Nov. 5, 1929. S. B. WRIGHT 1,734,104

TWO-WAY TRANSMISSION WITH REPEATERS

Filed July 17, 1926

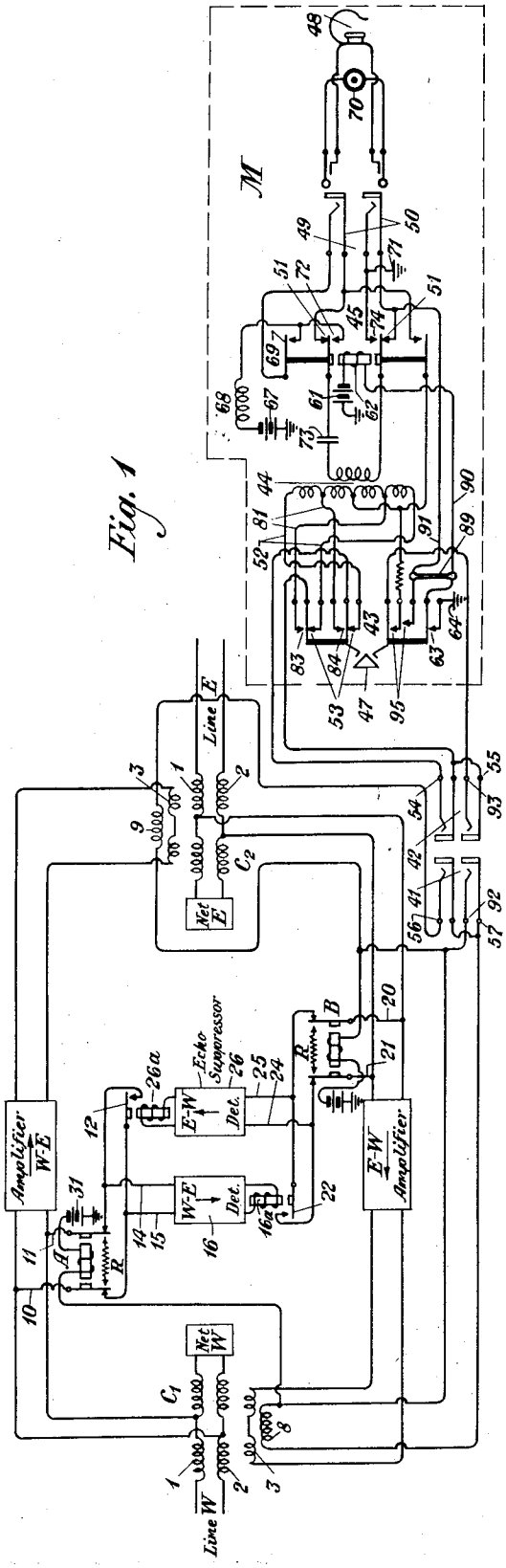

Fig. 1

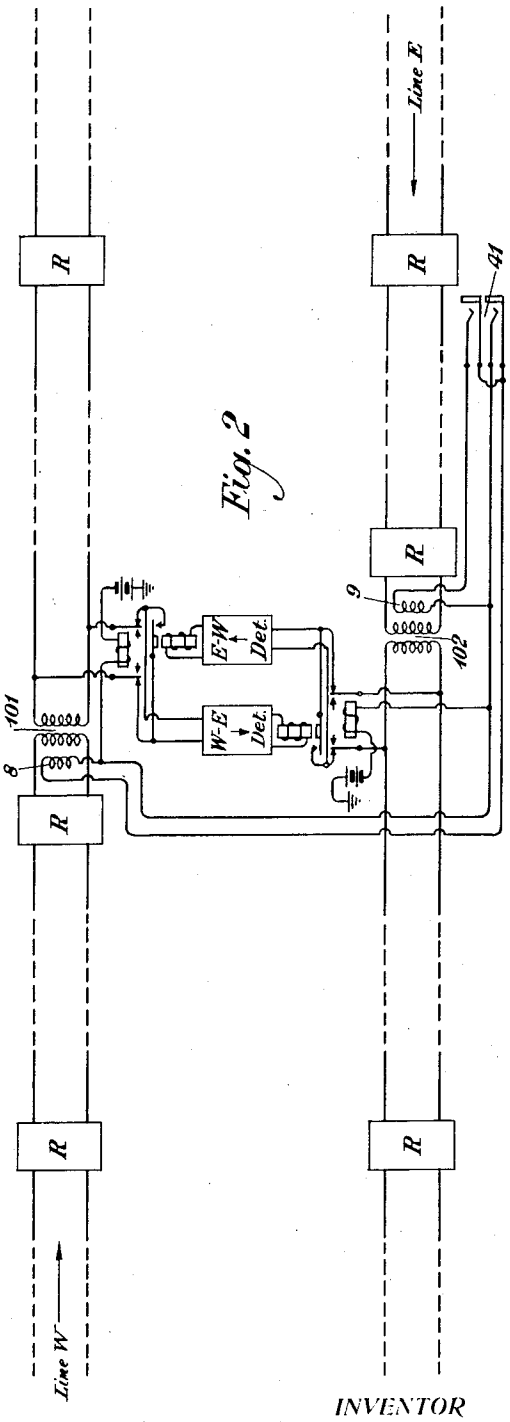

Fig. 2

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TWO-WAY TRANSMISSION WITH REPEATERS

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This invention relates to voice operated relay circuits of the type used in echo suppressing equipment, voice operated repeater circuits and the like, and more particularly relates to provision for suitable talking and monitoring on telephone repeater circuits containing such echo suppressors.

The need and the use of such echo suppression and one form of means to provide this are given in patent to Mills, 1,434,790, November 7, 1922. Experience has shown that two-way talking from the repeater cannot be satisfactorily accomplished on account of both sides of such an echo suppressor as is shown in the Mills' patent, cited above, operating and cutting off the repeater attendant's speech. This is particularly objectionable in lining up long circuits equipped with echo suppressors when the attendant must communicate with parties at both ends of the circuit.

Still more specifically then the invention provides for two-way talking and listening or monitoring from a repeater station at which an echo suppressor may be installed. In this invention means are provided to disconnect the echo suppressor during the time the repeater attendant is talking, and to restore it back to the circuit when his talking key is returned to normal position.

The various objects attained by means of the invention are set forth in detail in the following description and illustrated in the accompanying drawing in which Figure 1 shows a two-way repeater line with an echo suppressor adapted to be removed from the circuit under certain conditions, and Fig. 2 shows the invention applied to a four-wire repeater circuit.

Referring to Fig. 1, there is shown a two-wire transmission circuit with line W and line E going in their respective directions, and connected to a two-way repeater by means of hybrid coils C_1 and C_2, with which are associated the amplifiers W—E and E—W for amplifying telephone currents in the respective directions, all in a manner well understood in the art.

The transformers C_1 and C_2, in accordance with standard practice, comprise the coils 1 and 2 connected directly to the incoming lines and to balancing networks W and E. Connections from the midpoints of these coils 1 and 2 lead to the input side of the respective amplifiers. A winding 3 in each of these transformers is connected with the output circuit of its corresponding amplifier, and the windings in the transformers are so related that the coil 3 is conjugate with respect to the points of the coils 1 and 2 from which leads go to the input circuits of the repeaters, the circuit thus far described being in accordance with well understood practice.

For the purpose of suppressing the echoes which might otherwise exist in the line, there is connected to the amplifier W—E two leads 10 and 11 which may be short circuited through a contact 12, normally open. Also bridged across the lines 10 and 11 and in parallel to contact 12 are conductors 14 and 15 which lead to a voice operated relay 16 which comprises any suitable means, such as vacuum tube detectors, for operating upon the telephone currents which may enter it and thus cause the relay 16^a to close a contact 22.

An identical set of connections and elements are connected to the input circuit of the amplifier E—W, the various parts being represented by reference characters from 20 to 26^a.

The operation of the circuit as thus far described is as follows: If telephone currents arrive from line W they are amplified through the amplifier W—E and transmitted over the line E. At the same time a portion of the power from the incoming telephone speech is diverted to the voice operated relay 16, 16^a, closing the contact 22 and thus short-circuiting the input of the amplifier E—W and so disabling that circuit entirely for the time that speech currents are coming in on line W. On the other hand if speech currents come in on line E they are similarly amplified by the amplifier E—W and transmitted over line W. However a portion of the speech power is diverted over the conductors 20, 21 to the voice operated relay 26, 26^a which then closes the contact 12 to short-circuit the input of the

amplifier W—E and disable that path of the circuit. This operation is also now well understood in the art.

For the purpose of monitoring and talking from this repeater station to the remote portions of the transmission line, monitoring windings 8 and 9 are provided on transformers C_1 and C_2. These windings may be used for listening or monitoring by the attachment of a suitable telephone receiver, but it is found that if a transmitter circuit is connected to these coils the talking current coming therefrom will alternately operate the voice relays and thus interfere seriously with talking and monitoring from the repeater station. In order to obviate this difficulty this invention provides means by which the echo suppressors are disconnected from the circuit during the time that the attendant's talking circuit is on the line, this being accomplished specifically on the part of the attendant by the operation of a talking key. To this end a relay A with battery 31 is connected to one side of the winding 8, the contacts of this relay being adapted to break the circuit from the conductors 10 and 11, thus disconnecting the relay 16 from the amplifier W—E. Similarly a relay B is connected with the winding 9 and through its contacts may disconnect relay 26 from the amplifier E—W.

For the purpose of monitoring and talking the windings 8 and 9, with the associated relays A and B, may then be connected to an attendant's telephone set through a switching mechanism shown as a whole in the dotted rectangle M, the details of which will be apparent from the description to be given hereinafter. The windings 8 and 9 may be connected to the double jack 41 which may in turn be connected to a similar jack 42 by suitable cords. The jack 42 is connected with a manually operated multiple-point switch 43, which is in turn connected with a repeating coil 44 and relay mechanism 45 for the purpose of monitoring alone or talking and monitoring.

When the key 47 of the multiple-point switch 43 is in normal or released position the following circuit is established. Receiver 48 is associated with the sleeves 50 of the double jack 49. The circuit is then established through contacts 51 and one winding of the repeating coil 44. The other side of this coil 44 is connected by leads 52 through contacts 53 to the points 54 and 55 of the jack 42, and points 56 and 57 to the coils 8 and 9 in series. The attendant is thus enabled to monitor at any time but is not able to talk for the reason that the transmitter 70 is disconnected from the circuit as may readily be observed from the drawing.

Upon operation of the key 47 a change takes place, resulting in the following connections: a circuit may now be traced from the grounded battery 61 through relay 62 to the contact 63 to ground at 64. The operation of the relay 62 now permits the tracing of the following circuit: from grounded battery 67 through induction coil 68, through contact 69, transmitter 70 and back to ground 71, thus putting the battery on the transmitter. At the same time a path is provided for the telephone currents generated by said transmitter through the contact 72, condenser 73, one winding of the repeating coil 44 and contact 74. At the same time a portion of the secondary winding of the coil 44 is now connected by leads 81 through the contacts 83 and 84 to the points 54 and 55, and thus, as formerly, to the windings 8 and 9, in series. Thus talking and monitoring circuits are provided to the windings 8 and 9, but as pointed out above the presence of the talking current would normally cause the operation of the echo suppressors. To provide against this it is necessary to supply a ground connection for the relay circuits A and B when the key 47 is operated. This is accomplished by placing a short-circuit connection 89 across the leads 90 and 91. A circuit may now be traced from the grounded battery 31 through the relay A to winding 8, points 92 and 93, contacts 95 and thence to ground 64 through the short-circuiting strap 89. A similar circuit may be traced from the relay B to ground so that it is apparent that when the attendant operates the key 47 the echo suppressors are completely disconnected from the repeater circuits, and he may then talk as well as listen in both directions and thus keep himself informed while making adjustments on the line, whereas when communication has been established he may yet monitor on the line by placing the key 47 in normal position, in which case the echo suppressors are in position to be operated in the manner intended.

When the suppressors are removed, it is evident that echo effects from talkers on the circuit terminals may be excessive. In order to prevent this, a transmission loss may be put into the circuit by resistances R—R, which are bridged across the inputs of the amplifiers when the suppressors are disconnected. These resistances are so proportioned as to keep the echoes negligible on through transmission.

The description thus far relates to a two-wire transmission line, but it may be equally well applied to a four-wire transmission line as shown in Fig. 2. In this figure line W represents the pair of conductors for transmitting currents from the west, and line E represents the circuit for transmitting currents from the east. A plurality of one-way repeaters or amplifiers, represented by R, may be inserted in each of these lines. At some intermediate point in the transmission line it may be desirable to introduce an echo suppressor and at the same time provide talking and monitoring facilities for the

attendant. In this case the connection of the echo suppressors to the lines are identically the same as in Fig. 1 except that the transformers C_1 and C_2 of Fig. 1 do not appear in the same form but are replaced by repeating coils 101, 102. In general the echo suppressors would be bridged across the secondaries of these coils. The monitoring windings 8 and 9 would in this case be associated in any convenient manner with the transformers 101 and 102 and then would function in precisely the same manner as described in connection with Fig. 1. Inasmuch as the talking and monitoring set would be the same in either case, it has not been repeated in the showing of Fig. 2, but the drawing terminates at the jack 41.

While one specific circuit arrangement has been shown for accomplishing the purpose of this invention, it is apparent that numerous modifications might be made without departing from the spirit of the invention.

What is claimed is:

1. In a telephone system, a repeater comprising separate paths for the telephone currents in opposite directions, an echo suppressor adapted to disable either of said paths when telephone currents are on the other, a monitoring and talking circuit to be associated with said repeater, and relays associated with said circuit for disconnecting said suppressor and connecting the talking circuit.

2. In a telephone system, a repeater comprising separate paths for the telephone currents in the opposite directions, an echo suppressor adapted to disable either of said paths when telephone currents are on the other, a monitoring and talking circuit associated with said repeater, and a relay circuit in one condition permitting monitoring and in another condition disconnecting the suppressor and connecting the monitoring and the talking circuit.

3. In a telephone system, a repeater comprising separate paths for the telephone currents in opposite directions, an echo suppressor adapted to disable either of said paths when telephone currents are on the other, a relay connected with each separate path and adapted upon operation to disconnect the suppressor from the said paths, a monitoring and talking circuit associated with the repeater, said circuit comprising means which in normal condition connects a monitoring circuit to the line, and in another condition operates the relays to disconnect the suppressor and to connect the monitoring and talking circuit to the line.

4. In a telephone system, a repeater comprising separate paths for the telephone currents in opposite directions, an echo suppressor for disabling either of said paths when telephone currents are on the other, a relay connected with each separate path and which upon operation disconnects the suppressor from the said paths and bridges a resistance across each of said paths to introduce a desired transmission loss.

5. In a telephone system, a repeater, an echo suppressor adapted to suppress waves travelling in one direction when conversation is transmitted in the opposite direction, a transmitter, and means for rendering the suppressor inoperative and for associating the transmitter with the repeater to permit talking therefrom.

In testimony whereof, I have signed my name to this specification this 15th day of July, 1926.

SUMNER B. WRIGHT.