2 Sheets—Sheet 1.

J. E. SMITH.

Telegraphic Repeater.

No. 18,022.

Patented Aug. 18, 1857.

Fig: 4.

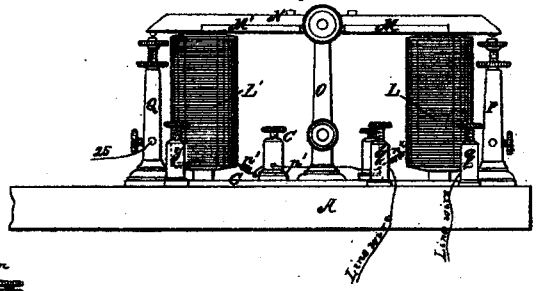


Fig: 2.

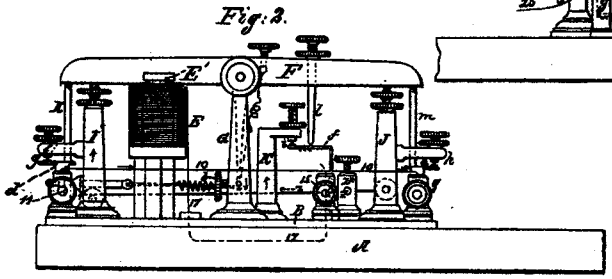


Fig: 6.

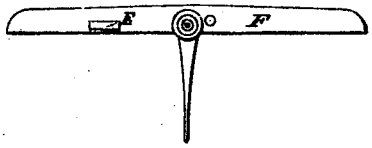


Fig: 1.

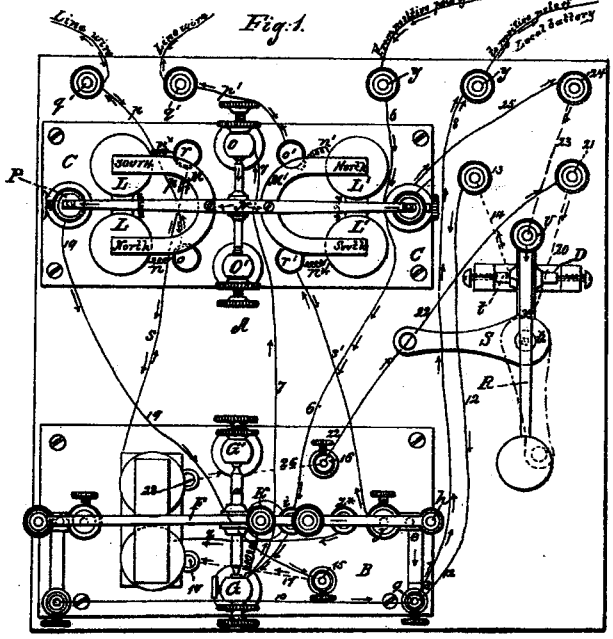
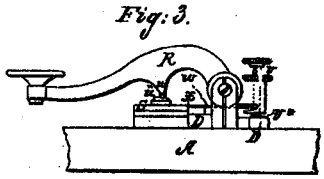


Fig: 3.



2 Sheets—Sheet 2.

J. E. SMITH.

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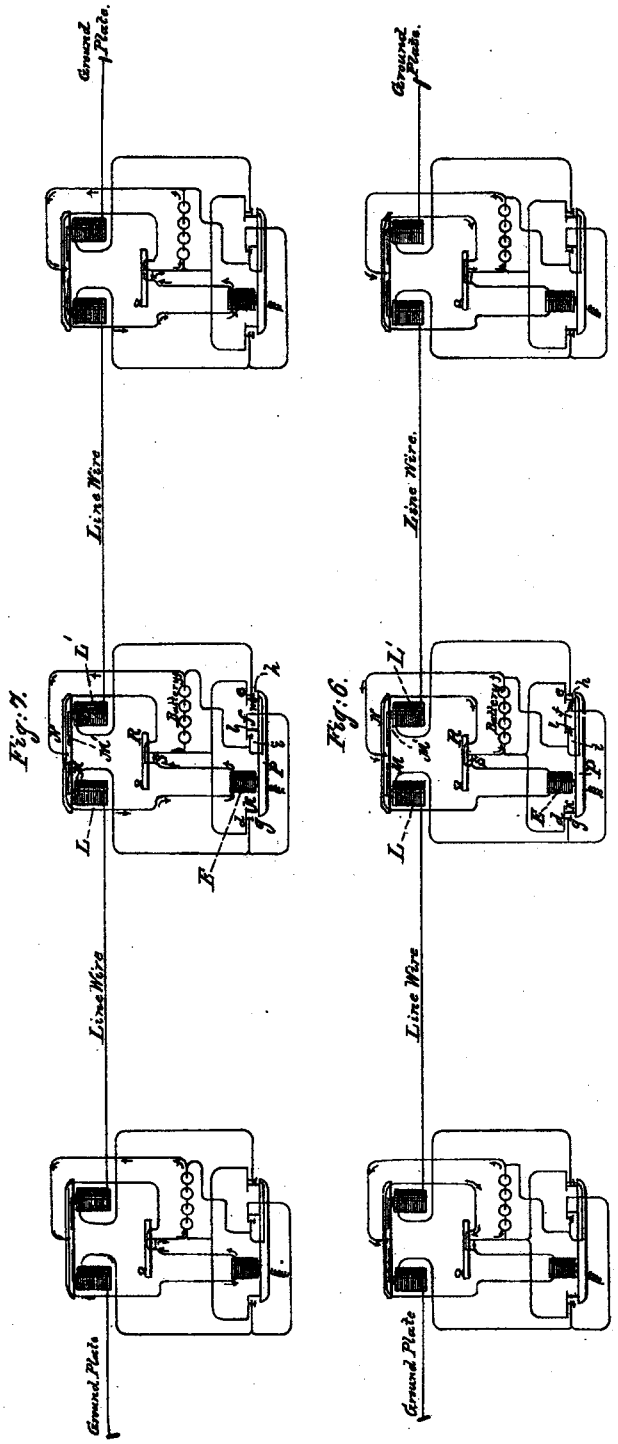

UNITED STATES PATENT OFFICE.

JOHN E. SMITH, OF TROY, NEW YORK.

IMPROVEMENT IN TELEGRAPHIC REPEATERS.

Specification forming part of Letters Patent No. **18,022**, dated August 18, 1857.

To all whom it may concern:

Be it known that I, JOHN E. SMITH, of Troy, in the county of Rensselaer and State of New York, have invented certain new and useful Improvements in the Electro-Magnetic Telegraph; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, forming part of this specification.

This invention relates to certain improvements in Morse's electro-magnetic telegraph which dispense with the use of a main battery continually on the line and enable the telegraph to be worked by local batteries at the several stations, by which means, together with the reversing of the current over the line by every stroke of the key, I hope to overcome much of the difficulty arising from the constant escape of current to the ground, which occurs where large batteries are in constant connection with the line-wire.

The improvements consist in the novel construction of the register, the relay, and the key, and arrangement of their connections, as hereinafter described.

Figure 1 in the drawings is a plan of my improved register, relay, and operating-key, showing their conections with each other and the connections to a local battery and line-wire. The register is shown without the mechanism for feeding the paper, which, being the same as in Morse's telegraph, needs no explanation. Fig. 2 is a side view of the register. Fig. 3 is a side view of the operating-key. Fig. 4 is a side view of the relay-magnet. Fig. 5 is a view of the registering-lever detached. Figs. 6 and 7 are two diagrams, showing different conditions of a line with two terminal and one intermediate stations, exhibiting only the mere elements of the apparatus without any of the mere supporting parts.

Similar letters of reference indicate corresponding parts in the several figures.

A represents the top of a table or any suitable base, of wood, to which the several portions of the apparatus are attached. B is the metal bed-plate of the register, C that of the relay, and D that of the key, all screwed to the table A.

The principal parts of the register shown in Figs. 1 and 2 consist of a stationary electro-magnet, E, and a metal lever, F, hung on an arbor, *a*, central in two posts, G G′, that are secured to the bed-plate B, and carrying the armature E′ of the magnet. The register-lever F is of T form, as shown in the detached view, Fig. 5. Two metal posts, I and J, fitted with adjusting-screws at their upper ends, are erected upon the bed-plate B, but insulated therefrom, under and near the ends of the two straight arms of the lever F, which is drawn into contact with the top of the post I by the attraction of the electro-magnet E acting on the armature E′, and into contact with the post J by a spiral spring, *b*, which connects the perpendicular arm of the lever with the post I. Under the lever are three springs, *d e f*, made of bent pieces of metal, secured to the bed-plate B, but insulated therefrom, said springs tending, by their elasticity, to rise into contact with the points of screws *g h i*, which screw into the arms attached to the posts I, J, and K. The latter post is secured to the bed-plate B without insulation. The lever F has attached to it three perpendicular ivory rods, for the purpose, when the lever is set in operation, of depressing the springs *d e f* out of contact with the screws *g h i*, to reverse the current of electricity through the relay, as will be hereinafter described. A coil of wire, *c*, leads from the lever F to the post G, to make a sure connection between them.

The principal parts of the relay shown in Figs. 1 and 4 consist of two upright stationary electro-magnets, L L′, and a metal lever, N, carrying two permanent magnets, M M′. The lever is fitted with and balanced upon an arbor, *a′*, at the middle of its length, which arbor is centered in two upright metal posts, O O′, erected upon the bed-plate C midway between the two electro-magnets L L′, and the permanent magnets are so arranged upon it that their poles stand over the poles of the electro-magnets, the positive and negative poles being arranged, as indicated in Fig. 2, by the words "north" and "south" marked on them.

Under the ends of the lever N two posts, P Q, are erected upon the bed-plate C, but insulated therefrom. These posts are furnished with adjusting-screws, by which such an adjustment of the lever N is obtained that each permanent magnet may alternately come so much nearer than the other to its respective

electro-magnet as, by its own attraction, to hold the lever in contact with the post P or Q until a passage of electricity through the electro-magnet takes place.

The ends *n n'* of the coils of the electro-magnets L L' are respectively connected by insulated screw-clamps *o o'*, wires *p p'*, and screw-clamps *q q'* with the line-wire. The other ends *n* n*'* are respectively connected by insulated screw-clamps *r r'* and wires *s s'* with the posts I and J of the relay. The post I of the register is connected by a wire, *z*, with a screw-clamp, *z**, which is connected with the spring *f*, said screw-clamp and spring being insulated from the bed-plate B. One end, 17, of the coil of the electro-magnet E of the register is connected with an insulated screw-clamp, 15, from which another wire, 19, runs to the post P of the relay. The other end, 18, is connected with an insulated screw-clamp, 16.

The key consists of a lever, R, exactly like that of Morse, provided with an arbor, *t*, working between centers in standards that are formed with the metal bed-plate D, and having a spring, *w*, applied in the same way as that of Morse's key; but instead of being placed in the main circuit, like Morse's, it is placed in the local circuit, which it breaks in two places—viz., at the point *u* and at the point of the screw *v*. The pins *u* v**, on which the point *u* and screw *v* strike to close the circuit, are insulated from the bed-plate D; but the first-named pin is fitted with a lever, S, which is formed with an eccentric end, which enables it to open or close a circuit through the bed-plate by turning one-quarter of a revolution, as indicated by Fig. 1 by the two positions of the lever represented in black and red outlines, the former position showing it in contact with the bed-plate at *x*, but the latter showing the contact broken. It is scarcely necessary to add that the bottom surface of the lever S requires to be insulated from the bed-plate.

The positive pole of the local battery is connected with a screw-clamp, *y*, secured to the wooden base A, and from this screw-clamp a wire, 6, runs to the post G of the register. From this post G another wire, 7, runs to the post O of the relay. The negative pole of the local battery is connected with a screw-clamp, *y'*, which is connected by a wire, 8, with a screw-clamp, 9, on the bed-plate B of the relay, which latter clamp holds the spring *e*, and with the said spring is insulated from the bed-plate. From the screw-clamp 9 a wire, 10, runs to the screw-clamp, 11 on the bed-plate B, which clamp holds the spring *d*, and with the said spring is insulated from the bed-plate. Another wire, 12, runs from the clamp 9 to a clamp, 13, on the base A, and from the said clamp 13 a wire, 14, runs below the base A to the bed-plate D of the key A. Wire 20 runs from the pin *u** of the key to a screw-clamp, 21, on the base A, from whence a wire, 22, runs to the insulated screw-clamp 16 on the base-plate of the register, and another wire, 23, runs from the pin *v** of the key to a screw-clamp, 24, on the base A, from whence a wire, 25, runs to the post Q of the relay.

Having now described fully the construction and arrangement of the several parts of the telegraph, I will proceed to explain its operation.

When all parts are properly arranged and adjusted, the lever S stands in the position shown in black outline in Fig. 1 until the operation commences. The current is then passing through the magnet L of the relay and the lever N is in contact with post P and separated from post Q, the lever F of the register is in contact with post I and separated from post J, and the ivory rod *k* depresses the spring *d*, and the ivory rods *l* and *m* allow the springs *f* and *e* to close against the screws *i* and *h*. The current which holds the lever F thus takes the course indicated by black arrows in Fig. 1, passing from the positive pole of the battery to clamp *y*, over wire 6 to post G of the register; thence over wire 7 to post O of the relay, through arbor *a'* and lever N, down post P on wire 19, through electro-magnet E to clamp 16; thence over wires 22 and 20 to the pin *u** of the key, through the point of contact *x* of the lever S to the bed-plate of the key; thence by wires 14, 12, and 8 to battery, making a complete circuit. In this position of the lever S no electricity passes over the line; but it takes the shorter route above specified, which is the only short route, owing to the insulations of clamps and posts before described and the position of the lever F and springs *d e f*. On moving the lever S to the position shown in red outline in Fig. 1, out of contact with the bed-plate D, to commence telegraphing, this short or local circuit is broken, which allows the spring *b* of the register to separate the lever F from the post I and bring it in contact with post J. The rise of the rod *k* with the lever allows the spring *d* to close on the screw *g*, and the descent of the rods *l* and *m* separate the springs *f* and *e* from the screws *i* and *h*; but owing to a little play being allowed between the ivory rods and the springs the local circuit just broken traverses the line in an interval of time that elapses between the starting of the lever from the post I and the movement of the springs, taking the course from the battery in the direction of the dotted arrows—viz., along the wire 6 to the post G, down which it passes, through the bed-plate, and up the post K, (see Fig. 2,) down the spring *f* to the clamp *z**, from whence it takes the course indicated by dotted arrows in Fig. 1—viz., through wire *z* to post I; thence over wire S, electro-magnet L, and wire *p*, over the line-wire and wire *p'* to the electro-magnet L', over wire *s'* to the post J of the register; from thence through screw *h*, down spring *e* to clamp 9, and over wire 8 to the battery. The passage of electricity through the electro-magnet L makes its polarity the same as that of the permanent magnet M stationed over it, and consequently causes them to repel each

other, and passing through the electro-magnet L′ makes its polarity the reverse of M′ and causes them to attract each other, by which means the lever N is separated from post P and brought into contact with the post Q, again shutting the battery from the line on another short circuit. The current now flows, as at first described, and indicated by black arrows, from *y* along wire 6 to post G, along wire 7 to post O, and along arbor *a′* to the lever N of relay; but from this point it takes the direction indicated by red arrows—viz., along lever N to post Q, down post Q, over wires 25 and 23 to the insulated pin *v**, below the screw *v* of the key-lever, through the screw *v*, key-lever R, and arbor *t* to the bed-plate, from which it passes over wires 14, 12, and 8 to the battery, as indicated by the black arrows before referred to.

By depressing the long arm of key-lever R the local circuit is closed at *u u**, but broken at *v v**, which again throws the current over the line, but in a reverse direction to that previously described, and indicated by dotted arrows. The current now passes, as indicated by blue arrows, over wire 6 to the post G, thence along lever F to the post J, down the said post, along the wire *s′* to and through the electro-magnet L′ of relay, making its polarity the same as that of the permanent magnet M′, and causing it to repel it. From L′ it passes over the wire *p′* to and over the line-wire, and from thence over the wire *p* and through the electro-magnet L, whose polarity is thus made the reverse of that of the permanent magnet M, by which means it is made to attract it. The repulsion of the magnets M′ and L′ and attraction of M L cause the lever N to leave the post Q and touch P. From the magnet M the current passes, as indicated by the blue arrows, along the wire *s* to the post I of the register, up the said post to the screw *g*, down the spring *d* to the clamp 11, and thence along the wires 10 and 8 to the battery. The last-described movement of the relay-lever N again cuts the battery from the line and sends the current through the register-magnet E, which then attracts the lever F and brings it in contact with the post I and separates it from the post J, thereby causing the rod *k* to descend and separate the spring *d* from the screw *g*, and causing the rods *l* and *m* to rise and allow the springs *f* and *e* to come in contact with the screws *i* and *h*, in which condition all parts are again at rest until the key is allowed to rise, the battery being shut from the line, the same as before the key was opened at the point *x*, by bringing the lever S to the position shown in red outline. When the long arm of the key-lever is allowed to rise the local circuit is again broken, the same action is produced as by the opening of the key in the point *x* by the lever S, as at first described.

It will be understood by the foregoing description that the current passes over the line only when the key or relay-lever breaks the local circuit, and that the movements of the levers of the relay and register immediately follow that of the key. The current of electricity, when thrown on the line-wire, passes through any number of instruments connected with it, and by passing both ways over the line, as described, every time the key of any instrument is operated is caused to pass through every other instrument, first in the course indicated by dotted arrows, and afterward in the direction indicated by blue arrows, and by that means to produce similar movements in all the instruments to that produced in the one whose key is operated, and bring all the local batteries into connection with the main line. It will be understood, however, that the local battery of each instrument furnishes motive power for the whole line-wire.

Fig. 6 represents the line in the condition after opening the key S or after removing the finger from the knob of the key R, the intermediate instrument being that from which the communication is supposed to be in course of transmission and the keys S of the other instruments being closed. Fig. 6 represents the current having passed over the line-wire and the batteries being shut from the line. Fig. 7 represents the line in the condition when the knob of the key R is depressed, the current having been reversed over the line and the battery again shut off from the line. The former figure represents that branch of the local circuit through the register-magnet open at *e h* and *f i* and the other branch closed, and the latter figure represents the reverse condition. The direction of the current is indicated in all the instruments in both figures by arrows.

I do not claim the opening and closing of the local circuit by magnetism produced by the opening and closing of the main circuit; but

I claim—

1. The connection of a battery at each station with the line-wire and with two local cross-connections in such manner that by means of the key and relay-lever the cross-connection through the register-magnet and the other cross-connection are alternately broken and the battery thrown upon the main line and its current caused to operate the relays on the line-wire like a main current till shut from the line by the relay-lever, as herein described, whereby each battery is made to perform the duty of an ordinary local battery while not wanted on the line-wire and to perform the duty of a main battery while not wanted as a local.

2. The key placed in the local circuit, and constructed, as described, to open and close the said circuit in two branches, to give two directions to the current over the line-wire, substantially as and for the purpose set forth.

JOHN E. SMITH.

Witnesses:
MOSES WARREN,
H. E. LASEELE.