G. A. YANOCHOWSKI.

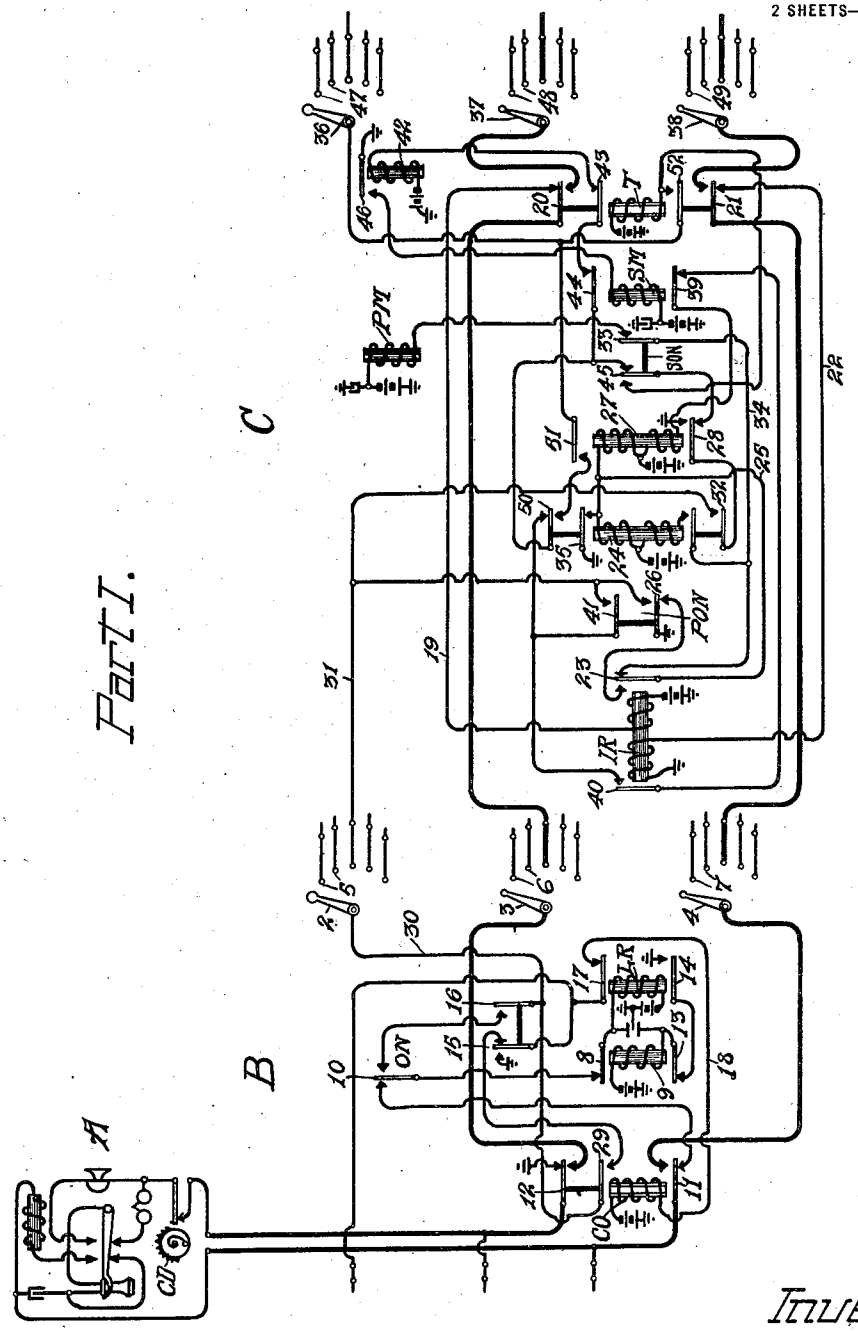
CONNECTOR SWITCH.

APPLICATION FILED AUG. 1, 1917.

1,423,897.

Patented July 25, 1922.

2 SHEETS—SHEET 1.



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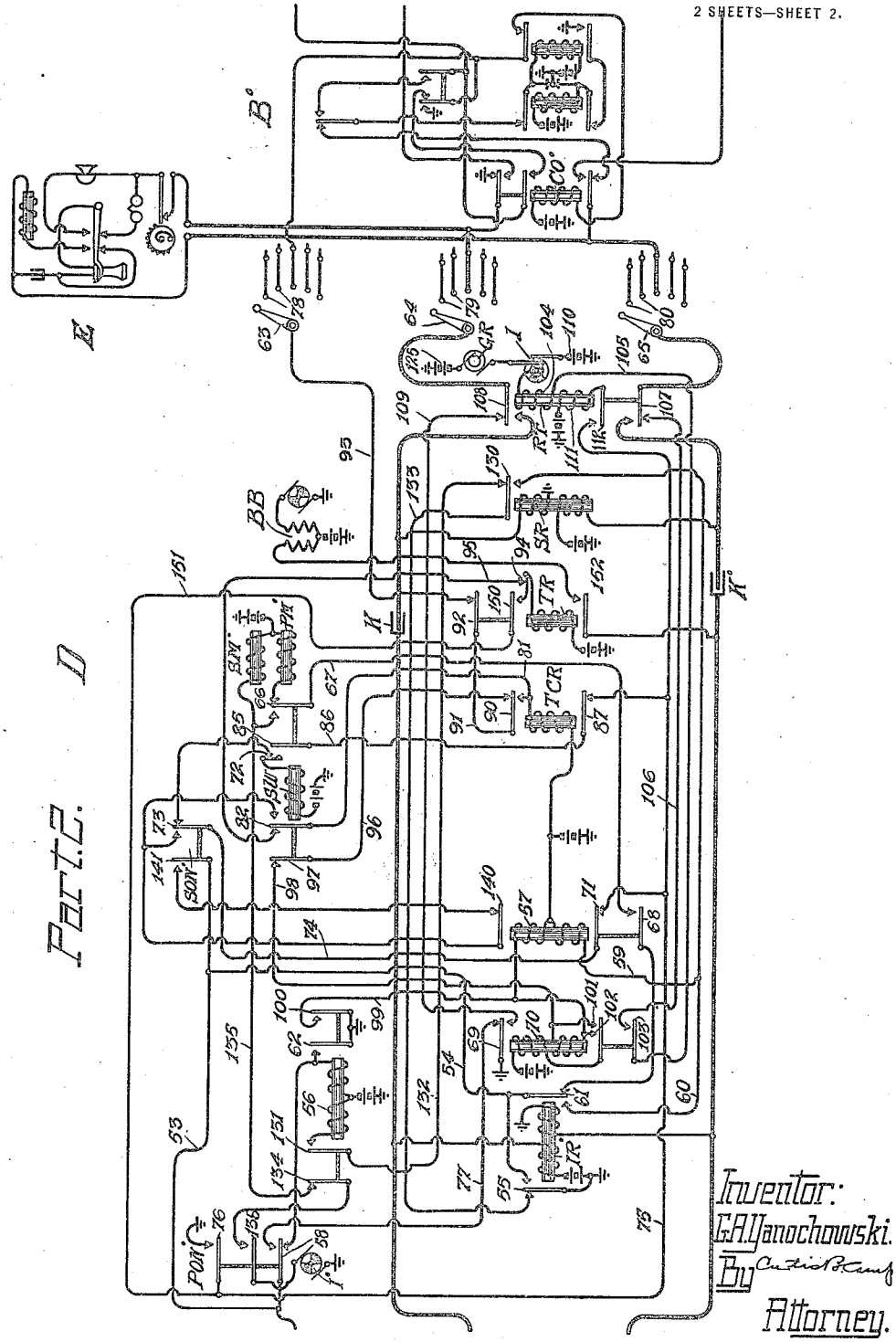

UNITED STATES PATENT OFFICE.

GEORGE A. YANOCHOWSKI, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD AND SUPPLY COMPANY, OF CHICAGO, ILLINOIS, A CORPORATION OF ILLINOIS.

CONNECTOR SWITCH.

1,423,897. Specification of Letters Patent. Patented July 25, 1922.

Application filed August 1, 1917. Serial No. 183,870.

To all whom it may concern:

Be it known that I, GEORGE A. YANOCHOWSKI, a citizen of the United States of America, residing in Chicago, county of Cook, State of Illinois, have invented certain new and useful Improvements in Connector Switches, of which the following is a specification.

My invention relates to telephone exchange systems of the kind in which automatic switches are employed at the exchange or central office for establishing connections between subscribers' lines, and relates more particularly to systems of the two-wire type which employ switches of the two-dimension type.

The general object of my invention is to provide an improved circuit arrangement for a connector switch of the class described above.

One of the features of my invention is the provision of an improved test arrangement for the connector switch, in which the busy control relay locks up over a local circuit, independent of the busy potential upon the busy contact engaged by the connector switch, and the test conductor of the connector switch is interrupted to disconnect the test mechanism of the connector switch.

Another feature of my invention is the provision of a novel, simple, and efficient arrangement whereby automatic ringing is furnished with a minimum amount of apparatus.

A further feature of my invention is the provision of means for instantaneously cutting off the ringing current from the called subscribers' line when the called subscriber responds to a call.

The above and other features of my invention will be hereinafter described in the ensuing specification, and more particularly pointed out in the appended claims.

For a better understanding of my invention, reference may be had to the accompanying drawings which comprise Part 1 and Part 2. In order to more fully understand the circuits as pointed out, Part 2 is to be placed to the right of Part 1, to form a continuation thereof and a complete circuit. In Parts 1 and 2, I have diagrammatically illustrated the complete circuit arrangement necessary for connecting a calling subscriber to a called subscriber. The circuit shows a calling substation A terminating in an individual line switch B, which line switch B is adapted to connect with an idle first selector C. The first selector C in turn is adapted to connect with the idle connector D, and the connector D is adapted to connect with the terminals of the called substation E. The called substation E also terminates in an individual line switch B^1.

The substation A includes the usual talking equipment of a common battery telephone with the addition of a calling device CD adapted to break the continuity of the subscriber's line circuit. The circuit for the subscriber's substation A will be carried through a series of continuations, finally establishing connection with a called subscriber's telephone as E.

The line switch B as illustrated is of the self-restoring type of individual switch and is provided with a rotary shaft that carries a private test wiper 2 and a pair of line wipers 3 and 4. A line relay LR is provided which is energized over the subscriber's line conductors in series. A cut-off relay CO is also provided for disconnecting the subscriber's line circuit from the line relay LR and for connecting the switch wipers to the subscriber's line circuit. A motor magnet 9 is provided for stepping the switch wipers 2, 3 and 4 step by step through the medium of ratchet and pawl mechanism over the bank contacts 5, 6 and 7 to an idle set of bank contacts leading to an idle first selector. An off-normal switch ON is provided which is actuated upon the first step of the wipers off normal. The switch is also provided with a pair of movable contacts 15 and 16 which are adapted to operate with the off-normal contact 10 upon the first movement of the switch wipers from normal position. The switch contacts 15 and 16 are restored to their normal position by the energization of the cut-off relay CO and are caught in their normal position where they are held until the switch shaft and wipers return to normal, at which time the said springs 15 and 16 are placed in condition to be operated again by the first movement of the switch shaft from normal. The cut-off relay controls a holding pawl in such a manner that when it is energized and then de-energized it removes the holding pawl from engagement with the switch ratchet, thereby permitting the return of the switch shaft

and wipers to normal. The motor magnet 9 besides being provided with a driving pawl for rotating the switch shaft also controls a pair of contacts 8 and 13. The switch wipers are spring restored and are adapted to be released to normal when the cut-off relay CO is de-energized.

The circuits shown for the selector C and connector D are adapted to work with a switch structure similar to that shown in application H. H. Ide, Serial No. 175,364, filed June 18, 1917. It is to be understood, however, that the circuits shown may be used in connection with various other switch structures of the prior art.

The first selector C comprises an impulse relay IR, which relay is energized and de-energized by impulses from the calling device CD at the calling substation A, and the energization and de-energization of the relay IR brings about the actuation of the primary magnet PM to step the first selector switch wipers 36, 37 and 38 in a primary direction to a certain group of contacts. A secondary magnet SM is provided for said selector which automatically steps the wipers 36, 37 and 38 in a secondary direction over the contacts 47, 48 and 49 in the selected group to seek an idle set of contacts leading to a connector, as D. A switching relay T is also provided which when energized extends the connection of the calling substation A to the idle connector D. Primary and secondary off-normal contacts PON and SON, respectively, are provided. The said primary off-normal contacts PON assume their alternate position on the first step of the wipers in a primary direction, and the secondary off-normal contacts SON assume their alternate position upon the first step of the wipers in a secondary direction.

The connector switch D is provided with an impulse relay IR^1, responsive to the impulses of the calling device CD at the calling substation A, which relay IR^1 brings about the actuation of the primary magnet PM^1 to step the connector switch wipers 63, 64 and 65 in a primary direction to a certain group of contacts containing contacts of the called line E. A switching relay SW is provided which energizes upon the termination of the first set of impulses to connect the secondary magnet SM^1 in circuit with the impulse relay IR^1, to be actuated by the energization and the de-energization thereof to step the connector switch wipers 63, 64 and 65 over the contacts 78, 79 and 80 in the selected group to seek the contacts of the called line. A test control relay TCR is provided which assists in the test of the called line as to its idle or busy condition, and a test relay TR is provided which is actuated upon connection with a busy called line through the agency of the relay TCR. The said relay TR operates to connect busy-back apparatus BB to the calling substation to notify the calling subscriber of the busy condition of the called line and disconnects the relay TCR from the test wiper 63. A ringing trip relay RT is also shown which is operated when a called subscriber removes his receiver in response to a call, the said relay opening the ringing circuit to disconnect the ringing current from generator GR which passes through the interrupter I. Should a called subscriber remove his receiver during either a ringing or a silent period, the ringing current is immediately disconnected, as will be more fully hereinafter described. The relay RT is provided with a locking winding to prevent a reapplication of ringing current to the called subscriber's line prior to a disconnection of the connector D from the line of the called subscriber. With this ringing arrangement, it is only necessary to provide one control relay for the ringing current. A back bridge or supervisory relay SR is also provided which operates upon the actuation of the ringing trip relay RT. Primary and secondary off-normal contacts PON^1 and SON^1 are provided and assume their alternate positions, respectively, upon the primary and secondary movements of the wipers 63, 64 and 65.

To the right of the drawing in Part 2, I show a called substation E, similar to that of A, the said subscriber being provided with a line switch B^1, similar to line switch B.

Having described in general the apparatus embodying my invention, I will now describe more in detail the operation of the system as illustrated. Assuming now, for instance, that a call is to be traced from the calling substation A to the called substation E, upon the removal of the receiver by the subscriber at the substation A, a circuit for the line relay LR of the individual line switch B is established, this circuit being traced from battery through the winding of relay LR, normal contact 8 of relay 9, normal contact 10 of the off-normal switch ON, normal contact 11 of relay CO, and through the closed contacts of the switch hook at substation A to ground at normal contact 12 of relay CO. The line relay LR, upon energization, establishes an energizing circuit for the relay 9, which may be traced from battery through the winding of said relay 9, normal contact 13 of said relay 9, and alternate contact 14 of relay LR to ground. Relay 9 upon energizing opens the circuit of relay LR at its contact 8 and rotates the switch shaft and its wipers one step. A further result due to the energization of relay 9 is the opening of its own circuit at its contact 13 as well as at contact 14 of relay LR. Upon the first step of the switch shaft, the

off-normal contacts ON assume their alternate position, and contacts 15 and 16 are also moved to their alternate position. The closure of alternate contact 15 places a ground or busy potential upon the private connector bank contacts of the calling line. The opening of alternate contact 14 of line relay LR brings about the de-energization of the relay 9, and should the private wiper 2 of the line switch B engage a busy contact 5 upon the first step of the wipers, a substitute circuit for the line relay LR is established, traced from battery through the winding of relay LR, normal contact 8 of relay 9, alternate contact 10 of off-normal contacts ON, and alternate contact 16 to ground at the busy contact 5 engaged by private wiper 2. The closure of the alternate contact 14 of the line relay LR again establishes a circuit for relay 9, as previously described, causing the switch wipers to take another step and engage the second set of contacts 5, 6 and 7. If the next private contact 5 is busy, relay 9 and line relay LR are again energized and de-energized to step the wipers 2, 3 and 4 step by step until an idle private contact 5 is encountered. When the contacts leading to an idle first selector C have been found, the line relay LR de-energizes, bringing about the de-energization of the magnet 9. The closing of normal contact 17 of relay LR establishes an energizing circuit for the cut-off relay CO traced from battery through the winding of the said relay CO, conductor 18 and normal contact 17 of relay LR to ground at alternate contact 15. The energization of the relay CO brings about the restoration of the contacts 15 and 16 to their normal position, opening the initial energizing circuit of the relay CO. As before stated, the operation and restoration of the contacts 15 and 16 to their normal position causes said contacts to be locked in such position by a spring-controlled member that retains contacts 15 and 16 in their normal position until the switch shaft returns to normal and moves the said spring-controlled member back to its normal position, thereby placing contacts 15 and 16 in a condition so that upon the next first rotary step of the shaft from normal, the said springs 15 and 16 are permitted to move to their alternate position. The return of the spring-controlled member to normal also restores the off-normal contact 10 to its normal position. The relay CO, being slow to release, has a substitute circuit established for it, as will be presently described, before it has had time to de-energize and permit its contacts to return to normal. The relay CO is adjusted not to pull up until relay LR de-energizes and a steady flow of current is established through its winding. The wipers 3 and 4 having engaged contacts 6 and 7 of the idle first selector C bring about the energization of the impulse relay IR of the said first selector C over a circuit traced from battery through the right hand winding of the relay IR, conductor 19, normal contact 20 of the relay T, bank contact 6, wiper 3, alternate contact 12 of relay CO, through the substation and back through alternate contact 11 of relay CO, wiper 4, bank contact 7, normal contact 21 of relay T, conductor 22, and through the left-hand winding of relay IR to ground. The closing of alternate contact 23 of relay IR establishes an energizing circuit for the relay 24 traced from battery through the upper winding of said relay 24, over conductor 25, and through alternate contact 23 of relay IR to ground at normal contact 26 of primary off-normal contacts PON. An energizing circuit for the relay 27 is also established when relay IR is energized, over a circuit traced from battery through the upper winding of the said relay 27, over conductor 25, and through alternate contacts 23 of relay IR to ground at normal contact 26. The closing of alternate contact 28 of relay 27 establishes a substitute circuit for the cut-off relay CO of the line switch B before it has had time to de-energize, said circuit being traced from battery through the winding of the relay CO, conductor 18, normal contact 17 of relay LR, normal contact 15, alternate contact 29 of relay CO, conductor 30, wiper 2, contact 5, conductor 31, and alternate contact 32 of relay 24 to ground at alternate contact 28 of relay 27, thus maintaining the relay CO of the switch B continuously energized until the conversation is terminated.

The idle first selector C having been selected by the line switch B, the subscriber at the calling substation A now actuates his calling device CD to call the first digit of the called number. Assuming that the number of the subscriber of the called substation E is 345, the subscriber at substation A actuates the calling device CD to send three impulses of current over the line, which impulses bring about three successive energizations and de-energizations of the impulse relay IR. Upon the first de-energization of the impulse relay IR, the circuit for the primary magnet PM is established, traced from battery through the winding of the magnet PM, normal contact 33 of the secondary off-normal contacts SON, conductor 34, normal contact 23, and conductor 25 to ground at alternate contact 35 of relay 24. The primary magnet PM is energized and de-energized three times due to the opening and closing of contact 23 of relay IR, which magnet operates to step the wipers 36, 37 and 38 of the first selector C in a primary direction to the third group of contacts corresponding with the desired second selector or connector. After the last impulse, the relay 27 de-energizes, due to a cir-

cuit being closed through the lower winding of the relay 27, traced from battery through the lower winding of the said relay, normal contact 39 of relay SM, alternate contact 40 of relay IR, and alternate contacts 41 and 26 of primary off-normal contacts PON to ground. The said primary off-normal contacts PON move to their alternate positions upon the first step of the wipers of the first selector C. The energizing circuit for relay 27 just mentioned is closed upon the first step of the wipers off normal, but the relay 27 does not de-energize during the sending of impulses, due to the construction and adjustment of the said relay 27. The differential relay 27 only receives short impulses of current during the operation of relay IR which do not affect the relay sufficiently to cause it to de-energize. As soon as the above-mentioned circuit through the lower winding of relay 27 is closed and receives a steady flow of current, the said differential relay 27 de-energizes. The opening of contact 28 of relay 27 disconnects ground from conductor 31 at this point but a substitute ground through alternate contact 26 of the primary off-normal contacts PON is substituted before said relay 27 de-energizes. The ground over conductor 31 also places a busy potential upon private contact 5, preventing any other individual line switch from engaging multiples of said contact. Owing to the construction and adjustment of differential relay 24, it is not de-energized during the rapid operation of relay IR. Upon the de-energization of the relay 27, an energizing circuit for the relay 42 is established, traced from battery through the winding of the said relay 42, normal contact 43 of relay T, normal contact 44 of secondary magnet SM, normal contact 45 of the secondary off-normal contact SON, normal contact 28 of relay 27, and alternate contact 32 of relay 24 to ground at alternate contact 26 of primary off-normal contacts PON.

The energization of the relay 42 establishes an energizing circuit for the secondary magnet SM, traced from battery through the winding of the said magnet to ground at alternate contact 46 of relay 42. Secondary magnet SM energizes and steps the wipers 36, 37 and 38 one step in a rotary secondary direction to engage the first set of contacts 47, 48 and 49. The energization of the secondary magnet SM brings about the restoration of the relay 42 due to the opening of normal contact 44 of said magnet SM. The opening of contact 39 of magnet SM again permits the energization of relay 27 by opening the circuit of its lower winding. The restoration of the relay 42 opens its alternate contact 46, bringing about the restoration of the secondary magnet SM. Upon the first step of the wipers 36, 37 and 38, the secondary off-normal contacts SON assume their alternate position, and the opening of the normal contact 45 of secondary off-normal contacts SON removes the initial ground from the relay 42; and should the private wiper 36 of the first selector C engage a contact leading to a busy connector D, an energizing circuit for the relay 42 is again established over a circuit traced from battery through the winding of the relay 42, normal contact 43 of relay T, normal contact 44 of magnet SM, alternate contact 50 of relay 24, alternate contact 51 of relay 27 and wiper 36 to the grounded busy contact 47. The closing of the alternate contact 46 of relay 42 brings about the energization of secondary magnet SM, as before described. The relay 42 and magnet SM are thus alternately energized and de-energized to step the wipers 36, 37 and 38 in a secondary direction to seek the contacts of an idle connector switch D. When a contact 47 leading to an idle connector as D is encountered by the wiper 36, the energizing circuit of the test relay 42 is maintained opened, thereby preventing further energizations of the secondary magnet SM. It will thus be seen that by this see-saw action of relay 42 and magnet SM a positive driving operation of the secondary magnet is secured, and that it is impossible to stop the selector C on a busy contact or to drive the said selector past an idle contact because unless relay 42 is energized magnet SM cannot be energized and relay 42 can only be energized when magnet SM is at normal and private wiper 36 is resting on a busy contact.

The relay 27 does not de-energize during the secondary movement of the wipers, due to its adjustment and the rapidity of the interruptions of normal contact 39 of secondary magnet SM. The closure of normal contact 39 of secondary magnet SM, after its last de-energization, closes a circuit for the lower winding of the relay 27 over a circuit previously described, and due to its differential action it de-energizes. Upon the restoration of the relay 27, an energizing circuit for the relay T is established, traced from battery through the winding of the said relay T, alternate contact 45 of the secondary off-normal contacts SON, normal contact 28 of relay 27, alternate contact 32 of relay 24 to ground at alternate contact 26 of primary off-normal contacts PON. The opening of normal contacts 20 and 21 of relay T opens the energizing circuit of the impulse relay IR. The relay IR upon de-energizing closes a circuit through the lower winding of the relay 24 traced from battery through the said lower winding, normal contact 23 of said relay IR, to ground at alternate contact 35 of said relay 24. The relay 24, due to its differential windings, neutralizes and

restores to normal. The relay 24 restoring, opens the circuit of relay 27, permitting the said relay 27 to restore. The closing of alternate contacts 20 and 21 of relay T extends the connection of the calling subscriber A to the idle connector D, engaged by wipers 36, 37 and 38 of selector C. The closing of alternate contacts 20 and 21 of relay T brings about the energization of the impulse relay IR¹ of connector D over a circuit traced from ground through the right-hand winding of said relay IR¹, bank contact 49, wiper 38, alternate contact 21 of relay T, bank contact 7, wiper 4, alternate contact 11 of relay CO, through the substation A, the alternate contact 12 of relay CO, wiper 3, bank contact 6, alternate contact 20 of relay T, wiper 37, bank contact 48, and through the left-hand winding of the interrupter relay IR¹ to battery and ground. The restoration of the relay 24 of the first selector C opens the initial energizing circuit of relay T of the first selector C, but the relay T being slow to release has a substitute circuit established for it, traced from battery through the winding of said relay, its alternate contact 52, wiper 36, bank contact 47, conductor 53, and conductor 54 to ground at alternate contact 55 of the impulse relay IR¹ before it has had time to de-energize. The said relay T remains energized until the termination of the conversation.

The energization of the relay IR¹ brings about the energization of the relays 56 and 57, the circuit of relay 56 extending from battery through the right-hand winding of said relay, normal contact 58 of the primary off-normal contacts PON¹, conductor 53 and conductor 54 to ground at alternate contact 55 of relay IR¹. The circuit for relay 57 extends from battery through the lower winding of the relay 57, conductor 59, conductor 60, and alternate contact 61 of the relay IR¹ to ground at alternate contact 55 of impulse relay IR¹. Upon the energization of relay 56, a locking circuit is closed for the said relay 56 extending from battery through its alternate contact 62 to ground. A circuit is closed through the upper winding of relay 57 at contact 100 of relay 56 when it energizes. The closing of this circuit causes the relay 57 to be de-energized due to its differential construction. However, the de-energization of relay 57 is without effect at this time because the instant the impulse relay IR¹ is de-energized when the subscriber starts to send impulses, the circuit through the lower winding of relay 57 is opened and the said relay instantly energizes and remains in its energized condition during the period that the impulse relay IR¹ is operated.

The subscriber now operates his calling device CD to send the second series of impulses, which are four in number, over the line. These four impulses bring about four de-energizations and energizations of the relay IR¹, causing the primary magnet PM¹ to energize and de-energize four times to step the wipers 63, 64 and 65 in a primary direction to the fourth group of contacts containing the contacts of the called line. The circuit of the primary magnet PM¹ may be traced from battery through the winding of the said magnet, normal contact 66 of switching relay SW, conductor 67, alternate contact 68 of relay 57, normal contact 61 of relay IR¹, conductor 54, conductor 53, and normal contact 58 of the primary off-normal contacts PON¹ to ground at alternate contact 62 of relay 56. The primary off-normal contacts PON¹ assume their alternate positions upon the first step of the wipers off normal. The opening of the primary off-normal contact 58 substitutes the ground fed from contact 69 of relay 70 for the ground fed through contact 62 of relay 56. After the last impulse of the series has been sent, the steady flow of current through both windings of relay 57 causes the said relay 57, due to its differential action, to neutralize and restore its contacts to normal. Relay 57 does not restore during the sending of impulses due to its adjustment, construction and the rapidity of the interruptions of contact 61. The closing of normal contact 71 of relay 57 brings about the energization of the switching relay SW traced from battery through the winding of said relay SW, the make-before-break contact 72 of said relay SW, normal contact 73 of secondary off-normal contacts SON¹, conductor 74, normal contact 71 of relay 57, and conductor 75 to ground at alternate contact 76 of primary off-normal contacts PON¹, the said primary off-normal contacts PON¹ having been moved to their alternate position on the first step of the wipers 63, 64 and 65 of the connector switch D. The closing of alternate contact 85 of relay SW closes a locking circuit for itself traced from battery through the winding of relay SW, alternate contact 85, conductor 86, normal contact 87 of relay TCR, conductor 75 to ground at alternate contact 76 of primary off-normal contacts PON¹. The said relay SW remains energized until the relay TCR is actuated, as will be presently described. The closing of alternate contact 66 of the switching relay SW now renders the secondary magnet SM¹ operative so that when the calling subscriber at the substation A actuates his call device again to send the last set of impulses, which we have assumed are five in number, the said magnet SM¹ will be energized and de-energized by the impulse relay IR¹ five times over a circuit traced from battery through the winding of the said magnet SM¹, alternate contact 66 of relay SW, conductor 67, alternate contact 68 of re-

lay 57, normal contact 61 of relay IR[1], conductor 54, conductor 53, alternate contact 58 of the primary off-normal contacts PON[1], and conductor 77 to ground at normal contact 69 of relay 70. The secondary magnet SM[1] now steps the wipers 63, 64 and 65 in a secondary direction to engage contacts 78, 79 and 80 of the called line. Upon the first impulse of the last set, that is, upon the opening of contact 61 of relay IR[1] the relay 57 again energizes to permit the secondary magnet SM[1] to be operated, and after the last impulse the relay 57 is again de-energized by having a circuit closed through its lower winding, as previously described. The restoration of the relay 57 closes a circuit for the relay TCR traced from battery through the winding of the said relay, conductor 81, alternate contact 82 of relay SW, alternate contact 73 of the secondary off-normal contacts SON[1], (said contacts having been moved to their alternate position upon the first step of the wipers in their secondary direction) conductor 74, normal contact 71 of relay 57, conductor 75 to ground at alternate contact 76 of the primary off-normal contacts PON[1], thus causing the said relay TCR to energize. The relay TCR, upon energizing, opens the locking circuit of relay SW at its contact 87, permitting the said relay to de-energize. The relay SW de-energizing opens the circuit of the relay TCR at its contact 82, leaving the relay TCR dependent upon the potential found on the private contact 78 of the called line.

The closing of alternate contact 90 of relay TCR connects the test relay TR in multiple circuit with the said relay TCR to the test wiper 63, the circuit of the test relay TR being traced from battery through the winding of said relay, its make-before-break contact 94, conductor 95, normal contact 82 of relay SW, conductor 81, alternate contact 90 of relay TCR, conductor 91, normal contact 92 of relay TR, conductor 93 to the test wiper 63. The circuit of the relay TCR may be traced from battery through the winding of the said relay, its alternate contact 90, conductor 91, normal contact 92 of relay TR and conductor 93 to the wiper 63.

Called line idle.

Assuming that the called line is idle, private contact 78 of the called line will have a battery potential upon it and the relay TR will not be energized but will remain at normal and the relay TCR failing to find a ground upon wiper 63 returns to normal, having its initial energizing circuit opened at alternate contact 82 of relay SW, as before described.

The relay TCR de-energizing brings about the energization of the relay 70 over a circuit traced from battery through the cut-off relay CO[1] of the individual line switch B[1], bank contact 78, through wiper 63, conductor 93, normal contact 92 of relay TR, conductor 91, normal contact 90 of relay TCR, conductor 96, normal contact 97 of relay SW, conductor 98, through the lower winding of the relay 70, conductor 99, to ground at alternate contact 100 of the relay 56. Relays 70 and CO[1] energize over this circuit. Relay CO[1] upon energizing, removes the called subscriber's control of the line switch B[1].

The closing of alternate contact 101 of relay 70 short-circuits the lower winding of the said relay and feeds ground to the cut-off relay CO[1] of the line switch B[1], and at the same time supplies the busy potential to the multiple private contacts of the called line. The closing of alternate contact 102 of relay 70 closes a circuit through the upper winding of said relay 70 traced from battery through its winding, the alternate contact 102 of said relay 70, and conductor 99 to ground at alternate contact 100 of relay 56. The closing of alternate contact 103 of the relay 70 closes a circuit for ringing current from generator GR to signal the called subscriber's substation, the path of said ringing current being traced from battery 125 through the ringing generator GR, through the live segment of the interrupter I, through the winding 104 of ringing trip relay RT, conductor 105, alternate contact 103 of relay 70, conductor 106, normal contact 107 of relay RT, wiper 65, contact 80, through the call bell and condenser of the called substation E, back through contact 79, wiper 64, normal contact 108 of relay RT and conductor 109, to ground at alternate contact 69 of relay 70. The ringing current is intermittently connected to the called line due to the constantly rotating interrupter I, thus bringing about an intermittent actuation of the call signal at the called subscriber's substation E. The interrupter I is so arranged that ringing current from the generator GR and battery 110 are alternately connected to the called line so that should the subscriber answer in either a silent or a ringing period, ringing current is instantly disconnected, thus eliminating the undesirable feature of ringing the answering subscriber at the called substation in the ear should the subscriber remove his receiver during a ringing period. During the ringing and silent periods, and before the subscriber at the called substation E answers, the condenser at the said substation prevents a flow of battery through the winding 104 of the relay RT. The subscriber in response to the call signal removes his receiver, and should he remove it during a live period the combined generator and battery current of the generator GR and battery 125 bring about the energization of the relay RT over a circuit traced from battery 125 through the said generator

GR, through the interrupter I, the upper winding 104 of relay RT, conductor 105, alternate contact 103, conductor 106, normal contact 107, wiper 65 and contact 80, through the now closed contacts at the substation switch hook, back through contact 79, wiper 64, normal contact 108, conductor 109, to ground at alternate contact 69. The relay RT energizes over the circuit just traced and closes a locking circuit for itself, traced from battery through the lower winding 111 of relay RT, its alternate contact 112, and conductor 75 to ground at alternate contact 76 of the primary off-normal contacts PON[1]. Should the subscriber remove his receiver from the switch hook during a silent period, the relay RT will energize over a circuit from battery 110 through the live battery segments of the interrupter I, the upper winding 104 of relay RT, and over the previously described path to ground at alternate contact 69, which causes the relay RT to energize and close the locking circuit for itself through its winding 111, as before described. Thus it may be seen that ringing current is instantly disconnected from the called line either during live or silent periods by the opening of contacts 107 and 108 of relay RT. Upon the energization of the relay RT, an energizing circuit for the supervisory relay SR is established traced from battery through the lower winding of said relay SR, alternate contact 107 of relay RT, wiper 65, contact 80, through the substation back to the contact 79, wiper 64, alternate contact 108 of relay RT and through the upper winding of the relay SR to ground. The subscribers are now in conversational circuit and the talking circuit may be traced over the heavily marked conductors, the said conductors having the condensers K and K[1] interposed.

The subscribers having finished conversation, and assuming that the subscriber at the substation A is the first to replace his receiver upon its switch hook, the opening of the switch hook contacts brings about the de-energization of the impulse relay, IR[1] of the connector D. The restoration of the relay IR[1] brings about the opening of the holding circuit of the relay T of the first selector C, and the closing of normal contact 43 of the restored relay T of the first selector C closes an energizing circuit for the relay 42 which may be traced from battery through the winding of the relay 42, normal contact 43, normal contact 44 of magnet SM, normal contact 50 of relay 24, and alternate contacts 41 and 26 of primary off-normal contacts PON to ground. The closing of alternate contact 46 of the relay 42 brings about the energization of the secondary magnet SM. The relay 42 and the secondary magnet SM are alternately energized and de-energized, as previously described, the secondary magnet SM thus stepping the wipers 36, 37 and 38 beyond the last contacts of the row of bank contacts, from which point the wipers are restored to normal. The secondary off-normal contacts SON and primary off-normal contacts PON restore to normal, and the opening of alternate contact 26 of the primary off-normal contacts PON opens the energizing circuit of the cut-off relay CO of the individual line switch B. The restoration of the cut-off relay CO of the line switch B brings about the restoration to normal of the wipers 2, 3 and 4 of said individual switch B. The subscriber E placing his receiver upon the switch hook interrupts the circuit of the relay SR of the connector D at the switch hook contacts, causing the said relay to de-energize. The closing of normal contact 130 of relay SR closes a circuit through the left-hand winding of the relay 56, which may be traced from battery through the said left-hand winding of relay 56 through its alternate contact 131, conductor 132, normal contact 130, and conductor 133 to ground at normal contact 55 of the relay IR[1]. Due to the differential construction of the relay 56, the said relay neutralizes and restores to normal. The closing of normal contact 134 of relay 56 closes the circuit of secondary magnet SM[1], which may be traced from battery through the winding of said secondary magnet SM[1], conductor 135, normal contact 134 of relay 56, alternate contact 136 of primary off-normal contacts PON[1], through the interrupter I[1] to ground. The secondary magnet SM[1] thus steps the wipers 63, 64 and 65 beyond the last set of contacts in the group, and the wipers then restore to normal from this position. The restoration of the relay 56 also brings about the opening of the circuit of the relay 70 at alternate contact 100, bringing about the restoration of the said relay 70. The primary off-normal contacts PON[1] having restored upon the restoration of the switch, the opening of alternate contact 76 of the contact SPON[1] brings about the restoration of the relay RT. The relay 56 also causes the de-energization of cut-off relay CO[1] of the line circuit B[1], which is associated with the called subscriber's substation E. All of the apparatus used in establishing the connection between the calling subscriber at the substation A and the called subscriber at the called substation E is now at normal and available for use in establishing other connections.

Assuming now that the subscriber at the called substation E is the first to replace his receiver upon the switch hook, the opening of the switch hook contacts at the substation E brings about the de-energization of the relay SR. Nothing else happens at this time as the relay IR[1] is still maintained energized over the line of the calling sub-

station A. The calling subscriber at the substation A replacing his receiver interrupts the circuit of the impulse relay IR^1 at the switch hook contacts. The relay IR^1 de-energizing, closes a circuit through the left-hand winding of relay 56, causing the said relay to de-energize, as herein-before described. The restoration of the individual switch B, first selector C and connector D is the same as previously described from this point on.

Should the called subscriber E fail to replace his receiver upon the switch hook after the conversation is terminated, the replacing of the receiver at the substation A brings about the de-energization of the impulse relay IR^1 of connector D, the same as before, and the opening of alternate contact 55 of the impulse relay IR^1 opens the circuit of the relay T of the first selector C, as before described, and causes the release of the selector C and individual switch B. The subscriber at the called substation failing to replace his receiver upon the switch hook permits the continued energization of the relay SR, thus holding contact 130 of said relay in its alternate position, preventing the differentially wound relay 56 from restoring to normal and closing the energizing circuit for the secondary magnet SM^1. The relay 57 energizes when the impulse relay IR^1 drops back but is immediately restored to normal due to the closure of an energizing circuit through the lower winding of the said relay 57, which may be traced from battery through the lower winding of the relay 57, conductor 59, conductor 60, alternate contact 130, conductor 133, to ground at normal contact 55 of the now restored impulse relay IR^1. The relay 57 being differentially wound restores to normal, and the closing of normal contact 140 of said relay 57 places a ground upon the private contact of the connector D over a circuit which may be traced from ground to alternate contact 76 of primary off-normal contacts PON^1, through conductor 75, normal contact 71 of relay 57, conductor 74, alternate contacts 73, normal contact 140 of relay 57, alternate contact 141 of secondary off-normal contacts SON^1 and conductor 53 to the private contact 47. The placing of the busy potential upon the private contact prevents any first selector switch C from engaging the contacts of this busy connector.

Called line busy.

Assuming now that the called line is busy, the operation of the circuit is the same up to and including the time when the relay TCR energizes, as previously described. The line being busy, private contact 78 has a busy potential placed upon it, thus closing the multiple circuit for the relay TCR and the test relay TR, the circuit of the relay TCR being traced from battery through the winding of the said relay TCR, its alternate contact 90, conductor 91, normal contact 92 of relay TR, conductor 93, to the busy grounded private contact 78. The circuit of the test relay TR is traced from battery through the winding of the said relay TR, the make-before-break contact 94 of said relay, conductor 95, normal contact 82 of relay SW, conductor 81, alternate contact 90 of relay TCR, conductor 91, normal contact 92 of relay TR, conductor 93 and wiper 63 to ground at busy private contact 78. The contacts 94 and 92 of the relay TR are so adjusted that the alternate contact 150 makes before the contact 92 breaks, thus closing a locking circuit for relay TR through its alternate contact 150 before the normal contact 92 of the said relay breaks. The locking circuit of the said relay TR extends from battery through the alternate contact 150 of the relay TR, conductor 151, to ground at alternate contact 76 of primary off-normal contacts PON^1. The locking circuit for the said test relay TR is independent of the grounded private contact and the opening of the normal contact 92 of the relay TR opens the circuit for the relay TCR which restores to normal. The falling back of relay TCR does not affect relay 70 due to the fact that the test conductor 93 is held open at contact 92 of relay TR. The locking circuit for the test relay TR is thus independent of the busy grounded contact 78. This arrangement does away with the method usually employed of locking the busy relay up to the busy private contact of the called busy line. The closing of alternate contact 152 of relay TR connects the busy-back signal BB to the calling line to transmit a busy signal to the said calling subscriber at the substation A, thus notifying him of the busy condition of the said called substation E.

The calling subscriber now replaces his receiver upon the switch hook, bringing about the de-energization of IR^1. The relay IR^1 restoring opens the circuit for the relay T of first selector C, which closes the circuit of the secondary magnet SM, as previously described, thus bringing about the release of the first selector C and individual switch B. The relay IR^1 deenergizing brings about the restoration of the relay 56, due to the fact that the relay SR is not energized. The closing of normal contact 134 of the said relay 56 closes the circuit for the secondary magnet SM^1 which magnet steps the wipers 63, 64 and 65 beyond the last set of contacts. The wipers then restore to normal. Primary off-normal contacts PON^1 and secondary off-normal contacts SON^1 are also restored. The apparatus used in this busy connection is now at normal and available for use in establishing other connections.

Should the called line become idle during the time of the transmission of the busy signal and the time the calling subscriber replaces his receiver, nothing happens as the contact 92 of relay TR is in its alternate position, preventing the energization of relay 70, and thus preventing ringing current from being sent out to the now idle called line.

While I have shown a system of 1,000-line capacity, it is to be understod that by inserting second selectors this system may be increased to 10,000 lines, etc.

While I have described my invention operating in connection with a well-known system, I do not wish to be limited to this exact disclosure as my invention may be applied to other systems without departing from the spirit of the invention, and I, therefore, do not wish to be limited to this exact disclosure but aim to cover all such changes and modifications as come 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 including a called subscriber's line, a connector switch for extending a connection to said called subscriber's line, a test circuit for said connector switch, a test control relay and a test relay for said connector switch, means for momentarily energizing said test control relay, contacts controlled by said test control relay for connecting said test relay to a test contact of the called line, and means controlled by said test relay if said called line is busy to interrupt said test circuit.

2. A telephone system including a called subscriber's line, a connector switch for extending a connection to said called subscriber's line, testing mechanism for said connector switch including a test conductor and a test control relay, a test relay for said connector switch, means for energizing said test control relay, contacts controlled by said test control relay for connecting said test relay to said test conductor, and means controlled by said test relay for interrupting the said test conductor if said called line is busy.

3. A telephone system including a called subscriber's line, a connector switch for extending a connection to said called line, testing mechanism for said connector switch including a test conductor and a pair of cooperating relays, means for energizing one of said relays whereby said pair of relays are connected to said test conductor, self-locking means for maintaining the other of said relays in an energized position if said called line tests busy, and means controlled by said last relay for interrupting the circuit of said test conductor.

4. A telephone system including a calling subscriber's line and a called subscriber's line, an automatic connector switch provided with a line relay controlled over the two sides of said calling line in series for extending a connection to said called subscriber's line, a differential secondary relay for said connector switch, testing mechanism for said connector switch including a test conductor, means controlled by said differential relay for associating said testing mechanism with said called subscriber's line, and means controlled by said testing mechanism for maintaining said test conductor open if said called line tests busy.

5. A telephone system including a calling and a called subscriber's line, an automatic connector switch provided with a line relay controlled over the two sides of the calling line in series for extending a connection to said called subscriber's line, a differential secondary relay for said connector switch, testing mechanism for said connector switch including a test conductor, means controlled by said differential relay for associating said testing mechanism with said called subscriber's line over said test conductor, means controlled by said testing mechanism for opening said test conductor, and a locking circuit for said test mechanism independent of said test conductor.

6. A telephone system including a calling and a called subscriber's line, a side switchless connector switch for extending a connection to said called line, a line relay individual to said connector switch controllable over the two sides of said calling subscriber's line in series, testing mechanism for said connector switch including a test conductor and a test relay, means controlled by said line relay for associating said test relay with said called subscriber's line, self-locking means for said test relay for holding it in an energized position if the called subscriber's line test busy, and means controlled by said test relay for maintaining said test conductor open until said connector is released to normal.

7. A telephone system including a calling and a called subscriber's line, an automatic side-switchless connector switch provided with a line relay controllable over the two sides of said calling line in series for establishing connection with said called subscriber's line, testing mechanism for said connector switch including a test conductor adapted to be connected to a test contact of said called subscriber's line and a test relay, means controlled by said line relay for connecting said test relay to said test contact, a local locking circuit for said relay adapted to be closed if said called line tests busy, and means controlled by said relay for maintaining said test conductor open until said connector switch is restored to normal.

8. A telephone system including a calling and a called subscriber's line, a connector

switch provided with a line relay for connecting said lines in conversational circuit, a differential switching relay for said connector switch, testing mechanism for said connector switch including a test conductor, means controlled by said differential relay for associating said test mechanism with said called subscriber's line, and means controlled by said test mechanism for maintaining said test conductor open if said called subscriber's line tests busy.

9. A telephone system including a calling subscriber's line, a connector switch provided with a differential switching relay for establishing connection with said called subscriber's line, testing mechanism and a test conductor for said connector switch, means controlled by said differential relay for associating said test mechanism with said called subscriber's line, and means controlled by said test mechanism for interrupting said test conductor and maintaining it open until said connector is released if said called line tests busy.

10. A telephone system including a called subscriber's line, a connector switch for extending a connection to said called subscriber's line, a differential switching relay for said connector switch, automatic ringing mechanism for said connector switch, means controlled by said differential relay for associating said ringing mechanism with said called subscriber's line, said automatic ringing mechanism comprising means for instantaneously disconnecting itself from said called subscriber's line when said called subscriber responds during either a ringing or a silent period.

11. A telephone system including a calling and a called subscriber's line, a side-switchless connector switch, a switch shaft for said connector switch provided with wipers adapted to be moved in one direction to select a group of lines and in a plane at right angles thereto to establish connection with said called subscriber's line. a line relay for said connector switch controllable over the two sides of the calling subscriber's line in series, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with said called subscriber's line, said ringing mechanism being controllable by the response of the called subscriber to instantaneously disconnect or cut off the ringing current from the called line.

12. A telephone system including a called subscriber's line, a connector switch for extending a connection to said called subscriber's line, testing mechanism for said connector switch including a test conductor and a test control relay, a test relay for said connector switch, means for energizing said test control relay, contacts controlled by said test control relay for connecting said test relay to said test conductor, means controlled by said test relay for opening said test conductor whereby said test control relay is caused to de-energize and all connector switch mechanism disconnected from said test conductor, and a local locking circuit for said test relay.

13. A telephone system including a called subscriber's line, a side-switchless connector switch for extending a connection to said called line, testing mechanism for said connector switch including a test conductor and a pair of co-operating relays, means for energizing one of said relays whereby said pair of relays are connected to said test conductor, self-locking means for maintaining the other of said relays in an energized position if said called line tests busy, and means controlled by said last relay for interrupting the circuit of said test conductor thereby causing the de-energization of said first relay and disconnecting all connector switch mechanism of the connector switch from the test contact of the called line.

14. A telephone system including a calling subscriber's line and a called subscriber's line, a side-switchless connector switch, a switch shaft for said connector provided with contact makers adapted to be moved in one direction to select groups of lines and in another direction in a plane at right angles to complete connection between said calling and called subscribers' lines, a line relay for said connector switch controllable over the two sides of the calling line in series for effecting such connection, signaling current, a relay, automatic means for intermittently connecting said current through a winding of said relay to said called subscriber's line, said relay being adapted to be energized when the called subscriber responds during either a silent or ringing period to disconnect said signaling current from said called subscriber's line.

15. A telephone system including a calling subscriber's line and a called subscriber's line, a connector switch for use in extending a connection from said calling subscriber's line to said called subscriber's line, a differential switching relay individual to said connector switch, testing means for said connector switch including a test conductor adapted to be connected to a test contact of the called subscriber's line, means controlled by said differential switching relay for operatively associating said testing mechanism with said called subscriber's line, and means controlled by said testing means for interrupting the said test conductor thereby disconnecting all mechanism of the connector switch from said called subscriber's line.

16. A telephone system including a called subscriber's line, a side-switchless connector switch for connection to said called sub-

scriber's line, a differential switching relay for said connector switch, testing mechanism including a test conductor and a test relay, a circuit for said test relay including said test conductor, and a locking circuit for said testing relay independent of said test conductor, said test relay operating to interrupt said test conductor when energized.

17. A telephone system including a called subscriber's line, a side-switchless connector switch for establishing connection therewith, a differential switching relay for said connector switch, a switching relay controlled by said differential relay, a test relay, a test control relay adapted to be energized by an operation of said differential relay, contacts controlled by said test control relay for de-energizing said switching relay and for connecting said test relay and said test control relay in multiple to a test contact of said called subscriber's line, whereby said test relay is energized if said subscriber's line tests busy, and a local locking circuit for said test relay independent of the energizing circuit of said test relay.

18. A telephone system including a calling subscriber's line, a side-switchless connector switch for establishing connection therewith, a differential switching relay for said connector switch, a switching relay controlled by said differential relay, a test relay, a test control relay adapted to be energized by an operation of said differential relay, contacts controlled by said test control relay for de-energizing said switching relay and for connecting said test relay and said test control relay in multiple to a test contact of said called subscriber's line, whereby said test relay is energized if said subscriber's line tests busy, contacts controlled by said test relay for opening the circuit of said test control relay, and a local locking circuit for said test relay for maintaining said multiple circuit open during the time said connector is in use.

19. A telephone system including a calling subscriber's line, a connector switch for establishing connection with said called subscriber's line, a differential switching relay for said connector switch, ringing mechanism, means controlled by said switching relay for connecting said ringing mechanism with said called subscriber's line if said called subscriber's line tests idle, and means controlled by said called subscriber for immediately disconnecting said ringing mechanism from said called subscriber's line when he responds.

20. A telephone system including a called subscriber's line, a calling subscriber's line, a side-switchless connector switch operable over the two sides of said calling subscriber's line in series for connecting to said called subscriber's line, signalling means associated with said connector switch, a trip relay, a control relay for connecting said signalling means through a winding of said trip relay to the said called subscriber's line, means for intermittently applying said signalling means to said called subscriber's line, and a circuit for said trip relay effective upon a response of the called subscriber during either a ringing or a silent period.

21. A telephone system including a called subscriber's line, a side-switchless connector switch for establishing a connection therewith, a switch shaft for said connector having movable contact makers adapted to be moved in a vertical plane to select groups of subscribers' lines and to be rotated in a plane at right angles thereto to select the subscribers' lines, a signalling generator, a ringing relay, means for connecting current from said signaling generator through the winding of said ringing relay to said called subscriber's line, means for intermittently interrupting the circuit of said ringing current, and substation controlled means responsive to an act on the part of the called subscriber for energizing said ringing relay during either a ringing or a silent period, and a locking circuit for said ringing relay independent of said energizing circuit.

22. A telephone system including a calling and a called subscriber's line; a connector switch for use in connecting said calling subscriber's line with said called subscriber's line; a line relay for said connector switch controllable over the two sides of said calling line in series; a differential switching relay for said connector switch controllable by said line relay; automatic ringing mechanism; a test control relay controllable by said switching relay and adapted upon being connected to said called line, if said called line is in an idle condition, to connect said ringing apparatus to said calling subscriber's line, and a relay controllable over the two sides of the called line in series to instantaneously disconnect said ringing mechanism when said called subscriber responds.

23. A telephone system including a calling and a called subscriber's line; an automatic connector switch, provided with a line relay controlled over the two sides of the calling line in series, for extending a connection to said called subscriber's line; a differential secondary relay for said connector switch for controlling a secondary switching circuit; automatic ringing mechanism for said connector switch; and means controlled by said line relay for associating said ringing mechanism with said called subscriber's line; said ringing mechanism being responsive to a control exercised at the called subscriber's substation during either a ringing or a silent interval to disconnect said ringing mechanism from association with said called subscriber's line.

24. A telephone system including a called subscriber's line, a connector switch having motion in two directions for extending a connection to said called subscriber's line, a line relay for said connector switch controlled over the two sides of a calling subscriber's line in series, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with said called subscriber's line, said ringing mechanism being controllable over the called subscriber's line during either a ringing or a silent interval to disconnect itself from association with said called subscriber's line, and a differential release relay for said connector switch controllable by said line relay for controlling the release of said connector switch.

25. A telephone system including a called subscriber's line, a connector switch having motion in two directions for extending a connection to said called subscriber's line, a line relay for said connector switch controlled over the two sides of a calling subscriber's line in series, signaling current, a relay, automatic means for intermittently connecting said current through a winding of said relay to said called subscriber's line, said relay being adapted to be energized when the called subscriber responds during either a silent or a ringing period to prevent a reapplication of signaling current to said called subscriber's line or to disconnect said signaling current from said called subscriber's line, depending upon whether a response is had during a silent or a ringing period, respectively, and a differential release relay for said connector switch controllable by said line relay.

26. A telephone system including a called subscriber's line, a connector switch having motion in two intersecting planes for extending a connection to said called subscriber's line, a line relay controllable over the two sides of a calling subscriber's line in series for controlling the motions of said connector switch, a secondary differential relay controllable by said line relay for assisting in the control of said connector switch, automatic ringing mechanism for said connector switch adapted to be associated with the called subscriber's line to intermittently operate the call bell at the called substation, and means included in said ringing mechanism responsive to a control exercised at the called substation during either a ringing or a silent interval to disassociate said ringing mechanism from said called subscriber's line.

27. A telephone system including a called subscriber's line and a calling subscriber's line, a side-switchless connector switch for connecting said calling subscriber's line to said called subscriber's line, a line relay for said connector switch controllable over the two sides of the calling subscriber's line in series for effecting such connection, automatic ringing means for said connector, a differentially wound relay for said connector switch for controlling the association of said automatic ringing means with said called subscriber's line, and means included in said automatic ringing means controlled over the called subscriber's line for disassociating said ringing means from said called subscriber's line.

28. A telephone system including subscribers' lines arranged in groups, an automatic side-switchless connector switch for connecting two of said subscribers' lines in telephonic conversation, movable contact makers for said connector switch adapted to be moved in one direction to select groups of lines and to be moved in a second direction in a plane at right angles to the plane of first movement to a line in the elected group, a line relay for said connector switch controllable over the two sides of a calling one of said subscriber's lines in series for controlling the movements of said contact makers, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with the called one of said subscribers' lines, said ringing mechanism being controlled by the response of the called subscriber to instantaneously disconnect or prevent a reapplication of ringing current to the called line.

29. A telephone system including subscribers' lines arranged in groups, an automatic side-switchless connector switch for connecting two of said subscribers' lines in telephonic conversation, movable contact makers for said connector switch adapted to be moved in one direction to select groups of lines and to be moved in a second direction in a plane at right angles to the plane of first movement to a line in the elected group, a line relay for said connector switch controllable over the two sides of a calling one of said subscribers' lines in series for controlling the movements of said contact makers, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with the called one of said subscribers' lines, said ringing mechanism including a relay adapted to be energized when the called party responds during a ringing interval to disconnect said ringing mechanism from the called subscriber's line, off-normal contacts, and a locking circuit for said relay extending through said off-normal contacts.

30. A telephone system including subscribers' lines arranged in groups, an automatic side-switchless connector switch for connecting two of said subscribers' lines in telephonic conversation, movable contact makers for said connector switch adapted to be moved in one direction to select groups

of lines and to be moved in a second direction in a plane at right angles to the plane of first movement to a line in the elected group, a line relay for said connector switch controllable over the two sides of a calling one of said subscribers' lines in series for controlling the movements of said contact makers, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with the called one of said subscribers' lines, said ringing mechanism including a relay adapted to be energized when the called party responds during a ringing interval to disconnect said ringing mechanism from the called subscriber's line, said relay also being responsive during a silent interval to prevent a reapplication of ringing current from said ringing mechanism to said called subscriber's line.

31. A telephone system including subscribers' lines arranged in groups, an automatic side-switchless connector switch for connecting two of said subscribers' lines in telephonic conversation, movable contact makers for said connector switch adapted to be moved in one direction to select groups of lines and to be moved in a second direction in a plane at right angles to the plane of first movement to a line in the elected group, a line relay for said connector switch controllable over the two sides of a calling one of said subscribers' lines in series for controlling the movements of said contact makers, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with the called one of said subscribers' lines, and substation-controlled means responsive to an act on the part of the called subscriber during a ringing interval to disconnect the ringing mechanism from the called subscriber's line and during a silent interval to prevent a reapplication of ringing current from said ringing mechanism to said called subscriber's line, said last means when actuated remaining in its actuated position until said connector switch is released.

32. A telephone system including a called subscriber's line, a side-switchless connector switch for establishing connection therewith, contact makers for said switch, a magnet for moving said contact makers in one direction, a second magnet for moving said contact makers in another direction in a plane at right angles thereto, an impulse relay for said connector switch controllable over the two sides of a calling subscriber's line in series, an auxiliary relay provided with individually controlled contacts for switching the impulse circuit controlled by said impulse relay from one of said magnets to the other of said magnets, a signaling generator, a ringing relay, means for connecting current from said signaling generator through the winding of said ringing relay to said called subscriber's line, means for intermittently interrupting the circuit of said ringing current, and substation-controlled means responsive to an act on the part of the called subscriber for energizing said ringing relay during either a ringing or a silent period, and a locking circuit for said ringing relay independent of said energizing circuit.

33. A telephone system including a called subscriber's line, a side-switchless connector switch for establishing connection therewith, contact makers for said switch, a magnet for moving said contact makers in one direction, a second magnet for moving said contact makers in another direction in a plane at right angles thereto, an impulse relay for said connector switch controllable over the two sides of a calling subscriber's line in series, an auxiliary relay provided with individually controlled contacts for switching the impulse circuit controlled by said impulse relay from one of said magnets to the other of said magnets, signaling current, a relay, automatic means for intermittently connecting said current through a winding of said relay to said called subscriber's line, said relay being adapted to be energized when the called subscriber responds during either a silent or a ringing period to disconnect said signaling current from said called subscriber's line.

34. A telephone system including a called subscriber's line, a side-switchless connector switch for establishing connection therewith, contact makers for said switch, a magnet for moving said contact makers in one direction, a second magnet for moving said contact makers in another direction in a plane at right angles thereto, an impulse relay for said connector switch controllable over the two sides of a calling subscriber's line in series, an auxiliary relay provided with individually controlled contacts for switching the impulse circuit controlled by said impulse relay from one of said magnets to the other of said magnets, automatic ringing mechanism for said connector switch, means controlled by said line relay for associating said ringing mechanism with said called subscriber's line, said ringing mechanism being controllable by the response of the called subscriber to instantaneously disconnect or cut off the ringing current from the called line, and means for preventing a reapplication of ringing current to the called line until after the connector switch has been returned to normal and is again operated to connect with an idle line.

Signed by me at Chicago in the county of Cook and State of Illinois, this 30th day of July, 1917.

GEORGE A. YANOCHOWSKI.