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THE FRANKLIN INSTITUTE.

The Telepost.

[*The Report of the Franklin Institute, Through Its Committee on Science and the Arts, on the Telepost: A New System of Automatic Telegraphy, Devised by Patrick B. Delany, of South Orange, N. J. Sub-Committee: E. Alex. Scott, Chairman; Carl Hering, Wm. O. Griggs, Richard L. Binder.*]

[No. 2427.]

The United States Patents submitted by the inventor, Patrick B. Delany, Nos, 709,752, 720,004, 720,233, 790,193, 800,364, and 802,740, describe, respectively, means for handling receiving tape; means for utilizing the static charge of the circuit; receiving tape for chemical telegraphs; transmitting and receiving apparatus; telegraphic tape recording apparatus, and an electro-magnetic perforator.

The patents cover the latest development in automatic telegraphy, the purpose of the inventor being to adapt the system to existing business conditions and to cheapen the cost of the service. The system embraces both the Electro-magnetic and Electro-chemical methods of receiving messages and transmitting them by perforated tapes.

The use of perforated tapes, or ribbons of paper, is almost as old as the art of telegraphy. Bain, a Scotchman, was the pioneer in Automatic telegraphy, especially of the chemical method. A Philadelphian, nearly ninety years ago, made the discovery that an electric current could be used to make a mark, but Bain first used the principle for recording telegraphic signals. Wheatstone, an Englishman, followed with an ink recorder, and having a better machine for punching the tapes than Bain's and with better financial support, the Wheatstone system superseded Bain's in England. In America, Bain competed with Morse in the early days of commercial telegraphy, but did not remain long in the field.

The most notable use of the chemical system was by the Automatic Telegraph Company, which built lines in 1871 from New York to Washington and Charleston, with offices at Philadelphia and other intermediate points. It continued in business for about three years with fair success, when Jay Gould obtained control of the stock and sold it to Vanderbilt and Western Union interests. Delany, Edison, Johnson and some other well known electrical engineers, were prominent in that company, Mr. Delany being its general manager. He has never wavered in his belief that automatic telegraphy must eventually become universal. One by one he has overcome the electrical and mechanical difficulties which beset the system.

In the thirty-five years which have elapsed since the extinction of the Automatic Telegraph Company, there has been no increase of speed in the hand transmission of the Morse lines. On the contrary, the operating force has become less efficient, as is shown by the statement of the president of the Western Union Telegraph Company, who fixes the average speed of transmission of messages over the lines of that company at fifteen words a minute, not more than sixty per cent. of the average in 1875.

The principal difficulty encountered by all high-speed telegraphs, and which gave the old Automatic line the most trouble, is "retardation," or the "static charge," or "capacity," of the circuit. After a signal has been sent and the circuit has been opened at the sending end, a current continues to flow from the receiving end until the accumulated static charge has run out. This additional current leaves a record on the receiving tape and makes the message illegible. As each signal is followed by this residual current, the spaces between the dots and dashes

on the record are filled up, the words run together. This difficulty increases in proportion to the length of the lines, as the "capacity" is proportionate to its surface, and also to the character of the insulation covering the wire. The capacity of submarine cables is very great, and in practice the line is not fully discharged between signals, but merely varied in amount of static charge as messages are being sent.

In a former patent which came before the Institute in 1896, Mr. Delany described a method of sending dots only into the line, the dashes being received as a double line of dots, thus distinguishing them from the dots of the alphabet, which were received in a single line. This method had two advantages; first, the line received less current from the battery and the static charge was not so great as if dashes had been sent; second, the dots in the double line were readily distinguished as dashes, even though they ran together.

The most important of the patents submitted in the present application is United States Patent 720,004, which deals with the objectionable static charge. In this patent Mr. Delany describes a method of utilizing the "capacity" of the circuit in producing the record on the receiving tape. Dots only are sent into the line. The sending tape is so punched that immediately after the dot signal is sent, a reverse current is sent from the opposite pole of the battery, which neutralizes the static charge on the line. If, however, a dash is intended, the reverse current is not applied to the line until a sufficient interval has elapsed to permit the static charge to make a mark upon the receiving tape; the disturbing element is thus made to do work.

As the capacity of electric circuits varies with the length and size of the wire, capacity of instruments in circuits, character of insulation, and other conditions, it might happen that a circuit would have too small a capacity to produce a dash. The patent provides that in such cases capacity may be added to the desired amount by the introduction of condensers or similar means, such as a parallel circuit, so that the chemical method may be used on short as well as long lines.

The capacity of the line as a distributing factor having been removed, it is a short step to increase the speed and distance over which chemical telegraphs may be operated. So long as any current reaches the receiving station, the tape will record it, although

Keyboard

Perforator

Transmitter

Perforated tape

Receiver

Transcriber

with a lighter shade as the current decreases. The interruptions which interfere with the Electro-magnetic system, due to bad insulation, electric and magnetic storms, are entirely eliminated from the chemical system, which has no moving parts at the receiving end operated by the line current. It is only necessary that the circuit shall be clear enough for the operators to get intelligible Morse signals over it, to receive messages on the tape with absolute clearness.

The transmitting and receiving apparatus are described in United States Patent No. 790,193, which combines some recent improvements with prior patents to make the system more completely automatic and improve its efficiency. Among these improvements are electro-magnetic starting and stopping devices by which the movement of the transmitter may be automatically arrested, or started, by current from the distant station; or the receiving instrument at the distant station may be automatically started or stopped by current from the transmitting station. The instruments at both stations therefore start and stop simultaneously, or may be stopped at the will of the operator at either station. The running out of the transmitting tape automatically stops the receiving instrument. This feature keeps the operators in close touch with each other, and facilitates the transaction of business.

The transmitting and receiving offices are connected with each other over a circuit normally equipped with Morse instruments, and the operators communicate with each other by the Morse system. When messages are to be sent the transmitting operator places the punched tape, rolled up on a block, on a spindle, with one end of the tape between the rolls which draw it past the transmitting fingers. He then notifies the receiving operator, who places a roll of chemical tape on the receiver. By throwing one switch the Morse set of instruments is disconnected, the automatic instruments are put on the circuit, and the apparatus at both stations is set in action. Should anything go wrong, the receiving operator can instantly stop the transmitter at the sending station.

One difficulty with receiving tapes has been that they expand when placed in the chemical solution after having been rolled up on a reel for use. This expansion tears the tape and unfits it for use. To remedy this Mr. Delany passes the tapes through crimping rolls, which corrugates them in different styles, longitudinal,

transverse, in straight or wavy lines, which permits of their being wound as firmly as may be necessary for handling without disturbing the coil, and allows for saturation by the fluid without rupturing the tape. This is covered by United States Patent No. 720,233.

United States Patents Nos. 800,364 and 802,740 cover claims for improvements in Electro-magnetic recorders and perforators for transmitting tapes, such as may be used for transmission in automatic telegraphy, or such perforations of, or record upon the tape as may be actuated from a distance through the medium of an electric circuit, and which may be used as the final record, or be used for transmitting through another circuit.

The latter of these is an improvement upon a former patent, and is designed to adapt the apparatus for use with a single polarity of current. Two polarized relays with biased armatures are used instead of a single relay with a neutral armature. One acts by the movement of its armature to open the circuits of the punch magnets; the second polarized relay controls the first. The punch magnets are alternately energized for a brief period only, while the armature of one relay is passing from its back stop to the contact which energizes the other relay. The punches therefore do not impede the movement of the tape.

This apparatus is designed particularly to be operated from a distant point. Business houses connected with the central telegraph office by wire, as many are now connected, may send their message by the Morse system and have it received as a perforated tape. This would be used in transmission over the high-speed line to destination, where it would be received chemically. Or the tape could be used in place of an operator to send the message over a branch line to a Morse operator, at a speed suited to his ability to receive it.

Where messages pass through repeating stations, they may be received on a perforated tape at a speed several times greater than by a Morse operator, and retransmitted over another circuit. This method would greatly facilitate the handling of business from branch lines and relieve the overburdened trunk lines. Press dispatches may thus be sent to local points at a very small cost, a single tape sufficing for several circuits.

In connection with this apparatus Mr. Delany has invented a key by which the Morse characters can be made at a very much

higher rate of speed than by the ordinary Morse key. The operator moves the lever horizontally to the left, closes the circuit and makes a dash. He releases it, and a vibrating arm, weighted at the end, opens and closes the circuit, making dots until the operator again moves the lever for a dash. Very rapid writing can be done in this way without fatigue.

The Committee saw the apparatus covered by these patents in operation on two occasions, and tested the speed of transmission of the chemical system at twelve hundred words a minute. The record on the tape was perfect, much more uniform than could possibly have been made by hand transmission. The same tape transmitted at a slower speed was received on the Electro-magnetic recorder as a punched tape, and to the ear of an experienced operator was perfectly clear and intelligible.

The commercial importance of Mr. Delany's completed system of high-speed automatic telegraphy, and particularly of his elimination of that bane of telegraphy, the static charge, or retardation, becomes more and more evident as its application to existing conditions is considered. High speed upon long or short lines is now assured. The carrying capacity of a line is made sixty-fold greater than hand-worked lines. Expert service is reduced to a minimum. Errors in transmission are eliminated. Line maintenance is decreased in proportion to increased speed. As a result of these conditions the cost of service can be made so low that the volume of business should be very great.

The Institute is of the opinion that the invention described in Mr. Delany's patent, United States Patent No. 720,004, in connection with the improvements covered by the other patents referred to, by which the capacity effect of the circuit is used to assist in forming the record, is worthy of the highest award, and the Elliott Cresson Gold Medal is therefore conferred upon Patrick B. Delany.

Attest:

WM. H. WAHL, *Secretary.*

Philadelphia, April 1, 1908.