

Oct. 6, 1925.

1,555,870

H. NYQUIST

TELEGRAPH REPEATER

Filed June 27, 1923

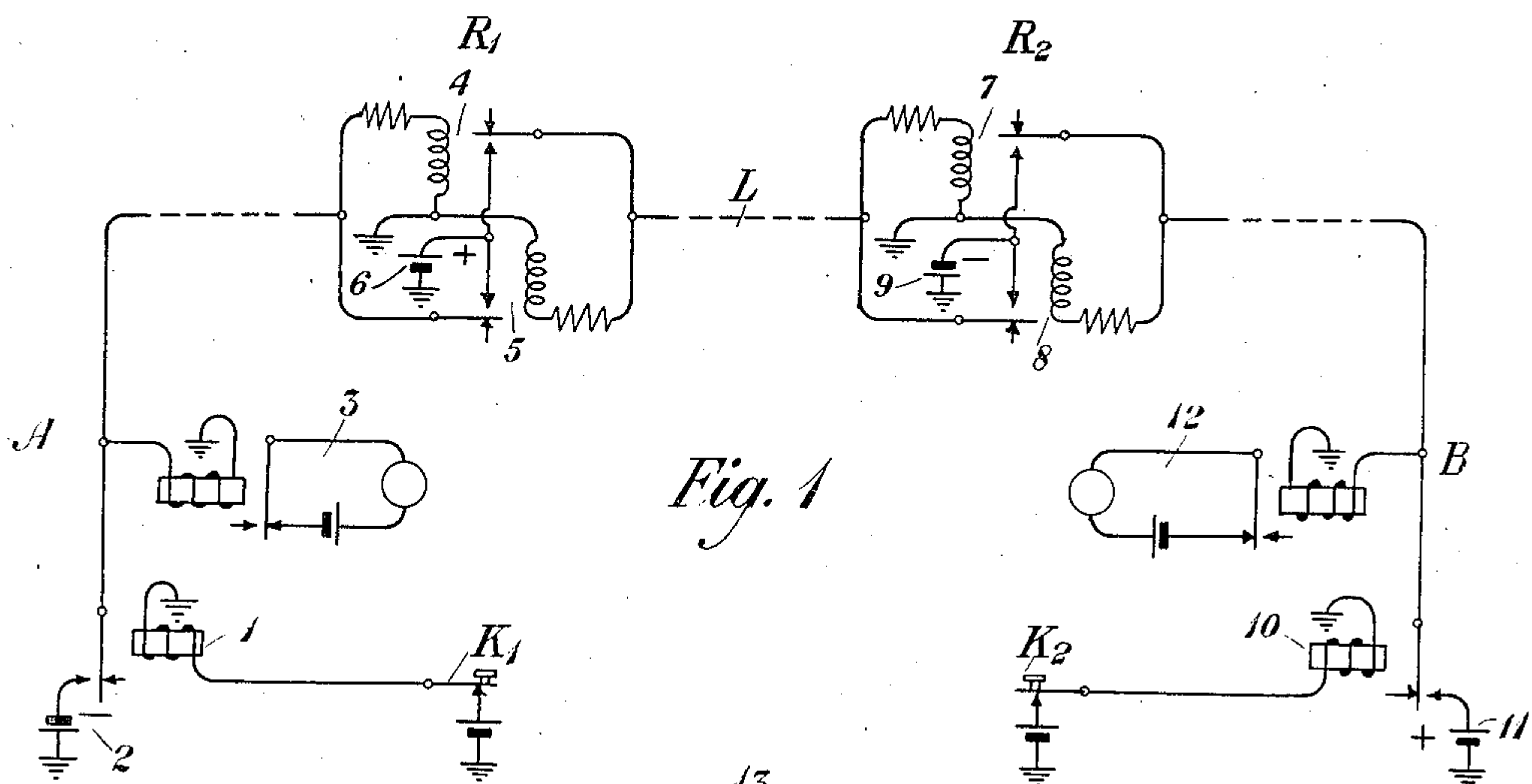


Fig. 1

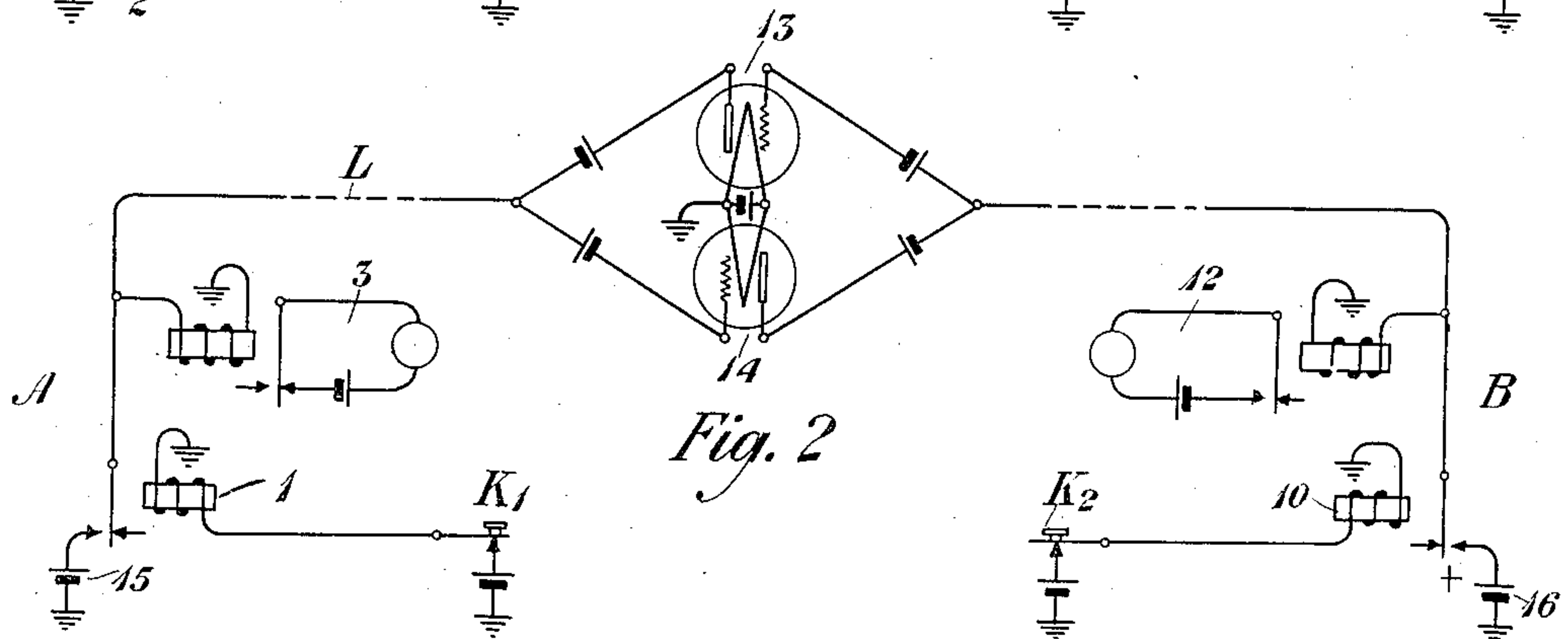


Fig. 2

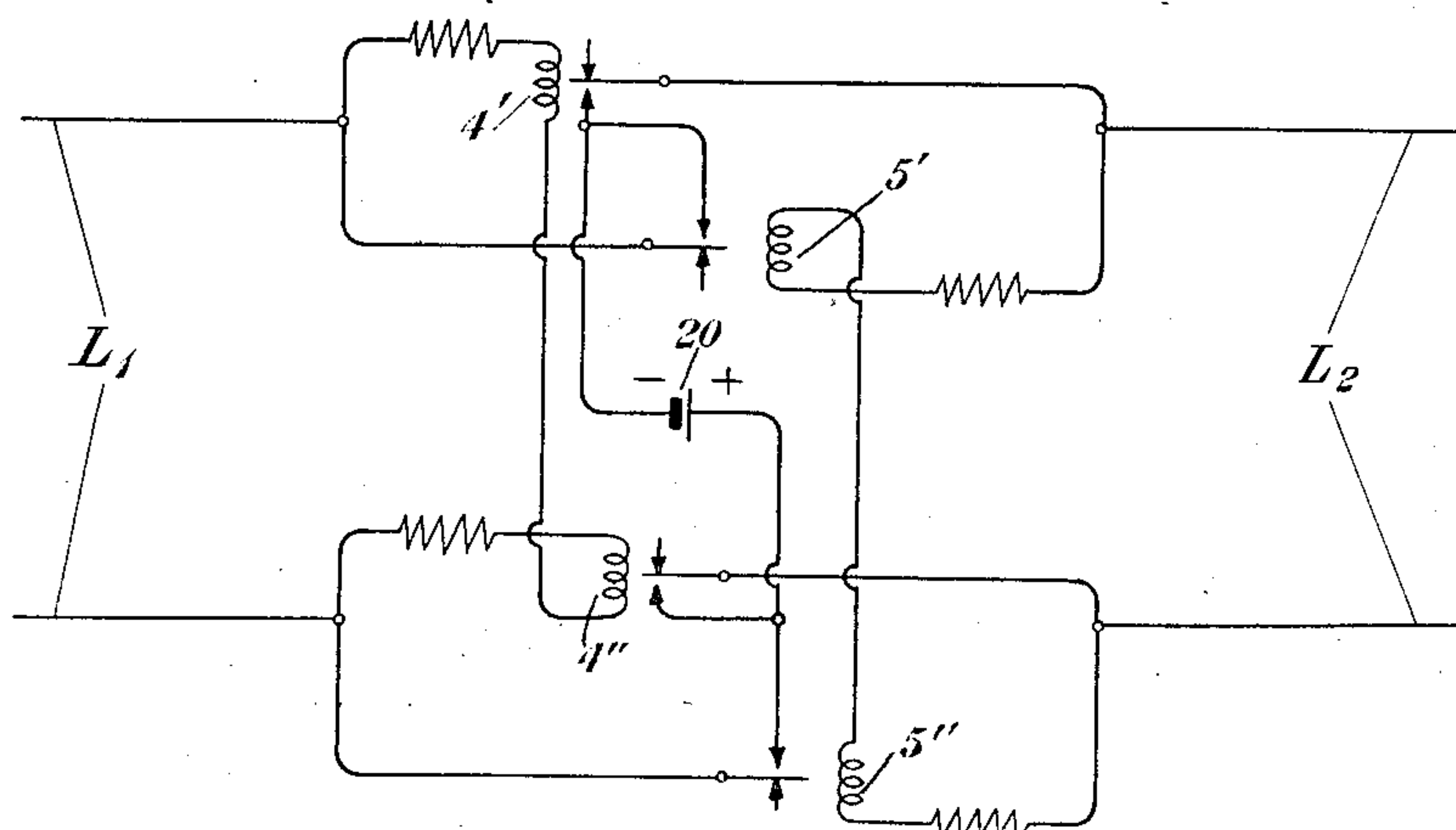


Fig. 3

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UNITED STATES PATENT OFFICE.

HARRY NYQUIST, OF ELMHURST, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

TELEGRAPH REPEATER.

Application filed June 27, 1923. Serial No. 648,068.

To all whom it may concern:

Be it known that I, HARRY NYQUIST, residing at Elmhurst, in the county of Queens and State of New York, have invented certain Improvements in Telegraph Repeaters, of which the following is a specification.

This invention relates to improvements in telegraph circuits and more particularly to repeater arrangements utilized in such circuits.

The telegraph system of this invention is similar to the so-called single line telegraph and half-duplex systems in that it permits operation in either direction but not both simultaneously. The means whereby this is accomplished are, however, different from those employed in former systems. Whereas selectivity as to direction is attained in the single line telegraph by means of holding relays and in the case of half-duplex by means of balance, the arrangements of this invention utilize differences in polarity between the voltages employed for attaining such selectivity. This is accomplished by making the repeaters responsive to voltages of a given polarity and at the same time capable of impressing voltage of the opposite polarity on the line. Where a number of repeaters are employed adjacent repeaters are made to respond to opposite polarities. Other features and objects 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, 2, and 3 of which the invention is illustrated. Fig. 1 shows a circuit diagram of the telegraph system of the invention in which the repeaters comprise polarized relays. In Fig. 2 the repeater element is shown as comprising electron tubes. In Fig. 3 is shown a modification of one of the repeaters of Fig. 1 suitable for use on a metallic circuit. Similar reference numerals have been utilized to denote like parts in all of the figures.

In Fig. 1 is shown a telegraph line L interconnecting two stations A and B. At station A is shown sending apparatus comprising a key K_1 which controls a relay 1. The relay 1 through its armature controls the application of negative current from battery 2 to the line L. For receiving there is connected to the line at station A the

sounder apparatus 3. At station B would be located similar apparatus comprising the key K_2 which controls relay 10. The relay 10 through its armature controls the application of positive current to line L from battery 11. Included in the line are the telegraph repeaters R_1 and R_2 . It will be noted that each repeater consists of two polar relays, such as relays 4 and 5 and relays 7 and 8. These relays are slightly biased so as to remain in the position shown when there is no current in the windings. Consequently, when voltage of a certain polarity is impressed from the line the relay connected to that line will respond. If voltage of the opposite polarity is impressed on the line, however, the relay will not respond, the magnetizing effect merely serving to make firmer contact on the contact shown. When the relay operates it will be apparent that battery is connected to the opposite line to that from which the signaling impulse arrived over and the battery is of the opposite voltage from the incoming signaling impulse so that the repeater will not lock up. It will also be apparent from the drawing that when it is normal, i. e., when both keys are closed, there is no current in the line. If key K_1 is now opened, negative battery is impressed on the line from battery 2. This will operate relay 4 as its winding is poled to respond to potential of negative polarity. The relay 4 upon operating will connect battery 6 to the outgoing line section. This will apply to said line section potential of an opposite polarity to the incoming potential. In this instance battery 6 will apply positive potential to the outgoing line section. The winding of relay 5 is poled similar to that of relay 4 and hence will not respond to this positive potential so that the repeater will not lock up. The positive potential applied to the line from repeater R_1 will now operate relay 7 in repeater R_2 as the winding of said relay is poled to respond to potential of this polarity. The operation of relay 7 will connect battery 9 to the next line section. This battery will apply to said line section potential of a polarity opposite to that of the incoming current. In this instance battery 9 will apply negative potential to the succeeding line section. The winding of relay 8 is poled similar to that of relay 7 and hence will not respond to this negative potential

so that the repeater will not lock up. The current thus impressed on the line will operate the sounder apparatus 12 at station B. In like manner when key K_2 is opened positive potential from battery 11 will be applied to the line. This will operate relay 8 which will cause negative potential to be applied to the next line section but will not effect relay 7. This in turn will operate relay 5 which will cause positive potential from battery 6 to be applied to the next line section without effecting relay 4. This in turn will operate the sounder apparatus 3. Additional repeaters similar to R_1 and R_2 might also be connected into the line. It will be apparent, however, that the method of operation depends on the construction of a repeater such as to impress on the outgoing line section battery of the opposite polarity from that which it receives so that the outgoing impulse will not cause operation of the wrong relay and hence lock the repeater up permanently.

In Fig. 2 is shown an arrangement substantially similar to that of Fig. 1 except that the repeater element consists of the vacuum tube devices 13 and 14 instead of a set of polar relays. The functioning is the same in this case except that this type of repeater can be made to respond only to positive impulses, whereas the polar relay repeaters of Fig. 1 can be arranged to respond to impulses of either polarity. Hence it is not possible to have more than a single repeater of this type in a circuit.

In Fig. 3 is shown an application of the polar relay repeater of the invention to a metallic circuit. This arrangement is substantially similar to the arrangements shown in Fig. 1 except that two sets of apparatus are employed, one for each conductor, and the points which are shown grounded heretofore are now shown connected together. In the drawing are shown two metallic line sections L_1 and L_2 interconnected by the repeater apparatus which comprises two sets of polar relays 4', 4'', and 5', 5'' connected to each conductor. Relays 4', 4'' are arranged and poled so as to respond to current of a definite polarity or for purposes of illustration current flow from the upper to the lower conductor. Relays 5', 5'' are arranged and poled to respond to similar current. The operation of relays 4', 4'' will connect battery 20 to line section L_2 in such a manner as to transmit current of opposite polarity thereover to operate the relays at the next repeater, which are poled and arranged for such current, without interfering with relays 5', 5''.

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 telegraph line comprising two line sections interconnected by repeater apparatus, said repeater apparatus comprising means responsive to current of a definite polarity coming in over one line section, and means controlled thereby for applying current of a different polarity to said other line section.

2. A telegraph line comprising two line sections interconnected by repeater apparatus, said repeater apparatus comprising means associated with each line section responsive to current of a definite polarity coming in over either line section, and means controlled thereby for applying current of a different polarity to the line section other than the one over which the incoming current arrives.

3. A telegraph line comprising a plurality of repeaters, each of said repeaters comprising means responsive to incoming current of a definite polarity and means controlled thereby for transmitting outgoing current of a different polarity over said line, said responsive means in alternate repeaters being arranged to respond to currents of different polarities.

4. A telegraph line comprising two line sections interconnected by repeater apparatus, said repeater apparatus comprising a plurality of polar relays connected to each line section and adapted to respond to current of a definite polarity coming in over said line sections, a source of current of a different polarity from said incoming current, and means controlled by said relays for applying current from said source to either of said line sections.

5. A telegraph line, means to apply current of a definite polarity to said line, a repeater associated with said line, polar relays in said repeater responsive to said current of definite polarity, means controlled by said relays in said repeater for applying current to said line of a different polarity from said first mentioned current, a second repeater associated with said line, polar relays in said second repeater responsive to said second mentioned current, and means controlled by said relays in said second repeater for applying current to said line of a polarity like said first mentioned current.

In testimony whereof, I have signed my name to this specification this 26th day of June, 1923.

HARRY NYQUIST.