

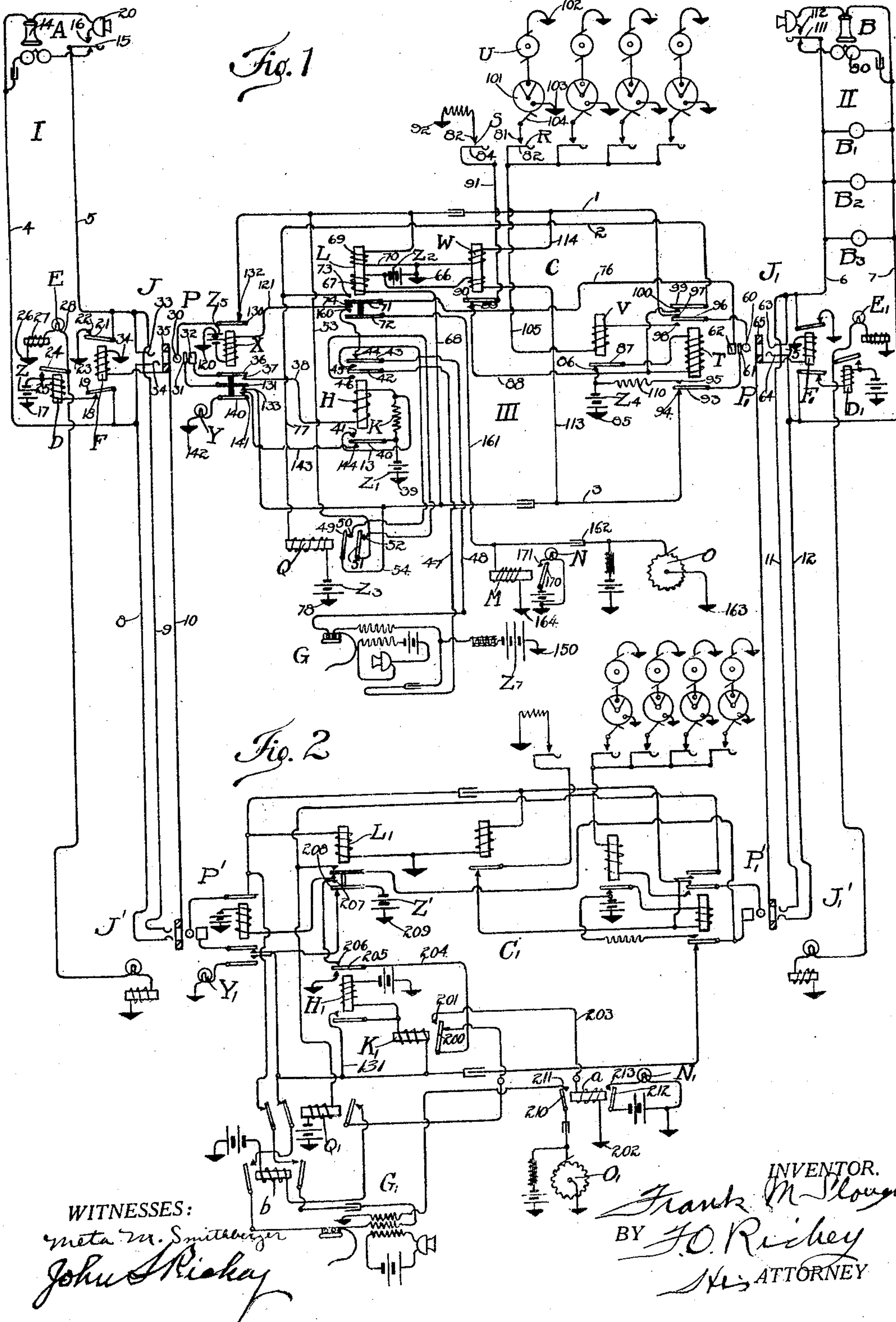
F. M. SLOUGH.
TELEPHONE SYSTEM.

APPLICATION FILED OCT. 14, 1914. RENEWED MAY 25, 1921.

1,407,892.

Patented Feb. 28, 1922.

2 SHEETS—SHEET 1.



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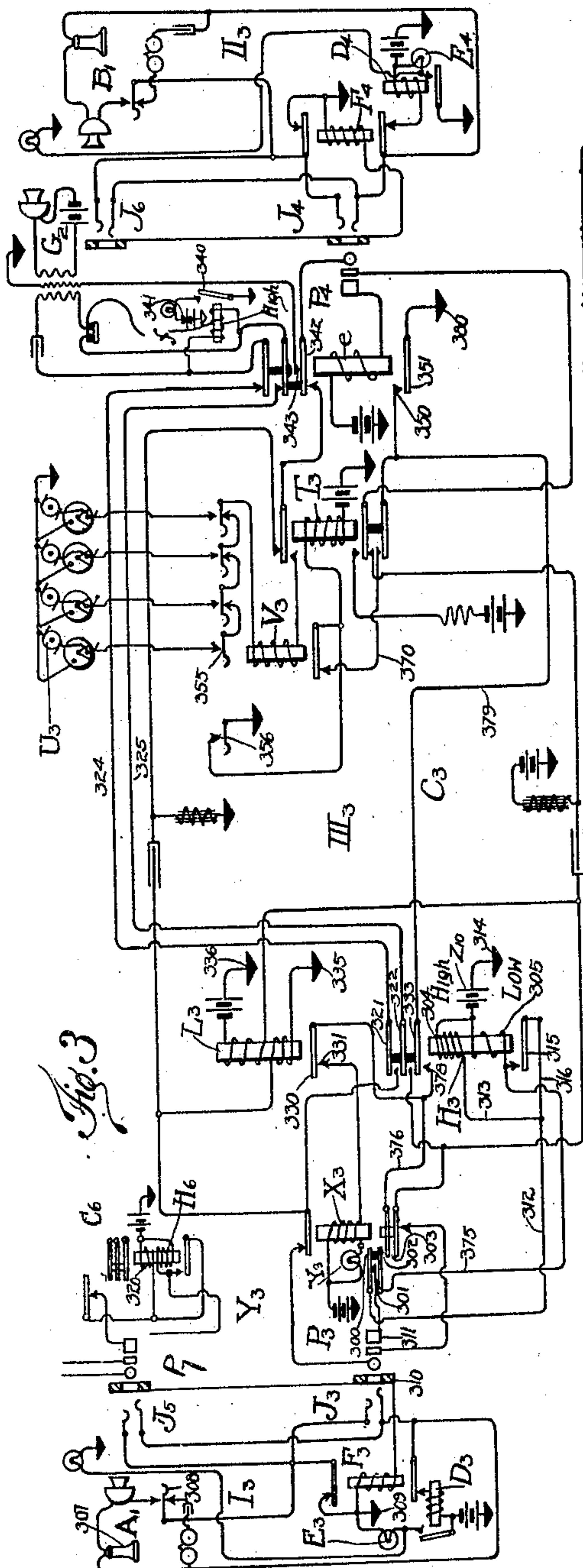


Fig. 3

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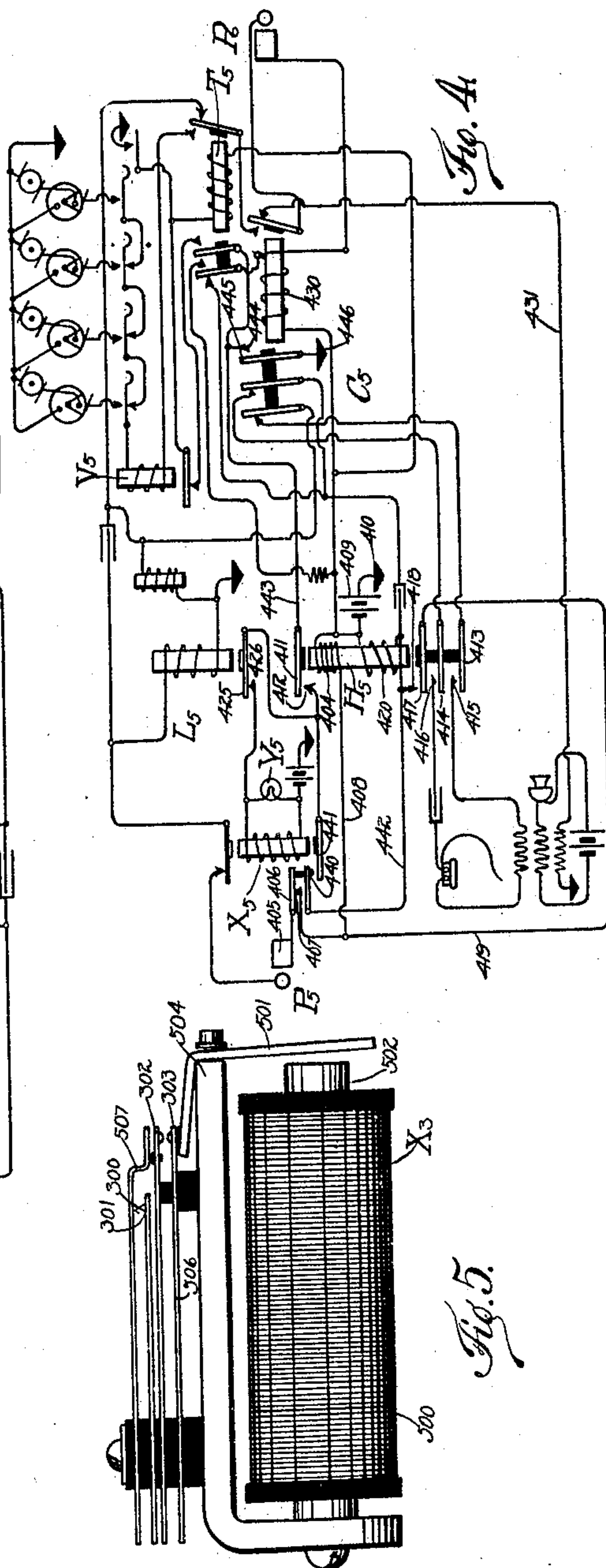


Fig. 4

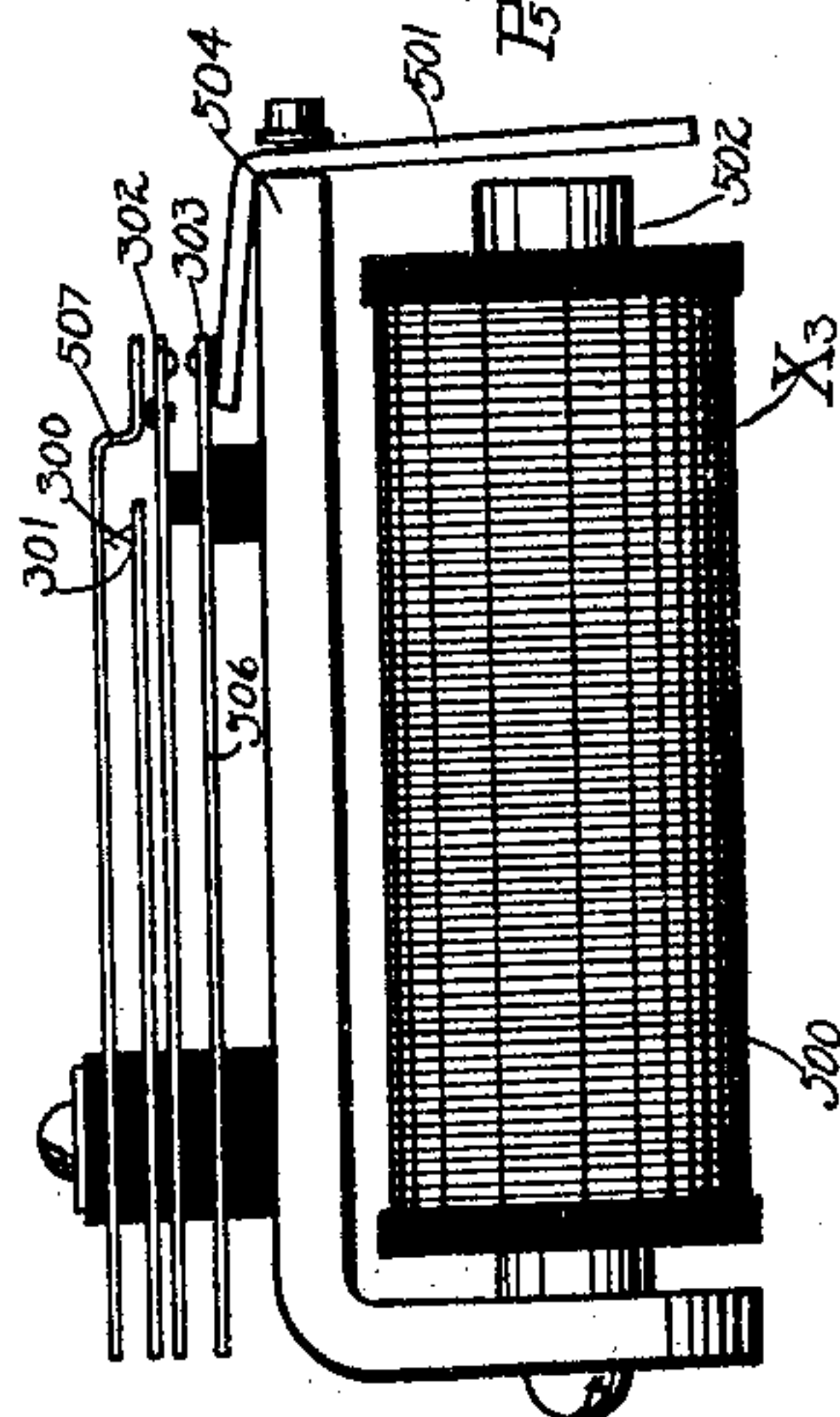


Fig. 5

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TELEPHONE SYSTEM.

1,407,892.

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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 systems in which an associate multiple is employed—that is, an improved system in which the call of a subscriber is indicated at a plurality of positions or before a plurality of operators, and may be answered by any operator, one of the objects of my invention being to provide means to indicate to operators who answer a call the fact that it has already been answered, when that is the fact. I aim to indicate this in a suitable and adequate manner, and to combine this feature with other desirable features in such a way, as to enable the apparatus to be installed without prohibitive complications or expense.

Another object of my invention is to prevent the operator from being connected to a line whose incoming call has already been answered by another operator. I aim to do this in a convenient and efficient way and by such a combination of apparatus as to meet all operating conditions, such as lines of various resistance, capacity, etc.

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

In Fig. 1 I have illustrated connecting links showing one embodiment of my invention.

Fig. 2 illustrates a second embodiment of my invention.

Fig. 3 illustrates a third embodiment of my invention.

Fig. 4 illustrates a fourth embodiment of my invention.

Fig. 5 illustrates in detail a relay employed in the embodiment of my invention illustrated in Fig. 3.

Referring first to the embodiment illustrated in Fig. 1, at I is illustrated a telephone line, here known as the calling line and which leads from a substation A to a main station at III. At II is shown a second telephone line, which leads from a plurality of substations, B, B₁, B₂ and B₃ to the main station at III. Suitable means are provided at the main station for connecting the telephone lines together, here illustrated as link conductors 1, 2 and 3, which may be in the form of a cord circuit C. Suitable switching means are provided for connecting the link conductors to the telephone lines, here shown as a jack J connected with the conductors 4 and 5 of the line I and a plug P connected to what is known as the answering end of the cord circuit. The switching means for connecting the cord to the line II consists of a jack J₁ connected to the line conductors 6 and 7 of the line II and a plug P₁ in the calling end of the cord circuit. Multiple jacks of the lines are shown at J' and J'₁.

The cord circuit of Fig. 2 is shown at C₁ and terminates in plugs P' and P'₁. The jacks J and J' are connected by multiple conductors 8, 9 and 10 and the jacks J₁ and J'₁ are connected by multiple conductors 11 and 12. The line I is provided with suitable line signaling apparatus shown as a line relay D, a line lamp E and with cut-off mechanism including the cut-off relay F.

The line II is provided with line signal apparatus including the line relay D₁, line lamp E₁ and with cut-off mechanism including the cut-off relay F₁. An operator's set is provided at station III adapted to be connected to the cord circuit C, illustrated at G, and another operator's set adapted to be connected at the cord circuit C₁, shown at G₁. The cord circuits C and C₁ are at different positions and employed by different operators.

When the plug P is inserted into the jack J, the relays F and H will be operated over a circuit including a resistance K, provided no other cord is connected to a multiple jack of the line I. If, however, a cord such as the cord C₁ is connected to a multiple jack of the line I, the relay H₁ thereof will have been operated and a shunt 131 will have been

closed about the resistance K_1 , completing a low resistance circuit which will be much lower than the circuit of the cord C including the resistance K , so that the relay H of the cord circuit C will not be operated. With a party on the line I, the relay L will be operated when the plug P is inserted into the jack J, whether another cord is connected to the line or not, and a circuit will be completed through a relay M which will cause the illumination of a lamp N, and signal the operator to indicate to her that the call has already been answered. The operation of the relay L will also complete a circuit from a special tone device O through the operator's set G, also indicating to her that the call has already been answered. If the cord C is the first to be connected to the line I, the relay H will be operated, the shunt 13 completed, the operator's set G will be connected to the cord and the operator will learn what station is desired. The plug P_1 will then be inserted into the jack J_1 and the relay Q operated to disconnect the operator from the cord. The operator will then depress the ringing key E and the master key S, both of which will lock down. The ringing relay T will be operated, interrupting the cord, connecting on the ringing generator U and completing an alternate circuit for the relay Q. The ringing will take place until the subscriber responds, when the relays V and W will be operated, interrupting the ringing, completing the cord and restoring the original circuit of the relay Q. When the conversation is completed, the relay X will be operated, disconnecting the plug P from the cord, interrupting the circuit of the relay H and causing the operation of the signal Y, which indicates to the operator that the conversation is completed.

Perhaps my system and its functions will be better understood from a detailed description of the operation, which is as follows: Assuming first that the subscriber at A desires to communicate with the subscriber at B, the receiver 14 is removed from the switch hook 15, which being spring pressed upward, will rise and engage the contact 16, completing a circuit through the relay D, as follows: ground at 17—battery Z—relay D—switch 18—19—conductor 4—receiver 14—transmitter 20—contacts 16—15—conductor 5—contacts 21—22 to ground at 23. The relay D will be energized, attracting its armature 24 and closing a switch 24—25, completing a circuit through the line lamp E, as follows: 26—resistance coil 27—E—28—24—25—Z—17. The same arrangement of line signal and lamp will be provided at various positions, and the first operator available will insert a plug into the jack.

Assuming the operator controlling the cord C is the first to observe the call, the

plug P of the cord C is inserted into the jack J, the tip contact 30, sleeve contact 31 and ring contact 32, engaging respectively with the tip spring 33, sleeve spring 34 and thimble 35 of the jack. A circuit will be completed through the relays F and H as follows: ground at 34, relay F—contacts 35 and 32—switch 36—37—conductor 38—relay H—resistance K—battery Z_1 and ground 39. If no other cord has been connected to the line, the current flowing through this circuit will be sufficient to operate the relays F and H. The relay F will attract its armatures 19 and 21, cutting off the line relay D and line lamp E from the line at 21—22 and 18—19, the relay H will attract its armature 40 closing a switch 40—41 in a shunt 13 about the resistance device K, thereby, as will be explained, preventing any other operator from coming in to answer the call. The relay H will also attract its armatures 42 and 43, opening a switch 43—44 and closing switches 43—45 and 42—46. The closing of the last two switches will connect the operator's set at G to the cord circuit through the conductors 47—48, the switches named, switches 49—50 and 51—52 and conductors 53—54. The operator now communicates with the subscriber at A, learning that it is the subscriber at B that is desired. The line II is tested in the usual manner, and having been found idle, which we will assume, the plug P_1 is inserted into the jack J_1 , the tip contact 60, sleeve contact 61, and ring contact 62 engaging respectively with the tip spring 63, sleeve spring 64 and thimble 65 of the jack J_1 . When the connection was made with the line I, the relay L was operated over the following circuit: ground 66—battery Z_2 —winding 67—conductor 68—over the talking strands of the cord—conductors of the calling line—the substation set at A and the switching means J—P back through the coil 69 of relay L and to battery Z_2 over the conductor 70. This relay attracted the armatures 71 and 72 for purposes to be described. The insertion of the plug P_1 into the jack J_1 completed a circuit through the relays F_1 and Q as follows: ground 75— F_1 —65—62—76—71—73—77—Q—battery Z_3 —to ground 78. The relay F_1 cuts off the line relay D_1 and lamp E_1 , and the relay Q attracts the armatures 49 and 52 and disconnects the operator's set from the cord circuit.

Assuming that the signal 80 at the station B responds to the character of current produced by the generator U, the keys R and S are depressed, closing the switches 81—82 and 83—84. These keys lock down. A circuit is completed through the relay T as follows: ground 85—battery Z_4 —switch 86—87—T—conductor 88—switch 89—90—conductor 91—84—83—ground at 92. The

relay T thus energized, attracts its armature 93, breaking the sleeve strand of the cord at 93—94 and closing a switch 93—95 in the ringing circuit. The relay T attracts its armature 96, interrupting the tip strand of the cord 96—97 and closing a switch 97—98 in the ringing circuit. The relay T attracts the armature 99, closing a switch 99—100 and completing an alternate circuit for the relay Q to insure its operation during the ringing. This circuit is traced as follows: 78—Z₃—Q—77—conductor 2—99—100—88—89—90—91—84—83—92. The ringing now begins and continues at intervals determined by the commutator 101. The ringing circuit is traced as follows: during the ringing period from the ground 102—through U and the commutator 101 and during the silent period from the ground 103 to the commutator 101—in both cases to the spring 104—through the switch 81—82—conductor 105—relay V, which will not be actuated until the subscriber responds—98—96—60—63—6—80—7—64—61—93—95—resistance 110—Z₄—85. When the subscriber responds, the switch hook 111 will rise and engage the contact 112, substituting for the bell bridge a low resistance bridge, including the talking set. The flow of current over the circuit described, including the talking set at B, will now be sufficient to operate the relay V, which will attract its armature 87 and interrupt the circuit of the relay T at 86—87, restoring the switches controlled by the relay T to the position illustrated in Fig. 1, thereby restoring the cord circuit, taking off the ringing machine and restoring the circuit of relay Q through cut-off relay F₁.

When the subscriber responded, the relay W was also actuated over the conductors 113—114—the strands 1 and 3 of the cord circuit and the line conductors 6 and 7. This relay attracted its armature 90, further interrupting the circuit of the relay T at 89—90. Conversation now takes place with the operator excluded, and at the completion of the conversation, the subscribers hang up their receivers, whereupon the relays L and W will be de-energized. The deenergization of the relay L completes a circuit of the relay X, as follows: ground 120—battery Z₅—relay X—conductor 121—contacts 74—71—conductor 76—62—65—F₁—ground 75. The relay X attracts its armatures 130 and 131, interrupting the cord circuit at 130—132 and 131—133. The attraction of the armature 36 interrupts the circuit of the relays H and F at 36—37, restoring these relays and the switch controlled thereby to normal. The attraction of the armature 140 closes a switch 140—141 and completes a circuit through the lamp Y, as follows: 142—Y—140—141—143—144—40—battery Z₁—to

ground at 39. The illumination of the lamp Y indicates to the operator that the subscribers are through, so that she pulls out the plugs and restores the system to normal. By the operation of the relay X and the disconnection of the plug from the cord, the line at I is immediately released and its line signal restored to normal, so that the subscriber can at once send in a recall, which can be answered by the operator controlling the cord C, or the operator at another position. This line is also released for incoming calls during the period elapsing between the termination of the conversation and the withdrawal of the plug P from the jack J.

Assuming that in answer to the initial call of the subscriber at A some other operator plugged into a multiple jack of the line I before the operator controlling the cord C did so, in that case the shunt 13 at the other cord circuit will have been completed, so that all of the current will flow through this shunt and comparatively none through the relay H in the cord circuit C, owing to the presence of the resistance K therein. The relay L, however, will be actuated, completing a special tone circuit through the operator's set at G, as follows: ground 150—battery Z₇—operator's set at G—48—43—44—160—72—161—condenser 162—interrupter O—to ground at 163. This signal will indicate to the operator that she is too late, as the call has already been answered, whereupon she withdraws her plug P from the jack J. A visible signal will also be given to the operator, as a circuit will be completed for the relay M from ground 164—M—161—72—160—44—43—48—to ground at 150. The relay M will attract its armature 170, closing a switch 170—171 in the circuit of the lamp N, which will be energized. Observing either of these signals, the operator will withdraw the plug P from the jack J, allowing the other operator to complete the call without interference.

In the form shown in Fig. 2 a relay K₁ is employed in place of the resistance K illustrated in Fig. 1. If the operator controlling the cord circuit C₁ inserts the plug P' into the jack J', subsequent to the connection of some other cord to the line I, the current through the circuit including the relay K₁ will be insufficient to operate the relay H₁, but sufficient to operate the relay K₁, which will attract an armature 200 and close a switch 200—201, completing a circuit through the relay a as follows: ground 202—a—conductor 203—201—200—204—205—206—now closed contacts 207—208—battery Z'—ground 209—relay L₁ having been energized in the same manner as the relay L when the plug P' was inserted into the jack J'. The relay a will attract its armature 210, closing a switch 210—211 in a

circuit which includes a special tone device O_1 and the operator's set G_1 . The relay a will also attract the armature 212, closing a switch 212—213 in the circuit of the lamp N_1 , whereby the operator will receive both an audible and a visible signal. In this modification the relay Q_1 not only interrupts the circuit connecting the set G_1 to the cord, but interrupts the circuit of the relay b which controls the connection of the operator's set to the cord.

In the form shown in Fig. 2 the circuit of the disconnect lamp Y_1 is controlled by the relay L_1 instead of the relay H_1 .

In order to explain the functions and means to accomplish the same of the modification shown in Fig. 3, I will give a brief description of the operation. In order to complete a connection, the subscriber at A_1 removes the receiver 307 from the hook switch 308, which completes a circuit through the line relay D_3 and causes the operation of the line lamp E_3 , whereupon the operator at the station III_3 controlling the cord C_3 , will insert the plug P_3 into the jack J_3 , all of which will be understood from previous descriptions. A circuit will be completed through the cut-off relay F_3 and the high resistance winding 304 of the relay H_3 , as follows, assuming that the plug P_3 is the first to be inserted into a jack of the line I_3 to answer this particular call: ground at 309— F_3 —310—311—301—300—312—313—304—battery Z_{10} —ground 314. The relay H_3 will be energized, attracting its armature 315 and completing a shunt 316 about the high resistance winding 304. This shunt includes the low resistance winding 305, so that the relay will be maintained energized. If a second operator now inserts the plug of another cord into a multiple jack of the line A_1 , such as a plug P_7 of the cord circuit C_4 into jack J_5 , the relay H_6 , which corresponds to the relay H_3 will not be operated because the high resistance winding 320 thereof will be shunted by the low resistance winding 305 of H_3 . The relay H_3 will also attract armatures 321, 322 and 323, connecting the operator's set G_2 to the cord circuit through the conductors 324 and 325.

When the plug P_3 was inserted into the jack J_3 , the relay L_3 was operated over the cord and line circuit, whereupon the armature 330 will be attracted, opening a switch 330—331 in the circuit of the relay X_3 and lamp Y_3 . A relay f will also be energized over a circuit from ground at 335—the windings of relay L_3 —the portions of the cord—the conductors 324 and 325 and back to ground at 336. This relay will attract an armature 340 and cause the lighting of the lamp 341, which will indicate to the operator that she is the first to plug into a jack of the line I_3 . If, however, some other operator has preceded her, the relay H_3 not be-

ing energized, the circuit of the relay f will never be completed and the lamp 341 will never be lighted. Having learned that it is the subscriber at B_1 that is wanted, the operator tests the line through the contacts 342 and 343. Assuming that the line II_3 is idle, the plug P_4 is inserted into the jack J_4 , completing a circuit through the relay e and the called line cut-off relay F_4 . The relay e will interrupt the test circuit and cut the operator off from the cord circuit and will also close contacts 350, 351 in the circuit of the relay X_3 , which is now interrupted at 330—331. The springs 355, 356 are operated, closing the circuit of the relay T_3 , which interrupts the cord and puts on the automatic ringing apparatus, which will continue at intervals in the manner described, until the subscriber responds, when it will be interrupted by the actuation of the relay V_3 . The locking circuit 370 of the relay T_3 will be interrupted and the talking connections will be completed. At the termination of the conversation, the subscribers restore the substation sets to the condition shown in the drawing, which interrupts the circuit of the relay L_3 , thereby causing the completion of the circuit of the relay X_3 and lamp Y_3 at the switch 330—331. The relay X_3 will interrupt the strands of the cord circuit and the circuit of the cut-off relay F_3 and relay H_3 . An alternative circuit for the relay H_3 was, however, made before the circuit through the contacts 300 and 301 was interrupted. This circuit is as follows: ground at 314— Z_{10} —low resistance winding 305—conductor 375—302—303—376—378—333—379—350—351—to ground at 380. The illumination of the lamp Y_3 gives the disconnect signal and the operator withdraws the plugs, interrupting the circuit of the relay e , which will let go the armature 351 and interrupt the circuit of the low resistance winding 305 of the relay H_3 , whereupon the apparatus will be restored to normal.

Likewise a brief description of the operation of the embodiment shown in Fig. 4 will apparently be sufficient to describe the purposes of the apparatus. When the plug P_5 is inserted, a circuit will be completed for the high resistance winding 404 of the relay H_5 from the contact 405—through the switch 406—407 of the relay X_5 —conductor 408—winding 404—battery 409—to ground 410. The relay will attract an armature 411, closing a switch 411—412 in the circuit of the relay X_5 . It will also attract its armatures 413 and 414, closing switches 413—415 and 414—416 and connect the operator's set to the cord circuit. It will also attract an armature 417, closing a switch 417—418 and completing a shunt 419 about the winding 404. This shunt includes a low resistance winding 420 of the relay H_5 , which will maintain the energization of the relay. If now

the plug of a second cord is inserted into the multiple jack of the line to which the cord C_5 is connected the high resistance winding 404 thereof will be shunted by the low resistance winding 420 of the cord C_5 .

At the time the plug P_5 was inserted, the relay L_5 was operated, opening a switch 425—426 in the circuit of the relay X_5 . The plug P_6 is then inserted, energizing the relay 430 which disconnects the operator's set from the cord, closes contacts in the circuit of the relay X_5 , opens up the test circuit 431 and closes contacts in the cord. The operator then depresses the ringing key which energizes the relay T_5 and connects the ringing machine onto the cord circuit. At the response of the called subscriber, the relay V_5 will be energized and the ringing apparatus disconnected from the cord. When the calling subscriber hangs up, the relay L_5 will be de-energized and the circuit of the relay X_5 will be completed. Likewise the lamp Y_5 will be lighted. The relay X_5 will disconnect the plug P_5 from the cord and will interrupt the circuit of the winding 420 of the relay H_5 at 406—407. This interruption, however, will not occur until after the closing of a switch 440—441 by the attraction of the armature 441 by the relay X_5 . This will complete a second circuit for the winding 420 over the conductor 442—switch 440—441—412—411—conductor 443—switch 444—445—to ground 446. When the plug P_6 is withdrawn this circuit will be interrupted at 444—445 and in turn the circuit of the relay X_5 will be interrupted, so that the system will be restored to normal.

Fig. 5 illustrates a form of relay which may be employed to cause a make contact before a break. When the winding 500 is energized, the armature 501 is attracted towards the end of the core 502. This armature will rotate upon the edge of the return piece 504 and elevate the spring 506 which carries the contact 303. The contact 303 will engage the contact 302 and a subsequent movement of the armature will elevate the spring 507 and break the contacts 300, 301.

From the above description of the embodiments of my invention it will be apparent that my ideas may be incorporated in a number of different forms of apparatus, some of which I have illustrated simply for the purpose of describing the invention, and not that I desire to be limited to the form and details thereof, from which many departures may be made without departing from the spirit of the invention. It will also be seen that my invention contemplates novel features of construction and combinations and arrangements of the several parts of the improved system, whereby certain important advantages are attained by simple, inexpensive apparatus which performs the desired

functions, greatly speeding up the operation of a telephone system.

I claim:

1. In a telephone system, the combination of a main station, a plurality of telephone lines, one of which at least terminates at the main station in a plurality of terminals, a plurality of line connecting means at the main station, switching means for connecting each line connecting means to one of said line terminals, an operator's telephone set associated with each connecting means, conductors for connecting each set to its associate connecting means, contacts in said conductors, a plurality of similar relays one associated with each connecting means and each controlling contacts in the conductors connecting its associate operator's set with its associate connecting means, a circuit for each relay, a resistance in each relay circuit, a shunt about each resistance controlled by its associate relay, each relay when energized connecting its associate set to its associate connecting means and completing its associate shunt about the other similar relays and preventing the energization of the same.

2. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits, switching means to connect each cord circuit to a line terminal, an operator's set associated with each cord circuit, a plurality of similar relays, one of which is associated with each cord circuit, each relay controlling the connection of its associate operator's set with the cord circuit, a resistance connected with each relay and a shunt about each resistance controlled by the relay, means to connect said relays in parallel branches of a circuit, all of said relays except one being inoperative when one of said shunts has been completed.

3. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits, switching means to connect the answering end of each cord circuit to a line terminal, an operator's set associated with each cord circuit, a plurality of similar devices, one of which is associated with each cord circuit, each device controlling the connection of its associate operator's set with the cord circuit, current resisting apparatus connected with each device and shunts for disassociating said current resisting apparatus from said devices and mechanism to connect said devices in parallel branches of a circuit, all of said devices except one being inoperative when one of said shunts has been completed.

4. In a telephone system, the combination

of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cords at the main station, switching mechanism including a plurality of line terminal contacts and a plurality of cord terminal contacts, an operator's set associated with each cord, means to connect the answering end of each cord to a line terminal, and means controlled through a plurality of line terminal contacts to give a distinctive signal to an operator undertaking to connect the answering end of a cord with a line to which another cord is already connected.

5. In a telephone system, the combination of a main station, a plurality of telephone lines leading to the main station and terminating thereat in a plurality of terminals, a plurality of cord circuits at the main station each provided with an answering terminal, means to connect each cord circuit through its answering terminal to a line terminal, an operator's set associated with each cord circuit, means to connect said operator's set to the cord circuit and means controlled by substation apparatus to prevent the connection of an operator's set to a cord circuit and to give the operator a distinctive signal when she undertakes to connect her cord through its answering terminal with a line to which a cord circuit is already connected.

6. In a telephone system, the combination of a telephone line having a plurality of terminals, a main station at which said terminals are located, a plurality of cord circuits at the main station, means to connect each cord circuit to a terminal of said telephone line, an operator's set associated with each cord circuit, means to connect the operator's set to the cord circuit, a distinctive visible signal, a distinctive audible signal and means operating to give said operator said signals and prevent the connection of her set to the cord when she undertakes to connect said cord to a telephone line to which a cord has already been connected.

7. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of sets of link conductors for connecting telephone lines together, switching means to connect each set of link conductors to a line terminal, an operator's set associated with each set of link conductors, a plurality of similar devices, one of which is associated with each set of link conductors, each device controlling the connection of an operator's set with one of said sets of link conductors, a resistance connected with each device and means about each resistance controlled by a device and apparatus to connect said devices in parallel branches of a circuit, all of said devices ex-

cept one being inoperative when one of said last named means has been completed.

8. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits at the main station, an operator's set for each cord circuit, relays in the cord circuits controlling the connection of the operator's sets to the cord circuits, circuits for said relays including resistance devices and shunts of said resistance devices controlled by said relays.

9. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cord circuits at the main station, an operator's set for each cord circuit, relays in the cord circuits controlling the connection of the operators' sets to the cord circuits, circuits for said relays including resistance devices and normally open shunts of said resistance devices controlled by said relays.

10. In a telephone system, the combination of a plurality of cord circuits, a plurality of operators' sets, means to connect said sets to said cords including a plurality of relays, one for each set and cord, circuits for said relays, resistance devices independent of the relays, one in each circuit and a shunt of each resistance device controlled by the relay associated therewith.

11. In a telephone system, a plurality of sets of link conductors, an operator's set for each set of link conductors, a plurality of relays in multiple circuit, each relay controlling the connection of an operator's set to a set of link conductors, a resistance device independent of the relay in series with each relay and a shunt of each resistance device controlled by the relay associated therewith.

12. In a telephone system, the combination of a plurality of cord circuits, a plurality of operators' sets, one associated with each cord, a sleeve relay in each cord controlling the connection of the associate operator's set with the cord, means to connect said relays in multiple circuit, including a plurality of branches, a resistance device in each branch in series with one of said relays, and a shunt of each resistance device controlled by the relay associated therewith.

13. In a telephone system, the combination of a telephone line terminating at a main station in a plurality of terminals, a plurality of cord circuits at the main station, an operator's set associated with each cord, adapted to be connected to the talking strands of the cords, a relay associated with each cord controlling the connection of each set to its associate cord, a magnet in the circuit of each of said relays, a shunt of each

of said magnets controlled by such of said relays as is associated therewith and a distinctive signalling device controlled by one of said magnets for informing an operator when she has connected a cord associated with her set to a calling line to which another cord is connected.

14. In a telephone system, the combination of a plurality of sets of link conductors, an operator's set for each set of link conductors, each link conductor being provided with talking strands, a plurality of relays, (one associated with each link conductor), in multiple circuit, a circuit for each relay including a portion of a talking strand of its associate link conductors, each relay controlling the connection of an operator's set to a set of link conductors, a resistance device independent of the relay in series with each relay and a shunt of each resistance device controlled by the relay associated therewith.

15. In a telephone system, the combination of a main station, a plurality of telephone lines leading to the main station and terminating thereat in a plurality of terminals, a plurality of cord circuits at the main station, each provided with an answering terminal including a ring contact, means to connect each cord circuit through its answering terminal to a line terminal, said means including a ring contact, an operator's set and means controlled through said ring contacts to give a distinctive signal to an operator undertaking to connect the answering ends of a cord with a line to which another cord is already connected.

16. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of line terminals, a plurality of cords at the main station, an operator's set associated with each cord, means to connect the answering end of each cord to a line terminal and means to give a distinctive signal to an operator undertaking to completely connect the answering end of a cord with a line to which another cord is already connected.

17. In a telephone system, the combination of a main station, a telephone line terminating at the main station in a plurality of terminals, a plurality of cords at the main station, an operator's set associated with each cord, means to connect the answering end of each cord to a line terminal and means controlled by a telephone subscriber to give a distinctive signal to an operator undertaking to connect the answering end of the cord with a line to which another cord is already connected.

18. In a telephone system, the combination of a main station, a plurality of telephone lines leading to the main station and terminating thereat in a plurality of terminals, a plurality of link conductors at the main station, each provided with an answer-

ing terminal, means to connect each link conductor through its answering terminal to a line terminal, a supervisory relay in the link conductor, an operator's set associated with each cord circuit, means to connect said operator's set to a cord circuit and means including said supervisory relay to prevent the connection of an operator's set to a cord circuit and to give the operator a distinctive signal when she undertakes to connect her link conductor through its answering terminal with a line to which a link conductor is already connected.

19. In a telephone system, the combination of a calling telephone line with a substation set thereon, a plurality of operators' sets and means to connect each set to said line, means to prevent the contemporaneous connection of two of said sets to said line and apparatus controlled through a sleeve contact to give a distinctive signal to an operator undertaking to connect her set to said line while another operator's set is connected thereto.

20. In a telephone system, the combination of a telephone line having a plurality of terminals, a plurality of cord circuits, each provided with a plug adapted to co-operate with said line terminals, each cord having a tip and a second contact to the rear thereof, an operator's set for each cord, means to prevent the contemporaneous connection of two operators' sets to the same line and apparatus controlled through a second contact of a plug to the rear of the tip contact for giving a distinctive signal to an operator attempting to connect her cord to a line to which a cord is already connected.

21. In a telephone system, the combination of a calling telephone line, a sub-station telephone set thereon, a main station, a telephone switchboard at the main station comprising a plurality of operators' positions, an operator's telephone set for each position, means under the control of an operator to connect her set to the calling telephone line, means to disable the line connecting means of all except one of said operators' positions attempting to make connection with the said calling line, and visual signal apparatus controlled thereby to transmit a distinctive signal to the unsuccessful operators' positions.

22. In a telephone system, the combination of a calling telephone line, a substation telephone set thereon, a main station, a telephone switchboard at the main station comprising a plurality of operators' positions, an operator's telephone set for each position, means under the control of an operator to connect her set to the calling telephone line, means to disable the line connecting means of all except one of said operators' positions attempting to make connection with the said calling line, apparatus controlled thereby to transmit a distinctive signal to the unsuc-

cessful operators' positions, and a plurality of signals different in character at each operator's position and adapted to be operated under the control of said apparatus when
5 said line connecting means of the operator's position is made inoperative by apparatus of a previously connected operator's position line connecting means.

In witness whereof, I have signed my name in the presence of two witnesses this 10 12th day of October, 1914.

FRANK M. SLOUGH.

Witnesses:

F. O. RICHEY,
GEO. E. ROBERTS.