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TELEPHONE SYSTEM.

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To all whom it may concern:

Be it known that we, FRED SCHOENWOLF and RICHARD I. UTTER, citizens of the United States of America, residents of Chicago and Oak Park, respectively, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems, of which the following is a specification.

Our invention relates to telephone systems and has to do more particularly with service meter apparatus associated with manual link circuits and has for its object the provision of a new and improved system of the above character.

One of the features of our invention is the provision of improved means for actuating a service meter, associated with an operator's position, once for each original call and for each recall. Another object of our invention is the provision of improved means for preventing conversation between a calling and a called subscriber until the operator has properly assessed toll against either the called or calling subscriber. A further object of our invention is the provision of supervisory means for signaling an operator when to assess toll and to notify her whether the answering and the calling terminals of the cord circuit are operatively associated so that conversation may be carried on between the calling and the called subscribers. These and other features of our invention will be more particularly pointed out in the specification and claims.

For a better understanding of our invention reference may be had to the accompanying drawing in which a calling substation A and a called substation B are shown, being of the well-known common battery type, terminating at the exchange in the line circuits L and L¹, respectively.

The line circuit L comprises a line relay LR, a cut-off relay CO, a line signal S, and the multiple jacks J. The substation B is similar to the substation A except that party line terminals B¹, B² and B³ are shown. The line circuit L¹ to the right of the drawing is similar to L, bearing the same reference characters but having the suffix prime added. Associated with the substation equipment A is a coin collecting device CC. This device may be of any of the well-known types of

pay stations in which is provided a plurality of coin chutes or slots of different sizes adapted to receive coins or tokens of different denominations. The mechanism is arranged in such a manner that when a coin is deposited in one of the coin chutes an audible signal is caused to be transmitted to the operator at the central office to notify her of the denomination of the coin deposited.

Coin collecting devices of this character are well-known in the art and therefore it is thought unnecessary to go into detail as to the construction of the same, as our invention is not to be limited to any one specific type of pay station for it is obvious that many different types of paystations may be used.

The operator's cord circuit C comprises the usual answering plug AP and the calling plug CP, the two plugs being connected by the heavily marked tip and sleeve conductors and having the condensers K and K¹ interposed. At the answering end of the cord circuit is provided a tip answering supervisory relay AT and a sleeve answering relay AS, the two relays controlling the answering supervisory lamp AL. A link disconnect relay LD is also provided so that a calling subscriber may recall as soon as his receiver has been replaced prior to the removal of the answering plug AP from the jack of his line. The replacing of the receiver energizes the relay LD thereby disassociating the subscriber's line circuit from the answering plug of the cord circuit so that the subsequent removal of the subscriber's receiver will again cause the line lamp S to glow to notify the operator that the subscriber wishes to recall.

A service meter circuit SM which is common to an operator's position is associated with the answering ends of the cord circuits, and comprises a meter relay MR controlled by the relays AS and AT, a locking relay LO which is energized upon the actuation of the relay MR and the meter magnet MM controlled by the locking relay LO. The meter magnet MM directly controls the counting mechanism of the meter registering device.

In connection with the calling end of the cord circuit C is provided a calling sleeve

supervisory relay CS, and a calling tip supervisory relay CT, the said relays controlling the supervisory lamp CL. Automatic party-line ringing is provided, controlled by a party-line ringing key RK together with the ringing control relay RD which is energized when the ringing key is fully actuated. The relay RD controls the circuit of a ringing interrupter relay RI, which is intermittently energized and deenergized through the medium of an interrupter I for connecting ringing current to the called line. Automatic listening and disconnect of the operator's telephone set O is also provided. The operator's set O which is common to a plurality of cord circuits, is adapted to be connected to the cord circuit C through contacts of the relay AS when connection is made with a calling line, and disconnected by the operation of the relay CS when connection is extended to a called line.

A two-way key is also provided including the recall and answering contacts RA, and link connecting contacts CK. The key is adapted when thrown in one direction to close the contacts RA and when thrown in the opposite direction to close the contacts CK. The operation of these two sets of contacts will be more fully described in the ensuing specification. A second operator's listening key LK is provided for connecting the operator's set O to the calling end of the cord circuit. A link control relay LC is also associated with the calling end of the cord circuit and is operated upon response of the called subscriber to light the link control lamp LI. The lighting of this lamp notifies the operator that the link connecting contacts CK have not been operated to connect the subscribers in conversational circuit. The operation of the said contacts also opens the circuit of the relay LC to efface the signal LI. Should the calling subscriber be a pay-station, as illustrated at A, the lamp LI also serves the purpose of notifying the operator that she has not thrown the two-way key to close the contacts RA to request the subscriber to deposit the coin or token in the coin apparatus at the substation.

Having described in general the apparatus embodied in the preferred form of our invention; we will now describe in detail, the operation of the apparatus used in connecting a subscriber at the calling substation A to a subscriber at the called substation B. Assuming now that the subscriber at substation A initiates a call, the removal of the receiver thereat operates the line relay LR to bring about the lighting of the line signal S. The operator noting the lighted line signal S inserts the answering plug AP into the multiple jack J of the calling line. The insertion of the plug AP into the jack J establishes a series energizing circuit for the

answering supervisory relay AS of the cord circuit C and the cut-off relay CO of the line circuit L, said circuit being traced from battery through the winding of the said relay AS, normal contact 1 of relay LD, the sleeve contacts of the connected plug and jack, through the winding of the cut-off relay CO to ground. The energizing of the cut-off relay CO opens the circuit of the line relay LR to efface the line signal S.

The energizing of the relay AS of the cord circuit C connects the operator's set O through the alternate contacts 2 and 3 of the relay AS, the normal contacts 4 and 5 of the relay CS to the answering end of the cord circuit C, thus placing the operator's set O in conversational circuit with the calling subscriber. The answering tip supervisory relay AT is also operated upon the insertion of the plug AP into the jack J. The circuit for relay AT extends from battery through the winding of relay AS, contact 1 of relay LD, sleeve contacts of plug AP and jack J, to and through the substation, through the tip contacts of jack J and plug P, contact 39 of relay LD and through the upper winding of the relay AT to ground. The operation of the relay AT prevents the answering supervisory lamp AL from glowing. An energizing circuit for the meter relay MR of the service meter circuit SM is also established upon the energization of the relay AS, the circuit being traced from battery through the winding of the relay AS, conductor 6, normal contact 5 of relay CS, the alternate contact 3 of relay AS, conductor 7 through the winding of the relay MR, conductor 8, alternate contact 9 of relay AT, alternate contact 10 of relay AS and conductor 11 to ground at normal contact 12 of relay CS. Upon the energization of the relay MR an energizing circuit for the locking relay LO is established, traced from battery through the winding of the relay LO to ground at alternate contact 13 of relay MR. The relay LO then closes a locking circuit for itself, traced from battery through the winding of said relay, through its alternate contact 14, resistance 15, conductor 16, alternate contact 2, normal contact 4, conductor 17 and through the upper winding of the relay AT to ground. Upon the initial energization of the relay LO, an energizing circuit for the meter magnet MM is established, traced from battery through the winding of the said magnet to ground at alternate contact 18 of the relay LO. The magnet MM energizes and attracts its armature which operates the meter mechanism to register the connection set up by the operator in answering the call from the calling substation. The operator's set O having been connected upon the energization of relay AS, she now ascertains the wants of the calling subscriber, and assumes

ing that it is the subscriber at the substation B that is wanted, the operator tests the multiple jack J¹ of the wanted line as to its idle or busy condition, and if the line is busy she receives the customary click in her head receiver. Assuming that the line is idle, the operator now inserts the calling plug CP into the jack J¹ of the wanted line closing a series energizing circuit for the relay CS of the cord circuit C and the cut-off relay CO¹ of the line circuit L¹, traced from battery through the winding of the relay CS, sleeve contacts of the connected plug and jack through the winding of the relay CO¹ to ground; thus energizing the two relays in series.

Upon the energization of the relay CS, the normal contacts 4 and 5 are interrupted to automatically disconnect the operator's telephone set from the cord circuit. The normal contact 4 being interrupted opens the locking circuit for the relay LO, allowing the said relay to deenergize and as the service meter circuit SM is common to the position it places the meter circuit in condition to register the next call that may be set up by the operator at this position. The closing of the alternate contact 12 of the relay CS establishes a circuit for the calling supervisory lamp CL traced from battery through the said lamp, normal contact 21 of relay CT to ground at alternate contact 12 causing the said lamp to remain glowing until the called subscriber answers. The operator now actuates the proper ringing plunger of the ringing key RK to connect the proper generator frequency to ring the call-bell of the called substation, upon the actuation of the said key plunger to its fully depressed position, the end spring 20 assumes its alternate position closing an energizing circuit for the ringing control relay RD, traced from battery through the winding of the said relay, the closed contact 20 of the end spring, normal contact 21 of relay CT to ground at alternate contact 12 of the relay CS. The operator releasing the ringing plunger permits it to assume an intermediate position and allows the contact springs 20 to return to normal. The relay RD, however, upon energizing, establishes a locking circuit for itself, traced from battery through the winding of said relay, conductor 22, normal contact 23 of relay LD, conductor 24, alternate contact 25 of relay RD and normal contact 21 of relay CT to ground at alternate contact 12 of relay CS. Upon the energization of the relay RD, an energizing circuit for the ringing interrupter circuit RI is established, traced from battery through the interrupter I and through the winding of the relay RI to ground at alternate contact 26 of relay RD.

The ringing interrupter relay RI is thus intermittently energized and deenergized

through the medium of the interrupter I, to connect the ringing lead 27 to the tip strand of the cord circuit through the alternate contact 28 of the relay RI to ring the call bell at the called substation. The path for the ringing current extends from the ungrounded pole of the generator, through the alternate contact 28 of relay RI, the alternate contact 29 of relay CS, the tip contacts of the connected plug and jack, through the condenser and call bell of the called substation, the sleeve contacts of the plug and jack, the alternate contact 30 of the relay RD, and through the lower winding 31 of the relay AT through battery to ground. The call bell at the calling substation is thus intermittently rung until the subscriber thereat answers. The winding 31 of the relay AT is of few turns, preferably of German silver wire so that the ringing current passing through it induces sufficient current in the upper winding of the said relay AT to give the calling subscriber an audible signal to notify him that the called subscriber is being signaled. The called subscriber at the substation B in response to the call signal removes his receiver from its switch-hook, this act on his part closes an energizing circuit for the calling tip supervisory relay CT, traced from ground through the winding of the relay CT, normal contact 28 of relay RI, alternate contact 29 of relay CS, tip contacts of the connected plug and jack, through the substation, the sleeve contacts of the connected plug and jack through the winding of the relay CS to battery. The relay CT, upon energization, opens its normal contact 21 effacing the calling supervisory lamp CL, the effacement of this signal notifies the operator that the called subscriber at substation B has answered. The opening of the normal contact 21 also opens the locking circuit of relay RD which relay upon deenergizing opens the circuit of relay RI at contact 26. A further result due to the energization of the relay CT is the closing of a circuit through the link control relay LC, traced from battery through the winding of the relay LC, the normal contact 32 of the link connecting contacts CK the alternate contact 21 of the relay CT, to ground at alternate contact 12 of relay CS. The relay LC thereupon energizes and closes a circuit for the link control lamp LI, traced from battery through the lamp to ground at alternate contact 33 of relay LC, thus lighting the link control lamp LI. The said lighted lamp serves two purposes, it notifies the operator that she has not operated the key controlling the connecting contacts CK to place the calling and called subscribers in a conversational circuit, and also that she has not assessed toll against the calling subscriber at the substation A. The

operator then actuates the key LK to bridge her set O to the calling end of the cord circuit and she now ascertains the number of the called subscriber, and noting that it is the same number as is being called, the operator throws the two-way key to close the contacts RA to connect her set O with the answering end of the cord circuit and then notifies the subscriber at the substation A to deposit the required token in the coin collecting apparatus CC. After the calling subscriber at the substation A has deposited the proper coin or token, the operator actuates the two-way key to establish the continuity of the talking conductors of the cord circuit, at the contacts 34 and 35, this actuation places the calling subscriber at the substation and called subscriber at the substation B in conversational circuit. The actuation of the contacts CK also causes the deenergization of the relay LC by opening of the normal contact 32 of the said contacts CK, allowing the said relay LC to deenergize and efface the link control lamp LI.

As soon as the subscriber at the calling and called substations A and B have finished conversation, they replace their receivers upon their respective switch-hooks. The replacing of the receiver at the called substation B opens the energizing circuit of the relay CT, allowing it to restore to normal and again light the calling supervisory lamp CL. The replacing of the receiver at the substation A opens the energizing circuit of the relay AT allowing it to restore and again light the answering supervisory lamp AL. A further result due to the deenergization of relay AT is the closing of an energizing circuit for the link disconnect relay LD. This circuit extends from battery through the said relay LD, contact 38 of key springs RA, normal contact 36 of relay AT, alternate contact 37 of relay AS and alternate contact 12 of relay CS to ground. The relay LD, upon energizing, opens the circuit of relay CO at normal contact 1, closes a locking circuit for the relay AS and disassociates the calling line from the cord circuit. The locking circuit for the relay AS extends from battery through the said relay, alternate contact 1 of relay LD, alternate contact 37 of relay AS and the alternate contact 12 of relay CS to ground. The relay CO, upon deenergizing, restores the line circuit of the calling subscriber to normal to permit the subscriber to recall.

Should the calling subscriber wish to recall prior to the time of the removal of the answering plug from the jack of the calling subscriber, he may do so by simply removing his receiver and causing the line relay LR to cause the line lamp S to glow as hereinbefore described. The operator

immediately seizes the recall by throwing the two-way key to close the contacts RA to bridge her set O to the cord circuit to inquire the wants of the recalling subscriber. The operation of the contacts RA of the two-way key brings about the opening of the normal contact 38. The opening of the normal contact 38 interrupts the circuit of the relay LD allowing it to restore to normal to close its normal contacts 39 and 40 thereby operatively connecting the strands of the cord circuit to the line circuit of the recalling subscriber. On a recall the service meter registers when the calling plug CP is removed from the multiple jack with which it has remained connected from the previous call. Upon the removal of the calling plug CP, the calling supervisory relay CS restores to normal, allowing the alternate contact 12 to assume its normal position thereby closing the energizing circuit for the meter relay MR traced from battery through the winding of relay AS, alternate contact 5 of relay CS, alternate contact 3 of relay AS, conductor 7, winding of relay MR, conductor 8, alternate contact 9 of relay AT, alternate contact 10 of relay AS and conductor 11 to ground at normal contact 12. The meter mechanism is again operated as hereinbefore described, thus giving the operator credit for a connection on a recall. The operator then learns the desires of the recalling subscriber and completes the connection in the same manner as hereinbefore described.

In case a calling subscriber asks to have the charges reversed, that is to have the toll assessed against the called subscriber, the operator may do so, when she operates the listening key LK to connect her set O to the calling end of the cord circuit, in the same manner as she did when she assessed toll against the calling subscriber.

The relay LO is of comparatively high resistance as is also the resistance coil 15, thus when the said relay LO locks up through the upper winding of the relay AT to ground, as before described, should the subscriber at the calling substation replace his receiver before the connection to the called substation is completed, the combined resistance of this path is such as to allow the relay at AT to deenergize, so as to place the connected cord circuit available for other connections. I have arranged the circuit of the service meter so that an operator cannot fraudulently operate the same by touching the tip of the answering plug AP of one cord circuit to the sleeve of a plug associated with another cord circuit. If she attempts to do so only the answering tip supervisory relay AT will be operated and as the energizing circuit for the meter magnet MR is open at the con-

tact 10 of the answering sleeve supervisory relay AS, the said meter relay MR is prevented from operating and remains at normal to prevent the operation of the said meter registering device.

Although we have chosen a preferred embodiment for the purpose of illustrating our invention, we contemplate using it in other ways than that shown and therefore we do not desire to be limited to the exact structure as described and shown, but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described our invention, what we claim as new and desire to secure by United States Letters Patent, is:

1. A telephone system including subscribers' telephone lines, a link circuit provided with a pair of normally disconnected terminals for interconnecting said lines, an operator's key for uniting and disuniting the terminals of said link circuit, a supervisory signal indicating the position of said key, an operator's telephone set, and means for connecting said operator's telephone set to one of said subscriber's telephone lines while said operator's key is in normal position disuniting the terminals of the link circuit.

2. A telephone system including a calling and a called subscriber's line, a link circuit provided with a pair of normally disuniting terminal plugs for connecting said lines together, a supervisory signal indicating the response of the called subscriber, and means including a key switch for uniting said normally disuniting terminal plugs and for effacing said supervisory signal.

3. A telephone system including subscribers' telephone lines, a link circuit provided with normally disconnected terminals for interconnecting said lines, an operator's telephone set, automatic means for connecting and disconnecting said operator's telephone set and said link circuit, and key controlled contacts for connecting said operator's set to either terminal of the said link circuit to the exclusion of the other end.

4. A telephone system including subscribers' telephone lines, a link circuit provided with a pair of normally disuniting terminals for interconnecting said lines, an operator's key for uniting the terminals of said link circuit, a supervisory signal for indicating the position of said operator's key, an operator's telephone, and automatic means for connecting said operator's telephone to said link circuit.

5. A telephone system including a calling and a called subscriber's line, a link circuit provided with a pair of normally disuniting terminals for connecting said lines in conversational circuit, a supervisory signal, means controlled by the response of the

called subscriber for operating said supervisory signal, and operator controlled means for uniting said normally disuniting terminals and for effacing said supervisory signal.

6. A telephone system including a calling and a called subscriber's line, a link circuit provided with normally disuniting terminals for connecting said lines, a key switch for uniting the terminals of said link circuit, automatic means controlled by a connected one of said subscribers for disuniting the terminals of said link circuit, and operator controlled means for restoring said automatic means to normal.

7. A telephone system including a calling and a called subscriber's line, a link circuit for connecting said lines, an operator's telephone, automatic means for connecting and disconnecting said operator's telephone and said link circuit, manually controlled key contact springs for connecting said operator's telephone to either terminal of said link circuit to the exclusion of the other terminal, and automatic means for disconnecting said subscribers' lines.

8. A telephone system including subscribers' telephone lines, a link circuit provided with a pair of terminals for interconnecting said telephone lines, an operator's telephone, automatic means for connecting and disconnecting said operator's telephone and said link circuit, operator controlled key contacts for connecting said operator's telephone to either terminal of said link circuit to the exclusion of the other, and subscriber controlled means for disuniting the terminals of said link circuit.

9. A telephone system including a called subscriber's telephone line and a calling subscriber's telephone line, a link circuit provided with a pair of normally disuniting terminals for connecting said lines in conversational circuit, a supervisory signal, means controlled by one of said subscribers for operating said supervisory signal, and operator controlled means for uniting said normally disuniting terminals and for effacing said signal.

10. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with normally disuniting terminals for connecting said lines in conversational circuit, supervisory signals for said link circuit under the control of the calling and called subscribers, an auxiliary supervisory signal adapted to be operated by one of said subscribers, and operator controlled means for uniting said normally disuniting terminals and for controlling said last supervisory signal.

11. A telephone system including a calling and a called subscriber's line, a link circuit provided with a pair of normally disuniting terminals for connecting said lines in con-

versational circuit, an answering supervisory signal under the control of the calling subscriber, a calling supervisory signal under the control of the called subscriber, a third
 5 supervisory signal responsive to a control exercised at the called substation, and operator controlled means for uniting said normally disunited terminals and for effacing said third supervisory signal.

10 12. A telephone system including subscribers' telephone lines, a link circuit provided with a pair of normally disconnected terminals for connecting said telephone lines, an operator controlled key for connecting
 15 said terminals thereby completing the connection between said lines, an operator's telephone, means for connecting said operator's telephone to either of said subscribers' telephone lines at the time when the terminals
 20 of the said link circuit are disconnected, and automatic means controlled by one of said subscribers for breaking the connection between said subscribers' lines.

13. A telephone system including a calling
 25 subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with a pair of normally disassociated terminals for connecting said lines, an operator controlled key for associating said terminals
 30 thereby connecting said lines in conversational circuit, a supervisory signal for said link circuit adapted to be actuated when the called subscriber responds, a circuit for said supervisory signal adapted to be opened
 35 when said operator-controlled means is actuated to connect said lines in conversational circuit, and a relay under substation control for again disassociating the terminals of said link circuit.

40 14. A telephone system including a calling subscriber's telephone line and a called subscriber's telephone line, a link circuit for connecting said lines in conversational circuit, an operator's telephone, automatic

means for connecting and disconnecting said
 45 operator's telephone and said link circuit, operator controlled contacts for connecting said operator's telephone to the calling subscriber's line to the exclusion of the called subscriber, and operator controlled contacts
 50 for connecting said operator's telephone to the called subscriber's line to the exclusion of the calling subscriber.

15. A telephone system including a calling
 55 subscriber's telephone line and a called subscriber's telephone line, a link circuit provided with a pair of normally disconnected terminals for connecting said lines, an operator's telephone set, means for connecting
 60 said operator's telephone set to said calling subscriber's line, means for signaling the called subscriber, and an operator-controlled key operable thereafter to associate said terminals to connect said subscribers' lines in
 65 conversational circuit.

16. A telephone system including a calling
 subscriber's telephone line and a called sub-
 70 scriber's telephone line, a link circuit provided with a pair of normally disassociated terminals for connecting said lines, an operator's telephone set, means for connecting the operator's telephone set to said calling
 75 subscriber's line, a supervisory signal, means controlled by the called subscriber for actuating said supervisory signal, and an operator-controlled key actuatable thereafter to associate said terminals whereby connection is established between said lines and said
 supervisory signal is extinguished.

Signed by us at Chicago, county of Cook
 80 and State of Illinois, in the presence of two witnesses.

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Copies of this patent may be obtained for five cents each, by addressing the "Commissioner of Patents,
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