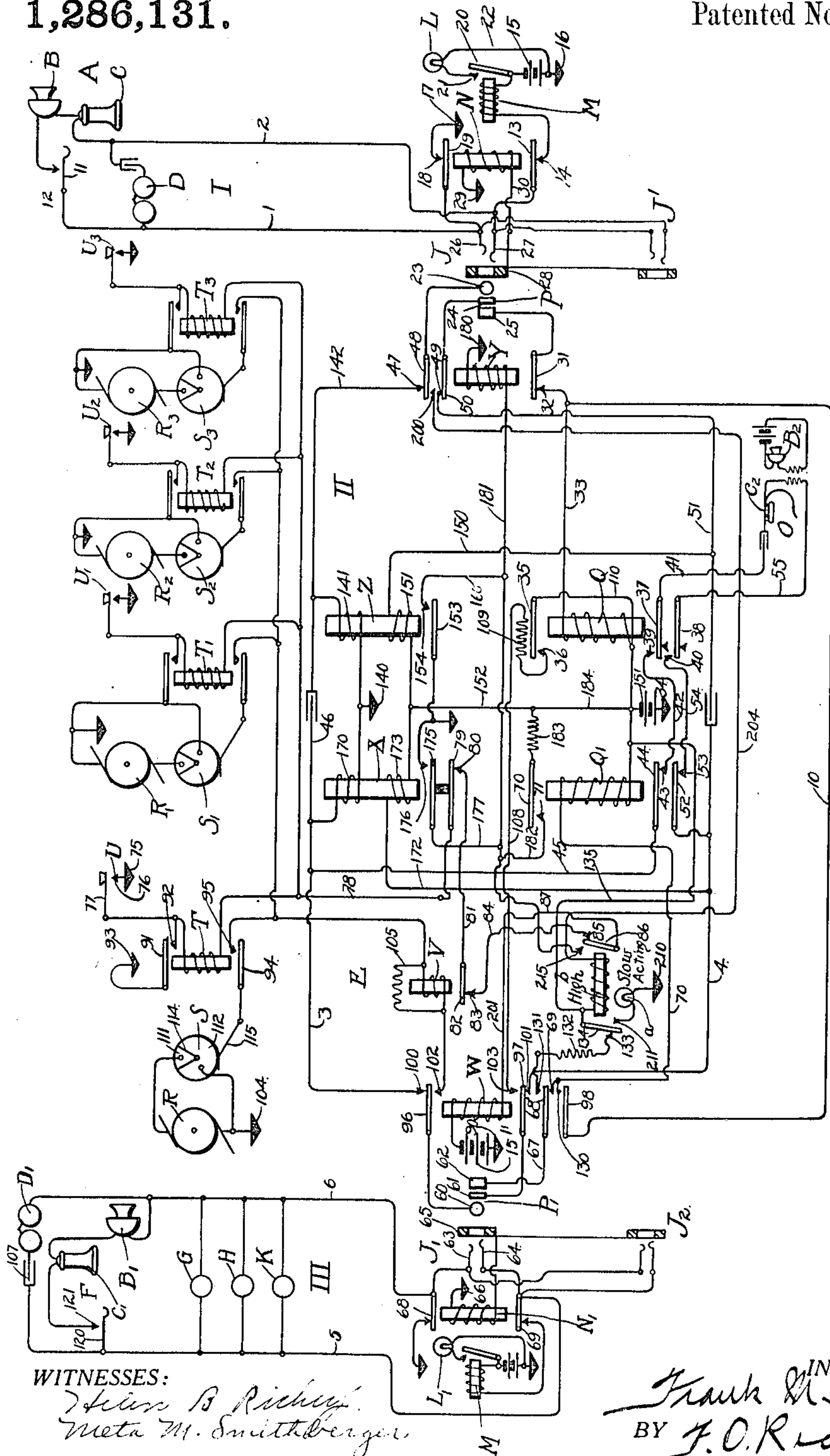


F. M. SLOUGH.
TELEPHONE SYSTEM.
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WITNESSES:

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STROMBERG-CARLSON TELEPHONE MFG. CO., OF ROCHESTER, NEW YORK, A
CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

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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 performing automatically many of the functions which are now performed manually, and at the same time to accomplish these purposes with a minimum amount of apparatus.

The more particular objects of my invention will probably be better understood from a detailed description of an embodiment of my invention.

The figure in the drawing illustrates one embodiment of my invention.

Referring now to the embodiment shown in the figure, at A is shown the substation apparatus of a subscriber's substation, consisting of a transmitter B, a receiver C and a signal device D. This substation is connected by a telephone line I, here shown as the calling line, which extends by its limbs 1 and 2 to the main station II. A second telephone line is illustrated at III. The lines I and III are provided at the main station with suitable means through which they are connected to other lines. In the form shown, this consists of multiple jacks J and J' and J₁ and J₂.

At the main station II suitable means are provided for connecting telephone lines together, here shown as link conductors which may be in the shape of a cord circuit E, which includes talking strands 3 and 4. Suitable means are provided for connecting the link conductors to the lines, here shown as plugs P and P₁, in which the cord circuit terminates. The second line is illustrated at III upon which there are a plurality of substations F, G, H and K. I have illustrated in detail the substation apparatus at only one of these stations, as it is substantially alike at each station. At the substa-

tion F, the substation apparatus consists of transmitter B₁, receiver C₁ and ringer D₁. The substations upon the line III are connected by the limbs of the line 5 and 6 to multiple jacks J₁ and J₂, which are located at the other station, and which are adapted to cooperate with the plug P₁ and connect the line to the cord circuit. The line III is here known as the called line. The calling line is provided with a line signal L, a line relay M and a cut-off relay N. The called line is provided with a line lamp L₁, a line relay M₁ and a cut-off relay N₁. The operator at the main station is provided with a set O, which includes a transmitter B₂ and a receiver C₂, together with other apparatus which as well known, is employed in a talking set. Means are provided for connecting this set to the talking strands of the cord circuit, which may include conductors and switches. These switches are controlled by the relays Q and Q₁, which thus govern the secret listening service. The relays Q and Q₁ are controlled through the cord circuit or line circuits and the switching means for connecting the same.

Means are provided for automatically ringing the called subscriber, which includes a series of ringing generators R, R₁, R₂, R₃, a series of commutators S, S₁, S₂, S₃, a series of relays T, T₁, T₂, T₃ and keys U, U₁, U₂, U₃ which exercise control over the connection of the generators R, R₁, R₂ and R₃ to the called line. This connection is further controlled by the relays V, W and X in a manner which will be described later. Means are provided for controlling the automatic disconnect of the ends of the cord circuit from the cord and releasing the lines when the conversation is completed. These means include the relays W, Y, X and Z. Means are provided for giving a disconnect signal, which includes a lamp a, a high resistance, slow acting relay b and the relay Y. Means are provided for maintaining the secret listening service and the called line signal cut-off service during the ringing.

The apparatus and the functions will probably be better understood from a detailed description of the operation of the embodiment illustrated. Assuming that the

subscriber at A desires to converse with the subscriber at F, the receiver at C is taken from the hook 11, upon which it normally rests, whereupon the hook 11 being spring pressed upward, rises and engages the contact 12 and completes a circuit as follows: contact 12—transmitter B—receiver C—conductor 2—the switch 13—14—the relay M—through the battery 15 to ground at 16, through the ground from 16 to the ground at 17, the switch 18—19—the conductor 1, back to the contact 11. The relay M will be energized, attracting its armature 20 and closing the switch 20—21 and completing a circuit through the lamp L, the conductor 22, the battery 15 and the switch 20—21 and causing the illumination of the lamp L, which being placed adjacent the operator, will by its illumination advise her that the subscriber at A desires a connection. The operator inserts the plug P into the jack J, whereupon the tip contact 23, the ringing contact 24 and the sleeve contact 25 of the plug P will engage respectively the tip spring 26, sleeve spring 27 and the thimble 28 of the jack J, and a circuit will be completed as follows: from ground at 29 to the relay N—conductor 30—contact 28—contact 25—switch 31—32—conductor 33—the relay Q—to battery 15'—to ground 34, completing a circuit through the relays Q and N which will be energized. The relay N will attract the armatures 13 and 19, interrupting the circuit of the relay M and cutting off the line lamp and signal from the line. The relay Q will attract its armature 35, closing a switch 35—36 for a purpose to be described. The relay Q will also attract its armatures 37 and 38, closing switches 37—39 and 38—40 and completing the connection of the operator's set to the cord circuit. The operator will then communicate with the subscriber over the following circuit: beginning at C₂—conductor 41—contacts 37—39—conductor 42—contacts 43—44—conductor 45—the side 46 of the conductor 3—the switch 47—48—23—26—through the line and substation set back to the sleeve spring 27—24—switch 49—50—the side 51 of the conductor 4—the switch 52—53—conductor 54—switch 40—38 and back to the receiver C₂—through the conductor 55.

Having learned from the subscriber at A that it is the subscriber at F that is desired, the operator will first test the called line in a manner and by apparatus well known, and which apparatus constitutes no part of my invention. Having found the line idle, which is assumed to be the case here, the plug P₁ is inserted into the jack J₁, the tip contact 60, sleeve contact 61—ring contact 62 of the plug P₁ engaging, respectively with the tip spring 63—sleeve spring 64 and the thimble 65 of the jack and completing the

connection of the cord circuit to the line III. A circuit will be completed as follows: from ground 66 through relay N₁—contact 65—contact 62—conductor 67—switch 68—69—conductor 70—relay Q₁, battery 15'—to ground 34. The relays N₁ and Q₁ will be energized over this circuit. The relay N₁ will attract its armatures 68' and 69, cutting off the lamp L₁ and the relay M₁ from the line III. The relay Q₁ will be energized, attracting its armature 70, and closing the switch 70—71 for a purpose to be described. The relay Q₁ will also attract its armatures 44 and 52, opening the switches 43—44 and 52—53 and disconnecting the operator's set from the cord circuit, thus excluding the operator from the talking circuit and insuring a secret communication between the subscribers, as far as the operator is concerned.

Assuming that the bell D₁ responds to the current produced by the ringer R, the operator depresses the key U, completing a circuit, as follows: ground at 75—contact 76—contact 77—relay T—conductor 78—switch 79—80—conductor 81—switch 82—83—conductor 84—switch 85—86—conductor 87—201—relay W—battery 15''—to ground 90. The relay T will be energized attracting an armature 91 and closing the switch 91—92 and completing a locking circuit for the relays T and W from ground 93—91—92—T—78—79—80—81—82—83—84—85—86—87—201—W—battery 15''—ground 90. The relay T also attracted an armature 94, closing a switch 94—95 for a purpose to be described. The relay W when energized over this circuit attracted its armatures 96—97—68 and 98. The attraction of the armatures 96 and 97 interrupted the talking strands of the cord circuit at 96—100 and 97—101 and closed contacts in the ringing circuit at 96—102 and 97—103. The purpose of the attraction of the armatures 68 and 98 will be apparent from later description.

The ringing now takes place over the following circuit: 104—R—on and off at S—94—95—relay V and a shunt thereof in multiple—102—96—60—63—6—D₁—condenser 107—5—64—61—97—103—conductor 108—resistance 109—36—35—110—15' to ground at 34. This ringing will automatically continue at intervals determined by the commutator S, until the subscriber at F responds. The commutator S consists of two conducting segments 111 and 112, separated from each other by a thin piece of insulation 114. When the segment 111 engages the brush 115, the generator R is connected into the circuit described. When, however, the segment 112 is connected to the brush 115, a circuit is completed as above described, except that instead of the circuit including the generator R and the battery 15', the

battery 15' alone is including in the circuit mentioned. As soon as the subscriber at F responds by removing the receiver C₁ from the hook 120, a switch 120—121 is closed, completing a bridge of the conductors 5 and 6, which is of much lower resistance than the bridge including the ringer D₁. Current will then flow through the circuit described as a ringing circuit, no matter which of the segments 111 and 112 is in engagement with the brush 115, and this flow of current will now, owing to the low resistance bridge at the substation, be sufficient to energize the relay V, which was not energized during the ringing period because of the high resistance of the ringer D₁. The energization of the relay V causes the opening of the switch 82—83 in the circuits of the relays T and W, which release their armatures, returning this portion of the system to the position illustrated in the drawing.

During the ringing it was necessary to maintain the energization of the relay Q₁ so as to insure the secret listening service during this period, and to maintain the energization of the relay N₁ so as to insure the continuation of the line signal cut-off service. Inasmuch as the circuit of both the relays Q₁ and N₁ were interrupted at 68—69 when the relay W was energized as described, it is necessary to provide other means for maintaining the energization of these two relays during the ringing period. The attraction of the armature 98 by the relay W completed an alternate circuit for the relay Q₁, as follows: 34—15'—Q₁—70—130—98—conductor 10—32—31—25—28—relay N to ground 29. The relay N₁ is maintained energized during the ringing period over the following circuit: 66—N₁—65—62—68—131—132—133—134—135—15'—to ground at 34. The resistances 109 and 132 are interposed to prevent accidental short circuits or the throwing of dead battery upon the plug.

When the operator inserted the plug P into the jack J, a circuit was completed for the relay Z as follows: ground 140—winding 141 of the relay Z—end 142 of the conductor 3—47—48—23—26—1—substation set at A—2—27—28—50—49—51—150—winding 151 of relay Z—conductor 152—battery 15'—to ground 34, energizing the relay Z which attracts its armature 153 and closing the switch 153—154 and completing a shunt of the relay Y through the conductor 160 and preventing the energization of the relay Y as long as the subscriber A is upon the line. When the subscriber at F responded, a circuit was completed for the relay X as follows: 140—winding 170 of relay X—3—100—96—60—63—6—talking set at F—5—64—61—97—101—4—conductor 172—wind-

ing 173 of relay X—conductor 152—15'—battery 34. The relay X attracts the armatures 79 and 175, opening a switch 79—80 in the ringing circuit to insure the continued interruption of this circuit. The attraction of the armature 175 closes a switch 175—176, completing a shunt 177 of the relay Y and preventing the same being energized as long as the subscriber F is upon the line. The subscriber at A and F are now connected and conversation proceeds between them over the lines I, III, the talking strands of the cord circuit E and through the contacts of the plugs and jacks, the operator being excluded. At the termination of the conversation, each subscriber hangs up his receiver, the subscriber at A opening the switch 11—12 and the subscriber F opening the switch 120—121. The opening of the switch 11—12 will interrupt the circuit of the relay Z, which was previously described and in turn, the shunt 160 will be broken at 153 and 154. The relay Y will then be energized as follows: ground 180—Y—conductor 181—182—71—70—183—conductor 184—15'—to ground at 34. The relay Y will attract its armatures 31, 50 and 48, cutting off the cord circuit from the plug 47—48—, 49—50, and 31—32. A switch 48—200 will be closed, closing contacts in the circuit of the relay b, as follows: ground at 17—the now closed switch 18—19 which was closed when the circuit of the cut-off relay N was interrupted at 31—32—contact 26—23—48—200—204—relay b—135—battery 15'—to ground at 34. The relay b will be energized over this circuit, attracting its armature 134 and closing a circuit through the lamp a as follows: ground 210—a switch 211—134—conductor 135—battery 15', to ground at 34. Current over this circuit will light the lamp a indicating to the operator that the conversation is terminated. The relay b will also attract the armature 86, closing a switch 86—215 and completing a circuit for the relay W, as follows: ground 90—15'—W—201—87—86—215—181—relay Y—to ground 108, energizing the relay W and continuing the energization of the relay Y. The relay W attracts the armatures 96, 97, 68 and 98, interrupting the strands of the cord circuit at 96—100, 97—101 and 68—69, and interrupting the circuit of the cut-off relay N₁, so that the line circuit is restored to normal, leaving the lines free for other connections. As soon as the operator has noticed the disconnect signal and has had time to pull out the plugs from the jacks, the system will be restored to the condition illustrated in the drawing, for the withdrawal of the plug P from the jack J interrupts the circuit of the relay b at 23—26, and the interruption of the circuit of the relay b will cause the interruption of the circuit of the relays W

and Y at 85—86 and of the disconnect lamp 134—211.

Should another operator insert the plug of another cord into the jack J' or some other multiple jack of one of the lines, thereby causing the interruption of the circuit of the relay *b* at 18—19, the circuit of this relay will be maintained through the following portions of the other cord—the tip, the winding of the relay corresponding to the relay Z, to ground at 140.

It will be readily understood that any suitable form of signaling device and any suitable form of relays may be employed, and that other numerous and extensive departures may be made from the form and the details of the apparatus which I have illustrated, this form and these details having been shown merely for the purpose of describing the invention.

I claim:—

1. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station, switching means for connecting each end of the cord circuit to a telephone line, the substation apparatus including a signal device, means at the main station for operating the signaling device at the substation, apparatus for automatically disconnecting one of said switching means from the cord circuit when the subscriber upon the corresponding line retires, and single wound electromagnetic means controlling said apparatus and said means for operating the substation signal, said means being common to said apparatus and substation signal operating means.

2. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station for connecting telephone lines together, switching means for connecting each end of the cord to a telephone line, a signal at the substation, a ringing machine at the main station for supplying current to operate said signal, conductors for connecting said ringing machine to one of said switching means normally disconnected from said switching means, and a device controlling the connection of said conductors to said switching means where said switching means are normally disconnected from said conductors and for automatically disconnecting said switching means from the cord circuit when the subscribers interrupt the bridges of their talking sets.

3. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations and the main station, link conductors including talking strands at the main station for

connecting telephone lines together, means for automatically interrupting the talking strands when the subscribers at the substations retire their talking sets and a ringing key at the main station controlling said means.

4. In a telephone system, the combination of a plurality of substations, a main station, telephone lines connecting the main station and the substations, a cord circuit at the main station for connecting telephone lines together, including talking strands, automatic ringing mechanism at the main station normally disconnected from the telephone lines, a relay controlling the connection of the automatic ringing mechanism to the called line at the place where such mechanism is normally disconnected and a circuit for said relay controlled by the subscriber's talking set to automatically interrupt the talking strands of the cord circuit when said set is restored to normal.

5. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station adapted to connect telephone lines together, switching means for connecting the cord to the telephone lines, a signal at each substation, ringing mechanism at the main station for actuating the signal at a substation, a relay at the main station adapted when energized to connect the ringing mechanism to the called line, a circuit for said relay, a ringing key controlling said circuit, said relay controlling the continuity of the cord circuit, a second circuit for said relay and a switch acting to close said second circuit when the subscriber retires.

6. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station adapted to connect telephone lines together, switching means for connecting the cord to the telephone lines, a signal at each substation, ringing mechanism at the main station for actuating the signal at a substation, a relay at the main station adapted when energized to connect the ringing mechanism to the called line, a circuit for said relay, a ringing key controlling said circuit, said relay controlling the continuity of the cord circuit, and a subscriber controlled relay controlling said second circuit, said subscriber controlled relay causing the actuation of the first named relay to interrupt the continuity of the cord circuit when the subscriber retires.

7. In a telephone system, the combination of a main station, substations, telephone lines connecting the substations to the main station, a cord circuit at the main station connecting said telephone lines together, a

relay controlling the continuity of the cord circuit, a circuit for said relay, apparatus controlling said circuit governed by the talking set of a substation and adapted to cause the energization of said relay when the substation set is retired, whereby the continuity of the cord circuit is automatically interrupted when the talking set is retired, a signal at the substation, apparatus at the main station for supplying current to operate said signal, means for connecting said apparatus to the called line controlled by said relay, a second circuit for said relay and controlling means for said apparatus controlling the second circuit of said relay.

8. In a telephone system, the combination of a main station, a plurality of substations, telephone lines connecting the substations to the main station, a cord circuit at the main station, means for automatically interrupting the continuity of the cord circuit when the substation apparatus is restored to normal, including a single wound magnet, a signal at the substation, ringing mechanism at the main station for operating said signal and means controlled by said magnet for connecting said ringing mechanism to the called line.

9. In a telephone system, the combination of a telephone line, a subscriber's substation on said line, link conductors for connecting telephone lines together, switching apparatus for connecting said conductors to a line, ringing mechanism adapted to be connected through said apparatus to a telephone line, a relay adapted to be operated to connect said mechanism to a telephone line, means to cause the relay to operate a second time when the called subscriber responds to disconnect said mechanism, and devices to cause a third operation of said relay when the subscriber retires to disconnect said switching apparatus from said link conductors.

10. In a telephone system, the combination of a called telephone line, substation apparatus thereon, a calling telephone line, substation apparatus thereon, a main station, a cord circuit at the main station, answering switching mechanism for connecting the cord circuit to the calling line, calling switching mechanism for connecting the cord circuit to the called line, an operator's set at the main station, means for connecting the operator's set to the cord circuit, means for automatically disconnecting the operator's set from the cord circuit after a connection is completed, said latter means controlled by the calling switching mechanism and means for transferring the control of said automatic disconnect means to the answering switching mechanism.

11. In a telephone system, the combination of a main station, a calling telephone

line, a substation set on said line, a called telephone line, a substation set on said line, a main station, link conductors at the main station, calling switching mechanism for connecting the link conductors to the called line, answering switching mechanism for connecting the link conductors to the calling line, an operator's set, means to connect the operator's set to the link conductors and means for automatically disconnecting the operator's set from the link conductors when a connection is completed, including a circuit comprising contacts in the calling switching mechanism, and a second circuit for said automatic disconnect means comprising contacts in the answering switching mechanism, ringing devices and a relay controlling said ringing devices and said circuits.

12. In a telephone system, the combination of a telephone line, substation apparatus on said line, cut-off mechanism associated with said line, a main station, a cord circuit at said main station for connecting telephone lines together, a signal at the substation, ringing apparatus for operating said signal, a circuit for said cut-off mechanism, means controlling the connection of the ringing apparatus to the telephone line adapted when operated to interrupt the circuit of the cut-off mechanism and a second circuit for the cut-off mechanism established when the first circuit is interrupted.

13. In a telephone system, the combination of a cord circuit having three strands, a cut-off relay and a ringing relay controlling all three strands and adapted when operated to interrupt the three strands, and means controlled by said ringing relay for maintaining the operation of the cut-off relay while said ringing relay is actuated.

14. In a telephone system, the combination of a main station, telephone lines leading from substations to said main station, a cord circuit at the main station including normally closed talking strands, automatic ringing mechanism at the main station, a relay including contacts in said talking strands, a circuit for the magnet of the relay adapted to be closed to cause the energization of such magnet to open said talking strands and connect said mechanism to a telephone line and means controlled by apparatus at a substation to energize said magnet to interrupt said talking strands when the subscriber thereat retires.

15. In a telephone system, the combination of a main station, telephone lines leading to said main station, a substation on each line, a cord circuit at the main station for connecting telephone lines together, including talking strands, automatic ringing mechanism at the main station, a relay including contacts in said talking strands

adapted when energized to connect the automatic ringing mechanism to a called line, and a circuit for said relay controlled by the subscribers set to cause the actuation of
5 said relay to interrupt the talking strands of the cord circuit when said set is restored to normal.

In witness whereof, I have signed my name in the presence of two witnesses this 6th day of August, 1914.

FRANK M. SLOUGH.

Witnesses:

GEO. E. ROBERTS,
JOHN PEHRSSON.