it do?

No one can give answer. Electricians all over the country who have had an intimation of the secrets that are being unravelled down in the little brick laboratory are waiting for the machine to make its own answer. It is admitted that it will at least far exceed the capabilities of any machine now in operation.

The wireless telegraph from ships in the harbor of Havana has been read over the receiving instruments at the Omaha plant by Dr. Miller. The words clicked out from the Carthagen, plying in the waters of the island republic came up across the sea and land to be picked up by the antenna of the Union Pacific laboratory and sounded from the receiver clear and strong in the high-pitched note of the Marconi system. The sender at Brant Rock, Mass., was heard in the Omaha plant on that remarkable and memorable night. This performance of the wireless constitutes a record for transmission over land, a record which greatly discounts all that had been accomplished before.

A weird interest attaches to the messages received from Brant Rock and the far away ships. It was in those clear, quiet hours of the night that Dr. Miller and G. L. Milliken, government engineer in charge of wireless telegraph plants and experimentation, were sitting at the instrument in the Union Pacific laboratory. They were idly "feeling" through space with the tuning coils, when the call of the Brant Rock station came in across the 2,000 miles. The listeners had hardly recovered from their astonishment when they heard the cruisers at sea give answer. Then the Carthagen at Havana spoke up across the continent.

With such performances possible from apparatus of the capacity of the type used, a wide range for expectation of greater and more remarkable feats from the coil now in making exists. Certain it is that messages from Omaha to the Atlantic seaboard, and perhaps leagues beyond that, will be handled readily.

When the energized waves go arising up against the walls of the Rocky mountains another interesting situation will be produced. Will they go beyond? If they do, how far? It is altogether within the limits of possibility that with two such plants that Dr. Miller is building at the Union Pacific's research laboratory messages could be made to gird the world. The statement perchance sounds a bit extravagant, but the wireless has ways of its own. The increased capacity of the transformer which generates the impulses may result in the multiplication of the range by many factors.

The transformer in its obvious physical aspects is interesting to one versed in the literature of electrical science. It represents just the last word and one more in transformer construction. The core or body of iron, in which the lines of force are produced by the 400-volt current, in the primary winding is built up of laminated steel. The metal itself is peculiarly composed for the purpose. It is known as silicon steel. The introduction of silicon is for the purpose of reducing the tendency of the core to retain its magnetism or generation of lines of force when the current is cut off or reduced to zero. All of which means that the core shall be clear to take up and set upon each individual impulse which comes into the primary winding clear from any "hangover" from the impulse which went before.

Hundreds upon hundreds of sheets of silicon steel are piled together, presenting much of the appearance of a pile of butcher paper. Each separate sheet has been treated to a bath in a silicic prepara-

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