F. SCHOENWOLF.

AUTOMATIC SELECTING SYSTEM.

APPLICATION FILED MAY 6, 1907.

988,390.

Patented Apr. 4, 1911.

3 SHEETS—SHEET 1.

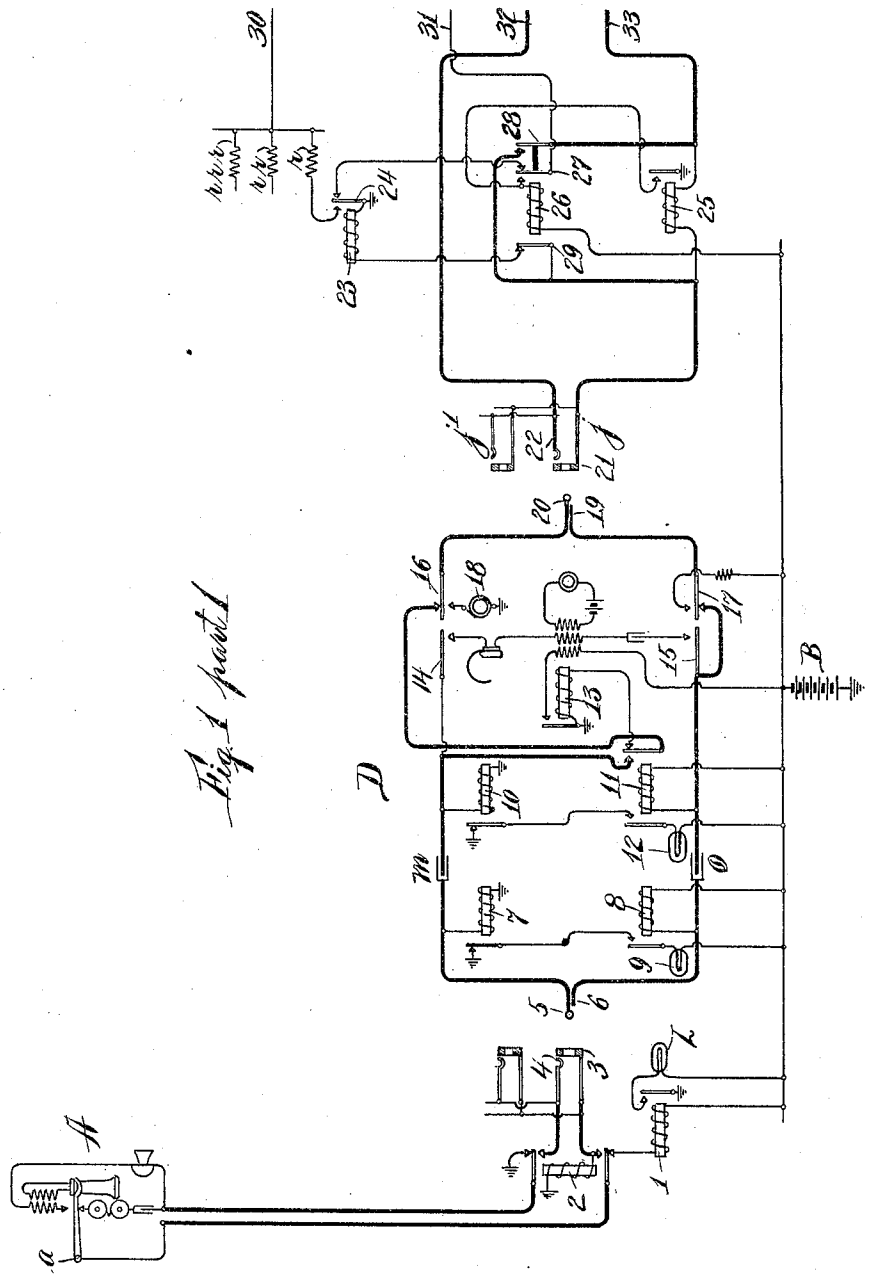

Fig. 1 sheet 1

Witnesses

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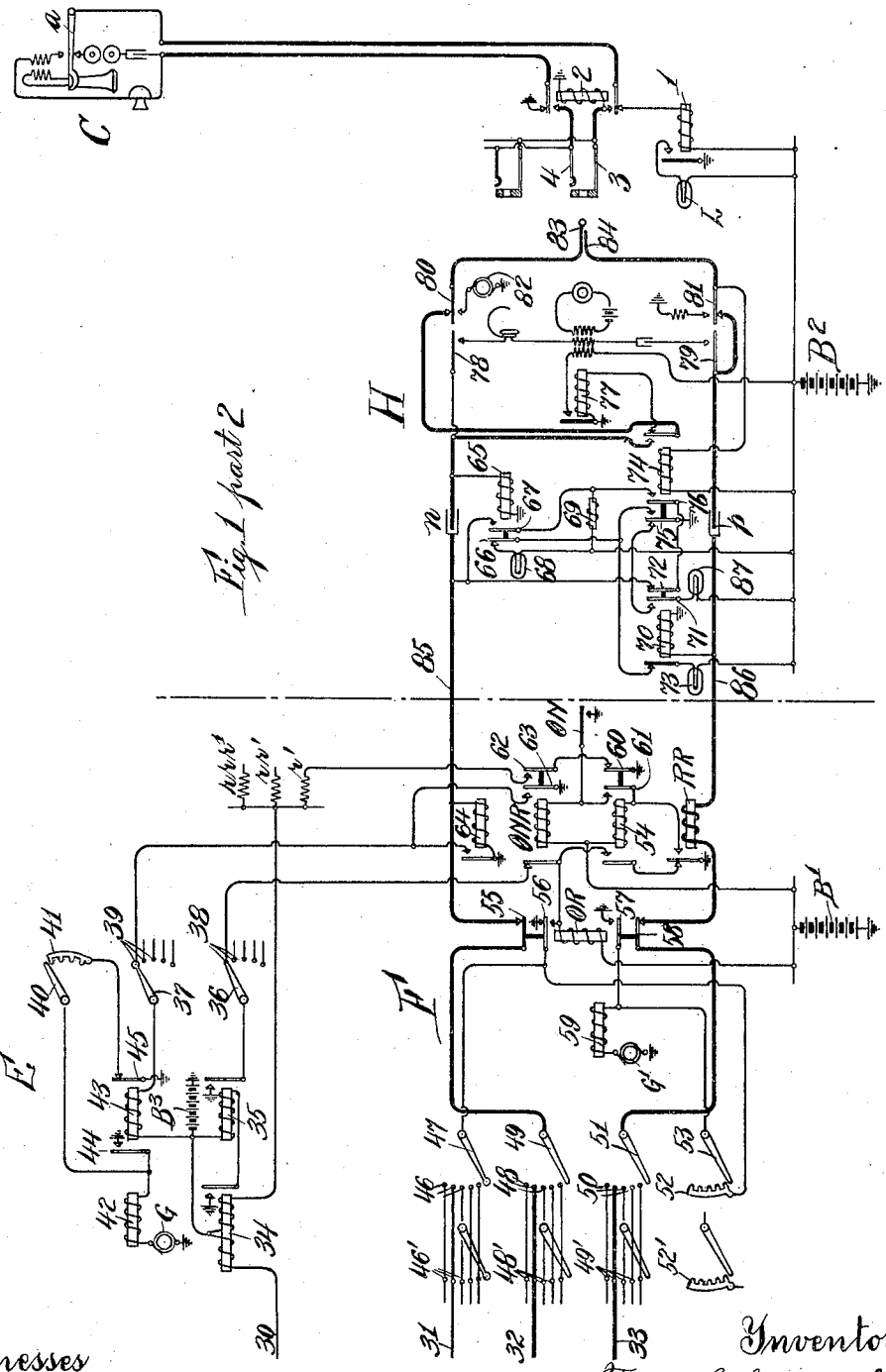

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3 SHEETS—SHEET 3.

Fig. 2

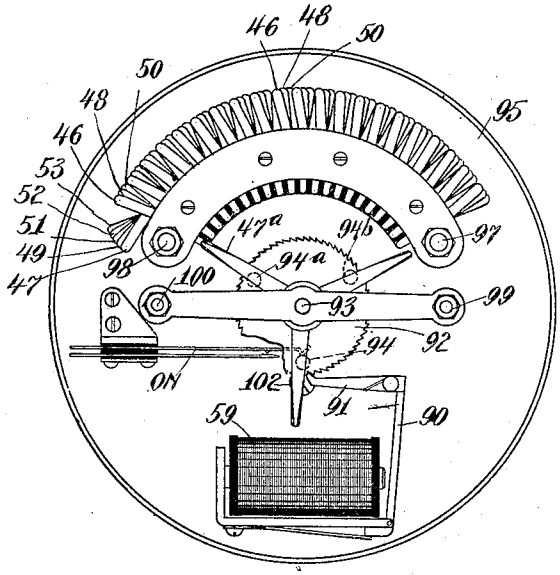


Fig. 3

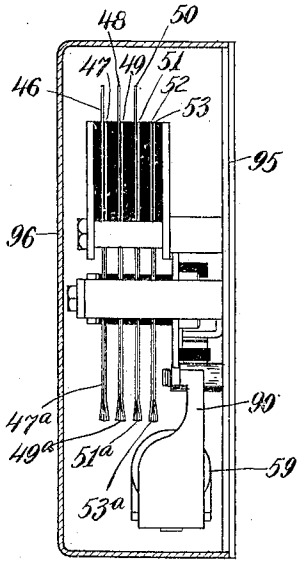


Fig 4

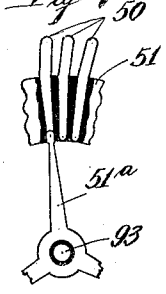
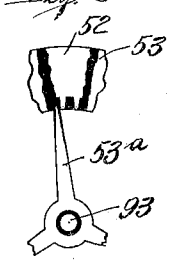


Fig. 5



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UNITED STATES PATENT OFFICE.

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AUTOMATIC SELECTING SYSTEM.

988,390. Specification of Letters Patent. Patented Apr. 4, 1911.

Application filed May 6, 1907. Serial No. 372,257.

To all whom it may concern:

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

My invention relates more particularly to means involved in controlling selective switches in such systems and has primarily for its object the preventing of improper action of the switches. Especially in step by step switches, which are not provided with a retaining pawl and arranged for a return restoring movement, on withdrawal of such pawl, there has been found a tendency to occasionally stop at a joint intermediate of two operative positions. Take, for instance, switches comprising a series of sets of adjacently disposed stationary contacts with switch wipers adapted to move from contact set to contact set. Such an arrangement in a telephone system would ordinarily comprise two talking wipers carrying the talking connections and a private or test wiper having test means associated with it to enable it to pick out a set of idle contacts through which a talking circuit may be completed. In such structures, it is customary to provide the test wiper with an end sufficiently broad so that it may engage a second contact before leaving the one previously engaged by it, while the talking wipers are preferably narrow at their contact extremities so as not to engage the next contacts until after they have left the ones previously engaged by them. This, of course, is to prevent the possibility of the talking wipers being left in an intermediate position engaging contacts of two talking circuits.

In the systems to which I have more specifically applied my invention, the selector switch is provided with an operating relay which, when the switch is traveling, is connected to the private wiper, the said wiper moving from contact to contact, holding the relay energized as long as it is passing over contacts connected to one side of the battery. As soon as a contact, not thus connected, is reached and the private wiper passes free from the preceding contact, the operating relay has its circuit opened and is deënergized. As this relay must be quick to respond and as it controls the travel of the switch, it may happen that the switch wipers will stop at a time when the private wiper has left the last busy contact and before the talking wipers have moved sufficiently to engage the talking contacts corresponding to the idle contact found by the private wiper. It will be understood that in the use of spring-restoring switches, such troubles are of less probability because a retaining pawl there ordinarily operates upon a ratchet and will, in case of such a half step, fail to engage the next tooth of the ratchet, and the spring will then restore the switch back to the preceding contact set.

As before indicated, my invention is for the purpose of preventing the difficulties above mentioned and in the preferred embodiment of my invention, as applied to a switch having a driving magnet, I provide two operating circuits for the magnet; one, which may be called a primary circuit, being controlled by a front contact of an operating relay; the other, which may be called a secondary circuit, including a back contact of the operating relay and what may be called auxiliary contacts of the switch. The secondary circuit is not employed at all in the preferred embodiment of my invention except at such times as, by mischance, a partial or uncompleted step of the switch has occurred, at which time the premature deënergization of the operating relay allows the closing of the back contact included in the secondary operating circuit of the magnet.

Referring now to the drawings, I show in Fig. 1 a simple automatic selecting system as applied to a semi-automatic telephone exchange employing two switches of varying characters, in the arrangement of each of which my invention has been included; Figs. 2 and 3 are respectively top and side views of a selective switch mechanism that may be employed in connection with the circuit of Fig. 1; Fig. 4 shows the private wiper of the switch and its contacts; and Fig. 5 shows an auxiliary wiper of the switch and its contacts.

Referring first to Fig. 1, I show at A and C, respectively, two subscribers' lines of well-known character, and at D, E, F and H, the exchange instrumentalities for inter-connecting them. The apparatus at D is an A operator's cord-circuit,

while that at H is a B operator's cord-circuit. The apparatus for establishing a connection between the cord-circuit D and the cord-circuit H includes a spring-jack *j* comprised of the contacts 21 and 22, multiple terminals 46, 48 and 50 pertaining to said jack, and a number of selecting switches, one of which, F, is shown including the wipers 47, 49, 51 and 53. The selector switches such as F are normally at rest and an idle one is started through the instrumentality of the distributer switch E having its circuits in operative relation with the jack *j*. Each A operator will have a number of cord-circuits such as D, and a number of jacks such as *j*. The terminals 46, 48 and 50 of the springjacks would be grouped together before the wipers of the switches F, it being understood that each switch F pertains to a link-circuit including conductors 85 and 86 extending to a cord-circuit similar to H. The jacks *j* may or may not be multiple jacks, although I have shown at *j* one multiple for the jack *j*.

The distributer switch shown at E includes the differential relay 34 controlling the starting relay 35 which is placed in operative relation with idle switches F through its armature, the wiper 36 and the contacts 38. Included in the switch E is also the operating relay 43 with its winding connected to the test wiper 37, arranged to sweep over the contacts 39 of the different switches F, the said relay 43 being thereby rendered sensitive to the idle or busy conditions of such switches so that when the switch E is once started, it will continue its travel until the test wiper 37 engages the contact 39 of an idle switch. When relay 43 is operated, the driving magnet 42, controlling the switch wipers 40, 37 and 36, receives successive current impulses from generator G to ground through the attracted armature 44. The strip 41 is provided with a series of projections adapted for successive engagement by the auxiliary wiper 40. The wipers 40 and 37 may conveniently be placed one above the other on a rotary shaft, and the contact projections of the strip 41 extend intermediate of the different test contacts 39 of the selectors. If the switch E, under the influence of magnet 42, moves its wipers one full step, the wipers 40, 37 and 36 will be moved a full step so that wiper 40 will be resting free of the strip 41 and between two projections, while wipers 37 and 36 will be moved a full step to engage the next contacts 39 and 38. If, as before indicated, the wiper 37, having engaged an idle contact 39, opens circuit through relay 43 and the said relay retracts its armature 44 so quickly that magnet 42 cannot complete its armature stroke to drive the wipers the full step, then wiper 36 may be intermediate of two contacts 38 so that when the switch E is to be again used to start an idle selector, the operation of its starting relay 35 will be ineffective because the wiper 36 will be on open circuit. As the initiation of travel of the switch E is dependent upon the starting of the switch F, it will be obvious that in such case as that just described, the switch E might be rendered inoperative. This would be especially undesirable in the master-switch, inasmuch as it would ordinarily be common to a large number of circuits, for starting the switches to select them, and all the circuits would be rendered useless until the trouble was detected and rectified. In the structure at E, however, the wiper 40 and the contact projections of 41 are effective, if relay 43 is, as indicated, prematurely de-energized, to cause another impulse to flow from generator G through magnet 42, wiper 40, the intermediately positioned projection of 41, and to ground through the back contact of armature 45. This additional actuation of magnet 42 does not move the switch wipers a full step, but merely causes them to complete this step already partially made, because the armature-driven pawl of magnet 42, as will be understood from the hereinafter given description of Fig. 2, will engage the same tooth of its associated rotary ratchet as that engaged by it when it made the false move and will drive the switch only a partial step. Of course, on the completion of the second actuation of magnet 42, wiper 40 will have been brought to a position between two projections of 41 and no further actuations of magnet 42 will be produced.

The switch at F, for selecting the jacks at the A operator's position, may comprise an operating relay OR, a driving magnet 59 controlled by said operating relay, the said magnet being controlled over a primary circuit including the front contact of armature 57, and over a secondary circuit including the back contact of armature 56 and the wiper 53 arranged to engage one of the projections of the strip 52 at all times except when the private wiper 47 and the talking wipers 49 and 51 are resting substantially squarely upon one of their contact sets; the arrangement being in a general way similar and adapted to serve the same ends as the arrangement at the distributer switch E. In the operation of the switch F, the relay OR, initially operated over wiper 36 and contact 38 at switch E, is by armature 56 operatively related to the test wiper 47 so as to be sensitive to the normal or altered electrical conditions of the private contacts 46 pertaining to the different springjacks *j*. The off-normal switch spring ON controls the off-normal relay ONR, which latter has contacts for controlling the circuits of the distributer switch E after the

switch F is started. The release relay RR is provided to cause the return of the switch F to normal by causing travel thereof in the direction in which it was initially operated to a zero point.

To describe Fig. 1 and its operation in detail, and assuming that the subscriber at A desires his line connected for conversation with that of the subscriber at C, the subscriber at A removes his receiver from the hook-lever *a* which then bridges the transmitter and the primary of the induction coil across the two limbs of the line, the upward movement of said lever *a* also operatively dissociating the call-bell from the line limbs in the well-known manner. A circuit for direct current is thereby closed from battery B through line relay 1, normal contact of relay 2, lever *a* and its alternate contact, returning through the upper armature of relay 2 and to ground, energizing relay 1 to display lamp L. The operator, observing the signal, inserts the answering plug into the answering jack of the subscriber's line, closing contacts 5—4 and 6—3 and a path for current from battery B, sleeve relay 8, contact 6—3, cut-off relay 2 to ground, the cut-off relay attracting its armatures to operatively extend the line limbs to the springjack contacts. The resulting energization of relay 8 would display supervisory lamp 9, were not relay 7 at this time operated by current from ground over contact 5—4 through the substation, returning through contact 3—6 and relay 8 to battery. The operator, depressing levers 14 and 15, bridges her telephone in circuit and learns the exchange of the subscriber wanted. The jack *j* is assumed to be a jack having a circuit adapted to be selected by a selector F forming a terminal of a trunk line leading to the exchange wherein the called subscriber's line terminates. If the same be considered a multiple jack which, as before indicated, it may or may not be, the A operator will first touch tip 20 to sleeve 21 of the jack, which sleeve, if it pertains to an idle jack, will be grounded through armature 29 and relay 23, without there being any connection to the active side of battery at said springjack. In such case, the test relay 13, connected with tip contact 20 of the plug, being also grounded, no flow of current through said relay occurs and its armature remains inert, no "click" being then caused in the operator's telephone receiver. If, however, the jack *j* be busy, another cord-circuit plug will have been inserted in a multiple thereof, producing a potential other than ground at the sleeve 21, in which case test relay 13 will be operated and a "click" caused in the operator's receiver.

Assuming the jack *j* to be idle, the operator inserts the calling plug therein, closing contacts 20—22 and 19—21, whereupon current flows from battery B, relay 11, normal contact 17, contact 19—21, armature 29, relay 23 to ground, operating relay 11 to close a contact in the tip talking strand of the cord, and relay 23 to attract armature 24, closing circuit from ground through armature 24, resistance *r*, over common conductor 30, left winding of relay 34 to battery B^3, operating relay 34, whose attracted armature energizes starting relay 35, whose attracted armature completes a circuit from ground, contact 36—38, armature of relay ONR, operating relay OR, to battery B'. Relay OR is energized, attracting armature 57 and causing a current impulse to flow from generator G', through magnet 59, said armature 57 to ground, the magnet being thereby actuated to drive the wipers of the switch F a step to engage their respective first contacts 46, 48 and 50. Armature 56 of the operating relay provides a locking circuit for relay OR extending through wiper 47 and through the first contact 46 to ground over a conductor 31, the back contact of an armature 27, the back contact of an armature 24 to ground, of a springjack circuit similar to that of jack *j*, it being understood that any convenient or desired number of multiple terminals of jack circuits similar to that of *j* may be associated with the switch. As long as such jacks are idle, their relays 23 and 26 will be unoperated and therefore ground connections similar to that before described will be found at the successive contacts 46 engaged by wiper 47 as the switch F travels over contacts of idle jacks—that is, jacks in which an operator has not inserted a plug. Thus relay OR will continue locked over wiper 47 and successive contacts 46 to successive grounded armatures 24, holding its armature 57 attracted, successive impulses from generator G' flowing through magnet 59, the switch being thus driven step by step until the wiper 47 engages the contact 46 of a calling jack. The relay 23 of said jack being operated as before described, the armature 24 will be attracted and its multiple contact 46 hence ungrounded; relay OR therefore becomes deënergized, and the pulsations cease through magnet 59; wipers 47, 49 and 51 then remaining upon the multiple contacts of the selected spring-jack *j*, while wiper 53 will be between two projections of strip 52. Inasmuch as switches such as that shown at F and in Fig. 2 may be operated at a speed up to sixty or more steps per second, it will be readily understood that the relay OR must, when its circuit is opened, allow the retraction of its armature 57 in a very small space of time; and as wiper 47 preferably leaves a contact 46 after engaging its successor before the wipers 49 and 51 engage the corresponding talking contacts, the relay OR may be deënergized and cut off the im-

pulse from generator G′, which may be an alternating current generator, before the armature of magnet 59 is fully attracted, thus causing a half or partial step of the wipers. If the wipers stop in such intermediate position on the deënergization of relay OR, one of the projections of strip 52, which are spaced intermediate of the private contacts 46, will be engaged by the wiper 53; and on the deënergization of operating relay OR, an impulse will flow from generator G′ through magnet 59, wiper 53 and a projection, back contact of armature 56 to ground, causing 59 to be again actuated, as it were, traction of its armature, thus stepping the switch wipers the remaining uncompleted distance to the operative position beyond that one at which they last were. It will be noted that armatures 55 and 58 of relay OR are attracted while the switch is operated, the talking wipers 49 and 51 being thus on open circuit while the switch is traveling.

When the switch F makes its first step, spring ON is shifted to engage its contact, operating off-normal relay ONR, whose left armature operatively disconnects relay OR from the starting wiper 36 so that, until restored to a normal position, it is free from the influence of the distributer switch E. Armature 62 completes a circuit from ground through armature 60, front contact of armature 62, resistance r' and the right winding of relay 34 to battery B^3. Circuits are now closed through both windings of relay 34, which windings are differentially disposed; and since the resistances r and r' are equal, the core of relay 34 is neutral and its armature is retracted, opening circuit through starting relay 35, whose retracted armature takes ground from starting wiper 36 so that it is on open circuit while the distributer switch E is traveling. The attracted armature 63 of relay ONR initiates travel of switch E by closing circuit from ground through contact 39—37, operating relay 43 to battery B^3, whereby the armatures of relay 43 are attracted, armature 44 closing a circuit for a current impulse from generator G, operating magnet 42, to ground. The first actuation of magnet 42 moves wipers 40, 37 and 36 a step, wipers 37 and 36 engaging the contacts 39 and 38 of the next switch F; and if this is a busy switch, relay 43 will be locked through attracted armature 63 of its off-normal relay ONR, a second impulse flowing through magnet 42, causing a second step of the switch, and successive locking circuits for relay 43 will be established through wiper 37 and successive contacts 39 until a contact of a switch F is encountered, which switch is at normal and has its off-normal relay ONR therefore deenergized. In such case, owing to the retracted condition of armature 63, relay 43 is deënergized and its armature is retracted, opening circuit through magnet 42. If the last actuation of magnet 42 produced a full step of the switch, then wiper 40 will be intermediate of two projections of strip 41. If, however, the last step is a partial step of the character hereinbefore described, then on the retraction of armature 45, a current impulse will flow from generator G through magnet 42, wiper 40 and a projection of 41 to ground at the back contact 45, causing magnet 42 to again attract its armature, its pawl engaging the same tooth of the switch ratchet previously engaged by it and completing the step of the wipers.

It is assumed that the switch F has now selected the contacts 46, 48 and 50 pertaining to the particular jack j in which the operator at D has inserted the calling plug of her cord. As soon as this selection was made as previously described, on the deenergization of relay OR, a current flow took place from battery B, through sleeve supervisory relay 11, through 17, 19, 21, 25, 33, 50—51, 58, relay RR, relay 70, to ground, operating relay 11 to display supervisory signal 12, and relay 70 at H to display call signal lamp 87. Relay 25 is actuated and attracts its armature to close circuit through relay 26 which is thereupon energized, its armature 28 closing a normally open contact in the talking circuit of conductor 33, which now short-circuits relay 25, causing its deënergization. Armature 27 is attracted to complete a locking circuit for relay 26 over conductor 31, contact 46—47, and to ground through back contact of armature 56. It will be noted that as soon as relay OR was deënergized on selection made, a ground was connected at retracted armature 56 through wiper 47 to the multiple contacts 46—46′ of the selected jack, whereby the said terminals will test busy to any other switch F. Attracted armature 29 of relay 26 opens the circuit of relay 23, which relay is deënergized, and circuit through the left winding of relay 34 is opened at the armature of said relay 23. The before-described current flow through relay RR attracted the relay's armature, energizing relay 54, whose attracted armature 60 opens the circuit through resistance r' and the right winding of relay 34 at substantially the same time that circuit is opened through the left winding, so that the relay 34 is not actuated a second time when the switch F has selected the jack.

The resistances rr and rrr, connected to conductor 30, extend to the alternate contacts of armatures 24 of relays 23 of other jacks; and if a relay 23 of such another jack is operated, relay 34 will, of course, continue actuated so that when the switch F selects the jack j and switch E reaches the contact of an idle selector, such idle selector will be started because the cutting out of re-

sistances r and r' will be unavailing on account of the other resistance rr or rrr still maintaining a circuit through the left winding of relay 34.

Armature 61 of relay 54, when the relay is energized, locks the said relay to ground at off-normal spring ON so that relays ONR and 54 are now both locked through the said spring and so remain until the conclusion of conversation and the return of the switch F to normal. The B operator at H now depresses levers 78 and 79 of her listening-key and inquires of subscriber A the number of the line wanted, into a springjack of whose line she inserts the plug of the cord-circuit H, closing contacts 84—3 and 83—4, provided the preliminary test, which she makes in the manner similar to that in which the operator D tested the jack j, has indicated to her that the line wanted is idle. Upon the insertion of the plug, current flows from battery B^2 through sleeve supervisory relay 74, through 81, 84—3, cut-off relay 2 to ground, operating the cut-off relay and connecting the line limbs to the jack contacts 3 and 4 respectively. The operated relay 74 closes a normally open contact in the tip talking strand, and attracted armature 75 puts out lamp 87 and would cause the display of supervisory signal 73 were not relay 70 at this time energized. The operator now throws over levers 80 and 81, including ringing generator 82 in circuit with the called-for line, current passing therefrom through the attracted upper armature of relay 2, the condenser and call-bell at the substation, returning to the attracted lower armature of relay 2 and through lever 81 to ground. The operator then restores her ringing-key levers and the called subscriber C, removing his receiver from the hook-lever, allows the elevation of hook-lever a, closing a low resistance circuit from ground, through relay 65, attracted right armature of relay 74, contact 80, contact 83—4, through the transmitter and induction coil at the substation, lever a, returning through contact 3—84 and relay 74 to battery. Relay 65 is thereby operated and, by attracting armature 66, puts out the calling supervisory signal 68, actuated, on the attraction of armature 75 of relay 74, by current from ground through said armature, armature 66 and its normal contact. On the extinguishing of lamp 68, the B operator at H knows that the call has been answered. The attraction of armature 67 of relay 65 completes a path for the flow of current from battery B^2 through the inductive resistance coil 69, armature 67, to the left over conductor 85, contact 49—48, conductor 32, plug and jack contact 22—20, normal contact 16, attracted right-hand armature of relay 11, supervisory relay 10 to ground; which relay 10, being energized, attracts its armature and puts out calling supervisory lamp 12, the A operator thus knowing that the call has been answered. The two subscribers A and C are now in conversation, battery being supplied to the transmitter of subscriber A through the windings of relays 7 and 8, while battery is supplied to the transmitter of subscriber C through the windings of relays 65 and 74; the talking circuit being traced through the exchange by the heavily marked conductors, condensers m and n being included in one side of the talking circuit, and o and p being included in the other side of the talking circuit.

Subscriber A, at the conclusion of conversation, replaces his receiver, opening circuit through relay 7, whose deënergization permits the display of supervisory signal 9; while when subscriber C replaces his receiver, this act is effective to deënergize the relay 65 whose retracted armature 67 opens the before-traced circuit over conductors 85 and 32 through relay 10 at D, whose armature is retracted and causes the display of supervisory signal 12. The falling back of armature 66 causes the signal 68 to be displayed and the operator at H may now withdraw the calling plug of her cord from the jack, which will restore the apparatus to the right of condensers n and p to normal by deënergizing relay 74, or she may wait until the operator at D, in response to the double display of the supervisory signals, withdraws the calling plug from the jack j, which act will be effective, in addition to restoring the selective switch to normal, to deënergize the relay 70 whose retracted armature will then cause the display of the other supervisory signal 73.

The restoration of the selector switch F, upon the withdrawal of the plug from the jack j, is effected as follows: On the opening of contact 19—21, the circuit before traced, extending over conductors 33 and 86 through relay RR, is interrupted at contact 21, relay RR is deënergized, and its retracted armature closes circuit from ground through the left armature of relay 54, through operating relay OR to battery B′, which relay OR is energized to place the talking wipers 49 and 51 upon open circuit and to close a circuit for magnet 59 and generator G′. Inasmuch as relay 54 is locked, as before described, to ground at off-normal contact ON, the circuit through the operating relay OR will continue closed until the switch is driven by magnet 59 in the same direction as that in which it was operated to a normal position, at which time the deënergization of relay 54, following the opening of contact ON, will permit the operating relay to fall back and the switch come to rest, ready to be started again by the distributer switch E after the said switch E shall have selected it. As soon as relay OR attracts armature 56, the locking circuit for relay 26 is opened and

the relay deënergized and all apparatus associated with the circuit of jack j and with the selective switch F is then at normal.

Referring to Fig. 2, the mechanical structure there illustrated is provided with reference characters corresponding to those of the circuit at F. This is also true of Figs. 3, 4 and 5. I have illustrated the switch as arranged for twenty operative contact sets 46, 48 and 50. There are in the said Fig. 2, however, shown, in all, twenty-one contact sets, but it will be understood that when the structure of Fig. 2 is employed for the purposes of the switch shown at F in Fig. 1, the first contact set at the left will be left disconnected. The additional contact is shown because when the switch is used as a distributer switch E, the wiper is always engaging an operative contact. In the mechanical structure of Fig. 2, the instrumentalities, shown for the sake of clearness as wipers in Fig. 1, are represented by the common strips 47, 49, 51 and 53, which extend around respectively beneath their contacts 46, 48, 50 and 52, the said common strips forming the true terminals of the circuits of the switch in the same manner that the wipers do in Fig. 1, while the wipers shown in Figs. 2 and 3, designated 47^a, 49^a, 51^a, and 53^a, have in themselves no circuit connections but serve merely to cross the common strips to successive contacts 46, 48 and 50, respectively associated with them.

The stationary contacts, as clearly shown, in Fig. 2, are arranged in an arc of one hundred and twenty degrees, the contact terminals and their respective commons being superposed and insulated one from the other in a rigidly supported bank mounted upon main frame 95. Carrying the wipers 47^a, 49^a, 51^a and 53^a which are three-pronged, the prongs extending at angles of one hundred and twenty degrees so that one will be leaving the arc of the bank as another is about to enter the said arc, is a shaft 93, suitably journaled to the main frame 95 and to a cross-bar supported by the posts 99 and 100. To this shaft 93, is fastened also the ratchet 92, adapted to be engaged by pawl 91 carried by the armature 90 of magnet 59, which pawl, an successive actuations of the magnet, drives the ratchet, carrying with it shaft and wipers, step by step. The stop 102 is provided for pawl 91, so that a definite limit is fixed to the extent to which a thrust of the pawl may move the ratchet. Three normal positions exist for the switch of Figs. 2 and 3. That is to say, when any one of the three wipers 47^a leave the arc of the contacts, one of the three studs 94, 94^a or 94^b, carried by ratchet 93, will come to engage the off-normal spring ON to hold it free from contact with its associated contact, whereby the travel to normal of the switch F, as indicated in connection with Fig. 1, is stopped. When the switch is in any of its normal positions, it will be understood that one or another of the three studs, carried by ratchet 92, will be in a position to hold spring ON from engagement with its contact; but that the first actuation of magnet 59, effecting a thrust of pawl 91, will move the ratchet, by turning it one step, to a position where whatever stud may have been engaging spring ON, will be moved out of supporting relation therewith and the off-normal contact closed.

In Fig. 4 is shown a view of the private wiper 51^a, the private common 51 and the private contacts 50, the insulation being shown as cut away to disclose the relation of the parts. When the private wiper is in the position shown in Fig. 4—that is, operatively engaging and resting squarely upon one of the contacts 50—then the wiper 53^a of Fig. 5 will be in the position there indicated; that is, one such that it fails to cross the common strip 53 to one of the projections of the strip 52. It will be seen, however, that on a very slight movement of wiper 51^a to the right from the position indicated in Fig. 4, wiper 53^a will engage a projection of the strip 52; and also that when the wiper 51^a has traveled for enough to engage the middle contact 50 of Fig. 4 and to just disengage the contact 50 at the left, then the wiper 53^a will still be engaging a projection of the strip 52 and will continue in such engagement until the wiper 51^a has practically attained its full operative position engaging squarely the middle contact 50; it being understood, of course, that the wipers 51^a and 53^a are mounted directly above each other upon the shaft 93. By the intermediate spacing indicated in Figs. 4 and 5, it is clear that each projection of the strip 52 serves to protect, in the manner hereinbefore described, the wiper 51^a from a partial step for one certain step in the operation of the switch, during the period existing between when the wiper leaves one private contact 50 to the time when it reaches its full operative position with respect to the next contact 50.

In the employment of the mechanical structure shown in Figs. 2 to 5 for the distributer switch shown at E, it will be understood, of course, that the off-normal switch spring ON is dispensed with and one of the wipers and its associated contacts and common may be left disconnected.

It will be understood that the structures of the figures described are merely for the purpose of indicating one form of mechanism to which my invention may be applied, but that the said invention is not to be in any way restricted to the specific mechanism in association with which I have illustrated and described it, or to the specific electrical circuit associations in connection with which I have applied it. While I have in Figs. 1 and 3 illustrated the protective projections

upon a different level of the switch from the private contacts, it is my intention not to limit myself in my claims to this particular arrangement, or to the employment of a special wiper for the protective purposes as hereinbefore described and explained. Many modifications, it will be understood, might be made without departing from the spirit of my invention, and

What I claim as new and desire to secure by Letters Patent of the United States is as follows:

1. An automatic selecting system including a selective switch stationary switch contacts included therein, means for rendering some of said switch contacts busy, other stationary switch contacts positioned intermediate of said first-mentioned contacts, a stepping magnet for said switch, means for initially actuating said magnet controlled over said first-mentioned contacts when busy, and circuit connections for said last-mentioned contacts effective after initial actuation of said magnet to insure complete actuation thereof.

2. An automatic selecting system including a selective switch, stationary switch contacts included therein, means for rendering some of said switch contacts busy, other stationary switch contacts positioned intermediate of said first-mentioned contacts, a stepping magnet for said switch, a primary operating circuit for said magnet controlled by the idle or busy conditions of said first-mentioned contacts, and a secondary operating circuit for said magnet controlled by said other stationary contacts effective on deficient operation of said primary circuit.

3. An automatic selecting system including a selective switch, stationary switch contacts included therein, means outside of said switch for rendering some of said switch contacts busy, a test wiper for said switch adapted to engage said contacts, an operating relay energized over circuits including said wiper and successive busy contacts, an operating magnet for stepping said wiper, an operating circuit therefor including a front switch contact of said relay, means for deënergizing said relay as soon as said wiper engages an idle contact, and a circuit for said magnet including a back contact of said relay effective on deënergization thereof to cause said magnet to complete a partially effected step of said wiper.

4. An automatic selecting system including a selective switch, a movable contact therefor, stationary contacts adapted for engagement thereby, a stepping magnet for effecting travel of said switch, an operating relay controlled over circuits including said movable contact and successive stationary contacts, a second movable contact for said switch, stationary contacts for engagement thereby, said contacts being operatively positioned intermediate of said first-mentioned contacts, and two operating circuits for said magnet, one including a front contact of said relay, the other including a back contact thereof, one of said last-mentioned contacts and said second movable contact.

5. In an automatic selecting system, the combination with a selective switch having stationary contacts and a traveling contact, of an operating magnet therefor, a relay for controlling the same sensitive to the electrical conditions of said contacts, auxiliary contacts interspacing said first-mentioned contacts, two circuits for said magnet, one including a stationary contact, the other including an auxiliary contact, and means operated by said relay controlling both said circuits including a contact closed when the relay is inert and a contact closed when the relay is operated for completing said circuits respectively.

6. An automatic selecting system including a selective switch, switch contacts included therein normally unselectable in character, means for rendering some of said switch contacts selectable, auxiliary switch contacts included in said selective switch and an adjusting magnet for said switch, means for initially actuating said magnet controlled over said first-mentioned contacts and circuit connections for said auxiliary contacts effective to insure complete actuation of said magnet.

7. An automatic selecting system including a selective switch, normally unselectable switch contacts included therein, means for rendering some of said contacts selectable, auxiliary switch contacts associated with said first-mentioned contacts, a stepping magnet for said switch, a primary operating circuit for said magnet controlled by the electrical conditions of said first-mentioned contacts, and a secondary operating circuit for said magnet controlled by said auxiliary contacts effective on improper operation of said primary circuit.

8. An automatic selecting system including a selective switch, multiple switch contacts included therein normally unselectable in character, means outside of said switch for rendering some of said switch contacts selectable, a test wiper for said switch adapted to engage said contacts, an operating relay energized over circuits including said wiper and successive unselectable contacts, an operating magnet for stepping said wiper, an operating circuit therefor including a front contact of said relay, means for deënergizing said relay as soon as said wiper engages a selectable contact and a circuit for said magnet including a back contact of said relay effective on deënergization thereof to cause said magnet to complete a partially effected step of said wiper.

9. The combination with a step-by-step

switch of an electromagnet controlling the stepping thereof, a principal operating circuit for said magnet, an auxiliary operating circuit therefor, and means for rendering said last-mentioned circuit effective only when on operation of said first-mentioned circuit an interstep position of said switch is assumed.

10. The combination with a selective switch, of switch adjusting mechanism controlling step by step travel thereof, and means for causing a re-operation of said mechanism to complete a step, effective when on initial operation of said mechanism an interstep position of said switch is assumed.

11. The combination with a selective switch, of switch adjusting mechanism controlling step by step travel thereof, circuit connections for controlling said mechanism, and means for automatically rendering said connections effective to cause a re-operation of said mechanism to complete a partially made step.

12. The combination in a selective switch with a switch adjusting ratchet and a controlling pawl therefor, of means for automatically re-operating said pawl when a partial switch step is made.

13. The combination in a step-by-step selective switch with principal electromagnetically operating means, of an auxiliary circuit for said means for preventing said switch from remaining in an interstep position.

14. The combination in a selective switch with multiple contacts, of means for automatically stepping said switch to select contacts in a particular electrical condition, and auxiliary circuit connections serving to prevent said switch from remaining in an interstep position.

15. In a step-by-step selective switch, the combination with principal electromagnetically operating means, of main contacts and wiper, auxiliary contacts and wiper, and an auxiliary circuit for said operating means closed through said auxiliary contacts for preventing said switch from remaining in an interstep position.

In witness whereof, I hereunto subscribe my name this 4th day of May, 1907.

FRED SCHOENWOLF.

Witnesses:
G. E. MUELLER,
J. G. KELLOGG.