(No Model.) 2 Sheets—Sheet 1.

O. R. ROBERSON.

TELEGRAPHY.

No. 583,418. Patented May 25, 1897.

Fig. 1,

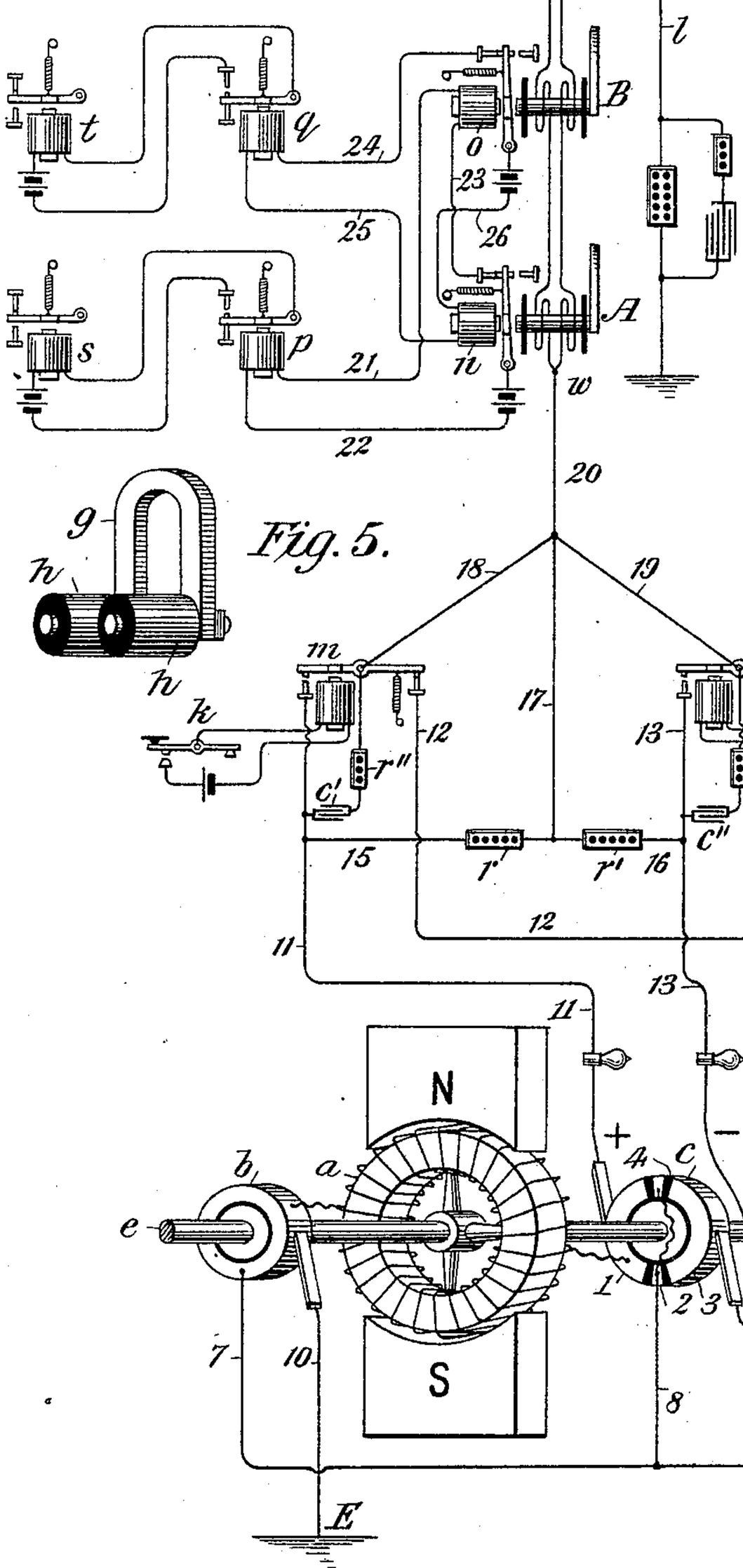

Fig. 2,

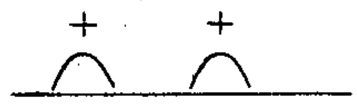

Fig. 3,

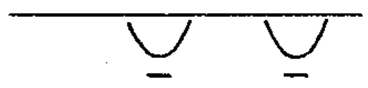

Fig. 4,

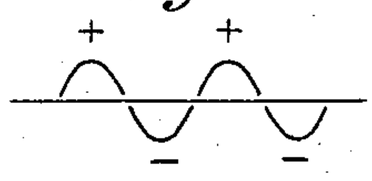

Fig. 5.

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(No Model.) 2 Sheets—Sheet 2.

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Fig. 6.

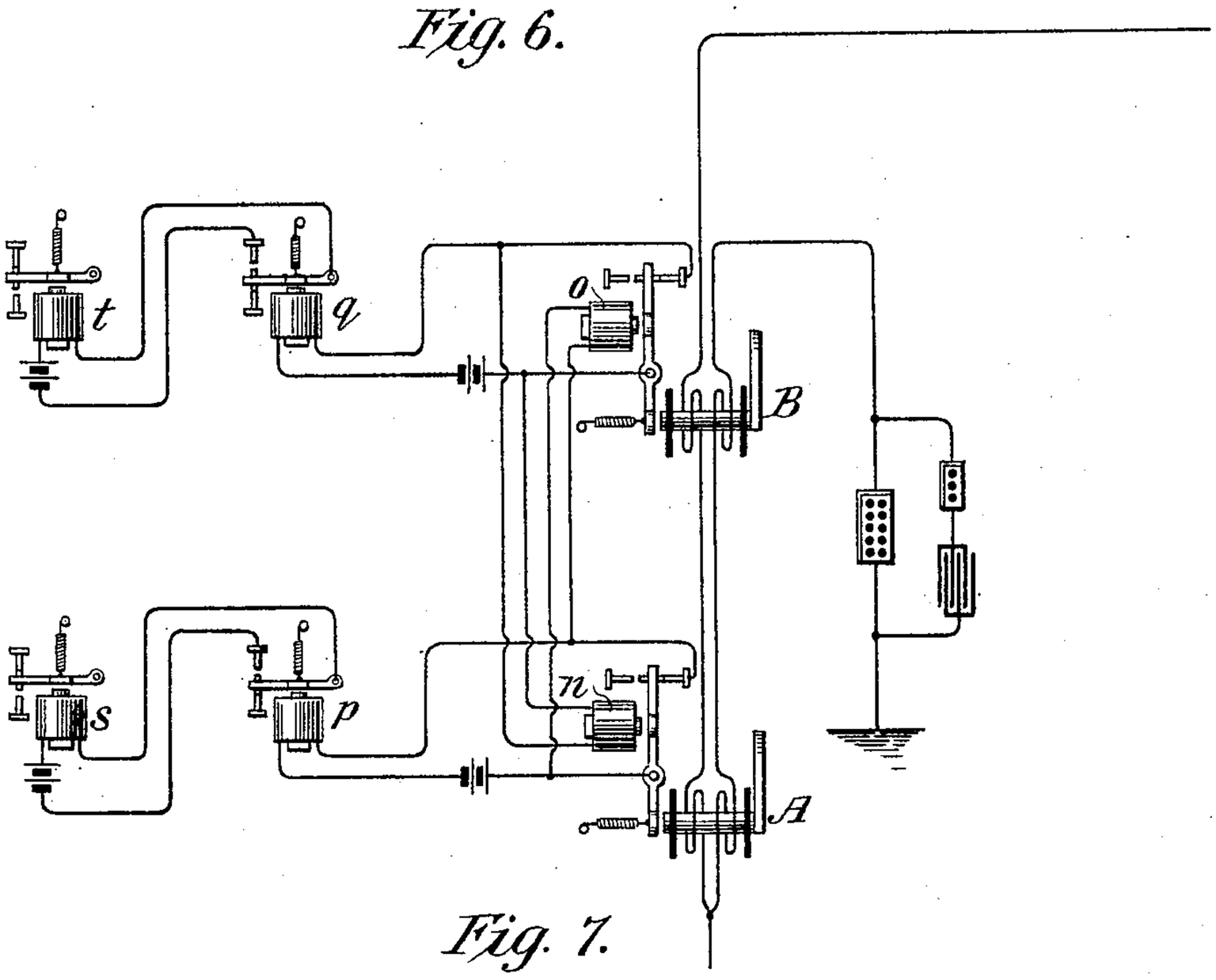
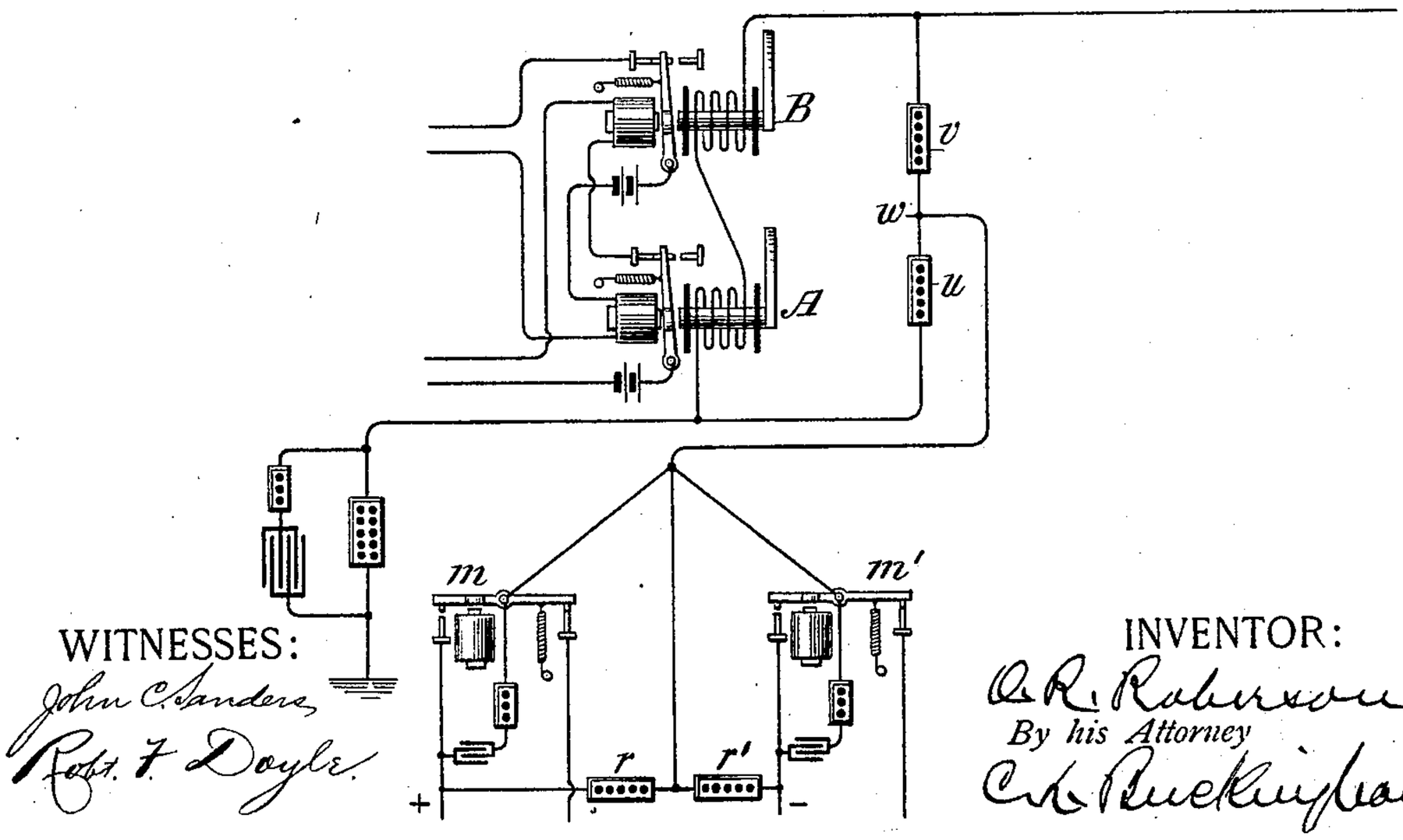


Fig. 7.



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UNITED STATES PATENT OFFICE.

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TELEGRAPHY.

SPECIFICATION forming part of Letters Patent No. 583,418, dated May 25, 1897.

Application filed August 24, 1896. Serial No. 603,682. (No model.)

To all whom it may concern:

Be it known that I, OLIVER R. ROBERSON, a citizen of the United States of America, residing at Glen Ridge, Essex county, and State of New Jersey, have made a new and useful Improvement in Diplex and Quadruplex Telegraphs, of which the following is a specification.

My invention relates to that class of telegraphs in which two messages are simultaneously sent in one direction over a main line by means of a rapid succession of positive and negative pulses. Others have heretofore proposed the transmission of pulses in this order for the sending of two messages; but in these cases the depressions of the keys have served to suppress the positive and negative pulses, respectively. In other words, the positive pulses of the series are suppressed by operating one key and the negative pulses by the other. In my system, however, one message is transmitted by positive and the other by negative pulses, although, preferably, I send to line at all times a series of weak alternating currents. On short lines signals may be transmitted by merely sending a series of positive or negative pulses, according to the key depressed; but upon longer lines signals are sent by increasing one polarity or the other or both of currents normally flowing to line—that is to say, the positive pulses are strengthened by depressing one key, while the negative pulses are strengthened by the other. Thus with both keys at back contact only weak alternating pulses are sent to line, while upon the depression of the keys strong positive or negative or strong pulses of both polarities are transmitted as one or the other or both of the keys are depressed. In this class of telegraphs others have suggested batteries and automatic vibrators for directing pulsatory currents upon the line; but such devices have been found impracticable, owing to the large sparks produced at vibrating contacts and the inequality of current-pulses produced. To avoid these difficulties and to secure other advantages hereinafter set forth, I employ at each station an alternating-current dynamo provided with suitable collector-rings and connections for sending to line positive and negative pulses for the two sets of signals and such further means as may be necessary for normally feeding weak alternating pulses into the main line and for directing thereto positive and negative currents of increased strength upon the depression of one or the other or both of the two keys, as above outlined. Again, in telegraphs employing rapidly-alternating currents and relays responsive one to positive and the other to negative pulses the principal difficulty has been that a receiving-relay which should respond to positive pulses only, or one which should respond alone to negative pulses, is placed under essentially-different conditions when called upon to act under the influence of a succession of pulses of both polarities, and it is to this difficulty that my invention is chiefly directed. Obviously a relay should be subject to the same forces as nearly as possible at all times when called into action—that is to say, to attain the desired result a relay responsive to negative pulses should be equally responsive either when negative pulses only are sent over the line or when both positive and negative pulses are transmitted; also, a relay responsive to positive pulses should be equally responsive either to positive pulses alone or to a succession of positive and negative pulses. Either positive or negative pulses alone will produce strong electromagnetic effects; but in a rapid succession of alternating currents the effect of any one current-wave is largely neutralized by the pulse which follows.

My invention further consists in other and more specific means of improvement hereinafter set forth.

Figure 1 represents a current-generator with transmitting and receiving apparatus at one station of my diplex or quadruplex system. Fig. 2 is a diagram representing waves of positive pulses which are transmitted for actuating one relay at the receiving-station. Fig. 3 represents the waves of negative pulses for actuating the second receiver at a station, while Fig. 4 represents both the waves of positive and negative pulses for simultaneously actuating both relays of a receiving-station. Fig. 5 represents a relay-magnet which, according to the polarity of the horseshoe magnet, is adapted to respond either to

positive or negative pulses. Fig. 6 shows a modification of the receiving relay apparatus shown in Fig. 1, while Fig. 7 represents a bridge form of diplex instead of the differential form of Fig. 1.

In Fig. 1 I have shown an alternating-current generator of the ring type with its armature-coils *a* connected in two branches to a ring *b*, insulated from the shaft *e* of the dynamo, while the other terminal of the armature branch is connected to section 1 of hub *c*, the latter also being placed upon the shaft *e*. The hub *c* is provided with four metallic plates, upon the periphery of which rest two brushes connected, respectively, with conductors 11 and 13. As shown in the drawings, one armature-terminal is in contact with wire 11, while plate 3, which is insulated from plate 1, is joined with branch 13. At the same time plates 2 and 4, which are insulated from 1 and 3, are connected together by wire 8 with the hub *b* and thence to earth by wire 10. Also, upon shaft *e* is placed a hub *d*, having sections 5 and 6, section 6 being permanently connected by conductor 9 through hub *b* to earth, while section 5 affords an insulated terminal either for wires 12 or 14, according to its position of rotation. By means of hub *d*, therefore, an earth connection is afforded from the main line for currents received from a distant station, either through wire 12 or 14. When, as in the position shown in the drawings, 12 is connected with segment 6, the main line is connected to earth through the wire 18, back contact of armature-lever *m*, wire 12, section 6, wire 9, wire 7, hub *b*, and wire 10; but upon a half-rotation of the dynamo-armature, however, and when section 6 is in contact with the brush with which wire 14 is joined the main line is given an earth connection through wire 20, wire 19, back contact of armature-lever *m'*, wire 14, section 6 of hub *d*, wires 9 and 7, hub *b*, and conductor 10. Upon operating key *k* connection between armature-lever *m* and conductor 12 will be broken; but in this case at points of the armature rotation an earth connection will be afforded by way of wire 18, the front contact of *m*, wire 11, hub *c*, the armature-conductor, hub *b*, and conductor 10, and at other points of rotation, when wire 11 is joined with sections 4 and 2, there will be an earth connection through wires 8, 7, and 10. During that part of rotation when wire 11 is in connection with segment 3 there will be no connection through hub *c*, but one will be afforded, as before, through wire 14 and hub *d* by way of conductors 9, 7, and 10.

In the transmission of messages to a distant station when key *k* is depressed positive pulses, as those shown in Fig. 2, will be transmittted from the dynamo through section 1 of hub *c*, wire 11, front contact of armature-lever *m*, and conductors 18 and 20, while the length of the pulses will be somewhat less than a full positive wave, depending upon the width of sections 4 and 2 and their surrounding insulating material. When section 1 is in contact with conductor 11, the pulse generated is transmitted to line, but when the shorter segments 2 and 4 are brought into contact with wire 11 the line will be disconnected from the dynamo and placed to earth, thus affording it an opportunity to become discharged. Also, the dynamo, when connected with wire 11, is disconnected from wire 13, so that while 11 is receiving a positive pulse no current will flow over 13. At the next half-rotation, however, section 1 is brought in contact with the brush of wire 13, when a negative pulse generated in the armature will be transmitted into said branch 13. Thus, as the armature rotates, 11 and 13 are alternately connected with the dynamo and are fed, alternately and respectively, with positive and negative pulses, while the main line at the termination of each positive and negative pulse is disconnected from the dynamo and is connected to earth to permit its electrical discharge.

The wires 11 and 13, while ready to receive pulses from the dynamo, will not be fed with full currents except as the armature-levers *m* and *m'* are depressed to front contact. If both *m* and *m'* are depressed at once, the two conductors 11 and 13 will receive positive and negative pulses, as above described. These branches, however, will receive considerable current regardless of the position of levers *m m'* from the fact that connections to the main line are effected by way of wires 15 16, the particular purpose of which will be more fully hereinafter described.

At a receiving-station are employed two relays A B, each of which is provided with a permanent horseshoe magnet *g*, soft-iron cores, and electromagnetic coils *h*, as shown in Fig. 5. It may be assumed that relay A at the distant station is actuated upon the depression of key *k* at the transmitting-station, and B by key *k'*. The cores and permanent magnet are so arranged that the positive pulses sent to line upon the depression of key *k* shall add to the permanent magnetism of A at the distant station and shall neutralize or diminish that of B, while upon the depression of key *k'* the permanent magnetism of A will be diminished and that of B increased. By this means, upon the depression of key *k*, relay A at the receiving-station will attract its armature, while the armature of B will be attracted upon the depression of key *k'*. Also, upon the simultaneous depression of both *k* and *k'* and the transmission of successive positive and negative pulses over the main line the armatures of relays A and B will both be attracted to a signaling position; but it is to be noted that upon the simultaneous transmission of positive and negative pulses positive pulses will not act upon the positive relay or negative pulses upon the negative relay, as if only positive pulses were being transmitted or only negative pulses, from the fact that a rapid succession of positive and

negative pulses through the coils of an electromagnet will tend to produce a neutral or non-magnetic effect, whereas positive or negative pulses alone will each produce strong magnetic actions. To overcome this difficulty is one of the objects of my invention, and to this end I have provided arrangements and means in which auxiliary electromagnets *n o* and the branches 15 16, with rheostats *r r'*, are essential parts, although in case of shorter lines the branches 15 16 may be omitted.

If positive pulses were received from a distant station only, the armature of relay A should be attracted, breaking the local circuit, including electromagnet *o*, but the local circuit, including magnet *n*, would remain closed and would still exert a retracting pull upon the armature of A—that is to say, upon the transmission of positive pulses only the armature of relay A is in a partially-balanced condition from the fact that it is pulled from the one side by magnet *n* and from the other by the cores of relay A. Likewise, if only negative pulses were transmitted from the distant station, B would attract its armature and break the circuit of magnet *n*, leaving the circuit of magnet *o* closed, and consequently the armature of relay B in a partially-balanced condition, as above described respecting the armature of A, under the influence of positive pulses alone. Thus upon the transmission of positive pulses for one message or negative pulses for a second transmission the armatures of A B will be partially retracted by their retracting-magnets *n o*. If, however, both positive and negative pulses, as those shown in Fig. 4, are transmitted from a distant station, the armatures of A and B will both be attracted and the circuits both of *o* and *n* will be broken, thereby leaving the armatures subject to the influence of A and B only. In this case the magnetism of A and B is much weaker than if the relays were subject to pulses of one polarity only, but while weaker they still have a capacity to pull their armatures with a force almost equal to that which they would have if under the influence of pulses of one polarity only with the retracting-magnets *o n* in action. To still further equalize the actions of relays A B under the influence of pulses of one polarity or of both, I provide the branches 15 16 with rheostats *r r'*. By this means positive and negative currents will at all times be transmitted, although of much less strength than those of normal force. (Shown in Figs. 2, 3, and 4.) By this arrangement pulses from the dynamo will be constantly directed to line, but owing to the resistances *r r'* they will be of comparatively small strength. These weakened pulses when received from a distant station will flow through the main-line coils of A B and produce an effect tending to neutralize the effects of stronger currents of one polarity. For example, if at the distant station the key *k* is depressed strong positive pulses will flow therefrom and through the main-line coil of relay A. At the same time, however, owing to the presence of rheostat *r'* and branch 16 at the distant station, weakened negative pulses will be transmitted in alternate order, thereby tending to neutralize in a degree the magnetism produced by the stronger positive pulses. Thus in relay A not only is the armature under a retractive force from magnet *n*, but its magnetism which would be produced by the strong positive pulses will be considerably reduced by the weakened negative pulses, and by both of these agencies the armature of A will be under substantially the same tendency to move to front contact as when strong positive and negative pulses are alternately transmitted.

As shown in Fig. 1, *l* represents the ordinary artificial line of a diplex or quadruplex system, while at the left are represented repeating-sounders *p q* and reading-sounders *s t*, such as are customarily employed in quadruplex systems where the main-line relays close their local circuits on back contacts. Also, in Fig. 1 are shown branches including condensers and rheostats around the front contacts of the transmitting-sounders, which serve to dissipate sparks arising at such points. The branch around the front contact of *m* includes condensers *c'* and rheostat *r''*, while the branch around the front contact of *m'* includes *c''* and *r'''*. It may also be noted that the presence of branches 15 16, including *r r'*, respectively, serve a similar purpose.

In Fig. 6 are shown receiving-relays, sounders, and connections, as in Fig. 1, except that the electromagnets *n o* act upon armatures independent of those which are under the influence of the relay-cores of A B. This form of relay, although somewhat more complicated in construction, I find advantageous in that the armature-lever is subject to less vibration than when the same armature is under the direct influence of two opposing magnetic poles.

In Fig. 7 the transmitting and receiving apparatus of Fig. 1 is replaced by the bridge form, in which two relays A B are placed in the cross branch of a system consisting of four branches formed of the main and artificial lines and the two rheostat branches *u v*, which are joined at *w* with transmitters *m m'*.

What I desire to claim and secure by Letters Patent is—

1. In a telegraph system, an alternating-current dynamo at a transmitting-station, two transmitting-keys, a main line, two receiving devices at the receiving-station, and collector-segments and earth connections for directing over the main line a series of positive pulses produced by said dynamo for transmitting one message, and a series of negative pulses produced thereby for transmitting a second message.

2. In a telegraph system, an alternating-current dynamo at the transmitting-station, a main line, collector-segments through which the main line is normally connected to the

generator, whereby weak positive and negative pulses are normally directed over said line, two transmitting-keys for directing over said line strengthened positive pulses for the transmission of one message, and strengthened negative pulses for a second message, and two receiving instruments placed at a distant station.

3. In a telegraph system, an alternating-current dynamo and two transmitters at the transmitting-station and two receiving devices at the receiving-station in combination with means for transmitting from said generator positive pulses for one message and negative pulses for the second in combination with two interconnected retracting-magnets, one for each relay at the receiving-station, so arranged that the action of one relay may throw out of action the retracting-magnet of the other, substantially as described.

4. In a telegraph system in which two messages are transmitted, one by positive and the other by negative pulses, two main-line relays A, B, responsive to positive and negative pulses, respectively, retracting-magnets *n*, *o*, and means whereby magnet *n* is rendered inactive by the operation of relay B, and magnet *o* by relay A, as and for the purpose described.

5. In a diplex-telegraph system, two main-line relays at each station, responsive to positive and negative pulses, respectively, which are normally subject to weak positive and weak negative pulses and which are brought into action by strengthened positive or negative pulses, respectively, retracting-magnets *n*, *o*, and means whereby the retracting-magnet *n* of relay A is removed from action by relay B while the circuit of magnet *o* is broken by relay A, as and for the purpose set forth.

6. In a telegraph system, an alternating-current dynamo at each station provided with earth connections, two transmitters, connections for joining the poles of said armature alternately with the main line by said transmitters, connections for joining the main line to earth immediately upon its disconnection from the generator, and connections for joining said generator to earth when the transmitters are in their back positions.

7. In a telegraph system, an alternating-current generator at one station, two transmitters *m m'*, an armature for said generator whose windings are connected to a hub, *b*, and thence to the earth, a hub *c* having sections 1, 2, 3, 4, for effecting alternate connections both from the dynamo to the front contacts of the two transmitters and also from the line to earth, and hub *d*, having sections 5 and 6 for affording alternate earth connections from the main line by way of the back contacts of the two transmitters *m m'*.

8. In a diplex-telegraph system, the combination of the two transmitters *m*, *m'* for sending two independent messages to line, an alternating-current dynamo, branches 11 and 13 leading to the front contacts of said transmitters, and branches 15 and 16 for normally connecting branches 11 and 13 with the main line, as and for the purpose set forth.

9. In a telegraph system, the combination of an alternating-current generator, two transmitters, branches 11 and 13, leading from said generator to the front contacts of said transmitters, branches 15 and 16 for permanently connecting conductors 11 and 13 with the main line, receiving instruments at the distant station consisting of relays A, B, and retracting-magnets *n*, *o*, whose circuits are closed at back contact, the circuit of *o* including the back contact of relay A, and the circuit of *n* the back contact of relay B, as and for the purpose set forth.

10. In a telegraph system, the combination of a main line, two transmitters at one station, two receiving devices at a distant station and an alternating-current generator having an armature *a* and shaft *e*, a hub *b* rigidly fixed upon said shaft having connections as set forth, a hub *c* placed upon said shaft having sections 1, 2, 3, 4, for connecting the dynamo-armature alternately with branches 11 and 13 and for connecting said branches with earth at intervals between pulses, as and for the purpose set forth, and hub *d* having two sections for alternately affording earth connections with the back contacts of transmitters *m*, *m'*.

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Witnesses:
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JOHN C. SANDERS.