

1,169,754.

F. SCHÖENWOLF.
AUTOMATIC TELEPHONE SYSTEM.
APPLICATION FILED AUG. 3, 1908.

Patented Jan. 25, 1916.

6 SHEETS—SHEET 1

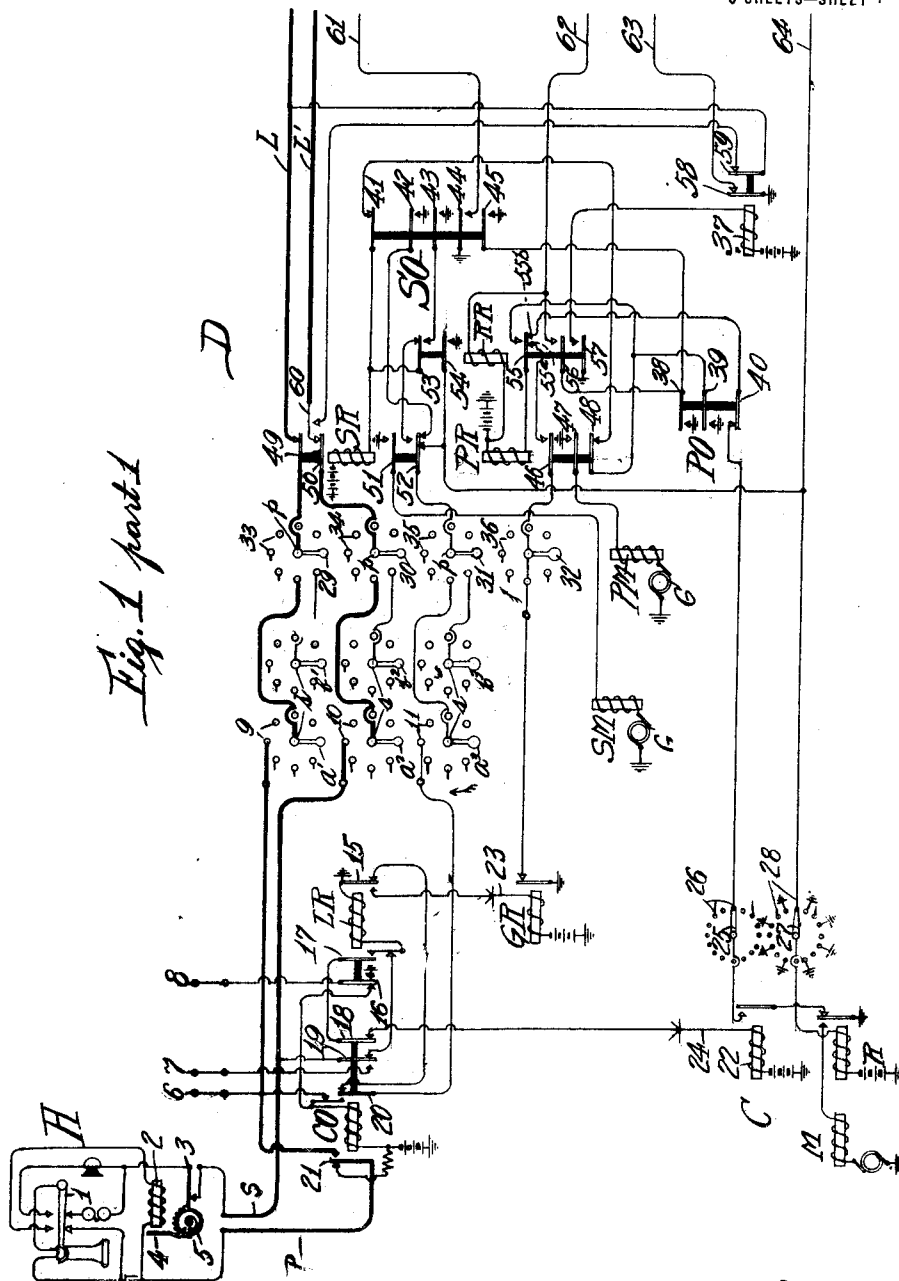


Fig. 1 part 1

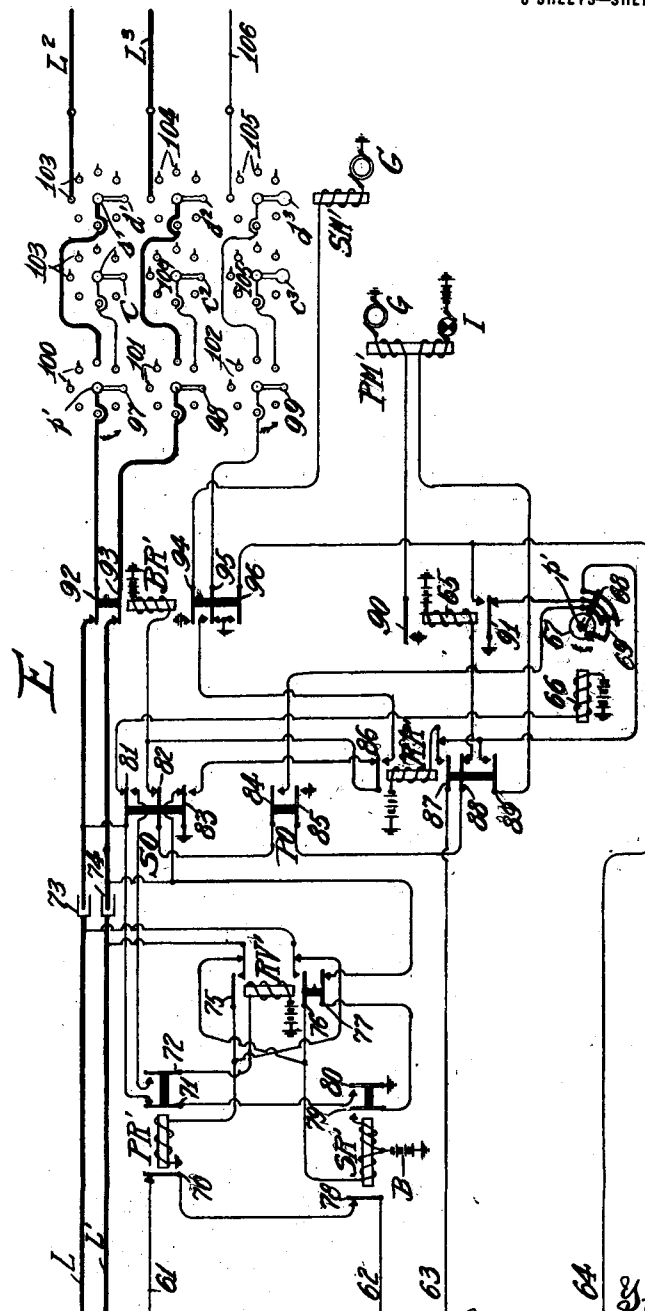
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 6 SHEETS—SHEET 2.

Fig. 1 part 2



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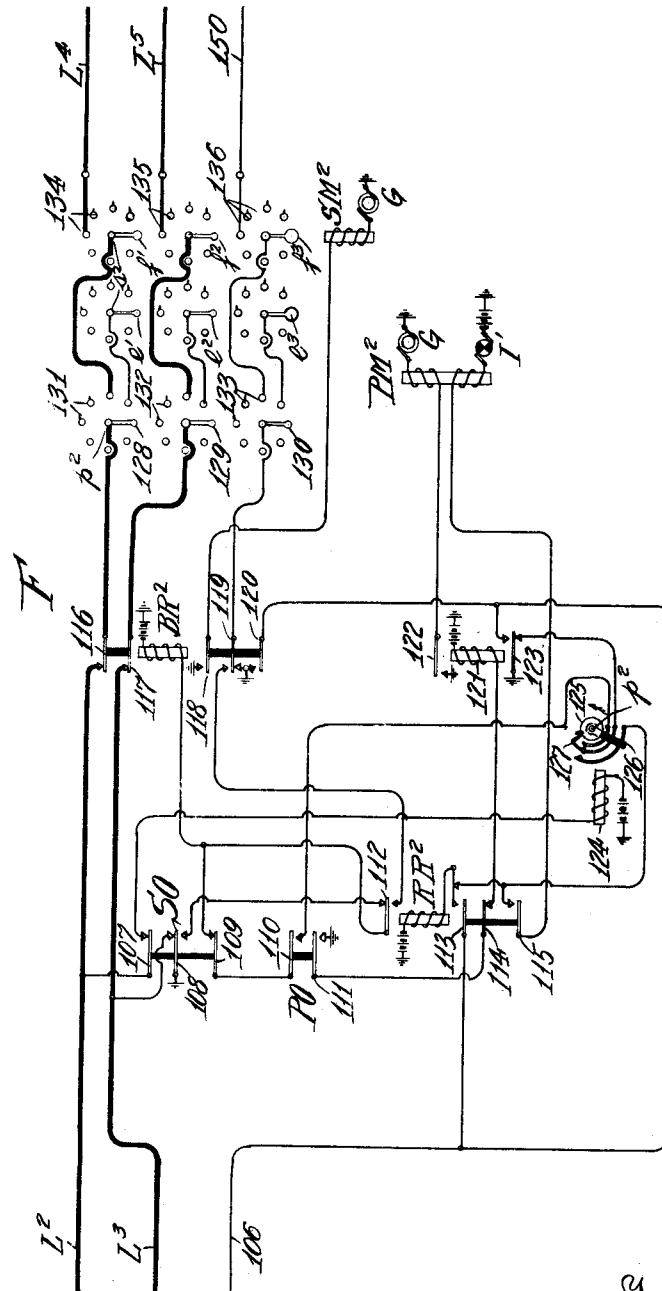
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6 SHEETS—SHEET 3.

Fig. 1 part 3



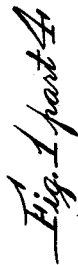
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6 SHEETS—SHEET 4.



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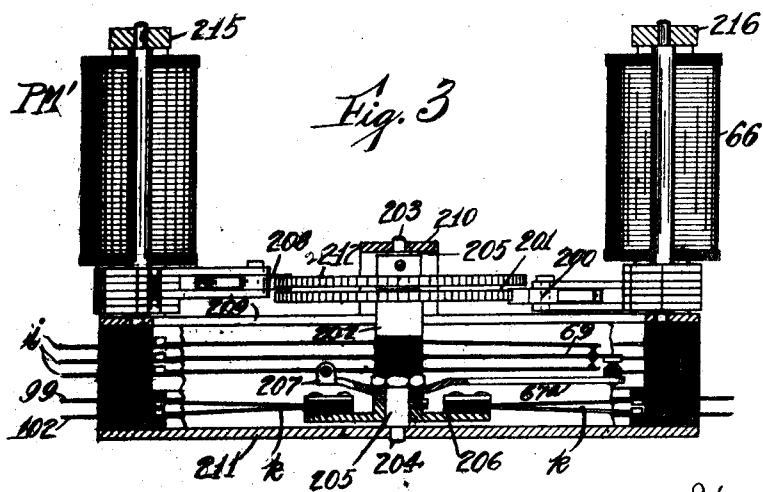
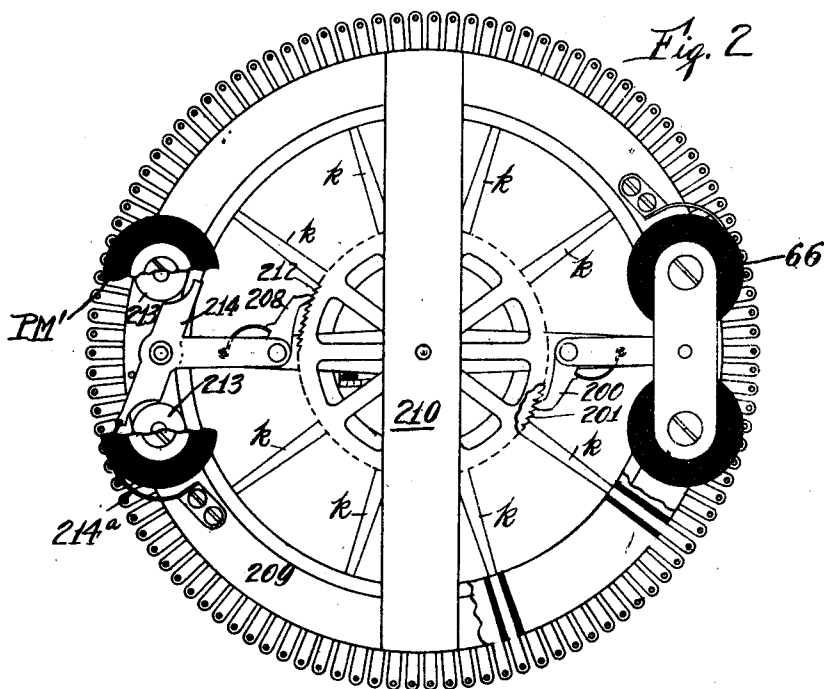
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6 SHEETS—SHEET 5.



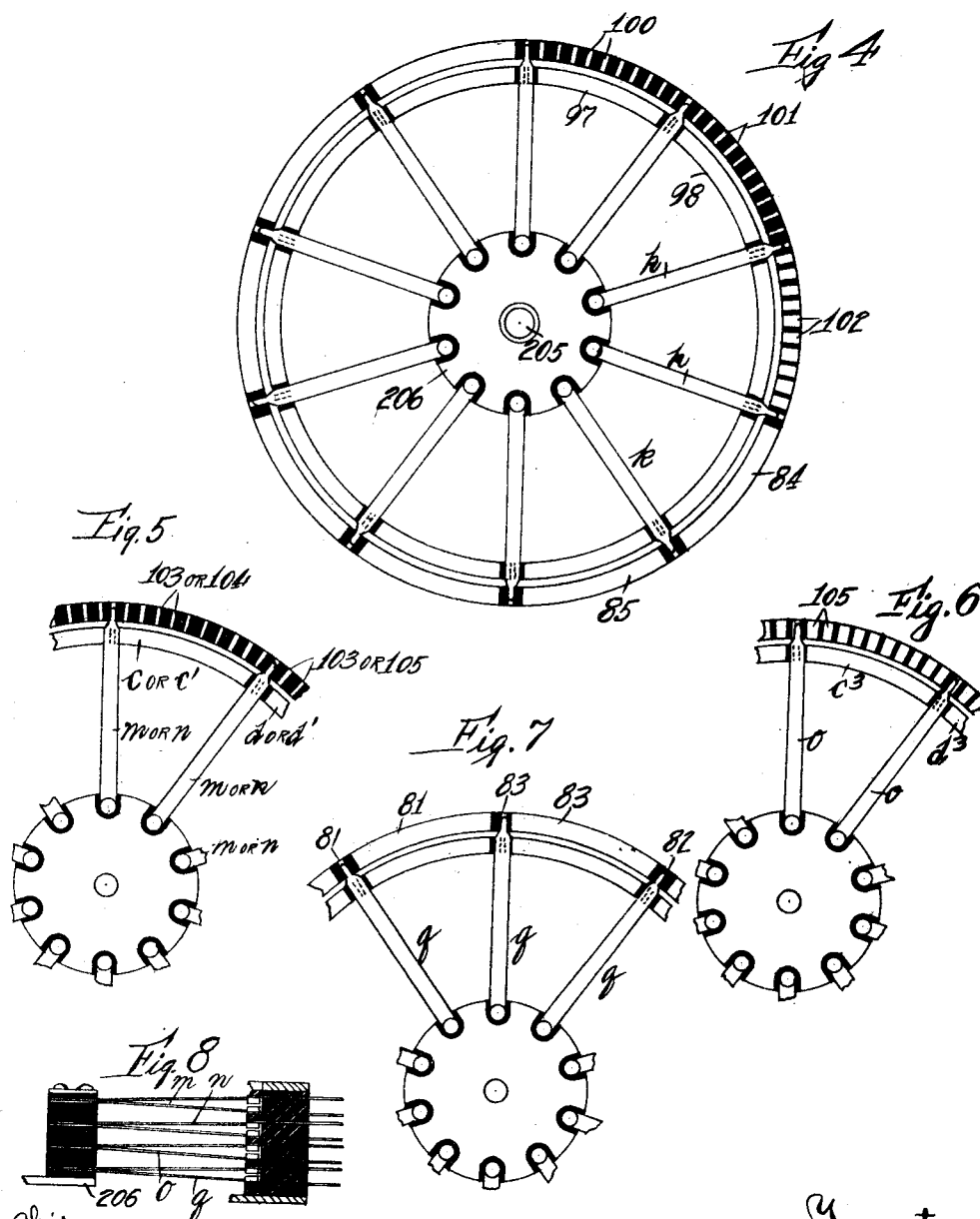
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6 SHEETS—SHEET 6.



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UNITED STATES PATENT OFFICE.

FRED SCHOENWOLF, OF CHICAGO, ILLINOIS, ASSIGNOR TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

1,169,754.

Specification of Letters Patent.

Patented Jan. 25, 1916.

Application filed August 3, 1908. Serial No. 446,645.

To all whom it may concern:

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

My invention relates to a system wherein selective switches at the exchange are adjusted responsive to currents controlled at the substations, the adjusting impulses being controlled by breaks made in a single conductor, so that the system does not employ, where metallic circuit telephone lines are used, the customary return conductor or ground connection. I am aware that systems of this character have heretofore been proposed and the present invention is directed to securing improved methods of operations in such systems.

To perform a switching operation at the exchange corresponding in function to that of the rotary or secondary impulse employed in the systems using a ground conductor, I provide, in association with the switch which is directly adjusted by the substation impulses, an auxiliary following switch, set into motion simultaneously with the first switch, which travels at such speed as to overtake a member adjusted by the directive switch very shortly after the transmission of the last directive impulse of a set. When such overtaking occurs, circuit changes are produced which result in the operations necessary to render the central office apparatus ready to receive a succeeding set of digit impulses. The indicated method of operation is employed not only in connection with the selectors of the system to initiate the travel for selecting an idle trunk out of a previously selected group, but is also employed in connection with the connector to shift the wire, transmitting the directive impulses, from its primary connection to its secondary connection at the proper time, and also to transmit the impulse for operating the test relay to test the called-for line after the connector has been fully adjusted.

Other more specific features of novelty will be referred to in connection with the description of the drawings, and the scope

of the invention will be more particularly pointed out in the appended claims.

Parts 1, 2, 3 and 4 of Figure 1 are to be placed adjacent to one another in consecutive order and, when so arranged, constitute a diaphragm of circuits of an automatic telephone system embodying the invention; Figs. 2 and 3 are, respectively, front and sectional views of a selective switch for employment with the circuits; Figs. 4, 5, 6 and 7 indicate the contact arrangements of primary and secondary switches; and Fig. 8 is a detail of the wiper-supporting means employed when the mechanism of Fig. 3 is used for a secondary switch.

The diagram of Fig. 1 shows a circuit of the mechanism required to establish a connection from a calling line to a called line in a ten thousand system. Assuming an exchange of ten thousand lines, said lines as calling lines are preferably divided into groups of one hundred lines each, and each line has multiple terminals 9, 10, 11, appearing in the banks of, say, ten line selectors D, thus making, for the ten thousand lines, one thousand line selectors in all. Said multiple contact sets 9, 10 and 11 of the lines of the group are preferably divided into ten sub-groups of ten contact sets each at the line selectors, and the operation of the line selector D, when set in motion, is first to seek out the sub-group containing the contact set of the calling line and then to seek out the individual contact set from the sub-group. In the illustrated system, each line selector includes a set of primary wipers 29, 30, 31, 32, all fastened to a primary shaft *p*, arranged to be driven by an armature-actuated pawl of primary magnet PM. Although less are shown, the primary wipers have before them ten sets of terminals, each set comprising a contact 33, 34, 35 and 36. The contacts 33, 34, 35 of each set extend to connection with a secondary wiper set *a'*, *a*², *a*³, or *b'*, *b*², *b*³, etc., there being a separate set of wipers adapted to sweep over the multiple line terminals of each sub-group of ten lines. The fourth contact 36 of each set is multiplied and extends to the normal contact of the armature of the group relay GR of the appropriate sub-group, there being

such a relay GR for each sub-group connected to a common conductor 23 which has ten branches, one to each line relay of its sub-group. The group contacts 36 of a sub-group and the individual contacts 9, 10, 11 in the sub-group, are normally unselectable. Each line has a line relay LR which is operated when the receiver is removed at the substation and is then effective to cause circuit changes whereby its sub-group's contacts 36 are rendered selectable at the line selectors and also the individual contact sets of the line. Furthermore, the operated line relay influences the master-switch mechanism C to start into operation an idle line selector D which will seek out the sub-group and then the terminals of the calling line. Each line selector D has connected to it by means of the wires L, L', 61, 62, 63, 64, a first selector E, so that there will be one thousand first selectors E for the ten thousand lines. The function of the line selector is thus to seek out the calling line and so connect its associated first selector therewith so that impulses transmitted from the calling station may adjust the first selector to select a group of multiple terminals connected to second selectors of the wanted thousand. After this, in the process of establishing connection, the second selector will be adjusted responsive to substation impulses to select a group of connectors assigned for connections to the wanted hundreds of the previously selected thousand, whereafter the second selector will automatically select terminals of an idle connector of the group. As called lines, the lines also have their multiple called terminals 6, 7, 8, grouped together by hundreds, the lines having directory numbers of the same hundreds value constituting a group. The multiple called terminals are preferably divided into ten sub-groups of ten contact sets each and are multiplied at the banks of, say, ten connectors, the lines of like tens value in the hundred constituting a sub-group. The calling line, having obtained access to a connector for the required hundred in the manner previously outlined, will transmit the proper impulses to cause the selector to select the tens group of the called line, whereafter the connector will be adjusted to select the individual contact set. After this, the called line will be tested and, if found idle, its bell will be automatically rung. If busy, a busy signal will be transmitted to the calling subscriber and he will replace his receiver to restore the central office mechanism. The first selector E, the second selector F and the connector G, like the selector D, are provided with a primary magnet PM having an armature controlled pawl to rotate the respective primary shaft p which carries the primary wipers. In the case of the first selector E, the primary wipers 97,

98, 99 have before them ten sets of contacts 100, 101, 102 (although less are shown) and each such contact set will extend to connection with a different set of wipers c' , c'' , c''' , or d' , d'' , d''' , and each such set of wipers will have before it the multiple contact sets of second selector F for a different thousand. The primary wipers 97, 98, 99 are first adjusted to select the contacts 100, 101, 102, connected with the wiper sets for the wanted thousand. The wiper sets for all the thousands are mounted upon the one shaft s' and actuations then caused of secondary magnet SM' will rotate all the wiper sets step by step until the private wiper of that set, rendered live by being selected by the primary wipers, encounters the multiple contact sets 103, 104, 105 of an idle second selector. In the second selector F, the same method of selection is employed, the primary wipers 128, 129, 130, mounted upon primary shaft p^2 being first rotated by primary magnet PM² to select the set of secondary wipers of the proper group, whereafter all the sets of secondary wipers e , f , etc., of which there will be ten in all, will be rotated by actuations of secondary magnet SM² until the private wiper f^3 , or which ever one has been rendered live by being selected by wiper 130, reaches a set of multiple contacts 134, 135, 136, pertaining to an idle connector. At the connectors G, the selection of the sub-group of the called line is effected by actuations of primary magnet PM³ rotating the primary wipers 207, 208, 209, mounted upon shaft p^3 , to select the contact set 210, 211, 212, connected to the wiper set assigned to the sub-group of contacts of the proper tens value, whereafter all the wiper sets g , h , etc., of which there will be ten, are simultaneously rotated by secondary magnet SM³ until the contact set 6, 7, 8 of the called line is reached.

Each selector, whether D, E, F or G, includes, in addition to the wiper mechanism already referred to, a primary off-normal switch PO having contacts shifted on the first step of the primary wiper, and a secondary off-normal switch SO having contacts shifted on the first step of the secondary wipers. All the mechanism in Fig. 1 is shown in its normal or resting condition and the shifting of the primary and secondary off-normal switches will effect circuit changes obvious from an inspection of Fig. 1. The talking circuit to be established is throughout indicated by heavy lines. The first selector E has mounted upon the primary shaft p' , in addition to the wipers, an arm 68 insulatingly supporting the spring 69 and its normal and alternate contacts. Fitting loosely about and independently rotatable with respect to shaft p' , is a notched disk 67, its notch be-

ing normally engaged by spring 69. The disk 67 is adapted to be rotated step by step in the direction indicated by the arrow by an armature actuated pawl of magnet 66, said magnet being responsive to the thousands impulses; and when said disk 67 is so rotated, the bent extremity of the spring 69 rests upon the periphery of the disk. As long as said spring 69 is upon the periphery and so engaging its alternate contact, the primary magnet PM' will receive current impulses and will drive the wipers 97, 98, 99 and the arm 68, which carries the spring 69 and its contacts, step by step in the same direction that disk 67 travels, but at a somewhat slower rate. According as a greater or less number of directive impulses have been transmitted to magnet 66, the disk 67 will have advanced a greater or less distance. As soon as the directive impulses cease, and sufficient actuations of magnet PM' are caused to bring the spring 69 to a position where it again slips into the notch of disk 67, said spring 69 will engage its normal contact and by so doing will effect circuit changes resulting in actuations of secondary magnet SM' which will step the secondary wipers step by step in a manner previously indicated to select idle contacts. In a similar manner, the hundreds impulses are transmitted to the magnet 124 of second selector F, which rotates disk 125, whereupon the magnet PM² has impulses transmitted to it, moving shaft p^2 , which supports the primary wipers and also the arm 126, carrying circuit changing spring 127 and its contacts, step by step in pursuit of the notch of disk 125. After the transmission of the last hundreds impulse, such pursuit will terminate and the reengagement by spring 127 of the notch in disk 125 shifts the said spring to normal, circuit changes being occasioned, resulting in actuations of magnet SM² which steps the secondary wipers in search of idle contacts. At the connector G, the magnet 195 is operated by the primary impulses and steps the disk 196 having a notch normally engaged by spring 197. Primary magnet PM³ immediately begins stepping the primary wipers, and arm 204, supporting spring 197 and its associated contacts, step by step in pursuit of the notch on disk 196. When the tens impulses cease, the disk of course rests, and when the shaft p^3 reaches the proper adjusted position, spring 197 shifts to normal and causes circuit changes to connect the magnet 200 to the impulse wire L⁴, the magnet 195 then being disconnected. The units impulses are transmitted to magnet 200, which steps disk 201, and the secondary magnet SM³ steps the secondary wipers and the arm 203, supporting spring 202 and its contacts, in pursuit of the notch of disk 201. When the units impulse ceases, and the

spring 202 thereafter engages the notch, the secondary wipers stop and the testing impulse is transmitted to test relay TR.

It will be understood that no specific ratio of operation between the speed at which impulses are transmitted to a magnet, as for example 124 at F to rotate the disk, and to the primary magnet PM², need be specifically stated. Assuming that each selector has ten groups to select as a maximum, it is only necessary that when the travel of the disk and of the primary shaft is initiated, as long as said disk is being rotated responsive to directive impulses from the substation, it shall keep slightly ahead of the following spring 127. For example, if disk 125 and primary shaft p^2 had each a ratchet wheel for driving them, having the same numbers of teeth, the substation calling device may be arranged to transmit impulses at, say, the rate of sixteen per second, while the interrupter I of actuating magnet PM' may be driven at the rate of ten impulses per second.

The remaining circuit connections not heretofore specifically described will be best understood from the following description of the operation, in which it will be assumed that substation A is that of the calling subscriber and that connection is desired with the line of substation Z, which may be assumed to have the number 2221. In initiating the call, subscriber A removes his receiver, whereupon hook-lever 1 rises and current flows from ground through line relay LR, normal contact 19, S, 3, hook-lever 1, magnet 2, P, normal contact 21 to battery, whereupon armature 15 grounds its branch of wire 23 and group relay GR attracts its armature, removing ground from multiple group contacts 36. The attraction of armature 15, by opening its normal contact, removes the normal ground from private contacts 11 at the line selectors, rendering the contact sets 9, 10, 11 selectable. Armature 16 grounds the multiple private contacts 8 at the connectors, rendering the line busy there. By armature 17, relay LR is disconnected from the line and locked through normal contact 18 and its branch of common wire 24 in series with master-switch relay 22. Master-switch C is common to a one hundred line group, and the ten line selectors D for selecting such lines and has a contact set 26—28 for each line selector D before its wipers 25, 27, and the arrangement is such that said wipers normally engage the contact set of an idle line selector, as hereafter more fully explained. The relay 22 is rendered common to the one hundred lines by conductor 24 having one hundred branches, one to each line of the group. When relay 22 operates, its attracted armature connects ground through contact 25—26, normal contact 40, normal contact 55, 130

through relay PR to battery, and said relay, by armature 47, closes circuit from generator G through primary magnet PM to ground. Said primary magnet receives actuations, stepping the primary wipers 29, 30, 31, 32 until wiper 32 engages the multiple group contact 36 of the sub-group of the calling line, since, until this occurs, relay PR will remain operated by current through normal contact 55—55^a, attracted armature 46, wiper 32 and successive engaged group contacts 36 of sub-groups not having a calling line among them, their group relays GR being accordingly deenergized. When in the present case, wiper 32 engages the second contact 36, the circuit of the relay PR is open at the armature of relay GR and the relay PR deenergizes, the retracted armature 47 preventing further actuations of magnet PM. On the first step of the primary wipers, the primary off-normal contacts 38, 39 and 40 were shifted to their alternate positions, the opening of contact 40 rendering relay PR solely dependent, for continued energization, upon the circuit traced through wiper 32. The retraction of armature 48 of relay PR closes circuit from ground through contact 39—41, secondary relay SR to battery, and said relay is energized, its armature 51 closing circuit from generator G through secondary magnet SM to ground. As long as relay SR remains operated, magnet SM receives actuations, stepping the wiper sets *a*, *b*, etc., step by step over their respective sub-groups of contact sets 9, 10, 11. Such stepping will continue until the private wiper *a*³, now connected through contact 35—31 and alternate contact 52 with relay SR, engages the private contact 11 of the calling line, since successive contacts 11 of non-calling lines will be grounded, thus holding relay SR energized over successive locking circuits. When the contact 11 of the calling line is engaged by wiper *a*³, the absence of ground found there will deenergize secondary relay SR and its armatures will be retracted, preventing further actuations of secondary magnet SM. The secondary off-normal SQ contacts 41 to 45 inclusive were all shifted on the first step of secondary shaft *s*, the shifting of contact 41 rendering secondary relay SR solely dependent for its energization upon the circuit traced to wiper *a*³. Because of the shifting of contact 42, the retraction of armature 52 connects ground through contact 31—35 and through wiper *a*³ to private multiples 11 of the calling line, rendering them again unselectable. At this time, circuit may be traced from battery at C, relay R, contact 27—28, normal contacts 52, contact 42 to ground, whereby master-switch relay R energizes and closes circuit through motor-magnet M which receives generator impulses, stepping wipers 25, 27 over the contact sets 26, 28, in search of a set pertaining to an idle line selector D. The contacts 28 of line selectors which are not at normal will be grounded so that successive locking circuits for relay R will be established with the travel of wipers 25, 27, until the contact 28 of an idle line selector is encountered, when its ungrounded condition will occasion the deenergization of relay R and the stopping of master-switch C, whose wipers will then rest engaging the contact sets of an idle line selector ready for starting it when another call is initiated. As soon as relay SR energized to initiate travel of the secondary wipers, wires L and L' were conductively connected through alternate contact 60, whereupon relays PR' and SR' of first selector E (which, together with battery B, are, through normal contacts at 76 and 75, bridged across wires L and L') were energized. When relay SR deenergizes, contact 49 closing, establishes a circuit from ground through relay PR', extending over wire L, normal contact at 20, cut-off relay CO to battery, and said relay attracts its armatures, whereof 20 locks it to ground through wipers *a*³, 31, and contacts 52, 42. On the operation of relay CO, a substitute circuit for relay PR' is established extending over alternate contact 21, limb P, magnet 2, 1, 3, S, *a*²—10, 34—30, 50—60, L', relay SR' to battery. These circuit changes occur without relay PR' permitting the retraction of its armature, and said relay is now dependent for its energizing circuit entirely upon the last traced circuit extending over the line limbs of the calling line. Attracted armature 18 of relay CO deenergizes relays LR and 22, whereupon the retraction of armature 16 connects the ground from wiper *a*³ through alternate contact 20 to the multiple private contacts 8 at the connectors, continuing them busy against incoming calls. At substation A, a dial 5 is provided having teeth adapted to vibrate the spring 3 when the dial is rotated clockwise and then released, to be returned to normal by its associated spring. The magnet 2 is provided with an armature pawl 4 normally engaging a notch in disk 5 and holding it against actuation. When the receiver is removed to initiate a call, current will for the moment flow through magnet 2 through its attracted armature to momentarily unlock dial 5. Instantly, however, armature 17 of relay LR removes ground from limb S of the line and magnet 2 deenergizes, its pawl then holding dial 5 locked until the line has finally been selected, when the bridging of battery B at E across the limbs P and S of the line through relays PR' and SR' again energizes magnet 2 which withdraws the pawl to permit clockwise rotation of dial 5 by hand. The subscriber A now rotates the dial until two teeth have

passed below spring 3, and releases it. The returning dial causes two openings at contact 3 and two deenergizations of relay PR' at E, while relay SR' remains energized by current flowing through its right winding, contacts 79, 77, 83, to ground. Each deenergization of relay PR' transmits an impulse from ground through contacts 80, 71, 81, magnet 66 to battery, which magnet effects two steps of disk 67 in the direction of the arrow, spring 69 engaging its alternate contact as before described. Thus on the first actuation of magnet 66, circuit may be traced from ground through contact 91, alternate contact 69, release relay RR' to battery, which relay, by armature 87, locks over wire 63 to ground at contact 58. Circuit may now be traced from battery through interrupter I, lower winding of magnet PM, alternate contacts 89, 69, normal contact 91 to ground. Successive actuations of magnet PM' drive shaft p' and wipers 97, 98, 99, and also arm 68 supporting spring 69 until said spring engages the notch. When this occurs, the wipers will be engaging the second set of contacts 100, 101, 102, connected with wipers d for the second thousand, and the shifting to normal of spring 69 opens the circuit of the lower winding of magnet PM' so that the wipers come to rest. Thereupon circuit is traced from ground through normal contacts 91, 69, contact 84, shifted on the first primary step, normal contact 82, busy relay BR' to battery, and said relay energizes, its armature 94 closing the circuit through magnet SM' which receives generator impulses, stepping all the sets of secondary wipers step by step over their respective contact sets. On the first step, the shifting of contact 82 disconnects relay BR' from its original energizing circuit so it thereafter depends for its continued energization upon current through alternate contacts 86, 95, contact 99—102, wiper d^3 and successive engaged contacts 105 of busy second selector F, the private contacts of busy second selectors being characterized by a ground connection. When the contact 105 of an idle one is reached, however, it will be ungrounded, relay BR' will be deenergized, and actuations of secondary magnet SM' will cease. Further, the retraction of armature 95 connects ground to the wiper d^3 and so to the multiple contacts 105 of the selected second selector, rendering it busy. It is assumed that the selected second selector of the second thousand is one shown at F in Fig. 1, Part 3. The calling subscriber now actuates dial 5 as before to cause two breaks at contact 3 and two resulting deenergizations of relay PR' are occasioned while relay SR' remains operated, the locking circuit of the latter being now traced through contacts 93, over wire L^3 and to ground through contact 108 at F. Each deenergization of relay PR' transmits a current impulse from ground through contacts 80, 71, contacts 92, 97—100, d' —103, L^2 , 107, magnet 124 to battery, actuating said magnet twice, which steps disk 125 two steps in the direction of the arrow, spring 127 riding upon the periphery of the disk. The closing of alternate contact 127 connects ground from 123 through release relay RR², which relay operates and, by armature 113, locks over wire 106 and to ground at normal contact 95. Circuit may then be traced from battery, through constantly traveling interrupter I', lower winding of magnet PM², contact 115, alternate contact 127 to ground at normal contact 123, and magnet PM² will receive actuations, stepping shaft p^2 , the primary wipers and the springs upon arm 126 until spring 127 reengages the notch when wipers 128, 129, 130 will be engaging the second set of contacts 131, 132, 133, terminals of the wiper set f for connections to the second hundred of the second thousand. The opening of alternate contact 127 prevents further actuations of magnet PM², and the closing of normal contact 127 operates busy relay BR² by current through contacts 109, 110, 127, 123, to ground. Relay BR² attracts its armature 118, closing generator circuit for secondary magnet SM² which steps all the sets of primary wipers e , f , etc., step by step over their contacts until the wiper f^3 engages an ungrounded, and so idle, private contact 136 of a connector of the selected group. While wiper f^3 is passing over grounded, and so busy, contacts, relay BR² remains operated by current through alternate contacts 112, 119, 130—133, f^3 , to grounds on successive engaged contacts 136. The set of contacts 134, 135, 136, connected to wires L^4 , L^5 and 150, extending to connector G, is assumed to be the idle contact set. When this is reached, the ungrounded condition of contact 136 deenergizes relay BR², since its original energizing circuit was opened at contact 109 on the first step of the secondary wipers, and the retraction of armature 118 prevents further actuations of magnet SM², while the retraction of 119 grounds the engaged multiple contacts 136, the wipers f' , f^2 , f^3 being now at rest engaging the contacts leading to connector G. The calling subscriber now actuates dial 5 to cause two breaks in the line circuit, deenergizing relay PR' twice, whereby two impulses are transmitted from ground through contacts 80, 71, conductors L^2 , L^4 , to G, through 160, 151, magnet 195 to battery, actuating said magnet which advances disk 196 two steps in the direction of the arrow, spring 197 then riding on the periphery of the disk. The resulting connection of spring 199 to ground through 198, 197, operates release relay RR³ by current through nor-

mal contact 185, whereupon armature 184 locks said relay through contact 183 to ground over the private wire 150. Pulsations now flow from battery through constantly traveling interrupter I^2 , upper winding of primary magnet PM^3 , contact 187, contacts 199, 198, 197, to ground, and primary shaft p^3 is advanced step by step, moving the wipers and the arm 204, carrying spring 197 and its associated contacts, in the direction of the arrow until the notch in disk 197 is again engaged, when the shifting to normal of the spring 197 opens circuit through primary magnet PM^3 and the primary wipers 207, 208, 209 rest engaging the second set of contacts 210, 211, 212, connected to wipers h' , h^2 , h^3 , having before them multiple contacts 6, 7, 8, of lines numbered 2221 to 2229 inclusive, followed by contacts of line 2220, zero being ten impulses. During the deenergizations of relay PR' , relay SR' remains operated by current flowing through its armature 79 and over wires L^3 and L^5 to ground, first at primary off-normal contact 157 and then through contact 198—197 to ground. On the closing of normal contact 197 after the primary wipers are adjusted, circuit is traceable from ground through said normal contact, 194, 153, 156, locking relay LO to battery, actuating said relay which, by contact 161, locks to ground through 165, 158, and, by armature 160, shifts wire L^4 from connection with magnet 195 to connection with magnet 200. When now the calling subscriber transmits the units digit 1, a single deenergization of relay PR' transmits an impulse as before from ground through wire L^4 , said impulse now passing through alternate contact 160 and magnet 200 to battery, and said magnet advances disk 201 a step in the direction of the arrow, whereby spring 202 rests upon the periphery of the disk and engages its alternate contact. Such engagement energizes primary release relay PRR , which, by armature 192, locks to ground at contact 159, while its armature 189 closes a circuit from battery through constantly traveling interrupter I^3 , upper winding of magnet SM^3 and alternate contact 202 to ground, so that magnet SM^3 receives actuations until spring 202 overtakes the notch in disk 201, when said spring shifts to normal to prevent further actuations of magnet SM^3 , at which time the secondary shaft s^3 will have rotated sufficiently so that wipers h' , h^2 , h^3 will be engaging the first contact set 6, 7, 8, that of the called line 2221. The shifting from normal of spring 202 sends an impulse from ground through contacts 154, 163, right winding of test relay TR, to battery, and said relay immediately energizes, opening contact 165 to deenergize locking relay LO, while armature 166 connects the left wind-

ing of said relay through normal contact 180, and contact 209—212 and wiper h^3 , to the multiple test contact 8 of the called line. The deenergization of relay LO disconnects the right winding of relay TR from the original energizing ground connection and the relay now depends for its continued energization upon such connections as may exist at multiple contact 8.

Assuming first that the called line is idle, its contacts 8, as indicated, will be connected to the same side of battery to which the left winding of test relay TR is connected, so that said relay immediately deenergizes, when the closing of normal contact 166 operates ringing control relay RC by current from ground through said relay, contacts 162, 152, normal contact 166, contacts 180, 209—212, h^3 —8, 16, cut-off relay CO of the called line to battery. The operation of said cut-off relay opens the normal battery connections of the line and line relay LR and connects the line wires P and S to contacts 6, 7, thereby establishing the talking connections of the line circuit. By the closing of alternate contact 20, the ground traced through relay RC to multiple contacts 8 is connected to the private contacts 11 at the line selectors, continuing said contacts unselectable. The energization of relay RC connects constantly operating interrupter I^5 with the so-called flip-flop relay FF^3 , and said relay alternately attracts and releases its armature, connecting and disconnecting ringing generator G with and from the called line, current from said generator passing over limb S, through the call-bell and condenser at the substation Z, returning over P, alternate contact 21, and through impedance 173 to battery. As soon as the called subscriber answers and removes his receiver, hook-lever 1 closes a conductive circuit through the substation, and as soon as the armature of relay FF^3 is retracted, circuit may be traced from ground through answering relay AR, contact 175, armature of FF^3 , contacts 208—211, h^2 —7, alternate contact 19, S, 3, raised hook-lever 1, magnet 2, P, alternate contact 21, contacts 6— h' , 210—207, 174 and impedance 173 to battery. Attracted armature 178 of relay AR energizes closing relay CR which, by armature 170, locks to ground at 181 and, by armature 171, disconnects interrupter I^5 from relay FF^3 , so that said relay remains inert and generator excluded from the called line. Attracted armatures 168, 169 now complete the talking circuit at the connector G, said talking circuit, as already stated, being indicated throughout the circuit drawing by the heavily marked conductors. By the closing of contact 168, the ground through answering relay AR is, over the called line, connected through wire L^4 and thence to the left through wire L^2 and alter-

nate contacts 81, 72, with reversing relay RV' and battery, whereby said relay becomes energized, and reverses the connections of battery B to the calling line. Such reversal may be employed to operate any of the known polarized meter or pay station devices of the art. The calling and called substations are now connected for conversation, central battery talking current being supplied to substation A from battery B through the impedances of PR' and SR', while current to called substation Z is supplied from the central battery through impedances 173 and relay AR, the condensers 73, 74 being interposed in the talking circuit at first selector E. The inductances of the magnets 2 serve as the impedance coils customarily employed in the transmitter battery supply branch of the substation talking circuits. When the subscribers finish their conversation, they replace their receivers. When subscriber Z does so, connector G alone restores to normal. When subscriber A does so, line selector D, first selector E and second selector F are all restored. Thus the replacing of the receiver at substation Z deenergizes relay AR and circuit is traced from battery through secondary release relay SRR, contacts 172, 179, to ground through contact 155. Armature 182 locks relay SRR to ground at 155, and attracted armature 181 closes generator circuit through the lower winding of secondary magnet SM² and actuations of said magnet will be produced until the secondary switch mechanism reaches normal, when the shifting of the secondary off-normal contacts will occasion the deenergization of relay SRR by the opening of contact 155 and retracted armature 181 will prevent further actuations of magnet SM². By suitable mechanical connections of secondary shaft 8², not only the secondary wipers and the springs carried by arm 203 are continued in their original direction of travel to a normal point, but the disk 201 is also rotated to normal. On the energization of relay SRR as described, its armature 183 opens the locking circuit of release relay RR² and said relay deenergizes, circuit being then traced from the generator through the lower winding of magnet PM² and contacts 190 and 188 to ground. When magnet PM² has been actuated a sufficient number of times to bring the primary wipers, arm 204 with its associated springs, and disk 196 to a normal point, the primary off-normal PO contacts will be shifted to normal, the opening of contact 159 deenergizing primary release relay PRR and retracted armature 190 will prevent further actuations of primary magnet PM² and the primary switch mechanism will be at normal. As soon as the wipers start their restoring travel, the circuit including relays RC and CO is opened

and both relays are deenergized. As soon as relay SRR energized as described, the opening of normal contact 181 deenergizes closing relay CR, whose retracted armatures 168 and 169 place the talking primary wipers on open circuit during release. It will be observed that during release, the wire 150, extending to private contacts at the second selector, is held grounded over two branches, one extending through alternate contact 182, and the other through contact 193 and armature 188, so that, until both the primary and secondary mechanism of the connector is restored and relays SRR and PRR are both deenergized, the connector is held busy at the second selector. When the calling subscriber A replaces his receiver, relays PR' and SR' at E both deenergize, there being no ground at this time connected to locking contact 79 at relay SR'. Circuit may now be traced from ground at D, through contact 44, wire 61, contacts 70, 78, wire 62, release relay RR, to battery. Relay RR, by its armature 56, locks to grounds at contacts 38 and 45, whereby said relay RR will remain energized until both the primary and secondary switch mechanism is restored. Attracted armature 53 energizes secondary relay SR by current flowing to ground at contact 43, and said relay SR remains energized, holding closed at contact 51 the generator circuit for secondary magnet SM, until the secondary wipers reach normal and the opening of contact 43 deenergizes relay SR when, its armatures being retracted, further actuations of magnet SM are prevented. When relay RR energized, its attracted armature 55 operated relay PR by current flowing to ground at contact 39, and said relay PR, by armature 47, closed the generator circuit of magnet PM, and the primary wipers are continued in the original direction of travel until they reach a normal point when the opening of contact 39 deenergizes relay PR and, its armatures being retracted, further actuations of magnet PM are prevented. As soon as both primary and secondary off-normal contacts are restored, relay RR has its circuit opened and deenergized. Upon the initial energization of relay RR, before described, attracted armature 57 operates relay 37 and its armature 58 ungrounds wire 63, whereby release relay RR' at E is deenergized. On its deenergization, relay BR' operates by current through retracted armature 86, to ground at contact 83, and attracted armature 94 closes generator circuit of magnet SM', which rotates the secondary wipers in the original direction to a normal point when the shifting of contact 83 deenergizes relay BR' whose armature 94 prevents further actuations of magnet SM' and the secondary wipers rest at normal. Further, on the deenergization of relay RR',

relay 65 operates by current through normal contact 88 and contact 85 of the primary off-normal switch to ground. Armature 90 closes the generator circuit for the upper winding of magnet PM' and said magnet receives actuations, turning the primary wipers, arm 68 with its associated springs, and disk 67, in the original direction until a normal point is reached, when the primary off-normal contacts are restored, the opening of contact 85 preventing further actuations of magnet PM' by causing the deenergization of relay 65, the mechanism of first selector E being then at normal. At master-switch C, the private contact 28 of the switch pair DE is held grounded until both selectors have reached normal, ground being traced at D, through attracted armature 54, and at E through attracted armatures 91 and 96, so that until the switch pair is fully restored, the wipers of the master-switch cannot come to rest upon the contacts of said switch pair. As soon as relay BR' at E operated, attracted armature 95 removed ground from wire 106 extending to F, so that release relay RR² at second selector F deenergized. Its armature 112 then operated busy relay BR² by current to ground at alternate contact 108, and the resulting closing of contact 118 caused generator impulses through secondary magnet SM², which turned the secondary wipers around to a normal point, at which time the shifting to normal of contact 108 deenergizes relay BR² and its retracted armature 118 prevents further actuations of magnet SM². Further, on the deenergization of relay RR², relay 121 operated by current to ground at contact 111, and attracted armature 122 closed a generator circuit through the upper winding of magnet PM², which receives actuations, turning the primary wipers, the arm 126 with its associated springs, and disk 125 around to a normal point, when the opening of contact 111 will deenergize relay 121 and second selector F will rest at normal, the opening of contact 122 preventing further actuations of magnet PM². During restoration, the multiple private contacts 105 or F are held grounded over wire 106, through alternate contacts 123 and 120, so that until selector F is fully restored, its terminals at the first selectors E remain busy.

Assuming that at the time test relay TR at G was operated to connect its left winding with wiper h³ to test the called line, said line was busy, then the multiple contacts 8 would have been connected to ground in one of the several ways heretofore referred to and relay TR would have remained locked, holding the busy back machine I⁴ operatively connected to talking conductor L⁴, and the busy signal would be transmitted over the talking circuit to the calling subscriber station A, where the calling subscriber, hear-

ing it in his receiver, would replace the same upon the hook-switch to cause the restoration of selectors D, E and F as before described. Under the present circumstances, his act will also restore connector G, since, as soon as relay BR² at F operates, ground is removed from conductor 150 and release relay BR³ will be deenergized. Since answering relay AR has not operated, the closing of contact 186 will operate secondary relay SRR by current through normal contact 206 and to ground at contact 155, and the connector G will be automatically restored to normal in a manner which will be understood from the preceding description. As soon as the locking circuit of relay TR through contact 8 of the busy line is opened by the restorations of the wipers, the relay TR will be deenergized. It will be observed that when the called line is busy, the answering relay AR, the ringing control relay RC, and the closing relay CR remain deenergized. The reason why the calling subscriber cannot release the connector in the case that the called subscriber has answered, is because at such time the armature 205 of relay AR is attracted, thus placing an additional ground upon the locking armature 184 of release relay RR³ and rendering its deenergization solely dependent upon the position of the hook-lever at the called substation. The circuits are so arranged that if the calling subscriber operates part of the switches and then replaces his receiver without completing the connection, the operated switches will be restored to normal. For example, suppose that as soon as the first selector E is connected with the called line, the receiver is replaced. Relay PR' deenergizes, but relay SR does not immediately deenergize because of a locking circuit extending through contacts 79, 77, 83, to ground. The deenergization of relay PR' accordingly transmits an impulse from ground through contacts 80 and 71, 81, and magnet 66 to battery, and said magnet advances disk 67 a step and the primary wipers initiate their travel and select the first group. When this occurs, secondary travel is initiated in the usual manner and contact 83 of the secondary off-normal switch is shifted to its alternate position, opening the locking circuit of relay SR', which deenergizes, closing the release circuit between wires 61 and 62 and the release of selectors D and E proceeds as before.

If the calling subscriber had operated first selector E to select second selector F and then replace his receiver, relay PR' would deenergize and relay SR' would not deenergize, being locked over wire L³ to ground at 108. An impulse will accordingly flow through contacts 80 and 71, over wire L² to magnet 124. The second selector F

would then select its first group of contacts and its secondary travel would be initiated in a manner obvious from the above paragraph, the opening of contact 108 then de-energizing relay SR' to close the release circuit between wires 61 and 62.

If the calling subscriber, after adjusting selectors E and F so that connection extended to connector G, then replaces his receiver, the deenergization of relay PR' will transmit an impulse over wires L² and L⁴ to G and through contacts 160, 151, to magnet 195, relay SR' remaining locked over a circuit extending over wires L³ and L⁵, first to ground at 157 and then to ground at contact 198—197 until spring 197 engages the notch in disk 196. When this occurs, locking relay LO will operate before relay SR' allows its armatures to retract, and said relay will remain locked through contacts 164 and 177 to ground. Accordingly, current will flow over wire L⁴, through alternate contact 160 and magnet 200 to battery, and the connector G will select the first contact set of the first group. Then on the operation of test relay TR, relay LO is deenergized, ground is removed from wire L⁵, and release circuit between wires 61 and 62 at E is closed by the resulting deenergization of relay SR', and the disconnect operations proceed in a manner which will be understood from the preceding description, the removal of ground from wire 150 (when, in the course of the release, relay BR² at F energizes) opening the circuit of release relay RR³ so that the connector G also restores.

In constructing the system, the secondary off-normal contacts 83 at E, and 109 at F, are preferably arranged so as not to disengage their normal contacts until the respective secondary private wipers have engaged their first contact set so as to insure that relays BR' and BR² do not deenergize on the first secondary step of their respective switches.

Referring now to Figs. 2 and 3, I there show mechanism adapted more specifically for employment to perform the switching operations necessary for the primary wiper and control arrangements of a first selector, second selector or connector. For convenience, where applicable, reference characters corresponding to first selector E have been applied to Figs. 2 and 3. The primary wipers *k*—*k* are insulatingly mounted upon the support 206, fastened to the rotary shaft 205, journaled at 203 to bridge 210, and at 204 to circular base-plate 211. The primary ratchet 212 is also fastened to the shaft 205 and adapted to be driven step by step by the armature-actuated pawl 208 of primary magnet PM'. Said magnet is provided with two spools having the upper ends of their cores joined by a bridge of magnetic ma-

terial 215, the transversely extending armature 214 being pivoted for reciprocating action between the pole-pieces 213 at the opposite or lower ends of the cores and provided with a retracting spring 214^a. The elements, which for convenience are indicated as wipers in Fig. 1, are represented by common strips in the mechanical drawing, as indicated, for example, at 99 in Fig. 3, the contacts 102 being placed adjacent to the common strip, the wipers *k* serving only to cross the said commons to successive contacts when the wipers are rotated. Supported by a shaft 204, is also an arm 67^a, having at one extremity a buffer of insulating material normally engaging the spring 69 and holding it in engagement with its normal contact. The hub 202, to which is fastened the ratchet 201, fits loosely about the shaft 205 and is freely turned thereon, when actuations of magnet 66, which is similar in construction to magnet PM', by armature-actuated pawl 200, drive the ratchet 201 step by step. Thus on the first actuation of magnet 66, the spring 69 will be brought forward, as viewed in Fig. 3, clear of the stud upon arm 67^a, and said spring will, by its tension, free its normal contact and engage its alternate contact. Then when sufficient actuations of magnet PM' are caused to drive ratchet 212 and shaft 205 to move the wipers and arm 67^a until the buffer on the end of said arm engages spring 69, said spring will be shifted to normal and the mechanism will have operated the spring 69 in the manner required by the circuit E. Then, when later actuations of magnet PM' are caused to rotate the wipers to a normal point, the stud 207 upon the left end of arm 67^a, which engages the alternate contact of spring 69 whenever the buffer on arm 67^a engages said spring 69, will move the hub 202 and its spring 69 with its contacts around to a normal point.

In Fig. 4, is illustrated diagrammatically the preferred arrangements of the primary contact mechanism. As indicated in Fig. 2, the contacts are mounted in a circular bank, insulatingly held between ring 209 and circular base-plate 211. The wipers of Fig. 1 are represented by the segments 97, 98 and 99, having adjacent to them their respective ten contacts 100, 101, 102, the latter contacts 102 being made somewhat broader than the line contacts 100 and 101, so that the segment 99, representing the wiper of Fig. 1, will be connected to a succeeding contact 102 before leaving the one to which it was previously connected. The wipers *k*, of which there are ten, supported by the piece 206 on shaft 205, and which extend at angles of thirty-six degrees, have no circuit connections in themselves, but serve only to cross the commons 97, 98 and 99 to successive associated contacts as the wipers are moved step

by step. At 84 and 85, are indicated the two "make" primary off-normal contacts of Fig. 1, Part 2. The normal positions of the wipers *k* are the intersegmental, as shown.

- 5 For a complete operation and restoration to normal of the primary switch mechanism, it is therefore only necessary to move the wipers over the space occupied by one common or segment. Thus, if the fifth contact set 100, 101, 102, is to be selected, five steps of the wipers *k* will be produced by magnet PM'; and when the release is caused, six additional steps will bring them to a normal point.
- 10 For the secondary switch mechanism of a first selector E, a device, having driving mechanism like that illustrated in Figs. 2 and 3, may be employed. In such case, however, the magnet 66 and its associated ratchet wheel 201, the hub 202, and spring 69 with its contacts, are omitted. The contact arrangement of the secondary mechanism will, however, differ from that employed for the primary selector mechanism.
- 15 As indicated in Fig. 8, the piece 206, fastened to shaft 205, will support four superposed and insulatingly mounted wiper sets *m*, *n*, *o* and *q*. The contact bank is circularly arranged, as before, and the ten sets of secondary wipers will be represented by ten sets of segments *c*, *d*, etc., arranged in a circle, each having its appropriate ten contacts 103 placed adjacent to it. In Fig. 5, is indicated the arrangement employed for the talking contacts 103 and 104, and the associated common contacts *c* or *c'*, *d* or *d'*.
- 20 The commons *c*, *d*, etc., and their contacts form the top level of the circular contact bank and are crossed when the switch is operated by wipers *m*, and that the next level below will be composed of the commons *c'*, *d'*, etc., and their associated talking contacts 104, crossed by wipers *n*. Below the two circular levels of talking commons and contacts, are placed the private commons *c*², *d*², indicated in Fig. 6, with their associated contacts 105 made broader than the talking contacts and crossed by wipers *o*.
- 25 Underneath the private commons and contacts, are placed the off-normal strips and contacts as indicated in Fig. 7, the operation of the break and make contact 81, of the break and make contact, 83, and of the break contact 82, by the wipers *q* moving away from their normal inter-group positions, being sufficiently obvious. As in the case of the primary wiper mechanism, a complete operation and restoration to normal of the secondary switch is obtained by moving the wipers a total of eleven steps and so from one normal position to the next normal position.

The primary switch and its associated secondary switch are preferably mounted adjacent to each other, and short wires are

employed to connect the respective contact sets 100, 101, 102, in the primary switch, with the appropriate commons in the bank of the adjacent secondary switch.

It will be understood that the term "selector", as applied to mechanism of the described character, is used as referring to a primary switch and its associated secondary switch as a unit.

For the second selector F, switch devices like those just described will obviously be employed. For the connector G, the primary switch will be like that already described, the spring arrangement indicated at 197, 198, 199 being, of course, supplied. The secondary switch mechanism of the connector will be like that just described, except that it will have added to it the hub 202 shown in Fig. 3, with the proper magnet to drive the same and associated spring contacts indicated at G.

For the line selector D, the secondary switch mechanism will be like that described for switch F, and the primary mechanism will be the same as that indicated in Figs. 3 and 4, except that there will be an additional wiper common over those indicated in Fig. 4 and its associated contacts to serve the purpose of the group selecting wiper of Fig. 1. For the line selector, the hub 202, its associated mechanism, and its ratchet and magnet are superfluous and may be omitted.

In adapting the switch mechanism described for the various switches, the primary and secondary off-normal spring combinations indicated in the circuit diagram will, of course, be provided.

Obviously, modifications may be made in the circuits and mechanisms employed without departing from the substance of the invention.

I claim as my invention:—

1. A selector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, an auxiliary switch member traveling when said first member travels, and controlling means for automatically transmitting a secondary impulse after adjustment of said first member is completed.
2. A selector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, switch wipers and adjusting mechanism to move said wipers, and means for stopping said wipers when said mechanism engages said member, whereby the extent of adjustment of the latter controls that of the former, such engagement also serving to automatically transmit a secondary impulse.
3. A selector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, switch wipers and adjusting mechanism to move said wipers, means effective on

initiation of travel of said member to cause operation of said adjusting mechanism whereby said mechanism overtakes said member after adjustment of the latter is completed, and an auxiliary selector circuit having its connections automatically changed responsive to such overtaking.

4. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, an auxiliary switch member traveling when said first member travels and temporarily coordinated therewith, and a test relay having its electrical condition altered when travel of both members is completed by cooperative action between said members.

5. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, an auxiliary switch member traveling when said first member travels and temporarily coordinated therewith, and a test relay controlled by joint action of said members.

6. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, terminal selecting traveling contacts for said connector and normally at rest adjusting mechanism for moving said contacts, and means for stopping said contacts when said mechanism engages said member.

7. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, terminal selecting traveling contacts for said connector and adjusting mechanism for moving said contacts, means for stopping said contacts when said mechanism engages said member, and a test relay having its electrical condition altered responsive to such engagement.

8. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, an auxiliary switch member traveling when said first member travels and temporarily coordinated therewith, and a switch operated by joint action of said members.

9. A connector for automatic systems including an impulse transmitting conductor, a primary switch controlling member adjusted responsive to impulses over said conductor, traveling contacts for said connector and adjusting mechanism for moving said contacts, a secondary switch controlling magnet for said connector, and a switch cooperatively controlled by said member and said mechanism for connecting said magnet with said conductor.

10. A connector for automatic systems including an impulse transmitting conductor, a primary switch controlling member adjusted responsive to impulses over said conductor, traveling contacts for said connector

and adjusting mechanism for moving said contacts, a secondary switch controlling magnet for said connector, means for stopping said contacts when said mechanism engages said member, and means responsive to said engagement to connect said magnet with said conductor.

11. A connector for automatic systems including an impulse transmitting conductor, a primary switch controlling member adjusted responsive to impulses over said conductor, traveling contacts for said connector and adjusting mechanism for moving said contacts, controlled by said member, and a switch controlled by joint action of said member and said mechanism to alter the connections of said conductor.

12. An automatic telephone system including a selector having a traveling switch device adjusted responsive to directive impulses, terminal selecting contacts and mechanism for adjusting said contacts operating simultaneously with said device, and apparatus adjusted by said mechanism to overtake said device after the latter's adjustment is completed.

13. An automatic telephone system including a selector having a traveling switch device adjusted responsive to directive impulses, terminal selecting contacts and mechanism for adjusting said contacts operating simultaneously with said device, apparatus adjusted by said mechanism to overtake said device after the latter's adjustment is completed, and a circuit changing contact shifted by such overtaking.

14. An automatic telephone system including a selector having a traveling switch device adjusted responsive to directive impulses, terminal selecting contacts and mechanism for adjusting said contacts operating simultaneously with said device, apparatus adjusted by said mechanism to overtake said device after the latter's adjustment is completed, a busy relay, and circuit connections altered responsive to such overtaking to alter the electrical condition of said relay.

15. A selector for automatic systems including contacts arranged in groups, a device adjusted responsive to directive impulses to determine selection of the group, automatically operating mechanism adapted to pursue said device and overtake the same after its adjustment is completed, apparatus for controlling automatic selection of a contact set of the selected group, and means solely controlled by such overtaking to set said apparatus in operation.

16. A selector for automatic systems including contacts arranged in groups, a device adjusted responsive to directive impulses to determine selection of the group, automatically operating mechanism adapted to pursue said device and overtake the same after its adjustment is completed, and means

solely controlled by such overtaking to initiate secondary travel of said selector to select contacts of the selected group.

17. A telephone system including a selector having a metallic circuit, a calling device for causing directive impulse interruptions in said circuit, a pair of relays bridged to opposite sides of said circuit adapted to be energized when the circuit is closed, a locking circuit for holding one of said relays energized while the other vibrates its armature responsive to the directive interruptions, and selector mechanism responsive to a prolonged interruption of said metallic circuit to open said locking circuit whereby said locking relay deenergizes.

18. A telephone system including a selector having a metallic circuit, a calling device for causing directive impulse interruptions in said circuit, a pair of relays bridged to opposite sides of said circuit adapted to be energized when the circuit is closed, a locking circuit for holding one of said relays energized while the other vibrates its armature responsive to the directive interruptions, selector mechanism responsive to a prolonged interruption of said metallic circuit to open said locking circuit whereby said locking relay deenergizes, and a release circuit closed by such deenergization.

19. A telephone system including a selector connected with a calling telephone line, a pair of relays held energized by current over said line, one of said relays having in addition a local locking circuit, means whereby the opening of the line circuit causes travel of said selector, and a switch device operated by such travel to open the locking circuit, whereby said relay having said circuit becomes dependent for continued energization upon the line circuit.

20. A telephone system including a selector connected with a calling telephone line, a pair of relays held energized by current over said line, one of said relays having in addition a local locking circuit, means whereby the opening of the line circuit causes travel of said selector, a switch device operated by such travel to open the locking circuit whereby said relay having said circuit becomes dependent for continued energization upon the line circuit, and a release circuit jointly controlled by said relays.

21. A telephone system including a telephone line connecting a substation with the exchange, a selector connected with said line at the exchange adapted for primary and secondary travel, circuit connections effective when the receiver is replaced at said substation to cause first primary and thereafter secondary travel of said selector, and a release circuit closed responsive to initiation of secondary travel while the receiver is replaced.

22. A telephone system including a telephone line connecting a substation with the exchange, a selector connected with said line at the exchange adapted for primary and secondary travel, means for opening the line circuit at the substation, circuit connections for causing primary and secondary travel of said selector responsive to such opening, and release connections operated responsive to secondary travel while the line circuit is open.

23. A telephone system including a telephone line connecting a substation with the exchange, a selector connected with said line at the exchange adapted for primary and secondary travel, a normally closed off-normal contact for said selector, and means whereby the opened condition of said contact, while the line circuit is open, will restore said selector.

24. A telephone system comprising an automatic switch, means for transmitting current impulses from a control point, a starting device for said switch mechanically associated therewith set by said impulses in a position dependent upon the number of impulses transmitted, and step-by-step driving mechanism for advancing said switch to a position dependent upon the position at which said starting device is set.

25. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting current impulses from a control point, a starting device for said switch set by said impulses in a position dependent upon the number of impulses transmitted, means actuated thereby to adjust said switch to a primary position dependent upon the position at which said starting device is set, and means dependent upon the position of said starting device for giving said switch its secondary adjustment.

26. A telephone system comprising an automatic switch, means for transmitting current impulses from a control point, a starting device for said switch having a member set by said impulses in a position dependent upon the number of impulses transmitted and a following member for following and overtaking said first member in response to the advance of said switch, and means for starting the advance of said switch upon the initial movement of said first member and discontinuing it only when said following member has overtaken said first member.

27. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting current impulses from a control point, a starting device for said switch having a member set by said impulses in a position dependent upon the number of impulses transmitted and a following member for following and overtaking said first member in

response to the primary adjustment of said switch, means for starting the primary adjustment of the switch upon the initial movement of said first member and discontinuing it only when said following member has overtaken said first member, and means for starting the secondary adjustment of said switch as soon as said following member overtakes said first member.

28. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting primary and secondary current impulses from a control point, a primary starting device for said switch set by said primary impulses in a position dependent upon the number of primary impulses transmitted, means actuated thereby to adjust said switch to a primary position dependent upon the position at which said primary starting device is set, a secondary starting device for said switch set by said secondary impulses in a position dependent upon the number of secondary impulses transmitted, and means actuated thereby to adjust said switch to a secondary position dependent upon the position at which said secondary starting device is set.

29. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting primary and secondary impulses from a control point, a primary starting device for said switch having two members, the first member set by said primary impulses in a position dependent upon the number of primary impulses transmitted and the second member for following and overtaking the first member in response to the primary adjustment of said switch, means for starting the primary adjustment of said switch upon the initial movement of said first member and discontinuing it only when said second member overtakes said first member, a secondary starting device for said switch having two members, the first member set by said secondary impulses in a position dependent upon the number of secondary impulses transmitted and the second member for following and overtaking said first member in response to the secondary adjustment of said switch, and means for starting the secondary adjustment of said switch upon the initial movement of the first member of said secondary starting device and discontinuing said adjustment only when it is overtaken by its second member.

30. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting primary and secondary current impulses from a control point, means responsive to said primary impulses to give said switch a primary adjustment, a starting device for said switch set by said secondary impulses

in a position dependent upon the number of secondary impulses transmitted, and means actuated thereby to adjust said switch to a secondary position dependent upon the position at which said starting device is set.

31. A telephone system comprising an automatic switch capable of primary and secondary adjustments, means for transmitting primary and secondary current impulses from a control point, means responsive to said primary impulses to give said switch a primary adjustment, a starting device for said switch having a member set by said secondary impulses in a position dependent upon the number of secondary impulses transmitted and a following member for following and overtaking said first-mentioned member in response to the secondary adjustment of said switch, and means for starting the secondary adjustment of said switch upon the initial movement of said first-mentioned member and discontinuing said adjustment only when said following member overtakes said first-mentioned member.

32. A telephone system comprising a telephone line, a pair of relays at the exchange connected with said line, a selective switch, an armature for one of said relays serving to adjust said switch and adapted to vibrate responsive to circuit changes produced in said telephone line, a maintaining circuit for the second relay held closed while said armature vibrates, a release circuit for said selective switch controlled by said second relay, and means operating upon a prolonged retraction of said armature to deenergize said second relay.

33. A telephone system comprising an automatic switch, a starting device for said switch mechanically associated therewith and adapted to be set in any one of a plurality of positions, a substation telephone line connected to said switch and means controlled thereat for setting said starting device, and means for advancing said switch to mechanically cooperate with said setting device whereby said switch is stopped in a position dependent upon the position at which said starting device is set.

34. A telephone system comprising a selector switch connected with a calling line, a pair of relays held energized by current over the calling line, means whereby the opening of the line circuit causes travel of said selector, to extend the circuit of the calling line, means for establishing a locking circuit for one of said relays, effective during such travel, said relay then being dependent for energization upon the line circuits, and a release circuit controlled by said relay.

35. A telephone system including a selector switch connected with a calling line, connector switches adapted to be connected with by said selector, a pair of relays held energized by current over said line, one of

- said relays having an additional local locking circuit, means for opening the line circuit whereby one of said relays is operated, means responsive to the operations of said relay to cause travel of said selector to connect with a connector switch, a switch device operated responsive to such travel to open said locking circuit, whereby said relay having said circuit again becomes dependent for energization upon the line circuit, a second locking circuit for said relay established from said connector responsive to connection therewith, said second locking circuit being adapted to be interrupted responsive to operation of the connector switch, whereby said locking relay becomes dependent for continued energization upon the line circuit, and a release circuit, for said selector controlled by said locking relay.
36. A selector switch for telephone systems, having bank contacts divided into groups, wiper contacts for coöperation therewith, electromagnetic mechanism for operating said wiper contacts, switch contacts adapted to be moved to a position corresponding to a group of said contacts, and operated responsive to such movement, a control circuit for said mechanism rendered effective responsive to such operation of the switch contacts, to cause said mechanism to move said wiper contacts to a selected group, whereby said switch contacts are adapted to be operated by said mechanism to render said control circuit ineffective.
37. A telephone system comprising a selector switch connected with a calling line, connector switches adapted to be connected to by said selector, a pair of relays held energized by current over said line, one of said relays having an additional local locking circuit, means whereby the opening of the line circuit operates the other of said relays, means responsive to such operation of said other relay to cause travel of said selector to connect with a connector switch, a switch device operated responsive to such travel to open said locking circuit, whereby said relay again becomes dependent for energization upon the line circuit, and a second local locking circuit for said relay established from said connector responsive to connection thereto.
38. A telephone system comprising a selector switch connected with a calling line, selector switches adapted to be connected to by said selector, a pair of relays held energized by current over said line, one of said relays having an additional local locking circuit, means whereby the opening of the line circuit operates the other of said relays, means responsive to such operation of said other relay to cause travel of said selector to connect with one of said selector switches, a switch device operated responsive to such travel to open said locking circuit, whereby said relay again becomes dependent for energization upon the line circuit, and a second locking circuit for said relay established from said selector responsive to connection thereto.
39. A selector switch comprising groups of contacts and coöperating wiper mechanism, a controlling member and means for moving said member to any one of a plurality of positions corresponding to said groups of contacts, means for moving said wiper mechanism into stopping engagement with said member when moved to one of such positions, whereby the corresponding group of contacts is selected, and means for thereafter operating said wiper mechanism to select a contact in the selected group.
40. A selector switch comprising groups of contacts and coöperating wiper and step-by-step driving mechanism, a control member having switch contacts for controlling said driving mechanism, means for moving said member to a position corresponding to a desired group of contacts, means for automatically stepping said driving and wiper mechanism to engage and operate said switch contacts to stop said driving mechanism.
41. A telephone system comprising a selector switch, trunk lines leading therefrom, a normally open metallic circuit telephone line connected to said switch, a pair of relays and means for energizing same responsive to closing of said metallic circuit, means for causing interruptions of said circuit, one of said relays vibrating its armature responsive thereto, a local locking circuit for the other one of said relays effective during such interruptions, means for operating said switch responsive to the vibrations of said first relay and a release circuit for said switch controlled through contacts of said second relay.
42. A selector switch for telephone systems comprising a primary relay, a second relay, a control circuit whereby said relays are energized, means for rapidly interrupting the control circuit whereby said primary relay is correspondingly operated for transmitting primary impulses, a local locking circuit for said second relay effective during such primary operations, means for operating said switch responsive to said primary impulses, means for deenergizing said second relay only responsive to a prolonged interruption of the control circuit, and a release circuit for said switch controlled by said second relay.
43. A primary and secondary selector switch for telephone systems comprising a primary relay, a second relay, a control circuit whereby said relays are energized, means for rapidly interrupting the control circuit whereby said primary relay is correspondingly operated for transmitting primary impulses, a local locking circuit for said second relay effective during such pri-

mary operations, means for primarily adjusting said switch responsive to said primary impulses, means for effecting a secondary adjustment of said switch, means
 5 for deenergizing said second relay only responsive to a prolonged interruption of the control circuit, and a release circuit for said switch controlled by said second relay.

44. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, terminal selecting traveling contacts for said connector and step-by-step adjusting mechanism for moving said contacts,
 10 and means for stopping said contacts when said mechanism engages said member.

45. A connector for automatic systems including a traveling switch controlling member adjustable responsive to directive impulses, terminal selecting traveling contacts for said connector and adjusting mechanism for moving said contacts while said member is in motion, and means for stopping
 15 said contacts when said mechanism engages said member.

46. A telephone system comprising a line, a selective switch at the exchange adapted to be associated therewith, impulse and release relays for said switch energized by
 20 current over said line, a locking circuit for said release relay, means for interrupting the circuit of said line to cause a vibratory action of said impulse relay, means for operating said switch responsive to said vibratory
 25 action of said impulse relay, and means for automatically restoring the control of said release relay to said line.

47. In a telephone system a subscriber's telephone line, an automatic switch adapted
 30 to be connected to said line for extending a call therefrom, impulse and release relays for said switch, means for energizing said relays over the line circuit, a locking circuit for said release relay, means for interrupting the circuit of said line whereby the said
 35 impulse relay is caused to vibrate to operate the said automatic switch, and means for automatically restoring the control of said release relay to the said line.

48. In a telephone system a subscriber's line, an automatic selector switch adapted to be associated with said line, an impulse and a release relay for said switch adapted
 40 to be energized upon the connection of said switch to said line, a locking circuit for said release relay, means controlled over the line circuit for causing said impulse relay to vibrate to operate said switch, and means for automatically restoring the control of
 45 said release relay to the said line.

49. A telephone system including a telephone line, a pair of relays connected with said telephone line, a selective switch, an armature for one of said relays serving to
 50 adjust said switch and adapted to vibrate

responsive to circuit changes produced in said telephone line, a local maintaining circuit for the second relay held closed while said armature vibrates and opened responsive to the cessation of vibration.

50. A telephone system including a telephone line, a pair of relays connected with said telephone line, a selective switch, an armature for one of said relays serving to adjust said switch and adapted to vibrate responsive to circuit changes produced in said
 55 telephone line, a local maintaining circuit for the second relay held closed while said armature vibrates and opened responsive to the cessation of vibration, and a release circuit for said switch having a contact controlled by said second relay.

51. In a telephone system, the combination with a telephone line, of a selective switch at the exchange, a directive impulse relay connected with said line and responsive to circuit changes produced therein to adjust said switch, a release relay also connected in circuit with said line and energized by current thereover, a local maintaining
 60 circuit closed to hold said release relay energized while said directive impulse relay adjusts said switch, and means effective after the adjustment of said switch by said impulse relay is completed, to open said local
 65 maintaining circuit whereby said release relay is solely dependent for energization upon current in said telephone line.

52. In a telephone system, the combination with a telephone line, of a selective switch at the exchange, a directive impulse relay connected with said line and responsive to circuit changes produced therein to adjust said switch, a release relay also connected in circuit with said line and energized by current thereover, a maintaining
 70 circuit closed to hold said release relay energized while said directive impulse relay adjusts said switch, and automatic adjusting means for said switch to open said circuit.

53. A telephone system including a telephone line, a pair of relays associated with said line, a selective switch, an armature for one of said relays serving to adjust said switch and adapted to vibrate in response to circuit changes produced in said line, means for initially energizing said second relay, and a local maintaining circuit for said second relay extending through a contact of
 75 said relay held closed while said armature vibrates, and opened in response to the cessation of vibration.

54. A telephone system including a telephone line, a pair of relays energized by current over said telephone line, a selective switch, an armature for one of said relays serving to control adjustment of said switch and adapted to vibrate responsive to rapid interruptions of said telephone line, a local
 80 maintaining circuit for the second relay held

closed while said armature vibrates and opened responsive to the cessation of vibration.

55. A telephone system including a telephone line, a pair of relays energized by current over said telephone line, a selective switch, an armature for one of said relays serving to control adjustment of said switch and adapted to vibrate responsive to rapid interruptions of said telephone line, a local maintaining circuit for the second relay held closed while said armature vibrates and opened responsive to the cessation of vibration, and a release circuit for said switch having a contact controlled by said second relay.

56. In a telephone system, the combination with a telephone line, of a selective switch at the exchange, a directive impulse relay energized by current over said line and responsive to rapid interruptions of said line to adjust said switch, a release relay also connected in circuit with said line and energized by current thereover, a maintaining circuit closed to hold said release relay energized while said directive impulse relay adjusts said switch, and automatic adjusting means for said switch to open said circuit.

57. A telephone system comprising a telephone line, a selective switch at the exchange, a directive impulse relay energized by current over said line and responsive to rapid interruptions of said line circuit to adjust said switch, a release relay also connected in circuit with said line and energized by current thereover adapted to have its circuit interrupted responsive to such rapid interruptions, a maintaining circuit for said release relay closed through normally open contacts thereof to hold said release relay energized while said interruptions occur, means for adjusting said switch

responsive to said operation of the impulse relay, and means for automatically restoring the control of said release relay to said line circuit after said adjusting movement of said switch.

58. A telephone system including a telephone line, a pair of relays energized by current over said line upon initiation of a call thereover, a selective switch associated with said line, means for rapidly interrupting said line circuit to operate one of said relays, a locking circuit for the other of said relays closed upon the initial energization thereof and adapted to maintain said second relay energized while said first relay is being vibrated, means for adjusting said switch responsive to said operations of the first said relay, and means for interrupting the locking circuit of said second relay after such adjustment of said switch whereby the control thereof is restored to said line.

59. A telephone system comprising a telephone line, a selective switch at the exchange associated therewith upon initiation of a call, impulse and release relays energized by current over said line upon the initiation of a call, means for rapidly interrupting the circuit of said line to cause a vibratory operation of said impulse relay, a locking circuit for said release relay closed upon its initial energization, means for operating said switch responsive to said vibratory operation of the impulse relay, and means for automatically restoring the control of said release relay to said line after said operation of the impulse relay.

In witness whereof, I hereunto subscribe my name this 31st day of July, 1908.

FRED SCHOENWOLF.

Witnesses:

CAROLYN WEBER,
G. E. MUELLER.