F. I. POPE & T. A. EDISON.

PRINTING TELEGRAPH APPARATUS.

No. 102,320. Patented Apr, 26, 1870.

Fig: 1.

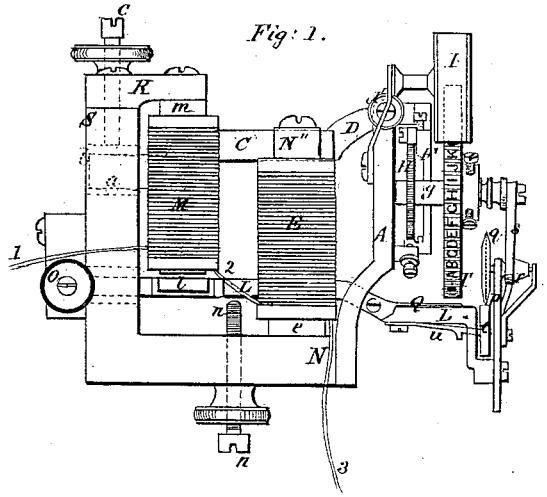


Fig 2

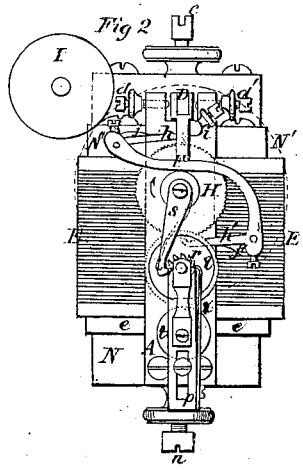


Fig 5

Fig 3.

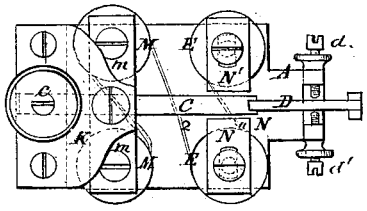


Fig: 4.

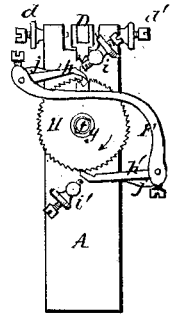
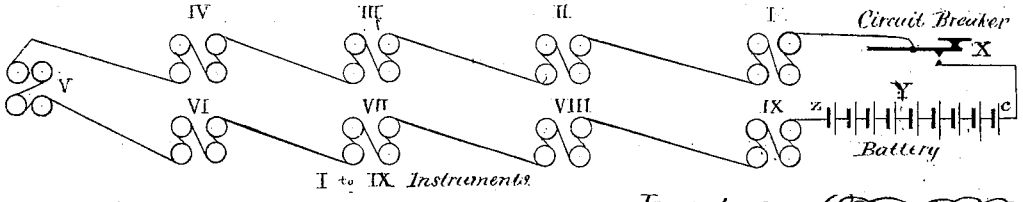


Fig 6



Witnesses:

M. M. Livingston

G. B. Beecher

Inventors:

Frank L. Pope

Thomas A. Edison

UNITED STATES PATENT OFFICE.

FRANK L. POPE, OF ELIZABETH, NEW JERSEY, AND THOMAS A. EDISON, OF NEW YORK, N. Y.

IMPROVEMENT IN PRINTING-TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **102,320**, dated April 26, 1870.

To all whom it may concern:

Be it known that we, FRANK L. POPE, of Elizabeth, in the county of Union and State of New Jersey, and THOMAS A. EDISON, of the city, county, and State of New York, have invented certain new and useful Improvements in Printing-Telegraphs; and we hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, which form part of this specification.

The nature of this invention consists in so arranging the parts of a telegraphic printing apparatus that the same is not only capable of receiving and recording communications in automatically-printed characters at a much greater speed than has been found practicable by the instruments in common use, but the same result is accomplished by the use of one wire without local batteries, which has heretofore required the use of two or more wires or a local battery, or both, in connection with each instrument.

In the accompanying drawings, Figure 1 is a side elevation of the receiving apparatus. Fig. 2 is an end elevation of the same, the type-wheel being removed. Fig. 3 is a plan view of a portion of said apparatus. Fig. 4 is a detached view, showing the details of the escapement in said apparatus. Fig. 5 is a plan view of the slotted presser; and Fig. 6 is a skeleton diagram, showing the arrangement of a number of instruments located at different stations and placed in the same electrical circuit operated simultaneously in unison by a battery placed at one point in the circuit.

Similar letters refer to like parts in the different figures.

E, Figs. 1, 2, and 3, designates a perpendicular electro-magnet composed of two cores of soft iron united below in the ordinary manner by a cross-bar, *e*, also of soft iron. The north pole of an angular-bent permanent magnet, N S, is screwed to the cross-bar *e*, to which it communicates north polarity beyond the point of contact, and also to both the cores and poles of the electro-magnet E. The soft-iron tongue C is supported upon a pivot, *a*, in a slot, *b*, in the south end S of the permanent magnet N S, being secured in position by a screw, *c*, or otherwise, from which it receives south polarity. The tongue C is so placed that it may vibrate in a lateral direction between the north poles N′ and N″ of the electro-magnet E. It will therefore be seen that the north polarized ends N′ and N″ will each exert an equal attraction upon the south polarized tongue C when the same is equidistant from each, and that the same will be attracted and firmly held by either N′ or N″ when placed in close proximity or contact with one or the other. An arm, D, projects from the end of the tongue C, passing between screw-stops *d* and *d′*, by means of which screw-stops its lateral vibration is controlled and limited. The arm D is constructed of brass or other non-magnetic metal, in order to prevent the inductive magnetic action from extending beyond the poles N′ N″ of the electro-magnet E.

The screw-stops *d* and *d′* are supported by a brass standard, A. Upon this standard is secured a shaft, *f*, Fig. 4, upon which is arranged a sleeve, *g*, carrying a ratchet-wheel, H, and a type-wheel, T, upon the circumference of which type-wheel are engraved such letters, numerals, or other characters as may be required.

The characters on the type wheel are supplied with ink by means of a fountain ink-roller, I, secured to a movable arm attached to the standard A.

The vibrating arm D carries a curved bar, F, to the extremities of which are pivoted pawls *h* and *h′*, which act respectively at opposite points upon the circumference of the ratchet-wheel H, as shown in Figs. 2 and 4. The movement of said pawls, and consequently that of the wheel H, is limited by the adjustable screw-stops *i i′* by the end of the said pawls falling in the spaces of the wheel H, and its upper beveled edge subsequently coming in contact with the stop *i* or *i′*, which may be adjusted so as to allow of any desired amount of movement of the said pawls *h* and *h′*, and the pawls are kept in contact with the teeth of the ratchet-wheel by springs *j j′*; but we will here remark that the pawls *h* and *h′* may be made of spring-steel and so arranged as to automatically bear in the interdental spaces of the wheel I, in which case the springs *j j′* may of course be dispensed with.

By means of the above-described arrange-

ment the vibrations of the arm D may be caused to communicate through the pawls a rapid intermittent rotary motion to the ratchet-wheel H, sleeve *g*, and type-wheel T in the direction shown by the arrow marked thereon.

The screw-stops *d d'* are so adjusted in reference to the stops *i i'* that when the tongue C is actuated by a powerful current tending to bend or otherwise disarrange the pawls *h h'*, ratchet-wheel H, and their appurtenances the slightest deflection of the arm D, after the pawls *h* or *h'* have come in contact with the stops *i* or *i'*, will bring said arm D against one of the stops *d* or *d'*, thereby relieving said pawls, ratchet-wheel, &c., from undue strain or pressure.

The manner in which the vibration of the tongue C and arm D is made to revolve the ratchet wheel H will be understood more clearly by reference to Fig. 4. Suppose the arm *d* to be moved from its position, as shown, toward the left, carrying with it the bar F and the pawls *h h'*. The pawl *h'* will engage with a tooth of the wheel H and carry it forward in the direction of the arrow until its movement is arrested by the pawl coming in contact with the stop *i'*. At the same time the pawl *h* will slip over one tooth of the wheel without obstruction. When the arm D, bar F, and pawls *h h'* are moved from left to right, the operation of the respective pawls is reversed, although the wheel H continues to be moved in the same direction as before. Each vibration of the arm D, either to the left or to the right, therefore advances the ratchet-wheel H the distance of one tooth.

The apparatus for taking the impression after the type-wheel has been brought to the desired position may be described as follows:

M, Figs. 1 and 3, is an electro-magnet of the usual form, its poles being united by the cross-bar *m*, which is secured to a lug, K. This lug is firmly secured to the south end S of the permanent magnet N S. This lug is made of brass, or any other non-magnetic metal, for the purpose of cutting off the magnetic induction which would otherwise take place between the permanent magnet N S and the soft-iron cores of the electro-magnet M. The armature *l* of said electro-magnet is attached to a lever, L, one end of which is pivoted at O, and which passes through a slot in the standard A. The lever L is capable of a vertical movement upon O as its fulcrum, the extent of such movement being limited in one direction by the face of the type-wheel T and in the other by the adjustable screw-stop *n*.

To the extremity of the lever L is attached a slotted adjustable standard, *p*, carrying a wheel, *q*, with a sharp serrated edge. Upon the same shaft with said wheel *q* is a ratchet-wheel, *r*, actuated by a hook-shaped pawl, *s*, attached to the extremity of the type-wheel shaft *f*. A roller, *t*, of hard rubber or other suitable material, is mounted upon a spring-axle, *u*, in such a manner as to be pressed firmly against the serrated edge of the wheel *q*.

A ribbon of paper (not shown in the drawings) may be made to pass horizontally across the lever L and beneath the slotted presser Q, (shown in plan in Fig. 5,) the edge of said paper passing between the serrated wheel *q* and the roller *t* in such a manner that the rotation of the wheel *q* will cause the ribbon to be drawn forward from right to left.

The slotted presser Q serves to keep the paper from coming in contact with any portion of the type-wheel except the letter of which the impression is desired.

The two electro-magnets E and M are placed in the same electrical circuit, the connections being arranged as shown in Fig. 3.

The manner in which the above-described apparatus is actuated by means of electric currents is as follows: If a momentary current of electricity be sent from the positive pole of a battery through the electro-magnets E and M, its tendency would be to magnetize the pole N′ of the electro-magnet E north and the pole N″ south; but as both poles were previously north by the inductive influence of the permanent magnet N S, the effect of this current is to strengthen the north magnetism of N′ and to weaken or entirely destroy that of N″. The tongue C is therefore attracted to N′ with double force, and remains on that side after the cessation of the current, being still attracted by the pole N′, whose distance from C is now much less than that of N″. If now a momentary negative current is sent, this effect is reversed. The pole N″ in turn attracts the tongue, and it moves that side, remaining until the polarity of the exciting-current is again changed. Thus, by transmitting through the helices of the electro-magnet E a rapidly-alternating series of positive and negative currents, it will readily be seen that the tongue C, the arm D, and its attachments may be caused to vibrate to and fro with great rapidity, causing a correspondingly rapid revolution of the ratchet-wheel H and type-wheel T. It will be seen, therefore, that the type-wheel L′ may readily be brought to any required position, simply by transmitting the requisite number of alternate positive and negative currents through the electro-magnet E. When the type-wheel T is thus brought to its proper position the impression of the required letter is taken from the wheel as follows:

The electro-magnet M, as heretofore explained, is in the same electrical circuit with E. In operating said electro-magnet advantage is taken of the fact that currents of such short duration as not to sensibly affect an electro-magnet of the ordinary construction will operate perfectly a polarized or combination magnet composed of permanent and electro magnets placed in conjunction, and also that the attractive force of an ordinary electro-magnet is the same whatever may be the polarity of the exciting-current. Therefore a succession of positive and negative currents may be sent through the wire 1 2 3, Figs. 1 and 3, of such short duration as not to affect in any manner

the electro-magnet M, while by the action of the polarized electro-magnet E the type-wheel T may be revolved until the desired letter upon its circumference is brought opposite the impression-lever L. The duration of the final current is then prolonged regardless of its polarity until the electro-magnet M has time to act, when its attraction raises the lever L and brings the paper ribbon in contact with the type upon the wheel T, the same having been previously inked by the fountain-roller I. When the attraction of the electro-magnet M ceases the lever L returns to its original position. At the same time the hooked pawl *s* catches a tooth of the ratchet-wheel *r* and causes it, together with the wheel *q*, to revolve a short distance, thus drawing the paper ribbon forward and leaving a clear space in readiness for the next impression. A click, *x*, prevents the ratchet-wheel *r*, and consequently the wheel *q*, from revolving in the opposite direction.

The downward movement of the lever L may be assisted by a retracting-spring, if necessary.

It will be seen from the above description that this apparatus is actuated entirely by electro-magnetic power derived from the battery at the transmitting-station, without the assistance of local or secondary batteries or of mechanical power derived from any source other than the said battery at the said transmitting-station, and that any required number of such apparatuses may be placed at various points included in the same electric circuit, and operated simultaneously in unison by the action of a single battery placed at the transmitting-station. This will be more clearly understood by reference to Fig. 6, where we have given a skeleton diagram illustrating an arrangement of instruments in connection with a main battery and circuit-breaker, whereby an operator can at one point form a connection with a main battery, so as to complete an electric circuit in such manner that the current of said battery shall pass through as many instruments on a main line unprovided with local batteries as desired, and record simultaneously in printed characters at each instrument the same message. For instance, at a point lettered X there may be located a circuit-breaker of any suitable construction, and at the point lettered Y a main battery of sufficient power, or in lieu thereof a number of small main batteries located at such point or elsewhere in the main circuit that a current may be caused to pass from the main battery or batteries through the electro-magnets of instruments I II III, &c. Hence it will be understood without further explanation that a communication may be printed simultaneously at as many different stations as may be desired without the use of local batteries or of mechanism—such, for instance, as weights or springs—for operating each instrument. In such cases the action of such local batteries or mechanism is simply controlled by the action of the main electrical circuit.

It is obvious that another electro-magnet can be placed in the same circuit for effecting other useful purposes—such as striking a bell to call attention, &c.—which may be actuated by increasing the strength of the electric current which operates the printing mechanism.

It is also obvious that a local battery may be employed to bring into action a magnet not in the same circuit by insulating one of the stops *d d'* upon the standard A and connecting it with the local circuit in such manner that the rapid vibrations of the arm D will not allow it to remain in contact with the stop long enough to permit the local or secondary battery to charge its electro-magnet; but when the vibrations are made to cease by the action of the transmitting-operator, or otherwise, the arm D will remain in contact with the stop *d'* a sufficient time to allow the secondary electro-magnet to become charged.

We do not confine ourselves to the particular form and arrangement of parts shown in the drawing. There are numerous and well-known means of producing the vibratory movement of a lever by the use of alternate positive and negative currents in combination with a permanent and an electro magnet acting upon each other, and of applying the same to the movement of a type-wheel. Neither do we wish to confine ourselves to any particular method of producing or transmitting alternate positive and negative currents for the purpose specified.

We have shown in Fig. 6 the main line passing through both magnets of each instrument, this being the simplest and most convenient way of operating; but it is obvious that two main lines or wires may be employed, one running through one magnet of each instrument and the other through the other magnet of each instrument. In this latter case one line or wire is worked to revolve the type-wheel in proper position and the other to cause the impression.

We are aware that it is not new to construct and operate one or more automatic printing-telegraph instruments in one or more circuits which derive all their motive power from electro-magnets, or to operate such instruments by the use of a single battery placed at some convenient point, in conjunction with mechanical power applied to each instrument separately. We are also aware that automatic printing-telegraph instruments have been operated by means of two or more distinct main circuits, in which case the impression or printing magnet of each instrument is placed in one of the said circuits, and one or more magnets for operating the type-wheel of each instrument is placed in one or more additional main circuits, as shown and described in the patent granted to E. A. Calahan on the 21st of April, 1868.

We believe to be new the arrangement of a number of automatic telegraphic printing in-

struments of any suitable construction connected by a single electric circuit, all the parts of said instruments being actuated exclusively by electrical power derived from one or more main batteries placed in and forming part of such circuit, without the aid of local batteries.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. The combination of a number of automatic printing-telegraph instruments arranged in one main circuit, and operating simultaneously in unison, when the electro-motive power used in operating the same is derived exclusively from one or more main batteries placed in such main circuit without the aid of secondary or local batteries, or of mechanism actuated by springs or otherwise, substantially in the manner and for the purpose set forth.

2. The combination of a polarized magnet with an electro-magnet placed in the same electrical circuit, and operated substantially as described, and for the purpose set forth.

3. The combination of the ratchet-wheel I, bar F, pawls *h h'*, stops *i i'*, and type-wheel T, arranged and operating substantially as and for the purposes herein specified.

4. The combination of an electro-magnet with the ratchet-wheel, bar, pawls, stops, and polarized magnet, substantially as and for the purposes herein specified.

5. The arrangement of the permanent magnet N S, polarized magnet E, electro-magnet M, tongue C, arm D, bar F, pawls *h h'*, stops *i i'*, springs *j j'*, ratchet-wheel H, type-wheel T, and standards A K, all constructed, arranged, and operating substantially as and for the purpose herein specified.

6. The roller *t*, serrated wheel *q*, pawl *s*, ratchet-wheel *r*, click *x*, and standard *p*, in combination with the polarized magnet E and the electro-magnet M, and their appurtenances, for the purpose set forth.

7. The screw-stops *d d'* upon the standard A, in combination with the type-wheel T, substantially as herein specified.

8. The arrangement of the tongue C in the slot *b* of the permanent magnet N S by means of a pivot, *a*, and screw *c*, whereby the inductive magnetic influence of the permanent magnet N S upon the tongue C is greatly increased, substantially as herein set forth.

FRANK L. POPE.
THOMAS A. EDISON.

Witnesses:
M. M. LIVINGSTON,
T. B. BEECHER.