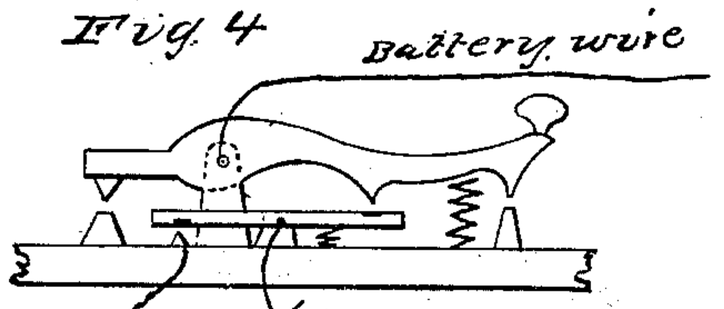
J. B. STEARNS.

Duplex Telegraph.

No. 78,548. Patented June 2, 1868.

Fig. 4 Battery wire

Fig. 1.



Line direct to station L Rhe — gr

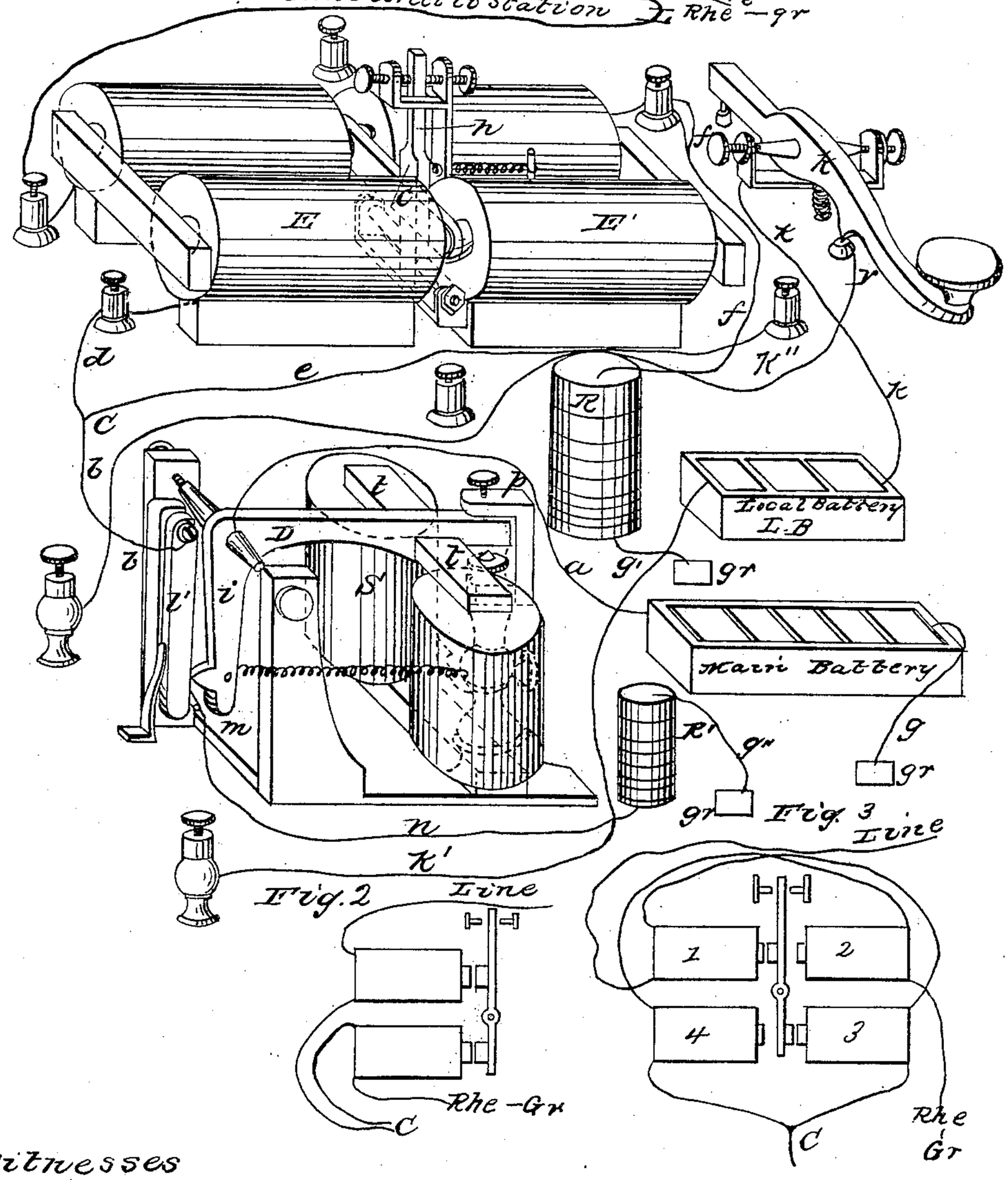


Fig. 3

Fig. 2

Line

Line

Witnesses
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UNITED STATES PATENT OFFICE.

JOSEPH B. STEARNS, OF BOSTON, MASSACHUSETTS.

IMPROVEMENT IN TELEGRAPH APPARATUS.

Specification forming part of Letters Patent No. **78,548**, dated June 2, 1868.

Be it known that I, JOSEPH B. STEARNS, of Boston, in the county of Suffolk and State of Massachusetts, have invented a new and useful Improvement in Electric Telegraphs, of which the following is a full, clear, and exact description, reference being had to the accompanying drawings making a part of this specification, and representing the various parts of a telegraphic apparatus for carrying out my invention.

Figure 1 represents a general view of the apparatus. Figs. 2, 3, and 4 are modifications of portions of the same.

The object of my invention is to provide an efficient means for transmitting two messages simultaneously over a single wire in opposite directions; and the invention consists in so constructing and arranging the key or other circuit-breaker and the electro-magnets that the current from the battery at what we will for convenience call the home station will, on being called into action, be divided, one portion passing through an electro-magnet, which in the drawing is marked E, to the line, and thence to the distant station, the other portion passing through a similar electro-magnet, marked E′ in the drawing, to and through a rheostat, R, and thence to the ground. The electro-magnets are so placed in relation to the armature that their effects upon it are equal and opposite to each other, and consequently the armature is unmoved, while at the same time a current from the battery at the distant station can pass over the line L through magnet E only, thence to lever *l′* of the key or circuit-breaker, and thence to the ground through wire *n*, rheostat R′, and wire *g″*, if the key D is in contact with its back stop *p*, or by lever *l* and wire *a* to the main battery M B, and thence by wire *g* to the ground, if key D is in contact with its front stop *o*. In either position of the key the current from the distant station finds a passage to the ground, and charges magnet E, moving the armature *h*. It is obvious that this armature may, by its movement, close a local circuit, and operate a second sounder for the accommodation of the receiving operator. Rheostat R is so adjusted that its resistance is about equal to that of the line to the distant station, and the apparatus there. It is evident that when the current from the distant station arrives at *c* it finds two channels open to it—one by wire *e*, through magnet E′ and rheostat R, to the ground, the other by wire *b* through lever *l′*, and to the ground either by lever *l*, wire *a*, battery M B, and wire *g*, or through R′ and wire *g″*, according to the position of the key or lever D of the circuit-breaker. Now, as the resistance offered to the current by the first-mentioned channel is exceedingly great as compared to that offered by the other channel, the proportion of the current that will be deflected and pass through this channel will be exceedingly small compared to that passing through the other and more direct channel, and thus the influence of magnet E′ upon the armature *h* will not be appreciable.

The object of rheostat R is, by its proper adjustment, to cause the same amount of electricity from the battery at the home station to pass through magnet E′ as through magnet E, and thus causing the attraction of E′ to be equal to that of E upon the armature. The object of the small rheostat R′ is, by its proper adjustment, to offer the same or nearly the same resistance to the current from the distant station as is offered by the battery M B, thus preserving the resistance for the current from the distant station always the same—a result of great importance, and, as I believe, never before accomplished. It also serves to prevent sparks at the points of contact in the key or circuit-breaker. Resistance-coils, for the purpose of preventing the sparks at the points of contact, may be inserted in the wire between the key and the ground, and between the key and the battery, thus leaving nothing for the rheostat R′ to do but to equalize the resistance, as already explained.

The key or circuit-breaker is so constructed that it closes one circuit or channel for the current from the distant station before or at the same time that it opens the other. In practice, I prefer to make the key or circuit-breaker in the form of a common sounder, the lever of which supplies the place of the lever of a common key, and, being furnished with an armature, can be manipulated by an electro-magnet, local battery, and common key, as shown in the drawings. The advantage of this arrangement is that the sending operator hears his own writing, and can thus

better guard against mistakes. Another advantage is that the writing is made with more firmness and regularity than by the finger-key.

Referring to the drawings, K represents a telegraph-key of the ordinary construction, and with which the sending operator works, and is used, in connection with local battery L B, electro-magnet S, and wires *k k' k''*, to manipulate the main-line key D, which has two levers, *l* and *l'*. From *l* a wire, *a*, extends to one end, say the positive, of the battery M B, from the opposite end of which the wire *g* extends to the ground *g r*. From lever *l'* a wire, *b*, leads to point *c*, where it connects with wire *d*, leading to magnet E, and thence to the line L, and with wire *e* leading to magnet E', and thence through rheostat R to the ground *g r'*. *m* is a stop, against which lever *l'* rests when the lever D is in contact with its back stop *n*. From stop *m* a wire extends to rheostat R', and thence to the ground *g r''*. The apparatus at the distant station is precisely the same as at the home station, with the exception that the negative end of the battery is connected with lever *l*, and the positive end with the ground.

The operation is as follows: The key K being depressed, and brought in contact with point *r*, a current is established through wire *k*, local battery L B, wire *k'*, electro-magnet S, and wire *k''*, completing the circuit, and attracting the armature *t* and lever D, or main-line key, lever *l* of which breaks the connection between *l'* and *m*, and establishes a connection between *l* and *l'*. The current from the battery M B now passes through wire *a*, levers *l* and *l'*, wire *b*, to point *c*, where it divides, one portion passing through magnet E to the line, and thence to the distant station, and through the apparatus there into the ground, and thence through the ground back to battery M B, completing the circuit, and charging magnet E, which tends to attract armature *h*. The other portion of the current passes from point *c*, through wire *e*, magnet E', rheostat R, and thence to the ground, and back to the battery M B, completing the circuit, and charging magnet E', which also tends to attract armature *h* in the other direction and with equal force, the result of which is that the two forces counteract each other, and produce no motion of the armature.

If, now, the key at the distant station is depressed, and the current of the battery there is thus thrown upon the line, this new current will pass over the line to the home-station, through magnet E, to point *c*, where it divides, one portion passing through magnet E' and rheostat R to the ground, the other portion passing by wire *b*, levers *l* and *l'*, wire *a*, to battery M B, and thence to the ground.

The proportion of the current that will be conveyed by the different channels will be in inverse proportion to the resistance of each, and, as the first-mentioned course contains many times as much resistance as the latter, the amount of current passing through magnet E' will not be appreciable, and magnet E will act upon armature *h* as though magnet E' were not present. If the key at the home station is not depressed at the time the current is thrown upon the line at the distant station, then that current passes over the line, and through magnet E, as before, and by wires *d* and *b*, lever *l'*, rest *m*, wire *n*, rheostat R', wire *g''*, to the ground, and back to the battery from whence it started, acting upon the magnet E and armature *h*, as in the former case.

The advantage of this method over all others heretofore devised consists in the facility with which it can be adjusted, for while in other methods the adjustment of the forces acting upon the armature depends almost wholly upon the proper regulating of the resistance of the rheostat, which in practice is found to be troublesome, in this method there are several modes of adjustment, and such as are more generally and readily understood by those who are commonly called upon to manage such instruments, such as varying the distance of one or the other or both of the magnets from the armature, so that the exact adjustment of rheostat R is of little moment, since, if it contains several times as much resistance at the line, thus allowing much less than half of the current from battery M B to pass through magnet E', the operator has but to move magnet E' nearer armature *h* to enable its feebler magnetism to balance the stronger magnet E. This adjustment is more easily understood and effected by operators than that by rheostat, and is therefore more practical.

Another and greater advantage that this method possesses over others is, that the current from either battery meets with exactly the same resistance, whatever may be the position of the key at the opposite end of the line. This is of great importance.

As a modification of the relay-magnet, the two magnets may be placed one above the other, as in Fig. 2, the armature-post carrying two armatures, with the fulcrum between them; or four magnets may be used, as in Fig. 3, with armatures arranged as before, but with magnets on each side of both. When arranged in the latter manner, magnets 1 and 3 may be connected, so as to act in concert upon the two armatures, and magnets 2 and 4 so connected as to oppose the action of 1 and 2.

I am aware that it is not new to make a key that shall close one circuit before or at the same time that it opens another. I am also aware that it is not new to place two or more electro-magnets in such position that they shall act upon the same armature-lever; but I believe it to be new to so place two or more electro-magnets that they shall act upon the same armature or armatures, upon the same post, in opposite directions, and with equal force, for the purpose of sending two

messages simultaneously over the same wire, in opposite directions.

I also believe it to be new to so arrange the several parts of an apparatus, for the purpose aforesaid, that the resistance to the current of the battery or batteries shall be at all times the same.

I also believe it to be new to so arrange and construct the several parts of an apparatus, for the purpose aforesaid, that the finer adjustments to prevent the movement of the armature may be effected by the movement of the electro-magnet toward or from the armature, and without changing the resistance of the rheostat.

I also believe it to be new to combine a key that shall close one circuit before or at the same time that it opens another with a relay composed of two or more electro-magnets operating upon the same armature or armatures, upon the same post, and in opposite directions, and for the purpose described.

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

1. The combination of a relay, consisting of two electro-magnets, so arranged as to act upon the same armature-post, in opposite directions, with a key that shall close one circuit before or at the same time that it opens another, when the same are constructed and made to operate substantially as described.

2. The combination of the relay, constructed substantially as described, the sounder-key S, and rheostat R, when the whole are connected and made to operate substantially in the manner and for the purpose set forth.

3. In combination with the rheostat R′, the double relay, when the latter is so constructed as to effect the finer adjustments of the forces acting upon the armature or armatures, as set forth.

4. So arranging the several parts of the apparatus that the resistance offered to the current from the battery at either end of the line is always the same, whatever may be the position of the key at the opposite end.

5. In combination with the key S, constructed as described, the rheostat R′, inserted between the key and the ground, substantially as and for the purpose described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

JOSEPH B. STEARNS.

Witnesses:
J. H. ADAMS,
M. S. G. WILDE.