AVY'S ELECTRO-CHEMICAL TELEGRAPH.

CHAPTER XVI.

Nature of the Invention described—The Transmitting Apparatus—The Receiver—The Instruments combined—The Manipulation—The Signal Alphabet.

NATURE OF THE INVENTION DESCRIBED.

On the 4th of July, 1838, was sealed a patent to Mr. Edward Davy, of England, for an electric telegraph, which combined the fundamental elements of subsequent chemical systems. The patent was very extensive, and embraced many valuable improvements in the art. It was bought by the Electric Telegraph Company of England, but never used.

The following outline description of the invention will serve to give an idea of its combinations:

Three wires were to be used, and points of metal wire were to be caused to press, by means of the motion of magnetic needles, upon chemically prepared fabric at the distant or receiving station.

The fabric to be employed was calico or paper, and it was to be moistened with a solution of hydriodate of potash and muriate of lime.

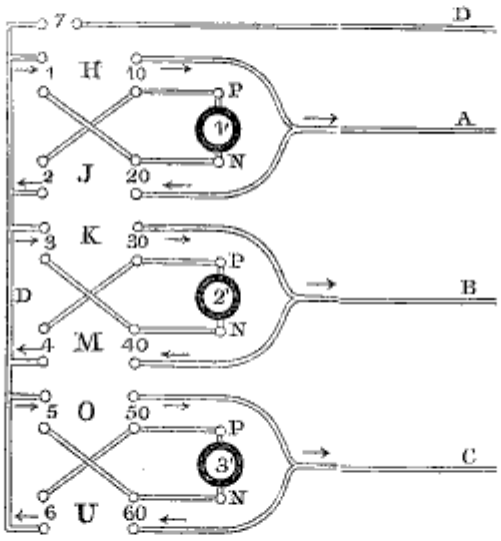
The motion of a needle to the right caused a mark to be made on *one* part of the fabric, and the motion of the same needle to the left, caused a mark to be made on *another* part of the fabric; and the same for *each* needle attached to the respective wires. Thus the single or combined marks were made to express letters or other desired symbols.

THE TRANSMITTING APPARATUS.

Fig. 1 represents a top view of the arrangement of the wires, mercury cups, and batteries of the *transmitting station.* The close parallel lines represent the wires, of which D A B and

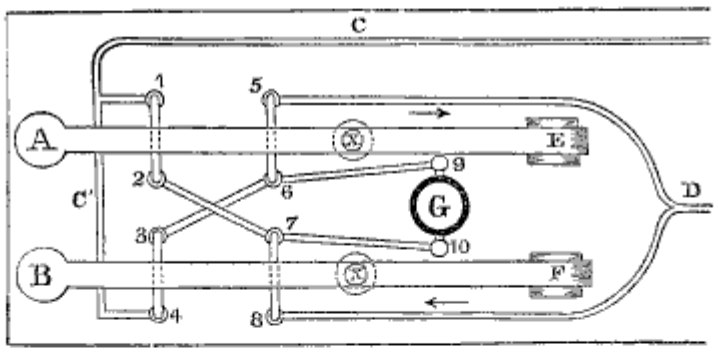
c are those which proceed to the receiving station. 1′ 2′ and 3′ are the three batteries, of which P and N are their respective

Fig. 1.



poles. The small circles formed at the termination of the wires, and marked 7, 1, 10, 2, 20, &c., are mercury cups, in which the terminating wires are immersed. The wires 1 and 20, and 2 and 10, &c., which cross each other, are no in contact, but perfectly insulated. The wires shown in this figure are all

Fig 2.



secnred permanently, with their mercury cups to one common base-board. The letters H J K M O and U represent the places of the six finger-keys used in transmitting signals. There is

also another key at 7, for uniting the wire D and D. In this figure, however, the keys themselves are omitted, in order to render more clear the arrangement of wires under and around them. Another figure, 2, is here introduced to illustrate the plan of one set of wires and their two keys. In fig. 2 is represented, in a top view, the two wooden keys, A and B, and their axes, at E and F. G is the battery, of which 9 is the positive pole, and 10 the negative pole. The small circles, marked 1, 2, 3, 4, 5, 6, 7, and 8, represent the mercury cups. C and C′, and also D, are the extended wires. The keys, A and B, have each two wires, passing at right angles through the wooden lever. The wires of the key A are marked 1 and 2, and 5 and 6, and those of the key B are marked 3 and 4, and 7 and 8. These wires, directly over the mercury cups, are bent down a convenient length, so as to become immersed in the cups, when the lever is depressed, and rise out of them, when the lever is elevated. Now, if the key A is depressed, the cup 1 is brought in connection with cup 2; and 5 is connected with 6 by the wires, supported by the lever, being immersed in the mercury; and the key B not being depressed, there is no connection of the cup 3 with 4, or 7 with 8. At X and X, under the lever, are springs, which keep the lever elevated, and, consequently, the wires out of the cups, when the keys are not pressed down.

Fig. 3.

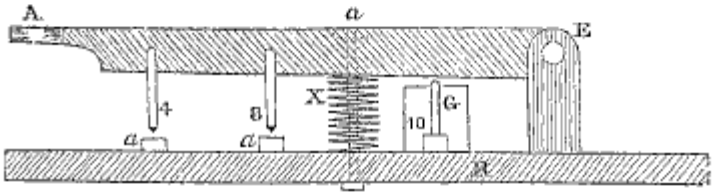


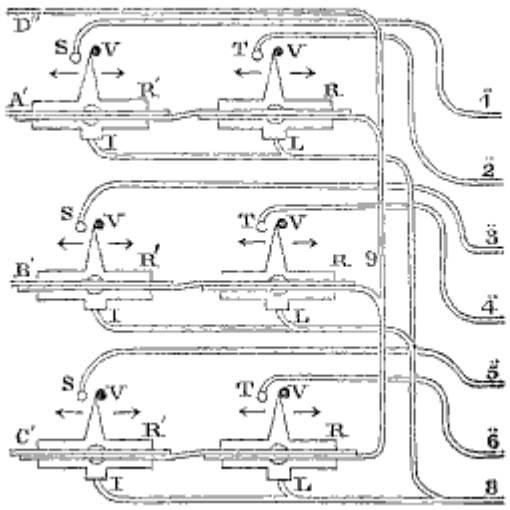
Fig. 3 represents a side view of the lever or key A, and its axis at E. B is the platform supporting the standard of the axis, the stationary wires, the battery G, and the mercury cups, *a a* and 10. X is the spiral spring, for the purpose of carrying back the lever, after the finger is taken off, and sustaining it in its elevated position. Through the centre of the spiral passes a rod, with a head upon it at the top of the lever, to limit its upward motion. At its lower end, the rod is secured in the platform B. 4 and 8 are the two wires supported by the lever A, and are seen to project down directly over the mercury cups, *a* and *a*, so that by depressing the key, they both enter the cups

and form a metallic connection. The key B, fig. 2, has the same fixtures, and is similarly arranged as the key A, fig. 3.

THE RECEIVING INSTRUMENT.

Fig. 4 represents a top view of the arrangement of multipliers at the *receiving* station. R′ R′ R′ and R R R are six magnetic needles or bars, each of which move freely on a vertical axis passing through their centres. The lower point of their axes is immersed in cups of mercury, in which also terminate the wires I I I and L L L. The wires D″ A′ B′ and C′ are

Fig. 4.



those coming from the *transmitting* station. A′ B′ and C′ each enter the needle arrangement, and first passing from left to right *over* the magnetic bars R′ R′ and R′, in the direction of their length, then down and under and round, making many turns, leave these three needles and pass *under* the needles R R and R, and in like manner from right to left round them, making a number of turns, then pass off and unite together in the wire 9, which is a continuation of D″. This wire is called the *common communicating wire*, and the wires A′ B′ and C′ are called *signal wires*, though they too are occasionally common communicating wires. At right angles, there projects from each magnetic bar a metallic tapered arm, which rests against the studs v v v v v v, when the needle is undisturbed. But when the needles are made to move in the direction to carry the arms

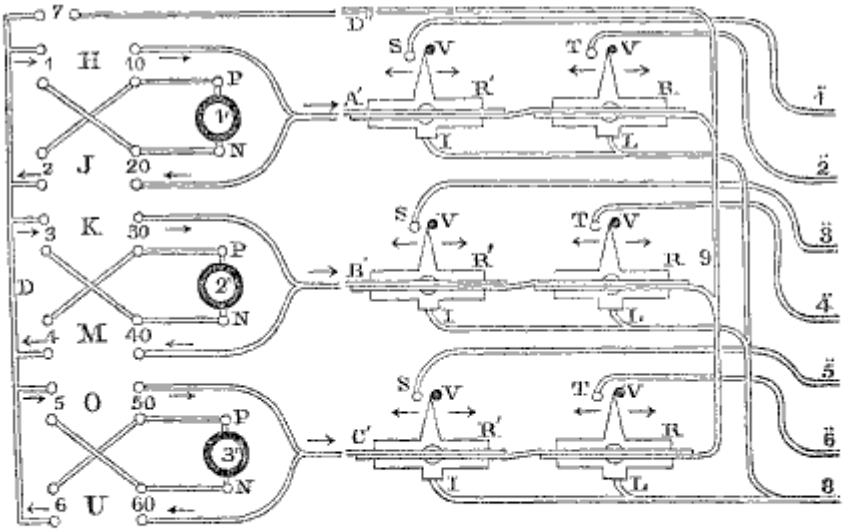
to the left, they are brought in contact with the metallic stops s s s and t t t. To each of these stops, it will be observed, a wire is soldered, and continued respectively from s s s to $\ddot{1}$ $\ddot{3}$ $\ddot{5}$, and from t t t to $\ddot{2}$ $\ddot{4}$ $\ddot{6}$. It will also be observed, that, from each of the mercury cups below the magnet bars, the wires r and l and r and l, and r and l proceed and unite in pairs at l l l; these three united wires are then continued, and the whole are joined in one at 8. The wires $\ddot{1}$ $\ddot{2}$ $\ddot{3}$ $\ddot{4}$ $\ddot{5}$ $\ddot{6}$ are continued, in a manner hereafter to be described, and are connected with one pole of a battery. The wire 8 is also continued and connected with the other pole. So that if any one of the needles should be made to move its arm to the left, thereby coming in contact with its metallic stop, the circuit would be complete, and the current would pass along the wire $\ddot{1}$, for example, to the metallic stop, then to the arm, and to the magnetic bar, then to the axis, then to the mercury, then to the wire r, and thence to the wire 8. In the same manner the current would pass, if any other arm was brought against *its* metallic stop.

THE INSTRUMENTS COMBINED.

In order to understand the combined operation of the keys and needles, fig. 5 is here introduced. The right-hand figure is the same as fig. 4, and the left hand the same as fig. 1.

Fig. 5.

Transmitting Station. Part of Receiving Station.



The wires D″ A′ B′ and C′ are detached from their corresponding wires of the transmitting station, and it may be imagined that many miles of wire intervene and connect the two. In the left-hand figure, those mercury cups above and below 1 and 10, are joined by two wires passing through a moving lever, in the same manner as has been described in fig. 2. We will, therefore, call the key carrying these two connecting wires H. In like manner the key for the cups above and below the numbers 2 and 20, is called J; for 3 and 30, is K; for 4 and 40, is M; for 5 and 50, is O; for 6 and 60 is U. The key which connects the two mercury cups on the right and left of number 7, of the wire D″, is called 7. There are 7 keys, two for each battery, 1′ 2′ and 3′, and each wire A′ B′ C′, and one for the common wire D″.

It will now appear, that if the key U and 7 are depressed, the cups above and below numbers 6 and 60, and the cups on each side of number 7, will be connected together, so that the current leaving P, or the positive pole of the battery 3′, goes to the lower cup 50; then by the stationary cross-wire to upper cup 6; then passes to lower cup 6, by the wire supported by the lever U, which is now pressed down, and its ends immersed in the two cups; then along the wire D, to the left-hand cup 7; then to the right-hand cup 7, by the wire supported by the lever 7, and which is immersed in the two cups; then through the extended wire to D″, of the *receiving* station; then through 9, to the two multiplying coils of the wire C′, deflecting the arm of the needle R to the right, against the stop V, and the arm of the needle R′ to the left, against the metallic stop S, as indicated by the arrow at S; then along the extended wire, back to the lower cup 60, of the *transmitting* station; then to upper cup 60, through the wire supported by the lever U; then to N, the negative pole of the battery 3′.

It will be observed of the two needles, R and R′, in the circuit of the same wire C′, that if R is deflected to the right against the stop V, then R′ will be deflected to the left against the metallic stop S. The current, to produce these deflections, is through the wire C′, in the contrary direction to that indicated by the arrow of wire C′. But if R is deflected to the left against the metallic stop T, then R′ will be deflected to the right against the stop V. The current to produce these deflections will then be through the wire C′, in the direction of the arrow of that wire. The same effect is produced upon the two other pairs of needles of the wires A′, and also B′. These contrary movements of the two needles, when *a current* is passing, are produced by the coils being so wound (as described with fig. 4), that the wire passes round one needle in a contrary direction to what it does round the other.

THE MANIPULATION DESCRIBED.

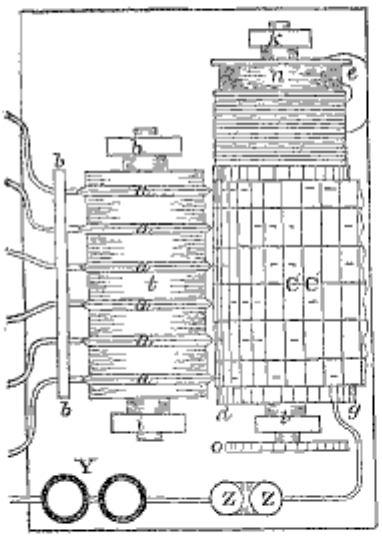
If the keys o and 7 be depressed, the cups above and below, 5 and 50, and on each side of number 7, will be connected. The fluid will then pass from P, or positive pole of the battery 3′, to the lower cup 50; then through the key wire to upper cup 50; then along the extended wire c′ to the *receiving* station; then through the coils of the multipliers, deflecting the arm of the needle R to the left against the metallic stop T; and the arm of the needle R′ to the right against the stop V, as indicated by the arrow at V; then to wire 9 and D″; then along the extended wire back to the *transmitting* station, to the right hand cup 7; then by the key wire to the left-hand cup 7; then to wire D; then to upper cup 5, and through the key wire to lower cup 5; then by the cross wire to upper cup 60, and then to N, or negative pole of the battery.

It has now been shown the route of the current, when the keys U and 7, and the keys O and 7 were depressed. It will be observed, that when the keys U and 7 were used, the current through the wire D″ was from *left* to *right;* and when the keys O and 7 were used, the current was from *right* to *left*. Thus, by means of the six keys, the current of each battery may be made to pass in either direction through the *common communicating* wire D″. By the keys U M J, with 7, the current is made to pass from *left* to *right* along the wire D″. By the keys O K H, with 7, the current is made to pass from *right* to *left* along the wire D″. By these six keys all those various deflections of the six needles are produced, which are necessary to close the circuit of such of the wires 1̈ 2̈ 3̈ 4̈ 5̈ 6̈, with the wire 8, as are required for making the signals desired, on an instrument now to be described.

Fig. 6 represents a top view of that part of the instrument at the *receiving* station, by which the signals are recorded. The seven wires on the left of the figure are a continuation of these wires, marked 1̈ 2̈ 3̈ 4̈ 5̈ 6̈ and 8, in fig. 5. The first six pass through a wooden support, *b b*, and terminate on the edge of the platinum rings *a a a a a* and *a*, forming a metallic contact. The six platinum rings surround a wooden insulating cylinder *t*, which revolves upon axes in the standards *h* and *i*. The rings are *broad* where they come in contact with the wooden roller, and are bevelled to an *edge* where they come in contact with the six wires. V represents a compound battery, with one pole of which wire 8, from the needle arangement, fig. 5, is connected, and from the other pole the wire proceeds to the electro-magnet z z; it then passes on, and is brought in connec-

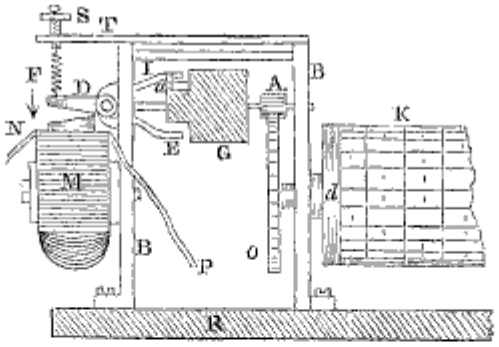
tion with the metallic cylinder *d*, at the point *g*. The cylinder *d* revolves upon an axis, and is supported in the standards *k* and *l*.

Fig. 6.



To the cylinder is attached a barrel *n*, upon which is wound a cord, supporting the weight *e*, by which the cylinder is made to revolve. *c' c'* represents a prepared fabric, such as calico, impregnated with hydriodate of potash and muriate of lime, and is placed between the platinum rings *a a a a a a*, and the metallic cylinder *d*; *o* is a cog-wheel upon the end of the axis of the cylinder *d*, and is connected with other machinery, omitted here, but shown in fig. 7, which is a side elevation of part of fig. 6; *o* is the cog-wheel, fig. 7, on the arbor of the cylinder *d*. B and B are the two sides of the frame containing the clockwork, and is secured to the platform R; *d* is part only of the metallic cylinder, upon which is seen a portion of the prepared fabric K. The cog-wheel *o* drives the pinion A, and the shaft of the fly-vane G. M is an

Fig. 7.



end view of the electro-magnet, represented by z z, in fig. 6, of which N and P are the two ends of the wire composing the helix.

D is its armature, constructed so as to move upon an axis represented by two small circles. To the armature are connected, and capable of moving with it, two arms, E and I, which project, so as to come in contact with the pallet *a* of the fly G. F is a spiral spring, one end of which is fastened to the armature D, and the other passes through a vertical hole in the screw S, in the bar T, by which the armature is held up in the position now seen, when not attracted by the electro-magnet. Now, if the wires N and P connected with battery Y, fig. 6, have their circuit closed, the current passing through the helix of the magnet M, brings down the armature D in the direction of the arrow, which raises the arm I, against which the pallet *a* of the fly-vane is resting, and releases the fly. It then makes a half revolution, and is again arrested by the pallet against the lower arm E, and the cylinder D, with its fabric, has advanced a half division. If the circuit is now broken, the armature D is carried up by the spring F, at the same time the arm E releases the pallet *a*, and the fly makes another half revolution, and is again stopped by the arm I. The cylinder now advances another half division, making a whole division the fabric has advanced. The purposes for which this is designed will now be described.

Fig. 8.

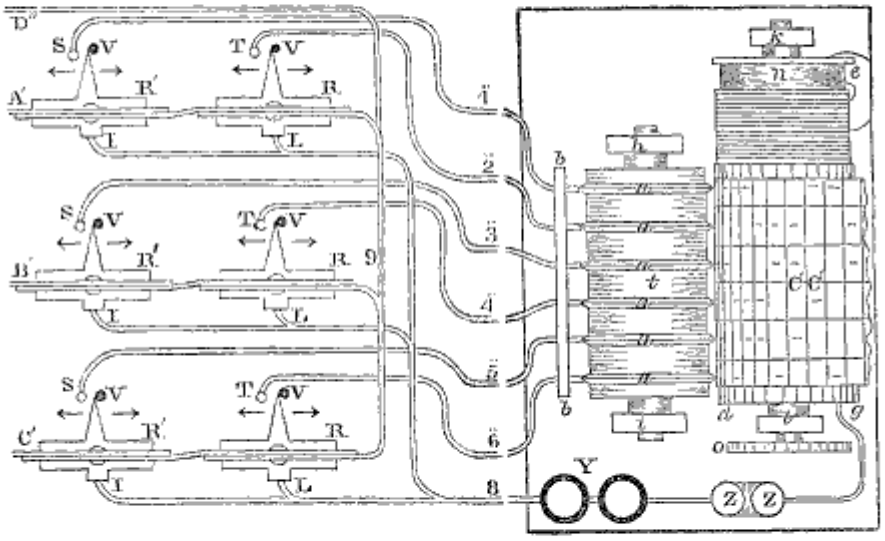


Fig. 8 represents a top view of the whole apparatus of the *receiving* station. The fabric, c′ c′, is marked in equal divisions across it, and in six equal divisions in the direction of its

length, thus marking it into squares. Each platinum ring, *a a a*, &c., when the instrument is not in operation, is in contact with the fabric at the *middle* of the squares across the fabric. It will be observed, that the wires $\ddot{1}$ $\ddot{2}$ $\ddot{3}$ $\ddot{4}$ $\ddot{5}$ $\ddot{6}$ are in connection with the battery Y and the circuit complete, except at the arms of the needles. Suppose, for example, the arm of the needle R′ of the wire C′, is brought up against the stop of the wire $\ddot{5}$, at S, the circuit is then closed, and the current leaves the battery, and passes to the electro-magnet, causing the cylinder and fabric to move half a division, then to the metallic cylinder *d;* then through the fabric *c′ c′*, resting upon the cylinder, where it is in contact with the platinum ring *a*, of the wire $\ddot{5}$, then to the platinum ring, then to wire $\ddot{5}$, then to the metallic stop S, then to the arm of the needle R′, along its axis to the mercury, then to the wire I, then to the wire 8, and to the other pole of the battery Y. Thus the current is passed through the prepared fabric, and a mark produced thereon in the middle of its square. If the circuit is now broken, the cylinder moves another half division, which will bring the rings to the centre of the squares, ready for the next signal.

But one battery, Y, is used for all the six circuits, formed with the wire 8, so that, when three of the circuits are closed at the same instant, as will be shown hereafter, the current passes through the three wires of their respective circuits, making each their appropriate mark upon the fabric.

I will now proceed to describe the manner of operating with the two instruments, at their respective stations: and, first, I will here designate each needle by its own peculiar mark of reference. Let the two needles upon the wire A′ be denoted by A S and A T; those of the wire B′ by B S and B T; and those of the wire C′, by C S and C T. It will appear obvious, from the foregoing description, that but *one* needle of each *wire*, A′ B′ C′, can be made to close its circuit at the same instant. However, *two* needles, or *three* needles of *different wires*, may close their circuits at the same instant, but no higher number than three. The various combinations of *one* mark, *two* marks, and *three* marks, upon the same row of six cross divisions of the fabric, constitute the characters representing letters.

Fig. 9 represents the *transmitting* station, which may be supposed to be *London*, and fig. 10 the *receiving* station, which may be at *Birmingham*, with four wires extending from station to station, or three only, if the *ground* be substituted for the wire D″. Now, if the keys be depressed, the following deflections of the two needles of each key will be produced:

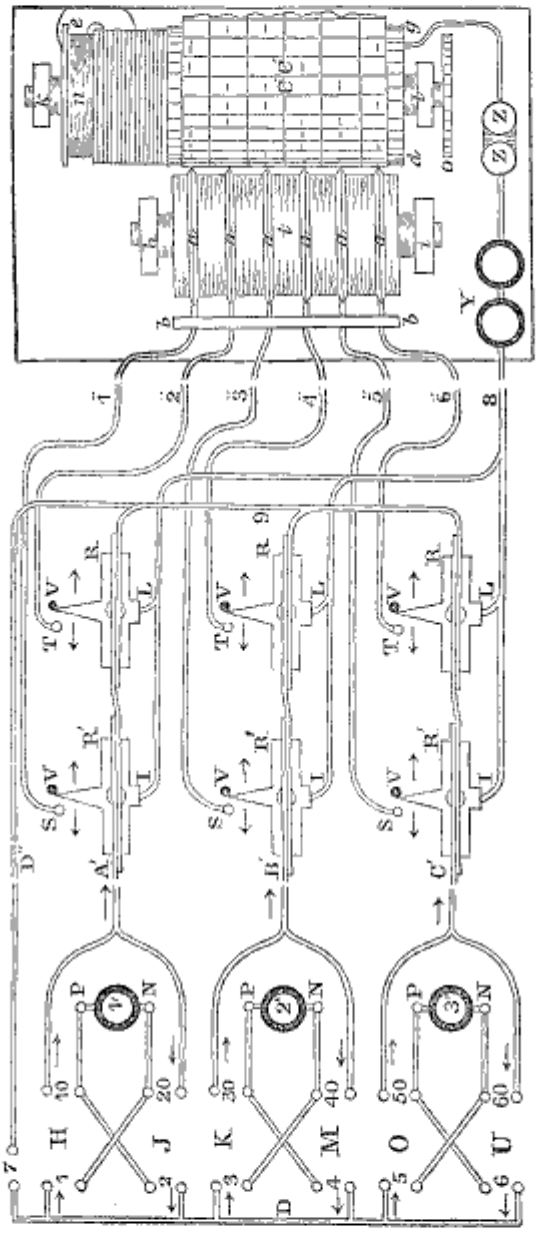


Fig. 9.

LONDON—*Transmitting Station.*

Fig. 10.

BIRMINGHAM—*Receiving Station.*

THE SIGNAL ALPHABET.

The keys, H 7, move the arm, A S, to the right, A T, to the left.
" J 7, " A S, " left, A T, " right.
" K 7, " B S, " right, B T, " left.
" M 7, " B S, " left, B T, " right.
" O 7, " C S, " right, C T, " left.
" U 7, " C S, " left, C T, " right.

These are all the various deflections which it is possible to give the six needles. Those, however, which deflect to the right, not closing the circuit, produce no effect, and are of no account. I will, therefore, omit them, and simply give the table, thus:

The keys, H 7, move the arm A T, to the left. No. 1.
" J 7, " A S, " " 2.
" K 7, " B T, " " 3.
" M 7, " B S, " " 4.
" O 7, " C T, " " 5.
" U 7, " C S, " " 6.

Telegraphic Letters.

The above represents the telegraphic characters marked upon the prepared fabric. The spaces are numbered from the top.

The first six of the telegraphic letters require each a signal wire, and the common wire D, with one battery.

The next six require each two signal wires, with two batteries, whose joint currents pass in the same direction on the common wires D.

The next six require each two signal wires only, with two batteries joined together, so as to form a compound battery; the negative pole of one connected with the positive pole of the other.

The next two require each three signal wires, with three batteries, whose joint currents pass in the same direction along the common wire D.

The next six require each three signal wires only, with three

batteries. One of the signal wires, with its battery, is used as a common wire for the other two. Hence the current of the two batteries of the two signal wires unite in one, and are connected with the battery of the common wire as a compound battery.

In the following table, the first column represents the keys, which, when depressed, produce a deflection of the needles, represented in the second, third, and fourth columns, by means of their batteries, and thus closing the circuit of the wires, $\ddot{1}$ $\ddot{2}$ $\ddot{3}$ $\ddot{4}$ $\ddot{5}$ and $\ddot{6}$, by which the fluid is made to pass through the prepared fabric, and mark upon its space, or spaces, numbered 1 2 3 4 5 and 6, in the fifth column. In the sixth column are the letters which the marks upon the fabric are intended to represent.

Keys.	Needles.	Needles.	Needles.	Spaces on Fabric.	Letters.
H 7,	A T,	-	-	1,	A
J 7,	A S,	-	-	2,	B
K 7,	B T,	-	-	3,	C
M 7,	B S,	-	-	4,	D
O 7,	C T,	-	-	5,	E
U 7,	C S,	-	-	6,	F
H K 7,	A T,	B T,	-	1 3,	G
J M 7,	A S,	B S,	-	2 4,	H
K O 7,	B T,	C T,	-	3 5,	I
M U 7,	B S,	C S,	-	4 6,	J
H O 7,	A T,	C T,	-	1 5,	K
J U 7,	A S,	C S,	-	2 6,	L
H M,	A T,	B S,	-	1 4,	M
J K,	A S,	B T,	-	2 3,	N
K U,	B T,	C S,	-	3 6,	O
M O,	B S,	C T,	-	4 5,	P
H U,	A T,	C S,	-	1 6,	Q
J O,	A S,	C T,	-	2 5,	R
H K O 7,	A T,	B T,	C T,	1 3 5,	S
J M U 7,	A S,	B S,	C S,	2 4 6,	T
H K U,	A T,	B T,	C S,	1 3 6,	U
J M O,	A S,	B S,	C T,	2 4 5,	V
H M U,	A T,	B S,	C S,	1 4 6,	W
J K U,	A S,	B T,	C S,	2 3 6,	X
H M O,	A T,	B S,	C T,	1 4 5,	Y
J K O,	A S,	B T,	C T,	2 3 4,	Z

The patent of Mr. Davy embraces the following claims, which will be found to be very important, in regard to the

combination of electric circuits. The claims are as follows, viz.:

First. The mode of obtaining suitable metallic circuits for transmitting communications or signals by electric currents, by means of two or more wires, which I have called signal wires, communicating with a common communicating wire, and each of the signal wires having a separate battery, and, if desired, additional batteries, for giving a preponderance of electric currents through the common communicating wire, as above described.

Secondly. I claim the employment of suitably prepared fabrics for receiving marks by the action of electric currents for recording telegraphic signals, signs, or communications, whether the same be used with the apparatus above described, or otherwise.

Thirdly. I claim the mode of receiving signs or marks in rows across and lengthwise of the fabric, as herein described.

Fourthly. I claim the mode of making telegraphic signals or communications from one distant place to another, by the employment of relays of metallic circuits, brought into operation by electric currents.

Fifthly. The adapting and arranging of metallic circuits in making telegraphic communications or signals, by electric currents, in such manner, that the person making the communication shall, by electric currents and suitable apparatus, regulate or determine the place to which the signals or communications shall be conveyed.

Sixthly. I claim the mode of constructing the apparatus which I have called the escapement, whether it be applied in the manner shown, or for other purposes, where electric currents are used for communicating from one place to another.

Seventhly. I claim the mode of constructing the galvanometer herein described.

And, lastly, I claim such parts as I have herein pointed out, as being useful for other purposes, as above described.