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CORD CIRCUIT REPEATER

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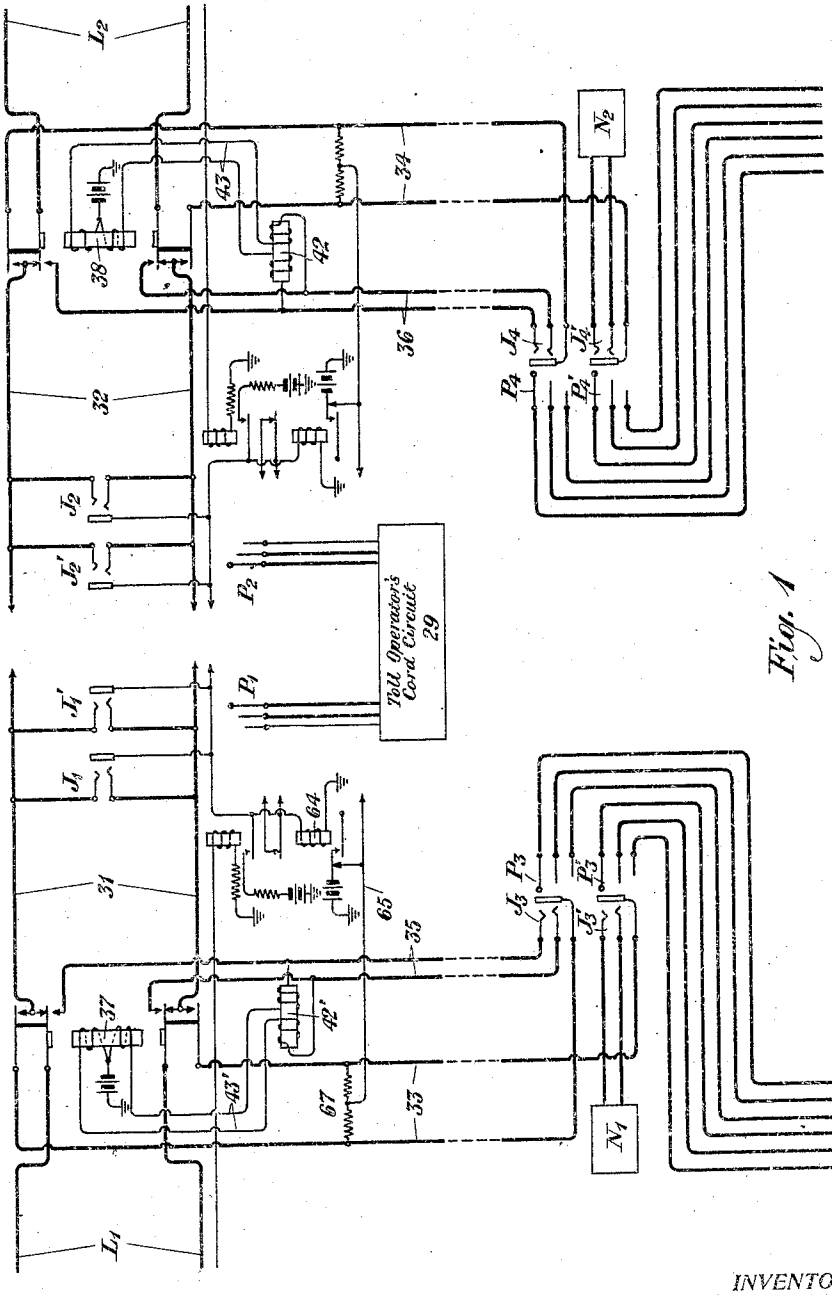


Fig. 1

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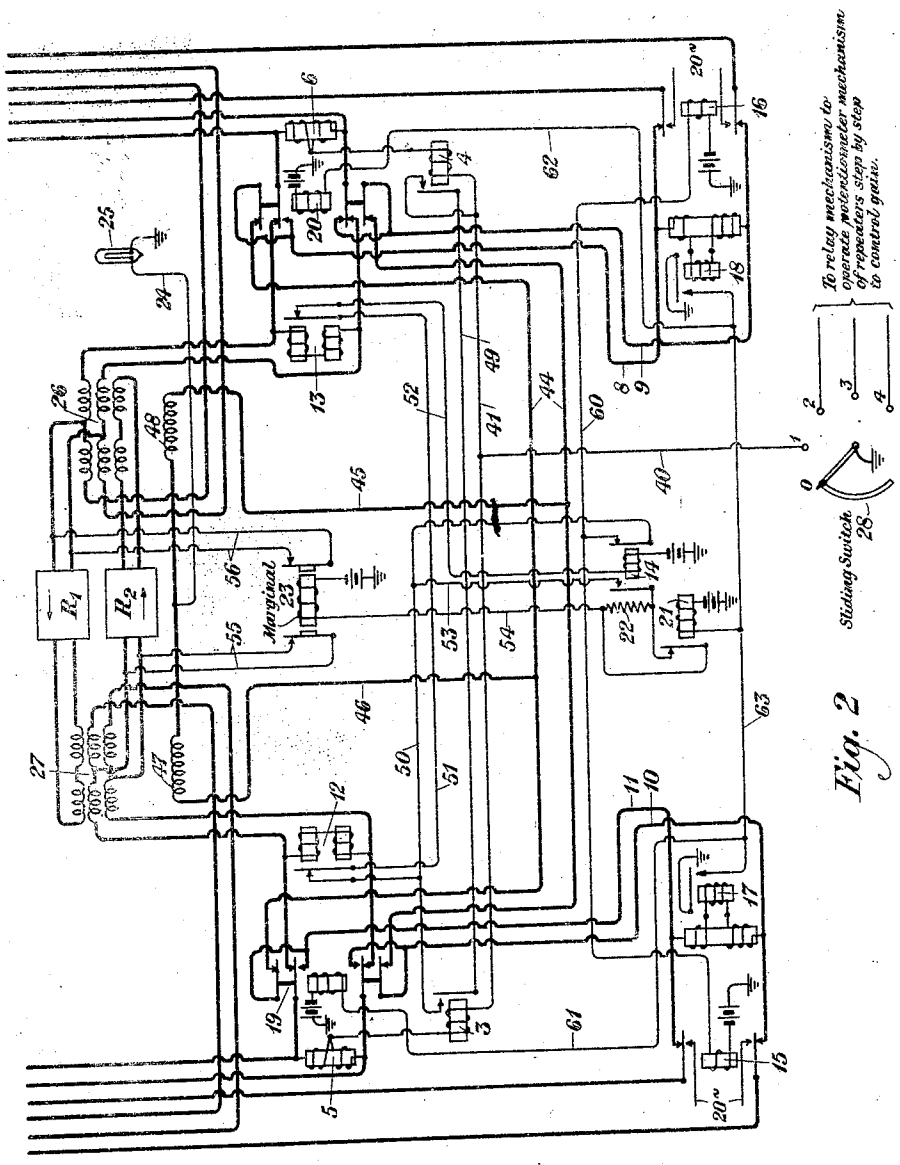


Fig. 2

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UNITED STATES PATENT OFFICE.

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CORD-CIRCUIT REPEATER.

Application filed October 7, 1925. Serial No. 61,096.

This invention relates to transmission lines and more particularly to improvements in arrangements for interconnecting such lines through repeater apparatus.

Heretofore it has been the practice to set aside certain specified positions in a switchboard to handle calls requiring telephone repeaters. When a regular operator received a call between two lines which needed to be coupled by a repeater connection she would then transfer the call completely to an operator at one of the special repeater positions. The special repeater operator would then build up the remaining circuits, establish the connection through a repeater cord circuit, monitor on the connection and have general supervision of the call until its absolute completion. This practice placed quite a heavy traffic load on the special repeater operators. The time required for the repeater operator to complete the many duties required by each call made it necessary to provide a large number of special repeater positions and operators and to have each repeater operator handle comparatively few repeaters. The service, however, was subject to considerable delay. This practice caused some uncertainty in securing repeaters on designated connections since the call, which was passed by the originating operator was received by a regular operator who then transferred the call and a new operator to the connection had to receive the instructions. On a certain proportion of the calls the originating operator failed to repeat the call for a repeater the second time and the connection would be completed without a repeater. This resulted in extra traffic load on the originating operator as well as on the operators at the repeater point.

With the arrangements of this invention the regular operator upon receiving a call between two lines which need to be coupled by a repeater connection does not effect a complete transfer of the call to the repeater operator but merely communicates with her over a call circuit and tells her to interconnect by a repeater cord circuit these two lines, special jacks for which are located at the repeater operator's position. Means are provided by this invention whereby the regular operator will then complete the connection and have complete supervision thereover until its absolute completion. In other words with the arrangements of the invention all that the special repeater operator has to do is to connect a repeater cord circuit operatively between the two designated lines and all of the other duties fall on the regular operator. Under such conditions the special repeater operator is able to handle a great many more repeater cord circuits than heretofore and connections of this type may be completed in a much shorter time. Furthermore, the number of special repeater positions may be greatly reduced. Accordingly, it will be seen that the arrangements of the invention serve to materially increase the speed of the service, while at the same time reduce the equipment and personnel required. Further features and objects of the invention will appear more fully from the detailed description thereof hereinafter given.

The invention may be more fully understood from the following description together with the accompanying drawing in the Figures 1 and 2 of which the invention is illustrated. Figs. 1 and 2 when taken together show a circuit diagram of a preferred form of the invention.

In the upper portion of Fig. 1 are shown two lines L_1 and L_2 terminating in the multiple jacks J_1, J_1', J_2 and J_2' respectively located at positions on a switchboard taken care of by a regular operator. The operator's cord circuit 29 is shown schematically. Associated with the line L_1 and the circuit 31 is a relay 37. This relay serves to connect line L_1 to a circuit 35 and to connect circuit 31 to a circuit 33. Circuits 33 and 35 lead to the twin jacks J_3 and J_3' which are located at another position on the switchboard known as a special repeater operator's position. Another set of twin jacks J_4 and J_4' are located at this special repeater operator's position and may be connected to the line L_2 and circuit 32 by means of the relay 38 and circuits 34 and 36. In Fig. 2 is shown in detail the repeater cord circuit for interconnecting lines L_1 and L_2 through the twin jacks J_3 J_3' and J_4, J_4'. Associated with the twin jacks are the balancing networks N_1 and N_2 adapted to balance the lines L_1 and L_2 respectively. The cord circuit repeater includes a two-way two element repeater comprising the repeater elements R_1 and R_2 and the usual hybrid coils

26 and 27. A gain control device including the sliding switch 28 is also provided for setting the gain of the repeater elements. Other details of the arrangements will appear more fully from the following detailed description of the operation of the invention.

For purposes of illustration let it be assumed that the regular toll operator at a position on the outward board has built up a connection between two lines such as L_1 and L_2. The regular toll operator will be connected to these lines by her cord circuit 29, the plugs P_1 and P_2 of which being inserted respectively in the multiple jacks J_1, J_1' and J_2, J_2'. If the regular toll operator now desires to have these two lines interconnected through repeater apparatus she will communicate over a call circuit (not shown) with the special repeater operator at a different position on the switchboard, such as the position at which the cord circuit repeater of Fig. 2 would be located. The special repeater operator would then be instructed to interconnect the two lines L_1 and L_2 by a repeater cord circuit. As has been pointed out heretofore twin jacks, such as J_3, J_3' and J_4, J_4', for these lines would be provided at the special repeater operator's position. The repeater operator would then insert the twin plugs P_3, P_3' and P_4, P_4' of a repeater cord circuit into these twin jacks. The repeater operator will then advance the sliding switch 28 of her gain control apparatus from the zero position to one of the other positions. Only the switching or key mechanism of the gain control apparatus has been shown. The gain control apparatus would consist of potentiometers and apparatus for adjusting them associated with the input circuits of the repeater elements to vary the gain thereof. The separate circuits shown connected to the positions of the sliding switch 28 would control the mechanism for operating the potentiometers. As gain control mechanism for repeaters is well known in the art no further description thereof will be given. It is pointed out that the operation of the gain control mechanism may be either manual or automatic. As has been pointed out, the repeater operator will advance the switch 28 of her gain control apparatus as soon as she plugs in her repeater cord circuit. This will put ground on the following simplex circuit; from ground conductors 40 and 41, winding of relay 4, windings of retard coil 6, tip and ring conductors of plug P_4, circuit 36, windings of retard coil 42, circuit 43, windings of relay 38 to battery and ground. The closing of this circuit will operate relay 38. The operation of relay 38 will disconnect line L_2 from circuit 32 leading to the operator cord circuit 29 and will connect line L_2 to the conductors 36 and thence over the tip and ring conductors of plug P_4 and the contacts of relay 20 to the input windings of repeater R_1. The network windings of repeater R_1 will be connected over the tip and ring conductors of plug P_4' and jack J_4' to the balancing network N_2. The regular operator's cord circuit 29 will be connected over circuit 32, contacts of relay 38, conductors 34, sleeve conductors of plugs P_4 and P_4', contacts of relay 16, conductors 8 and 9, contacts of relay 20 conductors 44, and thence over conductors 45 and 46 and through the monitoring coils 47 and 48. In other words the operation of relay 38 will connect line L_2 to the talking windings of the repeater and will connect the regular operator's cord circuit 29 to the monitoring windings of the repeater. The operation of the sliding switch 28 of the repeater gain control apparatus will also close the following simplex circuit: from ground, contacts of switch 28, conductors 40 and 41, windings of relay 3 and retard coil 5, tip and ring conductors of plug P_3, conductors 35, windings of retard coil 42', conductors 43', and thence through the windings of relay 37 to battery and ground, thus operating relay 37. The relay 37 performs similar functions to those of relay 38. Accordingly the relay 37 upon operating will connect line L_1 to the input windings of repeater R_2 and will connect the operator's cord 29 to the monitoring windings of the repeater.

The special repeater operator will be provided with monitoring apparatus which has not been shown in the drawing. When she operates the sliding switch 28 of her gain control apparatus she will listen in on the connection by her monitoring apparatus to determine whether she has been able to introduce any gain in the connection by the repeater apparatus. This may be determined by the presence or absence of a condition of "singing" on the line. If she finds that it was not possible to introduce any gain by the repeaters she will restore her key 28 to the zero position. This will allow lines L_1 and L_2 to be interconnected through the toll operator's cord circuit 29 and the repeater cord will be removed from the lines. However if it is found that the repeater cord circuit does serve to introduce a desired gain in the circuit, the switch 28 will be left in its actuated position and the monitoring and other supervision will be done by the regular toll operator whose set has been connected to the monitoring windings 47 and 48 as has been pointed out heretofore.

It has been pointed out that when the switch 28 is operated that certain circuits are closed through the windings of relays 3 and 4 and that these relays are operated thereby. The operation of relays 3 and 4 will cause certain circuit conditions to be set up in the repeater cord circuit, among which are the following;—ground will be

applied from switch 28 over conductors 40 and 41, armature and contact of relay 4, conductor 49, armature and contact of relay 3, contact and armature of relay 12, conductor 51, armature and contact of relay 13, conductor 52, winding of relay 14, to battery and ground, thereby operating relay 14. The operation of relay 14 will pull open its right hand armature and contact and prevent the ground which was also applied to conductor 50 from being applied at this time to conductor 60 and thence to the ringing relays 15 and 16. The operation of relay 14 will close at its left hand contact a circuit from conductor 50 to which ground has been applied, over conductor 53, contact and armature of relay 14, contact and armature of relay 21, conductor 54, winding of marginal relay 23, to battery and ground. The closing of this circuit will operate relay 23 which will open the short circuits 55 and 56 across the input circuits of the repeaters R_2 and R_1 and hence place them in condition for operation.

Under the above described conditions a re-ring signal would operate in the following manner. For example, signaling current applied by the distant operator at the other end of line L_1 would come in over line L_1 and would operate the signal current responsive relay 12. This would open at its contact and armature the previously traced circuit through relay 14 and would deenergize relay 14. This would allow a circuit to be closed over the right hand armature and contact of relay 14 as follows:—from ground applied to conductor 50, armature and contact of relay 14, conductor 60, winding of relay 15, to battery and ground, thereby operating relay 15. This would connect a source of suitable signaling current, such as 20 cycles, to the sleeve conductors of plugs P_3 and P_3' and thence over conductors 33 and 31 to the signal responsive apparatus in the regular operator's cord circuit 29. In an operator's cord circuit, such as 29, the direction of the incoming re-ring signal is unimportant. In a similar manner a re-ring signal coming in over line L_2 would operate the relay 13 and cause the deenergization of relay 14 and the operation of relay 16 which would apply signaling current to the sleeve conductors of plugs P_4 and P_4' and thence over conductors 34 and 32 to the operator's cord circuit 29. The release of relay 14 in the case of a re-ring signal would also release relay 23 and close the short circuits across the inputs of the repeaters and thus prevent any "singing" at this time.

If the regular toll operator desires to ring out over either of the lines L_1 or L_2 while these lines are interconnected by the repeater cord circuit the operation is as follows: If, for example, the operator desires to ring out over line L_1, she will apply signaling current from her cord circuit 29, over conductors 31 and 33 and over the sleeve conductors of plugs P_3 and P_3' and over conductors 10 and 11 and thence through the winding of relay 17. This will operate relay 17 which will close the following circuit,—from ground, armature and contact of relay 17, conductor 61, winding of relay 19, to battery and ground. This will operate relay 19 which will connect conductors 10 and 11 to the tip and ring conductors of plug P_3. Accordingly the signaling current applied from the operator's cord circuit 29 will be transmitted from conductors 10 and 11, over the tip and ring conductors of plug P_3, over conductor 35, and thence out over the line L_1. The operation or relay 17 will also apply ground to conductor 63 and thus operate relay 21. This will open the short circuit around resistance 22 and include this resistance in the circuit of marginal relay 23 causing it to release. This will close short circuits 55 and 56 across the input circuits of the repeaters and thus prevent any "singing" from taking place at this time. In a similar manner ringing current transmitted from the operator's cord 29 to conductors 32 and 34 would be applied to conductors 8 and 9 and would operate relay 18. This in turn would operate relay 20 and connect conductors 8 and 9 to the tip and ring conductors of plug P_4 from which the ringing current would be applied to conductors 36 and thence out over line L_2. The short circuits across the repeater input circuits would also be closed at this time.

When the original operator receives a disconnect signal from the line she removes her cord circuit 29 from the multiple jacks such as J_1, J_1'. This would cause the relay 64 to release. This relay would have been energized when the original operator connected with the line. The release of relay 64 will allow the following simplex circuit to be completed,—from ground and battery, contact of relay 64, conductor 65, to the midpoint of resistance 67 and then over the parallel simplex circuit comprising conductors 33, sleeve conductors of plugs P_3 and P_3', conductors 10 and 11, conductors 44, conductors 45 and 46, windings of monitoring coils 47 and 48, to the midpoint of these coils, and thence over conductor 24 and through lamp 25 to ground. The completion of this simplex circuit will operate lamp 25 which will notify the special repeater operator to remove the repeater cord circuit from the line.

A further advantage of the arrangements of the invention consists in improved conditions of balance during a repeater connection. This is due to the fact that when the repeater cord circuit of this invention is

connected to the line all of the multiple cable and associated apparatus at the switchboard is disconnected therefrom. In other words the repeater cord circuit is connected directly to the line section alone, as over the contacts of relay 37, and circuit 31 and the multiple cable apparatus is eliminated from the talking connection. This multiple cable apparatus will vary to such a degree due to moisture and weather conditions that it would affect the balance of the line. With the arrangements of the invention however all this variation is eliminated as the artificial line only has to balance the line section L_1 itself.

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 other arrangements without departing from the spirit of the invention as defined by the appended claims.

What is claimed is:

1. A transmission line normally terminating in jacks located at a switchboard position, circuit arrangements associated with said line and terminating in jacks located at a different switchboard position, relay means associated with said line and said circuit arrangements, a cord circuit adapted to be associated with said jacks at said second mentioned switchboard position, and means in said cord circuit for operating said relay means whereby said line will be disconnected from said first mentioned jacks and connected to the talking conductors of said second mentioned jacks and said first mentioned jacks will be connected to the sleeve conductors of said second mentioned jacks.

2. A pair of transmission lines normally terminating at a regular switchboard position, a cord circuit at said position for interconnecting said lines, auxiliary circuits associated with said lines and terminating at a second switchboard position, a cord circuit at said second switchboard position for interconnecting said auxiliary circuits, supervisory apparatus in said second cord circuit, and relay means associated with said lines and said auxiliary circuits for disconnecting said lines from said first cord circuit and for connecting said lines to certain of said auxiliary circuits for interconnection through said second cord circuit and for connecting said first cord circuit to certain of said auxiliary circuits for connection with said supervisory apparatus in said second cord circuit.

3. A transmission line normally terminating at a regular switchboard position, a cord circuit connected to said line at said position, a pair of auxiliary circuits associated with said line and terminating at a second switchboard position, a cord circuit at said second position having a talking circuit and a supervisory circuit, means for connecting the talking circuit of said second cord circuit with the first auxiliary circuit, means for connecting the supervisory circuit of said second cord circuit with the second auxiliary circuit, and relay means associated with said line and said auxiliary circuits and controlled by said second cord circuit for disconnecting said line from said first cord circuit and connecting said line to said first auxiliary circuit and for connecting said first cord circuit to said second auxiliary circuit.

4. A transmission line normally terminating at a regular switchboard position, a cord circuit connected to said line at said position, a pair of auxiliary circuits associated with said line and terminating at a second switchboard position, a cord circuit at said second position having a talking circuit and a supervisory circuit, means for connecting the talking circuit of said second cord circuit with the first auxiliary circuit, means for connecting the supervisory circuit of said second cord circuit with the second auxiliary circuit, relay means associated with said line and said auxiliary circuits and controlled by said second cord circuit for disconnecting said line from said first cord circuit and connecting said line to said first auxiliary circuit and for connecting said first cord circuit to said second auxiliary circuit, a signaling circuit in said second cord circuit, signal responsive means associated with the talking circuit of said second cord circuit for controlling said signaling circuit, and means controlled by said signaling circuit for applying signaling current to said second auxiliary circuit.

5. A transmission line normally terminating at a regular switchboard position, a cord circuit connected to said line at said position, a pair of auxiliary circuits associated with said line and terminating at a second switchboard position, a cord circuit at said second position having a talking circuit and a supervisory circuit, means for connecting the talking circuit of said second cord circuit with the first auxiliary circuit, means for connecting the supervisory circuit of said second cord circuit with the second auxiliary circuit, relay means associated with said line and said auxiliary circuits and controlled by said second cord circuit for disconnecting said line from said first cord circuit and connecting said line to said first auxiliary circuit and for connecting said first cord circuit to said second auxiliary circuit, signal responsive means associated with said supervisory circuit in said second cord circuit, and means controlled thereby for connecting said supervisory circuit to said talking circuit in said second cord circuit.

6. A transmission line normally terminating at a regular switchboard position, a cord

circuit connected to said line at said position, a pair of auxiliary circuits associated with said line and terminating at a second switchboard position, a cord circuit at said second position having a talking circuit and a supervisory circuit, means for connecting the talking circuit of said second cord circuit with the first auxiliary circuit, means for connecting the supervisory circuit of said second cord circuit with the second auxiliary circuit, relay means associated with said line and said auxiliary circuits and controlled by said second cord circuit for disconnecting said line from said first cord circuit and connecting said line to said first auxiliary circuit and for connecting said first cord circuit to said second auxiliary circuit a simplex circuit associated with said second auxiliary circuit and the supervisory circuit in second cord circuit, signaling means in said second cord circuit controlled by said simplex circuit, and means controlled by said first cord circuit for controlling said simplex circuit.

In testimony whereof, we have signed our names to this specification this 5th day of October, 1925.

SAMUEL P. SHACKLETON.
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