C. S. WINSTON.

TELEPHONE SYSTEM WITH UNIVERSAL CORD CIRCUIT.

APPLICATION FILED JULY 30, 1914.

1,255,374.

Patented Feb. 5, 1918.

2 SHEETS—SHEET 1.

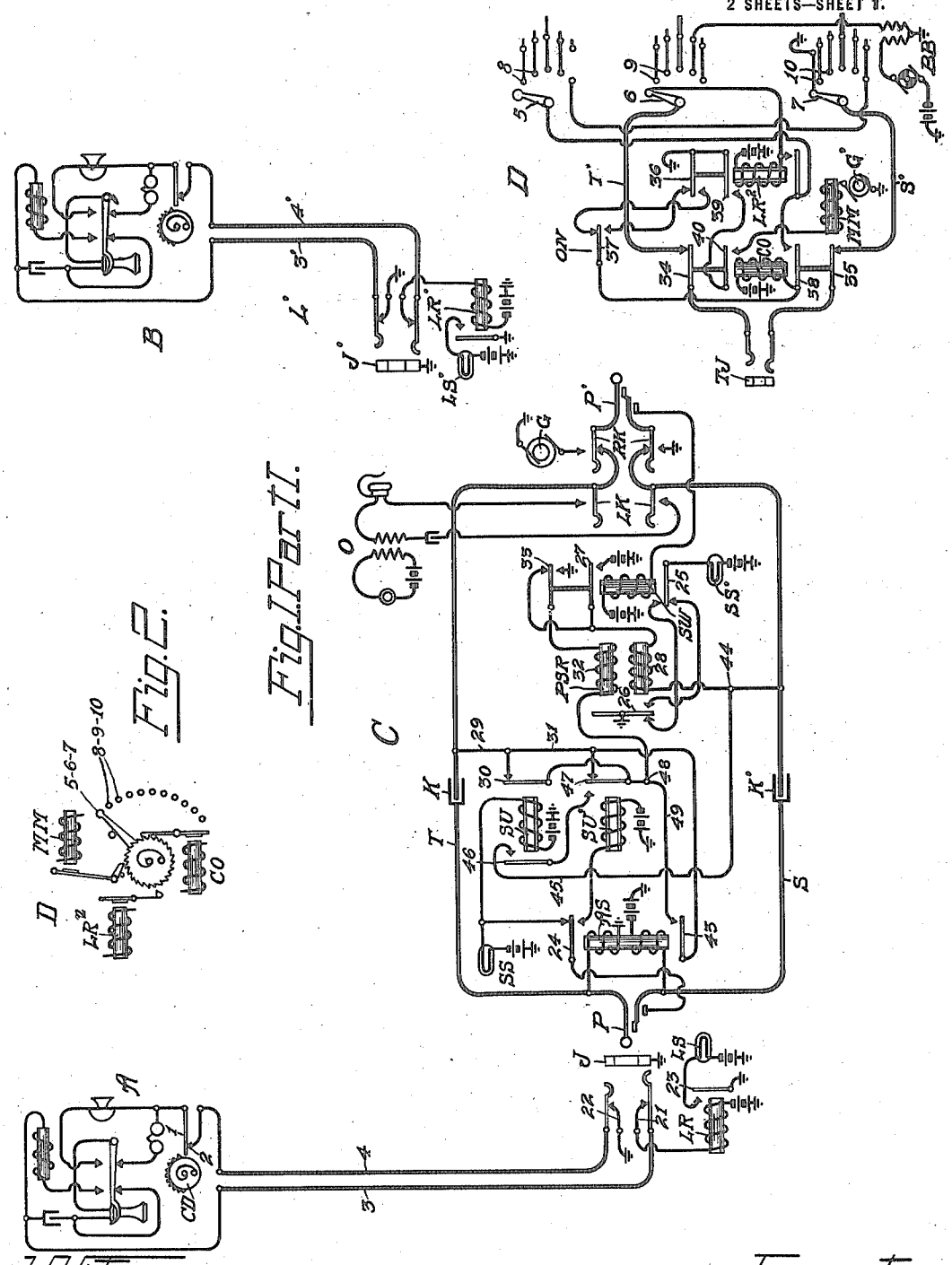

Fig. 1 Part II.

Fig. 2.

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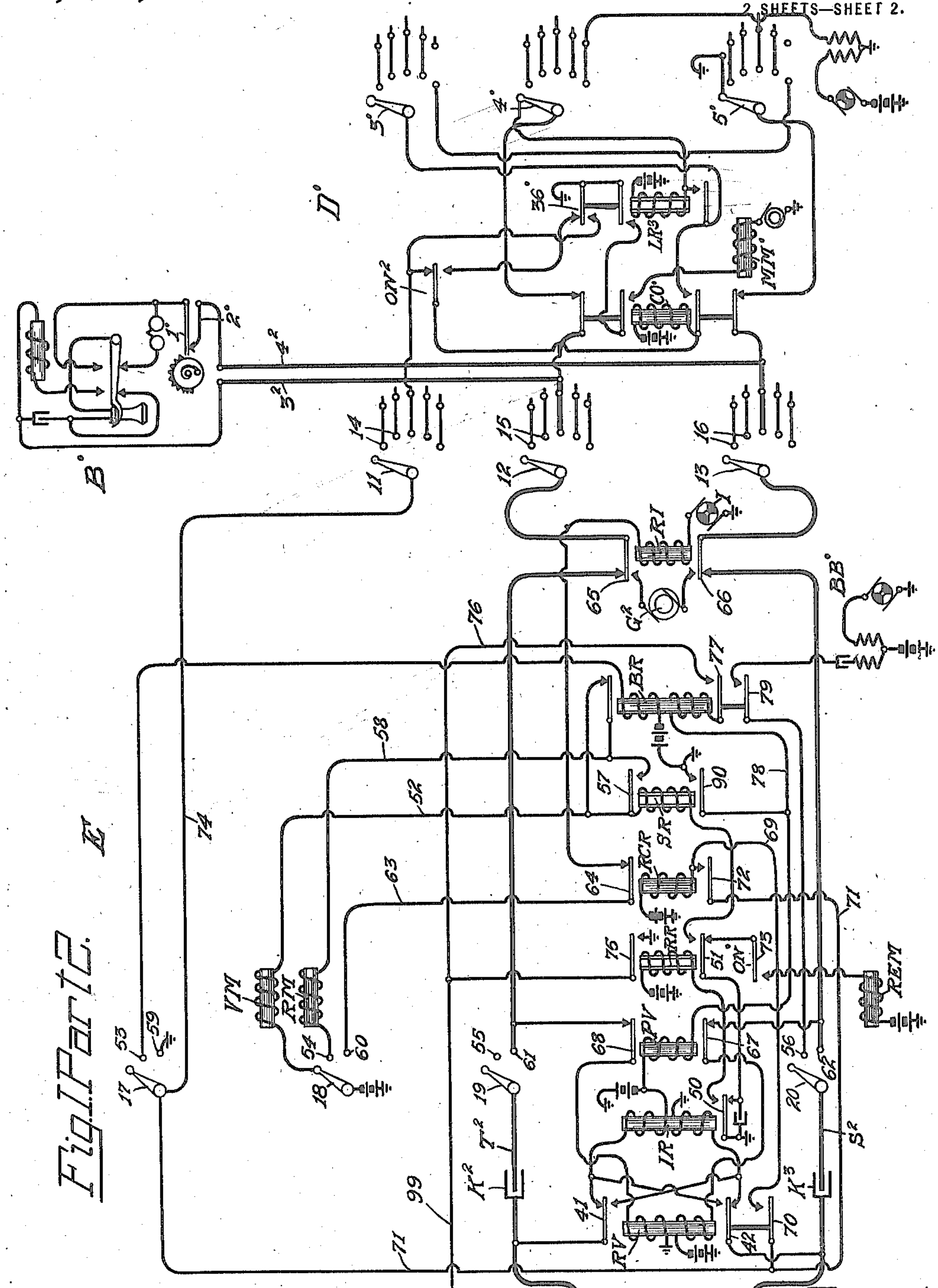

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TELEPHONE SYSTEM WITH UNIVERSAL CORD-CIRCUIT.

1,255,374. Specification of Letters Patent. Patented Feb. 5, 1918.

Application filed July 30, 1914. Serial No. 854,006.

To all whom it may concern:

Be it known that I, CHARLES S. WINSTON, a citizen of the United States of America, residing in Chicago, county of Cook, and State of Illinois, have invented certain new and useful Improvements in Telephone Systems with Universal Cord-Circuit, of which the following is a specification.

My invention relates to telephone systems and has to do more particularly with a telephone system with a universal cord circuit used for interconnecting lines of different character such as manual and automatic. The preferred form of my invention is especially adapted to operate in connection with private branch exchange systems such as are extensively used in hotels for interconnecting local telephones terminating at the branch exchange switchboard. A feature of my invention is the improved circuit arrangement of a universal cord circuit which is used for interconnecting local lines at the branch exchange or as the case may be if a calling line at the branch exchange wishes to talk to an outside line terminating at an automatic exchange, the party calling informs the operator that a connection is desired with an automatic line. The operator then connects the calling local line with one of a number of trunk jacks terminating at the branch exchange switchboard, the connected trunk jack extending the connected local line to the automatic exchange. The telephones at the branch exchange are preferably provided with impulse sending devices, the switch mechanism at the automatic exchange being operated through the cord circuit of the branch exchange. Other features of my invention will be pointed out in the ensuing specification, and claims.

My invention is adapted for other uses but for the purpose of describing it I have shown a certain form and now refer to the accompanying drawings in which—

Figure 1, Part 1, illustrates a cord and two link circuits of a private branch exchange, together with a trunk circuit extending to an automatic exchange as shown in Fig. 1, Part 2. Fig. 2 illustrates diagrammatically the line switches D and D^1.

Referring now more in general to my invention as illustrated it comprises a substation A, including a calling device CD which has contacts 1 and 2 and which upon actuation of the dial open and close the circuit of the line to send impulses through the universal cord circuit C to operate the switch mechanism of the automatic exchange. The substation A is connected by the line limbs 3 and 4 to the line circuit L which comprises a line relay LR, line signal LS and the jack J. The universal cord circuit C comprises answering and calling plugs P and P^1 connected by the heavily marked conductors and having condensers K and K^1 interposed. The answering end of the cord circuit is provided with an answering supervisory relay AS which controls the supervisory signal SS and also acts as an impulse relay when a local line as A is connected by means of the cord circuit C to an automatic exchange. Relay AS being in bridge of the conductors T and S is responsive to the impulses of the calling device CD to operate the switch mechanism of the automatic exchange.

The shunting relays SU and SU^1 are associated with the answering end of the cord circuit and are operated upon the energization and deënergization of the relay AS when affected by the actuated calling device. Relays SU and SU^1 being slow acting are not affected by the quick interruptions of the contacts of relay AS but remain energized during each set of interruptions of relay AS. The two relays SU and SU^1 remain actuated during each set of impulses and short circuit or shunt the polarized supervisory relay PSR. The polarized relay PSR is associated with the calling end of the cord circuit C and controls the supervisory signal SS^1. A switching relay SW is also associated with the calling end of the cord circuit C and is actuated only upon the cord circuit C being connected to another local line and this actuation places the polarized relay PSR in operative relation with cord circuit C, so that when the called local line answers the polarized relay PSR operates to efface the signal SS^1. A listening key LK is also provided which when thrown connects an operator's set O in circuit with cord circuit C and a ringing key RK is also provided which when thrown connects the ringing generator G in circuit.

To the right of the drawing I have illustrated a substation B similar to A, being connected by the line limbs 3^1, 4^1 to a line circuit L^1 comprising the line relay LR^1, line signal LS^1 and jack J^1.

Referring now to the automatic apparatus illustrated, which operates in connection with the universal cord circuit C, I show a trunk jack TJ, the jack being located at the branch exchange to which connection can be made by the cord circuit C. The jack terminates in an individual line switch D which comprises a line relay LR^2, cut-off relay CO and motor magnet MM, wipers 5, 6, 7 and the off-normal contact ON. The line relay LR^2 is energized when connection is made with the jack TJ and its operation in turn energizes relay CO to connect motor magnet MM to step wipers 5, 6 and 7 to select an idle connector E. A busy back BB is provided which is connected in case the individual switch D does not find an idle trunk. The connector E which is of the Strowger type comprises an impulse relay IR, a private relay PV, a secondary relay SR, a vertical magnet VM. A rotary magnet RM is provided which is energized by the last set of impulses to step the wipers 11, 12, 13 in a rotary direction to select the contacts of a wanted line. A busy relay BR is associated with the connector to connect busy back BE^1 in case the called line is busy. A ringing relay RI is intermittently energized and deënergized by an interrupter I to connect the ringing generator G^2 to ring the called line. A ringing control relay RCR is energized when the calling substation answers to disconnect ringing generator G^2. A release relay RR and a release magnet REM are associated with the connector, the magnet REM being energized upon the deënergization of the relay RR to release the switch mechanism. An off-normal contact ON^1 is associated with the connector and assumes its off-normal position upon the first step of the wipers off-normal. The side switch wipers 17, 18, 19, 20 are stepped to their different positions by the restoration of the relay PV.

An automatic substation B^1 is shown to the right in Fig. 1, part 2, being similar to that of A and B and being connected by the line limbs 3^2 and 4^2 to its associated individual line switch D^1 similar to D.

Having described in general the apparatus associated with my invention the operation will now be described.

Operation.

Assuming that a party at the local substation A wishes to converse with a party at the local substation B, the party at substation A removes his receiver energizing the line relay LR from battery through normal contact 21 of the jack J, line limb 3 through the substation, line limb 4, normal contact 22 to ground, closing its alternate contact 23 to light line signal LS and the operator noting the signal LS inserts plug P into jack J. The insertion of the plug P into jack J opens the circuit of the line relay LR at the contacts 21 and 22 of jack J, the line relay restoring and effacing the line signal LS. The supervisory or impulse relay AS is also energized, circuit being traced from battery through the lower winding of relay AS, sleeve contacts of plug P and jack J, line limb 3, through the substation, line limb 4, tip contacts of the jack J and plug P, the upper winding of relay AS to ground, the relay AS energizing and opening its contact 24 which prevents the supervisory signal SS from lighting. The relay AS energizing also closes its alternate contact 24 energizing shunt relay SU^1. The operator then throws her listening key LK and finding that local substation B is wanted inserts plug P^1 into jack J^1, energizing switching relay SW over a circuit traced from battery to ground at the sleeve contact of the jack J^1. The operation of relay SW closes a circuit for supervisory lamp SS^1 from battery through lamp SS^1, alternate contact 25, relay SW to ground at normal contact 26 of the polarized supervisory relay PSR. The operator then throws ringing key RK to connect generator G to signal the called for line. The subscriber at the local substation B answering closes a circuit for the polarized supervisory relay PSR traced from battery through alternate contact 27, of relay SW, winding 28 of relay PSR, sleeve conductor S, sleeve contacts of the plug P^1 and jack J^1, line limb 4^1, through the substation, line limb 3^1, tip contacts of jack J^1 and plug P^1, conductor T, conductor 29, normal contact 30 of relay SU, conductor 31, the winding 32 of relay PSR to ground at alternate contact 33 of the relay SW. The polarized relay operates and the contact 26 assuming its alternate position opens the circuit of the supervisory signal SS^1 effacing it. The two substations A and B are now in conversational circuit, this circuit being traced over the heavily marked conductors. When the party at the local substation A replaces his receiver relay AS is deënergized closing a circuit for supervisory signal SS traced from battery through SS, normal contact 24 to ground at the sleeve contact of jack J lighting the signal SS. The party at local substation B replacing his receiver opens the circuit for polarized supervisory relay PSR which again closes circuit for supervisory lamp SS^1 which again lights. The deënergization of relay AS also opens circuit for relay SU^1. The operator noting the signals SS and SS^1 removes plugs P and P^1 from jacks J and J^1 effacing signals SS and SS^1, the cord circuit C being now available for other connections.

Local to automatic.

Assuming now that the local substation A at the private branch exchange wishes to

converse with an automatic subscriber as B^1, whose line terminates into an automatic exchange, the party at the local substation A removes his receiver which energizes line relay LR and lights the line signal LS. The operator noting this signal inserts plug P into jack J opening the circuit of line relay LR at the jack J which relay restores and effaces line signal LS. The insertion of the plug P into jack J also energizes the relay AS, which operates and opens the circuit for the supervisory signal SS preventing it from lighting. The relay SU^1 energizes through alternate contact 24 of relay AS to ground at the sleeve of the jack J. The operator throws the listening key LK and upon finding that it is the automatic substation B^1 which is wanted she inserts plug P^1 into a jack TJ. The switching relay SW does not operate as the sleeve of the trunk jack TJ is on open circuit. The insertion of the plug P^1 into jack TJ operates line relay LR^2 of the individual line switch D, traced from battery through the winding of the relay LR^2, the wiper 6, conductor T^1, normal contact 34 of relay CO, tip contacts of jack TJ and plug P^1, normal contact 30 of relay SU and alternate contact 43 of relay AS in multiple, winding 32 of relay PSR, normal contact 33 of relay SW, winding 28 of relay PSR, sleeve contacts of the plug P^1 and jack TJ, normal contact 35 of relay CO, wiper 7 to ground. The energization of relay LR^2 closes an energizing circuit for cutoff relay CO from ground at alternate contact 36 of relay LR^2, normal contact 37 of off-normal contact ON, normal contact 38 of the cutoff relay CO, through the winding of CO to battery. The energization of relay CO closes an energizing circuit for motor magnet MM traced from ground at alternate contact 39 of relay LR^2, alternate contact 40 of relay CO through winding of motor magnet MM to the generator G^1. Motor magnet MM steps wipers 5, 6 and 7 of the individual switch D over the contacts 8, 9 and 10 to select an idle connector. The off-normal contact ON assumes its alternate position on the first step of the wiper 5, 6 and 7, but relays LR^2 and CO remain energized as long as the wipers 5, 6 and 7 are passing over grounded contacts, but as soon as the wiper 5 finds an ungrounded contact the circuit of the relay CO is opened to deënergize the magnet MM to prevent the wipers from being stepped beyond the selected contacts, the relay LR^2 remaining energized from ground at the private contact of the connector. Assuming that the number of the called automatic substation is 45 the party at the local substation A actuates his calling device CD to send the different series of impulses to select the called-for automatic station B^1. The relay AS of the cord circuit C is bridged across the line conductors T and S when the plug P is in the jack J, and when the calling device CD of the calling local substation A is actuated to send a certain number of impulses the relay AS being bridged across the line conductors of the cord C is energized and deënergized to open and close its contact 43 to effect the automatic apparatus to select the called line. When the calling device CD is actuated to send four impulses of current, which we will assume is the first digit of the called automatic substation's number, the opening and closing of the contacts 1 and 2 of the calling device CD interrupts the circuit of the relay AS 4 times. Upon deenergization of AS relay SU is energized from battery through its winding, normal contact 24 of relay S, sleeve contacts of the plug P and jack J to ground.

The relays SU and SU^1 being slow acting relays are not affected by the rapid interruptions of the contact 24 and therefore remain energized while the impulses are being sent. The energization of the relays SU and SU^1 will close a short circuit around the winding of the polarized relay PSR which may be traced from the point 44, conductor 45, alternate contact 46 of relay SU, alternate contact 47 of relay SU^1 to point 48 thus shunting out the relay PSR while the impulses are being sent. The energization and deënergization of relay AS opens and closes the circuit at the contact 43.

When the connector was selected, its relay IR was energized, the circuit being traced from battery through the upper winding of relay IR, normal contact 41 of reversing relay RV, conductor T^2, contact 9, wiper 6, conductor T^1, tip contacts of the plug P^1 and jack TJ, conductor 29, contact 43, windings of PSR, sleeve of jack and plug, wiper 7 and contact 10, normal contact 42 of relay RV, the lower winding of the relay IR to ground. The operation of the relay IR closes an energizing circuit for the release relay RR traced from ground through alternate contact 50 of relay IR and the winding of relay RR to battery.

The subscriber at the local substation A having actuated calling device CD to send four impulses which energize and deënergize the relay AS to interrupt its contact 43, said interruptions operating the relay IR four times. On the first deënergization of relay IR an energizing circuit for secondary relay SR and vertical magnet VM is established, traced from ground through the normal contact 50 of relay IR, alternate contact 51 of relay RR, the winding of relay SR, conductor 52, winding of the vertical magnet VM through the side switch wiper 18 to battery. The relays RR and SR being slow acting are not responsive to the rapid interruptions of the relay IR but the vertical magnet VM being quick acting is responsive to the said impulses and steps

wipers 11, 12 and 13 to the fourth level of the switch contacts. The relay SR remains energized while the impulses are being sent and the closure of its alternate contact 90 establishes an energizing circuit for the private relay PV traced from battery, the winding of the relay PV and the alternate contact 90 of relay SR to ground. After the first set of impulses relay PV deënergizes having its circuit opened at the alternate contact 90 and mechanically steps the side switch wipers 17, 18, 19 and 20 to their second position to engage the contacts 53, 54, 55 and 56. The side switch wiper 18 engaging the contact 54 places the rotary magnet RM in series circuit with the relay SR. The local subscriber now actuates the calling device CD to send five impulses, energizing and deënergizing relay AS opening and closing contact 43 to energize and deënergize the interrupter relay IR five times. Upon each deënergization of relay IR, relay SR and rotary magnet RM are connected in series, the circuit being traced from ground to normal contact 50 of relay IR, alternate contact 51, winding of relay SR, conductor 58, winding of magnet RM, side switch contact 54, side switch wiper 18 to battery. The rotary magnet being also a quick-acting relay is responsive to the quick interruptions and steps wipers 11, 12 and 13 to the fifth contacts of the fourth level which are the contacts of the wanted line, the off-normal contact ON^1 assuming its alternate position upon the first step of the switch movement. After this set of impulses are sent, the relay PV again restores having its circuit interrupted at contact 90, and the relay AS of cord C remains in its operated condition opening the circuit of the relay SU which removes the shunt from the polarized relay PSR, which again operates from battery through upper winding of IR, normal contact 41, conductor T^1, normal contact 34 of relay CO, tip contacts of the jack TJ and plug P^1, conductor T, conductor 29, normal contact 30, conductor 31 to the point 48, through the winding 32 of the relay PSR, normal contact 33 of relay SW winding 28 of relay PSR, conductor S, sleeve contacts of the plug P^1 and jack TJ, normal contact 35 of relay CO, conductor S^1, normal contact 42, lower winding of relay IR to ground. This energizes polarized supervisory relay PSR and the closing of its alternate contact 26 again lights the supervisory lamp SS^1 from battery through the lamp, normal contact 25, of relay SW, alternate contact 26, of relay PSR, to ground, the lamp SS^1 remaining lighted until the called subscriber answers.

After the last set of impulses the private relay PV deënergizes stepping the side switch wipers 17, 18, 19 and 20 to their third position engaging the contacts 59, 60, 61 and 62. The wiper 18 engaging the contact 60 closes an energizing circuit for the ringing relay RI traced from battery through the side switch wiper 18, conductor 63, normal contact 64 of relay RCR, the winding of relay RI, through the interrupter I to ground. The relay RI is energized and deenergized by the interrupter I to connect the ringing generator G^2 through the alternate contacts 65 and 66 of the relay RI to intermittently ring the call bell of the called-for substation B^1. When the party at substation B^1 removes his receiver from the switch hook, in response to the call the reversing relay RV operates, the circuit being traced from battery through its lower winding, normal contact 67 of relay PV, conductor S^2, normal contact 66 of relay RI, wiper 13, contact 16, line limb 4^2, through the substation, line limb 3^2, contact 15, wiper 12, normal contact 65, conductor T^2, normal contact 68 of relay PV, the upper winding of relay RV to ground. The operation of the relay RV reverses the original battery flow through the relay PSR of the cord circuit C causing the restoration of the relay PSR and effacement of signal SS^1. The operation of the reversing relay RV also closes an energizing circuit for the ringing control relay RCR traced from battery through the winding of the relay RCR, conductor 69, alternate contact 70 of relay RV, conductor 71, side switch wiper 17 to ground at contact 59, the energization of the relay RCR opens the circuit for relay RI at its contact 64, the ringing relay RI deënergizing and thus cutting off the ringing current when the called subscriber answers. The relay RCR closes a locking circuit for itself traced from battery through its winding, its alternate contact 72, conductor 71 to ground at contact 59, the relay remaining locked up to prevent ringing current being connected to the called line while conversation is going on, the relay remaining locked up until the parties disconnect.

After conversation has been completed, the party at the substation B^1 replaces his receiver upon its switch-hook, this act opening the energizing circuit of relay RV, which again restores and causes a reversal of battery which again operates the relay PSR to close its alternate contact 26 to ground lighting supervisory lamp SS^1 and thus notifying the operator that the called subscriber has replaced his receiver. The party at the substation A replacing his receiver upon the switch-hook deënergizes relay AS lighting lamp SS and the operator withdraws plugs P and P^1 thus opening the circuit of interrupter relay IR which opens the circuit for the release relay RR which in turn operates the release magnet REM and restores the connector. The restoration of switch E to normal restores the individual switch D due

to the removal of ground from the test conductor 99 at alternate contact 75 of relay RR. This removal of ground permits restoration of LR^2 of line switch D whereupon its normal contact 36 is closed causing the energization of CO. Relay CO being energized and relay LR^2 being deënergized, both retaining pawls are withdrawn and the wipers restored to normal as will be clear from an inspection of Fig. 2.

Assuming that the subscriber at the local substation A has operated the calling device CD to send the last set of impulses which are five in number to select the wanted line of the called substation and if the called substation is busy a ground will be connected to the private contact 14 of the called line from the alternate contact 36^1 of the individual switch D^1. This ground will establish an energizing circuit for the busy relay BR traced from battery through its upper winding, the side switch contact 53, switch wiper 17 which now is in its second position, conductor 74, private wiper 11, contact 14 to ground at the alternate contact 36^1 of the line relay LR^3 of the individual switch D^1. The busy relay BR locks up from ground at alternate contact 75 of relay RR, conductor 76, alternate contact 77 of relay BR, its lower winding, conductor 78 through the winding of the private relay PV to battery. The last set of impulses, five in number having been sent and a busy line encountered by the connector wipers and due to the relay SR being a slow acting relay it remains energized momentarily preventing the private relay PV from releasing until another circuit is established for it in series with the lower winding of the relay BR. The relay PV in remaining energized when the connector engaged a busy line does not step the side switch wipers, they remaining in their second position. The operation of the relay BR connects busy back BB^1 through alternate contact 79 of relay BR, side switch contact 56, side switch wiper 20 which now is in its second position, conductor S^2 back to the calling substation, this busy signal notifying the calling subscriber that the called line is busy. The subscriber at A in replacing his receiver opens the circuit of the relay AS, which restores again lighting the signal SS. The relay RV of connector E not operating does not reverse the battery flow for the relay PSR of the cord circuit C and therefore the signal SS^1 remains lighted. The operator noting the two signals SS and SS^1 removes the plugs from their respective jacks which effaces the signals. The restoration of the automatic apparatus being the same as before described.

Although in illustrating my invention I have shown an individual switch D and connector E for use in extending the calls from the private branch lines to the automatic exchange lines, it is to be understood that this is only for the purpose of illustration and I contemplate using my invention with larger sized exchanges which include first and second selector switches, and therefore I do not desire to be limited to the exact arrangement as disclosed, but aim to cover all that which comes within the spirit and scope of the appended claims.

Having described my invention what I claim as new and desire to secure by Letters Patent is:

1. A telephone system comprising private branch exchange telephone lines, a cord circuit for interconnecting said lines, trunk circuits extending from the switchboard at the private branch exchange to an automatic exchange, a polarized relay connected in bridge of the calling end of the cord circuit, a source of current and means for connecting said source in circuit with said polarized relay when connection is made between the calling end of the cord and a private branch line to furnish transmitter current to said line, circuit connections whereby said polarized relay is connected in bridge of the automatic trunk exclusive of said source of current when the calling plug is connected with said automatic trunk, and a relay for said cord circuit under substation control for transmitting impulses over said automatic trunk.

2. A telephone system comprising telephone lines, a cord circuit for interconnecting said lines, a trunk circuit extending from the switchboard of said lines to an automatic exchange, a two coil polarized relay at the calling end of the cord circuit, a source of current and means for connecting said source in circuit with said polarized relay coils at an intermediate point and in bridge of said cord circuit when connection is made between the calling end of the cord and one of said lines to furnish transmitter current to said line, circuit connections whereby said source of current is excluded and said polarized relay coils are connected in bridge of the automatic trunk when the calling plug is connected therewith, and a relay for said cord circuit for repeating impulses from a calling one of said lines over said automatic trunk to said automatic exchange.

3. In a telephone system, a calling subscriber's line, a link circuit connected thereto provided with a polarized relay associated with the calling end thereof, called subscribers' lines of different characters, means for connecting the calling end of said link circuit to the said called lines, means for either directly bridging the said polarized relay across said link circuit or for including a source of transmitter current in said bridge, said last means being dependent upon the character of the called line connected with, and a relay associated with the answering

end of the cord circuit for shunting said polarized relay.

4. In a telephone system, a calling subscriber's line, a link circuit connected thereto, a called subscriber's line, an automatic switch temporarily associated with said link circuit and having access to said called subscriber's line, a supervisory relay bridged across the calling end of the said link circuit, and means controlled by the calling subscriber when operating said automatic switch for shunting said supervisory relay.

5. In a telephone system, a calling subscriber's line, a plug ended link circuit connected thereto provided with a combination supervisory and impulse control relay, called subscribers' lines of different characters, means under the control of a central office operator for connecting said link circuit to a called subscriber's line of one of said characters, and means including said combination relay for extending a connection from said link circuit to a called subscriber's line of another of said characters.

6. In a telephone system, a calling subscriber's line, a link circuit connected thereto, a double wound polarized supervisory relay associated with said link circuit, a relay for controlling the manner of connection of said polarized relay to said link circuit, called subscribers' lines of different characters, means controlled by the character of the called line connected with for controlling the operation of said last relay for thereby controlling the connection of said polarized relay to the link circuit, and a relay for electrically connecting together the talking strands of the cord circuit at the calling end thereof.

7. A telephone system including a calling subscriber's telephone line, a link circuit for connection thereto, an automatic trunk circuit for connection with the other terminal of said link circuit, a supervisory relay connected across the calling end of said link circuit, and a relay controlled by the calling subscriber for shunting said supervisory relay.

8. A telephone system including a calling subscriber's line and a called subscriber's line, a link circuit for connecting said lines in a conversational circuit, a supervisory relay bridged across the calling end of said link circuit, a combination supervisory and impulse relay bridged across the answering end of said link circuit, and means controlled over the calling line for operating said combination relay to shunt said supervisory relay.

9. A telephone system including a calling subscriber's line, an automatic switch, an operator's link circuit for connecting said subscriber's line to said automatic switch, a combination supervisory and impulse relay bridged across the answering end of said link circuit, and subscriber controlled means for operating said relay to transmit impulses to said automatic switch.

10. A telephone system including a calling subscriber's telephone line, an automatic selector switch, an operator's connecting circuit for connecting said calling subscriber's line to said automatic switch, a combination supervisory and impulse relay for said connecting link, a supervisory relay bridged across the calling end of said connecting link, means controlled by said first relay for shunting said second relay and for transmitting impulses to said automatic switch, and subscriber controlled means for operating said first relay.

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

CHARLES S. WINSTON.

Witnesses:
GEORGE E. MUELLER,
WM. BERGHOLM.