

March 8, 1938.

A. E. BACHELET ET AL

2,110,284

REPEATER SYSTEM

Filed Sept. 5, 1936

7 Sheets-Sheet 1

FIG. 2

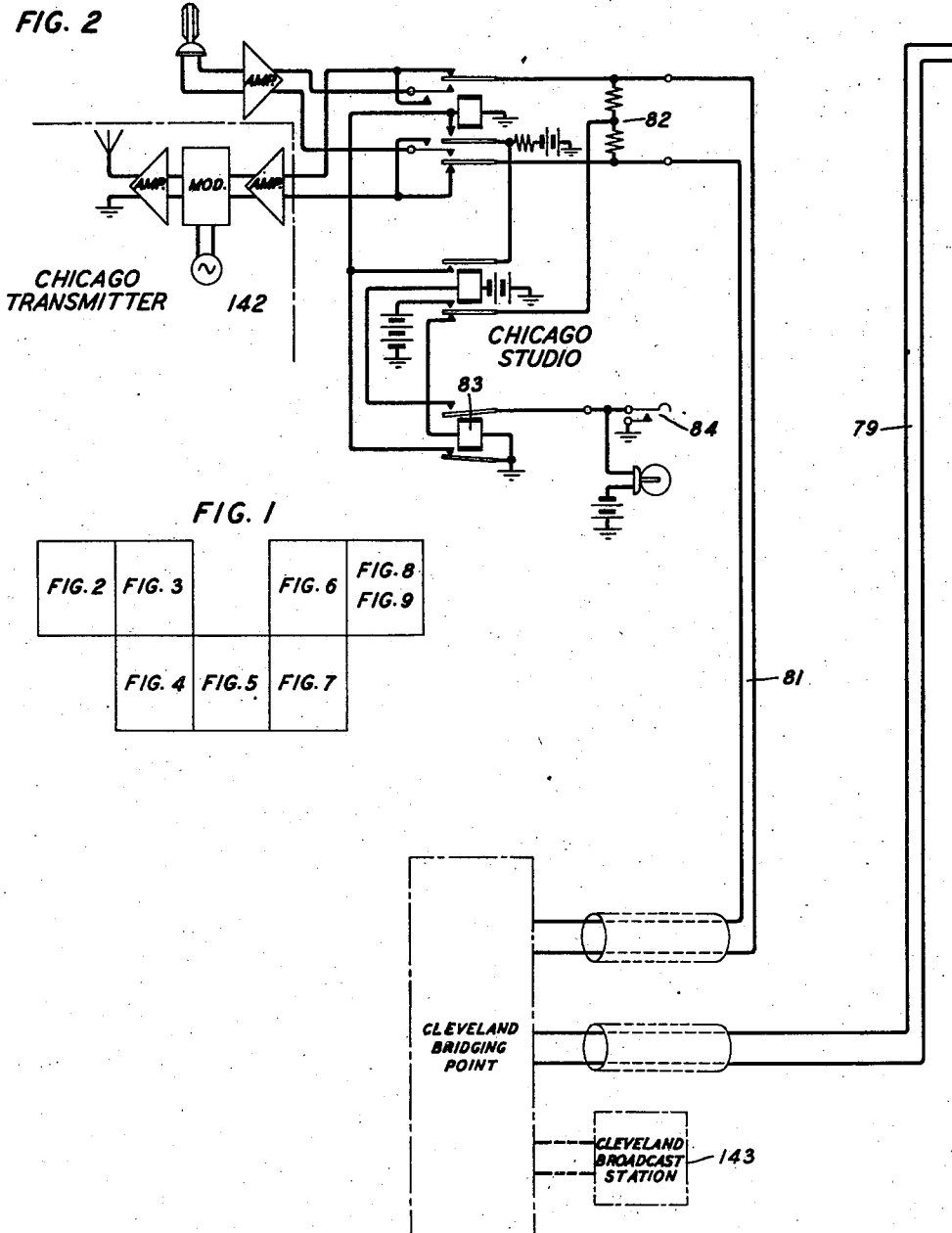


FIG. 1

FIG. 2	FIG. 3	FIG. 6	FIG. 8 FIG. 9
FIG. 4	FIG. 5	FIG. 7	

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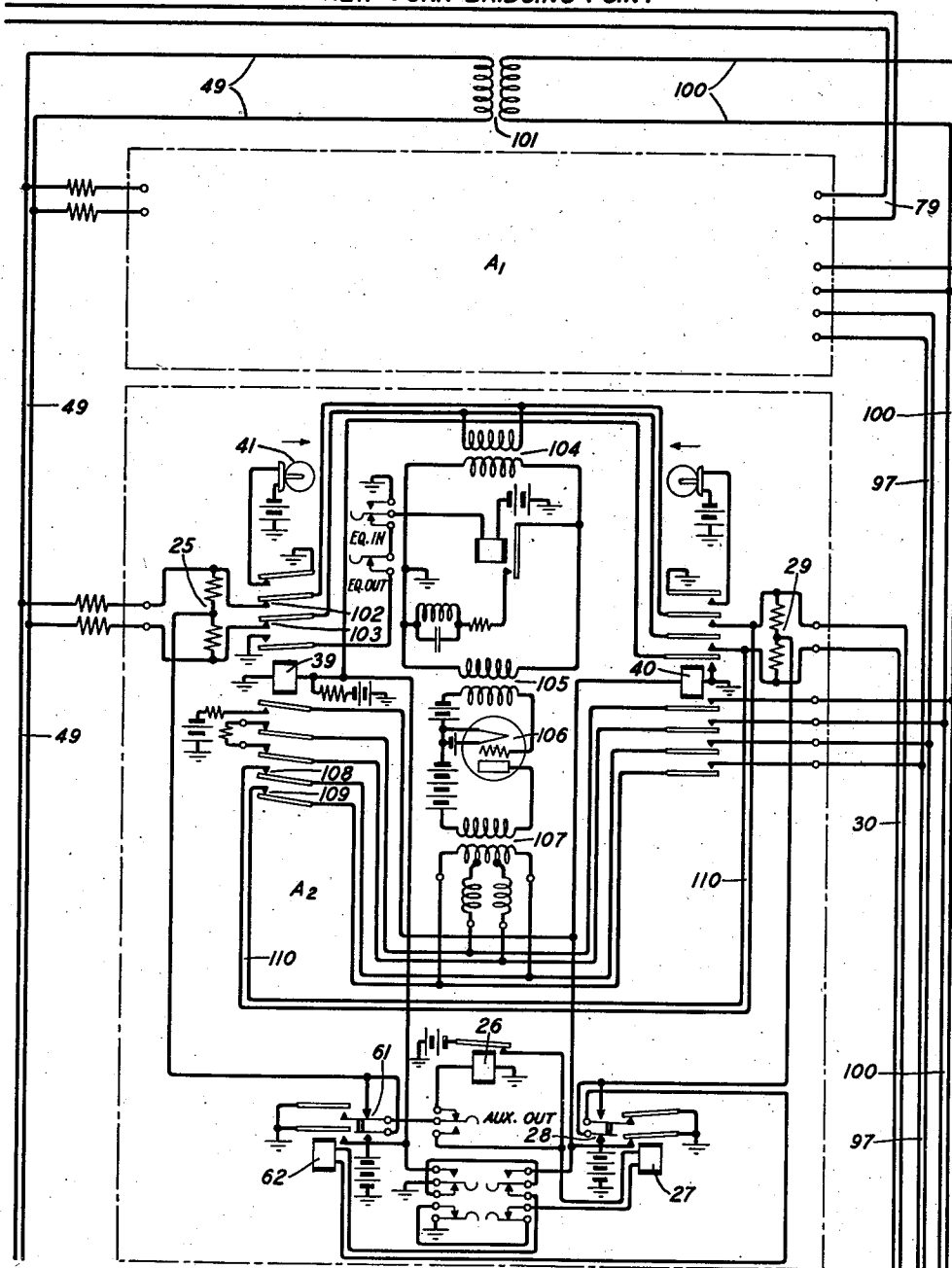
REPEATER SYSTEM

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FIG. 3

NEW YORK BRIDGING POINT



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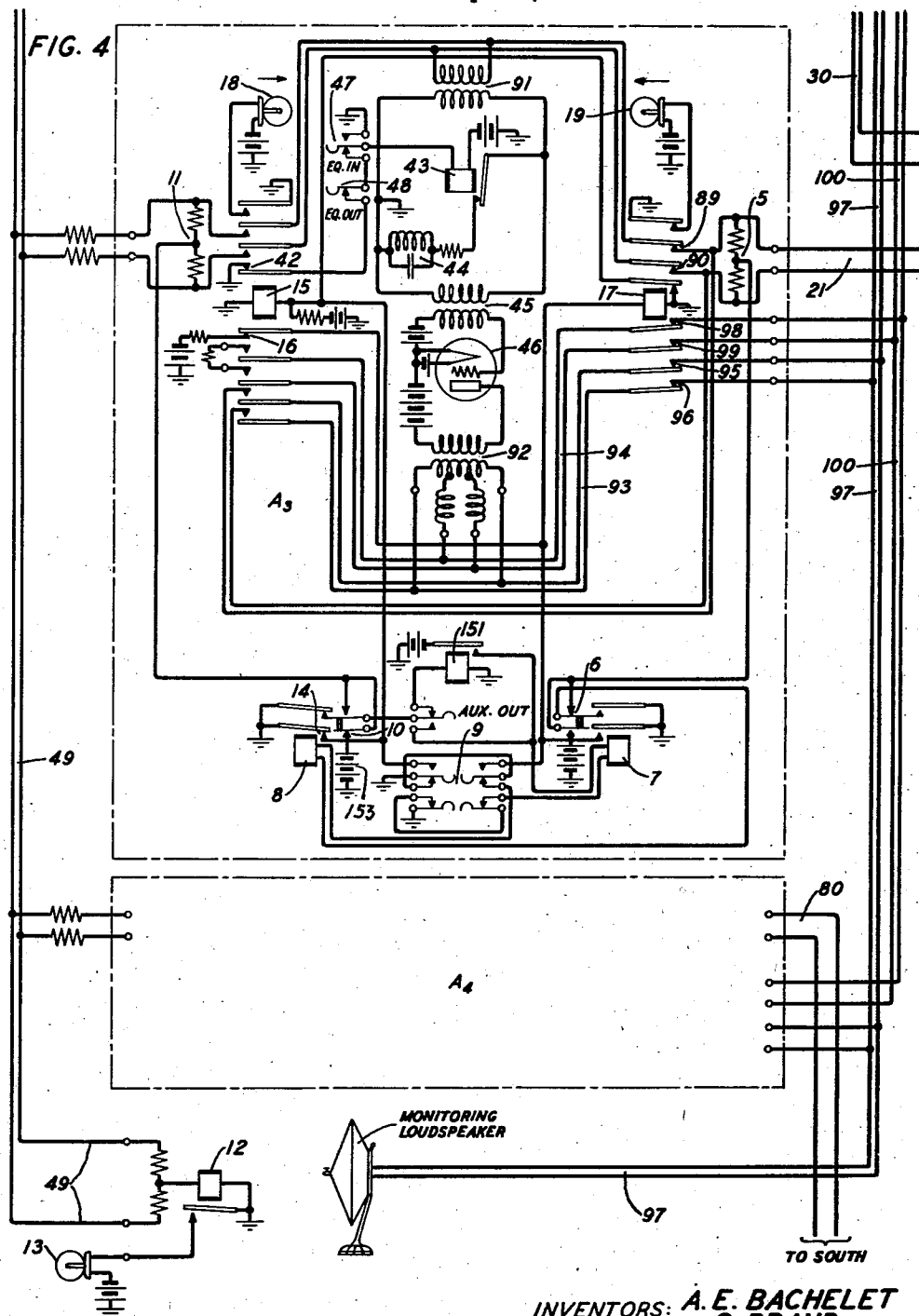
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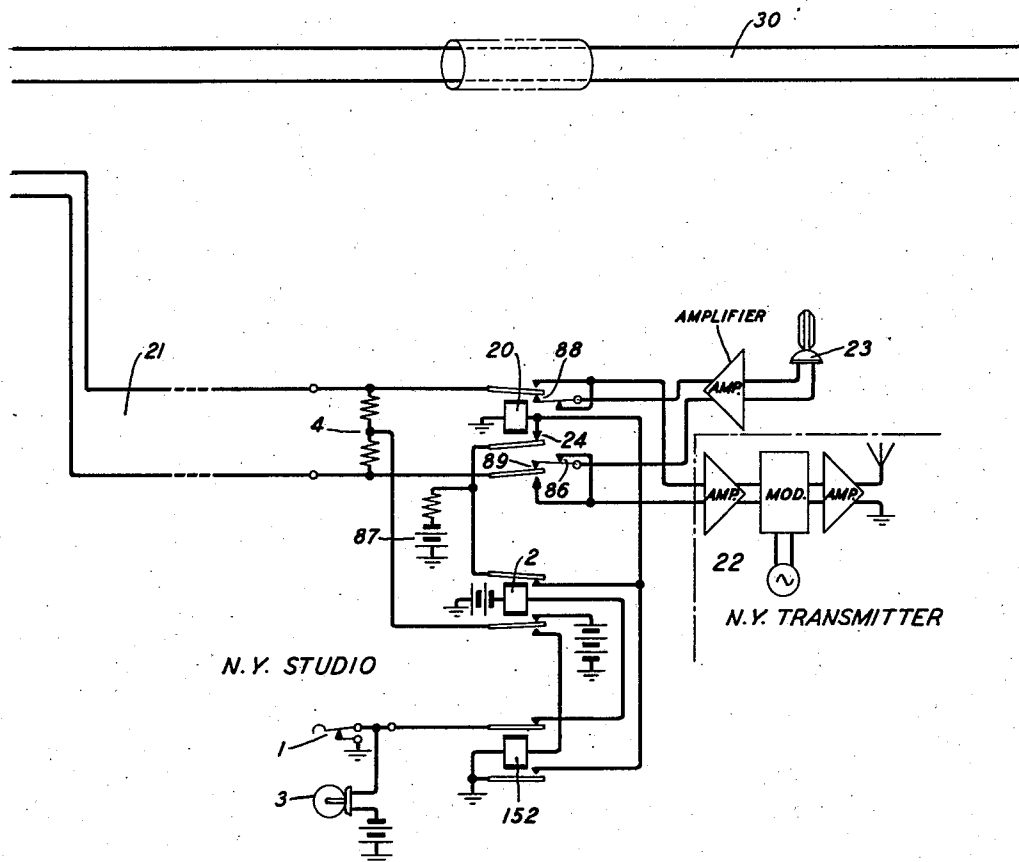
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FIG. 5



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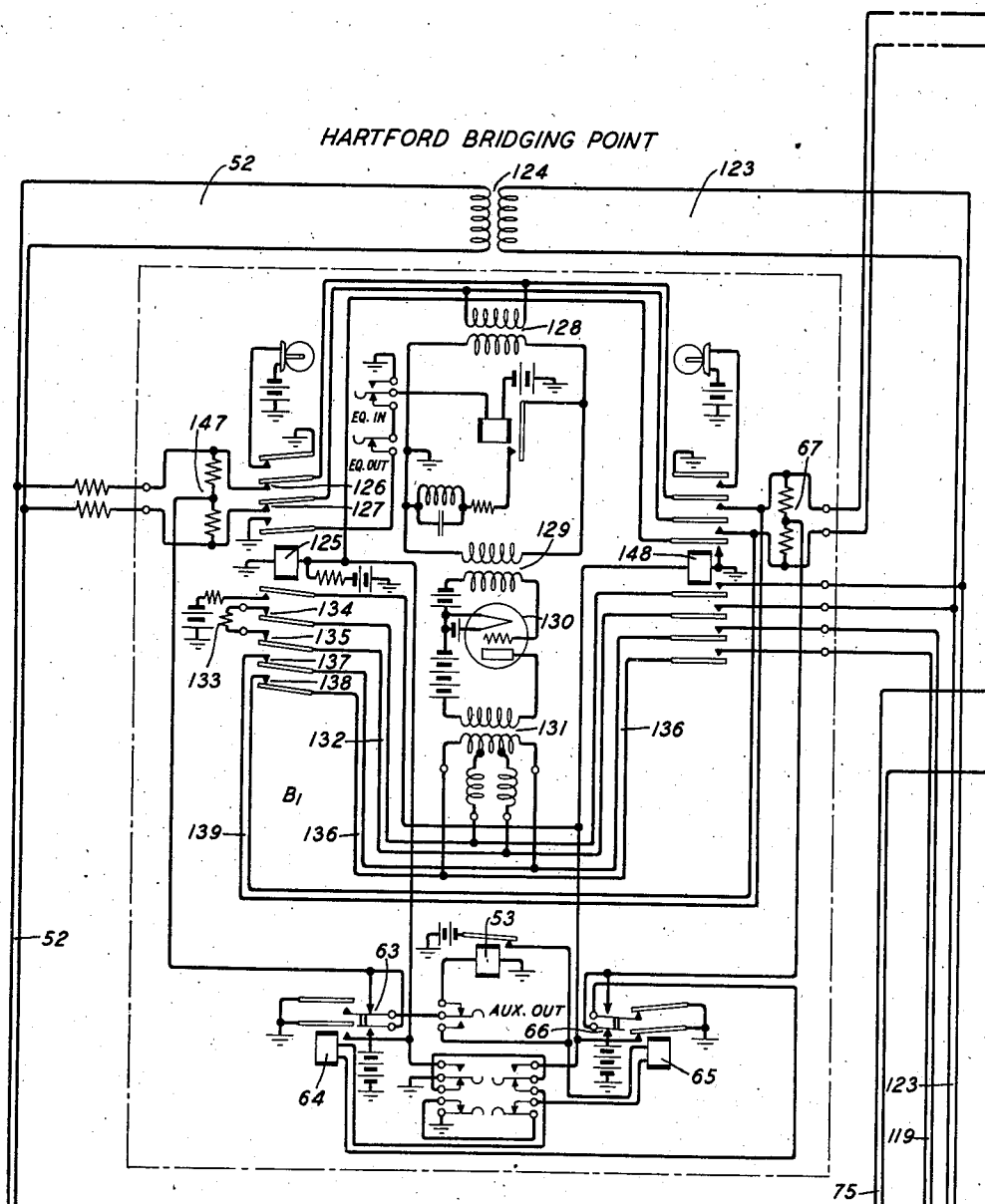
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REPEATER SYSTEM

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FIG. 6



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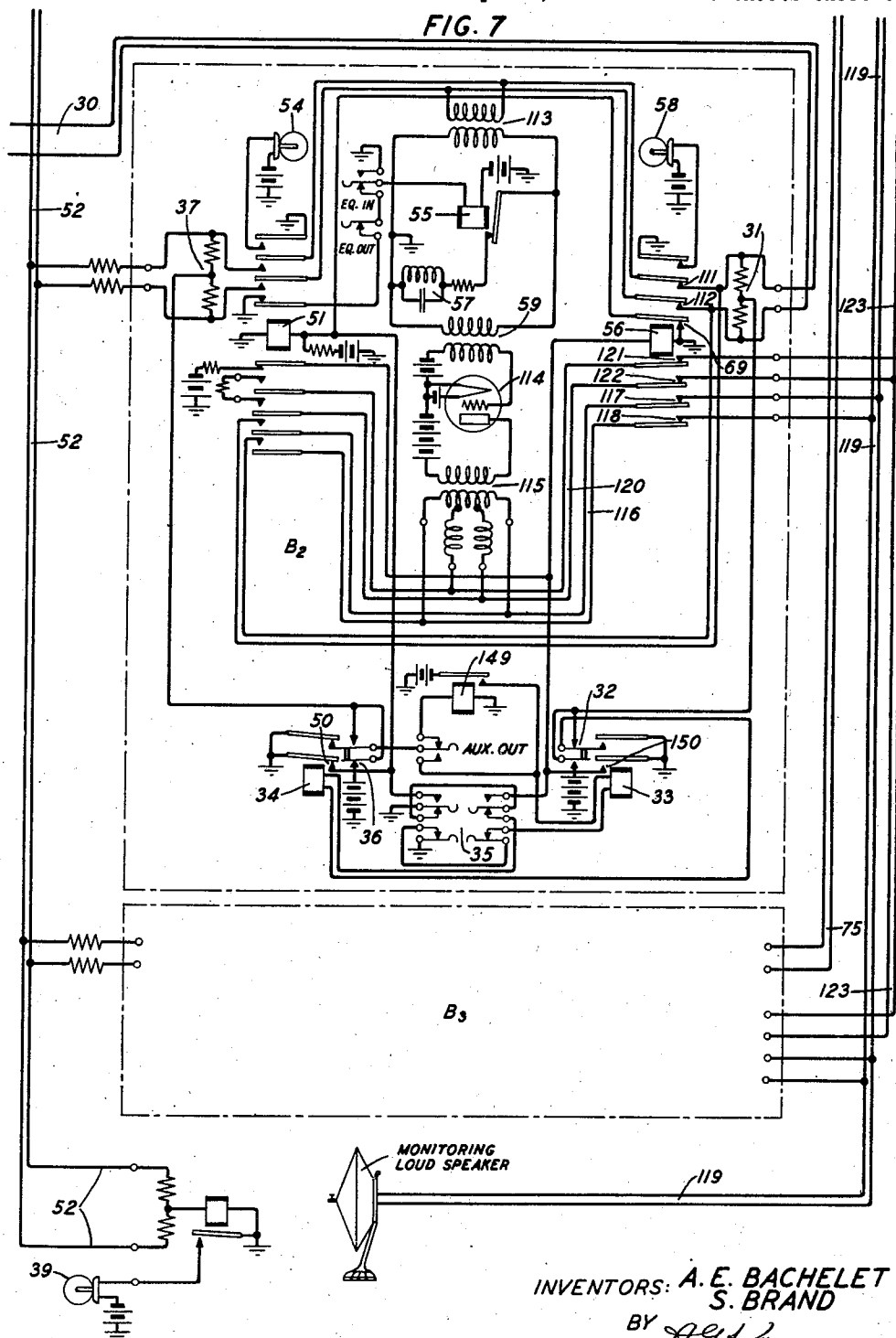
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REPEATER SYSTEM

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FIG. 7



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REPEATER SYSTEM

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FIG. 8

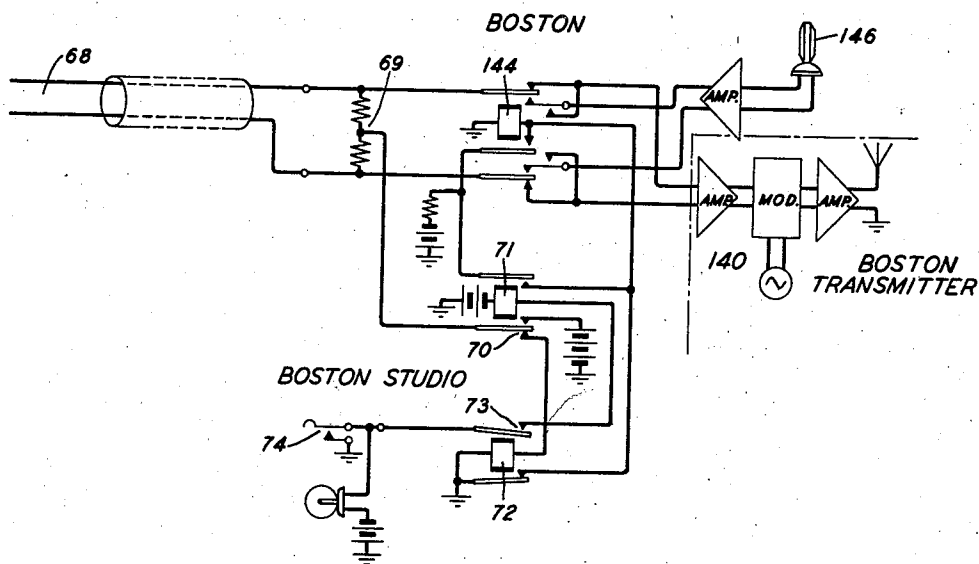
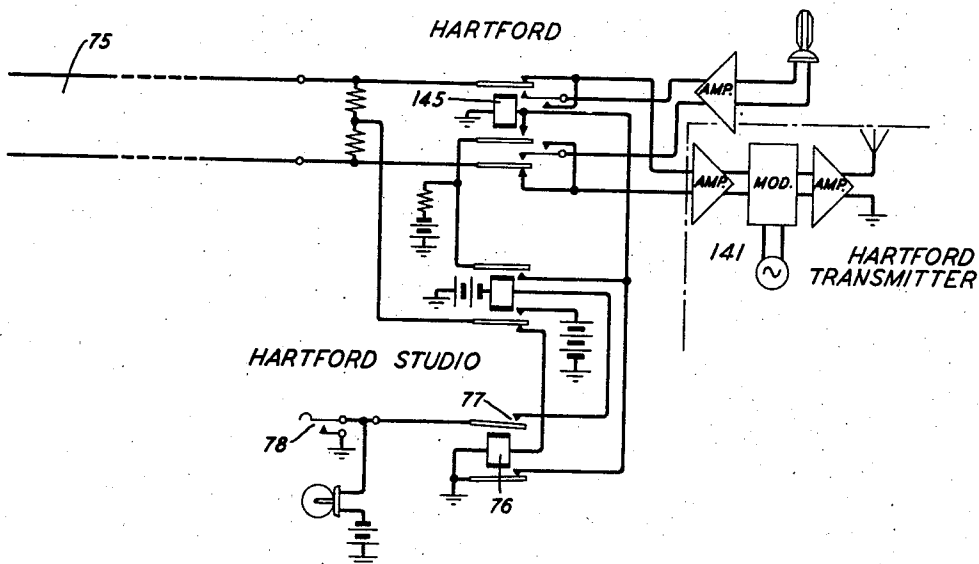


FIG. 9



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2,110,284

REPEATER SYSTEM

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Application September 5, 1936, Serial No. 99,564

8 Claims. (Cl. 179—1.1)

This invention relates to telephone transmission systems and more particularly to systems for transmitting radio broadcast programs over wires from one broadcasting station to another.

An object of the invention is to provide a simple and flexible transmission network, employing one-way amplifiers, for interconnecting a plurality of broadcasting stations whereby any station may assume control of the network and condition all amplifiers in the network to transmit from that station to all other stations and to prevent interference, by any of the other stations, as long as said first station retains control.

Other objects and features of the invention will appear from the following description, claims and appended drawings, Figs. 2 to 9 of which when placed adjacent to one another as shown in Fig. 1, show a hypothetical network extending from Chicago in the middle west to Boston on the eastern seaboard with intermediate bridged connections to local broadcasting stations along the route and also to points to the south.

In the drawings, Fig. 2 shows a broadcasting station at Chicago connected by a program circuit to a bridging point (Cleveland) at which point a local broadcast station is connected. From Cleveland the circuit continues east to the next bridging point (New York, Figs. 3, 4, and 5), where a broadcasting station is connected and where two other circuits are branched, one to the south, Washington, for example, and another to the east, with a bridging point at Hartford (Figs. 6 and 7) where a local station is connected (Fig. 9) and from which point a circuit is extended to Boston (Fig. 8).

A description of the circuit arrangement, in accordance with the invention, will now be given.

It will be assumed that the New York studio (Fig. 5) is to transmit a program and therefore control key 1 (Fig. 5) will be operated. When key 1 is operated an obvious circuit is closed to operate relay 2 and light guard lamp 3. Relay 2 operated connects 130-volt battery, at its lower alternate contacts, to the middle of simplex coil 4 connected across the line between the studio and the nearest bridging point, in this case the New York toll office. From this point the circuit can be traced to the middle of the corresponding simplex coil 5 (Fig. 4) at the toll office or bridging point and from that point over contact 6 of relay 7, winding of relay 8 and contacts of key 9 to ground. Relay 8 operates in this circuit and closes its contact 10 thereby connecting 130-volt battery 153 to the mid-point of simplex coil 11 bridged across the multiple

connection 49 between the amplifiers A1, A2, A3, and A4. Relay 12 connected to this simplex circuit operates and lights cue lamps 13 as an indication to the attendant at the bridging point that one of the studios has control of the circuit. Operation of relay 8 also closes its contact 14 and short-circuits the normally operated relay 15 of amplifier A3 which relay thereupon releases. When relay 15 releases it closes its contacts 16 thereby closing a circuit to operate amplifier relay 17. Relay 15 in releasing also opens the circuit for normally lighted direction lamp 18 and the operation of relay 17 lights the opposite direction lamp 19 which indicates to the attendant that amplifier A3 is now reversed and set to transmit from its associated studio into the network. Operation of relay 17 connects ground at its innermost upper contacts to place a second short circuit around relay 15 thereby holding relay 15 released in case the contact key 1 at the New York studio should be released thereby removing battery from the simplex circuit and releasing relay 8 which would remove ground, at its contacts 14, from relay 15.

It should be here pointed out that the amplifiers at the bridging point, i. e. Cleveland (Fig. 2), New York (Figs. 3 and 4) identified as A1, A2, A3 and A4 and Hartford (Figs. 6 and 7) identified as B1, B2 and B3, are arranged to normally transmit from left to right, i. e., the left-hand switching relays, for example relay 39 of amplifier A2 (Fig. 3) are normally operated and the right-hand switching relays, for example relay 40 of amplifier A2 (Fig. 3), are normally released. This condition will be indicated to the attendant at the bridging point or repeater station by the lighting of the direction lamps associated with the respective relays, for example lamp 41 associated with relay 39 of amplifier A2. When an amplifier is reversed, i. e. arranged to transmit in the opposite direction, the left-hand switching relay is released and the right-hand relay operated as in the case just described in connection with amplifier A3, whereupon normally lighted direction lamp 18, for example, is extinguished and direction lamp 17 is lighted.

Continuing with the circuit description, release of relay 15 closes, at its contacts 42, a circuit to operate equalizer relay 43 which operates and connects the equalizing network 44 in shunt to the primary winding of input transformer 45 which feeds the amplifier tube 46, this equalizing network being for the purpose of compensating for transmission distortion in-

roduced in the program signal frequencies by the circuit over which they arrive at the amplifier, in this case, the line 21 from the New York studio. Keys 47 and 48 are for manually controlling the equalizer relay 43. Corresponding relays, equalizing networks and keys are associated with each of the other amplifiers.

When relay 8 (Fig. 4) operated, and connected 130-volt battery to the middle of simplex coil 11, current flowed over the multiple connection leads 49 in parallel whereupon relay 26 of amplifier A2 and the corresponding relays of amplifiers A1 and A4 operate in a circuit including contacts 61 of relay 62, in the case of amplifier A2. Relay 26 in operating closes its contacts and operates relay 27 in an obvious circuit. Relay 27 operated connects, at its contact 28, 130-volt battery to the middle of simplex coil 29 and thence over the two conductors in parallel of cable line 30 to the next eastern bridging point (Hartford) where the circuit may be further traced from the middle of simplex coil 31 of amplifier B2 (Fig. 7) and contact 32 of relay 33, winding of relay 34 and contact of the switch 35 to ground. Relay 34 operates in this circuit and at its contacts 59 short-circuits relay 51 which releases. Operation of relay 54 also closes its contact 36 which connects 130-volt battery to the middle of simplex coil 37 and thence to the multiple connection 52 between the amplifiers B1, B2, and B3 which causes operation of relay 53 associated with the amplifier B1 in a circuit including contact 63 of relay 64 (Fig. 6) and the corresponding relay associated with amplifier B3 (Fig. 7). Also relay 38 operates to light cue lamp 39 as an indication to the Hartford repeater attendant that the network is in use.

Release of relay 51 of the amplifier B2 extinguishes the direction lamp 54, operates equalizer relay 55 which connects the equalizing network 57 across the primary winding of input transformer 59 and operates relay 56 which in turn lights direction lamp 58. Relay 56 in operating connects, at its contact 60, a second short circuit around relay 51 to maintain this relay released in case relay 34 is released due to release of the control key 1 at the New York studio and the consequent sequential release of relays 8, 27, and 34.

Relay 53 of amplifier B1 in operating operates relay 65 which relay connects 130-volt battery, at its contact 66, to the mid-point of simplex coil 67 from which point the circuit can be traced over the conductors of line 68 in parallel to the Boston repeater station and to the mid-point of the simplex coil 69 connected across the line at that point (Fig. 8).

From the mid-point of coil 69 the circuit can be traced over contact 70 of relay 71 and through relay 72 to ground. Relay 72 operates in this circuit and opens its contact 73 thereby preventing the accidental operation of the control key 74 at the Boston studio from interfering with the connection established by the operation of key 1 at the New York studio as long as key 1 remains operated.

When battery was connected to the multiple connection 52, (Figs. 6 and 7) by the operation of relay 34, it also caused relays in amplifier B3, corresponding to relays 53 and 65 of amplifier B1, to operate thereby connecting 130-volt battery to the line 75 leading to the Hartford studio (Fig. 9), where it caused operation of relay 76 thereby opening contacts 77 of that relay and preventing accidental operation of control key 78 from inter-

fering with the network connections established by key 1 at New York, as long as key 1 is operated.

Returning to the New York repeater station (Figs. 3 and 4) the connection of 130-volt battery to the multiple connection 49 causes relays in amplifiers A1 and A4, corresponding to relays 26 and 27 of amplifier A2 to operate thereby connecting 130-volt battery to simplex lines 79 to Cleveland and 80 to the south, respectively. The effect of connecting battery to the line 79 at New York is exactly the same as that when battery is connected to line 30 extending to Hartford and Boston which is also true with respect to connecting battery to the line 80 extending from the south.

In the case of line 79 to Cleveland the circuit operation at the Cleveland bridging point (Fig. 2) is exactly the same as at Hartford (Figs. 6, 7, and 9). From Cleveland a circuit 81 extends to Chicago where the studio circuit functions exactly the same as the eastern terminal of the circuit, i. e. Boston (Fig. 8). In other words battery connected to the line 81 at the Cleveland bridging point extends from the midpoint of the simplex coil 82 at Chicago through relay 83 to ground which relay operates to prevent accidental or other improper operation of control key 84 from effecting the switching of the amplifiers as established by key 1 at New York, as long as that key is held operated.

The key 1 at New York will in practice, be held operated until the end of the New York broadcast at which time it will be released thereby conditioning the network to be reswitched for a program from another studio, for example, Boston which will be later described.

It will now be seen that amplifier A3 at the New York repeater station or bridging point (Fig. 4), associated with and terminating the line 21 from the New York studio, is reversed for transmission away from the studio, i. e., is now set to transmit from right to left due to the operation of relay 17 and the released condition of relay 18.

Amplifier B2 at Hartford and the corresponding amplifier at Cleveland (not shown) which receive the program transmitted over lines 38 and 79, respectively, from New York are likewise reversed, i. e., arranged to transmit from right to left but all other amplifiers remain set to transmit from left to right, which is their normal setting.

The program transmission circuit can now be traced from the studio microphone 23 at New York (Fig. 5) through the associated amplifier, over contacts 85 and 86 of relay 20 now operated to the New York broadcasting transmitter 22, it being noted that when relay 2 is operated due to operation of the control key an energizing circuit is closed at its upper contact to operate relay 20 from battery 87 through relay 20 to ground. Relay 20 in operating closes its contact 24 thereby closing a holding circuit for itself to battery 87 independent of relay 2.

Operation of relay 20 also closed its contacts 88, 89 thereby connecting the microphone 23 to the line 21 extending to the repeater station, Fig. 4, where the circuit can be further traced over contacts 89 and 90 of operated relay 17 to the primary winding of repeating coil 91, the secondary of which is connected to the primary of input transformer 45, the secondary of which supplies the amplifier tube 46.

The output circuit of tube 46 includes output transformer 92 having a tapped secondary, the entire winding of which being connected to conductors 93 and the so-called monitoring tap be-

ing connected to conductors 94. The output of the tube 46 therefore has two branches, one over conductors 93 carrying the full gain of the amplifier which can be traced over contacts 95 and 96 of relay 17 and conductors 97 to the monitoring loud-speaker located at the repeater station and the other branch, 94, of reduced energy output, which can be traced over contacts 98 and 99 of relay 17 and conductors 100 to transformer 101. Conductors 100 are also connected to corresponding relay contacts of amplifiers A1, A2 and A4 but as the relays of these amplifiers, corresponding to relay 17, are unoperated the circuit to these amplifiers is open at this point.

Transformer 101 couples conductors 100 to multiple connection 49 and consequently the output transmission from amplifier A3 is further traced to the input circuits of amplifiers A1, A2 and A4 over contacts such as contacts 102 and 103 of normally operated relay 39 of amplifier A2.

Following the circuit through amplifier A2, for example, the transmission path extends to the primary of repeating coil 104 and thence through input transformer 105 to amplifier tube 106. The full energy output of tube 106 can be traced through output transformer 107 over contacts 108 and 109 of relay 39 and conductors 110 to the cable line 30 extending to Hartford where it enters associated amplifier B2, Fig. 7, over contacts 111 and 112 of relay 56, and through repeating coil 113 and input transformer 59 to the amplifier tube 114. From the output of transformer 115 two branches extend, one branch including the full secondary winding of transformer 115, conductors 116, contacts 117 and 118 of relay 56 and conductors 119 extend to the monitoring loud-speaker at the Hartford repeater station and the other branch, including only a portion of the secondary winding of transformer 115, conductors 120, contacts 121 and 122 of relay 56 and conductors 123 extends to the repeating coil 124 which couples conductors 123 with the multiple connection 52 which is bridged to the left-hand terminals of all three amplifiers.

Due to the fact that relay 51 of amplifier B2 is released the connection is open between conductors 52 and this amplifier, but as relay 125 of amplifier B1 and the corresponding relay (not shown) of amplifier B3 are normal, i. e., operated the transmission circuit now branches in two directions, one branch being over contacts 126 and 127 of relay 125 of amplifier B1 to the primary winding of repeating coil 128 and thence through input transformer 129 to the amplifier tube 130. The output of tube 130 includes the transformer 131 which has two branches; one the low level output, including the tapped portion of the secondary winding, connected to conductors 132 terminates in resistance 133 over contacts 134 and 135 of relay 125. The other, or high energy level branch of the amplifier output, which includes the full secondary winding of transformer 131, is connected to conductor 136 and extends over contacts 137 and 138, of relay 125 and conductors 139 to line 16 extending to the Boston station where it terminates in transmitter 140 from which point it goes on the air.

The other branch of the transmission circuit from repeating coil 124 is through amplifier B3 from left and right in exactly the same manner as that just described for amplifier B1 and thence over line 75 to the Hartford broadcast station where it terminates in the transmitter 141.

Returning to the New York repeater station (Figs. 3 and 4) the program transmission circuit

can be traced to the west from repeating coil 101 through amplifier A1 from left to right in exactly the same manner as that described in connection with amplifier A2 of Fig. 3 or B1 of Fig. 6, and thence over line 79 to Cleveland (Fig. 2) where it terminates in an amplifier (not shown) identical with B2, for example, at Hartford. The program signals received are amplified by this amplifier, passed to a second amplifier identical with B1 of Fig. 6 and extend over line 81 to Chicago where it finally terminates in the Chicago transmitter 142.

At Cleveland a third amplifier (not shown) but corresponding to B3 at Hartford is fed by the first amplifier in which line 79 terminates, which further amplifies the program signals and extends them to the Cleveland broadcast station 143.

Summarizing the foregoing description it will be noted that a transmission circuit now exists from the studio at New York (Fig. 5) over line 22 through amplifier A3 of Fig. 4 where it branches in three directions, one to the east through amplifier A2, Fig. 3, over line 30 and through amplifier B2 at Hartford where it branches in two directions, one through amplifier B1 and over line 68 to Boston and the other through amplifier B3 and over line 75 to the Hartford broadcast station.

At New York the second branch extends to amplifier A1 and over line 79 to Cleveland where it is branched in two directions, one branch passing over line 81 to Chicago and the other to the Cleveland broadcast station.

The third branch includes amplifier A4 and line 80 extending to the south where it may terminate in another bridging amplifier arrangement and be branched in two or more directions or it may extend to and terminate directly in a terminal broadcast station such as Washington, for example.

It will be understood that the line 30 from New York to Hartford, line 68 from Hartford to Boston, line 79 from New York to Cleveland, line 82 from Cleveland to Chicago and line 80 from New York to the south may, and in practice will, include further reversible amplifying means adapted to be switched or set to transmit in the direction of the program signals under control of the key at the studio originating the program. These amplifying means will be identical with the amplifiers shown, as before described, and further description appears to be unnecessary.

It will now be assumed that when the program being transmitted by the New York studio is finished and some well known "cue" signal, such as a musical note, is transmitted over the circuit which will be heard by an attendant of each of the connected broadcast stations, the attendant at New York will release key 1 and, as Boston is scheduled to transmit for the next period, an attendant at the Boston studio will operate the control key 74 at that point. The release of key 1 at New York will release relay 2 thereby disconnecting battery from the mid-point of simplex coil 4 connected across line 21. Relay 2 in releasing also opens at its upper contact the original energizing circuit for relay 20 but this relay is now held over its own contact 24 and consequently does not release at this time.

Removal of battery from the simplex circuit comprising line 21 releases relay 8 of amplifier A3 which disconnects battery from the mid-point of simplex coil 11 and also removes, at its contact 14, the original short circuit from relay 15. This relay, however, is now short-circuited at the inner

upper contacts of operated relay 17 and therefore remains released. Removal of battery from simplex coil 11 releases relay 26 of amplifier A2 and the corresponding relays, not shown, of amplifiers A1 and A4. The release of relay 26 releases relay 27 which disconnects, at its contacts 28, battery from simplex coil 29 which causes the release of relay 34 associated with amplifier B2. Release of relay 34 removes, at its contacts 36, battery from simplex coil 37 and also removes, at its contacts 50, the original short circuit around relay 51 which, however, does not operate due to the short circuit around this relay closed at contacts 60 of operated relay 56.

The removal of battery from simplex coil 37 releases relay 53 of amplifier B1 and the corresponding relay of amplifier B3. Release of relay 53 releases relay 65 which removes battery from simplex coil 67 which, in turn, releases relay 72 at the Boston studio which closes its contacts 73 thereby preparing a circuit to operate relay 71, under control of key 74, which we have assumed will be next operated.

The removal of battery from simplex coil 37 also causes the sequential release of relays (not shown) in amplifier B3 corresponding to relays 53 and 65 of amplifier B1 which causes battery to be removed from the simplex path over line 75 to the Hartford studio which causes the release of relay 76.

It will be noted that at all studios other than the one originating a program the operation of relays, such as 72 of Fig. 8 and 76 of Fig. 9, in addition to opening their upper contacts, also close their lower contacts thereby short-circuiting the corresponding switching relays 144 and 145 thereby insuring that these relays will not be falsely operated to interrupt the program being received and broadcast. Similar relays release in the same manner at Cleveland and Chicago (Fig. 2) due to disconnection of battery from the mid-point of simplex coil 11 of the New York amplifier A3.

As before stated, it will now be assumed that Boston is to originate a program for the next broadcast period and therefore when the cue signal is heard by the Boston attendant he will operate key 74. With key 74 operated, as soon as relay 72 releases, as just described, a circuit is closed to operate relay 71 which connects battery at its lower contacts, to simplex coil 69 and at its upper contacts closes an energizing circuit for relay 144 which operates and connects the studio microphone 146 through the amplifier to line 68 in multiple with the transmitter 140.

Battery on the simplex circuit of line 68 can be traced to the mid-point of coil 67 of the Hartford amplifier B1 where it operates relay 64 which connects battery to simplex coil 147 and short-circuits relay 125 which releases. The release of relay 125, closes its inner lower contacts, thereby operating relay 148, thus completing the reversal of amplifier B1 which is identical with the reversal operation of amplifier A3 as more fully described earlier in connection with the operation of key 1 at the New York studio.

Connection of battery to simplex coil 147 operates relay 149 of amplifier B2 which in turn operates relay 33. Operation of relay 33 connects battery to simplex coil 31 and, at its contacts 150, short-circuits relay 56 which now releases. The release of relay 56 opens its contacts 60 thereby removing the remaining short circuit around relay 61 which relay now reoperates. Amplifier

B2 is now reversed and arranged to transmit from right to left, i. e., from Hartford to New York.

Battery connected to simplex coil 147 operates relays (not shown) in amplifier B3 corresponding to relays 149 and 33 of B2 which connects battery over the simplex circuit superimposed on line 75 at the Hartford studio which operates relay 76 which again opens contact 77 to prevent false operation of key 78 from interfering with the switching arrangement established by key 74 at Boston. Relay 76 in operating closes its lower contacts thereby short-circuiting relay 145 and insuring that it will not be falsely operated.

As amplifier B3 was not reversed for the preceding broadcast its switching relay corresponding to relay 51 of B2 was operated and the relay corresponding to 56 was released and consequently operation of the relay corresponding to relay 33 has no effect on the relay corresponding to relay 56 and the amplifier remains in its normal condition, i. e., arranged to transmit from left to right into line 73 to the Hartford studio. Up to this point it will be noted that amplifier B1 is reversed, i. e., is adapted to transmit from right to left from line 68 coming from Boston into the other two amplifiers B2 and B3. Amplifier B2 which was in a reverse condition, i. e., arranged to transmit from the New York line 30 to the other amplifiers B1 and B3 during the previous broadcast is now turned around into its normal condition, i. e., adapted to transmit from the output of amplifier B1 into the New York line 30. Amplifier B3 remains in its normal condition, i. e., arranged to transmit from the output of amplifier B1 into the Hartford studio line 75.

Battery connected to coil 31 of amplifier B2 by the operation of relay 33 passes over line 30 to the New York repeater station and operates relay 62 of amplifier A2 which connects battery to simplex coil 25 and short-circuits relay 39 which now releases and in turn operates relay 40 thereby completing the reversal of this amplifier and conditioning it to transmit from right to left, i. e., from line 30 into the other amplifiers of the station, i. e., A1, A3, and A4.

Connection of battery at the mid-point of coil 25 operates relay 151 of amplifier A3 which in turn operates relay 7. Relay 7 in operating connects battery to the simplex coil 5 and short-circuits relay 17 which releases and removes the short circuit from relay 16 which thereupon reoperates thereby restoring this amplifier to its normal condition, i. e., for transmission from left to right and into line 21 to the New York studio. Connection of battery to the simplex coil 5 connected across line 21 causes relay 162 at the New York studio to operate thereby short-circuiting relay 20 which releases and disconnects the studio microphone circuit from line 21.

Battery on the simplex circuit of the multiple connection 40 also operates relays (not shown) in amplifiers A1 and A4 corresponding to relays 151 and 7, for example, of amplifier A3 which connects battery over the simplex circuit of line 79 to Cleveland and line 80 to the south, respectively.

Battery on the simplex of line 79 causes relays, not shown, at Cleveland to operate which connects battery to the simplex circuit of line 81 at Chicago and to the Cleveland studio line for the purpose of locking out the control keys at these points, key 84 at Chicago, for example.

As the amplifier at Cleveland was pointed in the normal direction, i. e., from left to right to transmit from line 79 to Chicago, and to the

Cleveland studio, this amplifier remains in this condition for the present broadcast which also arrives over line 79.

The program transmission circuits now established are the same as that previously described except that the New York station is now set to receive the program originated at Boston instead of the reverse condition previously assumed when New York was conditioned to originate and Boston to receive.

It will be understood that the network herein described is a purely hypothetical one and other arrangements, employing the same method and instrumentalities for securing transmission over a network in either direction with one-way amplifiers or repeaters may be used if desired without departing from the spirit of the present invention as covered in the appended claims.

What is claimed is:

1. In a two-way program transmission system, a plurality of program stations adapted to transmit or receive a program, a repeater station, a line for each program station connected in multiple to all other station lines at said repeater station, a one-way voice frequency amplifier in each line at the repeater station and normally pointed toward its respective program station, a simplex circuit, comprising the conductors of all said lines, extending from each station to all other stations, sources of direct current, manually controlled switching means at each station for connecting one of said current sources to said simplex circuit, means associated with each amplifier adapted to repeat said direct current around the amplifier in either direction, other means associated with each amplifier responsive to direct current arriving over the simplex circuit from its respective program station to reverse said amplifier and point it toward the other lines, and other means at each station responsive to direct current arriving over the simplex circuit for disabling the switching means thereat as long as said incoming current persists.

2. In a program transmission system, a plurality of program stations, a line for each station connected to all other station lines, one-way amplifiers in each line, means associated with each amplifier adapted, when operated, to reverse the connection of the amplifier with respect to its normal transmission direction in the line, manually controlled switching means at each station for transmitting a control current over its line to all other lines to actuate all reversing means associated with amplifiers which are normally connected to transmit toward the station at which the switching means is operated, and means at each station responsive to the control current received over the respective lines to disable the switching means thereat as long as said control current is received.

3. In a two-way program transmission system, a plurality of program stations, lines for each station connected in multiple to all other station lines, a one-way amplifier in each line adapted to be reversed with respect to its line, relay means associated with each amplifier for reversing the amplifier, manually controlled switching means at each station for operating all reversing means associated with amplifiers in the system which are not normally connected to transmit away from the station at which the switching means is operated, and other means at each station responsive to operation of a switching means at one station to disable the switching means at each of the

other stations as long as the switching means at the one station is operated.

4. In a two-way program transmission system, a plurality of program stations, lines for each station connected in multiple to all other station lines, a one-way amplifier in each line, means associated with each amplifier to reverse the pointing of said amplifiers in their respective lines, manually operated switching means at each station adapted to transmit direct current over all of the lines to operate the reversing means associated with amplifiers pointed in the direction of the station at which the switching means is operated, and other means at each station responsive to direct current, transmitted from another station, to prevent transmission of direct current therefrom.

5. In a transmission system, a plurality of lines connected together at one end and extending to stations at the other ends thereof, a one-way amplifier in each line, each amplifier being normally connected, in its respective line, to transmit in the same direction with respect to the connecting point, means associated with each amplifier to reverse its transmitting direction with respect to its associated line, manually controlled switching means at each station for transmitting control current over all of said lines to actuate all amplifier reversing means associated with amplifiers which are normally pointed in the direction of the station at which the switching means is actuated, said reversing means being arranged to operate only when said control current is received from the direction toward which the associated amplifier is normally pointed, and means at each station responsive to control current transmitted from another station to disable the switching means thereat while said control current is connected to the line.

6. In a program transmission system, a plurality of program stations, a line for each station connected in multiple to all other station lines, one-way amplifiers connected in each line, sources of control current, manually controlled switching means at each station for connecting one of said current sources to the respective line, means associated with each amplifier adapted to repeat said control current around the amplifier, other means associated with each amplifier adapted when operated to reverse the connection of the amplifier with respect to its normal transmission direction in its line, said reversing means being so arranged that it is responsive only to control current coming over the line in the opposite direction from that in which the amplifier is normally connected to transmit, and other means at each station responsive to control current received over the respective line to disable the switching means thereat and prevent the connection of other control currents to the line as long as said first control current is received.

7. A system in accordance with claim 6, in which each of said amplifiers has two output circuits, each of different energy level, and in which the higher energy output is normally connected to the line, characterized in this that means are provided responsive when said amplifier is reversed to disconnect the higher energy output from the line and substitute the lower energy output therefor, and to connect the higher energy output to a monitoring receiver.

8. A system in accordance with claim 6, in which each amplifier has an input circuit and two output circuits, each output circuit being of

5 a different energy level, and in which the higher energy output circuit is normally connected to the line in one direction and the input circuit to the line in the opposite direction, characterized in this that each reversing means is so arranged that when its operation is initiated that the input and high level output circuits of the associated

amplifier are first disconnected from the line and after a momentary delay the input circuit and the low level output circuits are connected to the line in the opposite transmission direction.

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