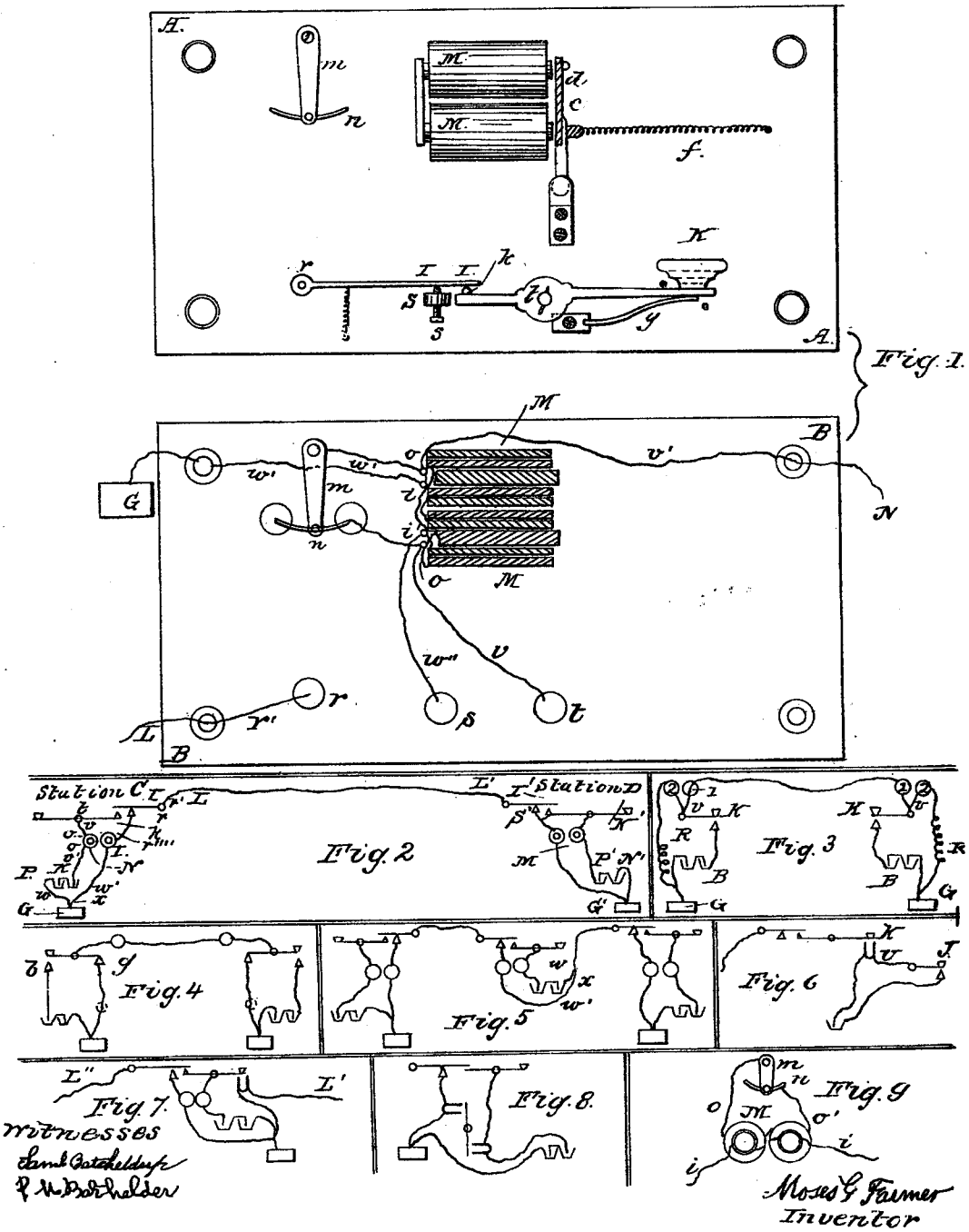
M. G. FARMER.

Duplex Telegraph.

No. 26,097. Patented Nov. 15, 1859.



UNITED STATES PATENT OFFICE.

MOSES G. FARMER, OF SALEM, MASSACHUSETTS.

IMPROVEMENT IN TELEGRAPHIC MACHINES.

Specification forming part of Letters Patent No. **26,097**, dated November 15, 1859.

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 Improvement in Electric Telegraphs; and I do hereby declare that the following is a full and exact description of the construction and mode of using the same, reference being had to the accompanying drawings, and to the letters and figures marked thereon.

Figure I[A] is a top view of the apparatus, and Fig. I[B] shows more particularly the connection of the several parts. The other figures are referred to in detail in this specification.

The object of my invention is to enable persons to transmit two dispatches simultaneously over a single wire or single line of telegraph. This I accomplish in the manner herein described.

Fig. II represents a line of telegraph with the skeleton of an apparatus at each end of it, the same being more definitely represented at A and B, Fig. I. The instrument or apparatus at one end of the line of telegraph is precisely similar to that at the other end, and consists, essentially, of a galvanic battery, P N, Fig. II, a finger-key or circuit-breaker, K *l s*, an electro-magnet or sounder, M, with the wires necessary to connect the several pieces with each other and to put them properly in the telegraphic circuit.

I will now describe the construction of the several parts of the apparatus represented in full in Fig. I and in skelton in Figs. II and IX.

K is the manipulating or finger key, movable around the axis 4. It differs from those in common use in being so constructed that when it is pressed down it shall make contact with the lever I by means of the stop *k*, and when it is let up it shall allow the lever I to descend and make contact with the stop *s*, and the spring *y* shall press up the key K so far as to break contact between *k* and *l* after that *l* has rested on *s*. The lever I is movable about the axis *r*. It is plain that in this construction by means of the downward motion of the key K the contact *l k* is made before the contact *l s* is broken, and in the upward motion of the key K, the contact *l s* is made before the contact *l k* is broken.

The electro-magnet or sounder (or relay, if a local circuit be used) is constructed as relays ordinarily are, with this exception: The wire composing each helix, instead of being in one continued length, is made in two distinct lengths, insulated from each other. In other words, several layers of insulated wire are wound on a leg of the magnet and the ends of the wire brought through the head. Then half as many more layers are wound on the leg outside of the former layers, and the ends of this wire are brought through the head and left free for the proper connections. It is not necessary that there should be exactly twice as many layers of the inner wire as of the outer; but I prefer that it should be so arranged that this one collection of layers with a given strength of current should be capable of exciting twice as much magnetism in the iron as the other collection of layers can do with an equal strength of current. The other leg of the magnet is wound in precisely the same manner, the ends of the wires being brought through the head of the magnet and left free for the proper connection, which is as follows: The inside ends of the inside coils on each leg of the magnet are joined together; also, the inside ends of the outside coils are joined together; so there are left projecting from the magnet all four of the outside ends—viz., *o o'*, belonging to the outside coils, and *i i'*, belonging to the inside coils—as seen in Fig. IX. They are now connected as follows: The outside end *o'* of the outside coils is connected by the wire *v* to the axis 4 of the key K. The outside end *o* of the outer coils is connected by wire *v'* to the pole N of the battery P N, the pole P being connected to the ground-plate G by the wire *w*. The outside end *i'* of the inner coils is connected by the wire *w''* to the stop *s* under the lever I. The outside end *i* of the inner coil is connected to the ground-plate directly by the wire *w*. The part *r* of the lever I is connected by the wire *r'* to the main line L. The pole P of the battery P N in Fig. II is connected to the ground, while the pole N' of the battery P' N', at the other end of the line L, is connected to the ground.

There may be used, when necessary, a rheostat, connected as shown at *m n*, Fig. IX. One

end, as *m*, of the wire of the rheostat may be connected to the end *o* of the wire of the outer helix of the magnet M, while the other end, *n*, of the wire of the rheostat is connected to the end *o'* of the outer helix of the magnet M. The object of this arrangement is to divert a portion of the currrent through the rheostat, and not to suffer all the current to flow through the outer helix. This is especially necessary when the two helices—the inner and the outer—are not properly proportioned to each other, and also when from imperfect insulation of the main line of the telegraph a portion of the transmitted current escapes.

I will now describe the operation of the instrument. When the apparatus at each end of the line L is properly connected and in working order there is normally no current on the line, the circuit of the battery being open at the point *k l*. If, now, at station C, Fig. II, the key K be depressed, contact is made between the points *k* and *l*, while at the same time it is broken between *l* and *s*. The current of the battery P N will flow through the outer helix, *oo'*, of the magnet M to the key K, thence to the lever *l*, thence by the wire *r'* to the line L, thence to the lever *l'* at station D, thence to the stop *s'*, thence to the inner helix of M', thence to the ground-plate G', and back by the ground to the plate G at station C and to the battery P N. The effect will be as follows: The current from the battery P N will not be able, flowing through the outer helix, *o o'*, of the magnet M, to charge it sufficiently to overcome the tension of the spring *f*, which tends to retract the armature *a* of the magnet M if the spring is properly adjusted; but this same current, flowing through the inner helix of the magnet M' at station D, will have sufficient strength to overcome its armature-spring, and will produce motion in its armature. This motion will be arrested by the stop *c*, Fig. I^A, and will produce a sound as is usual in telegraphic relays, which action being well known and understood, I need not here describe how information is conveyed thereby. If desired, the action of the armature *a* and the stop *c* can bring into action a local circuit and register or other apparatus for recording or indicating intelligence. If, now, while the key K at station C is depressed the key K' at station D be also depressed, the current from the battery N' P' will be caused to flow through the outer helix of M', the line L and the battery P N of the circuit be well insulated, the two currents thus united will form one of nearly double strength, and, acting through the outer helix of the magnets M and M', will thus be able to attract and move the armatures against the stops, and both will produce sounds or signs. Now, if either key be let up, as K at station C, the armature *a* at the other station, D, will be released, because there is no current of double strength flowing through its outer helix, there being only the current of the battery N' P' flowing through the outer helix of M' and through the inner helix of M, so that only the one armature *a* will be retained attracted. In this manner it is plain that communication can be kept up simultaneously at each end of a line of telegraph, and not only between two terminal stations, but between one terminal station and one way-station, or between two way-stations if the junction of the wires *w w'* at *x*, instead of being connected to the ground, be connected to the main line, as at *x* in Fig. V.

It is obvious that an electro-magnet, U, can be used to depress the key K, as in Fig. VI, the circuit of which electro-magnet can be closed by another key, J, situated near to or remote from the key K, and thus one line—say L'—be able to repeat its intelligence on another line, L'', as in Fig. VII.

It is obvious that two electro-magnets operating upon one armature-lever might be used, one or both of which could be capable of adjustment at different distances, as in Fig. VIII.

It is also obvious that, instead of using superimposed helices, the helix on one leg of the magnet can be used when the key is depressed and the helix on the other leg of the magnet when the key is let up, as in Fig. II; but I prefer the superimposed helices because their action does not alter the distribution of magnetism in the iron.

In Fig. III, I have represented the rudiments of Siemens' plan for transmitting two messages simultaneously. When the key K is depressed the current from the battery B splits or forks at the point *v*, and half goes through the helix 1 on one leg of the magnet and half through the helix 2 on the other leg of the magnet, the two half-currents neutralizing each the effect of the other, the relative strength of the two halves being adjusted by the rheostat R.

Fig. IV shows Cornell's key, which opens the ground-circuit at *g* before it closes the battery-circuit at *b*. My key, on the contrary, closes the battery-circuit before it opens the ground-circuit, as in Fig. II; but I think it preferable to use only one magnet with superimposed coils, as in Figs. I and IX, and care should be taken that the current should circulate in the same direction in the inner helix as in the outer one; otherwise the magnet will be obliged to lose all its polarity and acquire the opposite polarity whenever the circuit changes from the inner helix to the outer one, and this would cause an extra stroke of the armature, and though it would be only instantaneous, yet it would amount to an extra dot if used for a dot-and-line alphabet.

I am aware that it is not new to use an electro-magnet with two sets of helices wound upon it, nor yet two electro-magnets working upon the same armature-lever to turn it in the same direction. Neither is it new to make use of a key or circuit-breaker which shall close one circuit before or at the same time that it opens

another; but I believe it to be new to combine the two, so as to operate or conspire together to produce a useful result.

I therefore claim as my invention and desire to secure by Letters Patent—

The use of a key or circuit-breaker which shall close one circuit before or at the same time that it opens another, in connection with an electro-magnet with two sets of helices operating on one and the same armature-lever, or two separate electro-magnets operating upon one and the same armature-lever, for the purpose of transmitting two messages simultaneously upon a single wire.

MOSES G. FARMER. [L. S.]

In presence of—

SAML. BATCHELDER, Jr.,

J. M. BATCHELDER.