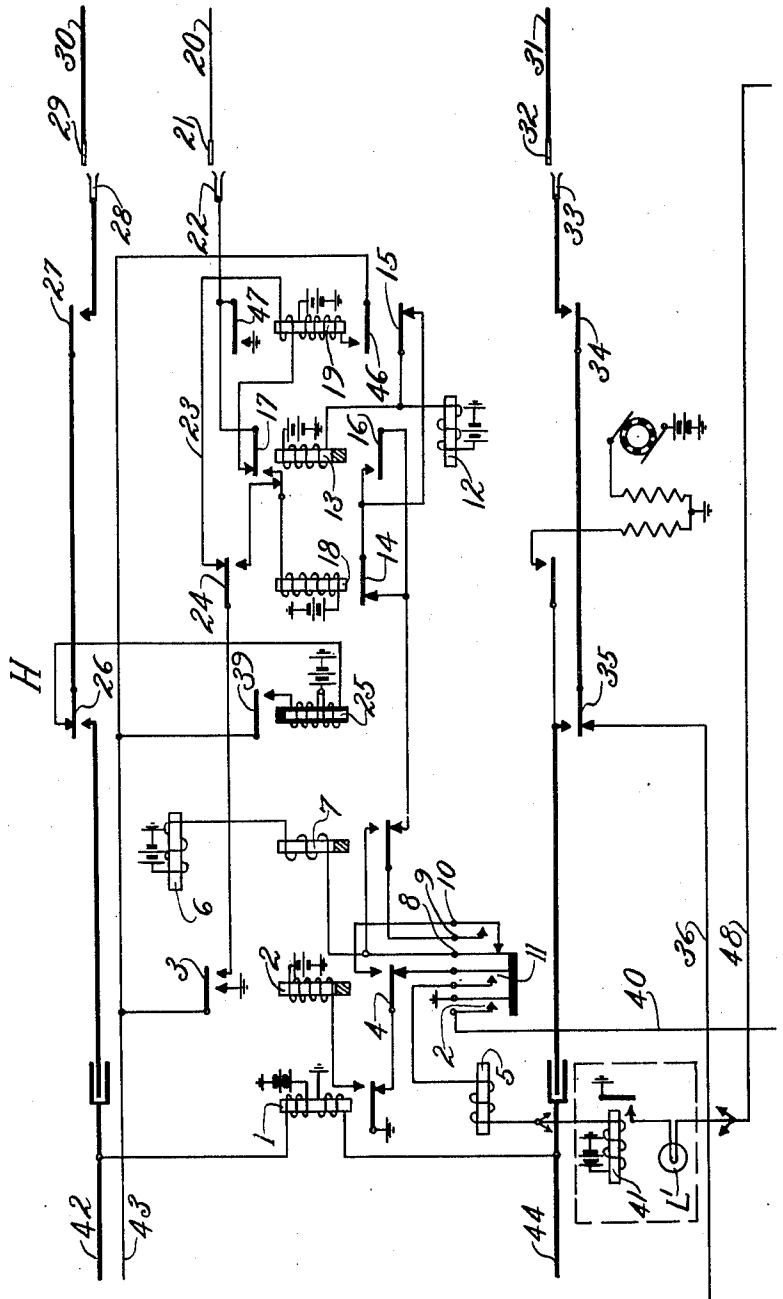
Dec. 21, 1926. 1,611,655

C. E. LOMAX

RINGING CURRENT INTERRUPTING AND DISTRIBUTING EQUIPMENT

Filed Nov. 21, 1924 2 Sheets-Sheet 1

Fig. 1



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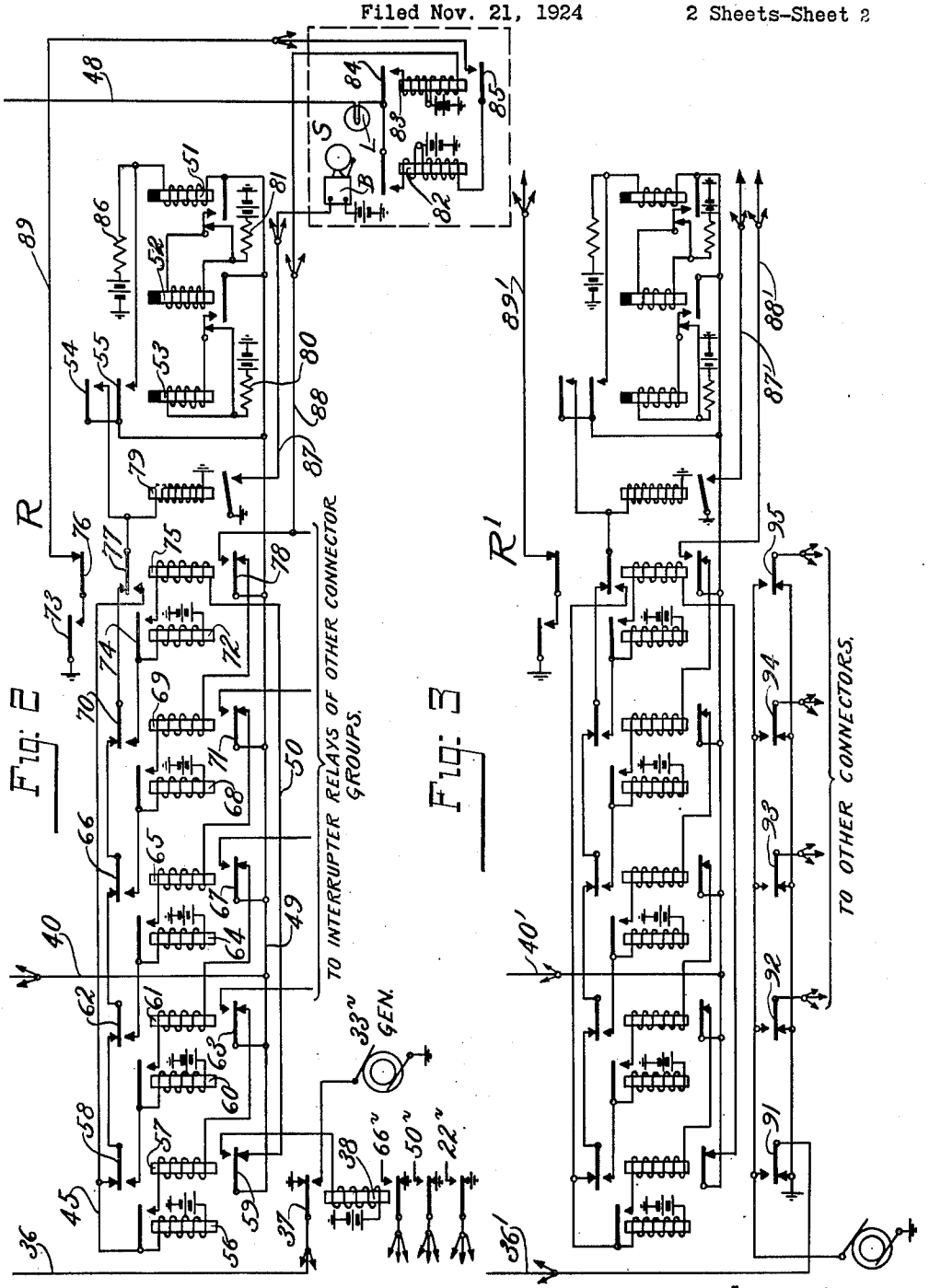


Fig: 2

Fig: 3

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Patented Dec. 21, 1926. 1,611,655

UNITED STATES PATENT OFFICE.

CLARENCE E. LOMAX, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO AUTOMATIC ELECTRIC INC., OF CHICAGO, ILLINOIS, A CORPORATION OF DELAWARE.

RINGING-CURRENT INTERRUPTING AND DISTRIBUTING EQUIPMENT.

Application filed November 21, 1924. Serial No. 751,211.

The present invention relates in general to ringing current distributing and interrupting equipment for use in connection with telephone systems, but is particularly concerned with the provision of equipment of this character which avoids the use of solenoid or dash-pot relay equipment.

A further feature of the invention has to do with the provision of release supervisory control circuits which, heretofore, have been controlled by a dash-pot relay, but which now may be controlled by the above interrupter equipment.

The invention has been illustrated in Figs. 1–3, inclusive, which show sufficient circuits for enabling the invention to be understood with the aid of the complete detailed description which follows.

Fig. 1 shows an ordinary two-wire vertical and rotary type connector switch H, which is of the well known type commonly used by calling subscribers of an automatic telephone system to complete connections to called subscribers' lines.

Fig. 2 shows a group of relays R, used to control the application and distribution of ringing generator to the various connector groups.

In the dotted rectangle in the lower left hand corner of Fig. 1 is shown a supervisory relay 41 and lamp L′ individual to the particular connector group to which H belongs, the lamp L′ being lighted only when some connector of this group fails to release.

Fig. 3 is a modification R′ of the relay group R of Fig. 2 designed for use where only one frequency of generator is to be used.

The supervisory control relay and signalling equipment S, included in the dotted rectangle at the lower right portion of Fig. 2, is equipment provided for giving an alarm to an attendant should certain of the equipment fail to release. This alarm equipment including the bell B, which is an alarm operated when any one of a number of series contacts go open, is common to the exchange.

There is nothing particularly new in the connector H shown, but it is considered necessary to show and briefly describe the operation of this connector in order to bring out the features of the invention having to do with the release supervisory equipment.

By placing Fig. 1 immediately above Fig. 2 with the corresponding lines in alignment, it will be appreciated that the connector H is one of a plurality of such connectors which are common to the ringing interrupter equipment R.

In describing the operation of the connector H, it is assumed that the conductors 42, 43 and 44 terminate in a line, or selector switch, depending on the size of the system, and that, in either case, a calling subscriber has had his line extended to the conductors 42, 43 and 44 of the connector H, resulting in the energization of the line relay 1. This relay upon operating completes a circuit for release relay 2, which operates, at its armature 3 grounding conductor 43 in order to maintain the previously operated switch or switches in operated position, at armature 4 opens a point in the operating circuit of release magnet 5, and at the front contact of this same armature prepares an operating circuit for the motor magnet 6 and series relay 7. Responsive to the actuation of the calling subscriber's calling device, the vertical magnet 6 is operated the desired number of times to position the wipers 28, 22 and 33 of the switch H opposite the desired level in which is located the desired called subscriber's line. The relay 7 is energized when the first impulse is transmitted to the vertical magnet 6 and remains operated throughout the entire series of impulses. As soon as the switch H elevates its wipers one step the off normal springs are operated, with the result that the operating circuit for magnet 6 and relay 7 is transferred so that it extends by way of off normal springs 9 and 10 and the armature and front contact of relay 7, instead of by way of off normal springs 8 and 10 and the windings of the relay 7 and motor magnet 6 direct.

The closure of off normal springs 2 starts the operation of ringing interrupter and distributing equipment R, the operation of which will be subsequently described. The operation of off normal springs 11 also close a point in the operating circuit of release magnet 5, which circuit, however, is not completed at this time due to its circuit being

open at armature 4 of the release relay 2 and the armature of line relay 1.

Proceeding with the operation of the switch H, shortly following the termination of the first series of impulses, the series relay 7 deenergizes, at its armature and back contact preparing an operating circuit for the rotary magnet 12 and the slow relay 13 in multiple. This circuit extends from the back contact of relay 1, armature 4 and its front contact, off normal springs 10 and 9, armature and back contact of relay 7, back contact and armature 14, back contact and armature 15, and the windings of motor magnet 12 and slow relay 13, respectively, to battery. When the next and final series of impulses is transmitted to the connector H, the rotary magnet 12 and slow relay 13 are operated, the slow relay 13 remaining operated throughout the series of impulses, while the magnet 12 is effective to step the wipers 28, 22 and 33 on to the particular contacts of the called line. The relay 13, upon operating, at its armature 17 and its front contact prepares an operating circuit for test relay 18, and at its armature 16 closes a point in the operating circuit of the motor magnet 12 so as to prevent any possible false operation due to the circuit being broken by operation of armature 14 when wiper 22 engages busy or grounded contacts.

It is assumed that the called line is idle, and, therefore, shortly following the termination of the final series of impulses, the slow relay 13 deenergizes and completes a circuit for the switching through relay 19. This circuit extends by way of battery supplied by the line switch of the called line, test conductor 20, bank contact 21, wiper 22, armature 17 and its resting contact, upper winding of relay 19, conductor 23, back contact and armature 24, and the front contact and armature 3 to ground. Relay 19 operates and locks up over its lower winding, front contact and armature 46 and grounded release conductor 43, at its armature 15 prevents any further operation of the rotary magnet should the subscriber happen to operate his calling device, at armature 47 applies ground to wiper 22 and bank contact 21 to make the called line busy to other connectors, and at armatures 27 and 34 connects ringing generator to the called line. This circuit for signalling the called subscriber extends from battery, lower winding of ring cut-off relay 25, back contact and armature 26, armature 27 and its working contact, wiper 28, bank contact 29, line conductor 30, to and through the called subscriber's signalling apparatus, back over line conductor 31, bank contact 32, wiper 33, front contact and armature 34, armature 35 and its back contact, conductor 36, and armature 37 of relay 38, the relay 38 operating intermittently to apply ground and generator to the conductor 36 and being controlled in a manner which will subsequently be explained.

Responsive to the removal of the receiver at the called station, ring cut-off relay 25 energizes, at its armature 39 and its front contact completes a locking circuit for itself, at armatures 26 and 35 disconnects ringing current from the called line, and at the front contacts of these armatures completes the talking circuit.

When the conversation has been completed, the calling subscriber, upon replacing his receiver, causes the deenergization of line and release relays 1 and 2, respectively, resulting in the various switches used in the connection being released, including the connector H. The release circuit for connector H extends by way of grounded armature and back contact of relay 1, armature 4 and its back contact, off normal springs 11, release magnet 5, and low resistance supervisory relay 41 to battery. Upon restoration of the switch H, the various off normal springs are restored to their normal position, the circuit for the release magnet 5 being broken at springs 11. At off normal springs 2 ground is also removed from the start conductor 40 which causes the operation of ringing interrupter and distributing equipment to be discontinued unless some other connector is off normal at this time.

Having described the operation of the connector H, the description of operation of the ringing interrupter and distributing equipment R will now be taken up.

Start conductor 40 of the equipment R is common to all connectors and, therefore, when any connector is seized and operated, conductor 40 is grounded and as a result the equipment R starts to function to cause the transmission and distribution of ringing current to the various connector groups, of which there are five in the system shown. The reason for distributing the ringing current to different groups of switches at different times, as is well known, is to enable the use of a generator having considerable less capacity than that required were ringing current supplied to all connectors at the same time.

Upon conductor 40 being grounded the slow to release relays 51, 52 and 53 operate in sequence followed by the operation of counting relay 56. The operation of relay 56 renders relay 57 operative upon deenergization of relay 53. The controlling circuits of relays 51, 52 and 53 are such that after these three relays have been energized they will, each in turn, be deenergized after a delay due to their slow acting characteristics. The deenergization of relay 53 permits relay 57 to operate to close a circuit for ringing interrupter relay 38, which operates to apply the different frequencies of generator to the different connectors of the first

group. Upon reenergization of the relays 51, 52 and 53, which takes place if the conductor 40 is still grounded, the next counting relay 60, of the pair comprising relays 60 and 61, is energized to prepare a circuit for relay 61, which operates upon deenergization of relay 53, to open the circuit of relays 56, 57 and the ringing interrupter relay 38, and to close a circuit for a similar interrupting relay (not shown) controlling the application of ringing current to the second group of connectors. The operation of relays 51, 52 and 53 are repeated and in turn cause the counting relays 64 and 65 to operate to disconnect ringing current from the second ringing control relay and to connect ringing current to the third connector group. These operations are continued till all five pairs of counting relays have caused the application of ringing current to all groups of connectors, after which the entire operation is repeated as long as conductor 40 remains grounded.

The description of operation will now be described more in detail. Upon grounding conductor 40 relay 51 operates to remove a normal short circuit about the winding of slow release relay 52, and to at the same time complete the operating circuit for this relay. Relay 52 operates to remove a normal short circuit from about the winding of relay 53 and to complete an operating circuit for this relay. The relay 53, upon operating, at its armature 54 applies ground potential to the winding of relay 56, via armature 77 and its resting contact, armature 70 and its resting contact, armature 66 and its resting contact, armature 62 and its resting contact, and armature 58 and its resting contact. Relay 53 also at its armature 55 shunts battery from the winding of relay 51, causing this relay to deenergize after an interval. Relay 56, upon operating, prepares an operating circuit for relay 57 which will be effective as soon as ground is removed from the conductor 45. Relay 51, upon deenergizing, again places a short circuit about the winding of relay 52, which, after an interval, deenergizes. Relay 52, upon deenergizing, again places a short circuit about the winding of relay 53, which, after an interval, restores to normal removing the shunt from the operating winding of relay 51, and also removing ground from the previously described circuit extending through the armatures 77, 70, 66, 62 and 58 to conductor 45. Since the conductor 45 is no longer grounded relay 57 energizes in series with relay 56, and, at its armature 58 prepares a circuit for relay 60 of the next pair of counting relays, and at its armature 59 completes a circuit for ringing interrupter relay 38. Relay 38, upon energizing, connects up generator to the generator lead 36 extending to the various connectors of the first connector group, which have access to subscribers' stations provided with signalling devices operated by 33 cycle generator, and at its other armatures applies 22, 50 and 66 cycle generator to connectors of the group having access to stations provided with signalling devices responding to these respective frequencies.

Now, shortly following the deenergization of relay 53, relay 51 is again operated, providing conductor 40 is still grounded, and in turn causes the operation of relays 52 and 53, respectively, in the same manner as previously described. This time, since relay 57 is now operated, the energization of relay 53, at its armature 54, completes an operating circuit for relay 60. This relay energizes and prepares a circuit for relay 61 in all respects similar to that prepared by the energization of relay 56 for relay 57. Relays 51, 52 and 53 now again deenergize in sequence and, upon the deenergization of relay 53, the shunt is removed from the winding of relay 61. Relay 61 now operates in series with relay 60 and opens the circuit extending through relays 56 and 57 at its armature 63, and closes a circuit for the ringing relay (not shown) which controls the application of ringing current to the second group of connectors. Relay 61, also, at its armature 62 opens the initial operating circuit of relay 60 and prepares an operating circuit for relay 64. Relay 57 upon restoring opens the circuit of relay 38, which restores to disconnect generator from the first group of connectors.

The pairs of counting relays 64—65, 68—69, and 72—75 are rendered effective in turn by the relays 51, 52, and 53, to cause the ringing interrupter relays to apply ringing current to their respective connector groups 3, 4, and 5, in order, in the same manner as ringing current was applied to the second group following the application of ringing current to the first group, and therefore a detailed description is thought unnecessary. It will be noted, however, that the counting relay 75 upon energizing completes a circuit for relay 56 which operates to again prepare a circuit for relay 57, which circuit will be completed as before upon deenergization of relay 53. It will be seen from this that the ringing current is applied to each connector group in turn and, after each connector group has been served, the operation is again repeated as long as the start conductor 40 is grounded.

It will be noted that the alarm relay 79 is normally energized from battery supplied by relay 56. The relay 79 is of very high resistance, approximately 12,000 ohms, and therefore contains so much copper that it is very slow to release. In ordinary operation the circuit of this relay is never opened a sufficient length of time to allow the same to restore, since it receives an almost con-

stant supply of battery from one of the relays 56, 60, 64, 68, or 72. However, in case one of the contacts of armatures 58, 62, 66, 70, or 77 gets out of adjustment and therefore fails to close a circuit for relay 79, this relay will restore after a prolonged interval to operate the common alarm signal B so that the trouble may be immediately remedied.

It sometimes occurs, when a calling subscriber hangs up his receiver causing the completion of the release circuit of the connector, that, for some reason or other, the switch fails to release when the release circuit is completed. Assume this to be the case when the calling subscriber caused the completion of the release circuit for connector H. Supervisory relay 41 energized and prepared a circuit for the lamp signal L', individual to the particular connector group in which H is located, and also prepared a circuit for lamp signal L, common to all connector groups. Now, as soon as the relay 75 energizes a circuit is completed for the lower winding of supervisory relay 83. This relay operates, at its armature 85 prepares a circuit for relay 82, and at its armature 84 completes a locking circuit for itself through lamps L and L' to ground. The upper winding of relay 83 is of sufficient resistance that it prevents lamps L and L' from glowing. As soon as the relay equipment R has completed a complete cycle of operation to a point where relay 72 energizes, a circuit is completed by this relay for supervisory relay 82, providing, of course, that the switch has not yet released, this circuit extending by way of grounded armature 73 and its front contact, armature 76 and its back contact, conductor 89, front contact and armature 85 and the winding of relay 82 to battery. Relay 82, upon operating, completes a locking circuit for itself through its front contact and armature, and through lamps L and L' to the front contact and armature of supervisory relay 41 and ground. Lamps L and L' now glow because of the fact that the upper winding of relay 82 is of very low resistance, and therefore permits sufficient current flow to cause lamps L and L' to glow.

The attendant, upon observing the lamp L glowing, knows that some connector has failed to release, while lamp L' informs the attendant as to the particular group in which the connector giving the trouble is located. Of course, relay 83 is operated each time relay 75 is operated. This operation may also occur at a time when the release magnet of some connector is completed, but will be without effect so far as causing the operation of the lamp signals are concerned, unless the holding circuit of relay 83 is not interrupted during the operation of the entire group of counting relays. It will be seen from the above that the supervisory control relays 82 and 83 are controlled by two impulses from the interrupter equipment R, which is common to the exchange instead of being controlled by a dash-pot relay or relays which are usually provided individual to the connector boards.

The ringing and distributing equipment R is used where the system is more or less elaborate, in that it provides ringing current of different frequencies. Now, in case it is desired to use this ringing and distributing equipment where only one frequency of ringing current is used, the relay equipment R may be modified as shown in Fig. 3, R'. In the equipment R' the ringing current is applied by armatures 91 to 95 directly to each connector group instead of through the medium of ringing control relays such as 38 of equipment R, otherwise the circuits are identical.

It will be noted that the time periods of application of ringing current in equipment R and R' are controlled exclusively by relays 51, 52 and 53, thus making it a simple matter to maintain the same in proper adjustment.

From the above it will be appreciated that applicant has designed ringing equipment which it is believed is more positive in operation than equipment of the type depending on the operation of solenoids and dash-pot relays, and has also effected a reduction in cost of installation by providing means common to the exchange for controlling the various individual supervisory circuits of the various connector boards.

The various features which applicant considers new and desires to have protected by Letters Patent are pointed out in the appended claims which follow.

What is claimed is:

1. In a telephone system, a source of alternating current for signalling purposes, a start conductor, means for connecting a source of current to said start conductor, a plurality of relays responsive thereto, a plurality of groups of connector switches, and means comprising a plurality of relays common to said groups and operating in co-operation with said first relays to apply alternating current to each connector group in sequence.

2. In a telephone system, a source of alternating current, a plurality of connectors, means comprising a group of relays co-operating with other groups of relays for causing said alternating current source to be applied to said connectors in sequence, a normally energized alarm relay included in a circuit extending through a plurality of said other relays, said alarm relay responsive to the improper operation of certain of said other relays to cause an alarm to be given.

3. In a telephone system, three slow acting relays, a source of current for operating said relays, means for closing an operating circuit for one of said relays, means controlled by said relay for removing a normal shunt from the winding of the second relay and for at the same time completing an operating circuit therefor, means controlled by the second relay for removing a normal shunt from the winding of the third relay and for at the same time completing an operating circuit therefor, and means operated by said third relay to cause the deenergization of said first and second relays to in turn cause the deenergization of said third relay, the three relays being operated and released individually in sequence as long as the operating circuit of said first relay remains closed.

4. In a telephone system, three slow to release relays, a source of current for operating said relays, means for closing an operating circuit for one of said relays, means controlled by said relay for removing a normal shunt from the winding of the second relay and for at the same time completing an operating circuit therefor, means controlled by the second relay for removing a normal shunt from the winding of the third relay and for at the same time completing an operating circuit therefor, means operated by said third relay to cause the deenergization of said first and second relays to in turn cause the deenergization of said third relay, the three relays being operated and released individually in sequence as long as the operating circuit of said first relay remains closed, a plurality of pairs of relays for causing the application of current to a like plurality of devices in sequence, means including one of said first relays for causing the operation of one relay of one pair followed by the operation of the second relay of the same pair and for causing the operation in sequence of the relays of the remaining pairs for the purpose set forth.

5. In a telephone system, an operated connector switch, a release circuit for said switch, a supervisory signal, a relay operated each time the release circuit is closed to prepare a circuit for said signal, a group of counting relays, a second group of relays operated whenever said connector switch is operated to cause the repeated operation of said counting relays, a pair of relays, means operated by one of said counting relays for causing a circuit to be completed for one relay of said pair, a locking circuit for said relay completed if the first mentioned relay is operated, means controlled by another counting relay for completing an operating circuit for the second relay of said pair, and a circuit completed by the operation of said second relay if the first relay of the pair is still operated for maintaining the first relay of the pair operated and for causing the supervisory signal to be operated.

6. In a telephone system, a plurality of counting relays, a group of relays for controlling the speed and operation of said counting relays, groups of automatic switches, a plurality of supervisory signals one individual to each switch group, means controlled by one of said counting relays for preparing an operating circuit for any one of said signals, and means responsive to another of said counting relays to cause said signal to be effective.

7. In a telephone system, a source of alternating current for signalling purposes, a start conductor, a plurality of groups of connector switches, means responsive to an operation of one of said connector switches for connecting a source of current to said start conductor, a plurality of relays responsive thereto, and means comprising a plurality of relays operating in cooperation with said first relays to apply alternating current to each connector group in sequence.

In witness whereof, I hereunto subscribe my name this 19th day of November, A. D., 1924.

CLARENCE E. LOMAX.