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H. J. FISHER

TELEPHONE SYSTEM

Filed March 18, 1926 2 Sheets-Sheet 1

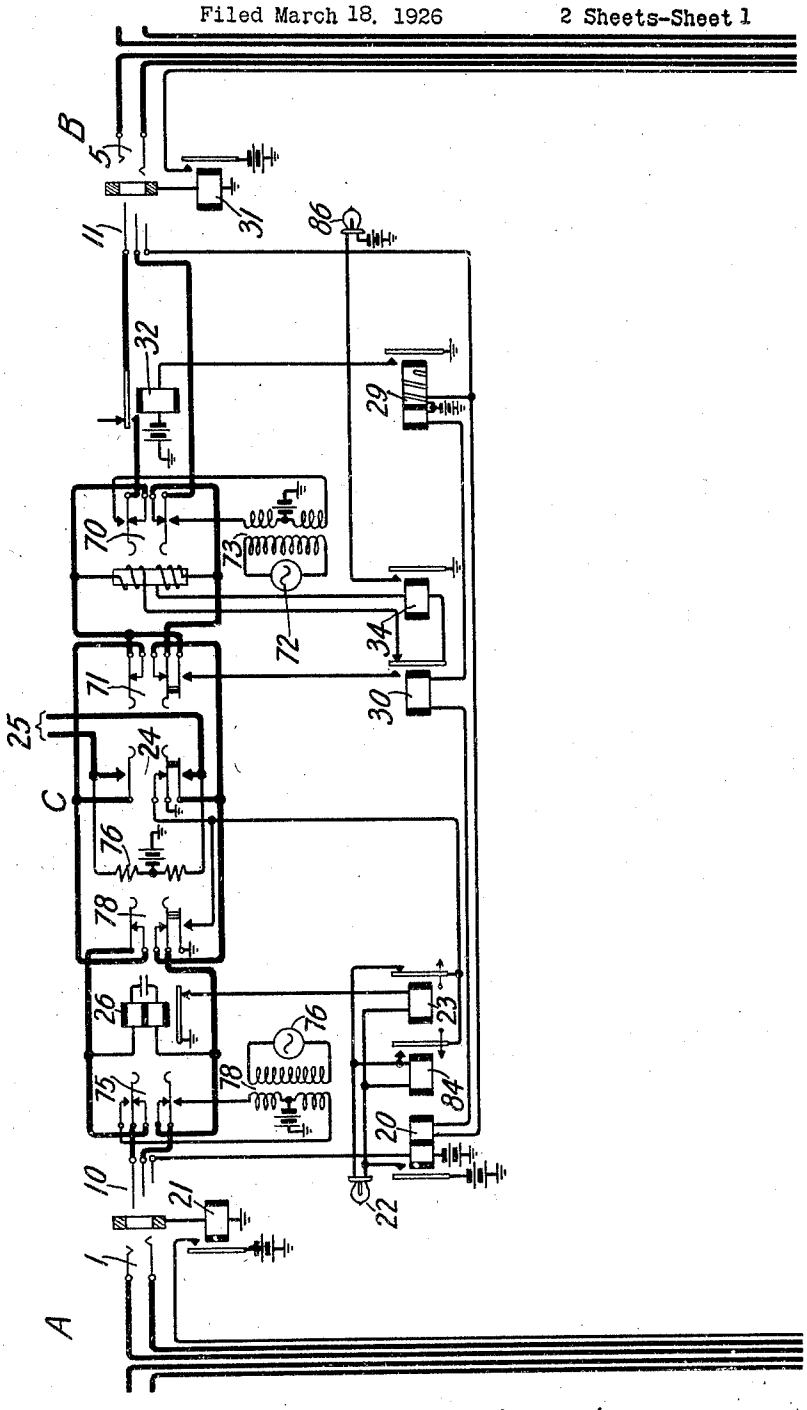

Fig. 1.

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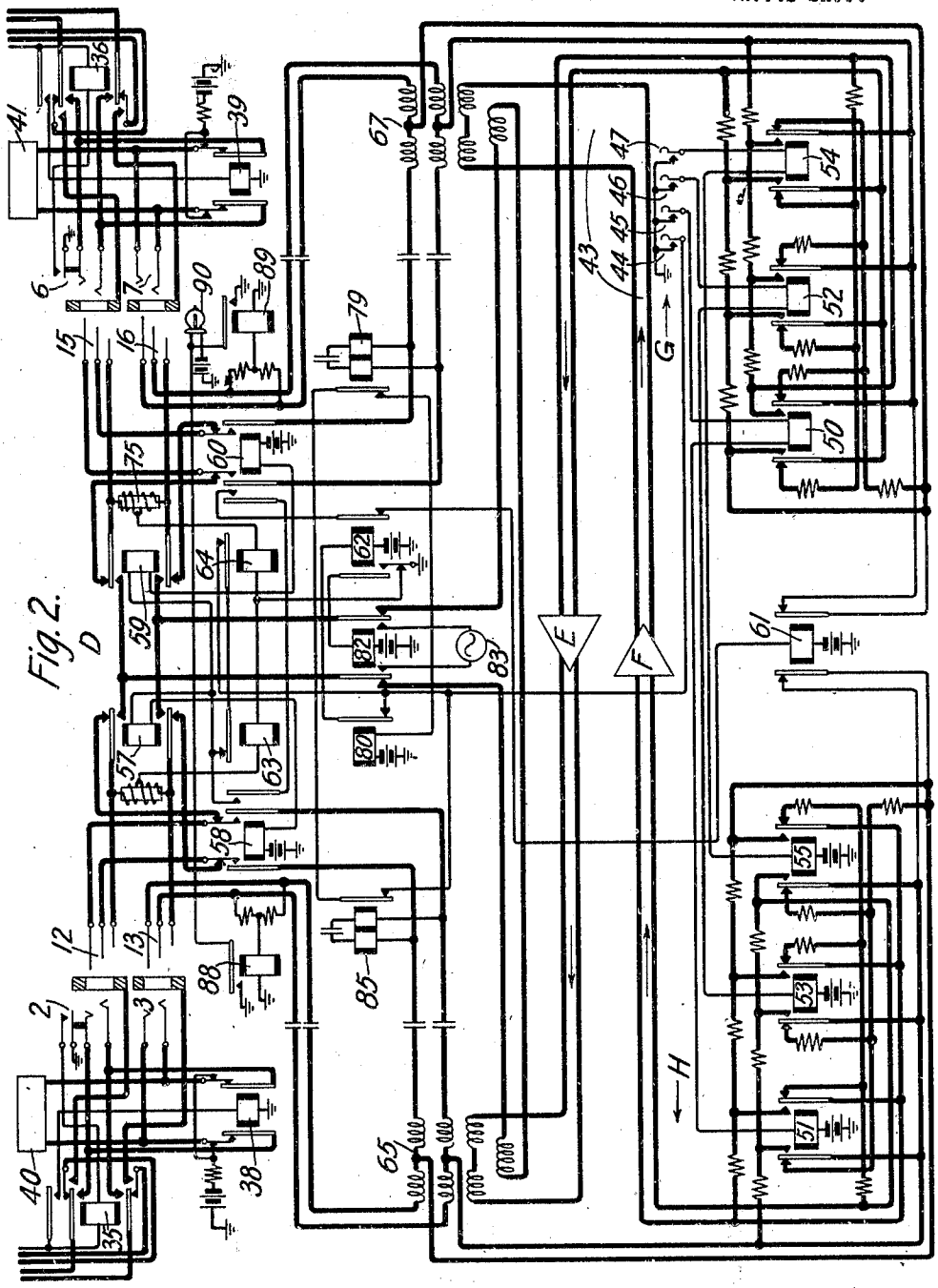

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

Application filed March 18, 1926. Serial No. 95,582.

This invention relates to telephone transmission lines, and more particularly to arrangements for interconnecting such lines to repeater circuits and apparatus.

In systems of this type, an ordinary or control operator receives a call requiring interconnection between two transmission lines, which need to be coupled through repeater apparatus. This operator communicates with a so-called repeater operator over an ordinary call circuit requesting her to interconnect the two lines through a cord circuit containing repeater apparatus. The repeater operator thereupon completes the connection and makes certain adjustments to regulate the transmission volume in accordance with the particular transmission lines employed. Thereupon her duties cease and the control operator assumes control of the connection. A system of this general character is disclosed in the Patent No. 1,635,227, issued to S. P. Shackleton and L. L. Glezen July 12, 1927.

It is an object of this invention to further improve systems of this type by providing means in the control operator's cord circuit for more efficiently controlling and supervising an established connection. In accordance with this object means are provided for talking from the control operator's position directly out on a transmission line rather than through a devious path including part of the repeater equipment and for ringing directly out on a transmission line rather than relaying the ringing current around the repeater equipment.

A further object is to provide for a more efficient control by the control operator of the use of the repeater apparatus during the operation of the system so that the repeater apparatus will not interfere in any way with the transmission efficiency of the connection.

In accordance with one feature of the invention means is provided whereby the repeater apparatus itself may be disconnected when the control operator desires to establish a talking connection over either one of the two lines or when she desires to signal out over either one of the lines.

Another feature is the provision of means whereby incoming signals from either one of the lines are relayed directly to the control operator's cord circuit.

Another feature is the provision of means whereby the repeater apparatus itself is disabled during all switching operations on the part of the control operator relating to the supervision of a connection.

The accompanying drawings illustrate a preferred form of the invention. Fig. 1 shows portions of the incoming ends of two transmission lines that may be connected by means of the control operator's cord circuits one of which is shown in this figure and embodies certain features of the invention. In Fig. 2 are shown the usual twin jacks and circuit arrangement which are associated with the incoming ends of these transmission lines and by means of which a connection may be established through repeater apparatus. This figure also shows a repeater cord circuit embodying certain other features of this invention with the usual twin plugs whereby the cord is connected to the transmission lines.

Referring now to the drawings in more detail, it will be observed that the incoming end of transmission line A is provided with a jack 1 for the use of the control operator and twin jacks 2 and 3 for use by the repeater operator, while the incoming line B is similarly provided with the jack 5 for use of the control operator and twin jacks 6 and 7 for the use of the repeater operator. The control operator may establish a connection between jacks 1 and 5 by means of a cord circuit such as C. Cord circuit C is equipped with plug 10 for insertion in jack 1 and plug 11 for insertion in jack 5. The twin jacks 2 and 3, and 6 and 7 usually terminate at a repeater operator's position where the repeater operator is equipped with a repeater cord circuit such as D. The cord circuit D is equipped with twin plugs 12 and 13 for insertion in twin jacks 2 and 3, respectively, and twin plugs 15 and 16 for insertion in jacks 6 and 7, respectively. Repeater cord circuit D is further equipped with a standard repeater equipment E merely indicated by means of a box as its construction is well known in the art. This equipment is for transmission between line B and line A. The cord circuit D is also

equipped with another standard repeater equipment F, also represented by means of a box for transmission from line A to line B. It will be noted that the cord circuit D is further equipped with a gain control circuit at G for right to left transmission and an identical gain control circuit H for left to right transmission.

To more clearly bring forth the various features of this invention, a detailed description will now be made of the establishing of a connection from line A to line B. The first step for accomplishing this is, after the calling operator on line A has caused the lighting of the usual line lamp (not shown) associated with jack 1, to insert plug 10 into jack 1. A circuit is thereby completed as follows: battery to winding of relay 20, sleeve terminals of plug 10 and jack 1, relay 21 to ground. This causes the operation of relays 20 and 21. Relay 20 in operating closes a circuit for the operation of relay 23 over a circuit as follows: battery, armature and front contact of relay 20, winding of relay 23, armature and back contact of the alternating current responsive relay 26 to ground. It will be noted that circuits are also completed for supervisory lamp 22 and relay 84 but as relay 23 is fast in operating and relay 84 is slow in operating this latter relay and the supervisory lamp 22 do not have sufficient time to become actuated before the circuits therefor are broken at the armature and back contact of relay 23. The control operator now operates the talking key 24 to include in an obvious manner her telephone set not shown but connected at 25, in the circuit to the calling subscriber.

The control operator now communicates with the calling operator connected to line A and receives the number desired. Upon receiving this number the control operator inserts plug 11 of cord circuit C into jack 5 of line B, which is assumed to be the line mentioned. A circuit is thereby completed from battery through the winding of relay 29, winding of relay 30, winding of relay 20, sleeve terminals of plug 11 and jack 5, relay 31 to ground. This circuit causes the operation of relays 29, 30 and 31. The operation of relay 29 closes an obvious circuit for relay 32 which in operating completes the tip conductor of cord C, so that the connection through this cord circuit is now established from line A to line B.

Relay 30 in operating opens the circuit bridging relay 34 across the talking conductors of cord circuit C; the purpose of this will be hereinafter described.

If a repeater apparatus is desired in this connection the control operator now requests the repeater operator over the usual call wire circuit to insert a repeater between the two lines. The repeater operator in complying with this request inserts the twin plugs 12 and 13, and 15 and 16 of repeater cord circuit D into the twin jacks 2 and 3, and 6 and 7, respectively. The first result of this action is that the relays 35 and 36 are respectively operated. The circuit for relay 35 may be traced as follows: battery, armature and front contact of relay 21, winding o relay 35, upper closed contacts of jack 2 t ground. The circuit for relay 36 may be traced from battery, armature and front contact of relay 31, winding of relay 36, upper closed contacts of jack 6 to ground. The operation of these relays causes obvious circuits to be closed for their respectively associated relays 38 and 39. The operation of the relays 35 and 36 switch their associated lines from the control operator's cord circuit to the repeater operator's cord circuit and at the same time connect the tip and ring conductors from the control operator's cord to the sleeves of jacks 2 and 3, and 6 and 7. The operation of relays 38 and 39 removes the short circuits around well known networks indicated merely by boxes 40 and 41 so as to include these networks for lines A and B respectively across the tip and ring termina's of jacks 3 and 7.

The repeater apparatus will now be connected into the circuit between the lines A and B by the operation of the key 43. This key is so arranged that the contacts 44 will always operate upon the actuation of the key whereas the contacts 45 and 46 or 47 may be successively operated. This is a standard well known arrangement for regulating the usual automatic gain control circuits to adjust the transmission requirements for different lines. For example, if merely contact 45 is operated relays 50 and 51 are operated to establish certain control conditions, whereas if keys 46 and 47 are also operated, the corresponding relays 52, 53, 54 and 55 are correspondingly operated to establish certain other conditions. As the construction of the grain control circuits forms no part of the invention, no further description will be made thereof. The operation of key 44 closes a circuit for the operation of relays 57, 58, 59 and 60 as follows: battery, winding of relay 58, winding of relay 57, also a parallel circuit from battery, winding of relay 60, winding of relay 59, armature and back contact of relay 63, armature and back contact of relay 64, key 44 to ground. It will be noted that relay 80 will also operate in an obvious circuit on the actuation of key 44 to prevent the operation of relay 62 the purpose of which will be hereinafter described. The operation of relays 58 and 60 closes a circuit for the operation of relay 61 that may be traced as follows: battery, winding of relay 61, right hand armature and back contact of relay 62, outer left hand armature and front contact of relay 60, outer right hand armature and

front contact of relay 58, armature and back contact of relay 63, armature and back contact of relay 64 to ground at key 44. The operation of relay 61 as noted removes the short circuit across the tip and ring conductors for the repeater equipments E and F, while the relays 57, 58, 59 and 60 include these equipments in the connection. The circuit for the repeater equipment F from line A to line B may now be traced as follows: tip conductor of line A, upper inner armature and front contact of relay 35, tip terminals of jack 2 and plug 12, inner right hand armature and front contact of relay 58, transformer 65, gain control circuit H and depending on the operated or non-operated condition of relays 51, 53 and 55 through the left hand armatures and front contacts of one or more of these relays, to include or remove corresponding portions of the network associated with this gain control circuit, to the tip conductor leading to the repeater equipment F through the usual input and output circuit thereof through windings of transformer 67, back over the ring conductor through the output and input circuits of the repeater equipment F, over the ring conductor to the gain control circuit H, the right hand armatures and front contacts of one or more of the relays 51, 53 and 55 to the transformer 65, left hand armature and front contact of relay 58, ring terminals of plug 12 and jack 2, lower armature and front contact of relay 35 over the ring conductor of line A. The other side of the circuit from line B may be traced as follows: tip conductor of line B, upper inner armature and front contact of relay 36, tip terminals of jack 6 and plug 15, inner left hand armature and front contact of relay 60, transformer 67, ring terminals of plug 16 and jack 7, network 41, tip terminals of jack 7, plug 16, transformer 67, right hand armature and front contact of relay 60, ring terminals of plug 15 and jack 6, lower armature and front contact of relay 36 through the ring conductor of line B. It will thus be seen that the operation of the above mentioned relays includes the repeater equipment F, the transformer 67, the automatic gain control circuit H and the network 41 in the connection for transmission from line A to line B. Similarly the repeater equipment E, the transformer 65, the automatic gain control circuit S and the network 40 are included in the connection for transmission from line B to line A. This latter circuit is not outlined as it can readily be traced in the same manner as the circuit for the repeater equipment for transmission in the opposite direction.

If the control operator has already signalled over the line B, the conversation between the parties at either end may now take place over the established connection. However, it is sometimes desirable to ring over the line after the connections through the repeaters have been established and the operation of the circuit in this connection will now be described.

To ring the party on line B the control operator operates ringing key 70. It will first be noted that the operation of this key supplies battery from the midpoint of the secondary winding of transformer coil 73 to the tip and ring conductors in parallel, tip and ring terminals of plug 11 and jack 5, upper inner make-before-break contacts and lower make-before-break contacts of relay 36, sleeve terminals of jacks 6 and 7, and plugs 15 and 16 through the retardation coil 75 over the single lead connected at the center of the winding of this coil, through the winding of relay 64, make-before-break contacts of relay 62 to ground. This circuit causes the operation of relay 64, which in operating opens the energizing circuit for relays 57, 58, 59 and 60. The release of relays 60 and 58 causes the release of relay 61 so that the repeater equipments F and E, the transformers 65 and 67 and the gain control circuits H and S are now disabled by being short circuited through the contacts of relay 61. On the release of relays 59 and 60 current from the ringing source 72 is transmitted through key 70 over the sleeve terminals of jacks 6 and 7 and plugs 15 and 16, to upper and lower armatures and back contacts of relay 59, make-before-break contacts of relay 60, tip and ring terminals of plug 15 and jack 6, upper inner and lower armatures and front contacts of relay 36 to the tip and ring conductors of line B. It is noted, therefore, that the operation of ringing key 70 will not only cause ringing current to be transmitted to the line B, but the repeater equipment in the cord circuit D will also be disabled or eliminated from the line. On the release of ringing key 70 the circuits will be restored to their previous condition, that is, relay 64 will release and the various relays connecting the repeater equipment into the cord circuit will be operated.

If the control operator desires to talk over line B, she may operate her talking key 24 and in this case the repeater equipments will also be eliminated from the cord circuit D. It will be noted that on the operation of key 24 a battery connection will be established through resistances 76 to the tip and ring leads in parallel through the contacts of key 24 to the tip and ring conductors of the cord circuit C to cause the operation of relay 64 to eliminate the repeater equipments in the same manner as when the ringing key 70 was operated. In this case it may be desirable to operate a splitting key 78 to prevent the party on line A from hearing the conversation.

Similarly, if the control operator desires to communicate with the party on line A she will operate the talking key 24 to connect the telephone set 25 to the line and eliminate the repeater equipment from the cord circuit D and in this case the splitting key 71 may be operated.

It will be noted that the cord circuit C is also arranged so that the control operator may ring over line A. In this case she may operate ringing key 75 and the operations are the same as when she operates ringing key 70 except of course that current from ringing source 76 is transmitted to the line A and relay 63 is operated in place of relay 64 from the battery at the mid-point of repeating coil 78 to eliminate the repeater equipment.

If either of the parties on line A or B desires to call the control operator the incoming ringing current, say, for example, from line B, will cause the relay 79 to be operated over a circuit as follows: through the tip and ring of the conductors of line B, upper inner and lower armatures and front contacts of relay 36, tip and ring terminals of jack 6 and plug 15, inner left hand and right hand armatures and front contacts of relay 60 through the windings of the alternating current responsive relay 79. The operation of relay 79 opens the circuit for relay 80. The release of relay 80 closes a circuit from the ground at key 44 for the operation of relay 62. The operation of relay 62 causes the release of relay 61 by the opening of its circuit through the right hand armature and back contact of this relay. The release of relay 61 short-circuits the repeater equipments during the remainder of the incoming ringing signal. The operation of relay 62 also removes ground from the windings of relays 64 and 63, thus preventing the accidental operation of these relays during the incoming signal. The operation of this relay 62 also causes the operation of relay 82 in an obvious circuit. The operation of relay 82 connects current from a ringing source 83 to the cord circuit D so that current from this source will now be transmitted both through the sleeve terminals of plugs 15 and 16 and jacks 6 and 7 through the tip and ring terminals of jack 5 and plug 11 and through the sleeve terminals of plugs 12 and 13 and jacks 2 and 3 through the tip and ring terminals of jack 1 and plug 10 through the windings of alternating current responsive relay 26 in the control operator's cord circuit C. The operation of relay 26 releases relay 23, thereby causing the operation of relay 84 from the battery at the armature and front contact of relay 20 through the normally closed contacts of talking key 24 to ground. The relay 84 establishes a locking circuit for itself through its armature and front contact independent of the armature and back contact of relay 23. Lamp 22 is also operated in this circuit through the armature and back contact of relay 23 or through the armature and front contact of relay 84 to ground at key 24.

If the party on line A desires to ring the control operator, the procedure is practically the same except that instead of relay 79 operating, relay 85 will operate to open the circuit for relay 80 and the functioning of the circuit from there on is the same as when the party on line B rings the toll operator, that is, lamp 22 is lighted in either case. The operation of lamp 22 thus indicates to the control operator that the party on either line B or line A desires to communicate with her. If, however, on the receipt of ringing current from the party on line B, key 71 should be operated lamp 86 is lighted to indicate that the signal originated from line B.

At the completion of a call which may also be indicated by the lighting of a lamp 22 the control operator will remove the plugs 10 and 11 from jacks 1 and 5, respectively, thus causing the relays in this cord circuit C to be restored to normal position. The removal of the plugs of this cord circuit from lines A and B naturally causes relays 35 and 36, and 38 and 39 to be returned to normal condition. The release of the relays 38 and 39 short-circuits the conductors to the networks 40 and 41 and the release of these relays also connects battery to the tip and ring terminals of plug 3 and jack 13 and plug 7 and jack 16. This connection to battery causes the operation of relays 88 and 89. The release of relays 38 and 39 also short-circuits the line and network windings of the output transformer in the repeater thereby preventing the repeater from singing due to the unbalance caused by the network being still connected to the transformer after the line has been disconnected by the release of relays 38 and 39. The circuit for relay 88 may be traced as follows: battery, make-before-break contacts of relay 38, tip and ring terminals of jack 3 and plug 13 in parallel through the winding of relay 88 to ground. The operation of relays 88 and 89 closes an obvious circuit for a supervisory lamp 90, which in lighting indicates to the repeater operator that disconnection is desired. The repeater operator now immediately removes the twin plugs 13 and 14, and 15 and 16 from the jacks 2 and 3, and 6 and 7, respectively, and the relays in the repeater cord circuit D return to normal condition.

What is claimed is:

1. In a telephone system, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second link circuit and normally disconnected therefrom, means in said second link circuit for connecting said repeater

in the connection between said lines, a key in said first mentioned link circuit, and means responsive to the operation of said key for disconnecting said repeater from the connection between the lines.

2. In a telephone system, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second link circuit and normally disconnected therefrom, means in said second link circuit for connecting said repeater in the connection between said lines, a telephone set, means for connecting said telephone set to said first mentioned link circuit, and means responsive to the actuation of said last mentioned means for disconnecting said repeater from the connection between said lines.

3. In a telephone system, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second link circuit, means responsive to the connection of said second link circuit to said lines for automatically excluding the first mentioned link circuit from the connection between said lines, means in said second link circuit for including said repeater in the connection between said lines, a key in said first mentioned link circuit, means responsive to the operation of said key and controlled over circuits including the tip and ring conductors of the first mentioned link circuit and sleeve conductors of the second mentioned link circuit for disconnecting the repeater from the connection between the lines and again including the first mentioned link circuit in the connection between the lines.

4. In a telephone system, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater, means in said second link circuit for connecting the repeater in the connection between said lines, a source of signaling current, means controlled from said first link circuit for transmitting signal currents from said source to said lines and for excluding said repeater from the connection between said lines.

5. In a telephone system, lines, a link circuit for establishing connections between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second link circuit, means responsive to the connection of said second link circuit to said lines for automatically excluding the first mentioned link circuit from the connection between said lines, means in said second link circuit for including said repeater in the connection between said lines, a key in said first mentioned link circuit, a source of signaling current, and means responsive to the operation of said key and controlled over circuits including the tip and ring conductors of the first mentioned link circuit and sleeve conductors of the second mentioned link circuit for disconnecting the repeater from the connection between the lines, for again including the first link circuit in the connection between the lines and for establishing a connection from said signaling source to said line.

6. In a telephone system, lines, a link circuit for establishing connections between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second mentioned link circuit and normally disconnected therefrom, means in said second mentioned link circuit for connecting said repeater in the connection between said lines, a signal device in said first mentioned link circuit, and means responsive to alternating current signals incoming over a line to said second mentioned link circuit for actuating said signal device in the first mentioned link circuit.

7. In a telephone circuit, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second mentioned link circuit, means in said second link circuit for including said repeater in the connection between said lines, an alternating current source associated with said second link circuit, a signal device in said first mentioned link circuit, and means in said second link circuit responsive to alternating current signals incoming over a line for transmitting a signal from said alternating current source to said first mentioned link circuit, and means in said first mentioned link circuit responsive to said signaling current for actuating said signal device.

8. In a telephone system, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second mentioned link circuit and normally disconnected therefrom, means in said second mentioned link circuit for connecting said repeater in the connection between said lines, a signal device in said first mentioned link circuit, and means responsive to alternating current signals incoming over a line to said second mentioned link circuit for actuating said signal device and for disabling said repeater.

9. In a telephone circuit, lines, a link circuit for establishing a connection between two of said lines, a second link circuit for connecting said lines, a repeater associated with said second mentioned link circuit and normally disconnected therefrom, means in said second mentioned link circuit for connecting said repeater in the connection between said lines, an operator's telephone set,

means for connecting said telephone set to said lines, a source of signaling current, means for transmitting current from said source to said lines, a signal device in said first mentioned link circuit, means responsive to alternating current signals incoming over said lines for actuating said signal device, and means for disabling the repeater responsive to the actuation of the means for connecting the telephone set and responsive to the actuation of the means for transmitting signaling current over the lines and responsive to alternating current signals incoming over the lines to actuate said signal device.

In witness whereof, I hereunto subscribe my name this 16th day of March, A. D. 1926.

HAROLD J. FISHER.