SEIMENS AND HALSKIE'S GERMANIC TELEGRAPH.

CHAPTER XXIII.

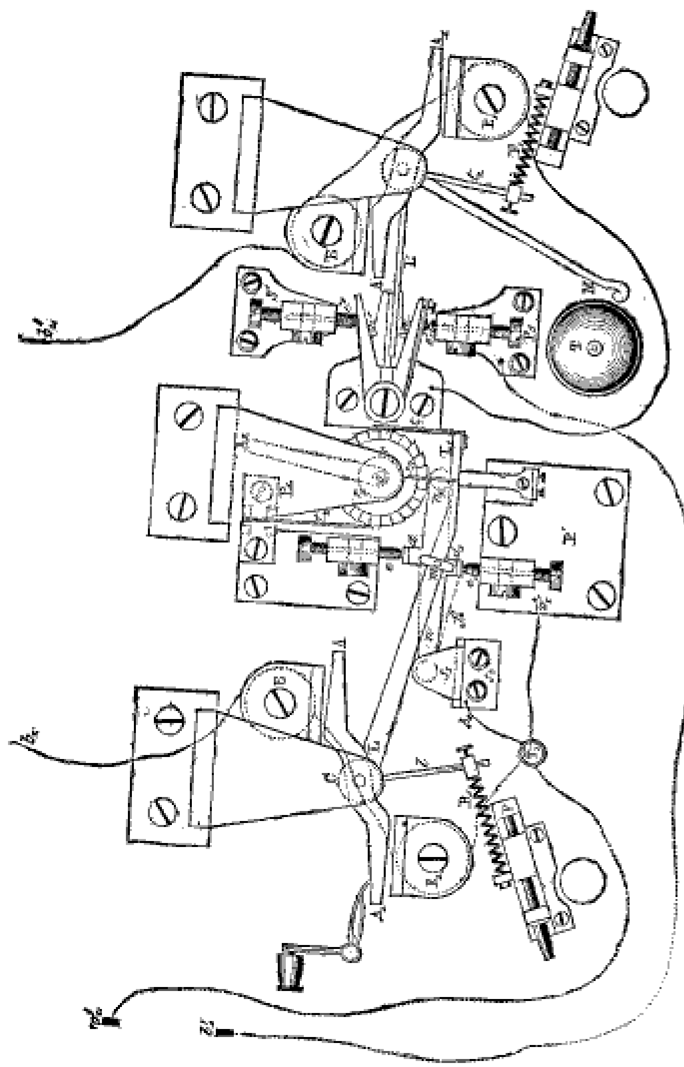
Description of the Telegraph Apparatus—The Alarum Bell—Electric Circuits and Manipulation—The Transmitter and its Application.

DESCRIPTION OF THE TELEGRAPH APPARATUS.

This apparatus is organized upon the principles of the dial-plate system, and is universally admitted to be the most perfect in the European telegraphic service. The following description, though very defective, will give the reader a knowledge of its mechanism and manipulation. I have seen this apparatus on the German railways; it was really a model of beauty, and to me very simple. It serves the purposes of rapid communication; it is easy to keep in order, and it is susceptible of manipulation by the ordinary employés of the railway service. In the organization and finish of the apparatus, and in the perfection of the system, Messrs. Seimens and Halskie have exhibited rare powers, fully sustaining the distinguished and enviable reputation enjoyed by those gentlemen in Europe, as telegraphers.

In fig. 1, E E_1 are the poles of an electro-magnet, perpendicular to the upper side of the box, or the plane of the drawing, flat on one side and round on the other. A A_1 is the armature, something like a reversed ∞, moveable around a vertical axis, which axis is supported by two gudgeons fixed on the support C; a lever-arm is fixed to the middle of the armature, and the spring R1 draws it continually upward toward the left, tending to separate the armature from the electro-magnet, so that it will not be in contact with it, except when under the influence of the attraction produced by the passage of the current, and so that the armature will separate therefrom, under the traction of the spring, when the current is interrupted. The figure shows how, by means of the screw v, and of its adjustment, the spring R_1 can be stretched more or less, and increase or diminish the facility with which the armature detaches

Fig. 1



itself from the electro-magnet. A long lever branch, L L_1 is also fixed to the armature, and turns with it on the same axis, and shares with it in the movement. This lever bears at its extremity L_1, a rod with a hook t_1, which engages in the teeth of a little steel-toothed wheel *r*; the ratchet in descending makes this wheel turn one tooth; when rising, on the contrary, it slides upon the inclined plane of the succeeding tooth, and engages itself above it, in order to make it descend in its turn. A second hook, t_2, borne by the plate P_1, prevents the toothed wheel from turning back during the ascending movement of the rod t_1; a steel needle or indicator O, fig. 1, and O I, fig. 3, borne by the axis of the toothed wheel r_1, turns with it upon the circular dial of the keys, fig. 3, and passes successively before the telegraphic letters or signals written or printed on the keys of fig. 2. It will be seen, therefore, that whenever the current is interrupted, the lever *l* detaches the armature, and makes it descend; the hook-rod L_1 t_1 lowers a tooth, makes the indicator advance one step, and brings it from one letter to a succeeding letter. The most essential part of this instrument has been called, by Messrs. Seimens and Halskie, the

Fig. 2.

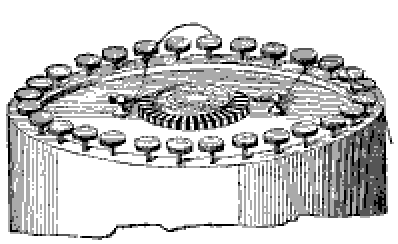
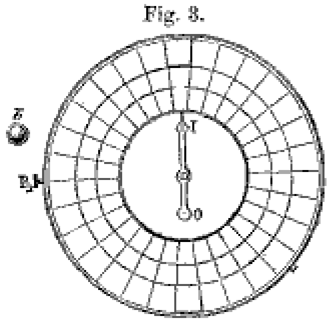


Fig. 3.



"shuttle," because it is similar in effect to a weaver's shuttle, moving continually from right to left, and from left to right, closing and opening the circuit, and giving also to the armature a continuous movement. The shuttle *n* n_1, scarcely perceptible in the drawing, is thus composed; upon the support s_3, is raised a little brass column, bearing on its upper part the little, elongated, rectangle *n* n_1 of copper, furnished with two right-angled appendages, with sockets *a* a_1, and very easily moved; this is the "shuttle."

At each of the extremities of the appendages *a* a_1, and perpendicular to the surface of the shuttle, is fixed a little piece of copper, pointed upward, and represented by the dotted lines on the faces *n* n_1. Underneath the extremity n_1, is a little foot, which has a to-and-fro movement, with the shuttle around the centre n_1, and rests at the bottom upon a little projecting metallic band. The shuttle, consequently, oscillates horizontally exactly at the middle of the lever-arm L L_1; its foot at n_1 rubs, in the least degree possible, upon the band which supports it; and, in order that the shuttle may be completely insulated from the metallic plate P_1, this foot is covered at its lower extremity with an agate stone. The movement of the shuttle, always quite circumscribed, is limited by the screws e e_1, and these screws are borne by two uprights, fixed to the plates P_1 P', and, their heads being rounded, they fit into the cavities of the metallic appendages a a_1; by means of these screws, the movement of the shuttle n n_1 can be regulated. When the appendage a_1 touches the screw e_1, the appendage a is at a small distance from the screw e, and reciprocally; a wire spring, slightly stretched at f_1, fixed to the shuttle itself, and which is shown by the dotted lines in the figure, tends to keep the appendage a_1 constantly in contact with e_1, and prevents the little jars and oscillations of the shuttle from ever occasioning a momentary separation of a_1 and e_1. It is then the appendage a_1 and the screw e_1, which establishes the metallic contact necessary for the closing of the circuit. The only function of a and e is to circumscribe the movement of the shuttle. The nut m is connected in the movement of the lever L L_1, and presses, alternately, sometimes upon a, and sometimes upon a_1; but as it is a trifle shorter than the distance between a and a_1, it cannot move between a and a^1 without taking the shuttle with it in its movement. In the figure, m presses against a_1, if the lever-arm moves from the side of a_1, the shuttle will, at first, remain immoveable, but a moment before the hook t_1 engages above the following tooth, the nut m presses against a, and at that instant it displaces the shuttle; there is then no longer communication between a_1 and e_1; a is then in non-metallic contact with e_1. The shuttle remains in this position until the armature, dropping down, makes the nut m press against $_1a$, and re-establishes the metallic contact between a_1 and e_1, by separating a from e; it will be seen that the extent of the movement of the lever-arm L L_1 is much greater than that of the shuttle, and that it is only at the moment that the lever has arrived at its maximum, right or left point of separation, that the shuttle makes a very small movement, first to the one side and then to the other.

One of the ends b_1 of the wire of the electro magnet connects with a pressure screw, the other end of the wire traverses the hole T_1, and connects at b_2 with the support s_1 of the shuttle; another wire is screwed to the plate P_1, and has metallic communication with e_1, which also traverses the hole T_1, and is fixed to a pressure screw. If, then, b_1 and a'_2 are united to the two poles of the battery, the circuit through the apparatus will be closed as long as a_1 touches e, and will be opened when a touches e.

In the position represented by the figure, the current coming from the positive pole of the battery to b_1, traverses the wire of the electro-magnet, comes to b_2, passes from b_2 into the shuttle, comes from the shuttle at a to a'_1, and goes to the negative pole through a'_2. The armature is attracted, the hook t_1 is placed above the next tooth, but at the same time the nut m presses a, and makes the shuttle advance toward e_1, the contact no londer exists between a_1 and e, the circuit is broken, the current is interrupted, the armature separates from the electro-magnet, the hook t_1 descends, taking with it a tooth, and making the indicator advance a step upon the dial; at the moment when this return movement attains its limit, the nut m presses against a_1, and a_1 against e_1, the current is again closed, and everything recommences.

In order to prevent the shock of the lever-arm against e from causing two teeth to pass, instead of one, or causing the hook not to pass over a single tooth, there is fixed:

1st. Upon each of the teeth of the wheel r_1 a steel feather, ratchet, or bevel edge, as indicated in the figure by the white rays.

2d. Upon the lever-arm $L\ L_1$ is a little vertical steel rod, indicated by t_2 at its extremity, and it is bent toward the bottom every time that t_1 engages in the space between the two succeeding teeth, and stops the wheel r, the bent extremity t_2 abandons the ratchet teeth, which are directed downward; but every time the lever-arm redescends, and sets the wheel r_1 in motion, t_2 places itself between two consecutive ratchets, makes the left ratchet pass, opposing the passage of the right-hand ratchet; in this manner, a movement of the lever-arm $L\ L_1$ toward e_1 can never let two teeth pass, and the needle of the indicator must always pass freely from the centre of one signal to the centre of the following signal. One of the principal characteristics of this telegraph is, that as long as the battery is in the circuit, the mechanism operates, and the needle of the indicator passes constantly over the dial without intervention of any clockwork.

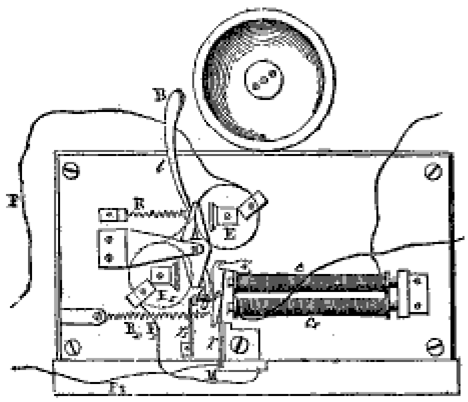
I will now notice the means by which the movement is stopped to indicate any letter. A circular key-board, fig. 2, forms a sort of a gallery around the apparatus, each key bears a letter, or signal, and is prolonged with a steel point, which, when pressed by the finger on the key, is caused to penetrate into the apparatus. The axis of the wheel r, which bears the indicator, carries with it a second needle A_2, situated under the plate P_1. Each key pressed down, becomes an insurmountable obstacle to the rotation of the needle, the wheel stops, and with it the indicator of the dial, as well as the lever-arm $L\ L_1$.

It will be seen, by the preceding, that, at the moment when the letter indicator attains the middle of a space, the lever-arm $L\ L$ goes toward e_1, the hook t_1 places itself in the interval of the two succeeding teeth. If, then, the indicator is to be placed before a letter, the lever-arm $L\ L_1$ must be stopped in its return toward e, before the nut m arrives in contact with a^1, and also before the indicator has reached the middle of the space at which it ought to stop. For that purpose, the needle A_1 is prolonged and inclined, so that it presses against the rod, sunk by the lowering of the key, before the nut m touches a_1, and before the indicator on the dial has reached the signal at which it ought to stop. If the finger is taken off the key, the rod rises, the needle A_2 is no longer stopped, the spring detaches the armature, the nut m presses against a_1, a_1 arrives in contact with e_1, the current circulates again, and the armature recommences its oscillations.

THE ALARUM BELL APPARATUS.

The alarum bell is represented, in part, by fig. 4. It is composed of a new electro-magnet, as seen in fig. 1, $E'\ E'_1$, having also its armature in the form of an ∞ reversed. $A'\ A'_1$, moveable around an axis; this axis bears the lever-arm L', which

Fig. 4.



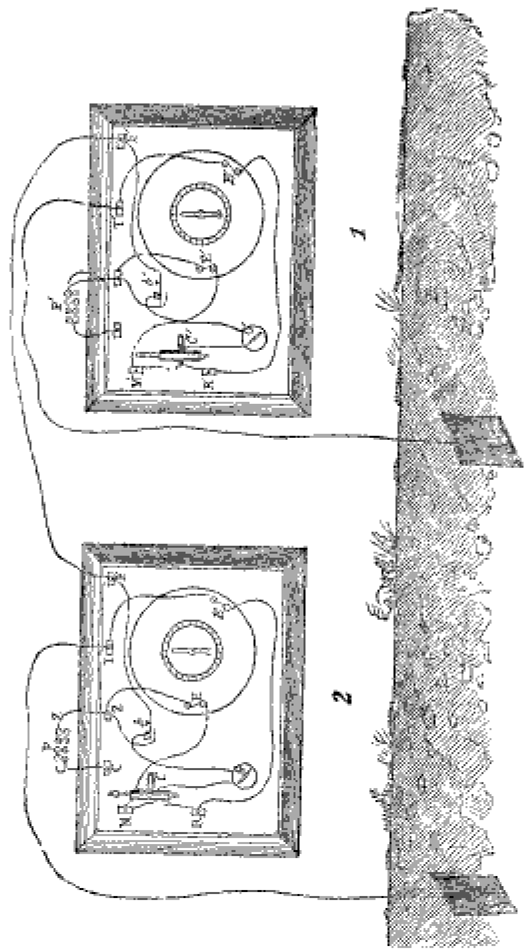
partakes of the to-and-fro movement of the armature. A metallic plate, P_2, serves as a support to a little foot, upon which a shuttle $n'\ n'_1$ rests, its form being different from that of the telegraph apparatus. It has a prong or a fork, moving within very narrow limits, between the two screw heads e' e'_1. Each interior jaw of the shuttle bears, near its middle, two little insulating bone or ivory buttons, against which the lever arm L′ strikes in its oscillations, making the shuttle n' n'_1 move in its turn, sometimes toward e' and sometimes toward e'_1; the jaw n'_1 bears a very elastic spring, with an insulating piece, and which, by its pressure, prevents the oscillations of the shuttle from ever separating a'_1 from e'_1. A spiral spring F_1, which can be stretched or loosened at pleasure, and which draws upon the lever-arm l'_1 fixed to the axis of the armature, tends to detach the armature from the electro-magnet, and even to detach it after the current has ceased to pass. This same axis bears a long, round-headed bar, which strikes upon the bell T as often as the armature is attracted.

The screw-poles e' e' (of which the first is insulated from the support s', while e_1 is in constant metallic contact with the opposite) must be adjusted and regulated for the intensity of the current and the tension of the spring. It will be seen that the bell apparatus is analogous to the telegraph apparatus. The entire mechanism is contained in a round brass box, fig. 3, some twelve inches in diameter, and upon the top of which is the circular key-board, the letter-dial, and the indicator. Two square screw heads are seen to project on the sides, which enables the operator to regulate, by means of a key, and without opening the box, the springs of E_1 E'_1; another screw-button, B_1, serves to act directly on the escapement, and to bring the indicator upon such letter or signal as we desire. The letters *s e* and *n* are written twice over, on account of their very frequent occurrence in the German language. Above and below are two vacant spaces, upon which the indicator is brought at the end of each word.

THE ELECTRIC CIRCUITS AND MANIPULATION.

Fig. 5 represents the circuits of the two apparatuses of two stations, united by the line wire and the earth wires. This figure is simple, and explains itself. P P′ are the two batteries, of which C C′ are their copper poles, and Z Z′ their zinc poles, united by wires to the pressure screws, indicated by the same letters in station 2. T T′ F F′ are the pressure screws, destined to receive the wires which go to the earth, and the conducting wires of the telegraph line. C C′ are two commutators, which communicate metallically sometimes with the pressure screws M M′, when it is desirable to transmit dispatches, sometimes with the pressure screws R R′, when the telegraphs are to remain at rest; E E E′ E′ are the electro-magnets of the indicators, and of the bell apparatus, and G G′ are two electrometers, placed in the circuit in the drawing. The station 2, at

Fig. 5.



the left, speaks and transmits signals to the station 1, at the right. The course followed by the current is indicated by the line wires and the station connections.

To place the commutators in contact with M M′, it is sufficient to press the button *b*, fig. 5.

The needles of the two indicators move constantly over the dials; and to transmit signals, it is only necessary to stop simultaneously the two needles upon the same letter. It has sufficed for this, to prevent the circuit from being closed in the apparatus at the first station, 1, producing the same results in effect. The circuit also rests open in the apparatus of the second station, 2; and neither of the two armatures will be attracted until the mechanism of apparatus 1 is permitted to close the circuit.

When the key of the first apparatus is pressed upon, the escapement wheel is stopped precisely in the middle of the movement which it was about to make, under the action of the spring, and the circuit cannot be again closed, until the operator has removed the obstacle by the withdrawal of the finger. During this time, nothing prevents the escapement of the apparatus of station 2, by its mechanism, from closing the circuit; but, inasmuch as the circuit is open at station 1, the armature will not be again attracted, and the indicator of the apparatus, at station 2, will stop over the desired letter, after the key is pressed corresponding to the same letter upon the apparatus at station 1.

In time of repose, when it is not desired to correspond, the circuit between the two stations, 1 and 2, is formed merely by the conducting wire, the earth, and the two spools or coils of the alarum bell. When the operator of station 1 wishes to communicate with the operator of station 2, he withdraws his bell apparatus from the circuit, and replaces it by a battery and his apparatus for telegraphing. Immediately, the bell of the station 2 gives the alarum, but the telegraph apparatus of that same station remains motionless. It may appear somewhat surprising, that two similar apparatuses, the telegraph and that of the bell, can be in the same circuit, the one operating and the other not operating. This effect is obtained by the unequal tension of the springs. Suppose, indeed, two apparatuses to be placed in the same circuit, the recoil spring of the one A is much stronger, or more tightly stretched than the apparatus B, thus, when the armature of B shall have been attracted, the electro-magnet A will not have acquired the force necessary to counterbalance the action of the spring. This result is owing to the difference as to tension in the recoil springs, the one being more susceptible and elastic than the other. The armature of A will remain firm and motionless, and the circuit constantly closed on that side. The apparatus B will alone move. It will be understood, then, that, from what actually takes place, the springs of the bell alarums are feebler than those of the telegraph. The bells will be sounded at each station, by the action of the battery of the other station, while the telegraphs will continue to remain motionless. To completely establish the correspondence, the operator of station 2, being notified by the alarum, withdraws his bell apparatus from the circuit, and puts in its place the telegraph and the battery. The telegraph apparatuses then immediately work together. This simultaneousness of movement will not take place if the operator of station 1, in giving the alarum, has not first introduced his telegraph into the circuit, and if his telegraph has not rested motionless while the bell of the other station is sounded.

If the operator of the second station wishes, in his turn, to correspond, or express some doubt, or ask some explanation, he places his finger upon a key, the needle of station 1 stops upon the signal corresponding to that key, and the sender of the dispatch is thereby notified that the operator of the other station wishes to speak. The interview then takes place, the explanations are exchanged, and the transmission of the signals is then resumed.

The normal movement of this telegraph is that whenever the needle passes over a demi-circumference of the dial. By this system, fifteen signals can be transmitted in a second. This rapidity is ordinarily attained. A Daniel battery, of five pairs, is sufficient to work a line of from one to two hundred miles. A battery of twenty-five pairs, with subterranean wires, makes the apparatus work very well over two hundred and fifty miles.

THE TRANSMITTER AND ITS APPLICATION.

To avoid increasing the number of pairs, an apparatus has been added to the Germanic telegraph, by the inventors, called a "transmitter," which is a peculiar relay magnet. When the circuit is closed, the current from the batteries of the stations do not enter at first into the two spools of the electro-magnets of the two stations. It passes first into the spools or coils of the transmitter, opposite the poles of which the armature turns, similar to those of the telegraph and of the bell apparatus. As soon as the armatures are attracted, they close an aperture which existed between the conducting stopper and the lever fixed to the armature, and when the armature is detached, the interruption is made to re-exist. The establishment and rupture of the contact is the only work performed by the transmitter. There can be given to their springs much less strength than that of the springs of the bells, and a very feeble current will suffice to give action to the transmitter.

When the transmitter has established the contact as above described, the current of the battery has opened before it a derivating circuit, much shorter and of less resistance, being composed of equal batteries and relay coils at each station.

These spools will then be traversed by a current much less intense, than if they had not had the transmitter. The armature of the telegraphs are attracted, and during their course, nothing is changed; but as soon as they have answered at the end of that course, the armatures interrupt the contact in the telegraphs. The current which animated the electro-magnets of the transmitters ceases, and the armatures of these magnets are detached by the springs. The auxiliary current, which rendered active the electro-magnets of the telegraph, ceases in its turn. The armatures of the telegraph are drawn back by their springs, and the indicators advance one step upon the dials, &c. The manœuvre for giving the alarum call is the same thing either with or without the transmitter. Fig. 4 will give an idea of the play of the transmitter or electro-magnet. It serves here to make a bell ring. E E_1 are the two poles of the large electro-magnet, the extremities of the wire which cover it go by the wires F F_1 to the two poles of a local battery. The wires of the transmitting electro-magnet terminate, one with the earth, and the other with the wires of the line. A is the armature of the small electro-magnet; it turns around a vertical axis, and bears the lever *l*, terminated by a hammer B, which strikes upon the bell at each attraction of the armature. The wire F goes directly to one of the poles of the local battery. The wire F_1 is at first attached to a metallic piece M; to this same piece, but insulated from it, is attached the platina wire, which makes the very feeble spring *r*, of which the extremity is very near to the little platina prolongation of M, so that a very slight movement of the spring *r* serves to bring it in contact with M. The wire F_2 unites the spring *r* with the second pole of the battery. The prolongation of the lever *l*, or the second arm *b*, seen below the armature A, bears at its extremity two little pins, between which is engaged a rod, fixed to the armature of the electro-magnet e e_1; this rod is terminated by a little bead or button, which presses whenever the armature is not attracted against another similar button, borne by a second platina wire spring r_1. The armature A and the armature *e* have their spiral springs R R_1, which tend to separate them from the electro-magnets, when they are no longer attracted. This being so, if the telegraphic circuit is strong enough, the electro-magnet e e_1 attracts its armature *e*, and this armature makes the spring *r* press against the metallic piece M, thereby the circuit of the local battery is closed, The current circulates, and renders active the apparatus of the bell. The hammer strikes one blow, but at the same time its prolongation *l* detaches from the electro-magnet $e\ c_1$, the armature of the relay. The spring *r* abandons the metallic piece M, and the circuit of the local battery is again opened.

I have said, in the beginning of this chapter, that this description of the ingenious telegraph apparatus was defective. It is the best that I have been able to get. The system is worthy of a more extended notice. I have frequently visited the telegraph manufacturing establishment of Messrs. Seimens and Halskie, in Berlin, Prussia, and I found it to be the most complete and extensive in the world