July 23, 1929. H. W. DUDLEY 1,722,039

SIGNAL OPERATED REPEATER CIRCUITS

Original Filed Dec. 31, 1926

Fig. 1.

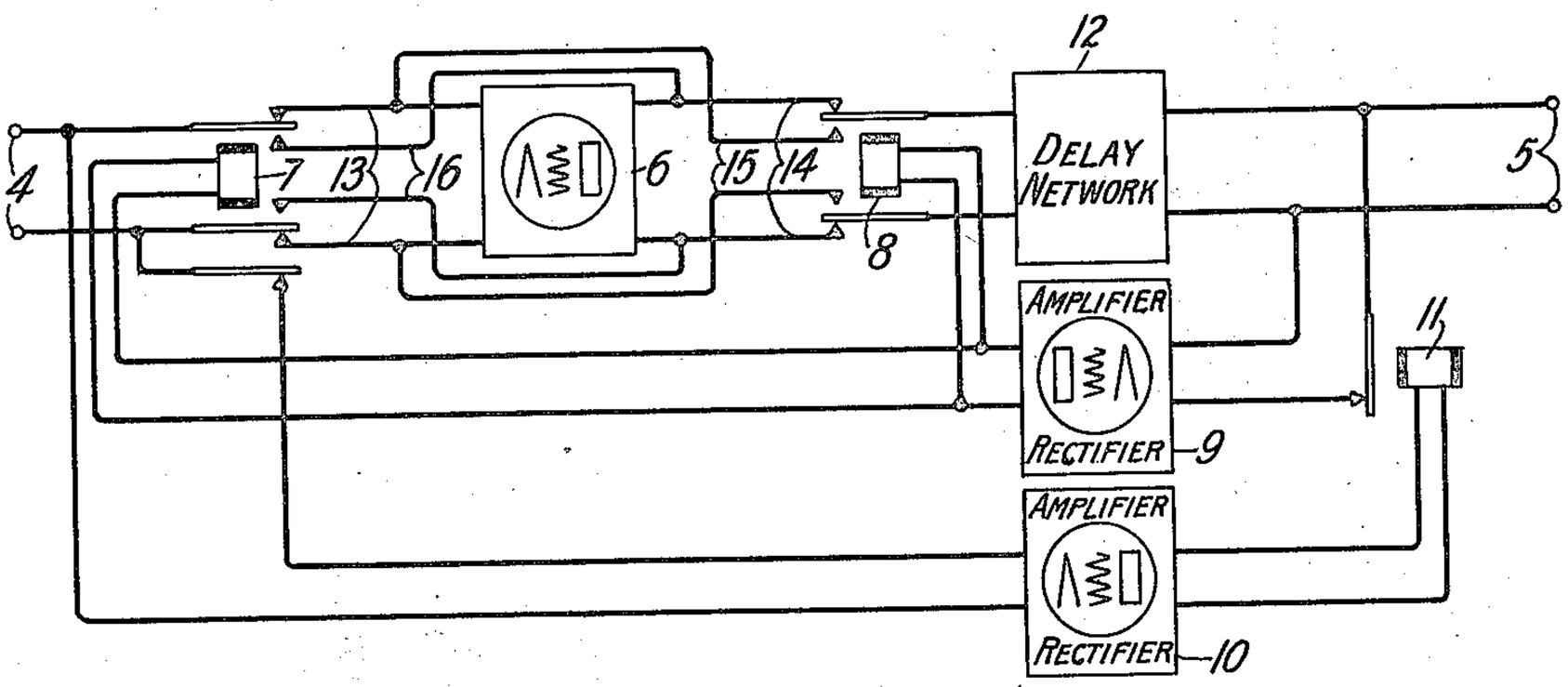


Fig. 2.

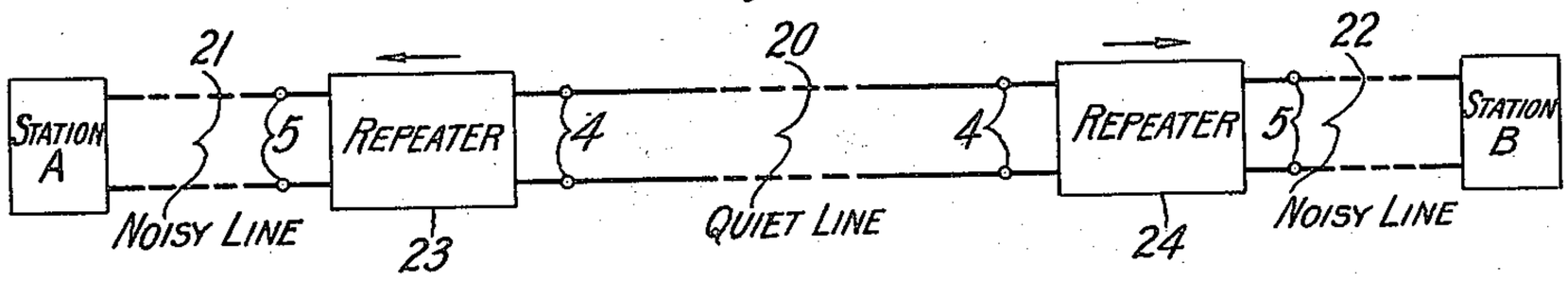
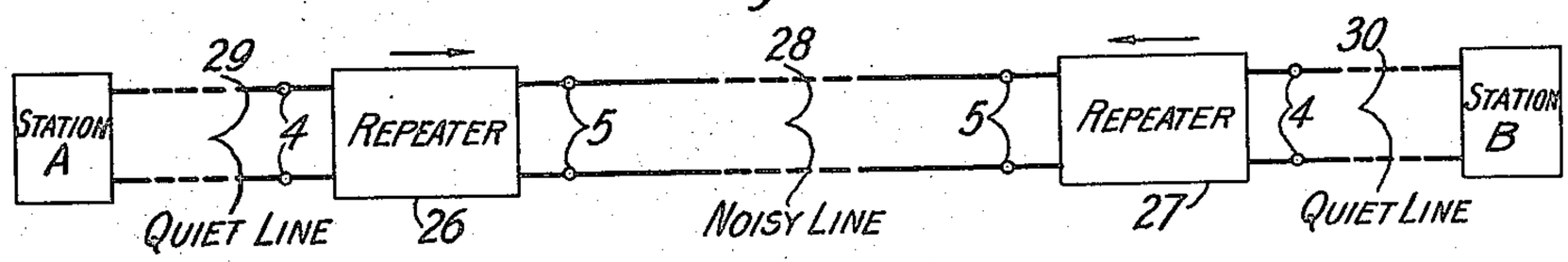


Fig. 3.



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UNITED STATES PATENT OFFICE.

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SIGNAL-OPERATED REPEATER CIRCUITS.

Application filed December 31, 1926, Serial No. 158,195. Renewed April 25, 1928.

This invention relates to signal operated repeater circuits in which one-way repeaters are arranged to be automatically pointed in the direction in which signal waves are being transmitted over a two-way line.

An object of the invention is to simplify signal operated repeater circuits.

Another object of the invention is to provide an improved signal operated repeater circuit for use between relatively noisy and relatively quiet signal lines.

Heretofore, so-called signal or voice operated repeater circuits have been of two general types, one, the so-called "biased" type in which a repeater is left in condition to transmit efficiently only in the direction in which it last transmitted until transmission in the other direction is initiated, and the other, the so-called "neutral" type in which, between periods of transmission, the repeater is not in condition to transmit efficiently in either direction.

In accordance with a feature of this invention, there is provided a repeater which is normally pointed in one direction, regardless of the direction in which transmission last took place, but which is pointed in the other direction when transmission in that direction is initiated.

In accordance with another feature of this invention, several repeaters of the above type are employed in a transmission circuit, part of them being pointed normally in each direction so that no matter in which direction waves are to be transmitted, only a part of the repeater pointing circuits will have to be operated to put the entire system in operation.

The repeater circuit of this invention is of the biased type for transmission in one direction and of the neutral type for transmission in the other direction so that it is well fitted for use in a transmission system in which the conditions are such that one type is best suited for transmission in one direction while the other type is desirable for transmission in the other direction. For example, it is well suited for connecting a relatively quiet line to a relatively noisy line in which case it is connected so as to normally transmit waves from the quiet line to the noisy line. When used in this manner, the signal operated circuit at the output of the repeater will not have to maintain so great a margin against amplified noise.

In addition, the circuit of this invention is very simple and requires only one amplifier and one delay circuit.

This invention can be more readily understood by reference to the following detailed description in connection with the drawing in which:

Fig. 1 shows diagrammatically one embodiment of the invention, and

Figs. 2 and 3 show two transmission systems employing repeater circuits of the type shown in Fig. 1.

Referring to Fig. 1, there is shown a repeater circuit having west terminals 4 and east terminals 5. There is provided a repeater or amplifier 6 which is preferably of the vacuum tube type. This amplifier is so connected to the terminals 4 and 5 that transmission from west to east may take place without any change in the transmission circuit. Relays 7 and 8 are provided for pointing the repeater in the opposite direction when transmission from east to west is initiated. The windings of these relays are connected to the output of an amplifier-rectifier 9, the input of which is connected to the terminals 5. The operation of relay 7 also opens the input circuit of a second amplifier-rectifier 10 which has a relay 11 connected to its output circuit for opening the input circuit of the amplifier-rectifier 9 when transmission from west to east is taking place. A delay network 12 is connected between the terminals 5 and the contacts of relay 8 so that the transmission of waves from east to west is delayed until the relays 8 and 7 have had sufficient time to operate to point the amplifier 6 in the proper direction. This network also delays the transmission from west to east for sufficient time to permit the operation of relay 11 to open the circuit supplying relays 7 and 8.

Thus, waves impressed on the west terminals 4 are directly transmitted through the amplifier 6 and at the same time a portion of the energy impressed on the west terminals is transmitted through a separate circuit to energize the amplifier-rectifier 10 to operate the relay 11. The relay 11 opens the input circuit of the amplifier-rectifier 9 so that it can not be energized by the amplifier waves in the output of the amplifier 6. Also, waves impressed on the east terminals 5 energize the amplifier-rectifier 9 to operate relays 7

and 8 repointing the amplifier 6 to transmit waves from east to west and opening the input circuit of the amplifier-rectifier 10 so that it will not be affected by the amplified waves.

If any correcting networks or filters are required for transmission in both directions, they may be included as part of the amplifier circuit 6 unless they are of value as delay circuits in which case they should be inserted in place of or as a part of the network 12. If it is desired to transmit with unequal efficiency in the two directions, appropriate networks for transmitting from west to east may be inserted in the input leads 13 or the output leads 14, and appropriate networks for transmitting from east to west may be connected in the input leads 15 or the output leads 16, as desired.

With the type of circuit described, no time is lost for transmission from west to east, but transmission in the opposite direction requires some time for operation of the relays. On the other hand, the relays 7 and 8 normally connected to the output of the amplifier must maintain a margin against amplified noise, so that noise on the west line, amplified by the amplifier 6, will not operate them.

With regard to the time of operation, the disadvantages may be overcome in a transmission system by pointing alternate repeaters in opposite directions so that, for the system as a whole, transmission in either direction will only require the operation of one half of the repeaters. In situations in which a noisy line is to be connected to a quiet line, a repeater of this type presents certain definite advantages as hereinafter described.

Fig. 2 shows a transmission system for transmitting between a station A and a station B. The system comprises a relatively quiet section of line 20 connected between two relatively noisy sections of lines 21 and 22. Repeaters 23 and 24, which are the type shown in Fig. 1, are connected between the line 20 and the lines 21 and 22, respectively. As indicated, these repeaters are connected in such a way that transmission normally takes place from the quiet line to the noisy lines and for transmission in the opposite direction they must be repointed. In this way no strict requirements as to margin against amplified noise are placed upon the relays connected to the output of the amplifiers. The quiet line might, for example, be a section of submarine cable of such length or attenuation that a sufficiently accurate balance to obtain the necessary high gain with the standard type of repeater could not be provided.

Fig. 3 shows a similar system in which repeaters 26 and 27 are connected between a noisy line 28 and two relatively quiet lines 29 and 30, respectively. In this system, as indicated, the repeaters are so connected as to normally transmit from the quiet lines to the noisy line in a similar manner to that of Fig. 2.

In the systems of both Figs. 2 and 3 transmission in either direction requires the operation of the printing circuit of only one repeater.

What is claimed is:

1. In a two-way signaling circuit, a one-way repeater normally connected to transmit waves in one direction, means responsive to waves in the other direction for pointing said repeater to amplify waves in that direction, and means responsive to waves being transmitted in said one direction for making said first means inoperative.

2. A combination according to the preceding claim, and a delay circuit common to a portion of said signaling circuit traversed by the waves transmitted in either direction therein, and located so as to prevent transmission of the waves in said one direction to the first mentioned means until the second mentioned means has operated, and to prevent transmission of the waves in said other direction to said repeater until the first mentioned means has operated.

3. In combination, a plurality of two-way transmission lines, and a plurality of signal operated repeater circuits connecting said lines, each of said circuits comprising a one-way repeater, and means for normally connecting said repeater to transmit waves in one direction and for automatically pointing said repeater in the opposite direction in response to waves being transmitted in that direction, substantially half of said repeater circuits being connected so as to normally transmit waves in one direction and the remainder of said repeater circuits being connected so as to normally transmit waves in the opposite direction.

4. In combination, a relatively quiet two-way signaling line, a relatively noisy two-way signaling line, a one-way repeater connected between said lines and operative always in the absence of signaling transmission in either direction in said lines, and for signaling transmission in the direction from said quiet line to said noisy line, to transmit waves from said quiet line to said noisy line and means for pointing said repeater in the opposite direction in response to signaling waves from said noisy line.

5. In combination, a pair of two-way transmission lines, a one-way repeater normally connected to transmit waves from one of said lines to the other, a relay responsive to waves from said other line for pointing said repeater in the opposite direction, and a second relay responsive to waves from said first line for making said first relay inoperative, said second relay being made inoperative by the action of said first relay.

6. A combination according to the preced-

ing claim in which a delay circuit is connected between the point in said other line to which said first relay is connected and said repeater.

7. In a two-way signaling circuit, a one-way circuit normally connected to transmit waves in one direction, means responsive to waves in the other direction for pointing said one-way circuit to transmit waves in that direction, and means responsive to waves being transmitted in said one direction for making said first means inoperative.

8. In combination, a pair of two-way transmission lines, a one-way circuit normally connected to transmit waves from one of said lines to the other, a relay responsive to waves from said other line for pointing said one-way circuit in the opposite direction, and a second relay responsive to waves from said one line for making the first mentioned relay inoperative, said second relay being made inoperative by the action of said first mentioned relay.

In witness whereof, I hereunto subscribe my name this 29th day of December A. D. 1926.

HOMER W. DUDLEY.