2 Sheets—Sheet 1.

M. G. FARMER.

Duplex Telegraph.

No. 21,329.

Patented Aug. 31, 1858.

Fig. 3

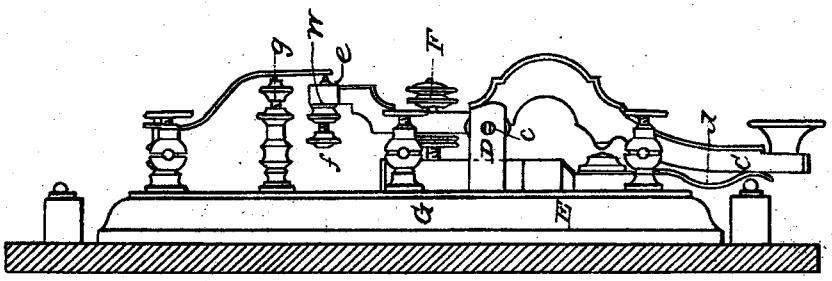


Fig. 2

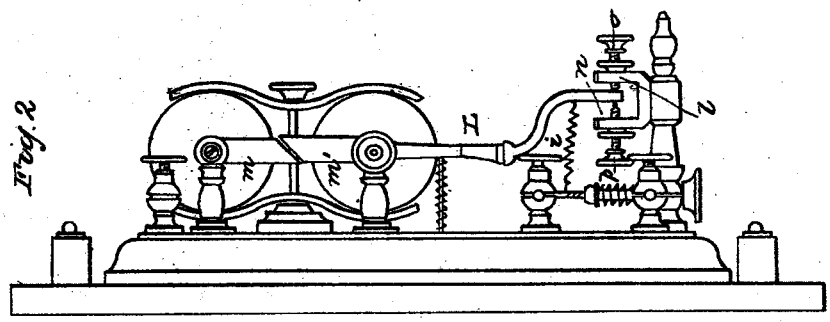
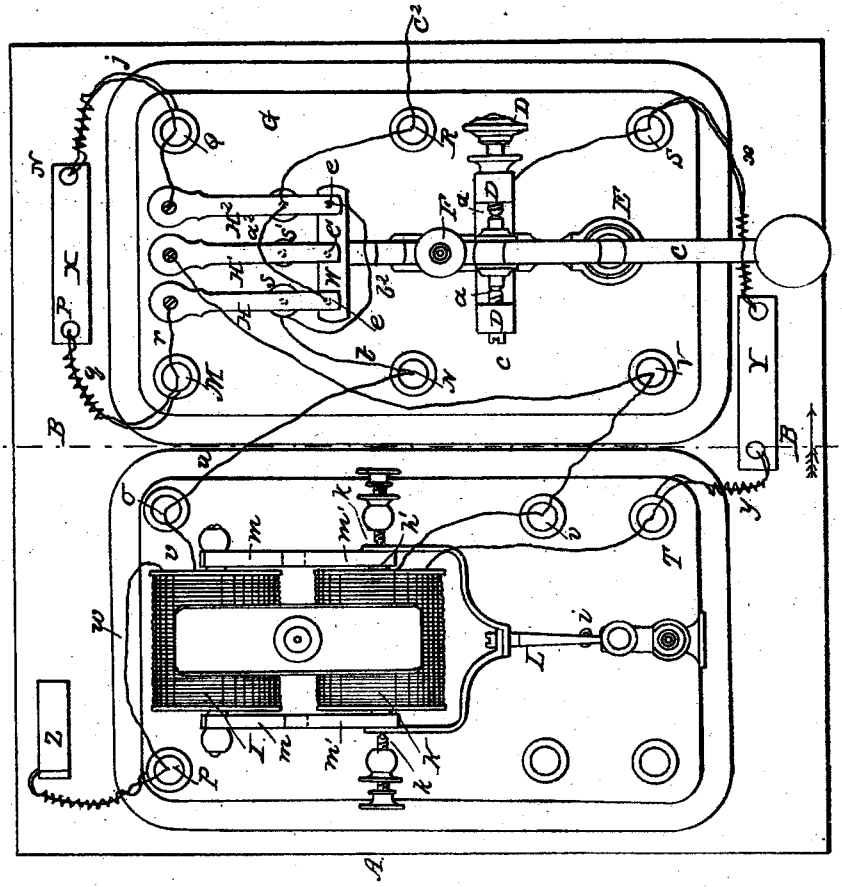


Fig. 1

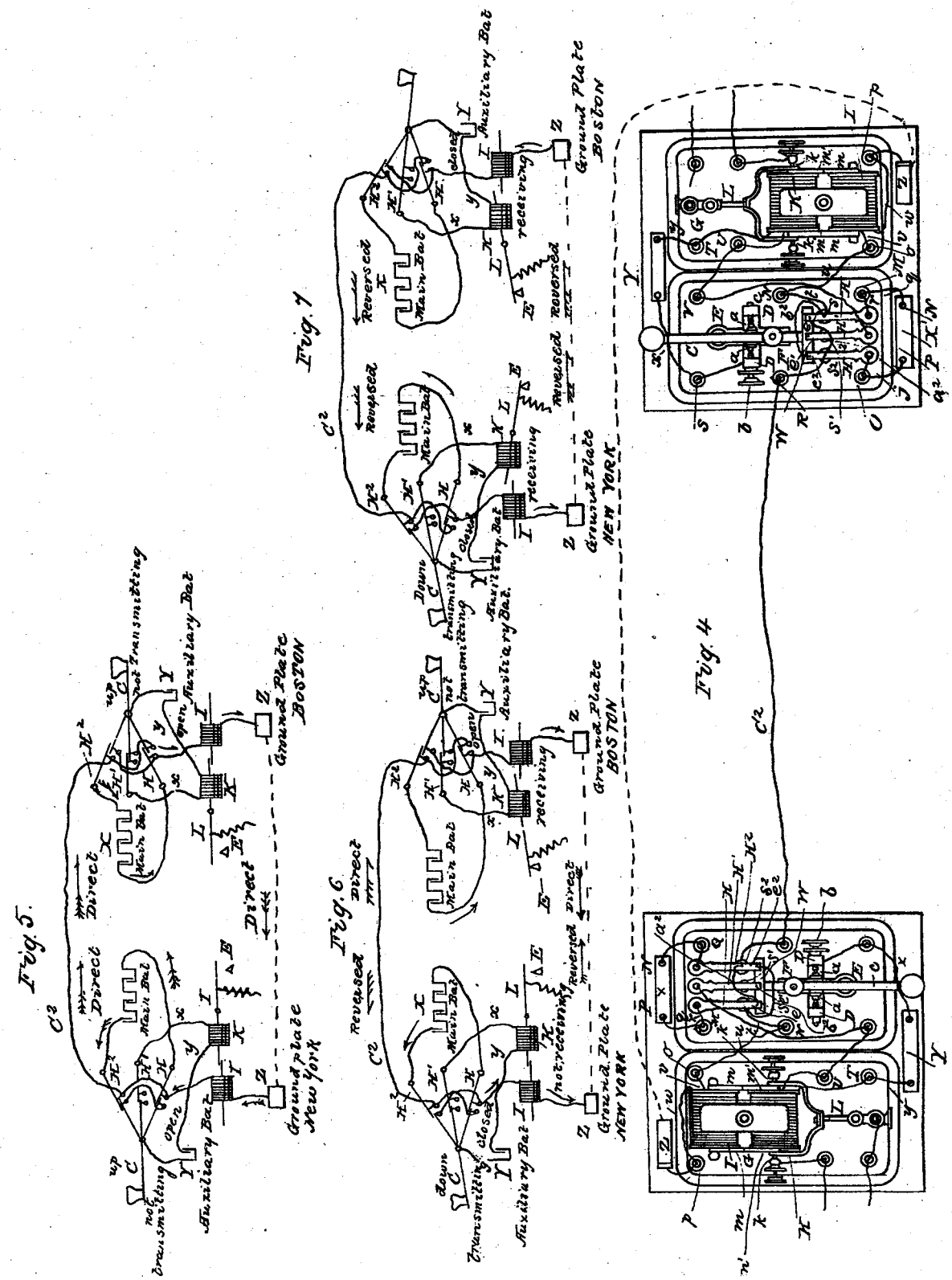


2 Sheets—Sheet 2.

M. G. FARMER.

Duplex Telegraph.

No. 21,329. Patented Aug. 31, 1858.



UNITED STATES PATENT OFFICE.

MOSES G. FARMER, OF SALEM, MASSACHUSETTS.

IMPROVED METHOD OF SENDING AND RECEIVING MESSAGES SIMULTANEOUSLY OVER THE SAME TELEGRAPHIC WIRE.

Specification forming part of Letters Patent No. **21,329**, dated August 31, 1858.

To all whom it may concern:

Be it known that I, MOSES G. FARMER, of Salem, in the county of Essex and State of Massachusetts, have invented an Improved Relay-Magnet and Key for Magnetic Telegraphs, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings, making part of this specification, in which—

Figure 1 is a plan of my instrument; Fig. 2, an elevation of the same, seen from the point A of Fig. 1; Fig. 3, a section upon the line B B of Fig. 1, looking in the direction of the arrow. Fig. 4 represents two instruments in working order at opposite ends of a line; Figs. 5, 6, and 7, diagrams that will be referred to hereinafter.

My invention has for its object to send and receive messages simultaneously over the same wire and upon one instrument; and this I accomplish by the employment of an accessory magnet and an accessory battery to each instrument, in combination with the main batteries and main magnets, and with a means of reversing the direction of the current of each of the main batteries, as will be hereinafter more particularly described. My apparatus consists, essentially, of two parts—the key or transmitting apparatus and the relay or reversing apparatus. The transmitting apparatus will first be described.

The key C (seen in plan in Figs. 1 and 4 and in elevation in Fig. 3) is pivoted at *a* to standards D, and is regulated in position horizontally by screws *b* and *c*. It is raised from its anvil E by the spring *d*, its motion in this direction being regulated by the adjusting screw and nuts F. At its rear end the key carries three platina points, *e e' e²*, (seen dotted in Fig. 1,) beneath the springs H H' H². One of these points is seen in elevation at *e*, Fig. 3, their distance from the springs being adjusted by thumb-screws *f*. The center point, *e'*, is in communication with the key C. The outside points, *e e²*, are insulated. The key and the other details of the instrument are insulated by the wooden foundation G, except so far as they are connected with the batteries and with each other by wires, as will be hereinafter more fully described.

H H' H² are contact-springs which rest upon the anvils *s s' s²*, Fig. 3, the height of which is adjusted by screws *g*. The outside contact-springs are for the purpose of reversing the poles of the main battery or the direction of the main currents. The middle spring, H', is for the purpose of opening or closing what I term the "accessory circuit." The key and the springs are so adjusted as to close one circuit or make one contact precisely at or before the time of breaking or opening another circuit or contact, and this is effected by so adjusting the springs with reference to the key that when the key is depressed it shall make contact with the springs at the very moment of beginning to lift them from their stops or anvils.

The relay-magnet is seen in plan in Figs. 1 and 4, and in elevation in Fig. 2.

I is the main magnet; K, the accessory magnet. The two are precisely similar, and each consists of a spool of fine insulated wire, inside of which are the cores or magnets, which consist of a round bar of iron armed at each end with a rectangular bar of soft iron, *m m'*, which may be called the "armatures." The face of the outer end of each armature is inclined at an angle of nearly forty-five degrees, as seen in Fig. 2, and the two are so arranged that when in contact they seem to form rectangular bars across the poles of the magnets. The armatures *m* of the main magnet are stationary; but the armatures *m'* of the accessory magnet, together with its arm L, are allowed to vibrate a short distance under circumstances which will be presently explained. The armatures *m m'* are separated from each other and the arm L drawn down by the spring *i*. When so drawn down the arm rests upon the platina point *n*, Fig. 2, and the local circuit is closed, the register (not shown upon the drawings) being thereby thrown into action. When the armature *m'* is drawn down upon *m* the arm L is carried up against the ivory point *l*, the points *n* and *l* being adjusted by the screws *o* and *p*, and the armatures *m'* and arm L pivoting with the bar *h'* upon the centers *k*.

From the above description it is evident that when from any cause the armatures *m m'* are attracted to each other the arm L will be raised and the register of that instrument will be thrown out of action; and when from any cause

the armatures are separated, as in Fig. 2, the arm L falls and the register is brought into action. If either one of the magnets be charged, or if they are both charged so that their armatures *m m'* indicate opposite polarities, the armatures are drawn together; but when both magnets are charged so that their armatures possess similar polarities, then the armatures repel each other and the register is set in action. The magnet I is included in the main telegraphic circuit and the accessory magnet in the circuit of the accessory battery, as will now be more fully explained.

When the instrument is not in operation, as in Fig. 5, the main circuit is closed, the positive current passing by the wire *q* to the screw-cup M; thence by the wire *r* to the spring H; thence to its anvil *s*, and by the wire *t* to the screw-cup N; thence by wire *u* to screw-cup O, from which, by the wire *v*, it passes to the main magnet I; thence by wire *w* to screw-cup P and ground-plate Z. From the corresponding ground-plate at the other station it passes through this machine in a direction the reverse of that just traced and enters the main battery at the negative pole. From the positive end of this battery it passes by the wire *j* to the screw-cup Q; thence to the spring H^2 and to its anvil S^2; thence by the screw-cup R over the line-wire C^2 to the instrument at the first station, which it re-enters by its screw-cup R, and by way of the spring H^2 and cup Q enters the negative pole of the main battery. The main magnets of both instruments are thus charged, and each register is held out of action by the elevation of the arm L. When the instruments are thus at rest the circuit of the accessory battery Y is broken, proceeding on the one hand by the wire *x* and screw-cup S to the key C, and on the other by the wire *y*, screw-cup T, through the magnet K; thence by screw-cups U and V to the contact-spring H'. Here the circuit is broken, the spring H' not being in contact with the key C, and consequently the magnet K remains uncharged and inactive. Thus far the currents of the two main batteries have acted in unison, their poles being reversed with respect to their machines.

It now remains to be seen what will be the consequence of a depression of the key of either one of the instruments. Whenever the key is thus depressed, as in Fig. 6, the contact of the springs is changed from their anvils to the points *e e' e^2* in the ivory bar W upon the end of the key. The current of the main battery of this instrument over the line-wire C^2 is now reversed, as will be seen by tracing out the connections. Starting from the positive end of the battery X, it proceeds by cup M, spring H, point *e*, and wire a^2 to anvil s^2; thence through screw-cup R over the line-wire in a direction contrary to that which it took before the key was depressed. Entering the other instrument, it proceeds through the course already marked out for this current, but in a reversed direction, and re-enters the first instrument by its ground-plate Z; thence by the magnet I and screw-cups O and N to anvil *s;* thence by wire b^2 to the insulated point e^2 on the bar W; thence by spring H^2 and screw-cup Q to the negative pole of the battery. No change having taken place in the direction of the current from the main battery of the other instrument, the two currents oppose each other, and their effect upon the main magnets of each instrument is neutralized, and these magnets are consequently both thrown out of action. Other and differing effects are also produced upon the two instruments. At that station where the key is not depressed, the main magnet ceasing to act, the armatures *m m'* are no longer attracted to each other, and the arm L drops, thus setting the register of this machine in action, as before explained, and this instrument receives the message sent. The main magnet of the transmitting-instrument is equally thrown out of action by the depression of its key; and it remains to show in what manner its registering apparatus is kept quiet while the one at the other end of the line is in action. As the key is depressed the point *e'* is brought in contact with the spring H', by which the circuit of the accessory battery is closed and the magnet K within this circuit is charged. By this means the armature *m'* is magnetized and is attracted toward the armature *m*, by which means the arm L is retained elevated, and the register of this instrument is not called into action on the depression of its key. The same state of things, however, does not exist upon the other instrument, as its accessory battery is not brought into action upon its magnet K.

It now remains to be seen what will be the result of a simultaneous depression of the keys upon both instruments, as in Fig. 7. By the depression of the first key the currents of the main batteries were caused to move in opposite directions and neutralize each other and the accessory battery and accessory magnet of the first instrument were brought into action, whereby the register of this instrument is still kept from acting. If, now, the key of the other instrument be depressed, the direction of the current of the main battery of this instrument is also reversed, and the united currents from the main batteries of the two instruments will proceed together in a direction contrary to that which they took before either key was depressed.

It should be mentioned here that the strength of each accessory battery is such that its effect upon its magnet K shall be equal, or very nearly so, to the effect produced upon the magnet I by the united currents of the two main batteries. The accessory batteries are so arranged with respect to their magnets K that the armatures *m'* shall indicate similar polarities with the armatures *m* of the magnets I when the currents of the two main batteries are reversed by the depression of the keys of both instruments. A similar state of things now exists on each instrument. The armatures

m m', being similarly magnetized, repel each other, the levers L drop, and both registers are brought into action, and thus a message may be simultaneously sent and received over a single wire by means of the instruments described.

Figs. 5, 6, and 7 are diagrams which illustrate the course of the currents when the instruments are at rest or in operation. The right-hand portion of each of these diagrams, which may denote the instrument in Boston, corresponds to the left-hand instrument in Fig. 4, and the left-hand portion of the diagrams, which may denote the instrument in New York, corresponds to the right-hand in Fig. 4. In Fig. 5 neither instrument is writing. The current from the positive end of the New York battery passes by the spring H^2 and line-wire C^2 to the instrument in Boston, and by the spring H^2 of this instrument to the negative end of its battery. Leaving the positive end of this battery, it passes by the spring H to the magnet I; thence to the ground-plate Z, and by the ground to the corresponding plate of the New York instrument; thence by the spring H to the negative end of the battery from which it first started. In Fig. 6 the New York key C is depressed, and the current from its battery then takes the following course: Starting from the positive end, as before, it passes by spring H^2 to the key C; thence by the wire b^2 of Fig. 4 and the anvil of spring H to the magnet I, the auxiliary magnet K of this instrument being brought into operation, as before explained, to hold the lever L up from its anvil. From the magnet I and ground-plate it passes to the instrument at Boston, and from its magnet I it passes by spring H to the positive end of this battery; thence from the negative end of this battery, by the spring H^2 and line-wire C^2, back to the New York instrument, entering by the anvil of the spring H^2; thence by the key C and spring H back to the negative end of the battery. The two currents, moving in opposite directions, neutralize each other, as before explained, and the arm L of the Boston instrument sets the register-battery of this instrument in operation. In Fig. 7 the keys of both the New York and Boston instruments are represented as depressed, the currents of both batteries taking the following course: Starting from the positive end of the New York battery, the current passes by spring H^2, key C, and anvil of spring H to magnet I; thence by ground-plate to Boston, entering the magnet I; thence by anvil of H, key C, and spring H^2 to the negative end of the battery; thence from the positive end of this battery to spring H, key C, and wire to the anvil of H^2; thence by main-line wire C^2 back to New York, and by the anvil of H^2 and wire to key C, and by spring H and wire back to the negative end of the battery.

It is evident that a branch of the main battery may be used as a substitute for an independent accessory battery without departing from the principle of my invention.

Thus far I have spoken of the employment of galvanic batteries as a means of generating the electric current. Any other suitable means of generating this current may be employed; but this forms no part of my present invention and need not be further discussed.

What I claim as my invention, and desire to secure by Letters Patent, is—

The employment of an accessory magnet and an accessory battery to each instrument, in combination with the main batteries and main magnets, and with a means of reversing the direction of the current of each of the main batteries, in the manner substantially as herein set forth.

MOSES G. FARMER.

Witnesses:

SAM. COOPER,

THOS. R. ROACH.