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PLURAL DUPLEX SYSTEM OF TELEGRAPHY

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2 Sheets-Sheet 1

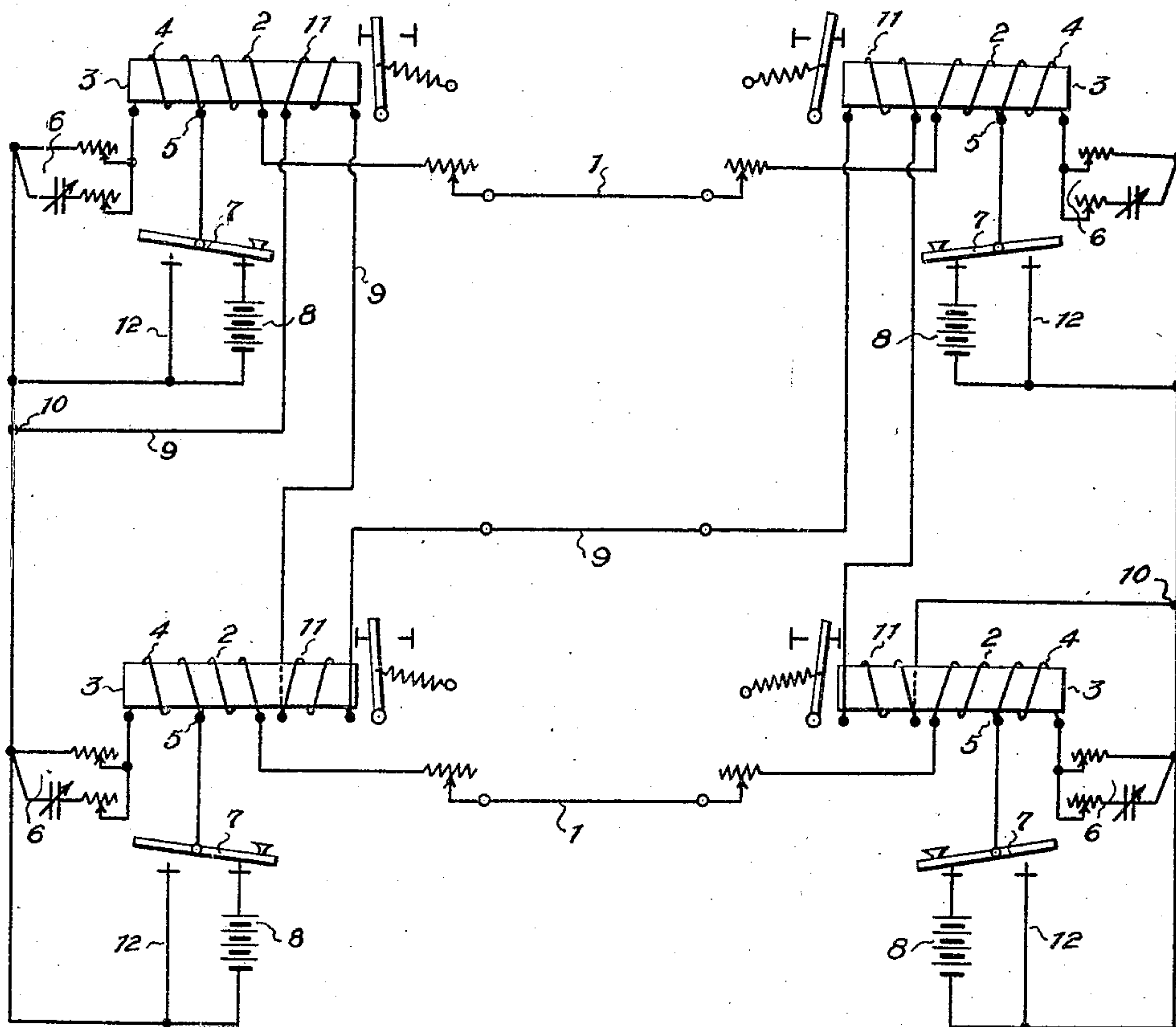


Fig. 1

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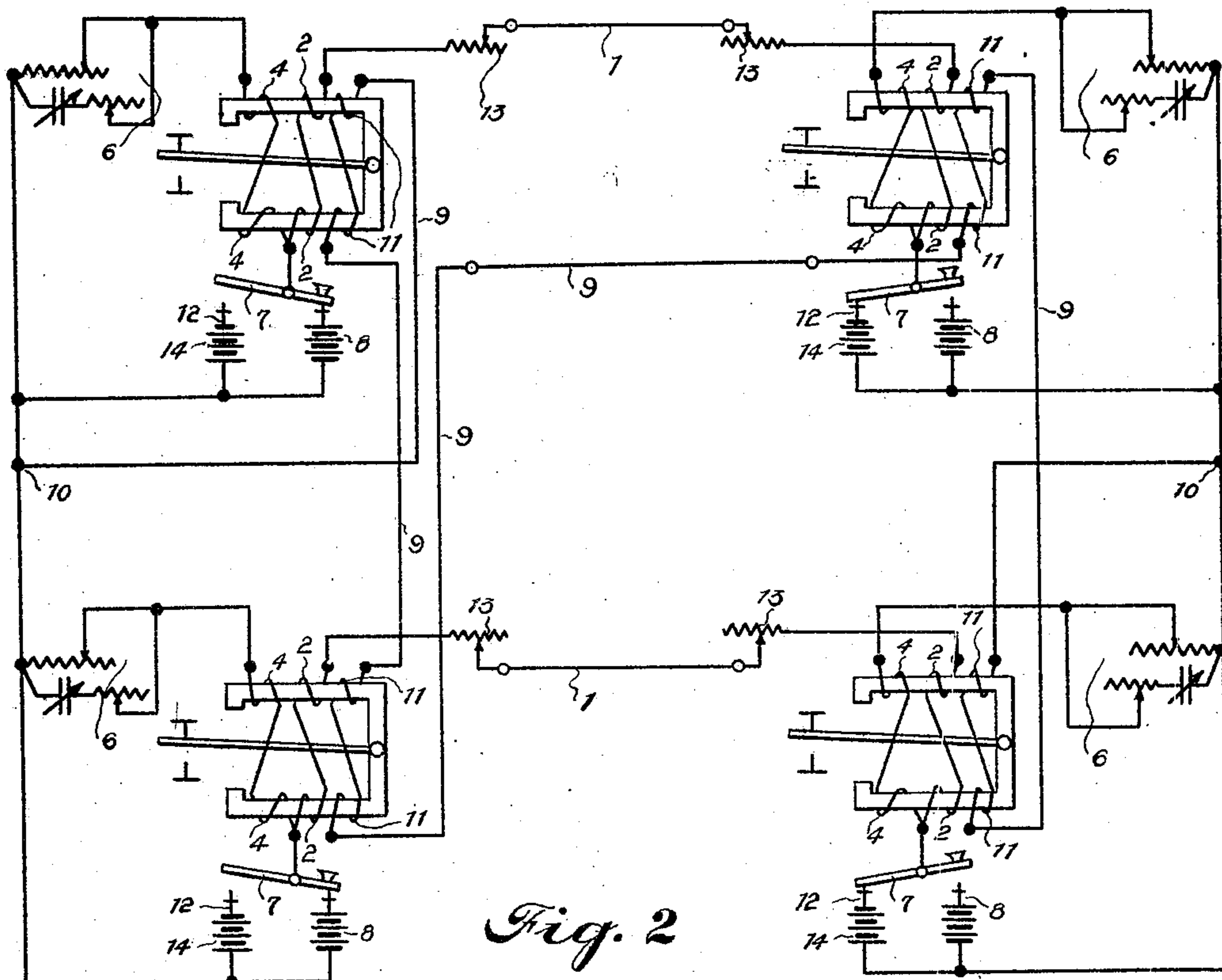


Fig. 2

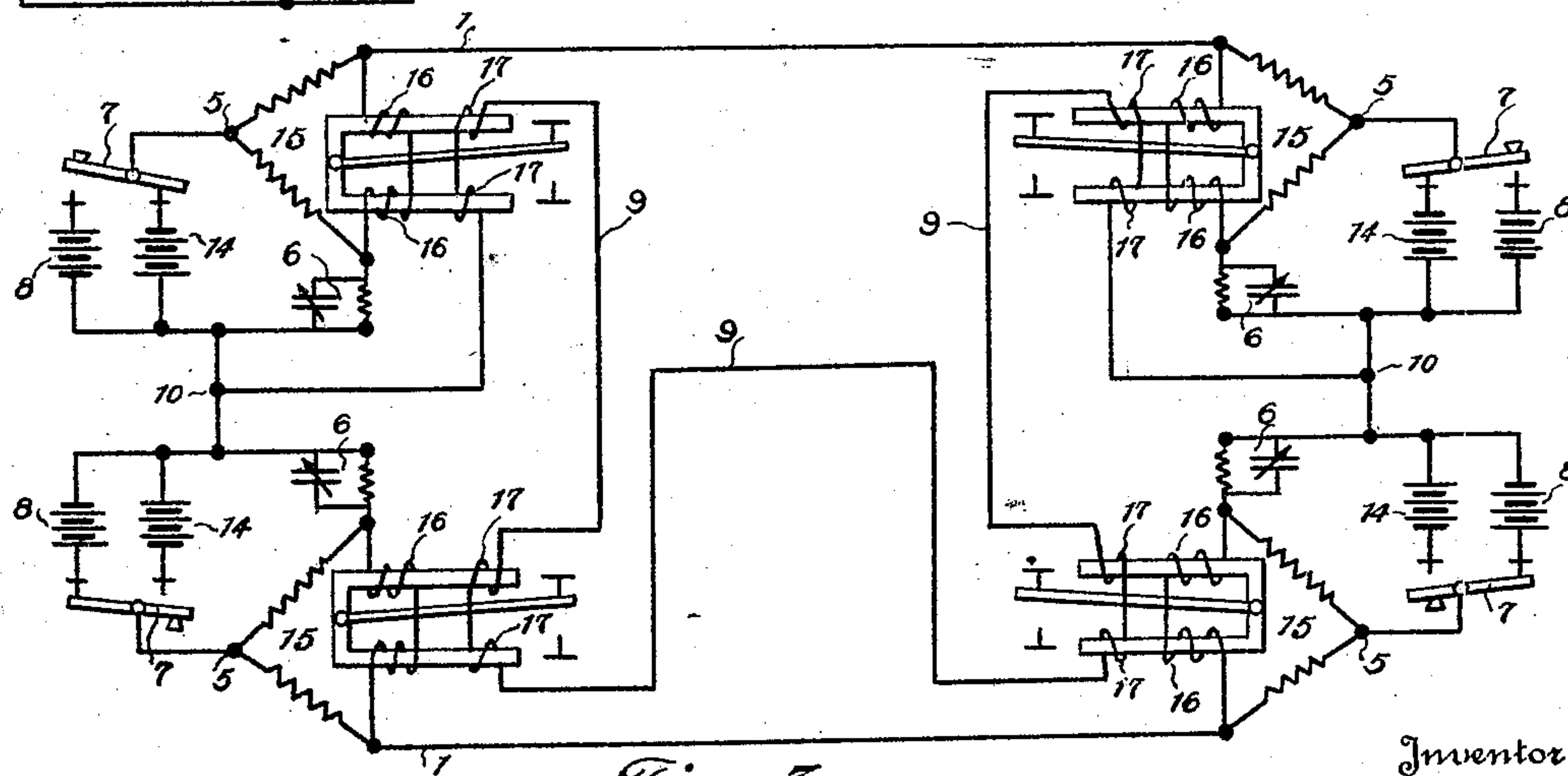


Fig. 3

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PLURAL DUPLEX SYSTEM OF TELEGRAPHY.

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The present invention relates to duplex systems of telegraphy.

As commonly used, duplex systems of the prior art utilize a single line conductor together with a ground return circuit, and a balancing artificial line at each terminal station in which an effort is made to duplicate the electrical characteristics of the line circuit in order that a perfect balance so far as possible, may be established. Owing to the external disturbances which affect the line circuit, and the ground potential variations at the grounded terminals, the extraneous currents flowing in such lines are at times of sufficient magnitude to prevent the practical operation of the circuits. The ground currents become particularly troublesome during the occurrence of the aurora borealis and other atmospheric electrical disturbances, so that in certain installations the ground return must be replaced by a metallic return circuit. When this substitution is made, however, the disturbances induced in the line by induction still occur but are usually reduced in magnitude.

An object of the present invention is to provide a means whereby a plurality of such duplex circuits may be operated over one return conductor, instead of providing an individual return wire for each of the duplex circuits.

By providing artificial balancing lines of electrical characteristics which are proportional to the values required to establish a balance rather than equal to the balancing values as is the common practice, and relying upon special winding arrangements in the return circuit to complete the balancing effect, and at the same time to neutralize extraneous currents, an improved plural metallic duplex arrangement is provided with the addition of a single extra line. In this way, for two complete metallic duplex circuits only three line conductors are required. For three metallic circuits ordinarily six line conductors are required, but by the application of the present invention only four are needed. Accordingly, another object of the invention is to provide a plural duplex metallic circuit arrangement in which the number of conductors are reduced to a minimum.

It is found that by the application of the special windings and proportional artificial

line arrangements in grounded plural duplex systems, improved ground return systems are provided in which a balance may be more readily effected and attained, and in which increased operating currents are obtainable. A further object of the invention is therefore the provision of improved ground return systems without the addition of an extra line.

Still other objects of the invention will appear in the appended claims and the following detailed description of preferred embodiments of the invention of which—

Fig. 1 shows a metallic system with two differential duplex lines using current and no-current signalling conditions.

Fig. 2 shows a metallic polar system with two differential duplex lines.

Fig. 3 shows a metallic bridge duplex arrangement in which the principles of the invention are applied.

Referring to Fig. 1, the lines 1 are connected at their ends through coils 2 of differential receiving relays 3. Windings 4 of relays 3 are connected between points 5 of the line circuit and the artificial or balancing lines 6. Transmitting keys 7 are connected to points 5 and are adapted to connect one of the terminals of transmitting batteries 8 or other sources of transmitting potential in the circuit. The other terminals of batteries 8 and of artificial lines 6 are connected to a return conductor 9 at points 10, and windings 11 applied to relays 3 are connected in series in conductor 9. On the back contacts keys 7 complete metallic circuits through branches 12 to points 10.

The windings 2 and 4 are arranged so that transmitted currents passing outward from points 5 over winding 2 to line 1 will set up magneto-motive forces which will be opposed by the magneto-motive forces set up by the currents passing outward from points 5 through windings 4 and artificial lines 6, while incoming currents will pass around windings 2 and 4 in well known manner to cause the magneto-motive forces caused thereby to add. The constants of artificial lines 6 are proportional but not equal to the main line constants or the constants necessary to establish a balanced condition, so that more current will pass through windings 4 than will pass through windings 2 with a result that the magnetic forces devel-

oped by transmitted currents in these windings will not balance. The windings 11 on relays 3 are, however, so proportioned and arranged that the magnetic effect thereof due to the returning currents, will be added to the magnetic effect of windings 2 in a manner to balance the magnetic effects of the transmitted impulses. It will be noted that for the received impulses, the direction of current in windings 2, 4 and 11 are such that the magneto-motive forces are added, and the result is an increased pull on the receiving relay over and above that which may be obtained using ordinary two coil differential relays.

In operation, for transmitted currents at any station, the effect of windings 2 and 11 will balance the effect of winding 4; but for received currents the effects of windings 2, 4 and 11 will be added to operate the relays 3, and duplex transmission may be carried on simultaneously over each line circuit 1. It will be apparent that a plurality of metallic return paths are provided in this arrangement with the addition of only one extra line, and for this reason, for the same values of applied potential higher operating currents are available than in single metallic duplex systems. For two duplex circuits on three line conductors a ratio of main circuit to artificial circuit constants of 3:2 will give excellent results; for three circuits on four conductors a ratio 4:3 may be used; for four circuits on five conductors the ratio may be 5:4 and so on, but it will be understood that these values may be varied within wide limits and the proportions of the relay windings may be varied accordingly.

In Fig. 2, a plural duplex arrangement using impulses of opposite polarities and polarized receiving relays is shown. The only change over the form shown in Fig. 1 is in the addition of suitable transmitting batteries 14 in the branches 12 so that when the keys 7 are open, potentials of a polarity opposite to the potentials when the keys are closed will be applied to the line. The proportions, arrangement and operation are readily understood from the description in connection with Fig. 1 and need not be repeated here.

The invention is applicable to bridge duplex systems and such an arrangement is shown in Fig. 3. The receiving relays 15 have windings 16 thereof connected in a bridge between line 1 and artificial line 6, and windings 17 thereof are connected in series in return conductor 9. The ends of 9 are connected at points 10 between the artificial lines 6 and the batteries 8. Artificial lines 6 have electrical characteristics which are proportional to but not equal to the characteristics of the corresponding main circuits, as above set forth, so that when signals are transmitted, an unbalanced cur-

rent will flow from through the winding 16 of the home relay. Windings 17 in line 9 are, however, so proportioned and arranged that the magnetic effect of this unbalanced flow in windings 16 will be compensated by the flow of the returning current in line 9. Because of the wide difference in characteristics of the main and balancing circuits, the unbalanced currents will always flow in the same direction through windings 16, and windings 17 may be properly designed to compensate therefor. For the received currents, the magnetic effect of windings 16 and 17 will add, and the relays will respond in accordance therewith.

By grounding the return line 9 at each station after it has passed through windings 11 in Figs. 1 and 2, or windings 17 in Fig. 3, the section of conductor 9 between the stations may be eliminated and an improved ground return system is provided using the proportional artificial lines and return circuit compensating windings.

Having described preferred embodiments of the invention, what is desired to be secured by Letters Patent and claimed as new is:

1. The method of operating a duplex system which comprises establishing a definite unbalanced condition in the home receiving relay, and compensating for the unbalanced condition by the current flowing in the return circuit of the system.

2. A duplex system comprising a main line circuit, and an artificial line circuit maintained in definitely unbalanced relation with respect to said main line circuit.

3. A duplex system comprising a main line, an artificial line maintained in definitely unbalanced relation with respect to said main line, and a return circuit for said main line.

4. The system as set forth in claim 3 together with a relay having a winding connected in said return circuit.

5. The system as set forth in claim 3 in which said return circuit is entirely metallic.

6. The system as set forth in claim 3 together with a relay having a winding in series with said main line, a winding in series with said artificial line, and a winding in series in said return circuit.

7. A duplex system comprising a plurality of main line conductors, artificial lines individual to said main line conductors, a common return circuit for said main line conductors, electro-responsive receiving means individual to each of said main line circuits, and a winding individual to each of said receiving means mounted in said return circuit, said return circuit being entirely metallic and said winding being connected in series therein.

8. A duplex system of telegraphy comprising a main line, an artificial line having

impedance different from that of said main line, a receiving relay having a plurality of windings, two of said windings connected in series respectively with the main line and
5 another winding connected with the artificial line, said windings being arranged in such a manner that the magnetic pull developed in the relay from a given received current is greater than the magnetic pull developed in a two-equal-coil differential relay 10 by an equal received current.

In testimony whereof I affix my signature.

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