T. A. EDISON.

DUPLEX TELEGRAPH.

No. 480,567. Patented Aug. 9, 1892.

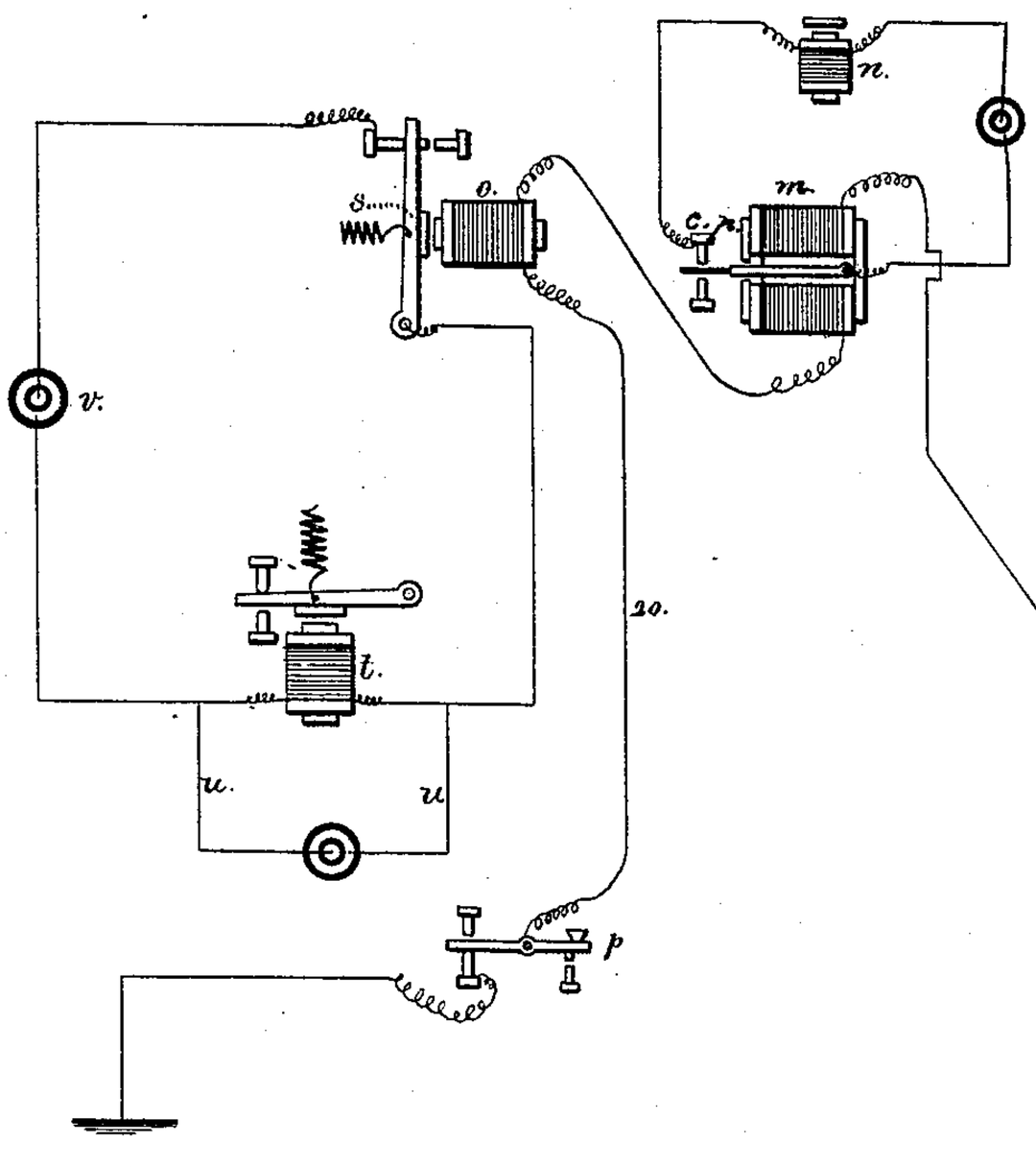

Fig. 1.

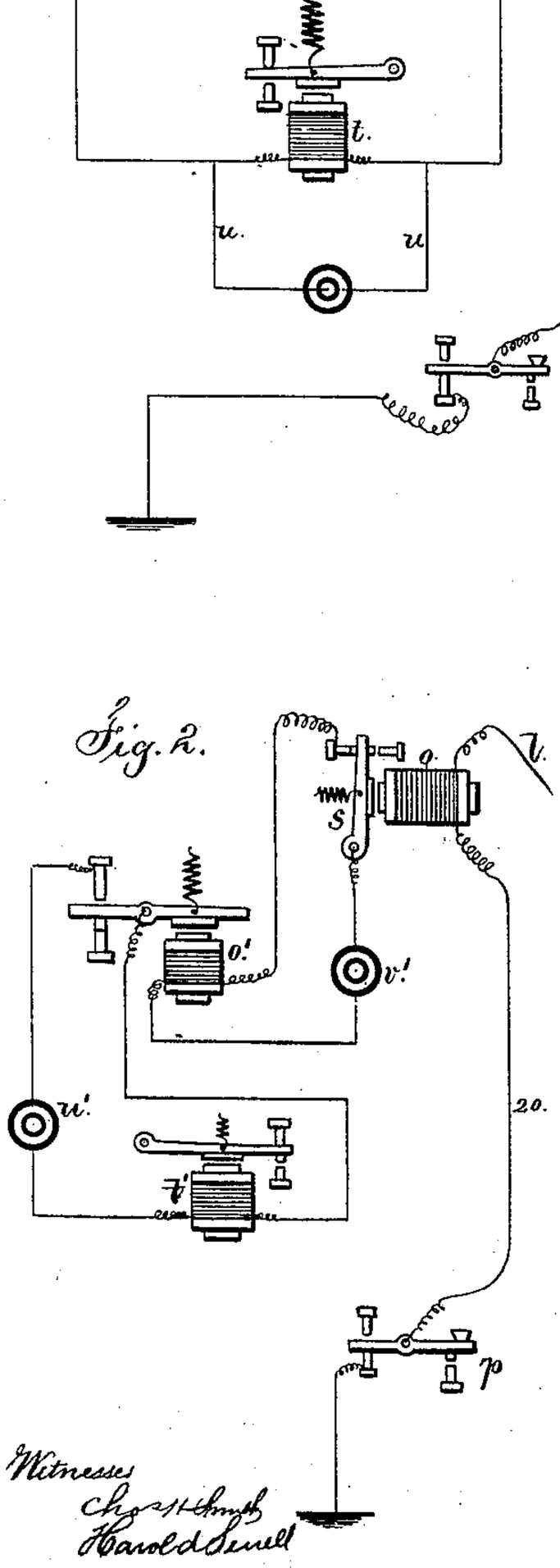

Fig. 2.

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UNITED STATES PATENT OFFICE.

THOMAS A. EDISON, OF NEWARK, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO THE WESTERN UNION TELEGRAPH COMPANY.

DUPLEX TELEGRAPH.

SPECIFICATION forming part of Letters Patent No. 480,567, dated August 9, 1892.

Application filed September 1, 1874. Patented in England February 5, 1875, No. 384; in France April 28, 1875, No. 107,859; in Italy April 30, 1875, Nos. 2,940 and 7,803; in Austria-Hungary June 28, 1875, No. 2,936 and No. 14,584, and in Russia May 24, 1878, No. 3,163.

To all whom it may concern:

Be it known that I, THOMAS A. EDISON, of Newark, in the county of Essex and State of New Jersey, have invented an Improvement in Duplex Telegraphs, of which the following is a specification, and for which I have obtained foreign patents in the following countries: Great Britain, dated February 5, 1875, No. 384; France, dated April 28, 1875, No. 107,859; Italy, dated April 30, 1875, Nos. 2,940 and 7,803; Austria-Hungary, dated June 28, 1875, No. 2,936 and No. 14,584, and Russia, dated May 24, 1878, No. 3,163.

The object of this invention is to enable two operators to simultaneously send over one wire in one direction, by reversal of a battery-current in one instance and increasing and decreasing the strength of the current in the other instance, and the connections are so arranged that the party at the receiving-station can signal to the sender to repeat in case of inaccuracy. By combining the apparatus and method hereinafter described with any suitable known method of simultaneous double transmission in opposite directions four transmitting-operators and four receiving-operators can work simultaneously over one wire, two of each being at each end.

In the diagram Figure 1 I have only shown the transmitting apparatus for two operators at one end of the line and the receiving apparatus for the two operators at the other end of the line. Fig. 2 is a diagram representing a modification of one portion of the circuits.

The battery *a b* is composed of unequal elements. Suppose *a* to represent seventy-five cells and *b* twenty-five cells. The single-circuit key or transmitter *e* modifies the strength of the current passing from the battery to the line by cutting in or out a portion of the entire battery; but it has no effect upon the polarity. It is a three-point key of well-known construction, its arrangement being such that the wire 5 is alternately connected with the wire 4 or with the wire 6. When the current passes through the wire 4, a portion of the battery only is in action; but when the current passes through the wire 6 the whole battery is in action, and this change is produced by the elevation or depression of the key *e*, which when depressed brings into action the whole battery and when elevated leaves a portion of it only in action. This key or transmitter *e* is preferably operated by means of an electro-magnet *d* and a local battery, in connection with a finger-key *c*. The wire 5 is attached to an insulated contact-spring upon the transmitter *e*, by means of which, when the circuit is shifted from the wire 4 to the wire 6, or vice versa, by the movement of the transmitter, one circuit is always closed before the other is broken. Hence when the finger-key *c* is open the section *b* only of the main battery *a b* is in circuit through wire 4, but when the key *c* is closed the whole battery *a b* is in circuit through the wire 6. This change in the power of the battery affects the corresponding instrument at the receiving-station, as hereinafter set forth.

The double-current or current-reversing key or transmitter *f i* controls the polarity of the current passing from the battery to the line, whether the whole or a portion of the battery is in action, and therefore has no effect upon its strength. It virtually consists of two single-current or three-point keys *f* and *i*, insulated from each other and mounted upon the same axis, so as to move together. It is preferably operated by the electro-magnet *g*, local circuit, and key *h*. When the key *h* is open as shown, the current from 5 passes by 10, 11, *f*, 12, and 13, out through tell-tale magnet *k* to the line *l*, and the return is through ground to 14, spring 15, lever-arm *i*, 16, and 3. When the key *f* is attracted by *g*, the circuit connections are reversed, so that the current from 5 passes by 10, 15, and, 14 to ground, thence returning through line 1, 13, 12, 16, and 3 to battery.

By bearing in mind that one operator at *c* makes his signals by changing the amount of battery-power, and that without breaking the metallic circuit, and that the operator at *h* signals by reversing the circuit, regardless of

the battery-power and without breaking the metallic connections, it will be understood that both parties can work without hinderance from the other. It now becomes necessary to show what instruments at the receiving-station are employed, the one to respond by the change of battery force, regardless of polarity, and the other to respond by change of polarity only, regardless of battery force.

The polarity relay-magnet *m* is in the line *l* and is made with a permanent or magnetized armature. Hence it will only respond when the circuit is reversed, and when it does respond by the reversal of the circuit by the operator of *h* the armature-lever works a local circuit and sounder *n*. The electro-magnet *o* is also in the main-line circuit that passes by 20 and key *p* to the earth. The normal condition of this key *p* is closed; but whenever either of the parties receiving perceives any inaccuracy or interruption of the message then the parties sending are notified by either receiver breaking the circuit at the key *p*, and the tell-tale magnet *k*, no longer responding to the pulsations of the keys *h* or *c*, indicates to the senders that the circuit is broken.

In order to produce a receiving-instrument that is operative only by the excess of the current, the spring of the armature *s* is tightened to the proper degree of tension, so that the magnet *o* will not respond except when the closing of the key *c* brings the entire battery *a b* into action.

If a reversal of current takes place when the entire force of battery is on the magnet *o*, there occurs a false movement of the armature *s*. To prevent an incorrect record or sound, the local circuit and receiving instrument are made as next described.

The local circuit and battery *u* is constantly operative in the receiving-magnet or sounder *t*, and hence the armature of *t* only flies back when an opposing current is sent through *t* to neutralize the current of *u* and demagnetize the core. This is effected by the battery *v* and circuit that is closed by the lever *s* on the back movement. Hence when *s* is attracted by *o*, the circuit of *v* being broken allows *u* to act unbalanced and gives the sound; but should *s* fly back on reversing the current it will be so instantly reattracted by *o* as to prevent the circuit *v* being closed long enough to neutralize the action of *u*. Hence the signals given by the operator at *c* will be correctly responded to by the receiver *t*.

The diagram Fig. 2 shows a modification of the receiving-circuit to prevent a false indication at the receiver.

The armature *s* operates the circuit of the battery *v'* to the electro-magnet *o'*, and the armature of *o'* closes and opens the circuit of *u'* to the receiving-instrument or sounder *t'*, and as the magnet *o'* is rather sluggish in movement its armature does not have time to move and break the circuit *u'* before the armature again flies back, should the circuit connections have been reversed while the key *c* is closed.

I claim as my invention—

1. The method herein described of transmitting two distinct messages by separate operators over one wire in the same direction and at the same time, one being transmitted by reversal of the battery-current and the other by increasing or decreasing the current from the battery, substantially as described.

2. A receiving instrument or relay *o* in the main-line circuit, in combination with a local relay *o'*, whose electro-magnet is brought into action through the back contact-stop of the main-line relay, and a sounder or other instrument whose electro-magnet is brought into action by means of the local relay *o'*, substantially as and for the purposes set forth.

3. The receiving instrument or sounder *t* in the constant battery-circuit *u u*, in combination with the balancing local battery *v*, circuit and circuit-closing armature *s*, and electro-magnet *o*, substantially as set forth.

4. In the duplex telegraph arranged for sending two separate messages simultaneously in the same direction and from the same end, the circuit-breaking key *p* at the receiving end and the tell-tale magnet *k* in the line at the transmitting end, as and for the purposes set forth.

5. In a single-line telegraphic system for the transmission of two independent messages, the combination at one station, substantially as specified, of two independent electrically-connected keys, one for each operator, one of which keys when operated reverses the polarity of the electric current independently of the position and action of the second key, which second key controls the strength of current, substantially as set forth.

Signed by me this 19th day of August, A. D. 1874.

THOS. A. EDISON.

Witnesses:
CHAS. H. SMITH,
GEO. T. PINCKNEY.