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F. M. SLOUGH

TELEPHONE SYSTEM

Original Filed Oct. 14, 1914

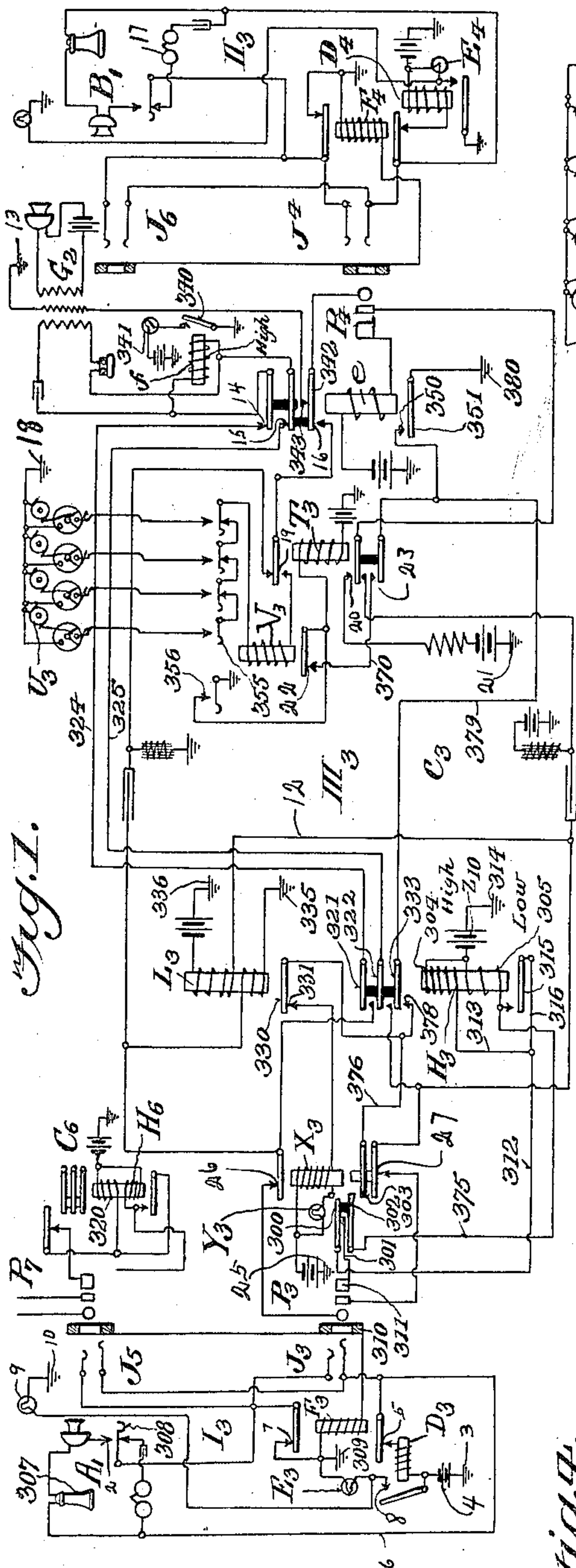


Fig. 1.

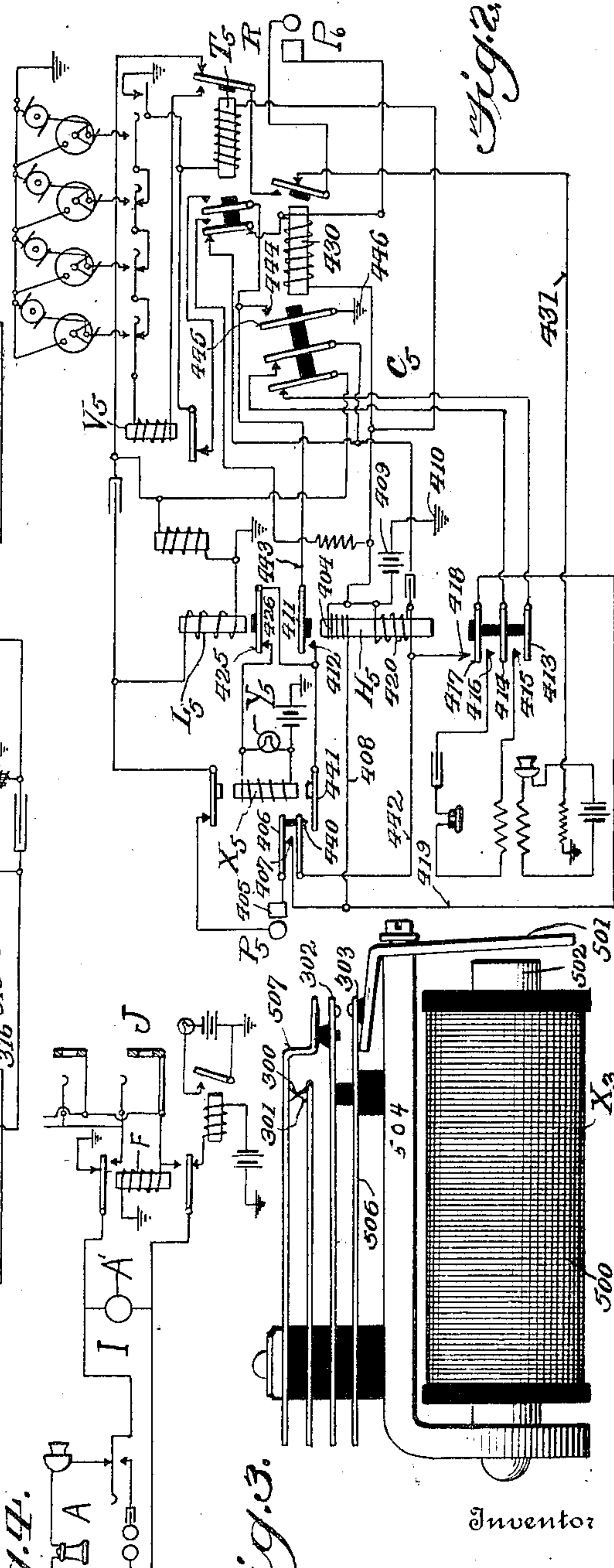


Fig. 2.

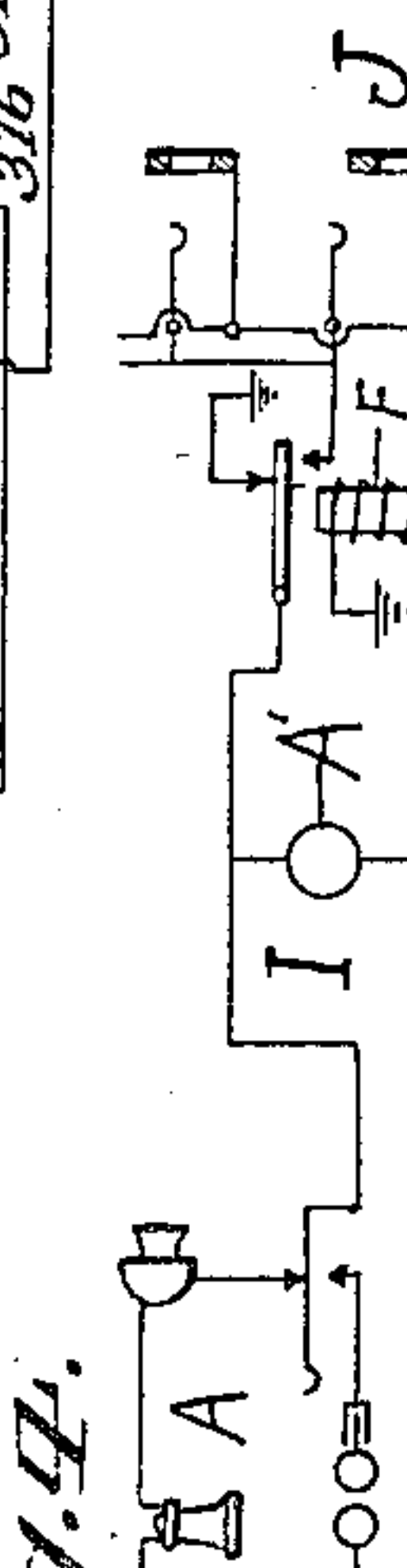
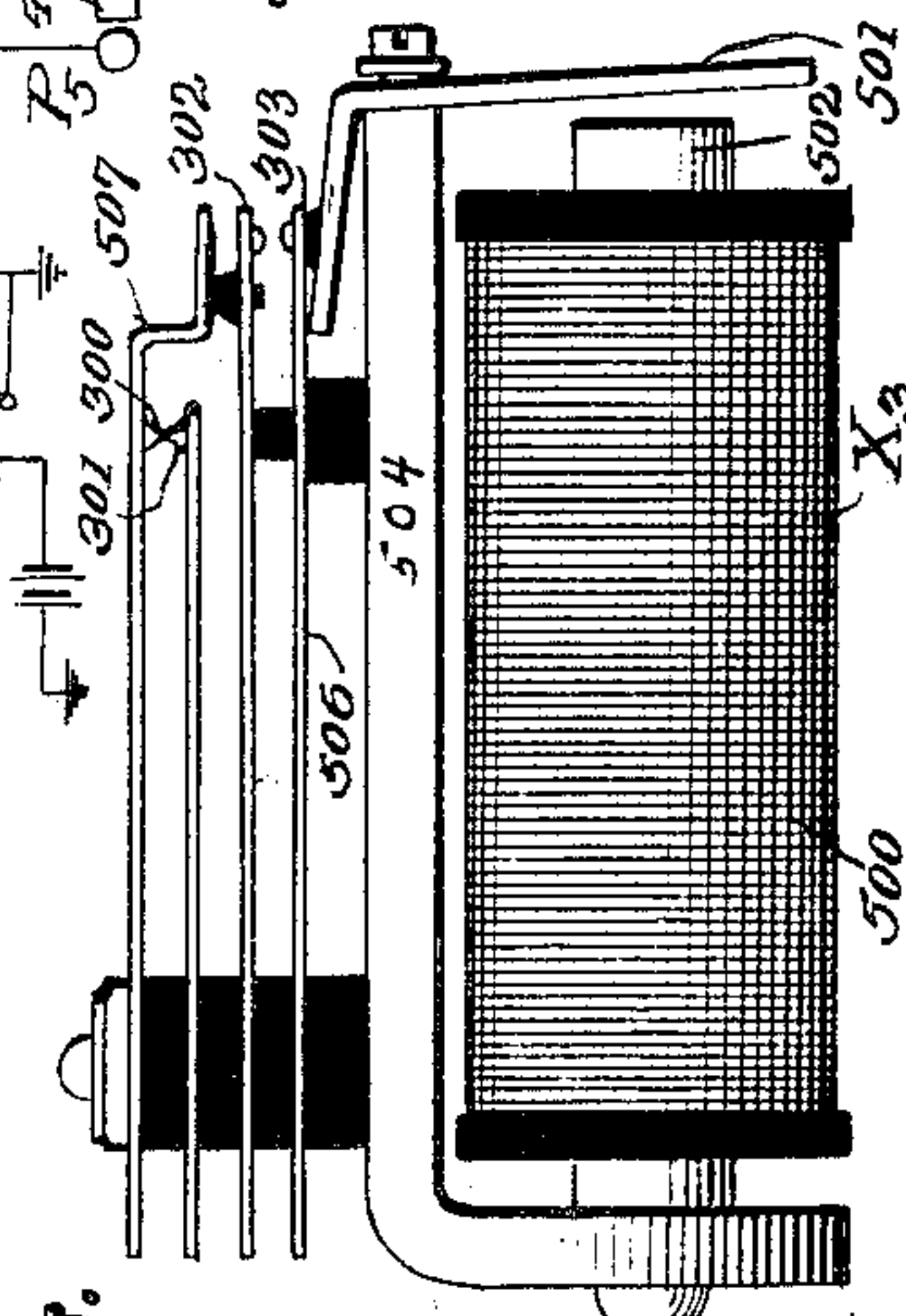


Fig. 3.

Fig. 4.

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Inventor

Frank M. Slough
J. O. Richey
His Attorney

UNITED STATES PATENT OFFICE.

FRANK M. SLOUGH, OF ROCHESTER, NEW YORK, ASSIGNOR TO THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, OF ROCHESTER, NEW YORK, A CORPORATION OF NEW YORK.

TELEPHONE SYSTEM.

Original application filed October 14, 1914, Serial No. 866,583. Patent No. 1,407,892, dated February 28, 1922. Divided and this application filed December 11, 1917. Serial No. 206,576.

To all whom it may concern:

Be it known that I, FRANK M. SLOUGH, a citizen of the United States, residing at Rochester, in the county of Monroe and State of New York, have invented certain new and useful Improvements in Telephone Systems; 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 is to provide improved means to indicate to operators who answer a call the condition of the line with respect to the previous connection of another line controlling mechanism to that line, or to its condition of disengagement from all other line mechanisms. I aim to indicate these conditions 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 provide improved means to prevent the operator from being connected to a line whose incoming call has already been answered by another operator. I aim also to accomplish these last functions by convenient and efficient means, and by such a combination of means as to meet all operating conditions, such as lines of various resistance, capacity, etc.

These and other objects of my invention, and the invention itself will be better understood from a description of embodiments thereof.

This application is a division of my Patent No. 1,407,892, patented February 28, 1922.

In Fig. 1 I have illustrated diagrammatically parts of a telephone system including two telephone lines and an interconnecting mechanism embodying my invention.

In Fig. 2 I have illustrated a telephone line connecting mechanism adapted to be employed in a system, and when so employed embodying my invention.

In Fig. 3 I have illustrated a particular form of relay adapted to be employed at X_3 in Fig. 1.

In Fig. 4 I have illustrated a form of telephone line adapted to be used in connection with the embodiment shown in Fig. 2.

It will be apparent that any suitable number and character of lines may be employed with the telephone line connecting mechanisms illustrated in Figs. 1 and 2.

Referring first briefly to the embodiment illustrated in Fig. 1, at I_3 is illustrated a telephone line, which may, for convenience, be spoken of as the calling line. The calling line leads to a main station, indicated by III_3 . At II_3 is shown a second telephone line, which leads from a substation B_1 to the main station III_3 . The line II_3 may be spoken of as the called line. While I have shown but a single station on each of the calling and called lines, it will be apparent that any suitable number of stations may be located upon these lines. In Fig. 4 I have shown two sub-stations upon the line.

Suitable telephone line interconnecting mechanisms are provided at the main station for connecting telephone lines together, and are here illustrated as link conductors C_3 and C_6 . A portion of the link conductor at C_6 only is shown, tho it will be readily understood by those skilled in the art what constitutes the remainder of this link conductor.

For convenience, I have shown manual cord circuits in Fig. 1. Suitable switching means are provided for connecting the link conductors to the telephone lines, here shown as jacks J_3 , J^4 , J_5 and J_6 and plugs P_3 , P_4 and P_7 . The jacks J_3 and J_5 are as-

sociated with the calling line, and the plug P_3 , which may be spoken of as the answering plug, is intended to co-operate with these jacks of the calling line. The jacks J^4 and J_6 are associated with the called line and the plug P_4 , which may be called the calling plug, is adapted to co-operate with these jacks. The structure and mode of operation and the results achieved by the embodiment shown in Fig. 1 will be understood by those skilled in the art thru a brief description of the operation of the apparatus shown in Fig. 1.

The subscriber at A_1 attracts the attention of the operator controlling the cord C_3 , thru the operation of the signal E_3 , in a well known manner. The plug P_3 is inserted into the jack J_3 , completing a circuit for the cut-off relay F_3 and the high resistance winding 304 of the relay H_3 . Both F_3 and H_3 will be operated, provided no other cord is connected to the line. If, however, another cord is connected to the line, the relay H_3 will not be operated, since a shunt will have been completed about the high resistance winding 304 in a manner which will be apparent from the description following.

The energization of relay H_3 completes a shunt 316 about the winding 304, including the low resistance 305, which maintains the energization of the relay H_3 , and which is so low as to prevent a supply of sufficient current to the high resistance winding 320 of a relay H_6 in a second cord C_6 , which might be connected to a multiple jack of the line L_3 by a second operator, in an effort to respond to the call of the subscriber thereon. The energization of H_3 connects the operator's set to the calling line and closes hitherto open contacts in the circuit of the relay X_3 , which is still open at the contacts of the relay e . In the meantime, the relay L_3 has been energized and a circuit is completed for the relay f , which causes the operation of the signal 341 to indicate to the operator that her set has been connected to the calling subscriber. The failure of the lamp 341 to light would indicate to the operator that some other operator had captured the call.

After learning the desire of the subscriber at A_1 , the operator connects with the called line, and assuming the same is idle, places the automatic ringing apparatus in operation, and upon the response of the called subscriber, such apparatus is disconnected and the two subscribers placed in telephonic communication. Upon the retirement of the subscribers, the relay L_3 will be de-energized and the relay X_3 energized, disconnecting the plug P_3 from the cord circuit. At the same time the signal Y_3 will be operated.

A circuit will also have been completed for the low resistance winding 305 of the

relay H_3 , which circuit includes the contacts 302 and 303 of the relay X_3 and is independent of the switch P_3-J_3 . When the plug P_4 is withdrawn from the jack J^4 , the relays X_3 and H_3 will be de-energized, and the whole system restored to normal.

A detailed description of the embodiment of the apparatus illustrated in Fig. 1 is as follows: To secure a connection with the subscriber at B_1 , the subscriber at A_1 removes the receiver 307 from the hook switch 308, which rises and engages the contact 2, completing a circuit thru the relay D_3 , as follows: ground 3, battery 4—relay D_3 —switch 5—line conductor 6—telephone set at A_1 —switch at 2—switch at 7 to ground at 309. The relay D_3 will be energized, closing the switch 8 and completing a circuit thru the lamps E_3 and 9 as follows: 3—4—8—and E_3 and 9 to ground 309 and 10 respectively. The lamp will be lighted, and being at different operator's positions, will indicate to the different operators that the subscriber at I_3 desires a connection. One of the operators will respond to this connection. Assuming that the operator controlling the cord C_3 is the first to respond, by inserting plug P_3 into jack J_3 , circuits will be completed for the relays F_3 , H_3 and L_3 , as follows: ground 309— F_3 —310—311—301—312, 313—the high resistance winding 304 of the relay H_3 —battery Z_{10} to ground 314. The relay F_3 opens the switches 5 and 7, disconnecting the line relay and lamps from the line A_1 and causing the extinguishing of the lamps. The relay H_3 closes a switch 315 and completes a shunt 316 about the high resistance winding 304, and circuit thru a low resistance winding 305. The circuit thru 305 is as follows: ground 314— Z_{10} —305—315—316—312—301—311—310— F_3 —to ground 309. Practically all of the current now flows thru 305 and energizes the relay H_3 sufficiently to hold down the already attracted armatures. The relay H_3 also closed switches 321, 322 and 333. The closing of the switches 321 and 322 connected the operator's set G_3 to the subscriber at A_1 , placing them in communication over the following circuit: beginning at 307 at A_1 —one side of 307—6—the sleeve spring of the jack J_3 and the sleeve contact of the plug P_3 —switch 322—conductor 225—thru the operator's setback over the conductor 324—thru the switch 321—thru the plug P_3 and jack J_3 —switch 2 and back to 307. The operation of the switch 333 closed contacts hitherto open in the circuit of the magnet of X_3 , which will be completed later, as later described.

The energization of the magnet of L_3 opens the switch 330 in the circuit of X_3 . During these operations, a circuit was com-

pleted for the magnet f (adjacent the operator's set G_2) as follows: ground 335—the lower winding of the magnet L_3 —a portion of the answering end of the tip talking strand of the cord circuit—switch 321—conductor 324—thru f —back over conductor 325—switch 322—a portion of the cord circuit—the conductor 12—the upper winding of the magnet L_3 —battery back to ground 336. The magnet f will close the switch 340 and complete a circuit thru the lamp 341, causing the energization of the same and indicating to the operator at G_2 that she has captured the call.

If now a second operator, such as for example, the one controlling the cord, a portion of which is indicated at C_6 , were to undertake to connect her set with the line A_1 , the low resistance winding 305 would shunt so much current from the high resistance winding 320 of the relay H_6 as to prevent the operation of such relay, and such connection; or, if, on the other hand, the operator controlling the cord C_6 had answered the call of the subscriber at A_1 and connected her cord to the calling line before the connection of the cord C_3 thereto, the relay H_3 would never have been energized, because of the low resistance shunt thru the lower winding of the relay H_6 , preventing the operation of the relay H_3 in the manner described. Of course, the magnet f would never have been energized, since its circuit is not completed until after relay H_3 is energized. The signal 341 would never have been lighted, and the operator would have been apprised, by the failure of 341 to light, of the fact that some other operator had captured the call, whereupon she would immediately withdraw her plug and proceed otherwise.

Assuming, however, that the operator controlling the cord C_3 had captured the call and had learned that it was the subscriber at B_1 that was desired, the operator seeks out a jack of the line II_3 and tests the same by applying to the terminal of a jack of such line the tip of the plug P_4 . The test circuit will be traced thru the switch 342 to ground at 13. I have shown this particular form of test circuit, tho any suitable form may be employed.

If the line II_3 were busy, the operator would so report to the subscriber at A_1 , but if II_3 were idle, the plug P_4 would be inserted into the jack J^4 . A circuit would be completed for the magnets of the relay e and F_4 in a manner which will be understood from the previous description, F_4 operating as F_3 disconnects the line relay and signals from the line. The magnet e closes the switch 351—350 in the still open circuit of the magnet X_3 . The magnet e opens the switches 14 and 15 and disconnects the operator's set. The magnet e opens the switch

342—343 in the test circuit, and closes a switch 16 in the cord circuit.

The operator next depresses a ringing key for the purpose of causing the ringing of the bell 17 at the station B_1 . Assuming that the switch 355 controls the character of current desired, 355 will be closed, together with the master switch 356. The closing of 356 completes a circuit for the relay T_3 , which interrupts the talking strands of the cord circuit and completes the ringing circuit. The ringing takes place over the following circuit: from ground 18—thru ringing machine U_3 and associate interrupter 355— V_3 —19—16—over one side of the called line—bell 17—back over the other side of the called line—thru switch 20—to ground at 21. The character of current flowing thru the relay V_3 and the signal device 17 would not be sufficient to cause the actuation of the relay V_3 ; however, when the subscriber at B_1 responds, the character of this current would be modified in such a way as to cause the actuation of the relay V_3 , which will open the circuit of the relay T_3 , which will in turn interrupt the ringing circuit, disconnecting the ringing apparatus from the line and completing the cord circuit. The circuit of the relay T_3 thus interrupted, included a switch 22, a switch 23 and switch 350—351, and was completed at 23 by the magnet of T_3 .

The subscribers at B_1 and A_1 are now in communication. At the termination of the conversation, their receivers are restored to the hooks and the circuit of the relay L_3 is interrupted, de-energizing this relay, whereupon the switch 330 and 331 is closed, completing a circuit thru the magnet X_3 and lamp Y_3 as follows: ground 25—lamp Y_3 and magnet X_3 in parallel—331—330—378—333—379—351—to ground 380. The magnet X_3 disconnects the plug P_3 from the talking strand of the cord circuit by opening the switches 26 and 27. The magnet X_3 completes a second circuit for the low resistance winding 305 of the magnet H_3 , so as to maintain the same energized. This circuit is as follows: 314— Z_{10} —305—375—302—303—376—378—333—350—351—to ground 380. The operator observing the burning of the lamp Y_3 withdraws the plug P_4 from the lack J^4 , interrupting the circuit of the magnet e , which permits the opening of the switch 350—351, whereupon the apparatus is restored to the normal condition illustrated in the drawing.

In view of the above description of the embodiment shown in Fig. 1, it is believed that a brief description of the embodiment shown in Fig. 2 will suffice.

When the plug P_5 is inserted, say into a jack J of a calling line I upon which there are stations A and A^1 , a circuit will be completed for the magnets of the relays F and

the high resistance winding 404 of the relay H_5 as follows: from ground 410—battery 409—404—408—407—406—405—thru F to ground. Relay H_5 will attract its armature 411, closing a switch 411—412 in the circuit of the magnet X_5 . H_5 will also attract armatures 413 and 414, closing switches 413—415 and 414—416 and connecting the operator's set to the cord circuit. It will also attract armature 417, closing a switch 417—418 and completing a shunt 419 about the high resistance winding 404, which shunt includes the low resistance winding 420, which will maintain the energization of the relay and prevent the connection of a second operator to the line I by shunting the high resistance winding 404 of the cord of such operator.

At the time the cord was connected to the calling line, the magnet of L_5 was operated, opening a switch 425 and 426 in the circuit of the magnet X_5 . Next, the plug P_6 is connected to the jack of the called line, whereupon the magnet 430 will be operated. 430 disconnects the operator's set from the cord, closes contacts in the circuit of the magnet X_5 , opens the test circuit 431 and closes contacts in the cord circuit. The operator then depresses the ringing key, which operates the relay T_5 and connects the ringing machine on to 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, completing the circuit for the magnet X_5 and the signal Y_5 . The magnet 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 and 407. This interruption, however, will not occur until after the closure of the switch 440—441 by the attraction of the armature 441 by the magnet X_5 . This will complete a second circuit for the winding 420 over conductor 442—switch 440—441—switch 412—411—conductor 443—switch 444—445—to ground 446. When the plug P_6 is withdrawn, the circuit will be interrupted at 444—445 and the circuit of the magnet X_5 will be interrupted and the system restored to normal.

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 telephone line, a telephone line interconnecting mechanism including talking strands, two operator's sets, means to connect each set to said telephone line, apparatus to prevent the contemporaneous connection of said sets to said lines including a magnet double-wound with one relatively high and one relatively low resistance winding and a shunt of the high resistance winding controlled by said magnet, and a circuit for said magnet including a portion of one of said talking strands.

2. In a telephone system, the combination of means including a relay for preventing the contemporaneous connection of two operator's sets to a single telephone line, means for automatically interrupting the strands of the link conductors with which said relay is associated when the calling subscriber retires, a circuit for said relay including contacts of the link and line terminals, means for maintaining said relay energized after the operation of said disconnect means, said means comprising a source of current and a circuit, said circuit comprising contacts adapted to be closed when the said automatic interrupting means is operated, and comprising other contacts, said other contacts being normally open and adapted to be closed when the link circuit is connected to a called telephone line and responsive to disconnect therefrom to open the said circuit, a pair of windings for the said relay, one of the said windings being of relatively low resistance, a circuit for the last named winding comprising normally open contacts of the relay.

3. In a telephone system, the combination of means including a relay for preventing the contemporaneous connection of two operator's sets to a single telephone line, means for automatically interrupting the strands of the link conductors with which said relay is associated when the calling subscriber retires, a circuit for said relay including contacts of the cord and line terminals and means for maintaining said relay energized after the operation of said disconnect means, said relay having a pair of windings, and said relay being initially operated by current passing through a relatively high resistance one of said windings.

4. In a telephone system, the combination of means including a relay for preventing the contemporaneous connection of two operator's sets to a single telephone line, means for automatically interrupting the strands of the link conductors with which said re-

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lay is associated when the calling subscriber retires, a circuit for said relay including contacts of the cord and line terminals and means for maintaining said relay energized after the operation of said disconnect means, said relay having a pair of windings, said relay being initially operated by current passing through a relatively high resistance one of said windings, and contacts controlled by the operation of the relay to direct current through its other winding. 10

In witness whereof, I have hereunto signed my name this 3rd day of December, 1917.

FRANK M. SLOUGH.