HIGHTONS' ELECTRIC TELEGRAPHS.

CHAPTER XX.

High Tension Electric Telegraph—Gold Leaf Instruments—Single and Double Pointer Needle Apparatus—Revolving Pointer—Improvements in Batteries and Insulation.

HIGH TENSION ELECTRIC TELEGRAPH.

The telegraphs invented and patented in Great Britain by the Rev. H. Highton and Mr. Edward Highton, though not in practical use as a whole at the present time, were evidently decided improvements on their introduction. Mr. Edward Highton had been for many years a telegraph engineer, and he had given evidences of a thorough knowledge of the intricacies of this mysterious science and art. In giving those improvements, I will present the descriptions made by Mr. Edward Highton, and also his opinion as to their advantages over other telegraphs of that day.

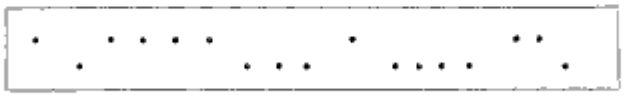
The first patent was taken out in 1844 by the Rev. H. Highton. In this telegraph electricity of high tension was employed, viz., that produced either from the ordinary electric machine, or from the hydro-electric machine: one wire only was used. A piece of paper, which was moved uniformly by clock-work mechanism, was conducted at the receiving station between two points of metal in connection with the line-wire, the points being placed one *above* the other, and on *opposite* sides of the paper. On sending currents of electricity, the paper was pierced by the electricity, every shock making a little hole through it. If the electricity transmitted were positive, a hole was pierced at *one* of those points, and if negative, a hole was made at the *other* point. By the combination of these perforations letters and symbols were denoted.

By an arrangement of these dots or holes, under the ordinary mathematical law, from 30 successive currents of electricity, occupying, say, 15 seconds of time, no less than 1,073,741,824 different signals could be made.

Ten miles of wire were erected on the London and North Western Railway for the purpose of testing the practicability of the plan, and of obtaining certain fundamental laws as to the transmission of electric currents. The signals were found to be given with great certainty, and the paper, moistened with dilute acid, was pierced even when a Leyden jar, filled only with water, and in size not greater than one's little finger, was employed.

The plan was submitted to the government, and an offer was made to connect Liverpool with London by means of this telegraph, and that at the sole risk of the Messrs. Highton, provided that the government would obtain for them, for such purpose, liberty to use the lines of the London and Birmingham, Grand Junction, and Liverpool and Manchester railways. The government, however, found that at that time they possessed no compulsory power to grant such license, even for a telegraph for their *own* use; and hence, in a bill passing through Parliament at the time with reference to railways, clauses were added, giving this power to government for telegraphs for their own purposes. This, it is believed, was done at the instigation of the late Sir Robert Peel.

The paper, when marked, would appear thus:



Highton's system of marks for high-tension electricity.

The above, on one plan, would correspond with the number 12,413,411, and would, in sending, occupy only some 5 or 6 seconds.

GOLD-LEAF TELEGRAPH APPARATUS.

The next patent was taken out by the Rev. H. Highton, M. A., in 1846. The telegraph included in this patent is known as the Gold-leaf telegraph.

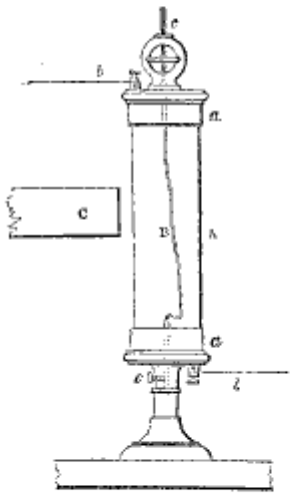
A small strip of gold-leaf, inserted in a glass tube, was made to form part of the electric circuit of the line-wire. A permanent magnet was placed in close proximity thereto. When a current of electricity was passed along the line-wire, the strip of gold leaf was instantly moved to the right or left, according to the direction of the current.

This is a very delicate instrument and is worthy of the reader's attention. In order that it may be properly understood, I have copied the following from the patent.

Extract from the Specification of the Patent granted to Henry Highton, for Improvements in Electric Telegraphs. Sealed February 3, 1846.

"In the electric telegraphs now commonly used on English railways, signals are given by the motions of magnetic needles, which are caused to move to either side by the action of electric currents passed in either direction through coils of wire surrounding magnetic needles. And I have discovered that signals can be exhibited in electric telegraphs by motions produced by electric currents in strips of metallic leaf, suitably placed, in a very cheap form of signal apparatus, resembling a gold-leaf galvanometer.

Fig. 1.



"The drawing hereunto annexed represents a signal apparatus, consisting of a glass tube, A, fitted in brass caps, *a*, *a*, at top and bottom, and having a strip of metallic leaf, B (gold leaf being the kind of metallic leaf which I usually employ), passing through its centre, loosely hung, in metallic contact with the said caps; the upper extremity of the metallic leaf being fixed at right angles to its lower end, so that the metallic leaf, from whatever direction seen, will present at some part its flat surface to the eye. The caps, *a* *a*, (which are moveable, in order that the metallic leaf may be replaced, if broken,) are placed in a circuit suitable for electro-telegraphic communication.

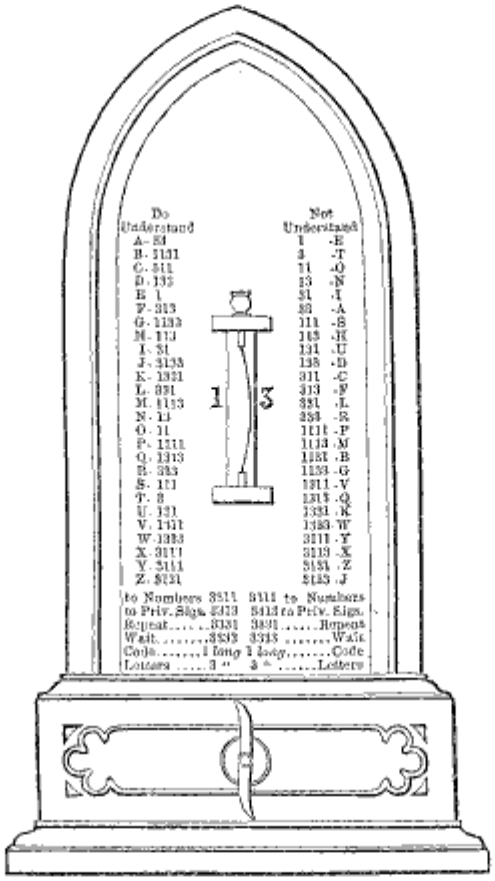
"Near to the metallic leaf (as on the outside of the glass) is placed either of the poles of a magnet c. And the effects of this arrangement is, that when a current of voltaic electricity is caused to pass through the circuit, and, therefore, also through the metallic leaf, B, included in it, the metallic leaf is deflected to one side or the other, according to the direction of the current. And the distinct motions so obtained may be repeated and combined, and used for the purpose of designating letters or figures, or other conventional signals.

"One of the above-mentioned signal apparatuses is placed at each terminus of telegraphic communication, and others may be placed at intermediate points.

"Each terminus, and also each intermediate station, is provided with a voltaic battery, and with one of the key-boards in use in single magnetic-needle electric telegraphs. The person in charge of the telegraph at either terminus, or at any inter-

mediate station, produces the requisite connections for causing an electric current to pass in either direction through the circuit, and, therefore, through the metallic leaf of the signal ap-

Fig. 2.



Gold-leaf Telegraph for one line-wire, with code-table shown on dial.

paratus of each terminal or intermediate station, and thus cause the metallic leaf of all the signal apparatuses to move simultaneously to either side, so as to give the required signal or signals.

"The key-board of each terminal or intermediate station has a handle, by moving which, the person in charge of the telegraph at any station can cause an electric current to pass through a circuit, in connection with a system of alarums at the terminal and intermediate stations, similar to those in use in magnetic-needle electric telegraphs."

The next patent was taken out in January, 1848, by Messrs. H. and E. Highton.

At this time Mr. Edward Highton was acting as telegraphic engineer to the London and Northwestern Railway Company, and was pressed by that company to invent a set of electric telegraphs free from the objections and defects inherent to most telegraphs then in use, and free also from any of the then existing patents.

Every telegraph proposed or executed at that time, was minutely investigated, and their defects studied with the greatest care. Neither time nor money was spared to accomplish the objects desired. The result was a series of inventions of great variety and extent.

For these inventions, the patentees received from the hands of His Royal Highness Prince Albert, as President of the Society of Arts, the greatest honor the society had the power to bestow, viz., their Large Gold Medal.

Several of the plans were immediately adopted on the London and Northwestern Railway, in preference to those of the old Electric Telegraph Company, who then possessed a great number of patents. The telegraphs gave the greatest satisfaction, and have been in constant daily use ever since.

The principal feature of the inventions in this patent were, viz.:

The horseshoe magnet was suited to coils, and was thought to be much superior to the old straight magnetic needle and coil of Cooke and Wheatstone. In step-by-step motion telegraphs, a means was provided for causing the pointer or disk at once to progress by one bound to zero on the starting point.

The maximum work capable of being produced by any number of lines was taken advantage of, and thus three wires were made to produce 26 *primary signals*, and so to show instantly any desired letter of the alphabet. Under Ampère's plan, 26 wires must have been used, and under Cooke and Wheatstone's patent, 6 wires. Suitable keys were devised for sending currents of electricity over three wires in the 26 orders of variation.

Direct-action printing telegraphs were devised, so that a single touch of one out of 26 keys caused instantly any desired one out of 26 letters or symbols to be printed.

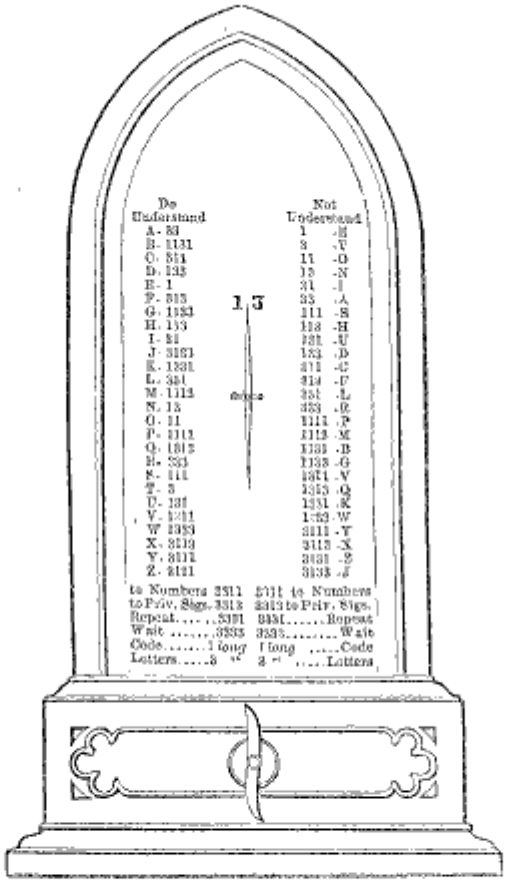
The insulation of wires was improved, and many other improvements relating to electric telegraphs effected.

The advantage of the horseshoe magnet over the straight magnet or magnetic needle of Professor Wheatstone was thus stated by Mr. Highton: When a coil surrounds a straight magnetic needle, as used by Messrs. Cooke and Wheatstone, *each* convolution of the wire has to pass *twice* over the central or *dead part* of the magnet; whereas, if the horse-shoe magnet

be employed, there is *wire only* where there is magnetism in the magnet to be acted on. This latter arrangement, therefore, enables all superfluous resistance in the circuit to be dispensed with; and hence the same amount of electric power is enabled to produce a far greater effect on the distant telegraphic instruments, or *less* power to produce an *equal* effect. Currents of electricity from secondary batteries were to be employed where great mechanical effects were desired at the distant station. An instrument was devised for this purpose, called a "persenode."

The next patent was taken out by Mr. Edward Highton on the 7th February, 1850.

Fig. 3.



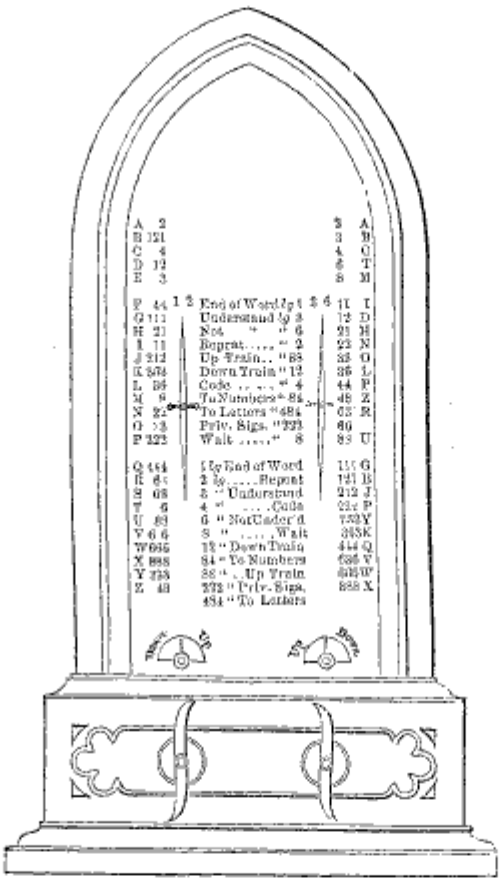
Single-pointer telegraph for one line-wire, with code shown on dial. The pointer is moved to the right or left by the horseshoe magnet and coil.

SINGLE, DOUBLE, AND REVOLVING POINTER TELEGRAPHS.

The patent contains a great many improvements in different classes of telegraphs. A few only of the principal features will be alluded to here.

The first part refers to modes of arranging electric circuits. Means of employing electricity of different degrees of tension,

Fig. 4.



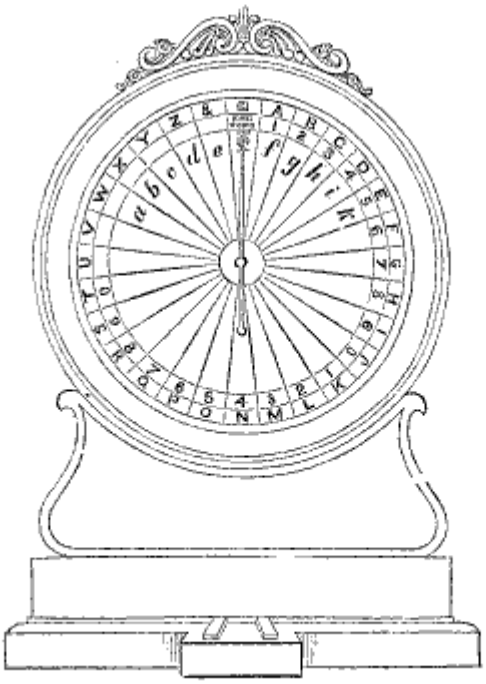
Double-pointer Telegraph for two line-wires, with code-table.

and of different periods of duration, are also shown, so that two kinds of electric apparatus may be connected to *one* line-wire, and one only worked, as desired. By this means one of the wires usually employed was rendered unnecessary. Other improvements relating to the dials are also made

A new mode of causing motion in soft iron, by temporarily

magnetizing it by the contiguity of a powerful magnet, is described, which promises to be of great value in electric telegraphs, as by the employment of this apparatus any demagnetization of the magnets in thunder-storms is entirely obviated, and the coils of wire are made to give out more power.

Fig. 5.



Revolving-Pointer Telegraph, with double action escapement, for either one or two line-wires, the pointer being able to progress from letter to letter, or to pass by one bound from any letter the whole distance up to zero.

The letters in the rays are substituted for the following, viz.: a—Numbers; b—Private Signals; c—Code; d—Letters; e—End of Message: end of the word; f—Repeat; g—Understand; h—Wait; i—Not understand; k—Go on.

Pendulous, or *vibrating* bodies, in step-by-step motion telegraphs, are introduced in order that a definite period of time may elapse between each successive current of electricity; and these same bodies are caused to make and break the circuit, so that no second current can be transmitted till all the instruments in a series have completed the word due to the prior current. In this way, all overrunning or lagging behind of one instrument, as before described, is entirely obviated.

Besides these improvements, Messrs. Highton made many others, in batteries, construction of lines, and in the administra-

tion of telegraph affairs. They invented a revolving disk telegraph, with a new double-action escapement for either one or two line-wires; also, a direct letter-showing telegraph for three line-wires, in which the instrument produced the desired letters instantly into view in the centre of the dial by means of three movable screws; and, also, a printing telegraph, suited for either one, two, or three line wires, according to the rapidity of transmission desired. In this telegraph the letters were printed by one touch of a key, when three wires were used.

IMPROVEMENT IN BATTERIES AND INSULATION.

Their improvement in batteries, which requires not the slightest attention for months together, many of which were employed in doing the most severe work on the London and Northwestern Railway, were not touched for periods of three, four, and even twelve months at a time, and yet they gave out, whenever required, a constant and equable flow of the electric power. This was accomplished by the substitution of a solution of the sulphates of the earths instead of sulphuric acid. These gentlemen invented an improvement, relating to the manner of protecting and using insulated submarine or subterranean telegraphic wires. It consisted in surrounding the insulated wires or strands of wire, by putting them in the middle of a wire-rope, so that the insulated wires may be surrounded with a flexible covering of iron, or galvanized iron or brass, or other hard wire, or small rods of such materials. This patent was dated September 21, 1850.