FRENCH ELECTRIC TELEGRAPH.

CHAPTER XXIV.

The Nature and Origin of the System—The Receiving Apparatus—The Manipulating Apparatus—The Process of Sending Signals—The Formation of the Alphabet.

THE NATURE AND ORIGIN OF THE FRENCH TELEGRAPH.

The French electric signal telegraph is of the needle order, but differs from that system in its index. It is fashioned after the semaphore of Chappé; the signals, however, are produced at the sending and destination stations, instead of at the sending station only, as in the semaphore. It will be remembered that, in the visual system, the receiving station observed the signals made at the sending station some miles distant therefrom. Those same signals are produced at the receiving station on an electric instrument by the operator at the sending station, any number of miles distant. A description of this apparatus I will embrace in this chapter.

It has generally been believed that this electric signal system for telegraphing has been preserved by the French administration, only because it reproduced the same character signals as the Chappé semaphore telegraph, and because it was not desirable to make modifications or changes of any kind in the vocabularies, or in the operative department of the telegraph. I notice that some of the French writers, among which Mr. Blavier may be named, deny the correctness of this impression. In 1854, when, by authority of His Majesty the Emperor, I made a careful and minute examination of the electric telegraphs of France, I certainly understood that the object of adopting the French electric system was to avoid the change which would be necessary in case of the organization of any other telegraph. This, however, is not a point of any consequence, nor does it lessen the merits of the French system. The apparatus was simple and beautiful. Hour after hour I have witnessed its operations with admiration, and I

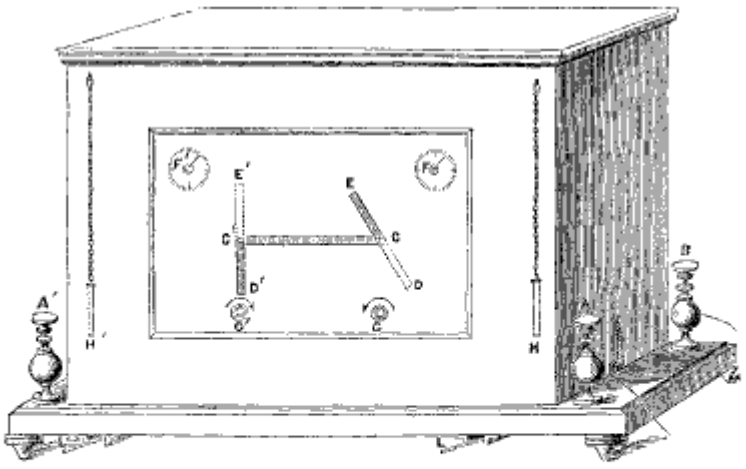
can readily appreciate the regret experienced by the French in the abandonment of their national telegraph for the adoption of the Morse system.

For some years circumstances have wonderfully changed things in Europe, and in fact throughout the world; but in nothing has there been a greater change than in the means of communication. "The same principle which justified and demanded the transference of the mail on many chief routes through the countries of the different nations, from the horse-drawn coach on common highways to steam-impelled vehicles on land and water, was equally potent in warranting the adoption of the electric telegraph—that last and most wondrous birth of this wonder-teeming age."

Although the French electric signal system has been superseded and put aside for the recording apparatus, nevertheless it will remain in the history of the telegraph as one of the most ingenious, and as that which, at its commencement and during its continuance, rendered the most important services. Such is the impression of the Frenchman Blavier, with whom I cordially concur in the well-merited encomium expressed in his commendations.

The following is a description of the French electric signal telegraph. It will be seen that it does not differ from the dial-plate apparatus, except in the number of teeth in the escapement-wheel, which number instead of being 13 is only 4. The needle in turning, instead of stopping 26 times, stops only 8 times, and as the angles themselves suffice to determine the signals, it is useless to mark them on the dial plate.

Fig. 1.



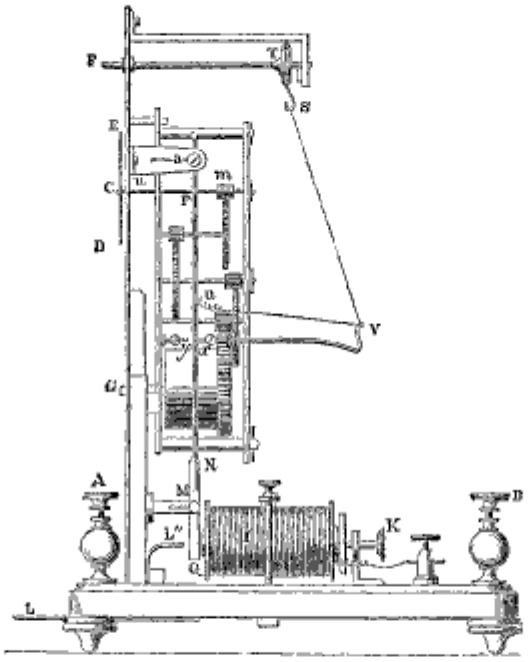
THE RECEIVING INSTRUMENT.

This apparatus comprises almost always two similar systems, so as to be able to operate with two needles.

D G E, D′ C′ E′, fig. 1, are the two indicating needles, made of mica, blackened on the side which marks the signal. They are fixed by simple friction on the axis C and C′. G and G′ are squares which correspond to the little barrel, and serve to wind up the clockwork. F and F′ the axis of the pulleys, which are turned by means of little keys H and H′, to tighten the recoil spring.

A and B, B′ and A′, are the knobs to which are attached the wires by which the current enters and passes off. The internal arrangement of this instrument will be seen by figure 2.

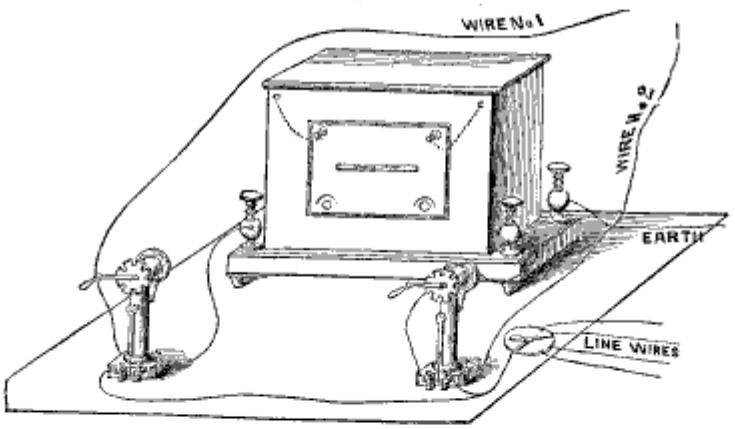
Fig. 2.



The electro-magnet I, instead of being at the upper part, as in a dial-plate apparatus, rests on the bottom of the case, and is held by two vertical rods, and a horizontal bar of copper. The soft iron of the electro-magnet may be advanced or drawn back by means of the screw K. The armature Q M,

is movable around two screws, one of which is visible at M. The rod of the armature N P, is terminated at the upper part by a horizontal point, engaged in a fork. The axis bearing this fork, and the escapement anchor, are retained by the screw *a*—the disposition analogous to fig. 3.

Fig. 3.



The clock-work is contained between two copper plates. The axis of the last wheel *m* C, bears the exterior needle D. C E, and the escapement-wheel furnished with 4 teeth, concealed in the figure by a rod of the armature. The two screws *x* and *y* limit the extent of the motion of the rod of the pallet.

The recoil spring is fixed at *u* to the rod N P, it is terminated by a wire passing in the hooks V and S, and is wound upon the little pulley T, the axis of which is prolonged as far as F.

L, figures 1 and 2, is a rod bent at L″, which serves to give direct motion to the armature. The wires of the electro-magnets terminate at two little buttons, which, by means of metallic strips, communicate with the exterior of knobs A and B.

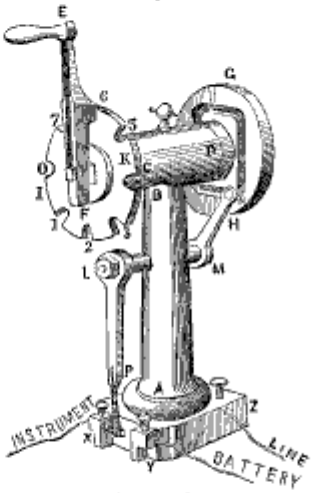
The movement of the apparatus is the same as the dial-plate apparatus.

When the current traverses the wire of the electro-magnet, the armature is attracted, the rods set in motion the little fork and escapement anchor, which suffers a single tooth of the wheel to pass, and during the movement the needle turns through an angle 45°. When the current ceases to pass, the armature returns to its first position, and the needle turns again 45°.

The needle, therefore, produces a series of angles of 45° ; from 0° up to 360°.

THE MANIPULATING APPARATUS.

Fig. 4.



This instrument is formed of a vertical copper column, fig. 4, A B, terminated by a horizontal cylinder, C D. In the interior of this cylinder an axis turns, which is fastened on one side to the crank E F, and on the other side to the quadrangular grooved wheel G H, of which the angles are rounded. I K is a disk or divisor, having 8 notches, into which the crank enters, being pressed by an internal spring. An elbow lever, L M N, enters into the groove at N. At its other extremity is fixed to the rod L P, at the upper part of which is a little spring hammer which strikes alternately against two points of contact, X Y. For the position of the crank marked 0, 2, 4, and 6, the hammer is upon X. For the other four positions, the hammer is on Y.

The two metallic pieces forming these points of contact, are insulated by means of an ivory plate, and they have little holes into which the wires which correspond enter, to the receiver for X, and to the battery for Y. The wire of the line is attached at Z to the base of the column.

When the crank is in one of the four positions, 0, 2, 4, and 6, the current coming from line at Z passes into the column and over the rod L P, and over the spring hammer, over the point of contact X, and goes to the receiver, through which it passes in order to arrive at the earth.

In the other four positions the pole of the battery is in communication, by means of the point of contact Y, with the spring hammer, the rod, and the column.

THE PROCESS OF SENDING SIGNALS.

The crank of the manipulator of one of the posts A, and the needle of the receiver of the other post B, have the same horizontal position. Let us suppose that we lower the crank and place it in front of the notch which bears number 1. At the same moment the current traverses the receiver of B, the needle turns through an angle of 45°, and remains in this position as long as the crank A does not change. If we place the crank upon the notch number 2, the current ceases to pass over the line, and the needle of B again advances 45°.

The same rotary movement takes place if we continue to turn the crank, and the angle which the needle forms with its primitive position is always the same as that of the crank.

In a state of rest, the receiver of the two corresponding posts ought to have their needles horizontal, the indicators concealing the bars traced on the dials. The cranks have the same position.

When we wish to send a signal to one of these, we turn the crank rapidly, passing first the upper part over the divisor, and we stop the crank at the notch corresponding to the angle which we wish to transmit. The needle of the other post immediately indicates the same angle. To produce a second signal, we continue to turn the crank in the same direction, as far as to the notch which represents the new angles. There would, evidently, be discord between the signals transmitted and those received, if we did not turn the crank in the same direction.

All the explanations, or descriptions of the dial-plate apparatus, apply also to the signal apparatus; thus, in order to regulate the apparatus, we tighten the screws x and y, so as to give a suitable play to the rod of the armature. We regulate the apparatus by causing to turn rapidly the crank of the corresponding post, and by tightening or loosening the recoil spring, until the movement of the needle shall become sufficiently rapid.

The electro-magnet can be advanced or drawn back when the current is too weak or too strong; but it is preferable to keep it at a very small distance from the armature.

The French apparatus operates ordinarily by means of two distinct wires. Fig. 4 shows the most simple disposition of a station.

The two column manipulators are fixed upon the table by strong screws, to correspond to the two wires of the line, and to the two sides of the receiver. The wires of the battery arrive at a communicator, which admits of the increasing or diminishing of the numbers of elements employed. A single wire extends from the communicator to the two manipulators. Although a single battery serves to transmit the current, either upon a single wire or upon the two, simultaneously, the intensity is so constant there is no perturbation in the transmission.

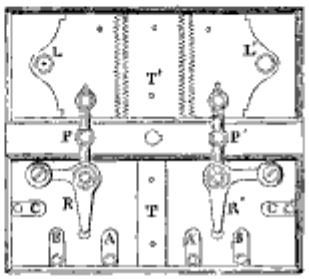
A single battery current has been found sufficient to operate this instrument on lines diverging in five or six directions.

The manipulation is performed by both hands. If we turn the cranks in order to stop at any two notches of the divisors,

the two positions which they take are reproduced identically by the needles of the receiver at the end of the line.

Small tables and special commutators are made for the apparatus. One of the commutators is represented by fig. 5. The two wires of the line arrive at the binding screws L and L′. The current traverses a copper plate, furnished with points in front of the plate T, which communicates with the earth. P and P′ are lightning rods; R and R′ are the commutators which connect the two wires of the line with any one of the wires attached at C B A, and C′ B′ A′. At A and A′, for example, we place the wires which correspond with the two manipulators at B and B′, wires of direct communication; at C and C′ are the bell-wires.

Fig. 5.



THE FORMATION OF THE ALPHABET.

The combination of the angles formed by the two needles furnishes 84 signals, which may represent the 24 letters, the numerals, the principal syllables, and several regulation signals.

When the indicator conceals the horizontal number of the apparatus, we do not indicate it in the drafting of the signal. When, on the contrary, it is on the prolonged line of the horizontal, we mark it with the index 0. The regulation position is that of the closed.

The call is made by the return of the crank, to which the correspondent answers in the same manner.

Every transmission of a dispatch commences with the "open." "Activity" precedes all private dispatches, and "urgency" precedes every official dispatch; but of this full explanations are given in another part of this book. The end of the word is indicated by closing the indicators.

When the signals are unintelligible, the receiving operator interrupts his correspondent or the sending operator, by turning the crank, and he passes the last word understood. On both sides the normal position of the cranks and indicators is re-established, and the correspondence goes on again, commencing with the last word understood, as common to all modes of manipulation. By having a key, or a pre-determined signal preceding the signals, 64 new combinations are obtained, by means of which we form tables of conventional phrases.

The transmission takes place with wonderful rapidity. The

reading is also rapid, for the signals are drawn by the angles which they make without the necessity, as in the dial-plate apparatus, of following the needle through the 26 positions which it may occupy, or of mentally counting the movements as in the English system.

A very skillful operator can pass as high as 230 letters a minute, but in ordinary circumstances we cannot count upon more than 120 or 130 letters. By combining the signals 2 and 2, vocabularies are formed containing an indefinite number of words or phrases, and so complicated that it is impossible to find a key to them. As these signals have no intelligible signification, the signals are passed by ten at a time, and each ten of the closed are caused to follow in such a way that when the crank and the indicator do not agree, it is readily seen. In such a case the ten seen to be erroneous are repeated.

The vocabularies can be taken, either by signals themselves, which are easily written, or by the letters and figures which they represent, according to the alphabet formed by the angles on the receiver. In the manipulation frequently the signals are named directly, using abstractly the letters or figures which they represent. Instead of designating them by their absolute value, the angles formed by the needles, or applying to them the simple numbers represented in the alphabet and numeral code, use is made of the ancient system of Chappé.

Zero is called the position of the needle at rest. Five, corresponding to an angle of 45°; ten, corresponding to an angle of 90°; fifteen, corresponding to an angle of 135°. To which is added the word "sky," to words formed above the normal or horizontal position, and the word "earth" to angles formed below it. Finally, when the needle is on the prolongation of the line of the centres, it is indicated by the term "great zero." In the denomination of a signal, commencement is always on the left side. In the formation of angles by the two needles, a single expression is made.

The signals formed are analogous to the aerial telegraph. Therefore the old vocabularies have been preserved for secret dispatches. The aerial telegraph can exhibit all the combinations of this system, except those which correspond to the case when the needle is on the prolongation of the dial; but the Chappé telegraph can furnish the same signals *carried vertically*.

In order to indicate the horizontal or vertical position of the signals, before the signal to be carried vertically, is placed the index o.

In many instances the transmission takes place by means of

a single wire, whether use is made of a special apparatus having a single indicator, or whether an apparatus is employed of two indicators of which only one operates. This must necessarily take place when the lines have but a single wire, or when the different wires of a line are separated in order to correspond with several stations. In this case, the same alphabet is used as on the instruments constructed for two wires; but the signals are divided into two parts, and are made by a single indicator. First, form the angle of the left, and then make the angle of the right. This change, which at first seems to render the manipulation complicated, is attended with no difficulty in practice, and a few days are sufficient to accustom the operator to its use.

The transmission by a single wire is slower than by two wires; but the signals thus passed are not reduced to one half. From 80 to 90 letters per minute, instead of 130, can be sent with facility. The rapidity of transmission is claimed to be greater than that obtained by a dial-plate apparatus, although it requires two stoppages for each letter. The reason is explained thus: for two turns of the crank, that is to say, for eight emissions of the current, are produced 64 combinations—while only 26 are obtained with the dial-plate apparatus, in the French instrument, and the current passes 130 times.

When two lines, each of one wire, terminate in the same station, and the operator is required to transmit in the two directions, these two wires are generally placed at the two sides of the same apparatus, thus occupying a middle or betwixt position. Attempts have been made to use repeaters in connection with the French system, but all the efforts have proved unsuccessful.

For ordinary purposes, however, it will be sufficient to insulate the two screws x and y, fig. 2, by means of strips of ivory, and to make them, as well as the pallet, communicate with the exterior binding screws, which will establish the following communication:

1st. The screw x, with another similar receiver. 2d. The pallet with one of the lines which terminate at the post; and 3d. The screw y with the battery.