

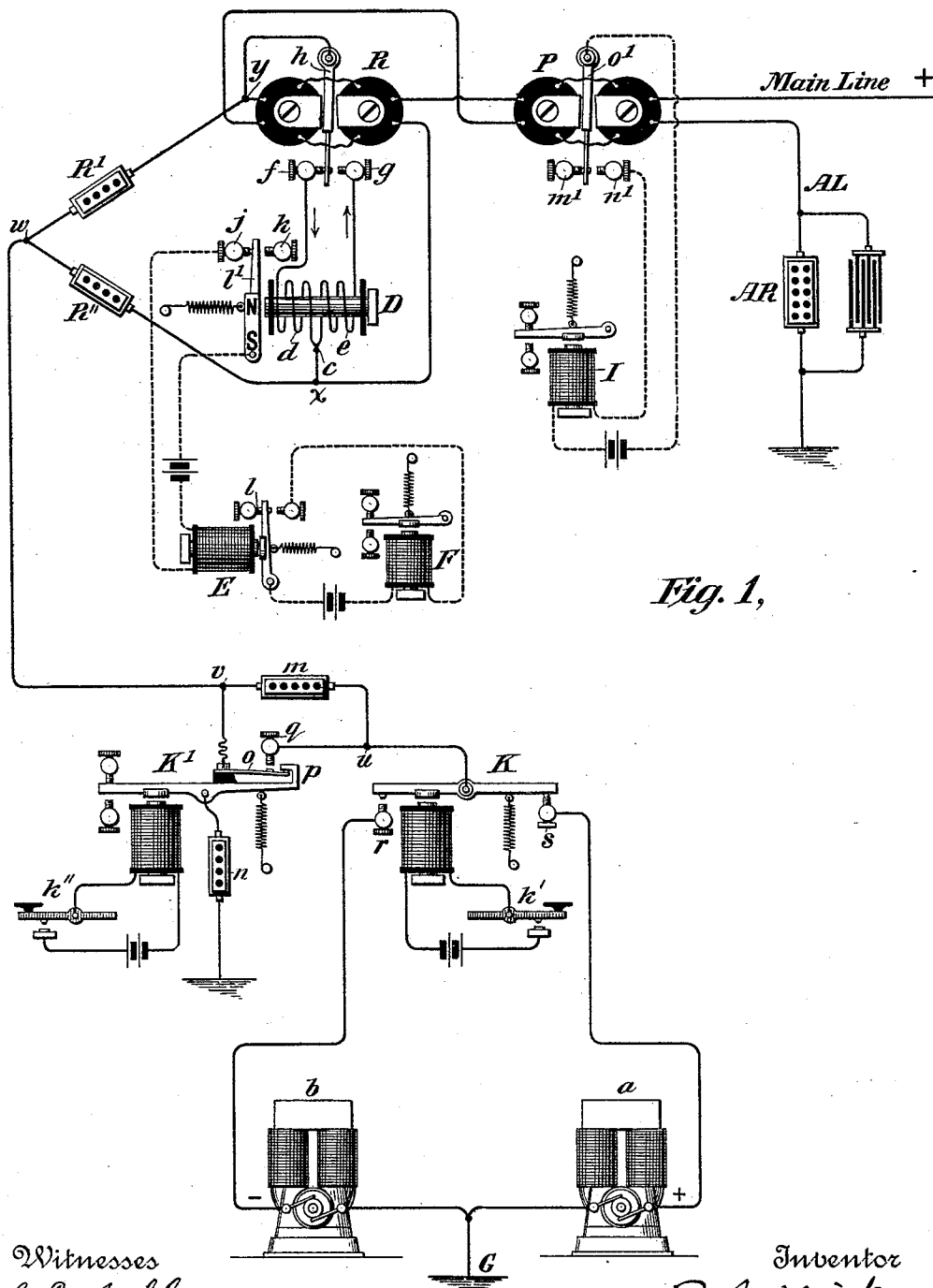
(No Model.)

5 Sheets—Sheet 1.

P. J. WICKS.
TELEGRAPHY.

No. 499,811.

Patented June 20, 1893.



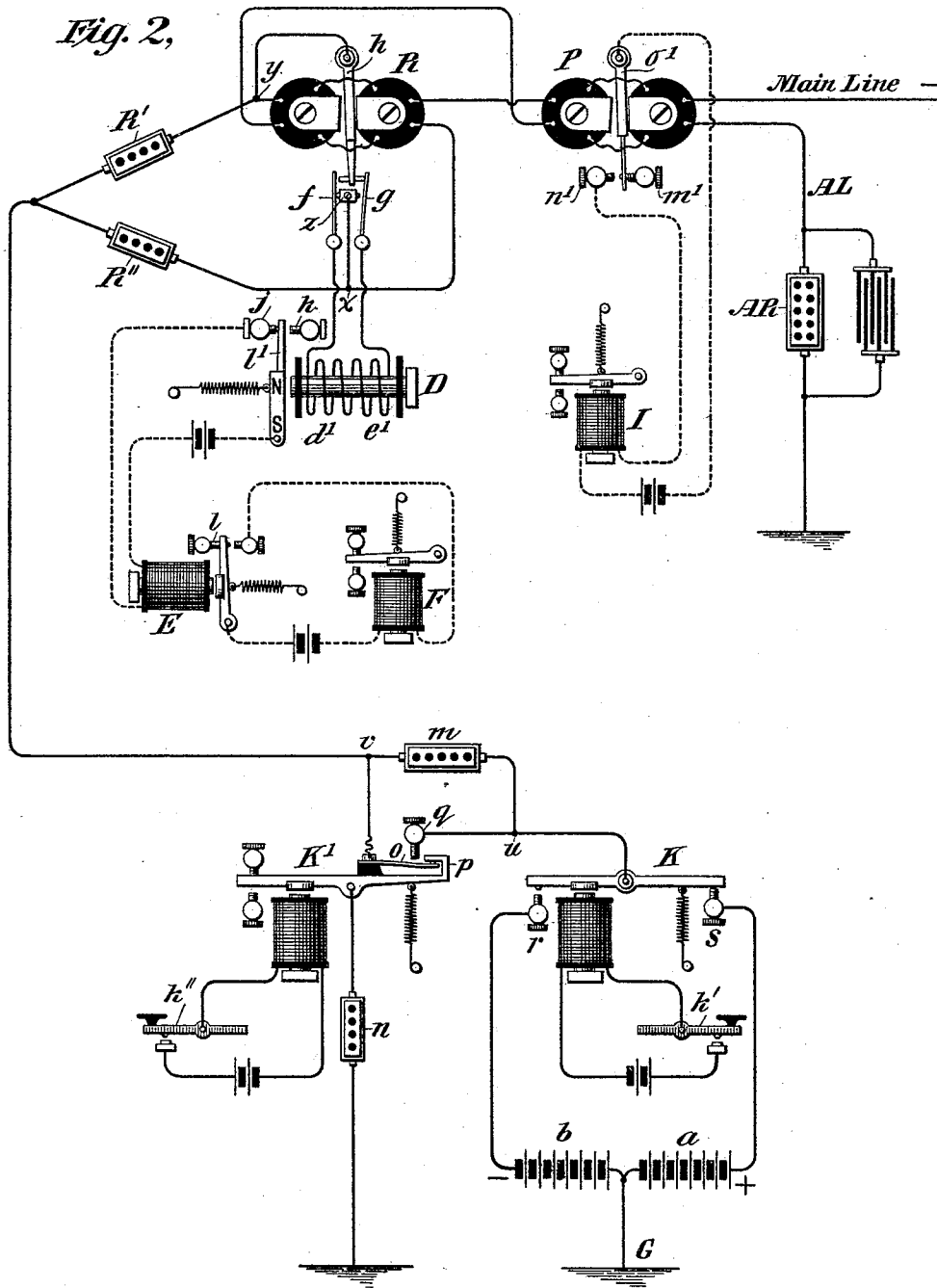
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Fig. 3.

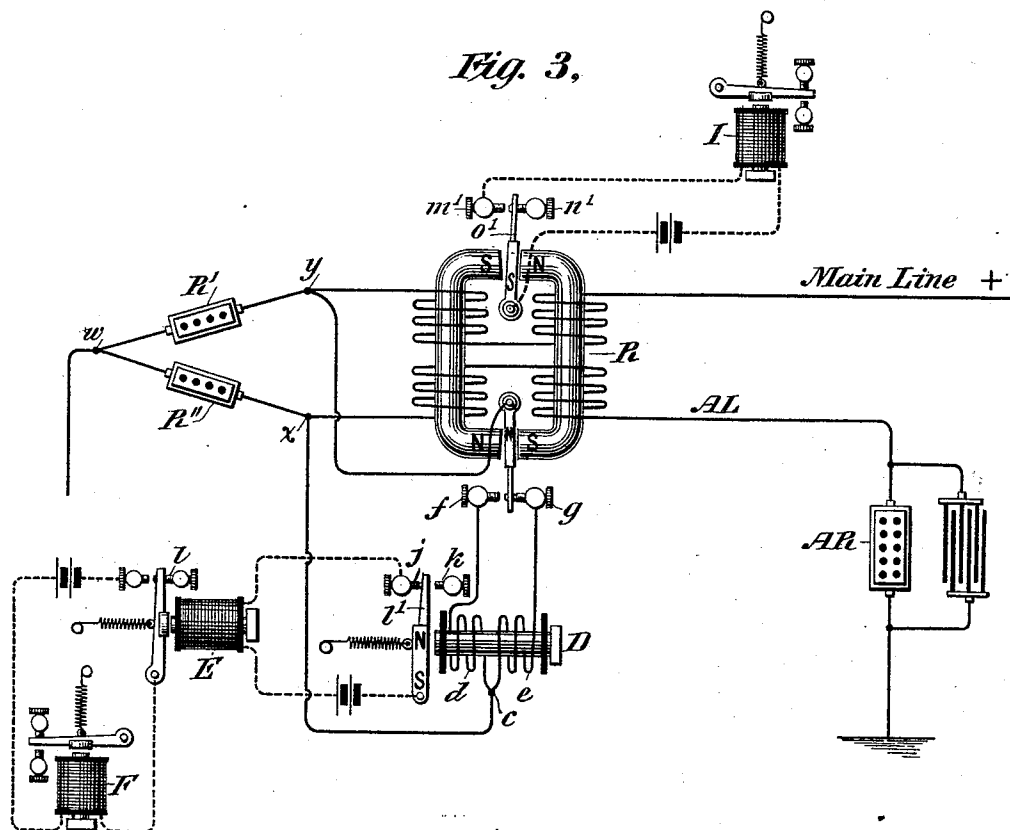
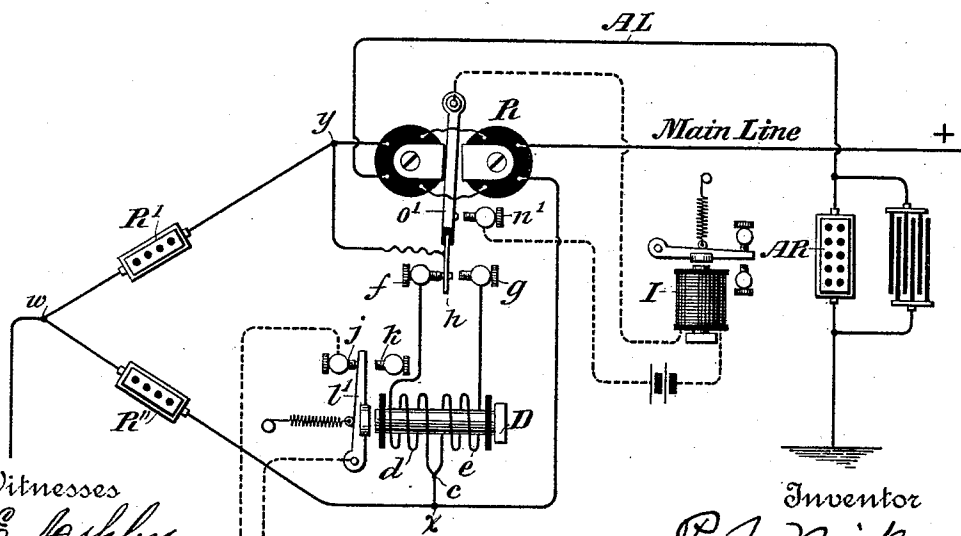


Fig. 4.



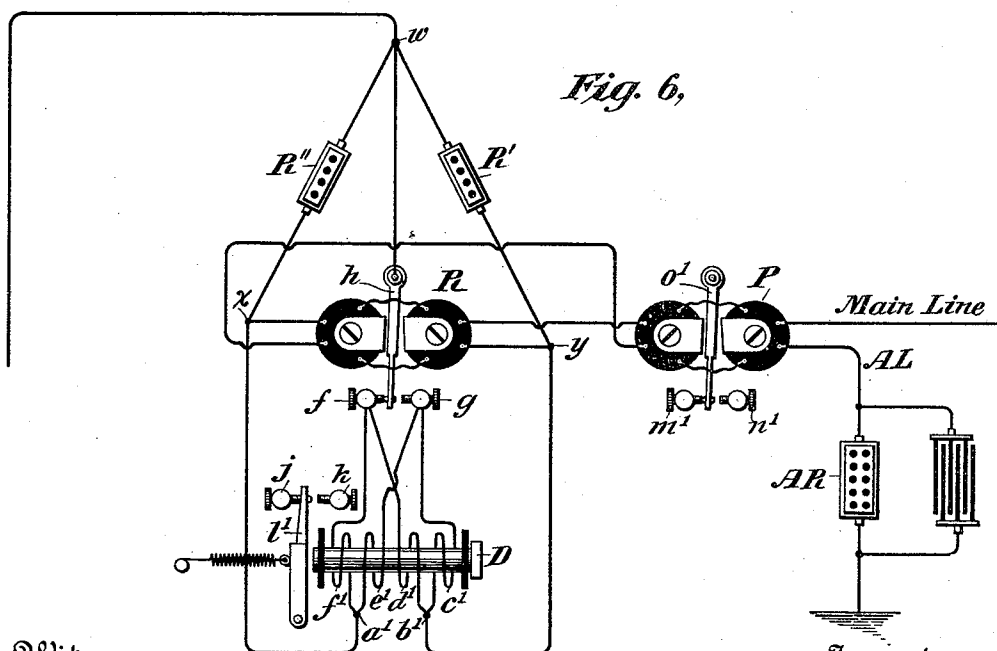
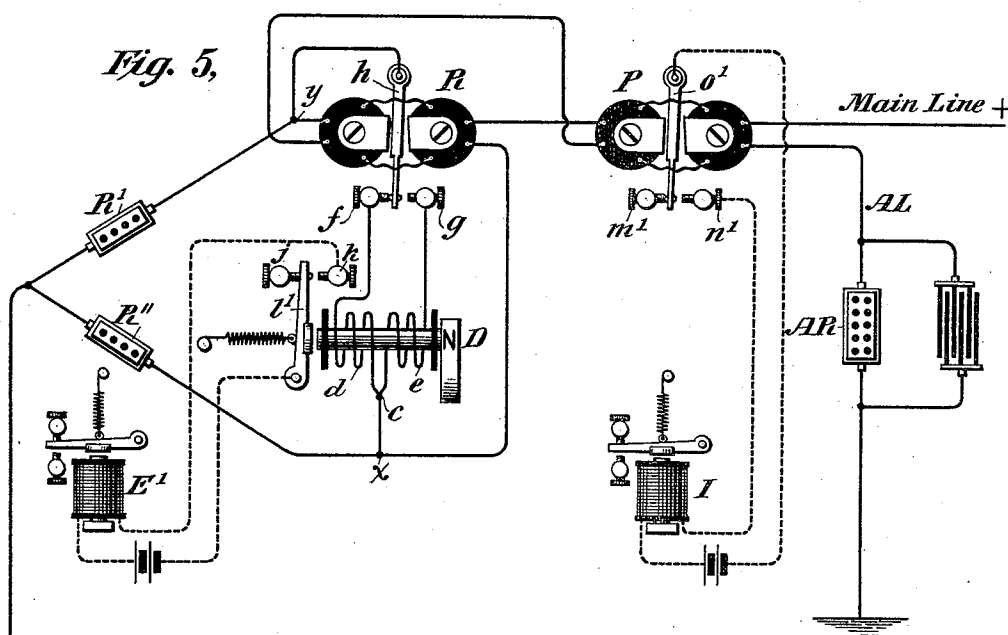
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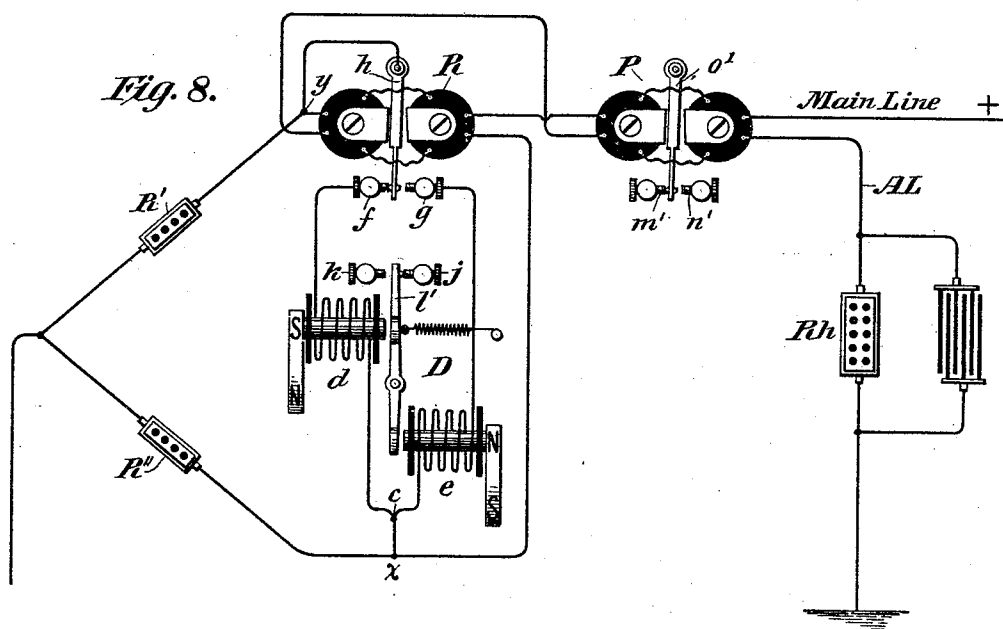
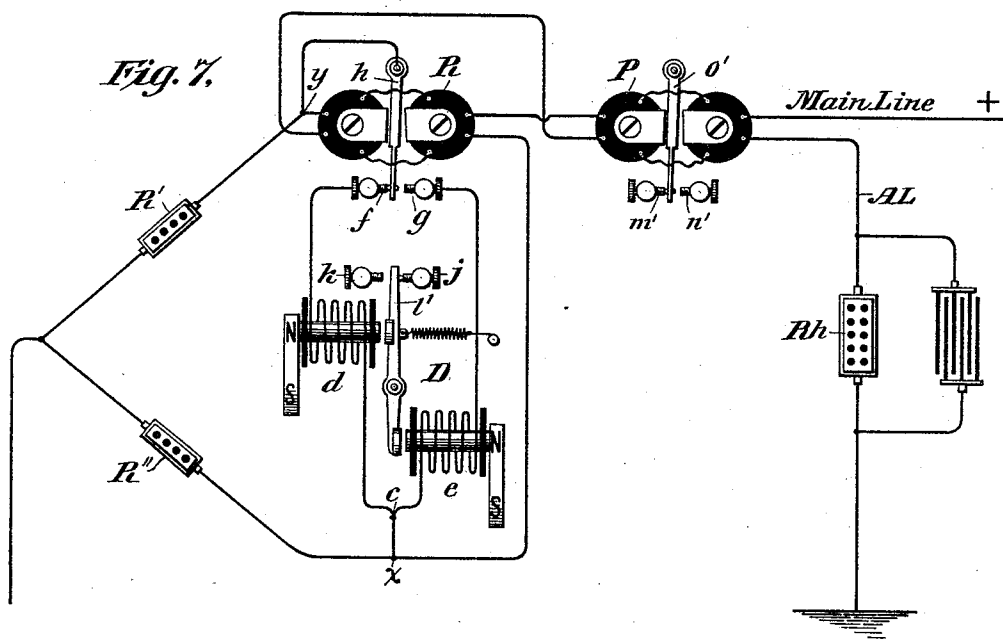
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5 Sheets—Sheet 5.

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SPECIFICATION forming part of Letters Patent No. 499,811, dated June 20, 1893.

Application filed March 3, 1893. Serial No. 464,510. (No model.)

To all whom it may concern:

Be it known that I, PIERSON J. WICKS, a citizen of the United States, residing at Brooklyn, county of Kings, and State of New York, have made a new and useful Improvement in Telegraphy, which is particularly applicable to those systems requiring means for avoiding false signals in a neutral relay during current reversals employed in the transmission of a second message or signal over the main line, of which the following is a specification.

In the quadruplex or diplex telegraph which has come into general use, one message is transmitted by current reversals and a second message by changes in current strength, the reversals being received upon a polar relay, while those due to changes in strength are produced upon a neutral magnet. The neutral relay, however, is found to respond to current reversals and to this extent there is a mutilation of signals, for not only is it necessary that the polar relay should be responsive to reversals only, but the neutral relay should be equally independent of reversals. At each reversal there is either a period of no current, or at least, a period of diminished current on the main line, and a correspondingly weakened magnetism in the neutral relay, and, as a consequence, if the armature of the neutral relay were held in an attracted or signaling position by an increased current, it would often be so far withdrawn by its retracting device as to produce false signals.

My invention is intended to overcome such difficulty, and to this end I avoid reversals of magnetism in the core of the neutral relay; and this I accomplish by instrumentalities controlled by the to-and-fro currents themselves, the means employed serving to so direct the alternating pulses as to create or maintain one direction of magnetic effect, or to avoid reversals of magnetism in the relay core or cores.

Figure 1 is a diagram showing a quadruplex transmitting and receiving apparatus, used at each end of the line, in which my invention is employed. Fig. 2 shows a like telegraph arrangement, in which a modified form of neutral relay and arrangement of circuits are used. Figs. 3, 4, 5 and 6 each show quad-

ruplex receiving apparatus and further modifications of the neutral relay and circuit connections. Figs. 7 and 8 show further modifications in which the same direction of magnetic effect is produced or maintained by two magnets. Where two magnets are used, either one or two armatures are employed. As shown in Fig. 7, two independent armatures are placed upon a single lever, while in Fig. 8 one magnetic bar is common to the two magnets.

Referring to Fig. 1, K is a pole-changer for alternately connecting dynamos *a*, *b*, to the main line in the transmission of current reversals, while K' is a transmitter for sending signals by changes in current strength, whatever the polarity, these devices being actuated by local electro-magnets and their respective keys *k'* *k''*. By opening and closing key *k'*, lever K is rocked to alternately rest on stops *r*, *s*, thus alternately joining the dynamos to line. If key *k''* be open, as shown in Figs. 1 and 2, the circuit from K is closed to line by way of point *u*, resistance *m*, point *v*, and thence to *w*; and at the same time a portion of the current is diverted from *v* to spring *o*, hook *p*, rheostat *n*, to earth. Thus the current from either generator is weakened by the insertion of resistance *m*, and partly diverted and wasted through the earth branch containing rheostat *n*, and, as a consequence, the flow to line is of minor strength. When, however, key *k''* is depressed to transmit a signal, the armature of lever K' is attracted until spring *o* is arrested against stop *q* and hook *p* is raised above the point of spring *o*, thereby breaking contact between *o* and *p*, at the same time that connection is established between *o* and *q*. And by this action the branch circuit to earth through rheostat *n* is broken, and a circuit from *u* to *v* is formed by way of *q*, and spring *o*, thereby short-circuiting resistance *m*, when a maximum current will flow to line and actuate at the distant station the neutral relay to form a signal. The receiving relays, R, P, are differentially wound and are therefore irresponsive to outgoing signals, and to this end the usual form of artificial line, AL, having a rheostat, AR, and condenser, is employed. Relay P is of the polar type and is responsive to reversals for the production of

messages sent from a distance by alternations of current, and its armature tongue, o' , vibrates between stops, m' , n' , to open and close the circuit of sounder I. Relay R is also of the polarized type, but it is employed wholly for the recording of messages due to changes of current strength, although in itself it is not capable of accomplishing this result, and is, in fact, only an auxiliary to the neutral relay which is preferably placed in a bridge between the main and artificial lines. The armature h of the relay R is electrically joined at point y with the main line, while the free end of the armature at each reversal of current from the distant station is vibrated between stops, f , g , to which, respectively, the differential coils, d , e , of relay D are connected, said coils being united at a point c , and thence joined with the artificial line at point x . It is now seen that a current flowing from the distant station over the main line divides at point y , a large part passing by way of armature h , stop f , and thence through coil d , and, owing to the direction of flow and the winding of the coil d , a south magnetic pole is produced in the relay core facing the armature. If, now the current on the main line, from the distant station, be reversed, the tongue of armature h will almost immediately and before any considerable amount of current can find its way through coil d , be thrown from stop f to stop g , the flow now taking place from point x through coil e , stop g , and armature lever h to y . Thus while the current is now flowing in an opposite direction on the main line, it is, nevertheless, so passed around the relay core by coil e as to produce the same polarity of magnetism in relay D as before, and the magnetism of the relay is therefore not reversed. While the weaker currents are flowing over the main line and through either coil d or e the core of D will not be sufficiently magnetized to attract armature l' ; but upon increasing the main-line current, the magnetism developed in the core of magnet D will attract armature l' from back stop j to its front contact k , thereby breaking the circuit of the repeating relay E and releasing its armature so that the latter may be withdrawn from its front contact l , and the circuit of sounder F closed to produce a signal.

In Fig. 2 I have shown galvanic batteries, a , b , in place of dynamos a , b , in Fig. 1, while upon relay D only one coil is employed. The relay tongue h , as before, is connected at its pivoted end with the main line at point y , but the artificial line in this case is connected from point x , to the anvil z , of a pole changer against which springs f , g , are alternately brought into contact and removed therefrom by the free end of tongue h . In this arrangement, a current flowing from the distant station passes from point y , to tongue h , spring g , and thence through the coil of D to spring f , stop z , and point x ; but upon a reversal of current, owing to the quick movement of tongue h , little or no current of the reverse

order will pass through the coil of D before tongue h and spring g are separated, and as h is almost immediately brought into contact with spring f , the flow will retain its direction in relay D and will still pass from spring g through coil d' e' to spring f , though the flow will now be from the artificial to the main line.

In Fig. 3 I have shown in place of the two polarized relays P, R, in Figs. 1, 2, 5, and 6, a compound relay having two tongues, the tongue o' vibrating between stops m' , n' , to record messages due to current reversals, while the lower tongue plays between f and g as an auxiliary of relay D, the latter still being employed to record signals due to changes in current strength. With this arrangement, as before, obviously, the two tongues of the compound relay are unaffected by outgoing currents, and although both are responsive to reversals from distant stations, relay D is only brought into action when main-line currents are sufficiently increased to enable the core of D to attract armature l' . The compound relay R, however, is virtually two relays, as is relay R of Fig. 4.

In Figs. 1, 2 and 3, I have shown armature l' as of the polarized type, and this form, for quickness of action, possesses many advantages, though I find it entirely feasible, as indicated in Figs. 4 and 6, to make said armature of soft iron.

In Fig. 4 is shown a modification of apparatus contained in Fig. 3, in which relay R, by means of a single armature, effects a record of the message due to reversals upon a sounder, I, which is actuated as armature lever o' is brought into contact with stop n' , while at the same time a spring, h , connected to but insulated from lever o' , is vibrated between points, f , g , thus connecting point, y , of the main line alternately to the differential coils, d , e , of relay D. Obviously in this arrangement, as in other forms already described, relay D is responsive to increased currents.

Fig. 5 is a modification of the receiving apparatus shown in Fig. 1, in that a different order of currents must be employed to actuate the tongue of relay D in forming signals. One end of a soft-iron core is fixed to a permanent magnet, N, in the construction of relay D, and the magnetism of the core which is developed from magnet N is only overcome or neutralized when a maximum current is flowing from the distant station. In the operation of such arrangement when the neutral transmitting key is open the strongest current is sent to line and the armature lever l' is permitted to fall against back stop j , but no signal is produced; if, however, the neutral transmitting key be depressed, as is necessary in this instance, and only a weakened current transmitted to line, enough magnetism in the core of relay D will not be developed to neutralize the opposing magnetism derived from N, and, as a consequence, l' will be attracted to point k . It is apparent that

if the current were removed entirely from the line, armature l' would still be attracted and more strongly than before.

Fig. 6 represents an arrangement in which the bridge containing relay D does not join the main and artificial lines at points of equal potential as x and y , shown in the other figures of the drawings. In this instance armature lever h , of relay R, is joined to a point w , and thence through one or the other of coils f' , e' , according to the position of armature h . In this case, therefore, the bridge in which relay D is placed is merely a shunt around rheostat R'' , but with this arrangement it is necessary to duplicate the coils of relay D in order that outgoing currents may be differentialized. If the coils of relay D, through which signaling currents from a distant station flow, could have their opposite extremities connected to points of equal potential on the main and artificial lines, such coils would constitute bridges in which outgoing currents would not flow; but if the coils be joined with the main line at points w and x , their extremities are at different potentials, and relay D, if unprovided with differential coils, is responsive to outgoing signals. To obviate this difficulty two additional coils, c' , d' , are so wound on the core as to neutralize the effect of outgoing currents in those coils (f' , e') through which signaling currents from a distant station arrive. Currents from the home station passing through differential coils f' , d' , produce no signals at the home station; and in like manner when h is attracted against stop g , currents flowing through c' , e' , neutralize each other in relay D; thus in respect to outgoing currents, as shown in Fig. 6, there is a flow of current through two differential coils in both positions of the relay tongue h , but in either position of h incoming currents flow through only one of the two coils, e' , f' .

In Fig. 7 is shown a further modification of relay D in which are employed two iron cores with separate coils acting respectively and alternately upon two independent armatures, both being mounted upon a lever l' , but obviously even where two separate magnets are employed I need not be limited to separate armatures, as the cores of both magnets may, as shown in Fig. 8, act upon an armature common to both. In these arrangements, however, it is preferable to permanently polarize the cores of both magnets and to so direct signaling currents through their coils as to reinforce the permanent magnetism. It will also be seen that in the organization shown in Fig. 7, both magnets may present the same poles to their respective armatures, as said armatures in this case are magnetically independent. Where, however, as in Fig. 8, the armature is an iron bar common to both magnets, one magnet should present a north and the other a south pole thereto. At the moment of reversal, if the action of relay R were slow in moving armature lever h , a reverse current would flow

through that coil of relay D last in action, and the object of my invention would be defeated. I find, however, that under ordinary conditions no such reversals in the coils of relay D occur, although it might well be assumed that before tongue h could be moved away from either f or g , enough current of opposite polarity would flow through the coil to reverse the magnetic polarity of its core. The action of h is so quick, however, that the mechanical effect of the reverse flow could be but slight, but if the tendency were greater it would ordinarily be dissipated by the self induction of the relay itself. And in some cases it may be desirable to so construct relay D that it shall have considerable self-inductive capacity or lag, but such remedy should be sparingly applied, as the effect of self induction is to render relays slow and inefficient as telegraphic receiving instruments.

Many other arrangements will be suggested by those already described in which alternating currents transmitted over a main line may so direct themselves that they shall not reverse the magnetic polarity of a neutral relay or one designed to receive only signals in response to changes in current strength, and I therefore wish to broadly claim all equivalent means and methods for accomplishing this desirable result.

What I claim, and desire to secure by letters patent, is—

1. In a quadruplex or other telegraph in which two messages or signals are transmitted in the same direction, one by current reversals and the other by changes in current strength, a relay which is responsive to current reversals, a relay for recording signals by changes in current strength, and means for developing the same magnetic polarity in said relay during main-line reversals.

2. In a telegraph system for simultaneously transmitting two messages in the same direction on one line, the combination of a receiving instrument which is responsive to current reversals for recording signals due to such currents, a main-line relay for recording signals due to changes in current strength, and means for maintaining the same direction of magnetic effect upon the armature of said second relay by main-line currents, irrespective of their direction.

3. In a quadruplex or diplex telegraph, a relay at a receiving station, a second relay for recording signals due to changes in current strength, and a relay for directing main-line currents to said second relay in either of two directions, according to the direction of main-line current.

4. In a telegraph system for simultaneously transmitting two messages in the same direction over one wire, two relays both of which are responsive to current reversals, one being employed to record signals due to such currents, and the other to actuate a commutator or switch, and a relay for recording signals due to changes in current strength, the

arrangement being such that main-line currents shall be directed through said relay in either of two ways, according to the direction of main-line current during reversals.

5 5. In a telegraph system for simultaneously transmitting messages over a single conductor, a relay for receiving signals due to current reversals, and means for receiving independent signals due to changes in current strength,
10 said means consisting of a main-line relay which is responsive to current reversals, a relay placed in a branch or branches of the main line, and a circuit-changing device for directing main-line currents through said relay in
15 either of two ways according to the direction of flow during reversals of current on the main line.

6. In a quadruplex telegraph, a main and an artificial line at each station, two relays
20 which are responsive to alternating currents received from a distant station, a third relay placed in a bridge joining the main and artificial lines, and controlling devices actuated by one of said relays for maintaining the
25 same direction of magnetic effect in said

bridge relay, irrespective of the direction of main-line flow.

7. In a quadruplex telegraph, the combination at one station of a main and an artificial line, relays R and P which are responsive to current reversals, a bridge conductor joining points *x* and *y* of said lines, a relay D included in said bridge, relay coils *d*, *e*, and armature lever *h*, for alternately directing the bridge current through said coils according to the direction of main-line flow. 30 35

8. In a quadruplex telegraph, the combination at one station of two polarized relays which are differentially wound, a bridge conductor joining the main and artificial lines of said system, a relay placed in said bridge having two coils, *d*, *e*, and an armature lever *h*, for alternately connecting said coils in circuit whereby the same direction of magnetic effect may be maintained in relay D, irrespective of the direction of main-line flow. 40 45

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