May 11 , 1926. 1,584,682

A. ATHERTON ET AL

DUPLEX TELEGRAPH SYSTEM

Filed July 23, 1924

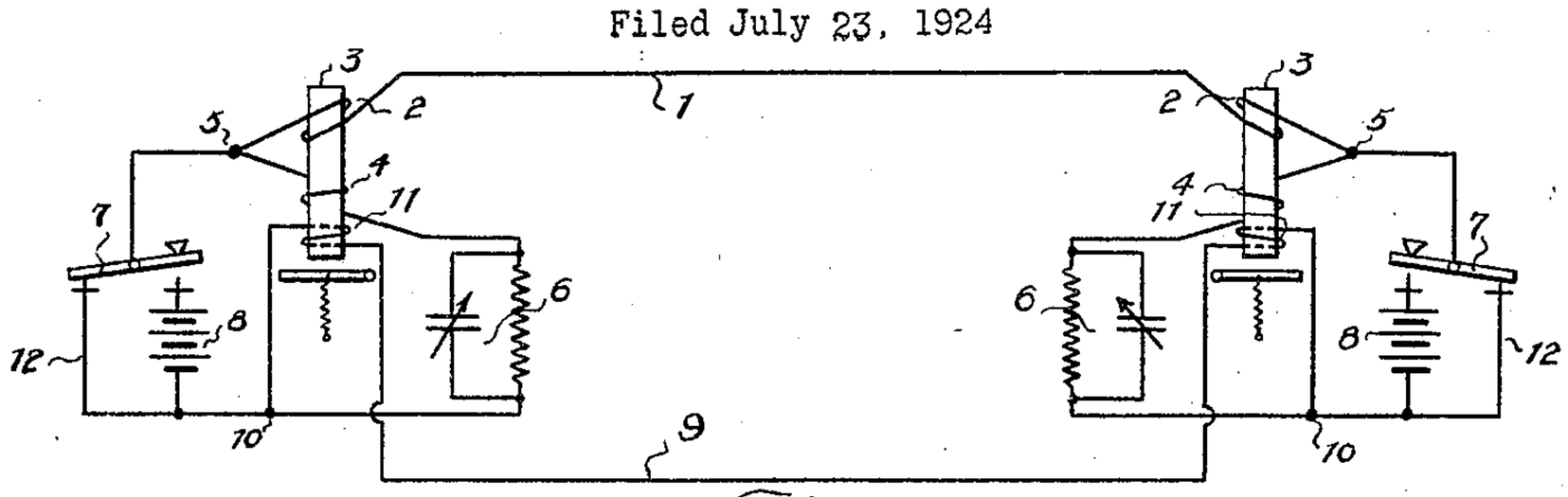

Fig. 1

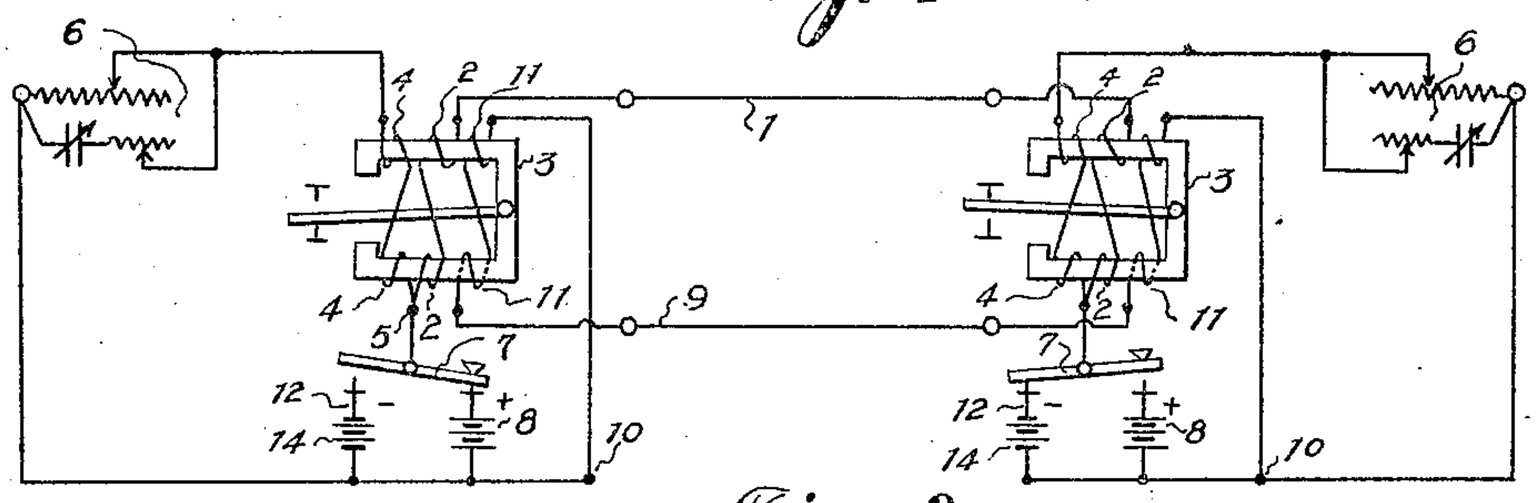

Fig. 2

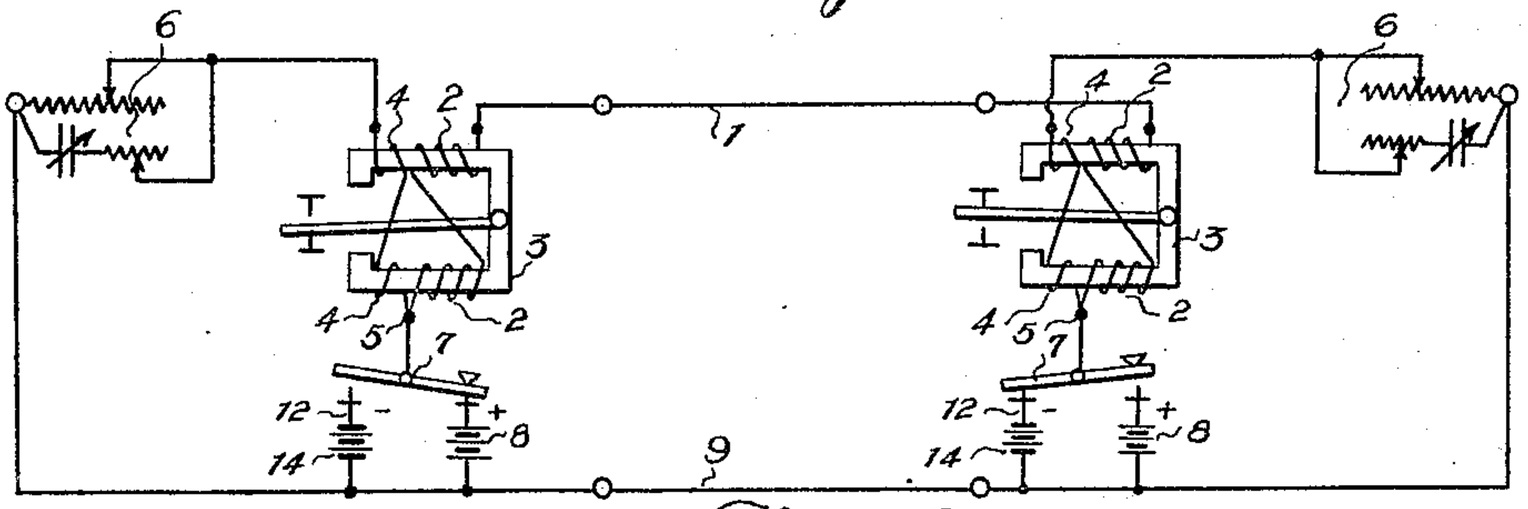

Fig. 3

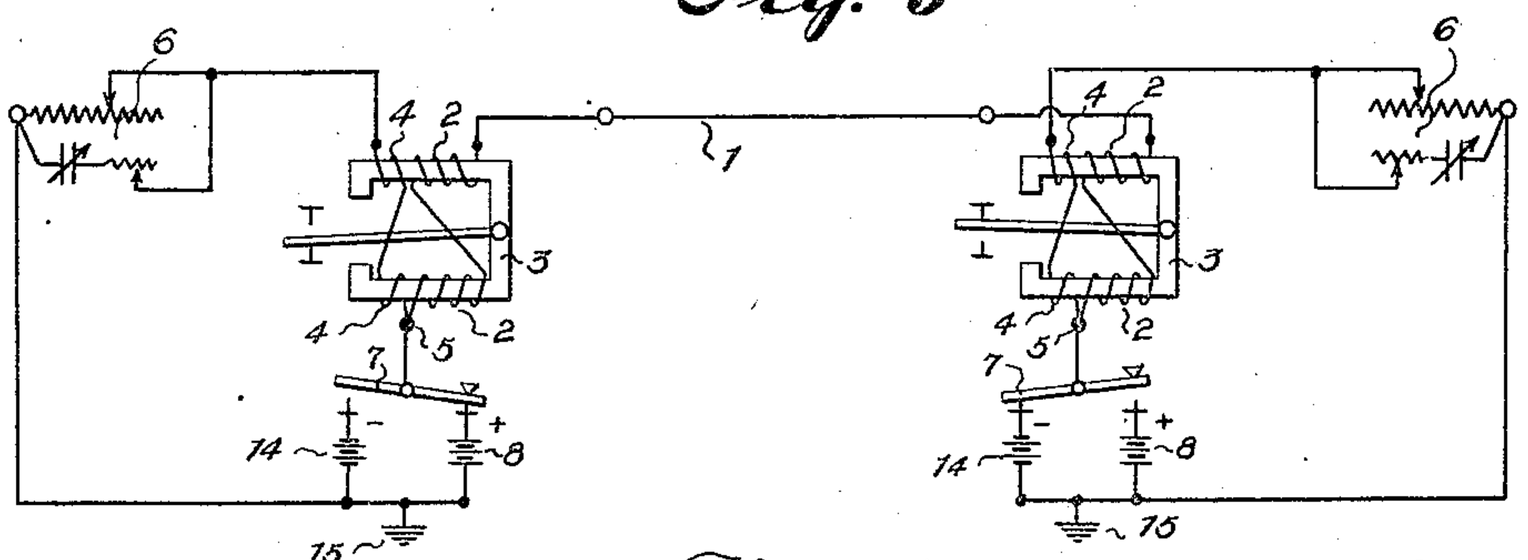

Fig. 4.

Inventors:
Albert Atherton
and George H. Janson

By
Eugene C. Brown
Attorney

Patented May 11, 1926. 1,584,682

UNITED STATES PATENT OFFICE.

ALBERT ATHERTON, OF WOODHAVEN, NEW YORK, AND GEORGE W. JANSON, OF NUTLEY, NEW JERSEY, ASSIGNORS TO THE WESTERN UNION TELEGRAPH COMPANY, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

DUPLEX TELEGRAPH SYSTEM.

Application filed July 23, 1924. Serial No. 727,750.

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 at times are 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 novel metallic duplex arrangement in which compensation is made for extraneous inductive, static, and like line circuit disturbances. This is in general accomplished by providing artificial balancing lines of electrical characteristics proportional to, rather than equal to the line characteristics and relying upon special relay winding arrangements to effect a balance, and at the same time to neutralize the extraneous currents induced in the line.

By applying the invention to existing circuits it is possible to produce decided increases of magnetic effects due to received currents in the relays. This makes possible operation with lowered line current values and potentials while maintaining the required magnetic pull in the relays to give satisfactory operation. Another object of the invention is the provision of efficient metallic circuit arrangements making possible satisfactory operation with lowered line currents and potentials.

It is found that by the application of the special windings and proportional artificial line arrangements in grounded duplex systems, improved ground return systems are provided in which a balance may be more readily effected and attained, 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 two-wire metallic differential duplex form, using three coil receiving relays and current and no-current signalling conditions.

Fig. 2 shows a two wire metallic polar differential duplex system embodying the invention.

Fig. 3 shows a modified metallic polar differential duplex system in which two unequal coils are utilized on the relays.

Fig. 4 shows a grounded duplex system utilizing relays with two unequal coils.

Referring to Fig. 1, the line 1 is connected at its 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 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 magnetomotive forces which will be opposed by the magnetomotive 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 so that more current will pass through windings 4 than will pass through windings 2 with a result that the magnetic forces developed 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 practice excellent results have been attained by adopting a ratio of 2:1 between the electrical constants of the main circuit and the artificial line, but it will be understood that by suitably proportioning the relay coils this ratio may be varied within wide limits and to suit the particular conditions to be met in individual circuits. The form shown in Fig. 1 is for a circuit using current and no-current impulses, but the invention is obviously applicable to circuits using polarized relays and signalling currents of opposite polarities.

In Fig. 2, a duplex arrangement using impulses of opposite polarities and polarized receiving relays is shown. The only change in connections 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 advantages of increased magnetic pull and effective operating currents obtained by use of the forms disclosed in Figs. 1 and 2 may also be attained by the use of two unequal windings applied on the receiving relays 3. Such an arrangement is disclosed in Fig. 3 which differs from the arrangement shown in Fig. 2 in that the main line windings 2 are materially increased in size, and the windings 11 in the return circuit 9 are eliminated. Windings 2 and 4 are so chosen and the artificial line constants are proportioned to the main line constants in such manner that the total ampere turns in windings 2 and 4 produced by transmitted currents are equal. The magnetic effect of transmitted currents will accordingly balance in the home relays, and the relays at each station will be actuated in accordance with the polarity of the received impulses only. The received impulses will pass from the main line 1 through coils 2 and 4 in series then through artificial line 6 and will return to the transmitting station through line 9. It will be noted that for incoming impulses the magnetic effects of coils 2 and 4 will be additive; giving for the same operating line currents, a decided increase in ampere turns in the receiving relays over and above what would be obtainable if the usual relays with two equal coils and artificial lines of constants equal to the main line constants are utilized. Accordingly, with this arrangement the actual line operating currents and potentials may be reduced from the values ordinarily required for satisfactory operation with equal coil relays.

The arrangement in Fig. 4, differs from that shown in Fig. 3, only in that the metallic return conductor 9 is eliminated and the return is completed by grounding at points 15.

In practice excellent results have been obtained by providing twice as many turns in windings 2 as are provided in windings 4, and proportioning the constants of artificial lines 6 so that twice as much transmitted current will flow in windings 4 as will flow in windings 2 and line 1. It will be understood, however, that these values may be varied widely to meet varying circuit conditions.

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

1. A duplex telegraph system comprising a main line circuit; artificial line circuits; receiving relays with certain windings thereof connected in series in said artificial line circuits and with other windings thereof connected in series in said main line circuit; said artificial line circuits being so proportioned with respect to said main line circuit that the outgoing currents in said first mentioned windings will differ substantially from the outgoing currents in said second mentioned windings.

2. The system as set forth in claim 1 in which said main line circuit comprises a metallic return conductor.

3. In a differential duplex system, a main line circuit; an artificial line circuit; and a receiving relay with a winding connected in series in said main line circuit and a winding connected in series in said artificial line circuit; said main line winding being provided with a number of turns substantially different from the number of turns in said artificial line.

4. The system as set forth in claim 3 in which the relative impedances of the main line and the artificial line, and the arrangement of said windings are such that the magnetic effects produced by outgoing currents in said windings will neutralize in the receiving relay.

5. In a differential duplex system, a main line circuit; an artificial line circuit, and a

receiving relay with a winding connected in series in said main line circuit and a winding connected in series in said artificial line circuit, said main line winding being provided with a number of turns substantially different from the number of turns in said artificial line, the relative impedances of the main line and the artificial line and the arrangement of said windings being such that the magnetic effects produced by outgoing currents in said windings will neutralize in the receiving relay, said main line circuit comprising a metallic return conductor.

6. In a duplex telegraph system comprising a main line, an artificial line, a receiving relay the proportions of the constants of the main line to the artificial line being 2 to 1.

7. The system as set forth in claim 6 in which the receiving relay comprises a winding in series with the main line and a winding in series with the artificial line.

8. A duplex system of telegraph comprising a main line, a receiving relay having a winding in series with the main line and a winding in series with the artificial line, and circuit connections whereby the magnetic pull due to received currents is greater than the sum of the magnetic pull in the two said windings.

9. A system as set forth in claim 8 in which said circuit connections include a third winding.

In testimony whereof we affix our signatures.

ALBERT ATHERTON.
GEO. W. JANSON.