May 29, 1923. 1,456,556

E. A. HUDSON

DUPLEX TELEGRAPH SYSTEM

Filed Dec. 29, 1921

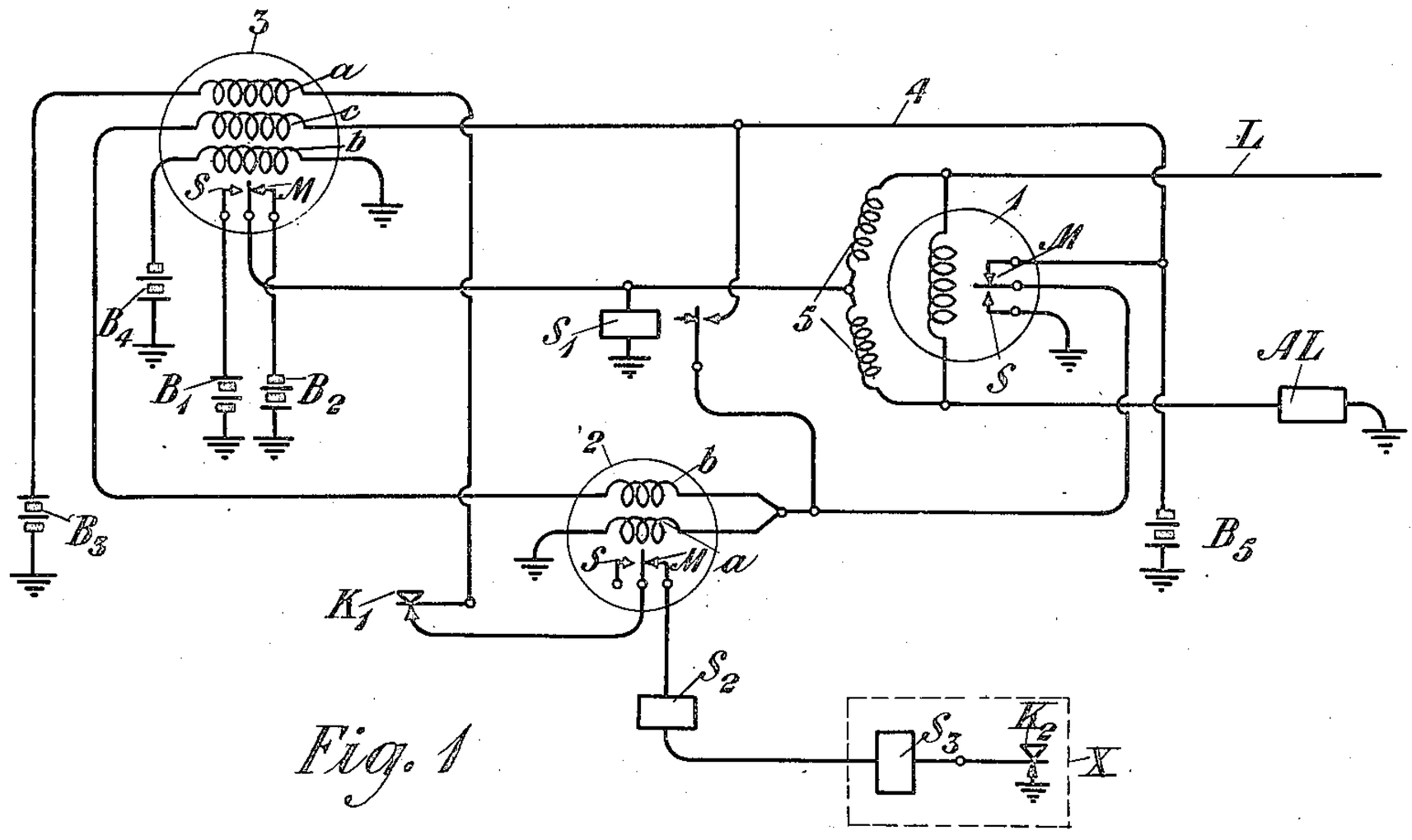

Fig. 1

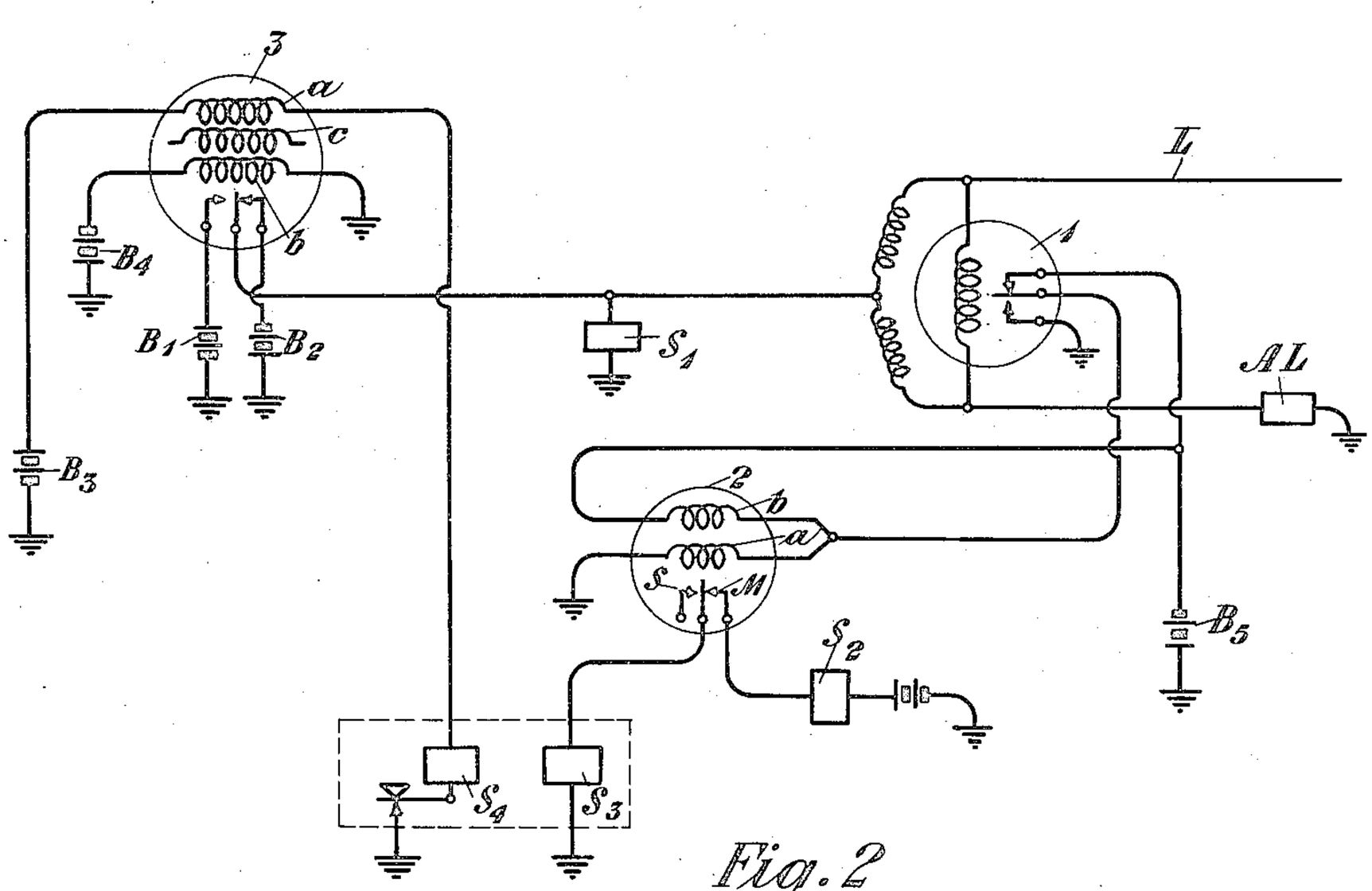

Fig. 2

INVENTOR
E. A. Hudson
BY
ATTORNEY

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UNITED STATES PATENT OFFICE.

EARL A. HUDSON, OF BROOKLYN, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

DUPLEX TELEGRAPH SYSTEM.

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To all whom it may concern:

Be it known that I, EARL A. HUDSON, residing at Brooklyn, in the county of Kings and State of New York, have invented certain Improvements in Duplex Telegraph Systems, of which the following is a specification.

This invention relates to duplex telegraph systems and the arrangements are suitable both for full duplex operation and half duplex operation. One of the cardinal features of the invention consists in utilizing polarized relays for the control and pole changer relays, which in former arrangements were of the neutral type. The arrangements of the invention accordingly permit the use of one type of relay throughout each duplex set in place of several different types used in former sets. Such standardization of equipment affords the advantage of greater interchangeability of equipment in the duplex set. Furthermore the arrangements of the invention give improved operating features and make it possible to eliminate certain of the supplementary contact springs of former duplex relay arrangements. Other features and advantages of the invention will appear more fully from the detailed description hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which are illustrated the arrangements of the invention as applied to a line suitable for half duplex and for full duplex operation respectively. Similar reference characters have been utilized to denote like parts in both figures.

In Fig. 1 is shown a line L terminating in a set suitable for half duplex operation. Line L is associated with the usual branched windings 5 and the balancing artificial line AL and there is associated therewith in the usual manner the polar line relay 1 including the marking and spacing contacts M and S. The line relay responds to the incoming signals from line L but not to the outgoing signals. The windings 5 are associated with the sounder S_1 and with the marking and spacing contacts M and S of the polarized pole changer relay 3. With these contacts are associated the oppositely poled batteries B_1 and B_2. Relay 3 has three windings, *a*, *b*, and *c*. Winding *a* is included in a local loop circuit comprising battery B_3, winding *a*, key K_1, marking contact M of the control relay 2, sounder S_2, sounder S_3 to key K_2 of the substation set X, to ground. The current in winding *a* tends to hold the armature of relay 3 on its marking contact M as shown. Winding *b* is included in a local circuit with battery B_4 and the current therein tends to hold the armature on the spacing contact S. Winding *c* is included in a circuit with battery B_5 and is controlled by the contacts of relay 1. This winding is known as a holding winding and tends to hold the armature of relay 1 on its marking contact when current is removed from the marking winding *a* by opening the loop circuit at the contact of the control relay 1 which would take place when the incoming signals operate relay 1 as will be pointed out later. Relay 2 is the control relay and includes the windings *a* and *b* which are differentially arranged for purposes which will be pointed out later. Relay 2 is also a polarized relay.

The arrangements of Fig. 1 operate in the following manner. It is assumed that similar equipment is connected to the distant end of line L and that a marking current is flowing through line relay 1. This marking current holds the armature of relay 1 on its marking contact M. Current then flows from battery B_5, through contact M, the armature circuit of relay 1, winding *a* of relay 2, to ground. No current at this time flows through winding *b* of relay 2 and winding *c* of relay 3, as both ends of the circuit through these windings are connected to the same side of battery b_5. The current through winding *a* of relay 2 will now hold the armature of said relay on its marking contact M closing the circuit from battery B_3, through winding *a* of relay 3, key K_1, contact M of relay 2, sounder S_2, and telegraph set at substation X, which includes sounder S_3 and key K_2. This current keeps the armature of relay 3 closed on its contact M. Sounder S_2 at the duplex set and sounder S_3 at the substation X are closed indicating to the operator at both points that a marking signal is being received.

When a spacing signal is received from

line L, it moves the armature of relay 1 from its contact M to contact S. While the armature is passing between these contacts, current flows from battery B_5, through conductor 4, winding *c* of relay 3, and windings *b* and *a* of relay 2, to ground. This current in winding *c* of relay 3 helps to hold the armature thereof on contact M, but in relay 2 windings *b* and *a* are opposing and have no effect upon the armature; consequently it remains on its contact M during this interval. When the armature of relay 1 reaches contact *s*, current is diverted from winding *a* of relay 2 by the short circuit to ground through said contact *s* of relay 1, and the current in winding *c* of relay 3 is somewhat increased by the removal of winding *a* of relay 2 from the circuit. This current holds the armature of relay 3 on contact M and moves the armature of relay 2 from contact M to contact S. Opening contact M of relay 2 removes current from winding A of relay 3 and from sounders S_2 and S_3. No change occurs at relay 3, as current in winding *c* still holds its armature on contact M, but sounders S_2 and S_3 are released, indicating to the operators at the duplex set and the substation that a spacing signal is being received.

When an incoming marking signal from line L again moves the armature of relay 1 to its marking contact M, the conditions first noted above are restored. However, while the armature of relay 1 is moving from the spacing to the marking contact, current flows through winding *c* of relay 3 and through windings *b* and *a* of relay 2. This current in relay 3 holds its armature on the marking contact, but in relay 2 it produces no effect, as windings *a* and *b* are opposing. The armature of relay 2 is therefore not moved to its marking contact until the marking contact of relay 1 closes.

If, when the circuits are normally closed, as shown in Fig. 1, either of the keys K_1 or K_2 in the local loop circuit are opened to transmit a spacing signal, current will cease to flow in winding A of relay 3. Thereupon the current which continually flows from battery B_4 through winding *b* will move the armature to the spacing contact *s*. A spacing signal will then be transmitted to the line. A small portion of this spacing current flows through sounder S_1, causing it to release, and the balance of the current divides at the apex of the windings 5, equal parts flowing through line L and artificial line AL in the usual manner and having no effect upon relay 1. Closing the key restores current to winding *a* of relay 3, and moves its armature to contact M, thus transmitting a marking signal, and closing sounder S_1. Thus signals passing over the line operate similar equipment at the distant end of the line to reproduce the signals in the same manner as described above. It is one of the functions of sounder S_1 to indicate to the operator at the duplex set that signals are being properly transmitted. Sounder S_1 is also polarized.

It is a further function of sounder S_1 to control the operation of the "break" which is a necessary feature of half duplex operation. When the operator opens the local loop circuit to give the "break" signal to get control of the line from the distant operator, the spacing current will operate sounder S_1. When the "break" signal is being transmitted it is necessary to prevent the incoming spacing signals which would operate the line relay from operating and opening the control relay which in turn would tend to lock the pole changer. This is accomplished by closing at the back contact of sounder S_1 a short circuit about the pole changer holding winding *c* and the control relay opening winding *b*. With this arrangement the operation of the line relay by an incoming spacing signal cannot then interrupt the "break" signal.

In Fig. 2 the arrangements of the invention are shown in a set adapted for full duplex operation. Similar reference characters have been used to denote like parts with respect to Fig. 1, Fig. 2 is substantially similar to Fig. 1 except that winding *c* of the pole changer relay 3 is inoperative and is not connected to winding *b* of control relay 2. Furthermore winding *b* of relay 2 is connected to battery B_5 in a slightly different manner than before. The principles of operation however are substantially similar to those already described and no further description thereof will be given.

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is understood that it is capable of embodiment in many and widely varied forms without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A duplex telegraph set comprising a polarized line relay, a polarized pole changer relay having marking, spacing and holding windings, a polarized control relay having marking and spacing windings differentially arranged, a circuit normally including in series both of the windings of said control relay and the holding winding of said pole changer relay, and means controlled by the operation of said line relay for short circuiting one of the windings of said control relay.

2. A duplex telegraph set comprising a polarized line relay, having marking and spacing contacts, a polarized pole changer relay having marking, spacing and holding windings, a polarized control relay having marking and spacing windings dif-

ferentially arranged, a circuit including in series both of the windings of said control relay and the holding winding of said pole changer relay, and means for short circuiting the marking winding of said control relay over the spacing contact of said line relay.

3. A duplex telegraph set comprising a polarized line relay, a polarized pole changer relay having marking, spacing, and holding windings, a polarized control relay having marking and spacing windings differentially arranged, a circuit including in series both of the windings of said control relay and the holding winding of said pole changer relay, means for controlling said circuit over the contacts of said line relay, and means controlled by said pole changer relay for closing a short circuit across first circuit between said relay windings and the contacts of said line relay.

4. A duplex telegraph set comprising a polarized line relay, a polarized pole changer relay having marking, spacing and holding windings, a polarized control relay having marking and spacing windings differentially arranged, a circuit normally including in series both of the windings of said control relay and the holding winding of said pole changer relay, and means controlled over the marking contact of said line relay for short circuiting said holding winding of said pole changer and one winding of said control relay.

In testimony whereof, I have signed my name to this specification this 28th day of December, 1921.

EARL A. HUDSON.