

April 13, 1926.

J. M. FELL

1,580,192

DUPLEX TELEGRAPH SYSTEM

Filed Sept. 20, 1924

2 Sheets-Sheet 1

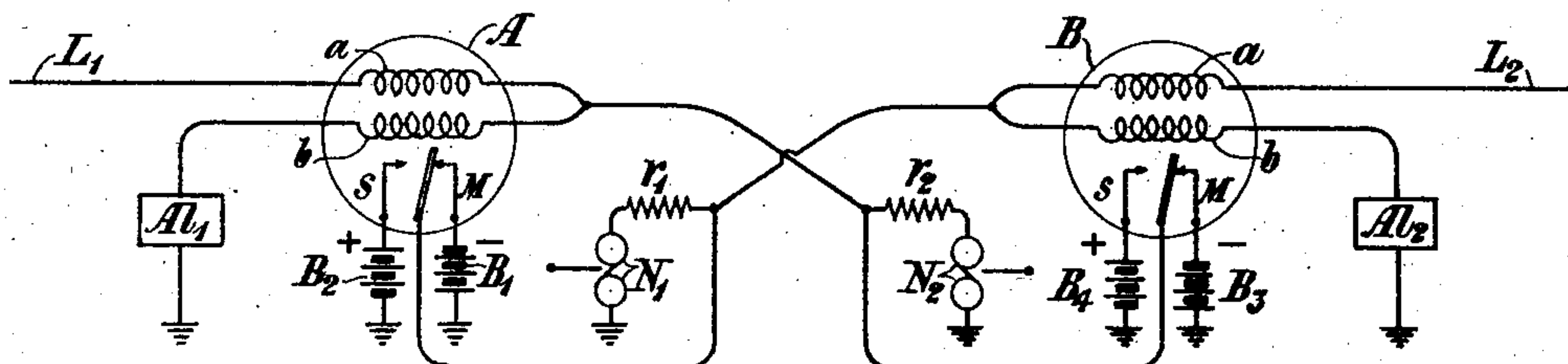


Fig. 1

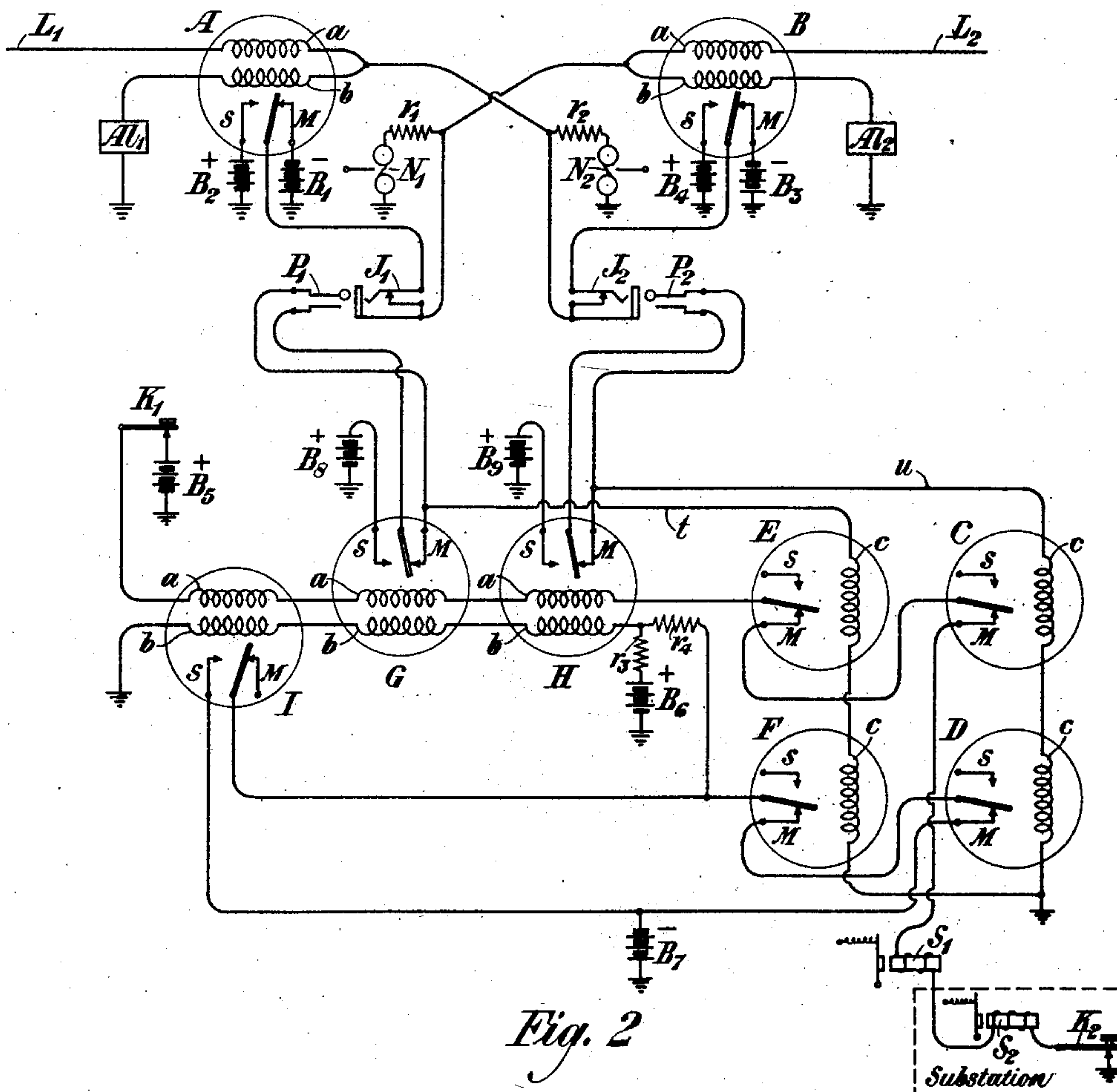


Fig. 2

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2 Sheets-Sheet 2

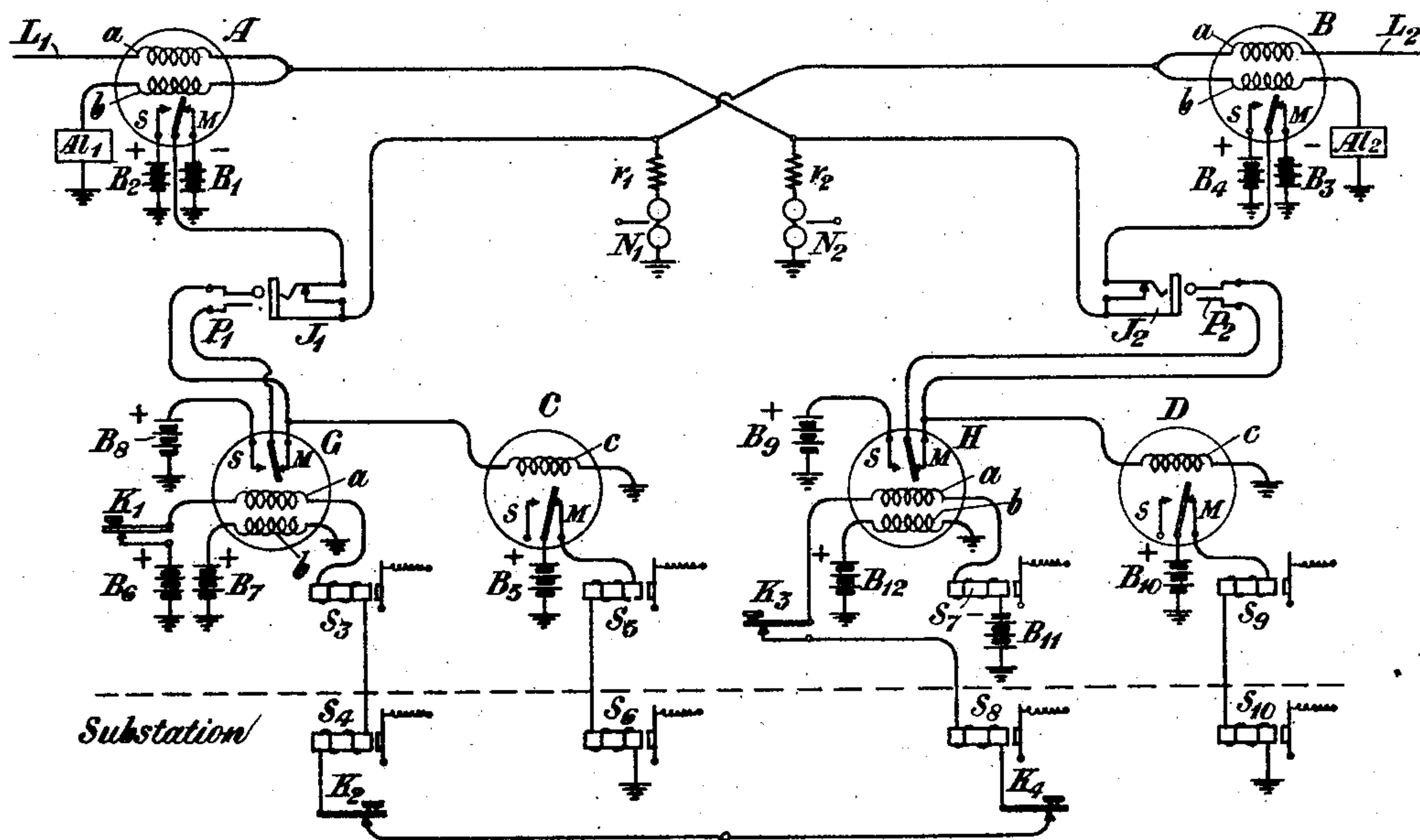


Fig. 3

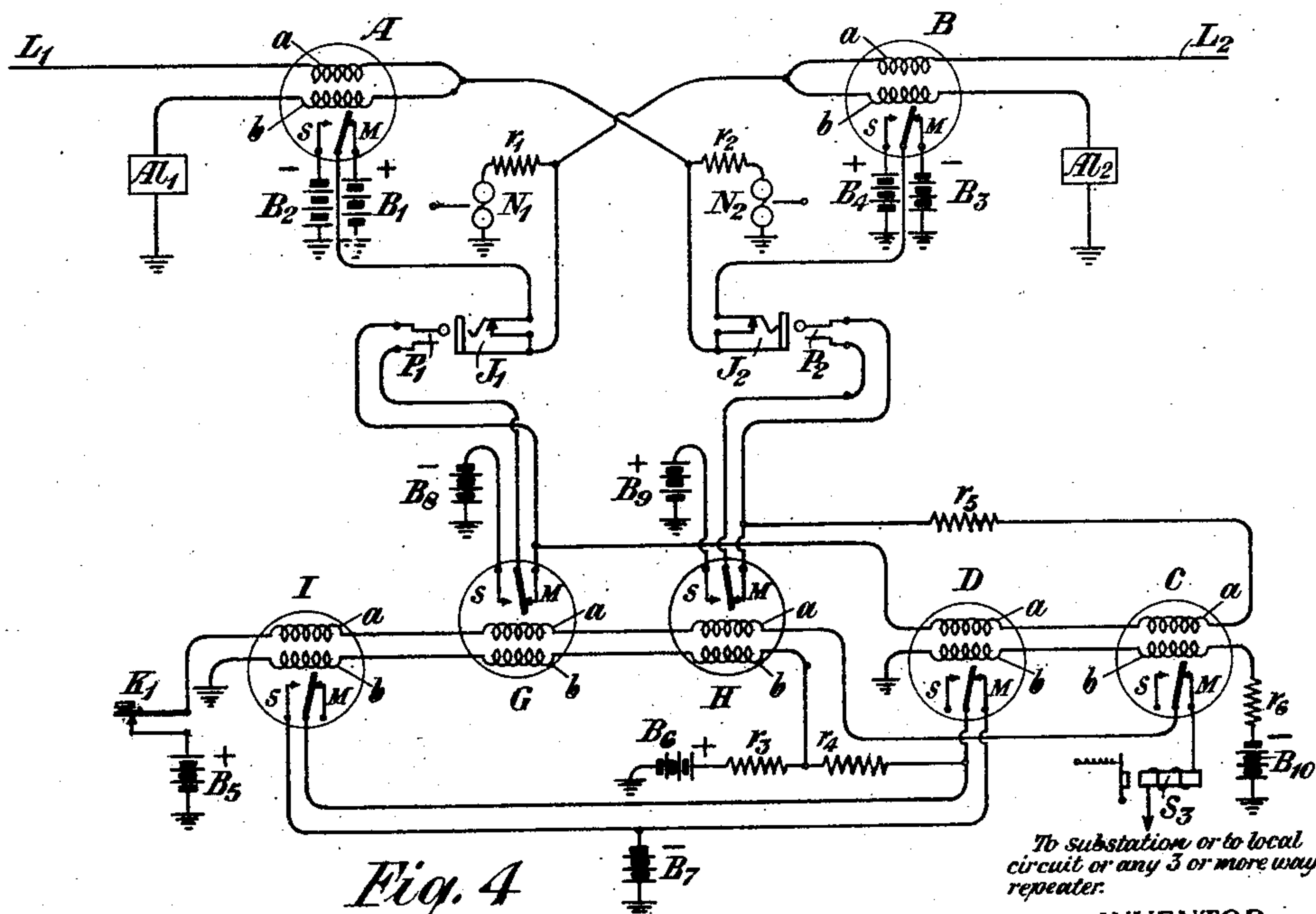


Fig. 4

To substation or to local circuit or any 3 or more way repeater.

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gator

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UNITED STATES PATENT OFFICE.

JOHN M. FELL, OF HACKENSACK, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

DUPLEX TELEGRAPH SYSTEM.

Application filed September 20, 1924. Serial No. 738,911.

To all whom it may concern:

Be it known that I, JOHN M. FELL, a citizen of the United States, residing at Hackensack, in the county of Bergen and State of New Jersey, have invented certain Improvements in Duplex Telegraph Systems, of which the following is a specification.

This invention relates to duplex systems, and particularly, to arrangements for adding local telegraph loop circuits or branch lines to telegraph repeaters used for through repeating in duplex telegraph systems. The arrangements of the invention may be utilized for full duplex operation, i. e., transmission both ways simultaneously, and for half-duplex operation, i. e., transmission one way at a time.

There is a limit to the length of telegraph lines that can be efficiently operated between any two stations. The more important of the limitations are the general electrical properties of the line and the quality of the service that must be maintained. When it is desired to operate a telegraph circuit of greater length than the normal operating limit, two or more lines of efficiently operable length are joined through telegraph repeaters, which receive the signals from one line and re-transmit them with new energy to the next line. The repeaters are often located at points where local telegraph stations must be operated in connection with a through line. One of the features of this invention is to provide a simpler, more economical type of through repeater for installation at the repeater stations, and to provide a limited number of comparatively inexpensive units, each of which may be connected to any repeater for the purpose of operating local telegraph loops or branch lines in connection with the through circuit. Other features and advantages of the invention will appear more fully from the detailed description hereinafter given.

In outlining the invention above and hereinafter describing it, the arrangements for a differential type of duplex repeater for grounded lines have been referred to. Embodiments of the invention are obtainable for other types of repeaters for grounded lines, for metallic telegraph repeaters and

for mechanical type repeaters of the carrier telegraph system.

The invention will be more fully understood when read in connection with the accompanying drawing, in which Fig. 1 is a circuit diagram of a through repeater, Fig. 2 is a circuit diagram of an arrangement for operating a loop at the repeater station in a half duplex system, Fig. 3 is a circuit diagram of an arrangement for operating loops at the repeater station in a full duplex system, and Fig. 4 is a circuit diagram of a modification of the arrangements of Fig. 2, suitable for half duplex operation.

Referring to Fig. 1, lines L_1 and L_2 , and the balancing artificial lines Al_1 and Al_2 are associated with a through repeater, the essential parts of which are diagrammatically represented. The armature of relay A moves between the marking and spacing contacts M and S of said relay, thereby alternately connecting the oppositely poled batteries B_1 and B_2 respectively, and the armature of relay B moves between its contacts so as to alternately connect the oppositely poled batteries B_3 and B_4 .

For signals originating in line L_1 relay A responds, and repeats the signal impulses into the circuit extending to the apex of relay B. At this point the impulses divide between line L_2 and the artificial line Al_2 in the usual way, having no effect upon relay B. The impulses passing over line L_2 operate the receiving relay at the distant end of the line. A branch circuit extends from the armature of relay A through resistance r_1 and the polarized sounder N_1 . A small portion of the signal impulses flows in this branch circuit, operating sounder N_1 to reproduce the signals for monitoring purposes. Similarly, the signals originating in line L_2 operate relay B, which repeats them into line L_1 and sounder N_2 .

Figure 2 diagrammatically represents an arrangement for operating a loop at the repeater stations when the duplex system is used for half duplex operation, i. e., for transmission one way at a time. In this arrangement jacks J_1 and J_2 are added to the through repeater and plugs P_1 and P_2 are inserted in jacks J_1 and J_2 respectively,

for the purpose of connecting equipment for operating a loop circuit. The tip conductor of plug P_1 engages the long spring of jack J_1 , thereby connecting the armature of relay A to the marking contact of relay G, and the sleeve of plug P_1 engages the shell of jack J_1 , thereby connecting the apex of the windings a and b of relay B to the armature of relay G. The tip conductor and the sleeve of plug P_2 engage, respectively, the long spring and the shell of jack J_2 , thereby connecting the armature of relay B with the marking contact M of relay H and the apex of the windings a and b of relay A with the armature of relay H.

The circuit from the armature of relay A thus passes through the armature of relay G before it reaches the apex of relay B. There is also a circuit from the tip side of plug P_1 through conductor t and the c windings of relays E and F to ground. Hence, a portion of the signal impulses flows through this branch circuit and operates relays E and F. Relay E repeats the signals into the loop circuit, which includes a monitoring sounder S_1 and may extend to a sub-station to operate sounder S_2 . Relay F causes relays I, G and H to be locked in their closed positions by current from the battery B_6 when the other windings of these relays are opened by the contact of relay E, as explained in applicant's copending application entitled "Duplex telegraphy", filed November 16, 1921, Serial Number 515,643.

The operation of the arrangements of Fig. 2 is as follows: Signals originating in line L_1 are repeated by relay A through the closed contact of relay G to line L_2 , and through the branch circuit of conductor t to the c windings of relays E and F. Relay E repeats the signals into the connected circuit while relay F prevents repetition of these signals back to the through line. Similarly, signals originating in line L_2 are repeated by relay B through the closed contact of relay H to line L_1 , and through the branch circuit from plug P_2 and conductor u to the c windings of relays C and D. Relay C repeats the signals into the loop circuit and relay D causes relays I, G and H to be locked.

By operating keys K_1 or K_2 signals originating in the loop circuit operate relays I, G and H. Relay G repeats these signals into line L_2 , and relay H into L_1 , marking currents for relays G and H being obtained from batteries B_1 and B_3 through the marking contacts of relays A and B, respectively, and the spacing currents from batteries B_8 and B_9 , respectively. The function of relay I which is to insure the transmission of a break signal from the loop circuit is fully explained in the copending application mentioned heretofore, filed No-

vember 16, 1921, Serial Number 515,643. The local circuit is of the type known as "the three or more way" and can be operated in series with similar circuits of other duplex repeaters, and, thus, other lines may be connected to the through line at any repeater station.

When the system is operated full duplex, i. e., simultaneous messages in both directions, loops may be added at a through repeater as diagrammatically represented in Figure 3. The local loop circuits are connected to the through repeater by inserting plugs P_1 and P_2 in jacks J_1 and J_2 , respectively.

Incoming signals from the westerly line L_1 are repeated by relay A through the marking contact M of relay G to line L_2 , current also flowing through the branch circuit which includes winding c of relay C. Relay C repeats the signals into the loop circuit, which includes the sounder S_5 at the repeater station and sounder S_6 at the sub-station. Similarly, signals from the easterly line L_2 operate relay B and are repeated through the marking contact M of relay H to line L_1 , current also flowing through winding c of relay D. Relay D repeats these signals into the loop circuit, which includes sounder S_9 at the repeater station and sounder S_{10} at the sub-station.

It is possible with the arrangements of Fig. 3 to transmit messages to either or both lines L_1 or L_2 as it may be required. When switch Q is opened the sub-station may transmit to both lines by operating key K_2 or key K_4 , which control the pole changing relays G and H, or the sub-station may transmit to line L_2 only, by closing switch Q and operating key K_2 which then controls pole changing relay G only, or to line L_1 only, by operating key K_4 with switch Q closed. For such transmission of messages from the sub-station, batteries B_1 and B_3 supply the marking currents, and batteries B_8 and B_9 supply the spacing currents.

Figure 4 is a modification of the arrangements of Figure 2, in which two relays, C and D, are used in place of the four relays C, D, E and F of Figure 2. This arrangement is suitable for half duplex operation, i. e., transmission one way at a time.

Marking and spacing signals in either line L_1 or L_2 will be repeated in exactly the same manner as heretofore described. The relays represented as C and D have two windings each. The a winding of these relays are included in a circuit with resistance r_7 from the tip side of plug P_1 to the tip side of plug P_2 . The b windings of these relays are included in the local circuit with battery B_{10} and resistance r_6 . A small current through this latter circuit tends to keep the relay

armatures on their spacing contacts. When the armatures of relays A and B are against the marking contacts battery B₃ will assist battery B₁ in sending a current through the α windings of relays C and D, and consequently, the armatures are held on their marking contacts M. When the armature of either relay A or relay B is moved to its spacing contact S, no current flows through the α windings of relays C and D, since the batteries at opposite ends of the circuit which includes the α windings are then alike in potential and polarity. The armatures of relays C and D are therefore moved to their spacing contacts. Relay C controls the loop circuit, including sounder S₃ and possibly a sounder at the sub-station, and relay D controls the locking feature of relays I, G and H, as heretofore described. It is obvious also that if the armatures of relays A and B are on their spacing contacts at the same time, the direction of the current through relays C and D is reversed and the armatures of these relays are moved to their spacing positions.

For transmission of signals from the sub-station to lines L₁ and L₂, key K₁ or a key at sub-station is operated. Upon opening the key no current flows from the battery B₅ through the α windings of relays I, G and H and the armatures of said relays move to the spacing contacts. Battery B₈ energizes line L₂ for a spacing signal, and battery B₉ energizes line L₁ for a like signal. Upon closing the key current again flows through the α windings of relays I, G and H, and the armatures of said relays move to the marking contacts. Battery B₁ supplies the energy necessary to transmit the marking signal to line L₂ and battery B₃ supplies the energy for transmission of the marking signal to line L₁.

While the invention has been disclosed in certain specific arrangements which are deemed desirable, it is to be 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. In a duplex telegraph system, a through repeater in which a polarized pole changing relay is associated with the first line, and a polarized pole changing relay is associated with the second line, each repeating signals to the other line, means for connecting a loop circuit to said through repeater, a repeating relay for repeating signals in said lines to said loop circuit, a control relay operated simultaneously with said repeating relay actuating the means to prevent the retrans-

mission of signals to said lines, and means for transmitting signals from said loop circuit to said lines.

2. In a duplex telegraph system, a through repeater in which a polarized pole changing relay is associated with the first line, a polarized pole changing relay is associated with the second line, means for connecting a local loop circuit to said through repeater, a repeating relay for retransmitting signals in said first line to said loop circuit, and a repeating relay for retransmitting signals in said second line to said loop circuit, relays actuated simultaneously with said repeating relays to prevent the retransmission of the signals received in said loop circuit to said lines, and means for transmitting signals from said loop circuit to said lines.

3. In a duplex telegraph system, a through repeater for repeating signals in a first line to a second line, or vice versa, a sounder for monitoring signals in said first line, a sounder for monitoring signals in said second line, plugs and jacks arranged to connect a loop circuit with said through repeater, a relay to control the reception at said loop circuit of signals in said lines, a relay to control means for locking said loop circuit to prevent the repetition of incoming signals to said lines, and means for transmitting signals from said loop circuit to said lines.

4. In a duplex telegraph system, a through repeater for repeating signals in a first line to a second line, or vice versa, said through repeater comprising a polarized pole changing relay associated with said first line, and a polarized pole changing relay associated with said second line, plugs and jacks to connect a loop circuit to said through repeater, a sub-station associated with said loop circuit, said sub-station having a sounder and a key to receive signals from and to transmit signals to said lines, repeating relays actuated simultaneously by said polarized pole changing relays, each of said repeating relays retransmitting signals in each of said first and second lines, respectively to said sub-station; two polarized relays operated simultaneously and associated with said first and second lines, said polarized relays being locked when signals are being received at said sub-station from said lines, and unlocked when signals are being transmitted to said lines from said sub-station, relays actuated simultaneously with said repeating relays to regulate the locking element of said polarized relays.

In testimony whereof, I have signed my name to this specification this 16th day of September, 1924.

JOHN M. FELL.