VAIL'S PRINTING TELEGRAPH.

CHAPTER XXIX.

Description of the Telegraph Apparatus—Manipulation and Celerity of Communicating—Arrangement of the Alphabet.

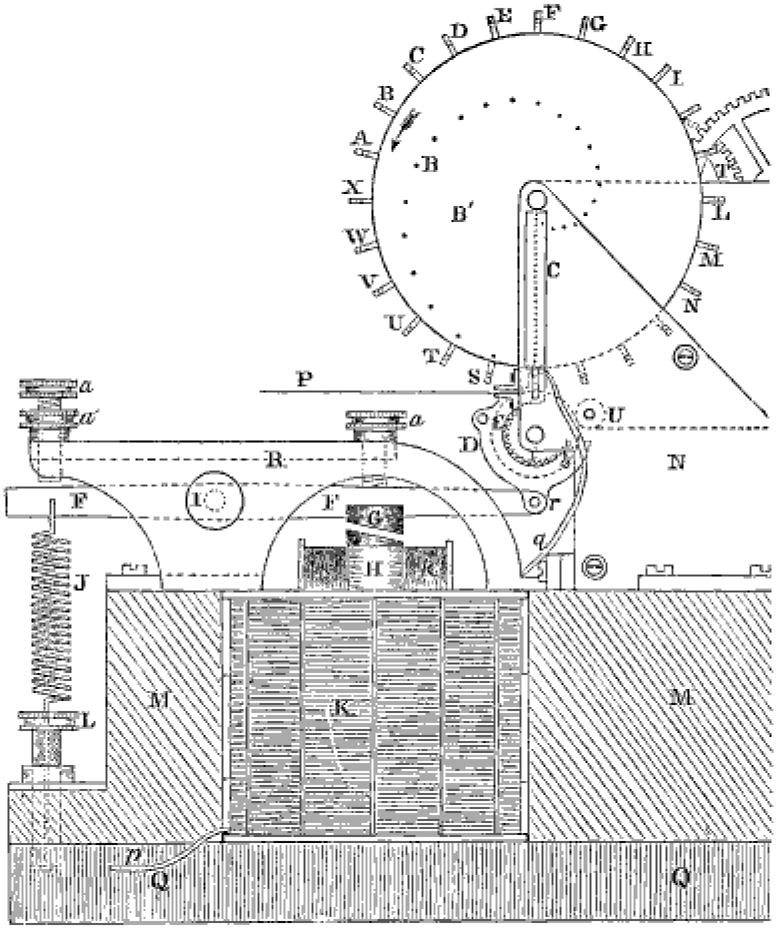
DESCRIPTION OF THE TELEGRAPH APPARATUS.

In September, 1837, Mr. Alfred Vail, of the United States, invented a printing telegraph. The following is his description of the apparatus:

Fig. 1 represents a front and side view of the instrument; fig. 4 is a top view; fig. 5 is a back view. The same parts are represented by the same letters in the three views. In fig. 1, Q Q is the platform upon which the whole instrument is placed. M and M are wooden blocks supporting parts of the instrument. K is the helix, the soft iron bar H passing through its centre, and there is another coil and bar directly behind this; the two making the electro-magnet. G is its armature fastened to the lever F F, which has its axis at I, seen in fig. 4, at X X. R is a brass standard for supporting the lever F upon its axis, by means of two pivot-screws; *a* and *a* are two screws passing vertically through the standard R, for limiting the motion of the lever F F. J is a spiral spring, at its upper end, fastened to the lever F, and at its lower end passes through the screw L, by which it is adjusted so as to draw the armature from the magnet, after it has ceased to attract, and for other purposes, hereafter to be explained. N O is a brass frame, containing the type-wheel B′ and the pulley E U. P and P represent the edge of a narrow strip of paper, passing between the type-weel and pulley E. D is the printer, which, at the bottom, forms a joint with the end of the lever F and *r*. B represents twenty-four metallic pins, or springs, projecting at right angles from the side of the type-wheel; each pin corresponding in its distance from the centre of the type-wheel to its respective hole, represented by dots upon the index C; so that, if the pin is put in any one of the holes, the type-wheel, in its revolution, will bring its corresponding pin in contact with it.

There are 24 holes, corresponding to the following letters of the alphabet: A B C D E F G H I K L M N O P Q R S T U V W X, and

Fig. 1.



the types are lettered accordingly. The cog-wheels, T and S, are a part of the train of the clock. The lever F F has two motions, one up and another down, and both are employed by an attachment at the end of the lever *r*, and in the following manner: figs. 2 and 3 represent a front and end view of the roller E and printer D, enlarged. D is the printer, fig. 2, of the form shown by D, fig. 3. E is the roller over which the paper

P is carried. A is the front of the type, having ears, *h h*, projecting from each side. Through the sides of the printer D D, a rod, U, passes, in order to give more firmness to the frame. The rod projects a little on each side of the frame at J J. These projections slide in a long groove in the frames N and O, fig. 1, by which the printer is kept in its position, and allowed freely to move up and down. It will be observed that the upper parts of the frame D D extends over the top of the roller E, and nearly touch each other, but are so far separated, as to let the type A,

Fig. 2.

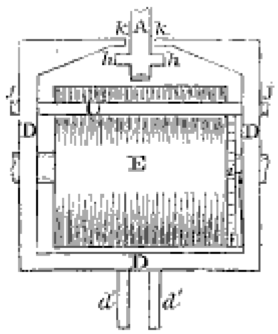
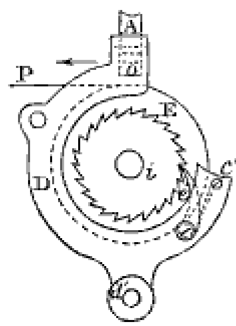


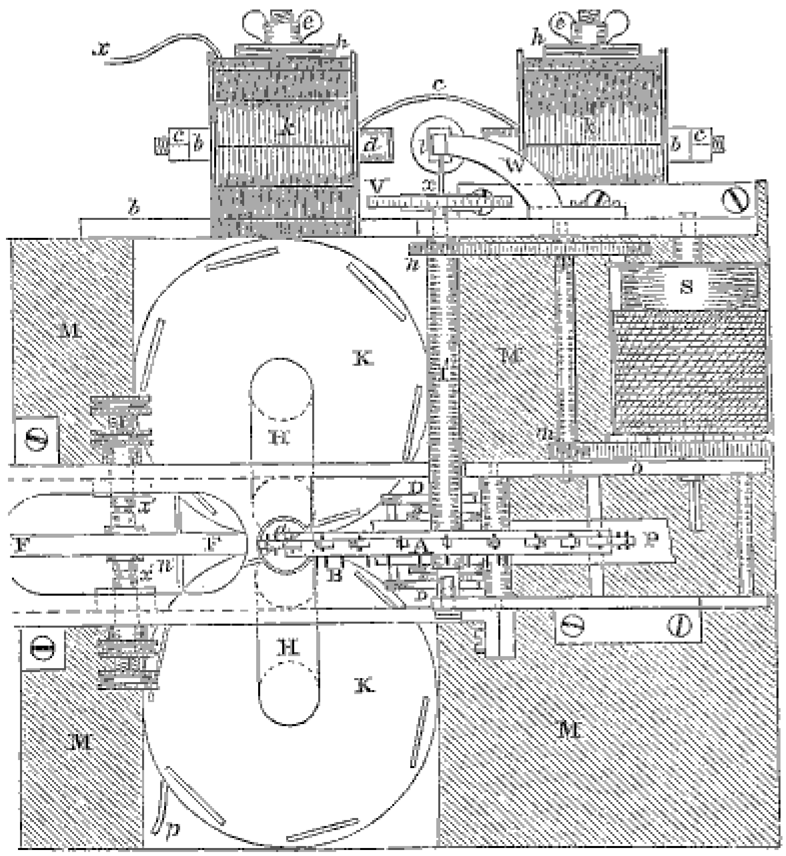
Fig. 3.



of the type-wheel, in its revolution, freely pass between them; *d' d'* are the sides of the joint, which are connected with the lever F, fig. 1. From the construction of this part, it will appear that, if the printer D is brought down by the action of the magnet upon the lever, the two projections, *k k*, will come in contact with the ears *h h*, and bring the type in contact with the paper upon the roller E, and produce an impression. In fig. 3 is shown a ratchet-wheel *i*, on the end of the roller E, a catch *e*, and spring *c'*, adapted to the rachet. Upon the release of the lever F, fig. 1, the spring J will carry down the lever on that side of its axis, and up at *r*, which will cause the roller E to turn, and consequently the paper P to advance so much by the action of the catch *e* upon the ratchet-wheel, as will be sufficient for printing the next letter.

Fig. 4 represents a top view of the machine: S is the barrel upon which is wound a cord, sustaining a weight which drives the clock-train, and upon the same shaft with it is a cog-wheel driving the pinion *m* on the shaft T; and on the same shaft T is another cog-wheel, driving the pinion *n* of the type-wheel shaft T'. K and K are the helices of the large magnet, of which H and H are the soft iron arms. M M M M are the blocks which support the instrument. F F is the lever, *a* and *a* its adjusting screws; *x′* and *x′* its axis; *k* and *k* are the two upper coils of the two electro-magnets at the back part of the instrument for purposes hereafter to be described; *x* is the wire soldered to the plate buried in the ground; *p* is the wire proceeding to the battery; *c* is the connecting wire of the two

Fig. 4.

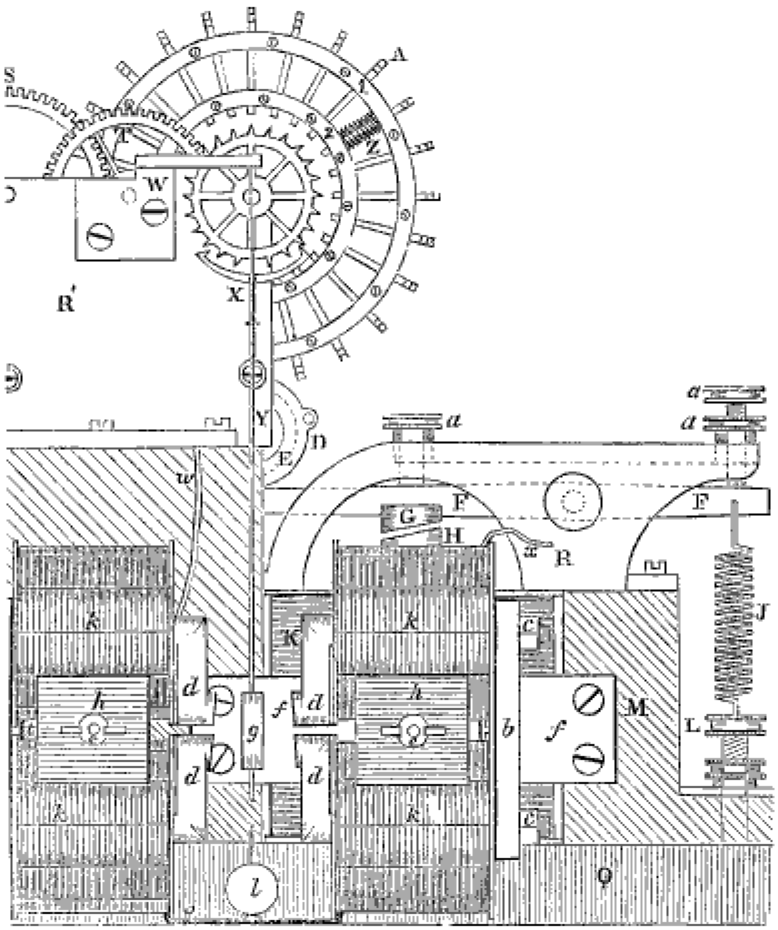


electro-magnets, *k k;* *w* is the support of the pendulum; *v* is the escapement-wheel; A is the type-wheel; D D is the printer, and B the roller over which the paper P is carried.

Fig. 5 represents a back view of the instrument; *k k* and *k k* are the coils of two electro-magnets, surrounding the soft iron bars *d d* and *d d;* *b* and *b* are the flat bars through which *d d* and *d d* pass, and are fastened together by the screw nuts *c c* and *c c*. The right hand electro-maguet is fastened to the blocks

M and M, by the support *f* and *f*, from which proceeds a bolt passing between the coils *k* and *k*, and the block *h*, with a thumbnut upon it, by which the whole is permanently secured. In the same manner the left-hand magnet is secured to the block

Fig. 5.



M. R′ is the outside portion of the brass frame containing the clockwork. W is a standard fastened to R′, for supporting the pendulum Y. X Y and *l* are parts common to a chronometer for measuring the time, viz., the escapement and pendulum. The escapement-wheel has 24 teeth, corresponding in number with the type on the wheel, and such is the arrangement of the parts, that when the pendulum is upon the point of return, either on the right or left hand, a type is directly over the paper, and the armature *g* is near the face of one or the other of the magnets; so that, if an impression is to be made with the type thus brought to the paper, the pendulum v is ready to be held by the magnet at the same time from making another swing, until the type has performed its office, which will be hereafter explained.

A shows the type as they are arranged on the wheel. The types are square, and move freely in a groove cut out of the brass type-wheel. At 1 and 2 are seen flat brass rings, which are screwed to the wheel, and over the types, confining them to their proper places. z is a spiral spring, of which there is one to each type, by means of which the type is brought back to its former position, after it is released by the printer. Through each type there is a pin, against which the inner end of the spiral spring rests. The outer end of the spring rests against the circular plate. *w* represents the wire from the upper helix, soldered to the metallic frame R′. The two helices of the left-hand magnet are joined together, and from the bottom helix the wire proceeds to the lower coil of the right-hand magnet. These two helices are likewise connected, and the wire leaves the upper coil at *x*. Thus the wire is continuous from *w* to *x*. From *x* the wire is continued to a copper plate buried in the earth. The frame R′, being brass, the arbor of the type-wheel and the wheel itself, and each being in metallic contact, they answer as a continuous conductor with the wire *w*, for the galvanic fluid.

The index *c*, fig. 1, is insulated from the frame N, being made of ivory. There is inserted in the ivory a metal plate, containing the holes, to which is soldered a wire *q*, connected with the back coil K. The two helices being connected, the wire of the front helix comes off at *p*, and thence is connected with one pole of the battery; from the other pole it is extended to the distant station, and is there connected with a similar instrument. It will be observed that the circuit is continuous, except between the type-wheel and the metal plate in the ivory. When neither station is at work, the batteries of both are thrown out, and their circuits, retaining in them the magnets of both stations, are closed. For this purpose, there is an instrument at each station, resembling in some respects a pole-changer. If one of the stations wish to transmit by reversing his circuit instruments, the battery is instantly brought into the circuit. Through the agency of the clock-work and weight, and the pendulum, both instruments are vibrating together, and their type-wheels are so adjusted, that when a type of one station is vertical, the A type of the other station is also vertical. Now, suppose one station wishes to transmit to the other, the word *Boston*, for example; he first brings his battery in the circuit, then places a metallic pin in the hole of his index, C, marked for the letter B. When the type-wheel shall have brought round the pin corresponding to the type B on the wheel, its pin will come in contact with the inserted pin of the index, and instantly the circuit is established. The fluid, passing through the coils of the magnets, on each side of the pendulum, will hold it, and also passing through the coils K, will bring down the lever F F, and with it the printer D, which, as heretofore described in figs. 2 and 3, will bring the type with considerable force against the paper. The instant the two pins have come in contact with the moving-pin, it is taken out and put in the hole O, when the same operation is performed, and in like manner for the remaining letters of the word. The pin can be so arranged, as to be thrown out the instant a complete contact is made.

MANIPULATION AND CELERITY OF COMMUNICATING.

The rapidity of this printing process would be as follows: Suppose the pendulum makes two vibrations in a second, that is, it goes from right to left in half a second, and returns in half a second. Since, then, a single letter is brought to the vertical position, ready to be used if needed, at the end of each vibration, it is clear that the two letters are brought to the vertical position every second, or 120 every minute. This is not, however, the actual rate of printing; for, in the word *Boston*, the type-wheel, after B is printed upon the paper, must make so much of a revolution as will bring the letter O to the paper. This will require 12 vibrations of the pendulum; S will require 4; T 1, O 18, and N 22; equal to 57, to which add 6, the time required to print each letter, will make it 63. This, divided by 2, gives 31½ seconds, the time necessary to print 6 letters. If we now take an ordinary sentence, and estimate in the same manner the time required to print it at the distant station, we shall be able to find what number of letters it can print per minute. As an example, viz.:

"There will be a declaration of war in a few days, by this government, against the United States. Orders have just been received to have all the public archives removed to Jalapa, which is 60 miles in the interior, for safekeeping."

Here are 184 letters, and would require 2,266 vibrations, to which add 184, the number of letters, would give 2,450 half seconds, equal to 1,225 seconds, the time required for printing the message; or over 20 minutes; the rate being six and two thirds seconds for each letter.

If, however, a vocabulary is used, with the words numbered, and instead of using the 26 letters of the alphabet on the type-wheel, we substitute the 10 numerals, in their place, we reduce the time required for a revolution of the wheel, and it is clear that this same message may be transmitted in much less time.

The following numbers represent the words of the same message, in the numbered vocabulary: 48687, 54717, 4165, 1, 12185, 34162, 54078, 25393, 1, 18952, 11934, 6177, 48766, 21950, 1106, 48652, 51779, 46532, 34475, 22991, 28536, 4321, 40254, 49085, 22991, 1391, 48652, 39087, 3845, 41278, 49085, 28536, 54536, 28668, 45008, 31634, 25393, 48652, 27326, 19865, 42813, 28592. Here are 42 numbers and 196 figures. To 196 add 42, the spaces required, and we have 238 impressions to make, to write the sentence thus represented. By calculation, we find there is required, in order to bring each numeral and space in its proper succession to the vertical position, 1627 vibrations of the pendulum, which, at the rate of two to the second, gives the time required to transmit the message at 812 seconds, or nearly 13 minutes, being at the rate of $18\frac{1}{3}$ letters per minute.

If, however, the vibrations of the pendulum are increased at the rate of 4 in a second, then the time required for the transmission of the message would be almost 7 minutes, and at the rate of $36\frac{2}{3}$ letters per minute. If it be increased to 6 vibrations per second, then the time would be $4\frac{1}{2}$ minutes, and at the rate of 55 impressions per minute.

ARRANGEMENT OF THE ALPHABET.

The modes of using the English letter for recording telegraphic messages are various. Among them are those using 26 types, one for each of the letters of the alphabet, and 13 extended wires, from station to station, with more or less battery. These types are arranged in a row, directly over the paper which receives the impression, and consequently require a strip of paper some 4 or 5 inches broad. Each type is furnish with an electro-magnet and lever, answering as a hammer to bring down the types upon the paper. As the types are arranged in a straight line, they present the order given on the next page. In this example, we have the style of this kind of printing. By spelling the letters on the first line, then on the second, and so on, the words "Printing Telegraph" will be made out. Those letters which follow each other in the word, and also follow each other in the alphabet, are placed upon the same line, but when a letter occurs preceding the last, a new line must be taken, otherwise the word cannot be read. It will appear that in this mode, sometimes two, or three or four letters, may be printed at one and the same instant, when they succeed each other in alphabetical order. This plan is extremely rapid for *one instrument*, but extremely slow for *thirteen wires*.

A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z
-				-		-	-	-			-		-		P		R		-						
-				-		-	-	I			-		N		-		-		T						
-				-		-	-	I			-		N		-		-		-						
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A							-								P										
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Let it be assumed, in order to make equal comparison throughout, that the number of successive motions of the type-lever, in these various plans about to be given, are 4 to a second. But as this instrument may make, with two or more of its levers, two or more impressions per minute, let it be 8 instead of 4 per second. It will then be capable of transmitting 480 letters per minute. With all this there are many disadvantages, which will be developed as we proceed.

Under the same class there is another plan, using the 26 types upon the ends of as many levers, each lever employing the electro-magnet, and the line consisting of 13 wires. In this arrangement the types are made to strike in any succession required by the message, at the *same point* upon the paper, *falling back* and resuming their first position, after having printed their letter, in order to allow the next type to occupy the same point previously occupied by the other. The printing of this plan will appear on paper as ordinary printing. Thus, PRINTING TELEGRAPH. If we suppose that 4 hammers, carrying type, can strike the *same point* in a second, and each resume its original position in succession, thus passing each other without collision, it may print at the rate of 240 letters per minute. The instrument would be a complicated one, and subject to derangement.