C. S. WINSTON.

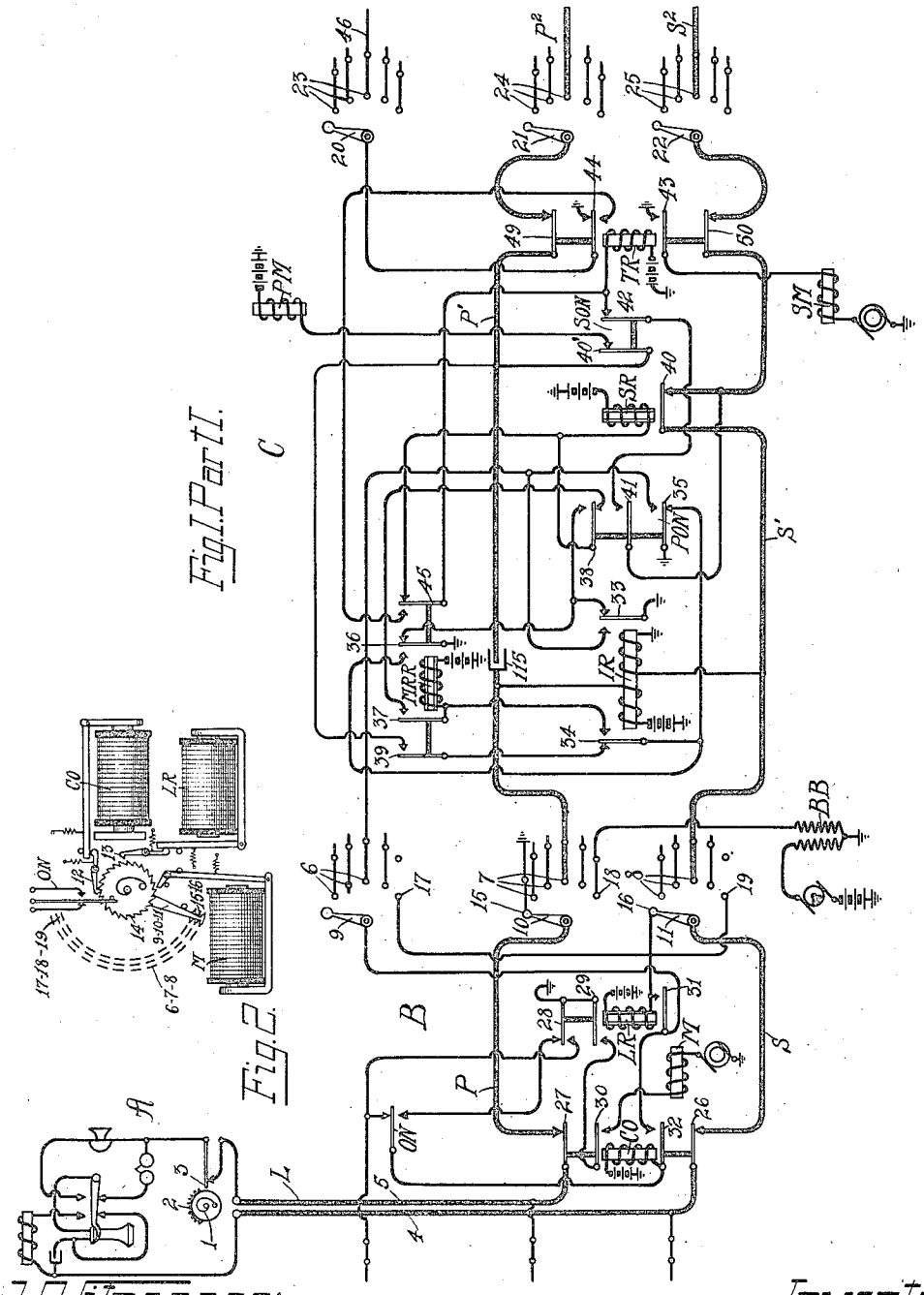
AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED MAR. 11, 1912.

1,247,197.

Patented Nov. 20, 1917.

3 SHEETS—SHEET 1.



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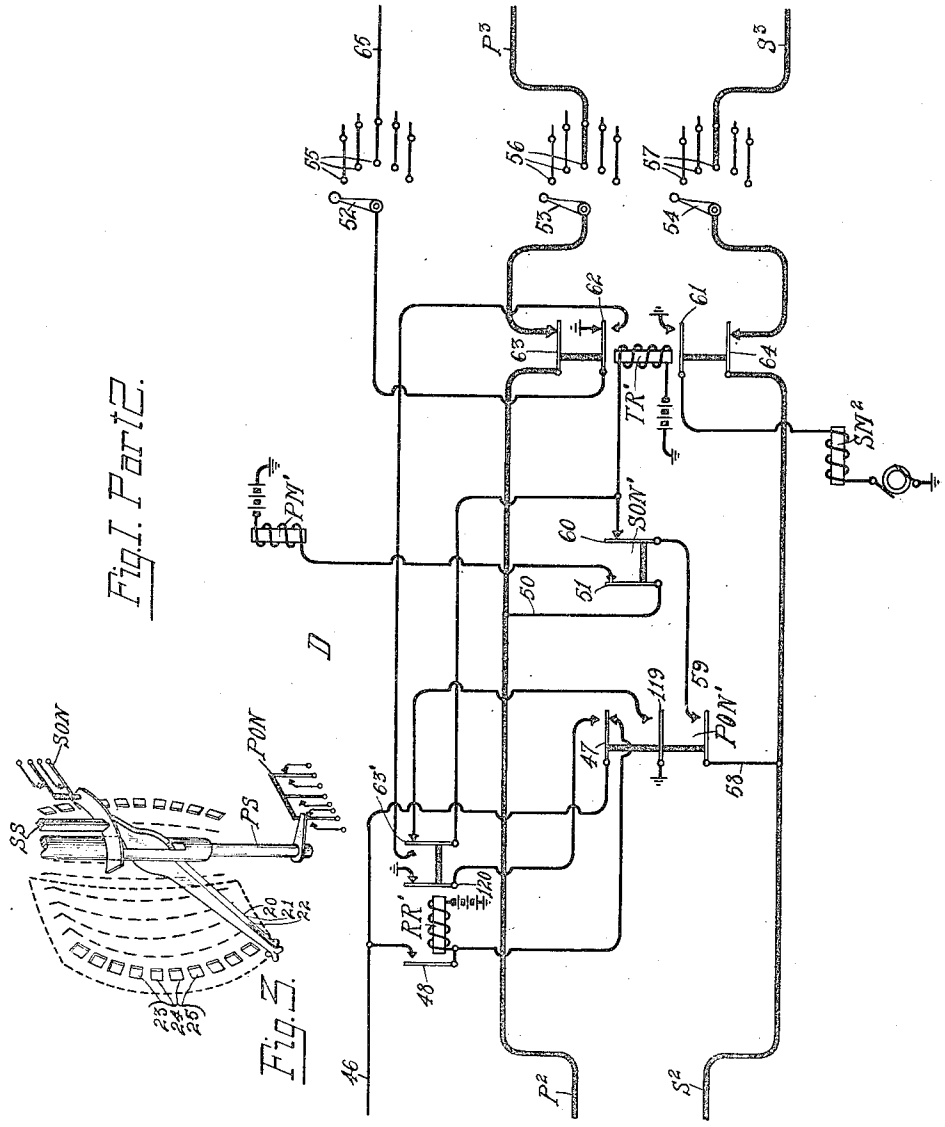

Fig. 1. Part 2.

Fig. 2.

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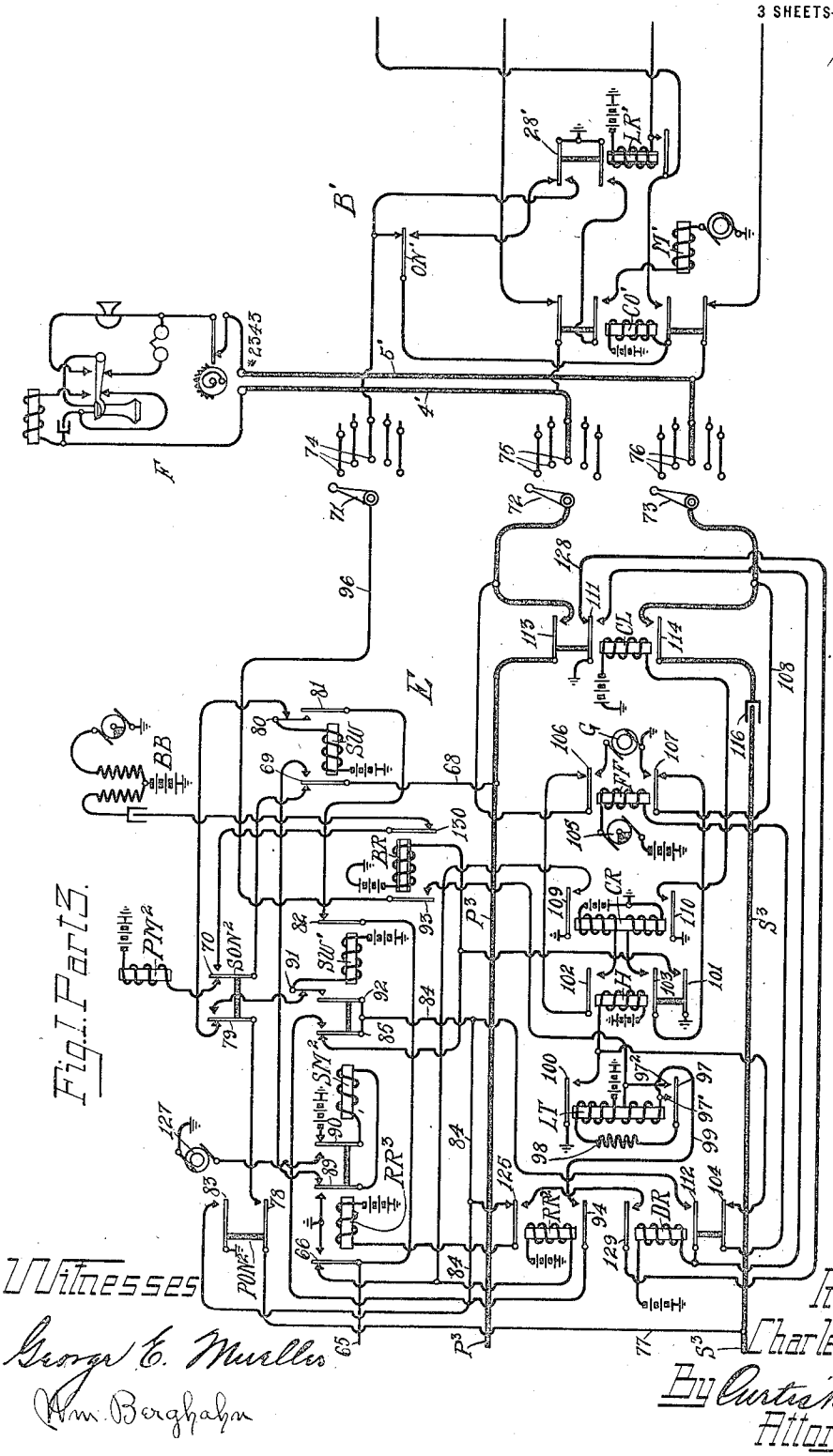

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UNITED STATES PATENT OFFICE.

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AUTOMATIC TELEPHONE SYSTEM.

1,247,197. Specification of Letters Patent. Patented Nov. 20, 1917.

Application filed March 11, 1912. Serial No. 683,010.

To all whom it may concern:

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

My invention has to do with telephone systems in which automatic switches are provided for establishing connections between calling and called substation telephone lines and more particularly to the so-called two wire or metallic line systems in which the directively controlled switches are operated responsive to interruptions of a metallic circuit, an object being to provide such a system having improved and simplified circuit arrangements. Certain features of my invention will be better understood after reference to the following specification and claims.

In the accompanying drawings which illustrate a preferred application of my invention and in which like reference characters indicate like parts,

Figure 1 comprising parts 1, 2 and 3 illustrates an automatic telephone exchange system adapted for establishing connections between calling and called substations.

Fig. 2 illustrates diagrammatically a mechanical structure adapted for coöperation with line switch B of Fig. 1 and

Fig. 3 illustrates in perspective a portion of the preferred selector switch mechanism.

My invention as illustrated in Fig. 1 includes in general a plurality of substation telephones A and F and lines L, a line switch B for each telephone line, first selectors C, second selectors D and connectors E. In accordance with the well known practice I preferably employ selector and connector switches having contact banks comprising one hundred sets of contacts each, and on the usual basis of ten per cent. trunking the system of Fig. 1 is adapted to serve ten thousand telephone lines. It is apparent that with switches of other capacities that exchanges of different capacities may be operated. I therefore also employ line switches as B, each having access to ten first selectors C.

The telephone apparatus at the substations A, F, may be of any desired common battery type, but I preferably employ the well known Kellogg substation including the usual switch-hook and receiver, transmitter call bell, condenser and impedance coil. A calling device 1 is also provided at each substation comprising a toothed rotatable dial 2 adapted to be adjusted by the operator, whereupon it is released being restored by a spring member, the restoration thereof interruping impulse spring 3 according to the initial adjustment thereof. The calling device is so constructed that as toothed member 2 is adjusted, its teeth will pass impulse springs 3 without interrupting their contact, but upon restoration of the toothed member 2 the impulse springs have their contact interrupted according to the number of teeth in member 2 which were initially advanced. This will be apparent from the illustration.

Each substation is connected to a central office by means of the line L comprising line conductors 4, 5, which terminate at a line switch B, which switch is individual to its associated line.

Line switch B.

While I have chosen to illustrate my invention in connection with a particular line switch, it is to be understood that line switches of other types may be used. The switch shown includes a line relay LR which is adapted to be energized upon initiation of a call over its associated line, a cut-off relay CO which is adapted to remove the substation control of its switch and to interrupt the talking conductors during travel of the switch, as will be more particularly pointed out, the motor magnet M and a contact bank having test contacts 6 and line contacts 7 and 8, together with coöperating wipers 9, 10 and 11.

Fig. 2 illustrates diagrammatically a switch construction adapted for coöperation with the circuits of line switch B, the like parts being indicted by like reference characters. The three wipers 9, 10, and 11 are preferably mounted upon a single shaft having a ratchet wheel 14 attached thereto and adapted to be advanced by operation of magnet M in such a manner that upon each actuation of magnet M the wipers are advanced from one set of contacts to the next, this advancement being against the tension of a spring as shown. Two retaining pawls 12 and 13 are provided being controlled by

relays CO and LR respectively. With line switch B at normal, pawl 12 is in engagement with the ratchet wheel 14 while pawl 13 is disengaged therefrom. Upon energization of CO, pawl 12 is disengaged from ratchet 14 and upon energization of LR, pawl 13 engages ratchet 14, these pawls being pivoted at an intermediate point as shown.

Upon initiation of a call over the line of substation A, line relay LR is energized, immediately followed by the energization of relay CO, thus reversing the position of pawls 12, 13, that is pawl 12 disengages itself from ratchet 14 while pawl 13 engages ratchet wheel 14. Responsive to the operation of these two relays, motor magnet M advances the wipers 9, 10, 11 until an idle set of contacts 6, 7, 8, are engaged whereby relay CO restores interrupting the circuit for magnet M, while relay LR is maintained energized. From this it will be seen that after a selecting operation of switch B both of the pawls are engaging the ratchet wheel 14, so that in order to release the switch, relay CO must be again energized while relay LR is deënergized, thereby disengaging both pawls 12 and 13 from the ratchet wheel 14 and allow restoration of the wipers. An off normal switch ON is provided being adapted to move to its alternate position upon the first step of the wipers off normal, being again restored upon the return of the said wipers to normal.

The lines L and associated switches B are preferably arranged in groups of one hundred, and for each group of one hundred lines ten first selectors C are provided, these switches C being multiply connected to the associated one hundred line switches B, although I have shown but two such multiple connections. Therefore I provide ten such contact sets 6, 7, 8, and in addition thereto I provide normal contacts 15, 16 which are normally engaged by the line wipers 10, 11. Overrun contacts 17, 18, 19 are adapted to be engaged by wipers 9, 10 and 11 respectively if all of the ten contact sets 6, 7, 8 are busy. Should switch B step to this additional set of contacts 17, 18, 19, a characteristic signal is adapted to be transmitted to the calling substation from apparatus BB, thus indicating to the calling subscriber that all the trunks are busy. The subscriber may then replace his receiver and restore switch B.

Selector and connector switch construction.

Before proceeding further with the description of the circuits, it is believed that their operation will be more readily understood by referring to the type of selector and connector switch mechanism preferably used.

For use with the selector and connector circuits of the system of Fig. 1 a switch such as is shown in an application of William Kaisling for automatic switch for telephone systems, Serial No. 600,664, filed January 3, 1911, may be used.

A set of primary off-normal spring contacts PON are moved upon the first primary step of the switch while a set of secondary off-normal spring contacts SON are moved upon the first secondary step of the switch.

The switch referred to in the previous paragraph, in general comprises a bank of contacts made up of 100 sets of contacts with three contacts 23, 24, 25 to each set, and divided into ten sub groups of ten contact sets each as illustrated diagrammatically in Fig. 3. A set of wipers 20, 21, 22 are provided, to coöperate with the bank contacts, a primary magnet being adapted to primarily adjust the wipers through the medium of a primary shaft PS to select a sub group of contacts, and a secondary magnet is provided to step the wipers through the medium of a secondary shaft SS in a secondary direction in a plane at right angles to the primary, to select a contact set of the selected sub group. The switch construction is such that the wipers are advanced against the tension of a pair of so-called watch springs, one spring opposing each movement respectively.

To release the wipers, that is, to restore them to normal, the secondary magnet is again actuated to step the wipers beyond the last contact of the sub-group whereby they are automatically restored to normal by the springs referred to, but over a different path than that taken by the wipers in the advance movement of the switch in selecting a contact. Thus, in the operation of the switch the contacting ends of the wipers travel in a primary direction to select a sub-group of contacts, then in a secondary direction to select a contact in the sub-group, and in the release of the wipers this secondary travel is continued until the contacting ends have passed beyond the last contact in the group, whereby they are automatically released to continue their restoration to normal, this continued movement being in a plane parallel to the primary movement but in an opposite direction until they reach a point directly above the starting point when they are moved downward through a plane parallel to the secondary movement, but in a direction opposite to the secondary movement, until they reach their normal starting point. The complete travel of the wipers is indicated by the dotted line in Fig. 3. It is to be understood that for a more complete understanding of this switch, reference is to be had to the above identified application.

First selector C.

The first selector C comprises an impulse relay IR which is adapted to be connected

in bridge of a metallic circuit including an impulse transmitter or calling device, this circuit being illustrated as the calling line circuit L, said relay IR being adapted to have its circuit interrupted responsive to interruptions of the connected metallic circuit whereby its armature is vibrated to transmit the impulses according to the operation of the connected calling device. A primary magnet PM is provided being adapted to primarily adjust wipers 20, 21 and 22 to select a sub group of contacts 23, 24, 25, and a secondary magnet SM is also provided for giving a secondary adjustment to said wipers to select a set of contacts in the selected sub group. I also provide a main release relay MRR which is energized responsive to impulse relay IR and as relay IR is adapted to vibrate its contacts as already referred to thereby interrupting the circuit of relay MRR, I preferably construct said relay MRR as a slow acting relay, so that after once being energized it does not release its armature responsive to short interruptions of its energizing circuit but only responsive to a prolonged interruption of its circuit.

Impulse relay IR is not only adapted to transmit impulses to primary magnet PM of switch C, but also to other switches which may be connected with it. After each set of primary impulses have been transmitted from IR, a so-called secondary circuit change is effected. To this end I provide a so-called secondary relay which is adapted to be energized and maintained energized while relay IR is operating and thereafter automatically effect such a secondary circuit change. Therefore, relay SR is preferably a slow-acting relay and may be constructed in any of the known methods in such a manner that when its circuit is rapidly interrupted by the vibrations of relay IR it will not release its armature responsive to such rapid interruptions, but only after a prolonged interruption of its circuit. Responsive to such secondary circuit change, a circuit for test relay TR is established causing its energization and closing a circuit for secondary magnet SM, whereby wipers 20, 21 and 22 are given a secondary adjustment to select an idle set of contacts 23, 24 and 25 in the selected sub group.

An off-normal switch PON is provided being adapted to be moved to its alternate position upon the first primary step of the switch, while secondary off-normal contacts SON are adapted to be moved upon the first secondary step of the switch. These off normal switches are restored by restoration of their respective shafts as is apparent in Fig. 3.

Second selector D.

Second selector D comprises the switch structure previously referred to, its magnets, relays and off-normal switches having functions similar to corresponding parts of switch C and being indicated by like reference characters but with a suffix prime added thereto.

Connector switch E.

The mechanical construction of connector E may be the same as previously described and also includes operating magnets and off-normal switches similar to the selector switches, these parts being indicated by like reference characters but with a different suffix added thereto.

Upon connection made with switch E, its release relay RR^2 is energized, and until a response is secured from the called substation F, said relay RR^2 is controlled from the calling substation, thus maintaining the release control of connector E from the calling substation until a response is secured.

In accordance with a well-known practice, I preferably operate both selective movements of connector switch E by directive impulses, the first series of primary impulses flowing through primary magnet PM^2 to primarily adjust the wipers and thereafter a secondary circuit change is effected whereby switching relay SW is energized to disconnect magnet PM^2 and connect secondary magnet SM^2 in circuit to be operated by the final series of primary impulses. After the final series of impulses have been transmitted through magnet SM^2, thus causing the selection of the terminals of the called line, a final secondary circuit change is effected whereby switching relay SW′ is energized to connect line test relay LT in circuit with the test terminals of the called line. Previous to this the busy relay BR was energized, this relay also being a slow acting relay as indicated, said relay BR having normally open contacts included in this test circuit so it must be energized to close these contacts 130 before a test can be made. Now if the called line is idle line test relay LT is energized, also causing the energization of the cut-off relay CO′ of the called line. The energization of test relay LT also effects energization of relay H, and maintaining it energized during the energization of relay LT, a result which is apparent as the circuit for relay H is controlled only through contacts of LT.

Should the called line be busy, line test relay LT does not energize and therefore busy relay BR restores connecting a characteristic busy signal from apparatus BB in circuit with the calling substation.

Now if the called line is idle and relays LT and H energize as stated, it will be noted that the windings of control relay CR are connected in bridge of the called line through contacts of relay H, but relay CR

does not energize as there is no circuit for direct current over the called line at this time, due to the condenser which is normally in circuit thereof at substation F. Also responsive to energization of relay LT a circuit for the so-called flip-flop or interrupter relay FF is established whereby its contacts are periodically operated to alternately bridge control relay CR and ringing generator G across the terminals of the called line. Upon response of the called subscriber control relay CR is energized, causing the operation of circuit closing relay CL followed by the energization of disconnect relay DR which interrupts the circuit for relay FF, rendering it inert and preventing further application of ringing current to the terminals of the called line.

Line switch B′ is similar to line switch B while substation F is similar to substation A.

Operation of Fig. 1.

Having described in general the switch structures and relay mechanisms preferably used in carrying out my invention, I will now describe the operation of the system in establishing a connection from a calling to a called substation.

Assuming now that the subscriber at substation A desires to communicate with a subscriber at called substation F whose telephone number we will assume is 2343, the subscriber at A removes his receiver from the switchhook whereby an energizing circuit for line relay LR is established, being traced from battery through the winding of said relay LR, contact 16, wiper 11, secondary talking conductor S, normal contact 26, line conductor 4, substation A, returning over conductor 5, normal contact 27, primary talking conductor P, wiper 10, contact 15 to ground, causing the energization of relay LR, whereby its alternate contact 28 is closed establishing an energizing circuit for cut-off relay CO whereby its contacts are moved to their alternate position. Upon energization of the said two relays a circuit for motor magnet M is established from ground through alternate contacts 29, 30 and the winding of magnet M to the alternating current generator, the impulses of current from said generator being effective to operate said magnet. The first operation of magnet M steps wipers 9, 10 and 11 into engagement with the first set of contacts 6, 7, and 8 respectively, and due to the interruption of the normal contacts on which wipers 10, 11, rested, the initial energizing circuit for relay LR is interrupted, but wiper 9 having engaged the first test contact 6 previous to said interruption, if said contact leads to a busy first selector C it will be connected to a ground or busy potential, whereby a locking circuit for relays LR and CO is established from the said ground through alternate contacts 31 and 32 and the windings of said relays LR and CO respectively to battery, maintaining these relays energized. Also upon the first step of switch B off-normal contact ON moves to its alternate position, interrupting the initial energizing circuit for relay CO, but if the first contact 6 is busy relay CO is maintained energized as stated. Of course if the first set of contacts lead to an idle switch relays LR and CO have their energizing circuit interrupted, whereby relay CO being a quick releasing relay deenergizes and interrupts the circuit for magnet M. But as stated the first set of contacts 6, 7, 8, being busy, relays LR and CO are maintained energized, whereby magnet M advances the wipers another step and in fact continues to do so as long as wiper 9 is engaging busy test contacts 6.

Upon reaching a set of contacts leading to an idle first selector C, the maintaining circuit for relays LR and CO is interrupted due to the test contact 6 of said set being free of a busy potential, therefore relay CO immediately releases its armature and interrupts the circuit for motor magnet M, rendering it inert. Relay LR it will be remembered is a slow acting relay and therefore does not release its armature immediately, in fact maintains its contacts closed until a substitute energizing circuit therefor is established from relay IR, as will now be referred to.

Upon the closing of normal contacts 26, 27 of relay CO due to its restoration, a circuit for impulse relay IR of first selector C is established over the calling line, resulting in its energization whereby its alternate contact 33 is closed establishing a locking circuit for relay LR. Alternate contact 34 of relay IR is also closed whereby an energizing circuit for main release relay MRR is established traced from the normal grounded contact 35 of PON, alternate contact 34 through the winding of MRR to battery. Alternate contact 36 is therefore closed, connecting ground through alternate contact 34 to relay MRR, this connection being effective to maintain relay MRR energized after switch C has made a primary step and interrupted normal contact 35. The closing of alternate contact 37 establishes an energizing circuit for secondary relay SR, traced from said grounded contact 37, normal contact 38 and the winding of SR to battery causing its energization.

It will now be seen that the calling line has been extended to first selector C and that impulse relay IR is maintained energized over the metallic circuit of the calling line and relays MRR and SR are energized.

The subscriber at A now operates his calling device 1 to effect two interruptions of its impulse contacts 3, these interruptions of course interrupting the circuit for im-

pulse relay IR, causing two operations thereof or in other words two deënergizations and subsequent energizations thereof. Although upon each interruption of alternate contact 34 the circuit for relay MRR is interrupted, these interruptions are of such a periodicity that relays MRR and SR do not retract their armatures until a comparatively prolonged interruption of their circuit. Upon the first operation of relay IR responsive to the first interruption of its circuit, an impulse of current is transmitted through primary magnet PM traced from the grounded alternate contact 36 of relay MRR, alternate contacts 34, 39, normal contact 40′ and the winding of PM to battery, causing an operation thereof and advancing wipers 20, 21, 22 a single primary step. Now upon the first step of the switch, off-normal switch PON moves to its alternate position, whereby the alternate contact 35 is closed establishing a maintaining circuit for relay LR until switch PON is restored. Also upon said movement of switch PON, its normal contact 38 is interrupted, thereby interrupting the initial energizing circuit for SR, but due to the closing of alternate contact 38 a substitute circuit for SR is established from the grounded normal contact 33 each time relay IR operates. Thus it will be seen that as long as relay IR is vibrating or operating, secondary relay SR maintains its armature attracted. Now responsive to the second operation of relay IR a second impulse of current is transmitted to primary magnet PM advancing wipers 20, 21 and 22 another step, thereby selecting the second sub-group of contacts 23, 24 and 25 which contacts lead to second selectors in the second thousand-group of lines, which group includes the line of called substation F. Of course it will be understood that after the last said interruption of relay IR it remains energized over the line circuit until the calling device 1 is operated again, this being of sufficient time to allow a long enough period of interruption of normal contact 33 to allow secondary relay SR to retract its armature and establish a circuit for test relay TR, from ground through the right hand winding of IR, secondary conductor S′, normal contact 40, alternate contact 41, normal contact 42 and the winding of TR to battery, causing its energization whereby its alternate contact 43 is closed establishing an operating circuit for secondary magnet SM.

Responsive to the first impulse of current from the alternating current generator through the winding of SM, said magnet is operated to advance wipers 20, 21, 22 a single secondary step into engagement with the first set of contacts 23, 24 and 25. Assuming these contacts lead to a busy second selector, test contact 23 thereof is at a grounded or busy potential whereby a maintaining circuit for relay TR is established from said grounded contact 23, wiper 20, alternate contacts 44, 45, winding of TR to battery, maintaining the circuit for magnet SM, which of course advances the wipers another step, and in fact continues to do so as long as the test wiper 20 is engaging busy test contacts 23.

As long as a set of contacts 23, 24 and 25 is idle its test contact 23 is at a potential substantially the same as the wiper 20, so that as wiper 20 engages such an idle test contact 23 which we will assume is the one leading to second selector D, the maintaining circuit for test relay TR is interrupted whereby it deënergizes interrupting the circuit for SM and therefore rendering said magnet inert and causing wipers 20, 21 and 22 to remain in engagement with the selected set of idle contacts. Upon closing of normal contact 44 of TR a ground or busy potential is connected to wiper 20 and the multiple contacts 23, thereby preventing any other switch from selecting the trunk connected to these contacts. This ground connection to test contacts 23 also causes the energization of release relay RR′ of the selected second selector D, the energizing circuit therefore being traced from said grounded contact 23, test conductor 46, normal contact 47, the winding of RR′ to battery, causing its energization whereby its alternate contact 48 is closed, thereby maintaining the circuit for relay RR′ after normal contact 47 is interrupted upon the first step of switch D. During the secondary travel of the wipers of first selector C, the line or talking wipers 21, 22 have their circuit interrupted at normal contacts 49, 50, but upon selection of a switch D, relay TR deënergizes and the circuit of the calling line is extended to second selector D.

As a second step in establishing the connection, the subscriber at A actuates calling device 1 to cause three operations of impulse relay IR, and responsive to the first deënergization of relay IR its normal contact 33 is closed, causing the energization of secondary relay SR which retains its armature attracted while relay IR is operating to transmit the said three impulses, relay SR thus interrupting its normal contact 40 which of course is maintained open unt l the impulses have been transmitted. The said three primary impulses follow a path traced from ground at alternate contact 36 of MRR, normal contact 34, alternate contact 39, primary conductor P′, normal contact 49, wiper 21, contact 24, conductor P^2, conductor 50, normal contact 51 and the winding of magnet PM′ to battery, causing three operations thereof, whereby wipers 52, 53, and 54 are advanced three primary steps to select the third sub-group of contacts 55, 56 and 57,

which are the contacts leading to connector switches in the third hundreds-group and which group includes the line of the called substation F.

Following the said three operations of relay IR it is, of course, again maintained energized by the circuit over the calling line and therefore secondary relay SR retracts its armature, establishing a secondary circuit change to start the secondary selecting movement of second selector D, this being brought about by an energizing circuit for test relay TR′ traced from ground through the right end winding of relay IR, conductor S′, normal contacts 40, 50, wiper 22, contact 25, conductor S^2, conductor 58, alternate contact 59 (switch PON′ now being closed) normal contact 60 and the winding of TR′ to battery, causing its energization whereby its alternate contact 61 is closed, establishing an operating circuit for secondary magnet SM^2 which advances wipers 52, 53, 54 into engagement with the first set of contacts 55, 56 and 57. If these contacts lead to a busy connector switch E, the test contact 55 thereof is grounded or at a busy potential and therefore a maintaining circuit for relay TR′ is established from said contact 55, wiper 52, alternate contacts 62, 63′, the winding of TR′ to battery. Therefore the wipers are advanced another step and in fact as long as test wiper 52 is in connection with a busy test contact 55, relay TR′ is maintained energized and magnet SM^2 continues to advance said wipers.

Upon reaching an idle set of contacts 55, 56, 57, there being no busy potential upon the test contact 55 thereof, relay TR′ restores interrupting the circuit for SM^2 which remains inert and the wipers 52, 53, 54, remain in connection with the selected set of contacts 55, 56, 57, leading to an idle connector switch E. It will be noted that upon the first secondary step of switch D, contact 60 of SON′ is interrupted thereby interrupting the initial energizing circuit for TR′ which, of course, depends upon the maintaining circuit through the test wiper as described. It will also be noted that during the secondary selecting movement of the wipers, line wipers 53, 54 have their circuit interrupted at normal contacts 63, 64 preventing interference with any existing connection, and upon restoration of relay TR′, normal contact 62 again closes connecting the ground or busy potential to test contacts 55, rendering the selected connector E busy and preventing any other switch from having access thereto. The circuit of the calling line has now been extended to a connector switch E, said circuit being traced over the heavily marked primary and secondary conductors P and S. Upon connection being made with connector switch E and upon connection of the busy potential to test contacts 55 a circuit for release relay RR^2 of switch E is established, being traced from the said grounded contact 55, test conductor 65, normal contact 66 and the winding of RR^2 to battery, causing its energization.

The subscriber at A now operates the calling device for a third time to cause four interruptions of his line circuit, thereby effecting four operations of impulse relay IR, these four operations corresponding to the tens digit of the called line's number. Responsive to the four operations of relay IR, secondary relay SR is energized and maintained energized in a manner as previously described, while four primary impulses are transmitted from ground at alternate contact 36 through normal contact 34, alternate contact 39, along the upper heavily marked conductor to conductor P^3 of switch E, conductor 68, normal contacts 69, 70, the winding of PM^2 to battery, causing four operations thereof and effecting four primary steps of wipers 71, 72, 73, to select the fourth sub-group of contacts 74, 75, 76, which is the sub-group including terminals of the line of the substation F.

Following the four operations of relay IR, secondary relay SR deënergizes effecting a secondary circuit change to cause the operation of switching relay SW, this being traced from ground through the right end winding of relay IR along the lower heavily marked secondary conductor to S^3 of switch E, conductor 77, alternate contact 78, normal contacts 79, 80 and the winding of SW to the battery, causing its energization, whereby its alternate contact 81 is closed establishing a locking circuit for itself traced through normal contact 82 and the grounded test conductor 65. Upon the first primary step of switch E, switch PON^2 moves to an alternate position closing its contact 83, whereby a circuit for busy relay BR is established from said contact 83, conductor 84, normal contact 85, the winding of BR to battery. This operation of BR disconnects busy back apparatus BB, preventing the premature application of a busy signal when relay SW is subsequently restored as will be again referred to, and also closes the circuit of test conductor 96 at contacts 93.

The subscriber at A now operates the calling device 1 for the fourth time, causing three operations of impulse relay IR thereby energizing and maintaining energized the relay SR as before and also transmitting three primary impulses over the primary conductor to connector E, conductor 68, alternate contact 69, normal contact 89, magnet SM^2 and normal contact 90 to battery, these four impulses causing four operations

of said magnet SM^2 which advances the wipers 71, 72, 73, three primary steps and bringing them into engagement with the terminals 74, 75, 76, of the called line.

Following the last three operations of relay IR, secondary relay SR retracts its armature whereby the final secondary circuit change is effected to cause the operation of switching relay SW′ of connector E, this being accomplished by a circuit traced from ground through the right end winding of relay IR, along the lower heavily marked secondary conductor to S^3, conductor 77, alternate contacts 78, 79, normal contact 91 and the winding of relay SW′ to battery, causing its energization and closing its alternate contact 92 to establish a locking circuit for itself over conductor 84 to the grounded contact 83 of PON^2. Due to the interruption of normal contact 82 of SW′, the locking circuit for SW is interrupted, causing its restoration. Also upon energization of SW′, the circuit for BR is interrupted but it being a slow acting relay, it will momentarily retain its armature after its circuit is interrupted, and if the called line is idle, a circuit is provided to maintain BR energized, but if the called line is busy, relay BR retracts its armature as will be more clearly pointed out.

Up to this period, the operation of the system is the same whether switch E has connected to the terminals of an idle or a busy line. Assuming now a condition with the

Called line idle,

its test terminal 74 has no busy potential, but is connected directly through cut off relay CO′ to battery so that when relay SW′ is energized responsive to the last secondary circuit change as previously referred to, line test relay LT is connected in circuit with test contact 74 to effect its energization and the energization of relay CO′, this circuit being traced from battery through the winding of said relay CO′, normal contact ON′, contact 74, wiper 71, test conductor 96, alternate contact 93, the lower winding of LT, conductor 99, alternate contacts 94, 85, conductor 84 to grounded alternate contact 83, this circuit causing the energization of said relays LT, CO′ in series.

The energization of CO′ removes the substation control of switch B′, and responsive to energization of LT, its alternate contact 100 is closed, causing the energization of relay H which closes its alternate contact 101 and reëstablishes an energizing circuit for relay BR, thus maintaining its armature attracted, which it is to be understood did not retract during the momentary interruption of its circuit. The closing of alternate contacts 102, 103, connect battery and the windings of control relay CR in bridge of the called line, to be subsequently operated when the subscriber answers the call as will be described.

Referring again to LT, upon the closing of its alternate contacts 97, the lower winding of said relay is shunted whereby ground from conductor 99 is connected through the closed contacts 97′, 97^2 to the wiper 71 and test terminal 74 placing a busy potential thereon and rendering said line unselectable by any other connector. Due to the closing of said alternate contacts 97 a locking circuit for relay LT is established from battery through the upper winding thereof, resistance 98 and closed contacts 97—97′, then over conductor 99 to ground.

The connection having been extended to the terminals of the called line, the substation F thereon has its call bell automatically rung responsive to the closing of alternate contact 100 of LT, a circuit for the flip flop or interrupter relay FF being thereby established from said grounded contact 100, normal contact 104, the winding of FF and interrupter 105 to battery, and due to the periodic interruption of said circuit, relay FF vibrates its contacts 106, 107, thereby alternately connecting ringing generator G and control relay CR in bridge of the called line. Current from generator G operates the call bell at substation F, the circuit thereof being traced from the upper pole of said generator G, alternate contact 106, wiper 72, contact 75, conductor 4′, the call bell at substation F, conductor 5′, contact 76, wiper 73, conductor 108, alternate contact 107 to ground.

Responsive to the signal received, the subscriber at F removes his receiver whereby upon the following restoration of relay FF, an energizing circuit for control relay CR is provided over the called line, this circuit being traced from battery through the upper winding of CR, alternate contact 102, normal contact 106, wiper 72, contact 75, contact 4′, upper switchhook contacts of substation F, returning over conductor 5′, contact 76, wiper 73, conductor 108, normal contact 107, alternate contact 103 and the lower winding of CR to ground, resulting in the energization of CR whereby relays CL and DR are energized and relay FF is rendered inert as will be now referred to. The closing of alternate contact 109 establishes an alternate energizing circuit for release relay RR^2, controlled at the called substation F, due to the fact that relay CR is maintained energized over the circuit of the called line, thereby preventing the release of switch E as long as the receiver at substation F is off its switchhook. The said operation of relays CL, DR is brought about as follows. Responsive to the closing of

alternate contact 110 of relay CR, relay CL is energized whereby its alternate contact 111 is closed, establishing a circuit for relay DR which is energized opening its contact 104 and thereby rendering relay FF inert. The closing of contact 112 of relay DR establishes a locking circuit for itself to ground over conductor 84 and alternate contact 83 of PON².

Upon closing of alternate contacts 113, 114 of relay CL, the talking circuit between the calling and called substations is completed, being traced over the heavily marked conductors, the primary conductor having a condenser 115 interposed therein at switch C while the secondary conductor has a condenser 116 interposed at connector E. The talking current for substation F is supplied from battery through the windings of relay CR, while talking current for substation A is supplied from battery through the windings of impulse relay IR.

Release.

I have preferably arranged my invention so that the release of line switch B, first selector C, and second selector D is controlled by the calling subscriber, while the release of connector switch E is controlled by the called subscriber, and irrespective of which subscriber replaces his receiver after a connection has been completed, such a control of the release is secured.

At connector switch E I have shown means whereby switch E may be released by the calling subscriber, that is the control of its release may be entirely removed from the called subscriber, this being indicated by the conductor 128. In other words with the circuit arranged with the conductor 128 included, the release of switch E is controlled at the called substation, while if this conductor is left out, switch E is released by the calling subscriber. In the immediately following description we will assume that the conductor 128 is included.

Assuming now that the subscriber at A is the first to replace his receiver upon its switchhook, the circuit for relay IR is interrupted whereby its contacts are restored and the circuit for relay MRR interrupted at alternate contact 34. Release relay MRR retracts its armature restoring its contacts and due to the closing of its normal contact 45 a release circuit for relay TR is established from battery through the winding of said relay, normal contact 45, alternate contact 38 of PON, to ground at normal contact 33, causing the energization of TR. It will be noted that upon the closing of normal contact 33 that relay SR is energized but this is only incidental. Responsive to the energization of TR its alternate contact 43 is closed, whereby secondary magnet SM advances wipers 20, 21, 22 in a secondary direction beyond the last contact of the bank whereby the restoration is continued in a manner as previously described. Due to the restoration of said wipers, off normal switches SON and PON are restored and due to the interruption of alternate contact 38 of PON relay TR has its circuit interrupted whereby it restores interrupting the circuit for SM.

Upon interruption of alternate contact 35 of PON, the locking circuit for relay LR of switch B is interrupted whereby its normal contact 28 is closed establishing an energizing circuit for relay CO, causing its energization. Therefore with relay CO energized and relay LR deënergized both of the retaining pawls 12, 13 are disengaged from ratchet wheel 14, allowing the restoration of wipers 9, 10, 11 and the restoration of switch ON, whereby the circuit for relay CO is interrupted allowing its restoration. Line switch B and first selector C are now at normal and the line of substation A is available for further use in the establishment of other connections.

Referring now to second selector D, this switch is restored responsive to the energization of relay TR of first selector D, this being effected due to the interruption of normal contact 44 of said relay TR, allowing the restoration of release relay RR′ of switch D. The closing of normal contact 63′ of RR′, closes circuit for relay TR′ traced from ground through alternate contact 119, of PON′, normal contact 63′, and the winding of TR′ to battery, causing its energization. Alternate contact 61 is therefore closed establishing a release circuit for SM² which now steps wipers 52, 53, 54 beyond the last contact of the bank whereby they are automatically restored as previously described.

It will be noted that upon restoration of RR′, due to the closing of its normal contact 120, ground is connected to test conductor 46 and contacts 23 rendering said contacts busy and preventing the selection of switch D during its restoration. Upon interruption of alternate contact 119 of PON′, relay TR′ deënergizes interrupting the circuit for SM². Switch D is now at normal and available for further use in establishing other connections.

Referring now to connector E, although the branch circuit for RR² from switch D was interrupted at said restoration of switch D, said relay RR² is still maintained energized from grounded alternate contact 109 of relay CR until the subscriber at F replaces his receiver.

Upon the subscriber at F replacing his receiver, the previously traced circuit for control relay CR is interrupted whereby it is restored interrupting its alternate con-

tact 109 whereby the circuit for RR^2 is interrupted causing its restoration. Therefore a circuit for RR^3 is established traced from battery through the winding of said relay RR^3, normal contact 125 to ground at alternate contact 83 of PON^2, resulting in the energization of RR^3. Also upon restoration of RR^2 its alternate contact 94 is interrupted whereby ground at alternate contact 83 of PON^2 is disconnected from relays LT and CO', allowing the restoration thereof. The restoration of LT interrupts the circuit for relay H which restores thereby disconnecting CR from the wiper terminals, and due to the interruption of alternate contact 101 of H, relay BR restores. The restoration of cut-off relay CO' restores the substation control of its line switch B'.

Referring again to relay CR, upon the interruption of its alternate contact 110 the circuit for CL is interrupted allowing its restoration and thereby interrupting the talking conductors at contacts 113—114. Although the interruption of alternate contact 111 of relay CL, disconnects ground from relay DR, said relay DR is still maintained energized over the circuit traced to ground at alternate contact 83 of PON^2.

Thus it will be seen that all of the relays of switch E with the exception of SW', DR and RR^3 are at normal, the said three relays being held energized over the circuit traced through alternate contact 83 of PON^2. Following the said energization of RR^3, its alternate contacts 89, 90 are closed whereby alternating current generator 127 is closed in circuit with the winding of SM^2, causing it to step wipers 71, 72, 73 beyond the last contact in the bank where they are automatically restored in a manner as previously described. Upon interruption of contact 83 of PON^2 relays SW', DR and RR^3 restore and the switch E now being at normal is available for use in establishing other connections. It will be noted that while relay RR^3 is energized its alternate contact 66 maintains a ground or busy potential upon test conductor 65 preventing the selection of switch E during this period.

In the release just described, it will be remembered that the calling subscriber replaced his receiver first followed by the restoration of the receiver at the called substation. In case the called subscriber should be the first to replace his receiver, the release of the switches is the same as before, that is switch E is restored by the called subscriber while the other switches are restored by the calling subscriber, although the release circuit for connector E operates slightly different, but the release circuit for the other switches is the same as that described. The subscriber at F being the first to replace his receiver upon its switchhook, interrupts the circuit for relay CR, causing its restoration. In this instance though, the interruption of alternate contact 109 does not allow RR^2 to restore as it is still maintained energized from the grounded test conductor 65, but upon interruption of alternate contact 110 of CR which causes the restoration of CL, normal contact 111 of CL is closed whereby a circuit for RR^3 is established traced over the conductor 128, alternate contacts 129, 125 and the winding of RR^3 to battery. The resulting energization of RR^3 of course causes the release operation of SM^2 as before.

The energization of RR^3 also causes restoration of RR^2 due to the opening of normal contact 66, and although the initial energizing circuit for RR^3 is interrupted upon deenergization of RR^2, that is during the time that lever 125 of RR^2 moves from its alternate to its normal position on the closing of normal contact 125, the circuit for RR^3 is again closed from ground at normal contact 83, and it is to be understood that this interruption is so short that relay RR^3 does not retract its armature.

Also upon restoration of RR^2 due to the opening of its alternate contact 94, relays LT, H, BR and CO' are restored and upon restoration of PON^2, relays RR^3, SW' and DR are restored as before. It will be apparent that upon restoration of RR^3 that RR^2 is again energized from the grounded test conductor 65, and it might also be added that when switches B, C and D are subsequently restored, a primary and a secondary impulse are transmitted to connector E causing a single primary step thereof followed by a release movement, but this is only incidental and in no way affects the disconnection.

The restoration of line switch B, first selector C and second selector D are effected in a manner as previously described, that is, they restore responsive to the replacing of the receiver at the calling substation.

Called line busy.

In the previous description it was assumed that at the time connector E connected with the terminals of the line of substation F, that said line was idle, now we will assume that said line is busy upon switch E making connection therewith. Therefore test terminal 74 has a busy potential connected thereto, either from alternate contact 28' of switch B' if substation F be calling, or if it be a called line, ground or busy potential has been connected to multiple contact 74 from a connector switch E in a manner as previously described.

As previously stated the operation of switch E is the same up to the last secondary circuit change whether connection is made to an idle or a busy line, and furthermore it will be remembered that up to and includ-

ing the period of the last secondary circuit change the relays RR², BR and SW′ are energized, SW′ having been energized responsive to the last secondary circuit change. Responsive to the energization of SW′, that is due to the closing of its alternate contact 85, line test relay LT is connected between ground at alternate contact 83 of PON² and wiper 71 and test contact 74. Due to the busy potential of test contact 74, in the present instance this being a direct ground, relay LT does not energize but remains inert. Therefore relay H does not energize, and so busy relay BR not having its circuit again closed at alternate contact 101 of H, retracts its armature interrupting its alternate contact 93 and again closing its normal contact 130. A characteristic busy signal from busy back BB is therefore applied to the primary conductor P³, being traced through normal contact 130, alternate contact 70, normal contact 69, then back along the upper heavily marked primary conductor out over the calling line and through the receiver at substation A, returning along the lower heavily marked secondary conductor and through the right end winding of relay IR to ground, the calling subscriber hearing the signal which is an indication that the called line is busy.

Therefore the subscriber at A replaces his receiver whereby restoration of line switch B, first selector C and second selector D is effected as previously described.

In this case switch E is also restored, this being effected following the restoration of switch D due to the interruption of the energizing circuit of RR² of switch E at the time relay TR′ of switch D is energized to cause the release of switch D, as it will be remembered that RR² has not had its alternate circuit through contact 109 of CR closed. Upon restoration of RR² the circuit for RR³ is established from battery through the winding thereof, normal contact 125, alternate contact 83, to ground, resulting in the energization of RR³ whereby a release circuit for SM² is established as before, causing the release of switch E. Upon restoration of PON², relays RR³ and SW′ are restored as before. Switch E being at normal is now available for use in establishing other connections.

Called substation not responding.

A third condition which often arises is where a connection is extended to a called line and no response therefrom is secured. In such case the operation of the system is the same as that previously described wherein the circuit of the calling line was extended to the called line and ringing current was being applied thereto. In such case it will be remembered that at connector E, relays RR², LT, H, BR, SW′ are energized, and relay FF is alternately bridging relay CR and generator G across the terminals of the called line. Until a response is secured, it will be remembered that relay RR² is only energized by a circuit over the test conductor 65 leading back to second selector D.

The calling subscriber after waiting for a short period and not receiving any response, replaces his receiver upon his switchhook, whereby switches B, C and D restore as previously described. In this instance though connector E is also restored, this being brought about by the restoration of RR² when its circuit is interrupted at TR′ when switch D is released. The restoration of RR² establishes a circuit for RR³ from battery through the winding thereof, normal contact 125, alternate contact 83 to ground, the resulting energization of RR³ establishing a release circuit for SM² whereby the wipers of switch E are restored as before. The restoration of RR² causes the interruption of its alternate contact 94 followed by the restoration of relays LT and CO′, the restoration of LT preventing further actuation of FF, due to the opening of alternate contact 100, the interruption of this contact also allowing restoration of relay H followed by restoration of BR. Upon restoration of PON² and due to the interruption of its alternate contact 83, relays RR² and SW′ have their circuit interrupted whereby they are restored to normal and switch E now being fully restored is available for use in establishing other connections.

The said deënergization of cut-off relay CO′ of course restores substation control of switch B′ while the restoration of switch E frees the line of substation F.

Another condition which frequently arises is where a connection has been extended to a busy called line and then the calling subscriber fails to restore his receiver previous to the removal of the busy condition of the called line, that is the connector switch is left with its wipers in engagement with the terminals of the busy called line after such busy condition has been removed. In certain systems, with such a condition ringing current will again be applied to the called line after the removal of the busy condition, thereby again operating the call bell at the called substation. In the present application should the calling subscriber fail to restore his receiver previous to such a removal of the busy condition from a called line, the called substation does not have its call bell operated again, but on the other hand it is necessary for the calling subscriber to restore the operated switches and make another call. To this end I preferably interrupt the test conductor 96 at connector E, if connection is made to a busy called line and

for this purpose preferably employ the relay BR which it will be remembered is energized upon the first step of switch E, and in connecting to a busy line restores interrupting its alternate contact 93 and thus interrupting the test circuit over conductor 96. It will be apparent that with the test conductor 96 interrupted and with switch E in connection with the busy line, should such a busy condition be removed from the called line to the line test relay LT still fails to energize and therefore the ringing apparatus is not rendered effective.

Although I have shown a plurality of batteries, it is to be understood that these may be all one and the same and this is also true with respect to the alternating current generators for operating the magnets, and while I have illustrated and described my invention in a specific manner it is apparent that many changes and modifications thereof may be made and therefore I do not desire to be limited to the exact structure as shown but aim to cover all those changes and modifications as come within the spirit and scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. A selector switch comprising primary and secondary talking conductors, an impulse relay and source of current connected in bridge of said conductors, an operating magnet for said selector, said relay being adapted to be operated for transmitting current impulses to operate said magnet, means responsive to said relay while so operating to interrupt one of said conductors and restore said conductor after such operation, and a test relay connected to said conductor and responsive to the restoration of the said conductor.

2. A selector switch comprising primary and secondary talking conductors, an impulse relay and source of current connected in bridge of said conductors, operating means for said selector, said relay being adapted to be operated for transmitting current impulses to operate said means, a normally closed contact included in said secondary conductor, means responsive to said relay while so operating to interrupt said contact and restore it after such operation, and means responsive to the restoration of said contact to initiate an automatic selecting operation of said switch.

3. A selector switch comprising primary and secondary talking conductors extending from the incoming to the outgoing ends thereof, an impulse relay and source of current connected in bridge of the incoming end of said conductors, operating means for said selector, said relay being adapted to be operated for transmitting current impulses to operate said means, a secondary relay responsive to said impulse relay while so operating to interrupt said secondary conductor between said bridge connection and the outgoing end and restore said conductor after such operation, and means responsive to the operation of said secondary relay to initiate a secondary movement of said switch.

4. A selector switch comprising primary and secondary talking conductors, an impulse relay and source of current connected in bridge of said conductors, an operating magnet for said selector, said relay being adapted to be operated for transmitting current impulses to operate said magnet, a slow acting relay having normally closed contacts including in said secondary conductor, a normally open circuit for said slow acting relay controlled from said impulse relay and adapted to be closed responsive to each operation of said impulse relay whereby said slow acting relay is energized to maintain said secondary conductor interrupted during such operation of said primary relay.

5. A selector switch comprising primary and secondary conductors extending from the incoming to the outgoing ends thereof, an impulse relay and source of current connected in bridge of said conductors, an inductive device connected in circuit of one of said conductors between said bridge and the outgoing end thereof, a normally closed contact in circuit with the other conductor between said bridge and outgoing end thereof, operating means for said switch, said relay being adapted to be operated whereby said operating means are rendered effective, automatic trunk selecting means for said switch, a slow acting relay for controlling said normally closed contact, an energizing circuit therefor including a contact of said impulse relay adapted to be closed during such operation of the impulse relay whereby said conductor is interrupted by said contacts during the operations of said impulse relay and restored thereafter, and means responsive to the restoration of said conductor to initiate the operation of said automatic trunk selecting means.

6. A telephone system comprising a metallic circuit telephone line, a selector switch in circuit with said line capable of primary and secondary adjustment, primary and secondary operating means, an impulse relay and source of current in bridge of said circuit, means for interrupting said circuit whereby said impulse relay is operated to effect the primary operation of said selector, and means for connecting a pole of said source through a winding of said impulse relay to said secondary selecting means responsive to the cessation of said operations of the impulse relay.

7. A selector switch adapted for primary and secondary adjustment, primary mechanism responsive to primary impulses for

producing such primary adjustment, secondary mechanism responsive to a secondary circuit change for producing such secondary adjustment, an impulse relay and source of current, means for operating said relay to produce said primary impulses, and means for connecting a pole of said source and a winding of said impulse relay in circuit with said secondary mechanism to produce said secondary circuit change for operation thereof.

8. A telephone system comprising a calling telephone line, selector and connector switches capable of primary and secondary adjustment for extending the circuit of said line, primary and secondary mechanisms for said switches, an impulse relay and source of current in bridge of said line, means for causing operations of said impulse relay to transmit primary impulses to the primary mechanisms of said switches, and means for connecting a pole of said source through a winding of said relay in circuit with said secondary mechanisms to cause operation thereof.

9. A connector switch including a test conductor and wiper, normally open contacts included in said test conductor, a relay adapted to be energized to close said contacts upon first movement of said switch off normal, and means for maintaining said relay energized upon connection made by said connector with an idle line.

10. A telephone system comprising a called line, a connector switch, a test conductor and wiper for said connector, normally open contacts in said conductor, means for operating said connector to connect with the terminals of said line, a relay for closing said contacts responsive to operation of said connector, and means for maintaining said relay energized and said contacts closed upon connecting with said line only when idle.

11. A telephone system comprising idle and busy telephone lines, a connector switch adapted for connection therewith, a test conductor and wiper for said connector, normally open contacts in said conductor, means for operating said connector to connect with the terminals of any of said lines, a relay, means for energizing said relay and closing said contacts responsive to operation of said connector, and means for maintaining or deënergizing said relay according to the idle or busy condition respectively of the line connected with.

12. A telephone system comprising idle and busy telephone lines, a connector switch adapted for connection therewith, a test conductor and wiper for said connector, normally open relay contacts in said conductor, means for producing primary and secondary circuit changes to operate said connector to connect with the terminals of any of said lines, means for operating said relay responsive to such primary circuit changes to close said contacts, and means for maintaining or interrupting said contacts according to the idle or busy condition respectively of the line connected with.

13. A connector switch including a normally open test conductor, means for closing said conductor and maintaining it closed or again interrupting it according to the idle or busy condition respectively of a line connected with by said connector.

14. A telephone system comprising a metallic circuit telephone line, a selector switch in circuit with said line capable of primary and secondary adjustment, primary and secondary operating means therefor, an impulse relay and source of current in bridge of said circuit, means for interrupting said circuit whereby said impulse relay is operated to effect the primary operation of said selector, trunk lines extending from said selector, means for connecting a pole of said source through a winding of said impulse relay to said secondary selecting means responsive to the cessations of said operations of the impulse relay to cause the automatic selection of one of said trunks, and release means for said switch responsive to a prolonged interruption of said metallic circuit for said switch.

15. A selector switch adapted for primary and secondary adjustment, primary mechanism responsive to primary impulses for producing such primary adjustment, secondary mechanism responsive to a secondary circuit change for producing such secondary adjustment, an impulse relay and source of current, means for operating said relay to produce such primary impulses, means for connecting a pole of said source and a winding of said impulse relay in circuit with said secondary mechanism to produce said secondary circuit change for operation thereof, and release mechanism for said switch responsive to a prolonged operation of said impulse relay.

16. In an automatic telephone system, a connector switch for establishing connections with called subscribers' lines, a normally open test circuit for said connector switch, means for closing said test circuit and for maintaining it closed or again opening it according to the idle or busy condition respectively of the called line connected with.

17. An automatic connector switch including a normally open test circuit, a test wiper connected to said test circuit for testing the contacts of called subscribers' lines, and electromagnetic means for closing said circuit and maintaining it closed or again opening it according to the idle or busy condition respectively of the contact engaged by said test wiper.

18. A connector switch for extending connections to called subscribers' lines, a normally open test circuit for said switch separate from the talking circuit, a test wiper connected to said test circuit for testing said called subscribers' lines, and electromagnetic means for closing said test circuit and for maintaining it closed if said test wiper engages the contact of an idle called line, said means being inoperative to maintain the said circuit closed if the test wiper engages a contact of a busy called line.

19. An automatic switch including a normally open test circuit, a test wiper connected to said test circuit adapted to engage the test contacts of busy and idle called lines, and electromagnetic means for closing said circuit and maintaining it closed or for again interrupting it according to the idle or busy condition respectively of the contact engaged by said wiper.

20. An automatic switch comprising a pair of talking conductors, an impulse relay and source of current connected in bridge of said conductors, a controlling magnet for said automatic switch, said impulse relay being adapted to be controlled over the said talking conductors for transmitting current impulses to operate said controlling magnet, electromagnetic means responsive to said relay while so operating to interrupt one of said conductors and to restore said conductor after such operation, and a second control magnet adapted to be operated responsive to the restoration of said conductor.

21. An automatic switch comprising a pair of talking conductors, an impulse relay and a source of current bridged across said conductors, a pair of operating magnets for said switch, said relay being adapted to be operated for transmitting current impulses to control one of said operating magnets, electromagnetic means responsive to such operation of said relay to interrupt one of said conductors and to maintain it open as long as said impulse relay is operating, and means responsive to the closure of said conductor for operating said other operating magnet.

22. An automatic switch comprising a pair of talking conductors, an impulse relay connected to one of said conductors, a normally closed contact in the other of said conductors, means controlled over said first conductor for operating said relay to cause a primary operation of said automatic switch, electromagnetic means responsive to such operation of said relay for opening said normally closed contact and maintaining it open during such operation, and means responsive to the closure of said contact to initiate a secondary operation of said switch.

23. An automatic switch comprising a pair of talking conductors, an impulse relay connected to one of said conductors, means controlled over said conductor for operating said relay thereby causing a primary operation of said switch, electromagnetic means controlled by such operation for opening the other of said conductors and maintaining it open during such operation of said relay, and means responsive to a closure of said last conductor to cause a secondary operation of said switch.

24. An automatic switch comprising a pair of talking conductors, an impulse relay connected to one of said conductors, means controlled over said conductor for operating said relay for causing a primary operation of said switch, electromagnetic means responsive to such operation of said relay for interrupting the other of said conductors and for restoring it after such operation, and a test relay connected to said last conductor for controlling a secondary selecting operation of said switch.

25. In a telephone system, a two-motion automatic switch provided with a pair of talking conductors, said automatic switch having one motion to elect groups of trunk lines and a second motion to automatically select an idle trunk line in a group, an impulse relay connected to one of said conductors, means for causing said relay to be intermittently operated, electromagnetic means controlled by such operation to interrupt the other of said conductors and restore said conductor after such operation thereby causing said switch to automatically select an idle trunk line.

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,
CARRIE E. ANDERSON.