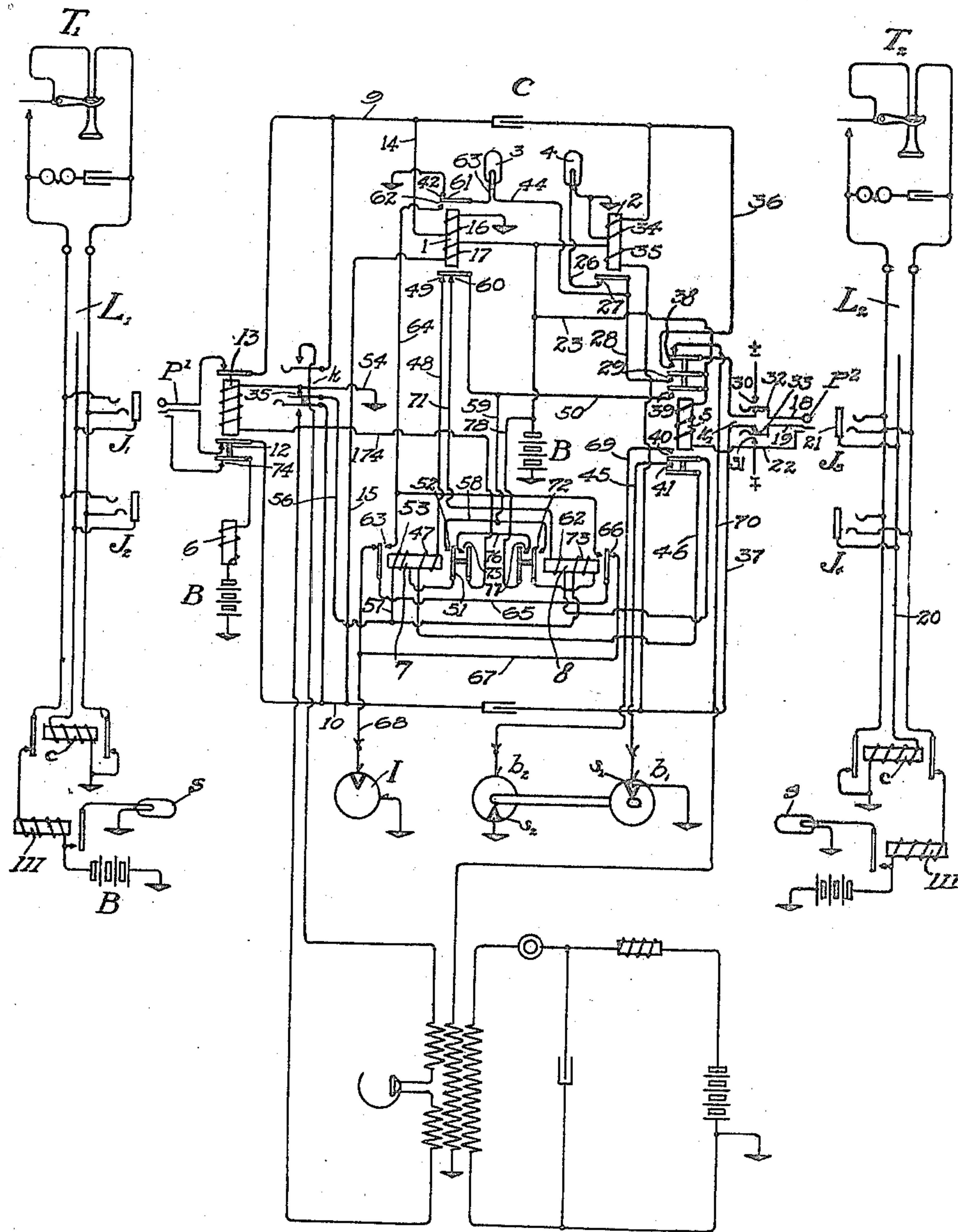


H. L. HARRIS.
TELEPHONE SYSTEM.
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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that I, HARVEY L. HARRIS, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephone Systems, the following being a clear, full, and exact description of the same.

The invention relates to telephone systems, and finds its fullest embodiment in that class of systems wherein the telephonic connection between two subscribers is completed by the manual act of an operator.

It is an object of my invention to provide means whereby the calling subscriber after having secured one connection can immediately make a recall, and upon making such recall initiate a characteristic signal individual to the operator's connective circuit to direct the operator's attention to such recall. It has been previously proposed by others to do this by instantaneously disconnecting the calling subscriber from the first cord circuit used upon the retiring of the subscriber's telephone from conversational circuit, and then upon recalling the subscriber would then again have access to the line lamp of that line, and the call would then come into the exchange exactly as a new call. Such procedure has been found undesirable for the reason that most of the recalls made by subscribers after having secured an initial connection, are related to that initial connection in such a way that the best service can be secured only by bringing the recall before the same operator who completed the first connection.

However, the instantaneous disconnect system as above outlined has its advantages, namely that the subscriber's line is not retained in a busy condition until the final disconnection of the connecting circuit by the operator and the number of times the line is recorded busy by operators of the exchange, is thus cut down.

In the system of my invention I combine the good features of the instantaneous disconnect system, and connective circuit individual recall signal system. I do this by so arranging the apparatus of the connective circuit, that if a subscriber makes a recall within a predetermined time which is a short interval—such as five seconds—the connective circuit apparatus will operate to display

before the operator who had completed the first connection a characteristic signal individual to the cord circuit; this I do by flashing the supervisory lamp of the connective circuit in a characteristic manner. However, if the subscriber does not make a recall within the short interval period above specified, the line will be automatically disconnected from the connective circuit and the busy test removed from the terminals of the line. Subsequent calls made from this line will then come in as new calls operating the line signal belonging to the line.

Other objects of my invention and the invention itself will be better understood from a description of the same which follows; reference being had to the accompanying drawing in which I show an embodiment of my invention in a cord circuit of a manual switchboard.

I show this cord circuit arranged to connect a calling line, such as is shown to the left of the cord circuit drawing to a called line such as is shown to the right of the cord circuit. In this drawing C represents the cord circuit. L_1 represents the calling line. L_2 represents the called line. The line circuits shown are of the standard form now commonly used in multiple switchboards having multiple jacks for the lines as J_1 and J_2 for the called line, the cut-off relay such as c for each of the lines and a line relay for each of the lines, each of the line relays controlling a line signal lamp s .

The cord circuit consists of a calling plug P_1 and a call plug P_2 , a calling supervisory relay 1, a called supervisory relay 2 controlling a calling supervisory lamp 3 and a called supervisory lamp 4, a called third strand relay 5, a calling third strand resistance coil 6, a disconnect relay 13, and two relays whose functions will be presently described, 7 and 8.

The system of my invention operates as follows:—The calling subscriber will initiate the call by taking his receiver from the hook, thereby bridging his telephone across the limbs of the telephone line L_1 and operating the line relay 111, bringing in the line signal s in a well-known manner. The operator observing the signal lamp will insert the answering plug P_1 , thus operating the cut-off relay c by means of battery flowing over a circuit including the source of current B ,

the third strand resistance coil 6, the co-operating third strand of the plug P_1 , the line jack J_1 , the winding of the cut-off relay c and thence to the ground pole of source of current. The cut-off relay being operated will disconnect the line relay and extinguish the line lamp in the well-known manner. The operator will operate her listening key k connecting her telephone set o across the talking strands of the cord circuits 9 and 10 which now are connected to the limbs of the calling line by means of co-operating contacts of the plug and jack switch P_1 and J_1 through normally made contacts 11 and 12 of the disconnect relay 13.

Battery is now supplied for the telephone of a calling subscriber over a circuit consisting of the limbs of the telephone line L_1 , co-operating contacts of the plug and jack switch P_1 and J_1 , the normally made contacts 11 and 12 of the relay 13, the talking strand of the cord circuit 9 and 10, the conductors 14 and 15, and the windings 16 and 17 of the supervisory relay 1. Thus the transmitter of the substation is properly supplied with current, and the current flowing through the winding 16 and 17 of the relay 1 will also operate this relay whenever the subscriber is on the line, and releasing it whenever the subscriber retires his telephone from the line. At this time the relay will be energized, therefore attracting its armatures for purposes later to be described.

The operator upon learning the number of the line desired will take the called plug P_2 , upon making a busy test in the usual manner and finding the line not busy by the absence of negative battery potential on the thimble of the jack of the called-for line which we will assume is the line L_2 , will insert the plug into the jack of the called-for line making a connection between the limbs of the line L_2 and the conductors 18 and 19 leading to the plug P_2 . At this time the third strand relay 5 will be energized and attract its armatures and the cut-off relay c associated with line L_2 will also be energized likewise attracting its armatures, the energization of these two relays being accomplished over a circuit as follows:—from the ground pole of battery, the winding of the cut-off relay c of the line L_2 , the conductor 20, the thimble 21 of the jack J_3 , the third strand conductor 22 of the cord circuit, the winding of the relay 5, the conductor 23 leading to the negative pole of battery B. The cut-off relay c having attracted its armatures, the line relay associated with the line L_2 will be disconnected therefrom by the breaking of the normally made contacts 24 and 25.

The relay 5 having attracted its armatures the called supervisory lamp 4 will be lighted being energized over a circuit comprising the ground pole of battery, lamp 4, conduc-

tor 26, the normally made contacts 27 of the called supervisory relay 2, the conductor 28, the now made contacts 29 of the relay 5, the conductor 23 leading to the negative pole of battery B. The operator will now ring the bell of the called-for subscriber in the usual way by operating the ringing key k_1 , whereupon the generator will be connected to the called-for line by the operation and closing of the contacts 30 and 31, which when closed form a circuit for the generator comprising said contacts, the conductors 18 and 19 of the plug, the limbs of the line now connected to the plug and the bell of the called-for subscriber connected to the called line. The bell will now ring as long as the operator keeps the key k_1 operated. During this time the cord circuit will be disconnected by the breaking of the contacts 32 and 33 of the key k_1 . Upon restoring the key these contacts are again closed and the connection between the called-for subscriber and the cord circuit is again reestablished.

Upon the response of the called-for subscriber which places the called-for subscriber's telephone across the limbs of the line, the called supervisory relay 2 will be operated by current flowing through the windings 34 and 35 of the relay 2 over a circuit comprising the source of current B, the windings 34 and 35 of the relay 2, the strands 36 and 37 of the cord circuit, the now made contacts 38 of the relay 5, the normally made contacts 32 and 33 of the key k_1 , the conductors 18 and 19 leading to the plug P_2 , the limbs of the line L_2 by means of the co-operating contacts of the plug and jack switch P_2 and J_3 , and the called subscriber's substation instrument T_2 . The relay 2 being operated will attract its armatures opening the circuit of the lamp 4 which is now extinguished. The two subscribers are now in conversational circuit. When the relay 5 was operated the contacts 39, 40 and 41 were closed to condition the relays 7, 8 and 13 for operation. None of these relays will be operated while the subscribers are in conversational circuit or until the calling subscriber retires his telephone T from his line circuit, at which time the calling supervisory relay 1 will be deenergized by the breaking of the circuit including its windings previously described at the contacts of the hook switch of the telephone T , and will release its armatures.

The upper armature shown in the drawing being released will close the normally made contacts 42, operating the supervisory lamp 3 over a circuit as follows:—from the ground pole of battery, the normally made contacts 42, the conductor 43, the lamp 3, the conductor 44, the now closed contacts 29 of the relay 5, and the conductor 23 leading to the negative pole of battery B. The lighting of this lamp gives a disconnect sig-

nal to the operator. If the operator immediately disconnects the cord circuit from the connecting lines all of the apparatus will be restored to normal. However, if the operator does not immediately disconnect, one of the relays 7 and 8 will be subsequently operated, the particular relay operated depending upon which of the revolving segments s_1 or s_2 first makes a contact with its associated brush b_1 or b_2 , the two having segments, each segment of disks mounted on a common shaft and preferably arranged on opposite sides of the shaft. The shaft being made to revolve at a predetermined rate of speed, the interval between the times of closure as above specified can be predetermined. If the segment s_1 first makes contact with its brush b_1 after the retiring of the calling subscriber's instrument in connection with the line, the relay 7 will be operated over a circuit which may be traced as follows:—from the ground pole of battery, segment s_1 , the brush b_1 , the circuit conductor 45 the now made contacts 41 of the relay 5, circuit conductor 46, the winding 47 of the relay 7, circuit conductor 48, the now made contacts 49 of the relay 1, circuit conductor 50, the now made contacts 39 of the relay 5, and circuit conductor 23 leading to the negative pole of battery, B. Thus energized the relay 7 will attract its armatures, one of which armatures 51 closing the contacts 52 forms a locking circuit for the second winding 53 of the relay 7, retaining the relay 7 in operation regardless of the continuity of the contacts 49 of the relay 1. This locking circuit may be traced as follows: from the positive pole of battery, the circuit conductor 54, the normally made contacts 55 of the listening key k , the circuit conductor 56, the circuit conductor 57, the winding 53 of the relay 7, the armature 51, the now made contacts 52 of the relay 7, circuit conductor 58, circuit conductor 59, circuit conductor 50, the now made contacts 39 of the relay 5, and the conductor 23 leading to the negative pole of battery, B.

Now if the subscriber makes a recall prior to the operation of the relay 8 which will operate when the revolving segment s_2 makes contact with its brush b_2 , the relay 1 will again be actuated, breaking the initiating circuits of the relays 7 and 8, but the relay 7 having formed a locking circuit will be retained in operation. However, the relay 8 not having yet been operated and contacts 60 of the relay 1 in the circuit of the winding 62 of the relay 8 being broken, the relay 8 will not be operated when the segment s_2 comes into contact with the brush b_2 . The relay 1 being re-operated by the connection of the subscriber's telephone to the line likewise causes the armature 61 to be attracted breaking the contacts 42 and interrupting the circuit of the lamp 3 to the

ground pole of battery through these contacts and forming a continuously interrupted circuit to ground through the now made contacts 62 of the relay 1, the circuit conductor 64, the now made contacts 63 of the relay 7, circuit conductor 65, the normally made contacts 66 of the relay 8, circuit conductor 67, and circuit conductor 68 leading through the interrupter I to the ground pole of battery. This constantly interrupted source of current then being applied to the lamp 3, and the other terminal of the lamp being connected as above to the negative pole of battery, the lamp will be lighted intermittently and will flash in a characteristic manner apprising the attendant operator that a recall by the subscriber is being made.

The operator upon operating the key k interrupts the contacts 55, breaking the circuit of the locking winding 53 of the relay 7, which circuit has been previously described, and the relay 7 will thereupon be deenergized restoring all of these armatures to normal and make another break in the locking circuit by the now opened contacts 52 so that the relay 7 will not be restored to its energized condition only upon the restoration of key k , when the operator restores this key to normal. The operator having thrown the key k thereby connects her telephone set across the talking strands of the cord circuit and can learn the wishes of the recalling subscriber and make permanent such other operation as may be desired by the subscriber.

Assuming however, that the subscriber after having retired his telephone does not make a recall within the period required for the second segment of the associated segments s_1 and s_2 to make contact with its brush after the first segment first made contact with its brush, then in such a case the relay 8 will be operated upon the contact being made by the second segment which in this case would be the segment s_2 over a circuit which may be traced as follows:—from the ground pole of battery, the segment s_2 , the brush b_2 , the circuit conductor 69, the now made contacts 40 of the relay 5, the circuit conductor 70, the winding 62 of the relay 8, the circuit conductor 71, the normally made contacts 60 of the relay 1, the circuit conductor 50, the now made contacts 39 of the relay 5, and conductor 23 leading to the negative pole of battery, B. The relay 8 being thereupon energized will attract its armatures just as did the relay 7, one of the armatures forming a locking circuit for the relay by the closure of contacts 72 in the circuit of a second winding 73 of the relay 8. The circuit of these locking contacts and locking winding being the same as the locking circuit and locking winding of the relay 7, need not be separately described. The

two relays 7 and 8 now are both operated and the locking circuits of both have been completed. In addition a circuit is closed comprising now made contacts of both of these relays and the winding of the disconnect relay 13. This circuit may be traced as follows:—from the ground pole of battery, conductor 54, the winding of the relay 13, circuit conductor 174, the now made contacts 75 of the relay 7, the circuit conductor 76, the now made contacts 77 of the relay 8, and the circuit conductor 78 leading to the negative pole of battery, B. Battery will thereupon flow over this circuit and energize the disconnect relay 13, which disconnect relay will operate these armatures opening the disconnecting contacts 11, 12 and 79. The first two contacts interrupt the talking strands of the answering cord leading to the line of the subscriber who initiates the connection, and the contacts 79 interrupt the connection between the operating third strand of the answering end of the cord circuit and the cut-off relay *c* of the line L_1 . The cut-off relay will thereupon be deenergized restoring the line relay 111 to connection with the limbs of the line L_1 , and thereby restore to the subscriber the control of line lamp *s*.

The negative pole of battery through the resistance coil 6 and leading to the thimble of the jack J_1 now being interrupted by the broken contacts 79 of the disconnect relay 13 negative battery potential will not be found upon the thimble of any connecting jacks of this line, and the line will not therefore test busy and it may be taken by other operators for use.

It will be understood that instead of the several sources of battery illustrated in the drawings that a single source in fact would ordinarily be used, although several may be used in the drawings. It will be also understood that the operator's telephone set, the three interrupters shown in the drawing and the generator are common to a plurality of cord circuits, and may be common to a plurality of operators' positions, it being economy to so use common apparatus in connection with a plurality of circuits.

I am aware that numerous departures may be made from the embodiment illustrated and described without departing from the spirit thereof, but what I claim is:

1. In a telephone system, the combination with calling and called telephone lines leading by their limbs from substations to an exchange, calling and called stations on the said lines, an operator's connecting circuit at the exchange to inter-connect said calling and called telephone lines, a disconnect relay for said operating connecting circuit, a recall signal circuit for said operating connecting circuit, a signal lamp in said recall signal circuit, means to associate said recall lamp with said circuit to operate said lamp,

common controlling means for said disconnect relay and said recall circuit, automatic timing means for said common controlling means, whereby said recall circuit is conditioned for operation for a given predetermined period of time and thereafter disabled.

2. In a telephone system, the combination of a plurality of telephone lines leading by their limbs from substations to an exchange, an operator's cord circuit, a disconnect relay adapted to sever the talking and operating strands of said cord circuit, a recall circuit, a signal for said recall circuit, common controlling means for said recall circuit and said disconnect relay, means to cause said controlling means to operate and associate said signal with said recall circuit and to condition said disconnect relay for operation, and means to delay the operation of said disconnect relay for a predetermined time after the said controlling means is operated.

3. In a telephone system, the combination of a plurality of telephone lines leading by their limbs from substations to an exchange, an operator's cord circuit, a disconnect relay adapted to sever the talking and operating strands of said cord circuit, a recall circuit, a signal for said recall circuit, common controlling means for said recall circuit and said disconnect relay, and substation controlled means to cause said controlling means to operate and timing mechanism to associate said signal with said recall circuit and after a predetermined period to condition said disconnect relay for operation.

4. In a telephone system, the combination of an operator's cord circuit, a recall circuit therefor, a disconnect relay therefor, common controlling means for said recall circuit and said relay, automatic timing means for said common controlling means, said automatic timing means being adapted to successively condition for predetermined periods the operation of said recall circuit and the operation of the said disconnect relay.

5. In combination, an operator's connecting circuit, a disconnect relay therefor adapted to sever the talking and operating strands of said cord circuit, a recall signal circuit for said cord circuit, common controlling means for said recall circuit and disconnect relay, a second controlling means for said recall signal circuit and said disconnect relay, and means to cause said second controlling means to operate after the operation of said first controlling means.

6. In a telephone system, the combination with a plurality of telephone lines extending by their limbs from substations to an exchange, an exchange link connector having calling and called switch terminals for interconnecting a calling and called one of the said telephone lines, flashing recall

mechanism in said link connector under the control of the substation of a connected calling line, automatic disconnect means to operatively dissociate the calling switch connected to a calling telephone line from said link connector, common timing mechanism for said flashing recall mechanism and said automatic disconnect means, said common timing mechanism operating to condition for a given predetermined period said flashing recall mechanism for operation, and to condition thereafter the said automatic disconnect means for operation.

7. In a telephone system, the combination of a plurality of telephone lines extending by their limbs from substations to an exchange, a cord circuit at the exchange to interconnect the said lines, a switch to connect the cord circuit to one of the lines, substation apparatus upon the said line, a flashing recall mechanism in the cord circuit under the control of the said substation apparatus, an automatic disconnect mechanism in the cord circuit to operatively dissociate the said switch from the said cord circuit, and common controlling means for the said automatic disconnect mechanism and the said recall mechanism.

8. In a telephone system, the combination of a plurality of telephone lines extending by their limbs from substations to an exchange, a link connector at the exchange for interconnecting said telephone lines, flashing recall mechanism in said link connector, automatic disconnect mechanism in said link connector, common controlling means for said flashing recall mechanism and said automatic disconnect mechanism, said common controlling means operating at one time to condition said flashing recall mechanism for operation and operating at a subsequent predetermined time to operate said automatic disconnect mechanism.

9. In a telephone system, the combination of a plurality of telephone lines extending by their limbs from substations to an exchange, a link connector for interconnecting said lines, flashing recall mechanism in said

link connector, automatic disconnect mechanism for said link connector, and time controlling means controlling the consecutive operation of means to condition said recall mechanism for operation and to operate said automatic disconnect mechanism.

10. In a telephone system, the combination of a plurality of telephone lines extending by their limbs from substations to an exchange, a link circuit at the exchange to interconnect said lines, a switch for said link circuit, automatic disconnect mechanism in said link circuit to disassociate said switch from the link circuit, flashing recall mechanism in said link circuit, means to condition said flashing recall mechanism for operation when a connected substation is retired, slow operating means to operate the automatic disconnect mechanism, after a predetermined interval, and manual switching means for said substation adapted to be operated within the said interval to prevent the operation of the said automatic disconnect mechanism, and to cause the operation of the said flashing recall mechanism.

11. In a telephone system, the combination of a plurality of telephone lines extending by their limbs from substations to an exchange, a link connector at the exchange for interconnecting said lines, a switch for inter-linking a calling line with said link connector, automatic mechanism to disassociate said switch from said link connector, substation controlling means to operate said disassociating means, delaying means to delay the operation of said disassociating means after the operation of said substation means, and a flashing recall mechanism for said link connector, said flashing recall means being conditioned for operation after the operation of said substation means.

In witness whereof, I hereunto subscribe my name this 12th day of March, A. D. 1917.

HARVEY L. HARRIS.