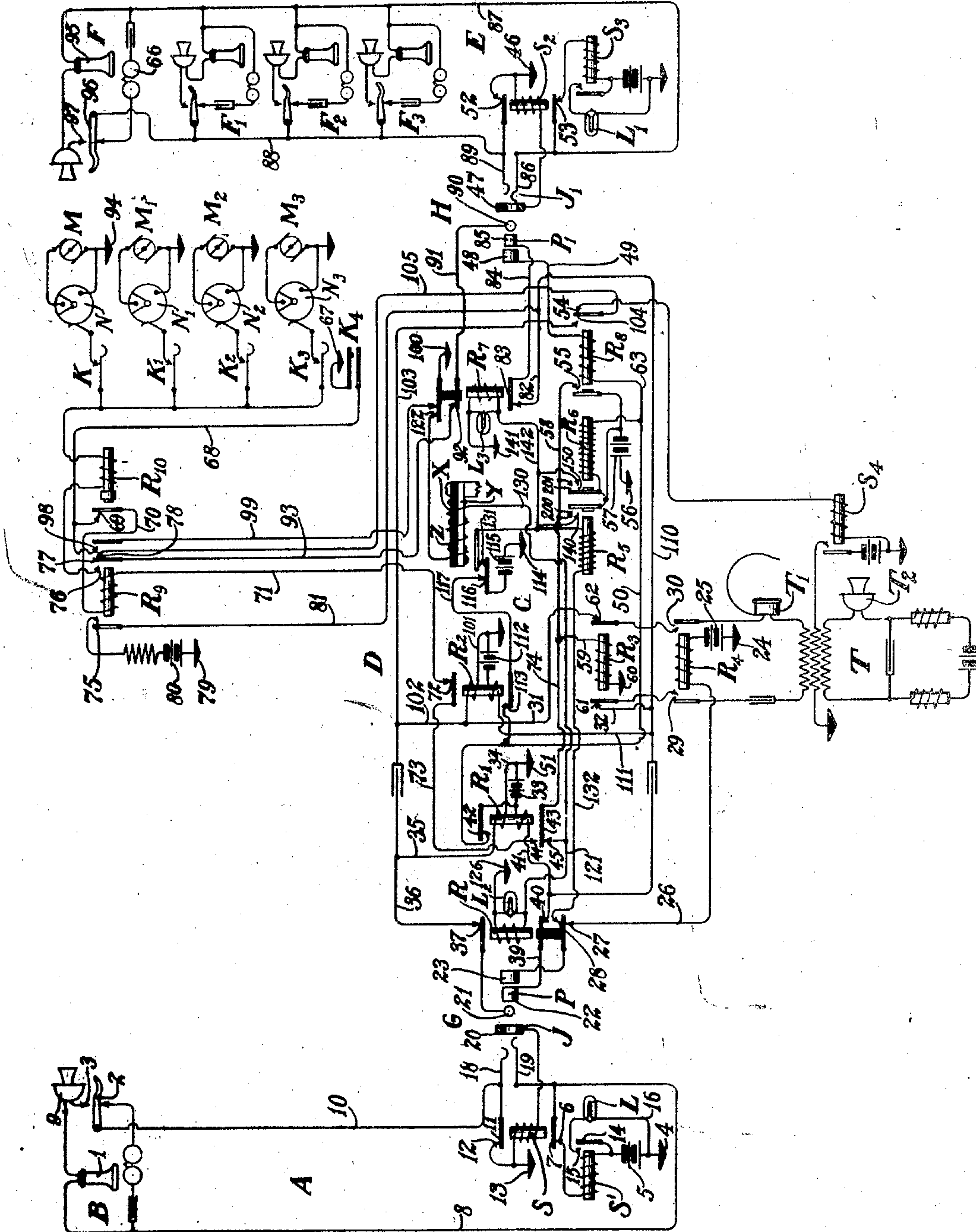


F. M. SLOUGH.
TELEPHONE SYSTEM.
APPLICATION FILED MAY 13, 1915.

1,324,749.

Patented Dec. 9, 1919.



INVENTOR.
Frank M. Slough
BY *G. O. Richey*
ATTORNEY

UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ELYRIA, OHIO, ASSIGNOR, BY MESNE ASSIGNMENTS, TO
STROMBERG-CARLSON TELEPHONE MFG. CO., OF ROCHESTER, NEW YORK, A
CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

1,324,749.

Specification of Letters Patent.

Patented Dec. 9, 1919.

Application filed May 13, 1915. Serial No. 27,748.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Elyria, in the county of Lorain and State of Ohio, have invented certain new and useful Improvements in Telephone Systems; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to telephone systems, and more particularly to systems in which the central station connecting circuits are automatically broken when the conversation is terminated.

One of the objects of my invention is to provide means for interrupting the central station circuit connections at both ends of said connections and assigning the control of such means to one of the subscribers who has been conversing.

Another object of my invention is to provide means to prevent the operation of the line lamp of the other subscriber during the time intervening between the hanging up of the receivers of the two subscribers.

Another object of my invention is to provide means for maintaining the interruption of the central station circuit connections at each end thereof between the retirement of the subscribers and the retirement of the connections by the operator, and placing the control of such means under one or both of the switches employed for connecting said circuit connections to a line.

Other objects of my invention and the invention itself will probably be better understood from a description of an embodiment of the invention.

The figure illustrates diagrammatically certain portions of a telephone system embodying my invention.

Referring now to the drawing and to the embodiment of my invention illustrated therein, at A is shown a telephone line to which a substation B is connected. At D is shown the main station provided with suitable means for connecting telephone lines together, such as a cord circuit C. A second line is shown at E to which are connected substations F, F₁, F₂ and F₃. Either of the lines may be single or multi-party lines, and each leads to the station D. Hereafter the

line A will be spoken of as the calling line 55 and the line E as the called line and the subscriber B as the calling subscriber and the subscriber F as the called subscriber. Suitable switching means are provided for connecting the circuit C to the telephone lines, here shown as plugs and jacks, the line A being provided with a jack J and the line E being provided with a jack J₁. The cord circuit terminates in the plugs P and P₁, constituting portions of said switching 60 means. Suitable means are provided for signaling the operator from the substations, consisting of line lamps L and L₁, associated respectively with the calling and called line. These line lamps are controlled respectively 65 by the relays S' and S₃. Cut-off relays S and S₂ are also provided. The central station operator is provided with a telephone set, shown at T, which includes a receiver T₁ and a transmitter T₂. The connection of 70 this set to the cord circuit is controlled by the relays R₃ and R₄.

A test circuit is provided controlled by the marginal relay S₄. Suitable sources of ringing current M, M₁, M₂ and M₃ are employed, each adapted to supply current of a particular characteristic. Commutators N, N₁, N₂ and N₃ may be provided for breaking the ringing up into silent and active periods. Ringing keys K, K₁, K₂ and K₃ associated 85 with a master key K₄ are provided. A relay R₅ controls the connection of the ringing current to the line E, and the relay R₁₀ is employed to control the disconnection of the same. Subscriber controlled relays are 90 shown at R₁ and R₂. The relays employed to interrupt the strands of the central station circuit connections, or where a cord circuit is employed, to disconnect the plugs from the cord, are shown at R and R₇, and 95 will be spoken of as the disconnect relays. The sleeve relay is shown at R₈. Relays R₅ and R₆ are provided for controlling the circuit connections of the disconnect relays and at X is shown a slow acting device, here 100 illustrated as a thermal arrangement, preferably made by connecting together two bars of metal having different characteristics, one of which expands faster than the other, causing bar Y to bow downward, as shown in 105 the drawing, with a slow movement.

When the switching connection at G is operated, the relay R¹ will be operated, and

when the switching device H is operated, the relay R_8 will be operated. The relay R_8 will not be operated at this time, however, because the relay R_1 has completed a shunt thereof. After the called subscriber responds, the relay R_2 will be operated, completing a second shunt of the relay R_6 . In the form shown, the primary control of the disconnect relays is assigned to the calling subscriber. When the calling subscriber hangs up, the relay R_1 will be deenergized and the first mentioned shunt to the relay R_6 will be broken. At the same time, circuits will be completed through the relay R and through the device X. The relay R will operate, disconnecting the plug P from the cord circuit and closing contacts in the circuit of the relay R_5 . When the circuit is completed through X it begins slowly to operate, approaching the switches 131 and 116. After a little while, the device X will complete the circuit of the relay R_5 , which will pull up its armature and complete a circuit for the relay R_7 , which, when operated, will disconnect the plug P_1 from the cord, completing the disconnection. The energization of the relay R_7 interrupts the circuit of the device X, so that it will be restored to normal and the system will stand ready for the withdrawal of the plugs and both lines be released for other calls. If the relay R_5 had failed to operate for any reason, the continued action of the device X, breaks the second shunt about the relay R_6 , which will operate over a circuit including relays R_8 and S_2 . The relay R_6 will then complete a circuit for the relay R_7 and cause the disconnection of the plug P_1 from the cord.

It will thus be seen that the disconnection of both ends of the cord and the release of both lines is effected by one of the subscribers, in the embodiment illustrated, by the calling subscriber. If, however, the disconnection at both ends was effected instantaneously and the called subscriber did not hang up as soon as the calling subscriber, the line lamp L_1 of the called line would come back and the operator seeing the same, would answer the call before the subscriber F retired, when there was no desire on the part of the subscriber F to institute a call, thus causing the operator unnecessary work, and delay the operation of the whole system. However, as the device X is slow acting, an interval of time is provided between the disconnection of the two plugs, which can be made of any suitable length and sufficient for all practical purposes to give the subscriber at F time to hang up. If, in the operation of the system, the subscriber at F hangs up first, the second shunt about the relay R_6 will be broken, and when the subscriber at B hangs up, the first shunt about the same will be broken, so that immediately when the subscriber B hangs up, the discon-

nection will take place, there now being no danger of the called subscriber's line lamp coming back, since he has retired.

Perhaps my invention will be better understood from a detailed description of the operation of the embodiment illustrated. Assuming that the subscriber B desires to talk with the subscriber F, the receiver 1 is removed from the switch-hook 2, which rises and closes a switch 2-3. A circuit is then completed for the relay S' as follows: ground 4, battery 5- S_1 -6-7-8-1-transmitter 9-3-2-10-11-12-to ground at 13. The relay S' is energized, pulling up the armature 14 and closing the switch 14-15, and completing a circuit through the line lamp L, including the battery 5 and the conductor 16. The lamp L is so positioned that its illumination will be observed by the operator at the station D, who is apprised thereby that a subscriber on the line A desires a connection. The operator then connects her circuit connections with the line A by operating the switching device G. In the form shown, the plug P is inserted into the jack J, the contacts 21-22 and 23 of the plug P registering respectively with the contacts 18-19 and 20 of J. A circuit will be completed through the relay R_1 as follows: ground 24-battery 25-relay R_1 -conductor 26-contacts 27-28-contacts 23 and 20-relay S-to ground 13, energizing the relay S which disconnects the lamp L and relay S' from the line by opening the switches 6-7 and 11-12. The relay R_1 will be energized, closing the switches 29 and 30 and connecting the operator's telephone T to the cord circuit, through the conductors 31 and 32. The relay R_1 will also be energized over the following circuit: from battery 33-conductor 34-upper winding of R_1 -conductor 35-conductor 36-switch 37-contact 21-over the line A-through the talking set at B-back through the contacts 19-22-conductor 39-switch 40-conductor 41-the other winding of the relay R_1 -back to the battery 33. The relay R_1 will close the switches 42 and 43-44, but opening the switch 43-45, all for purposes which will be described. The operator at D now learns that it is the subscriber at F who is desired, so after making the busy test in the usual manner, she connects her circuit connections to the line E by operating the switching device H. In the form shown, the plug P_1 is inserted into the jack J_1 . A circuit is immediately completed through the relays S_2 and R_8 as follows: ground 46-relay S_2 -contacts 47 and 48-conductor 49-relay R_8 -conductor 50-switch 42-battery 33-to ground at 51. S_2 will be operated, disconnecting the lamp L_1 and the relay S_1 from the line E by opening the switches 52 and 53. The relay R_8 will open a switch 54 in the circuit of

the test magnet S_1 , and will close a switch 55. The relay R_2 will now be actuated over the following circuit: ground 56—battery 57—switch 55—conductor 58—conductor 59— R_2 —to ground at 60. R_2 will be energized, disconnecting the set T from the cord by opening the switches 61 and 62. A circuit will also be completed when the switching device H is operated for the relay R_6 as follows: ground at 56—57— R_6 —63— R_6 —48—47— S_2 —46. The relay R_6 , however, will not be energized at this time because a shunt of the same has been completed, as follows: ground at 51—33—switch 42—conductor 50.

The operator now signals the subscriber at F by operating the signaling device 66, here illustrated as a bell, by completing the connections for supplying ringing current to such bell. She operates one of the keys which controls the ringing current from the generator adapted to operate the bell 66, which we will here assume to be the generator M. At the same time that the key K is operated, the master key K_1 will be momentarily operated by some suitable means associating the same, which are well known and understood, and therefore, not illustrated here. The closing of the switch K_1 completes a circuit for the relay R_9 , as follows: 67— K_1 —68—switch 69—conductor 70— R_9 —71—switch 72—conductor 73—switch 44—43—conductor 74—58—55—57—to ground 56. R_9 will be energized, closing the switches 75 and 76—77 and opening the switch 77—78, the latter in the circuit of the test relay S_1 . The closing of the switches 75 and 76—77 completed the ringing circuit which is as follows: ground 79—battery 80—switch 75—conductor 81—82—switch 83—conductor 84—contact 85—spring 86—conductor 87—bell 66—conductor 88—contact 89—90—conductor 91—switch 92—conductor 93—switch 77—76—relay R_{10} —switch K—commutator N—ringing machine M—to ground 94. The commutator will periodically interrupt the flow of ringing current, operating the bell at intervals. The flow of current over this circuit through the bell bridge 66 will not cause the operation of the relay R_{10} . However, when the subscriber responds the receiver 95 will be removed from the hook-switch 96, which will close a switch 96—97, substituting a circuit including the receiver and transmitter at the called station for the bell bridge, whereupon the flow of current in the ringing circuit will cause the actuation of the relay R_{10} , breaking the circuit of the relay R_9 at the switch 69 and causing the deenergization of the relay R_9 , whereupon the ringing connections are restored to normal.

When the relay R_9 was energized, it also closed a switch 98, completing a locking circuit for the said relay over the conductor

99 to ground at 100. When the called subscriber responds, the relay R_2 will be actuated over the following circuit:—conductor 101—upper winding R_2 —conductor 102—103—switch 104—conductor 105—switch 77—78—conductor 93—switch 92—conductor 91—contact 90—over the line E to contact 85—switch 83—conductor 82—conductor 110—conductor 111—through the lower winding of R_2 —to battery 112. This relay will be operated, opening the switch 72 in the circuit of the relay R_9 and closing a switch 113, completing a second shunt about the relay R_6 , as follows: from ground at 114—battery 115—switch 116—conductor 117—switch 113—conductor 50. With the apparatus in this condition the conversation takes place between the subscribers. At the termination of the conversation, assuming that the subscriber at B retires first, hanging up his receiver and breaking the switch 2—3 in the circuit of the relay R_1 , previously described, the armatures and switches controlled thereby will be restored to the condition illustrated in the drawing, breaking the first shunt about the relay R_6 at the switch 42 and completing a circuit for the relay R, as follows: ground 126—relay R—conductor 121—switch 45—43—conductor 74—conductor 58—switch 55—battery 57—to ground 56. The relay R will be energized, disconnecting the plug P from the strands of the cord circuit by opening the switches 37 and 40, interrupting the circuit of the relay R_4 and the cut-off relay S at 27, thereby releasing the line A, which will immediately be available for other calls. The relay R will also close a switch 28 in the circuit of the relay R_5 , which will, however, still be open elsewhere. When the relay R_1 was deenergized, a circuit was also completed through the device X, as follows: ground 100—switch 122—device X—conductor 130—switch 45—43—conductors 74 and 58—switch 55—battery 57—to ground 56. The device X begins to operate in the manner described, and if allowed to continue to do so, will first close the switch 131, which will complete a circuit through the relay R_6 , as follows: ground 114—battery 115—switch 116—switch 131— R_6 —conductor 132—switch 28—contact 23—relay S—to ground 13. The resistance of the relay R_6 however, is such that the flow of current in this circuit will not be sufficient to operate the relay S. The relay R_5 when energized, closes a switch 140, completing a circuit through the relay R_7 , as follows: ground 141— R_7 —conductor 142—switch 140—battery 57—to ground 56. R_7 will be energized, breaking the circuit of the device X and disconnecting the plug P₁ from the cord, thereby enabling the device X to return to normal, and releasing the called line for immediate use, in the same manner

as described in connection with the release of the calling line. If for any reason the device R_5 failed to operate, the device X would continue, and break the switch 116 in the second shunt of the relay R_6 , which now being unshunted, would operate over its circuit including the relays R_8 and S_2 , which has been previously described. This relay would close a switch 150, completing a circuit through the relay R_7 , including the battery 57 and cause the disconnection in the same manner as previously described.

If the subscriber at F hangs up before the subscriber at B, the previously described circuit of the relay R_2 will be broken and the second described shunt of the relay R_6 will be broken at the switch 113, so that when the calling subscriber hangs up and the first described shunt of this relay is broken at 42, the relay R_6 will be unshunted and will be operated, causing the disconnection as described, or, if during the interval of time between the beginning of the operation of the device X and the closing of the switch 131, the called subscriber hangs up, this same operation will take place. If at any time the device R_6 fails to operate, the device R_5 will operate as described, causing the disconnection. The disconnection having thus been made, is maintained by either or both of the relays R_5 and R_6 , as each of the relays R and R_7 is provided with a circuit controlled by each of the relays R_5 and R_6 . The relay R_6 controls the relay R_7 through the switch 150 and the relay R through the switch 201. The relay R_5 controls the relay R_7 through the switch 140 and the relay R through the switch 200. As the relay R_5 is controlled by the switch G and the relay R_6 is controlled by the switch H, the disconnect relays are controlled by each of the switches G and H, so that neither will release its contacts restoring the cord until both plugs have been withdrawn.

At the same time that the relays R and R_7 are operated, the lamps L_2 and L_3 will be operated, indicating to the operator that the conversation is terminated, whereupon the plugs will be withdrawn from the jacks and the system restored to normal. The high resistance to which the relays R_5 or R_6 are wound prevents the associated lines testing busy by the operator of any marginal test relay, as S_1 , of any testing operator. Either relay R_5 or R_6 will complete a circuit for the relay R_3 so as to maintain the same energized until the cord is restored to normal. These circuits will be over the conductor 58—one of the switches 200 or 201 to battery 57, thus preventing the connection of the operator's set T to the strands of the cord circuit after the relay R is deenergized.

It will be understood that any suitable form of slow acting device may be used at

X. I have illustrated a thermal device which is operated by the heat from the coil Z, mainly because it is convenient to show it in the drawing, the object being to provide some means which will delay the disconnection of the end of the cord associated with the called line and the release of the called line, so as to give the subscriber at F ample time to hang up. In fact, I do not wish to be limited to the details or the embodiment of my invention which I have illustrated for the purpose of better describing the invention, as it will be apparent that many departures may be made from both the form and the details of this embodiment, without departing from the spirit of the invention.

I claim:

1. In a manual telephone system, the combination of a main station, telephone lines leading to the main station, a substation on each line, line signal devices at the main station controlled from the substations over said telephone lines, said devices being removed from such control during the conversational period, conductors at the main station for connecting the lines together, a switch for connecting said conductors to one of said lines, a second switch for connecting said conductors to the other of said lines, mechanism at the main station for disconnecting said conductors from one of said switches, mechanism at the main station for disconnecting said conductors from the other of said switches, and means controlled by the switch hook of one of said subscribers for successively causing the actuating of said disconnecting mechanisms and releasing said line signal devices.

2. In a telephone system, the combination of a main station, telephone lines leading to the main station, a substation on each line, line signal devices at the main station controlled from the substations over said telephone lines, said devices being removed from such control during the conversational period, conductors at the main station for connecting the lines together, a switch for connecting said conductors to one line, a second switch for connecting said conductors to the other line, mechanism for disconnecting the switches from the conductors, the line signal device of the calling line being released when the switch thereat is disconnected, means at one of the substations controlling said disconnect mechanism and apparatus for delaying, an appreciable period of time, the disconnection of one of said switches from said conductors until after the disconnection of the other has taken place.

3. In a manual telephone system, the combination of a main station, telephone lines leading to the main station, a substation on each line, line signal devices at the main station controlled from the substations over said telephone lines, said devices being re-

moved from such control during the conversational period, cord circuit conductors at the main station for connecting telephone lines together, a switch for connecting said

5 conductors to one line, a second switch for connecting said conductors to the other line, mechanism for disconnecting the first named switch from said conductors, mechanism for disconnecting the second named switch from
10 said conductors, means for operating said mechanisms, a device at one of said substations controlling said mechanism operating means, and apparatus at the main station for delaying the operation of one of said
15 mechanisms until the other is operated.

4. In a manual telephone system, the combination of a main station, telephone lines leading to the main station, a substation on each line, a cord circuit at the main station
20 for connecting the lines together, a switch for connecting the cord to a telephone line, line signal means at the main station associated with the calling line and controlled by the calling subscriber removed from such
25 control when the cord is connected to the calling line, a second switch for connecting the cord to another telephone line, a relay for disconnecting the first switch from the cord and releasing said line signal means, a
30 second relay for disconnecting the second switch from the cord, means for operating said relays including a source of current and circuit conductors, apparatus controlling said means including a switch-hook at one
35 of said substations and apparatus for delaying, an appreciable period of time, the operation of one of said relays until after the other relay has operated.

5. In a telephone system, the combination
40 of a main station, telephone lines leading to the main station, including a calling and a called line, a substation on each line, a cord circuit at the main station for connecting the lines together, a switch including a plug
45 and jack at each end of the cord for connecting the cord to the lines, automatic disconnect apparatus controlled by the calling subscriber for disconnecting the plugs from the cord and means to cause the actuation there-
50 of automatically when the calling subscriber retires, and apparatus for delaying for an appreciable predetermined period of time the disconnection of the calling plug only from the cord when the calling subscriber
55 retires before the called subscriber.

6. In a manual telephone system, the combination of a main station, a calling and a called line extending to the main station, a substation on each line, cord conductors at
60 the main station for connecting the lines together, a switch for connecting the conductors to the calling line and a second switch for connecting the conductors to the called line, means controlled by one of said subscribers for automatically disconnecting the

switches from the conductors when such subscriber retires, and means for delaying the disconnection of the switch associated with the called line from said conductors when the calling subscriber retires before the
70 called subscriber.

7. In a telephone system, the combination of a main station, a calling line and a called line leading to the main station, a substation on each line, a cord circuit at the main sta-
75 tion for connecting the lines together, a plug and jack switch for connecting the cord to the calling line, a second plug and jack switch for connecting the cord to the called line, a relay for disconnecting the first
80 named switch from the cord, a circuit for said relay including a source of current, means controlling said circuit for causing the actuation of said relay governed by the switch-hook at the calling substation and
85 automatically actuated when the calling subscriber retires, a second relay controlling the connection of the second switch with the cord, means for causing the actuation of the second relay and the disconnection of the
90 second switch from the cord governed by the switch-hook at the calling station and means for delaying the operation of said second relay when the calling subscriber retires before the called subscriber.
95

8. In a manual telephone system, the combination of a main station, telephone lines leading to the main station, a subscriber on each line, cord conductors at the main station for connecting telephone lines together,
100 a plug on each end of the cord, means for disconnecting the plugs from the cord conductors controlled from one of said substations and a slow-acting relay for delaying the disconnection of one of said plugs until
105 after the other has been disconnected.

9. In a manual telephone system, the combination of a main station, telephone lines leading to the main station, including a calling and a called line, a subscriber on each
110 line, cord conductors at the main station, a plug on each end of said conductors, means controlled by a subscriber for disconnecting from said conductors the plug connected to such subscriber's line when the subscriber re-
115 tires, and means controlled by the same subscriber for later disconnecting the other plug from said cord conductors.

10. In a telephone system, the combination of a main station, telephone lines lead-
120 ing to the main station, substation devices including a circuit controller located on each telephone line and operable when the subscriber thereat retires, apparatus at the main station for connecting the lines together, in-
125 cluding circuit conductors and switches employing sleeve contacts, means for automatically interrupting said conductors when a subscriber at one of the substations retires and electromagnetic mechanism con-
130

trolled through the sleeve contact of each of said switches for maintaining said disconnection until the switches are operated.

11. In a telephone system, the combination of a main station, telephone lines leading to the main station, a cord at the main station for connecting the lines together, a plug and jack switch for connecting the cord to one line, a second plug and jack switch for connecting the cord to another line, means for automatically interrupting the continuity of the cord when the subscribers retire, and electromagnetic mechanism for maintaining the cord interrupted until the switches are open, said mechanisms being controlled through sleeve contacts of each of said switches.

12. In a telephone system, the combination of a pair of telephone lines, a cord circuit, a switch for connecting the cord to one of said lines, a second switch for connecting the cord to the other of said lines, a relay for disconnecting the first named switch from the cord, a second relay for disconnecting the second named switch from the cord, a circuit for each of said relays, a third relay controlling each of said circuits, a circuit for said third relay controlled by one of said switches, a fourth relay controlling the circuits of the first and second named relays and a circuit for said fourth relay controlled by the other of said switches.

13. In a telephone system, the combination of telephone lines, a main station, a cord circuit at the main station for connecting telephone lines together, an answering switch for connecting the cord to a telephone line, a calling switch for connecting the cord to another telephone line, means controlled by the calling subscriber for automatically disconnecting said switches from said cords when the calling subscriber retires, including a device for delaying the disconnection of the answering switch from the cord while the calling subscriber is on the line and means for automatically and instantaneously disconnecting the calling switch from the cord as soon as the called subscriber has responded independently of said delaying device.

14. In a telephone system, the combination of a calling line and a called line, a subscriber on each line, talking conductors for connecting said lines together, a calling switch and an answering switch for connecting said conductors to said lines, means controlled by the calling subscriber for automatically and instantaneously disconnecting said conductors from said switches when the calling subscriber retires and there is no called subscriber on the called line, a device for delaying the disconnection of the

calling switch from the talking conductors when the calling subscriber retires and a called subscriber is on the called line, and means for instantaneously causing the disconnection of the calling switch from the talking conductors when the called subscriber retires after the calling subscriber has retired and before the calling switch has been disconnected from the conductors.

15. In a telephone system, the combination of calling and called telephone lines, a substation on each line, talking conductors for connecting said lines together, an answering switch for connecting the talking conductors to the calling line and a calling switch for connecting the calling conductors to the called line, means controlled by the calling subscriber for automatically disconnecting the calling switch from the talking conductors when the calling subscriber retires instantaneously when there is no called subscriber on the called line, and means for delaying such disconnection when there is a called subscriber on the called line.

16. In a telephone system, the combination of calling and called telephone lines, talking conductors for connecting said lines together, switches for connecting the talking conductors to the telephone lines, means for automatically disconnecting said switches from said talking conductors when one of said subscribers retires and thermal means for delaying the disconnection of one of said switches from said talking conductors.

17. In a telephone system, the combination of telephone lines, link conductors including talking strands for connecting said lines together, a switch to connect said link conductors to a telephone line, mechanism for disconnecting said switch from the talking strands and for interrupting said talking strands automatically operated when a subscriber retires his talking set and apparatus for delaying the automatic operation of said mechanism for a predetermined and appreciable period of time.

18. In a telephone system, the combination of telephone lines, link conductors including talking strands for connecting said lines together, a switch to connect said link conductors to a telephone line, mechanism for disconnecting said switch from the talking strands and for interrupting said talking strands automatically operated when a subscriber retires his talking set and apparatus independent of said mechanism for delaying the automatic operation of said mechanism for a predetermined and appreciable period of time.

I have signed my name hereto this 10th day of May, 1915.

FRANK M. SLOUGH.