A. H. DYSON.

AUTOMATIC TELEPHONE SYSTEM.

APPLICATION FILED AUG. 3, 1907.

974,866. **Patented Nov. 8, 1910.**

3 SHEETS—SHEET 1.

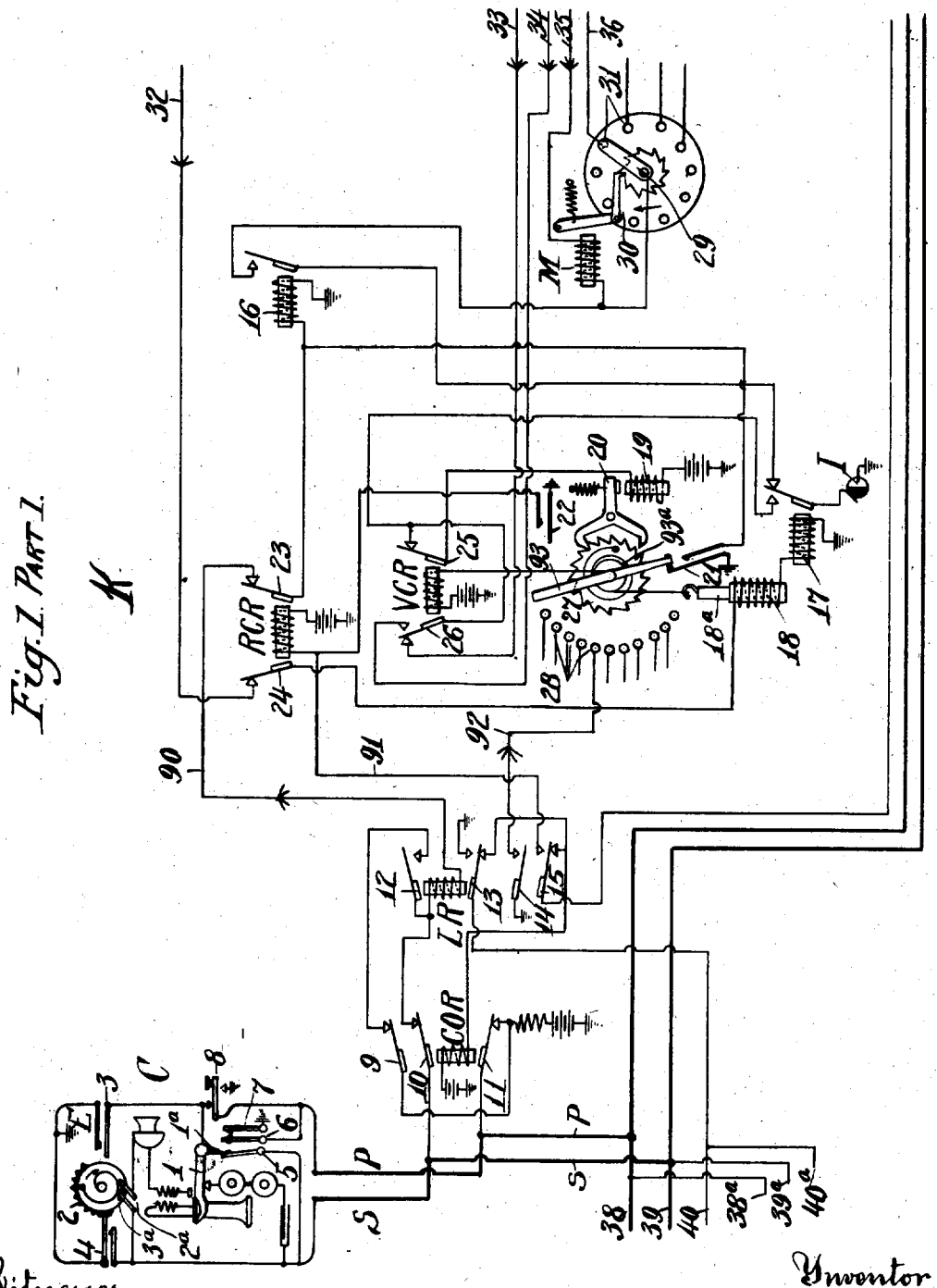

Fig. 1 Part 1.

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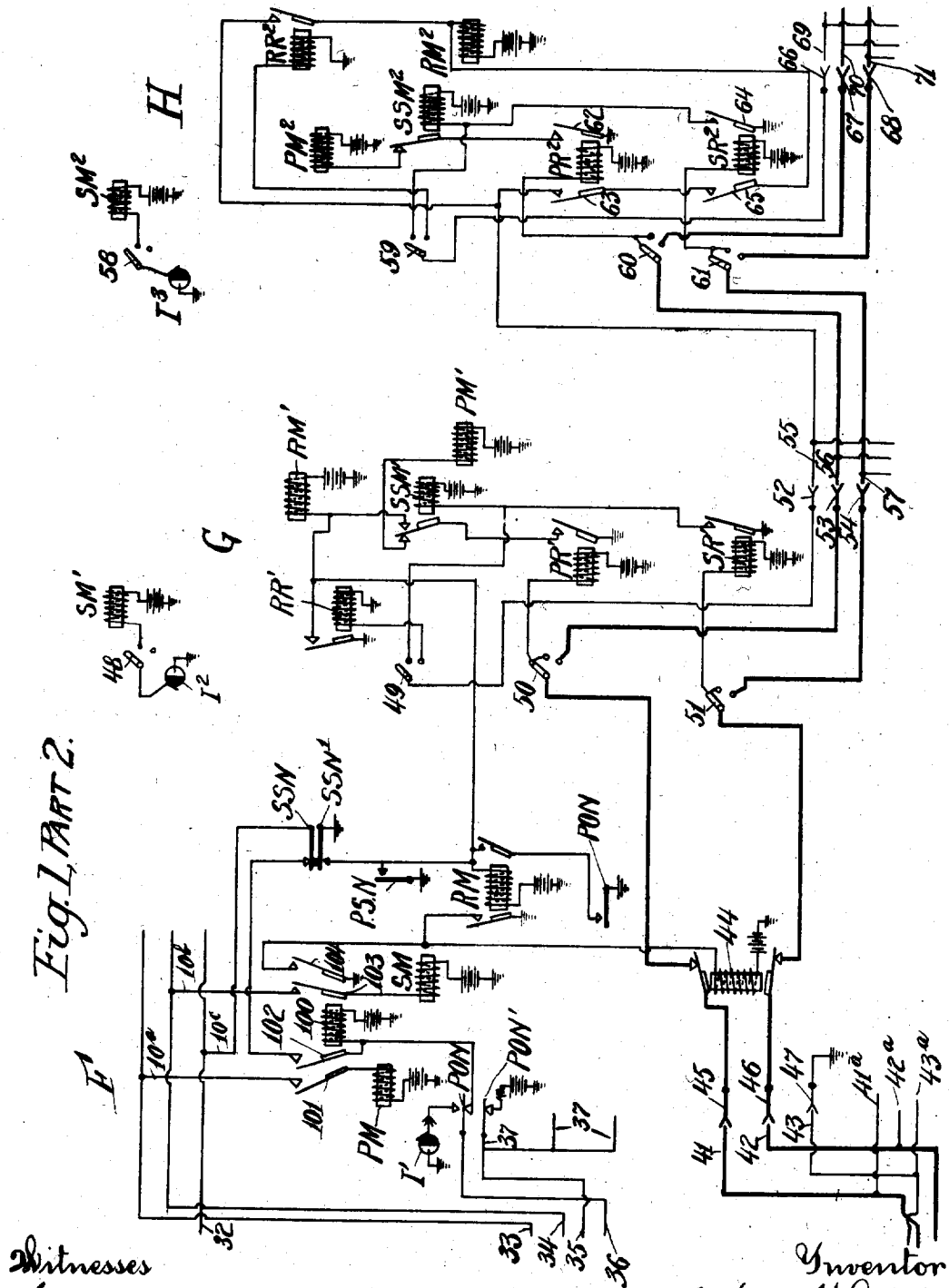

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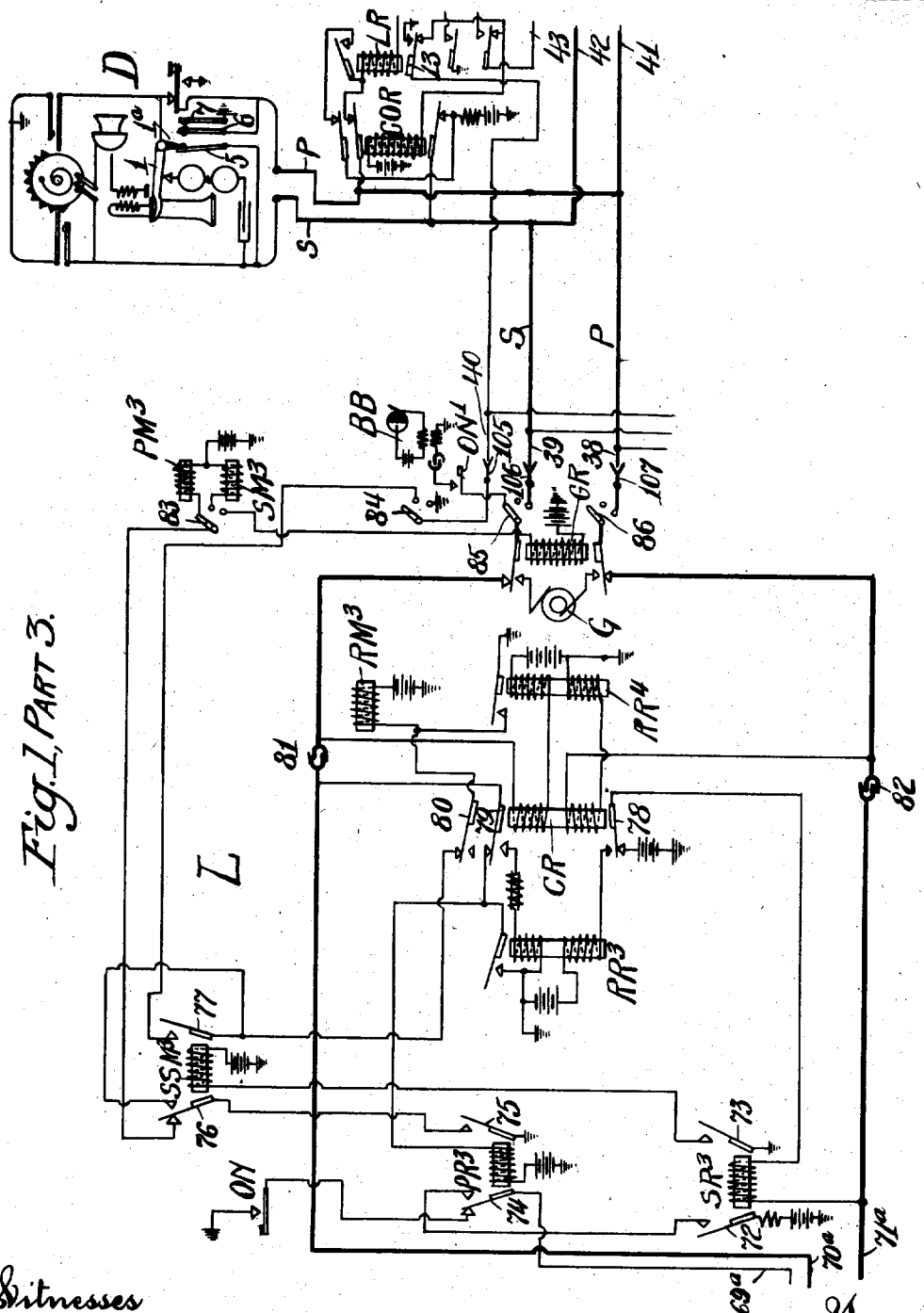

Fig. 1, Part 3.

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UNITED STATES PATENT OFFICE.

ALFRED H. DYSON, OF CHICAGO, ILLINOIS, ASSIGNOR, BY MESNE ASSIGNMENTS, TO KELLOGG SWITCHBOARD & SUPPLY COMPANY, A CORPORATION OF ILLINOIS.

AUTOMATIC TELEPHONE SYSTEM.

974,866. Specification of Letters Patent. Patented Nov. 8, 1910.

Application filed August 3, 1907. Serial No. 386,977.

To all whom it may concern:

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

My invention relates to automatic telephone systems in which a plurality of directively operated selective switches are employed in completing each connection, by linking together local trunk circuits at the exchange with which the switches are associated.

My invention has particularly to do with the means by which the selective switches of the class first operated, ordinarily called first selectors, are associated with the calling lines.

In accordance with my invention, each subscriber's line is provided at the exchange with passive called terminals, appearing in the banks of a number of connectors, and with passive calling terminals, appearing in the banks of a number of line selectors. Each line selector has preferably a first selector individual to and permanently linked with it, although I do not wish to be limited to this embodiment of my invention. The lines of an exchange, assuming, for instance, a ten-thousand line system, are preferably divided both as calling and called lines, in groups of one hundred, the connectors for making connection with the called terminals of a line group as well as the line selectors for making connection with the calling terminals of a line group, being preferably provided in numbers determined by the expected number of co-existing calls from the line group. Thus in a ten-thousand line system, there would be one hundred groups of one hundred lines each, each of which groups may have its calling terminals multiplied to ten line selectors, making a total of one thousand such switches. As before indicated, the first selectors would be equal in number to the line selectors, making one thousand, and the first selectors would have before their contact wipers multiple terminals, arranged in ten groups of ten contact sets each, of second selectors assigned for the connections to the different thousands of the exchange, in the well-known manner, the sets of each group or level being connected to second selectors for a different thousand. The second selectors would have before their contact wipers, ten groups or levels of multiple contact sets, each level comprising ten sets and being connected to connectors assigned to a different one hundred line group of subscribers of the thousand which the second selector serves.

The connectors would have before their contact wipers multiple terminals of the lines of a one hundred line group arranged in ten groups or levels, according to the tens values of the numbers of the hundred, the line terminals in each level being arranged according to the units values of the line numbers, all in the well-known manner. Thus assuming a first selector connected with a calling line, the calling subscriber transmits directive impulses to said first selector to select the level of the thousand wanted, the first selector thereupon automatically picking out terminals of the first idle trunk leading to a second selector of that thousand, whereafter the calling subscriber directively operates the second selector to pick out a group of terminals of the hundred wanted, whereupon the second selector automatically picks out terminals of the selected level leading to the first idle connector of the hundred wanted. The connector is directively operated both to select the group wanted and thereafter to pick out the particular line wanted, whereafter a busy signal will be transmitted to the calling subscriber or the bell of the called subscriber rung in the usual manner, according to the idle or busy condition of the called-for line. In a ten-thousand line system there would be one thousand connectors, multiplied to one thousand second selectors, which second selectors would be multiplied to the one thousand first selectors, in the usual manner.

In Figure 1, consisting of Parts 1, 2 and 3, I have illustrated one embodiment of my invention. The said parts when placed in consecutive numerical order, illustrate a complete circuit diagram including the necessary connections for completing a conversational circuit between a calling subscriber C and a called subscriber D, the apparatus being shown in its position of rest, the talking circuit to be established being indicated by the heavily marked conductors.

In connection with this circuit diagram, any approved form of mechanical switch may be employed, and my invention is not limited in this respect. The circuits shown are adapted for employment in connection with the well-known Strowger selector and connector switch illustrated in patent to Keith, No. 815,321, dated March 13, 1906, and patent to Keith, No. 815,176, dated March 13, 1906, respectively; and in the following description it will be assumed that switches having such mechanical connections as those above indicated are used in connection with the circuit diagrams at line selector F, first selector G, second selector H, and connector L. Referring to said Fig. 1, I show at C a diagrammatically illustrated common battery subscriber's telephone outfit comprising the usual transmitter, receiver, condenser and call bell, the hook lever 1 being arranged on the removal of the receiver to disconnect the call bell and complete an operative bridge of line limbs P and S including the primary of the induction coil and the transmitter. The calling device 2 is for actuation by the subscriber to transmit directive impulses over the telephone line, and is to be rotated by hand in the direction indicated by the arrow until as many of its teeth have passed below spring 3 as there are units in a digit to be transmitted. The device being thereafter released, is turned by its associated spring in the reverse direction, each tooth as it passes over spring 3 causing said spring to engage and disengage its associated contact, whereby limb P of the line will be grounded at E as many times as teeth are brought below spring 3. The last tooth at the left of dial 2 is, on actuation thereof, brought above the spring 4. As the dial reaches normal, the said tooth causes spring 4 momentarily to engage its contact, whereby limb S is grounded at E, this occurring after the last impulse is transmitted over limb P by way of spring 3. When dial 2 is at other than normal, pin 3^a is moved free of spring 2^a, which spring, by its tension, then disengages its associated contact, opening the conductive bridge of limbs P and S, the said calling device, on its return to normal, again closing said contact 2^a. Thus by successive actuations of dial 2, a calling subscriber can transmit a number of sets of directive impulses over limb P, each set being followed by a single impulse transmitted over limb S.

At the exchange, the line circuit of the line of C may comprise the multiple terminals 41, 42, 43 (see Part 2), one set of multiple taps for said terminals being shown at 41^a, 42^a and 43^a. It will be understood that the multiple terminals 41, 42 and 43 appear with those of nine other lines of the subgroup to which C belongs in one level of a line selector F. The multiple terminals 41, 42 and 43 of the other ninety lines of the group will appear by tens on different levels of the line selectors, which selectors have been assigned, as previously indicated, to the number of ten to a group of one hundred subscribers' lines, as calling lines.

At K I have indicated the circuits of a master switch mechanism which is preferably common to a calling group of one hundred lines and which serves the double purpose of selecting an idle line selector, the said line selectors being preferably not constantly operating devices, and for starting the idle line selector and transmitting directive impulses to the magnets thereof to place the wipers of such line selector in connection with the multiple terminals 41, 42 and 43 of a calling line, this operation being automatically effected on the removal of the receiver at the substation of such calling line.

Each subgroup of ten lines is provided with a group contact 28 before selecting arm 93 of the master switch, a common conductor 92 extending from the group contact 28 of the subgroup by ten branches to contacts of armatures 14 of the ten line relays L R of a subgroup, it being understood that each line is provided with its individual line relay L R and its individual cut-off relay C O R.

The line relay L R when actuated responsive to the removal of the receiver at the calling substation, alters the electrical condition of the group contact 28 of its subgroup at the master switch K and also the connections of its individual multiple private contacts 43 at the line selectors and the master switch K is started into operation, the said master switch first transmitting impulses to the primary or vertical magnet P M of line selector F to lift the wipers 45, 46 and 47 of such line selector to positions horizontal with the multiple contacts of the subgroup, among which the calling line has its contacts, this lifting being controlled by the wiper 93 moving over the contacts 28 until it reaches a contact 28 whose condition has been altered by a line relay of its subgroup. At this time the vertical movements cease, and impulses are transmitted from master switch K to the secondary or rotary magnet S M of the line selector, which magnet is used to rotate wipers 45, 46, 47 over the multiple terminal sets 41, 42, 43 of the selected subgroup until wiper 47 engages the contact 43 of the individual calling line, which contact, owing to the alterations of its connections by the operated line relay L R, is effective to prevent further actuations of the rotary magnet S M, whereby the wipers 45, 46 and 47 of the line selector rest in connection with contacts 41, 42 and 43 of the calling line, respectively.

Each line selector of the ten pertaining to a group of one hundred lines has a contact

31 individual to it before a wiper 29 of the master switch K, which wiper normally rests engaging the contact 31 of an idle line selector and is as soon as such line selector commences its travel, automatically moved over the contacts 31 in search of a contact belonging to an idle line selector, thus traveling simultaneously with the started one.

I am aware that systems embodying certain of the features above outlined have heretofore been proposed, and the present invention is directed more especially to the production of a system embracing certain preferred methods of operation in such systems.

A feature of the present invention is found in the means provided for locking the line relay L R as soon as the same is operated responsive to the removal of the receiver at the substation, said relay remaining locked until the calling line has been selected. This will serve to prevent the improper operation of the group wiper 93 of the master switch K. The structures referred to as hitherto proposed are of such character that on the transmission of a flash signal produced by a calling subscriber removing and replacing his receiver quickly, the group wiper 93 may move over all of its contacts 28 and remain "hung up" at its extreme operative position, there being then no means for restoring it to normal, so rendering the master switch mechanism unavailable for use by another subscriber, except by the aid of an attendant at the central office. Thus the transmission of a flash signal might well cause the master switch K upon which all outgoing calls of one hundred lines are dependent, to be rendered inoperative, a contingency which is effectively prevented by the locking of the line relay in the present system, as above indicated.

Other features of the invention are found in the improved arrangements provided for restoring the line selector and first and second selectors, which will be more fully pointed out in the detail descriptions and in the claims.

The remaining features of the system illustrated in Fig. 1 will be best understood from the following narration of operation, in which the calling subscriber C is to have his line connected for conversation with the called subscriber D, whose number is assumed to be 2345. Subscriber C removes his receiver, establishing a circuit from ground at master switch K, through the relay 16, armature 23, over common conductor 90 (having a branch to each line relay of the one hundred lines served by K), line relay L R, armature 10, limb S of the line, contact 2^a, transmitter, the shifted hook lever, normal contact of ringing key 8, limb P, armature 11, to battery; relay 16 and L R are both operated, the latter locking itself by armature 12 over a circuit extending to battery through normal contact 9. Armature 13 disconnects cut-off relay C O R from the private multiple contacts 40 at the connectors and connects ground to said contacts, whereby the calling line is rendered busy against incoming calls. Armature 14 places a ground upon the group conductor 92 and upon the group contact 28 before the group selecting wiper 93, it being assumed that the calling line belongs to a subgroup having their contacts in the fifth levels of the line selectors, the contact 28 of the subgroup being therefore the fifth contact engaged by wiper 93 in its travel from normal. Armature 15 in engaging its alternate contact, has connected the release control relay R C R of master switch K with the individual private multiple contacts 43 of the calling line at the line selectors, to render said relay sensitive to the engagement of the contact 43 at the line selector to be started by the private wiper 47 of such line selector.

The energization of relay 16 completes the circuit from constantly traveling interrupter I through the back contact of armature of relay 17, attracted armature of relay 16, the current then dividing, a portion flowing through the master switch wiper 29, the individual contact 31 of the idle line selector then engaged by said wiper over conductor 36, through the normally closed primary off normal contact P O N, and through relay 100 to battery, the remainder of the current passing through the magnet M, controlling, by its armature, the pawl 30, and through the conductor 35 to battery at normally closed primary off normal contact P O N^1. The relay 100 by armature 102 is locked over a circuit extending through contact S S N, over the common conductor 32 (which conductor has ten taps 10^c, one to each of the relays 100 of the ten line selectors serving a line group), the locking circuit extending through normal contact 24, through the winding of solenoid 18, and relay 17, to ground; the relay 17 then attracting its armature and connecting interrupter I to its front contact, whereby two effects are produced. The first of these is a stepping forward of the master switch wiper 29 in search of the contact 31 of an idle line selector F. This is effected by the opening of circuit through magnet M to allow its armature to be retracted if said circuit has not already been opened by travel of interrupter I, whereupon pawl 30 actuates a ratchet carried by the rotary shaft supporting the wiper 29, a step from left to right, wiper 29 being thereby moved from engagement with the contact 31 of the line selector F of Fig. 1 and into engagement with the next contact 31 pertaining to another line selector. If this line selector is busy, its contacts P O N

and P O N[1] will be shifted from the normal positions and an impulse will be transmitted from interrupter I[1] over contact P O N, conductor 36, contact 31, 29, then closed, magnet M returning over conductor 35 and by the tap wires 37, to battery, through the normal contact P O N[1] of any line selector that may be at rest, it being understood that the conductor 35 has a tap 37 to contact P O N[1] of each line selector serving a one hundred line group. The impulse transmitted by interrupter I[1] will cause an energization and deënergization of the magnet M, which will step wiper 29 to engage contact 31 of the next line selector, and if this be busy, the shifted condition of its primary off normal contact P O N[1] will cause another stepping of wiper 29. The stepping of wiper 29 will therefore continue by similar operations until the wiper engages a contact 31 connected to a line selector whose contact P O N is in its normal condition, interrupter I[1] being disconnected from such contact P O N, when the wiper will rest, engaging such contact 31, the master switch K, when restored to normal, as hereafter described, being then ready to operate the selected idle line selector in search of the terminal of an idle line as soon as a call is initiated. It will be seen that if all the line selectors of a line group are simultaneously busy, no travel of wiper 29 can be produced, because, although the interrupter I[1] will be connected to all primary off normal contacts P O N, the fact that all primary off normal contacts P O N[1] will be shifted will have opened all the branch conductors 37 and there will be no return path for current through magnet M.

While the wiper 29 is stepping as described, the interrupter I is transmitting impulses over the front contact of armature of relay 17, back contact of armature 25, through magnet 19 to battery and over a branch of this circuit extending through normal contact 26, the common conductor 33, having branches 10[a], one to each line selector of the group, through attracted armature 101 of relay 100, through primary magnet P M to battery. Each impulse actuates magnets 19 and P M, magnet 19 with each actuation attracting its armature, to turn escapement pawl 20 about its pivot, whereby its upper tooth disengages a tooth of ratchet 93[a], which then rotates a step under tension exerted by core 18[a] of the energized solenoid 18. Successive actuations of magnet 19 allow successive steps of ratchet 93[a] and wiper 93, which engages on each step, a successive group contact 28. Obviously, for each step of wiper 93, an impulse passes through primary magnet P M to step the shaft and wipers 45, 46 and 47 of line selector F a step vertically for each step of wiper 93. This synchronized stepping of wipers 93 and wipers 45, 46 and 47 will continue until wiper 93 reaches a group contact 28 grounded at armature 14 of the line relay of the calling line C. As soon as this occurs, a circuit will be completed from attracted grounded armature 14 over common subgroup conductor 92, the group contact 28, the wiper 93 engaging said contact, and through vertical control relay V C R to battery, actuating the said relay, whose armatures are thereupon attracted at 25 to open the previously existing circuit extending from interrupter I[1] through magnet 19, through armature 26, and also to open the previously existing circuit for magnet P M, armature 26 closing circuit extending from interrupter I through front contact of armature of relay 17, alternate contact 26, conductor 34, which conductor has ten branches 10[b], one to each relay 100 of the ten line selectors of the group, through attracted armature 103 of relay 100 of the operating line selector F and through it to secondary or rotary magnet S M, to battery. Impulses will continue flowing over this circuit, magnet S M being actuated to adjust wipers 45, 46 and 47 rotarily step-by-step over the multiple contact sets 41, 42 and 43 of the lines of the selected level until wiper 47 engages the private contact 43 of the calling line C, which will be connected through attracted armature 15 of line relay L R and conductor 91, having one hundred taps, one to each line relay L R of the calling line group, through release control relay R C R, to battery. As soon as this occurs, the ground upon wiper 47 causes energization of relay R C R whose attracted armature 24 opens the series circuit before mentioned, including relays 17 and 100 and the solenoid 18, so that all three are now deënergized on the energization of relay R C R. The deenergization of the solenoid 18 renders the restoring spring associated with the ratchet 93[a] and wiper 93 effective to restore the same back to normal, while the armature of relay 17 is retracted to engage its normal contact. Armature 23 of release control relay R C R opens the locking circuit of line relay L R which is deënergized, whereupon circuit is completed from battery, through cut-off relay C O R, normal contact 15, through contact 43, 47, to ground, armature 13 establishing a branch path of this circuit, whereby ground is continued on the multiple called contacts 40 of the calling line at the connectors, whereby the calling line is continued to be held busy against incoming calls. On the deënergization of line relay L R, armature 14 removes ground from the group contact 28, and, by the retracted armature 15, relay R C R is deënergized, so that the master switch mechanism K is in its original or normal condition and ready to

serve any other calling line of the group in adjusting a line selector to connection with such line.

It will be observed that although the master switch wiper 29 seeks out a terminal 31 of an idle line selector, immediately after initiation of a call, yet the calling subscriber retains the master switch mechanism K, as a whole, individual to his calling line until such line has been selected. This is because of the circuit which was initially established through the relay 100 of the idle line selector, which extended to primary off normal contact P O N and conductor 36, and by the locking circuit for said relay established over the common conductor 32. No other calling line is able to actuate the relay 100 of another line selector F until the first one has completed its selection, because the relay 17 continues actuated while the line selector is being adjusted and holds interrupter I disconnected from its back contact. Moreover, a downwardly extending arm of the wiper 93 on the first actuation of said wiper, closes a short circuit from the grounded spring 21 and its contact about the relay 16 deënergizing said relay, which short circuit will continue until the wiper 93 reaches normal, as before described, when contact 21 will be again opened.

It will be observed that while the line wipers 45, 46 were being adjusted, the relay 44 was held energized by a circuit extending from ground through attracted armature 104 of relay 100, the said relay 44, to battery, whereby the said line wipers 45, 46 were held on open circuit while wiping over contacts 41, 42 of lines not wanted and interference with possible conversations existing over such lines was prevented, said relay 44 being deënergized as soon as the circuit through relay 100 was opened, as before described, and its armature retracted. The energization of relay C O R by attracting its armatures 9, 10 and 11, disconnected the line relay L R from limbs P S of the line, so that the same may be no longer operable by current over the line limbs.

I have now explained the operation of the structure including the master switch mechanism K, whereby responsive to the removal of the receiver at the sub-station, a first selector G, linked with a line selector F, is connected to the calling line, and the manner in which the master switch mechanism K is thereafter restored to the use of any other line which may initiate a call to operate responsive to the line relay of such line, in connecting some other first selector G with such other line, and shall now proceed to indicate briefly the operation of the first selector and connector, the general features of these being known in the art.

The calling subscriber, by rotating dial 2, will bring two teeth beneath spring 3, and on his releasing it, the dial transmits two impulses from ground E over spring 3 and its contact, key contact 8, over limb P, through contact 41, 45, upper armature of relay 44, normal side switch contact 50, relay P R^1, to battery, actuating said relay twice. whose armature then transmits two impulses from ground through back contact of armature of side switch magnet S S M^1, primary magnet P M^1, to battery, which magnet lifts the wipers 52, 53 and 54 of the first selector two steps upward to position horizontal with a contact level including contact sets connected to second selectors H assigned for connections to a group of subscribers' lines including numbers 2000 to 2999. On the return of dial 2, an impulse is transmitted, as before described, from the earth E, through the contact 4, over limb S, contact 42, 46, lower armature of relay 44, normal side switch arm contact 51, secondary relay S R^1, to battery, energizing and deënergizing said relay whose armature energizes and deënergizes side switch magnet S S M^1, whose armature, by a well-known mechanical connection, shifts side switch arms 48, 49, 50 and 51 simultaneously from engagement with their normal contacts and to engagement with their middle contacts, it being understood that the shifting is accomplished on the back stroke of the armature of magnet S S M^1. Secondary magnet S M^1 is now actuated by current impulses flowing from interrupter I^2 through said magnet, to battery, said magnet being effective to step the wipers 52, 53 and 54 over successive sets of multiple contacts 55, 56 and 57 in search of a contact set of an idle second selector H. By a well-known mechanical connection, magnet S M^1 on its first actuation, thrusts the armature of magnet S S M^1 into its attracted position. If the first contact set 55, 56 and 57 is idle, the armature of magnet S S M^1 will be retracted when the impulse through magnet S M^1 ceases and the side switch arms moved to their third contacts. If, however, the first contact set pertains to a busy second selector, multiple private contact 55 will be grounded through the release relay R R^1 of some other first selector G, rendering the second selector busy, and side switch magnet S S M^1 of the seeking first selector G will be energized over circuit extending through intermediate contact and arm 49 to wiper 52, the busy contact 55, to its multiple engaged by the first selector, rendering it busy, and to ground through its release relay R R^1. Side switch magnets S S M^1 and release relays R R^1 have their windings so proportioned that current over the just traced circuit, while producing sufficient energization of S S M^1 to hold its armature attracted, does not produce sufficient energization of release relay R R^1 to cause it to attract its armature. As

long as magnet S S M^1 continues energized, the side switch arms cannot move to their third positions, and successive circuits for holding said magnet energized are produced as wipers 52, 53 and 54 pass over busy contacts of the selected level until wiper 52 engages a contact 55 pertaining to an idle second selector, which will be ungrounded, as shown in Fig. 1. At such time side switch magnet S S M^1 is deënergized and the arms 48, 49, 50 and 51 pass from their intermediate positions to their respective third or lower positions, whereby secondary magnet S M^1 has its circuit opened, and ground is connected through the winding of release relay R R^1 and the third contact of arm 49 to wiper 52 and the multiples 55 of the selected second selector H, rendering it busy. Arms 50 and 51 extend to the circuit of the calling subscriber's line, through to primary relay P R^2 and secondary relay S R^2 of the selected idle second selector.

The calling subscriber C now actuates dial 2 to transmit three impulses over limb P followed by one on limb S, the three passing through arm 50 and its third contact, contact 53, 56, arm 60, primary relay P R^2, to battery, which relay transmits three impulses through primary magnet P M^2, which adjusts wipers 66, 67 and 68 of second selector H to positions horizontal with the level of contact sets extending to connectors L assigned for connection to the third one hundred group of the second thousand group, one including lines numbered from 2300 to 2399. The impulse over limb S passes through arm 51 and its third contact, contact 54, 57, arm 61, secondary relay S R^2, which relay S R^2 attracts and releases its armature 64 to energize and deënergize side switch magnet S S M^2, whereby the switch arms 58, 59, 60, 61 are shifted to their intermediate positions, and the automatic selection of the first idle connector L of the selected group will proceed in the same manner as that of the idle second selector by the first selector, as already described.

On selection made, the side switch wipers 58, 59, 60 and 61 will be shifted to their third positions and four impulses now transmitted from the calling substation over limb P will pass through contact 53, 56, arm 60 and its third contact, contact 67, 70, thence over the heavily marked conductor 70^a, armature 79 and its back contact, through primary relay P R^3, to battery, which relay, attracting and releasing its armatures four times, closes circuit four times from ground through attracted armature 75, normal contact 76, side switch arm 83 and its normal contact, primary magnet P M^3, to battery, which magnet adjusts the wipers 105, 106, 107 four steps vertically to positions opposite a level of contact sets comprising those of lines numbered from 2341 to 2349 followed by terminal of line 2340, it being understood that zero is represented by ten impulses in automatic telephone systems. The impulse over limb S of the line of C, following the four over limb P, will pass through side switch arm 61 of switch H and its third contact, through contact 68, 71, conductor 71^a, secondary relay S R^3, normal contact 78, to battery, relay S R^3 attracting and releasing its armature 73, to energize and deënergize side switch magnet S S M^3 of the connector, whereby the side switch arms 83, 84, 85 and 86 are shifted from their normal contacts downward to engage their intermediate contacts.

Five impulses now transmitted from substation C over limb P will pass over the before-traced path, through primary relay P R^3, whose armature 75 will be attracted and released five times to transmit five impulses via normal contact 76, arm 83 and its middle contact, secondary magnet S M^3, to battery, which magnet will step wipers 105, 106 and 107 five steps in a rotary direction, the fifth step bringing them to engage the multiple contacts 40, 39 and 38 of line 2345, namely, the line at D. A single impulse over limb S following the five over limb P, passes over the before-traced path, energizing and deënergizing the secondary relay S R^3, which will energize and deënergize side switch magnet S S M^3, whose energization now causes the called line to be tested as to its idle or busy condition. It being first assumed that the called line D is idle (the busy line operations to be hereinafter described), on the deënergization of magnet S S M^1, the side switch arms 83, 84, 85 and 86 will be shifted to their third positions, arm 84 in engaging its third contact connecting ground over wiper 105 to the multiple contacts 40 of the called-for line, rendering the said line busy against incoming calls and also operating the cut-off relay C O R of said called line over a circuit extending from battery through said relay C O R, normal contact 13 of line relay L R, contact 40, 105, to ground through arm 84, whereby line relay L R of the called-for line is operatively dissociated from said line.

The calling subscriber C now depresses key 8 to ground limb P of the line, which act will produce an energization of primary relay P R^3 in the before-described manner, said relay being energized, and by its armature 75, closing circuit through normal contact 76, armature 83 and its third contact, generator relay G R, to battery, the said relay being energized as long as the subscriber C keeps key 8 depressed to include, by its armature 85, 86, the alternating current generator G in circuit with the called-for line, current therefrom passing out over the line and actuating the call bell at the substation.

The called subscriber having been sig-

naled, the calling subscriber releases key 8, whereby primary relay P R^3 and relay G R are deënergized. When now the called subscriber responds, the removal of his receiver permits hook lever 1 to complete a conductive bridge of limbs P and S at his substation, whereupon current will flow as follows: from ground at switch L, through lower winding of release relay R R^4, lower winding of control relay C R, through normal contact of lower armature of relay G R, through arm 86 and its third contact, contact 107, 38, over limb P of the called line, through the transmitter supplying talking current thereto, returning over limb S, contacts 39, 106, side switch arm 85 and its third contact, normal contact of upper armature of relays G R, through upper windings of relays C R and R R^4, to battery. The relay R R^4 is a differential relay, and having equal current flowing through its two windings, its core remains inert. The relay C R, however, is a cumulative relay and its armatures are attracted, whereupon 78, 79 complete a circuit for supplying talking battery to the calling line as follows: from ground, through the upper winding of the differential release relay R R^3, the impedance coil shown, through attracted armature 79, over conductor 70^a, contact 70, 67; 56, 53; 45, 41; over limb P and through substation of C, the transmitter being included in this circuit, returning over limb S, contacts 42—46, 54—57, 68—71, over conductor 71^a, through secondary relay S R^3, attracted armature 78, lower winding of relay R R^3, to battery, differential relay R R^3 remaining inert. The two subscribers are now in conversation through condensers 81, 82 interposed in the talking conductors of the connector, talking battery being supplied to their transmitters from a central source through the suitable inductive resistances included in the circuits just traced. When the subscribers finish their conversation, they replace their receivers on the hook switches, the hook levers 1 by their respective arms 1^a, which, on the removal of the receivers pass to the left of the spring 5, now cause the springs 5, 6 and 7 to be momentarily connected together until the arms 1^a pass over the top of the spring 5 to their normal positions shown. By this means it is apparent that when either subscriber replaces his receiver, the act is effective to simultaneously ground for a short space of time the two line limbs P S of his respective line. When subscriber D replaces his receiver, the act is effective to restore the connector L only to normal. When subscriber C replaces his receiver, the act is effective to cause the restorations to normal of line selector F, first selector G and second selector H.

Assuming the calling subscriber C first replaces his receiver, the simultaneous grounding of limbs P and S will cause current to be shunted from the upper winding of release relay R R^3 at connector L, and undiminished current will flow in the lower winding thereof over limb S and to ground of the substation. The said relay R R^3 will therefore have its core magnetized and its armature will be attracted to close a circuit from ground through said armature, through primary relay P R^3 to battery. Relay S R^3 being already energized, being included in the circuit of the lower winding of relay R R^3, a restoring circuit is now completed from battery through attracted armatures 72 and 74 over release wire 69^a, contact 69—66, arm 59 and its third contact, release relay R R^2 of second selector H, to ground, the said relay attracting its armature and closing a circuit from battery through release magnet R M^2, attracted armature of R R^2, through contact 55—52, to switch G, side switch arm 49 and its third contact, release relay R R^1, to ground, which relay, by attracting its armature, causes simultaneous energizations of release magnet R M^1 of the first selector G and of magnet R M of the line selector F. It may be here stated that the line selector F is restored to normal on the forward stroke of its release magnet's armature, being in this respect similar to the connector mechanism of the patent hereinbefore referred to, while the first selector G and second selector H are restored on the back stroke of the armatures of their respective release magnets. Thus when magnet R M of line selector F is energized, it closes circuit through magnet 44, whereby the line wipers 45, 46 are placed in open circuit, and as the magnet is fully actuated, the wipers are rotated in the reverse direction free of the contact bank, and descend to their normal levels, in the well-known manner. The magnet 44 is preferably rendered slow to release its armatures, in any of the well-known ways, in order to insure the wipers 45, 46 continuing on open circuit until they have been moved clear of the contact sets of lines not wanted. As soon as relay 44 is operated, if ground has not already been removed from the line at the substation, in which case relays P R^3, S R^3 will have already become deënergized, the said relays have their circuits opened, and the retraction of their armatures opens the before-traced circuit through relay R R^2 at switch H. This relay becoming deënergized, opens the before-traced circuit through release magnet R M^2 (which is deënergized to restore switch H) and release relay R R^1, whose retracted armature opens the circuit of magnets R M and R M^1, the deënergization of the latter restoring the switch G to normal, it being understood that in the case of the switches G and H the deënergization of the release magnets not only restore the

wipers, but shift the side switch arms to normal.

The off normal contacts O N and O N^1 at the connector L were shifted on the first vertical step thereof, in the well-known manner, the shifting of spring O N placing a ground upon the back contact of armature 74, to the end that if the calling subscriber first replaces his receiver as just described, the deënergization of relay P R^3 would, by armature 74, continue a ground connection upon multiple contacts 69 of the connector L at the second selectors, so that the connector L will continue busy with respect to any other second selector until the called-for subscriber, by replacing his receiver, restores the connector to normal. When he replaces it, the grounding of the two line limbs at the called substation D shunts current from the lower winding of release relay R R^4, while current continues flowing through the upper winding thereof, to ground, through spring 7 at the substation, whereby the relay R R^4 is unbalanced and its armature attracted to close circuit through release magnet R M^3, which is actuated to restore the wipers of connector L and its side switch arms to normal on the forward stroke of its armature. When this occurs off normal contact O N (and contact O N^1) are shifted, the former to remove the busy ground from multiple contacts 66 so that the connector L is thereafter selectable and available for use in the putting through of some other connection.

If the called subscriber D had replaced his receiver in advance of the calling subscriber C, the connector would have been restored to normal, as above described, and the circuit of control relay C R would have been open at side switch arms 85, 86 and the armatures of said relay retracted. When under these circumstances the line limbs at substation C were simultaneously grounded, relays P R^3 and S R^3 would be energized by current from ground at substation flowing through armature 79 and primary relay P R^3, to battery, and through relay S R^3, through normal contact 78, to battery. The simultaneous energizations of relays P R^3 and S R^3 would cause the switches H G and F to be restored in the manner heretofore described. Such simultaneous energization would also close a circuit from battery, through release magnet R M^3, through normal contact 80, through alternate contact 76 (side switch magnets S S M^3 being energized because S R^3 is energized), through attracted armature 75, to ground. The actuation produced thereby of magnet R M^3 is under the present circumstances ineffective, as the connector has already been released by the called-for subscriber. This, however, is the circuit for releasing the connector controlled by the calling subscriber, which is used should the called-for subscriber fail to answer the call or should the line of the called-for subscriber be found busy. It should be noted at this point that the control relay C R, which relay is energized on the response of the called subscriber, by attracting its armature 80, is a means for preventing the release circuit of magnet R M^3 from being completed by the simultaneous energizations of relays P R^3 and S R^3 as long as the called-for subscriber has his telephone off the hook.

I will now explain the conditions arising when the called-for line is busy. If the said line is busy because a selector, such as F, is traveling in search of terminals of the line as a calling line, the private multiple called contacts 40 of the said line will be grounded at attracted armature 13 of its line relay L R. If the line is busy because a line selector has selected said line, the multiple contacts 40 will be grounded through back contact of armature 13 of line relay L R, back contact of armature 15, to contact 43—47 of the line selector, to ground. If the called line be busy because another connector L is already connected thereto, the multiple private contacts 40 will be grounded at the third contact of side switch arm 84 of the connector, rendering the called line busy. In any of these cases as soon as the last impulse from ground at the calling substation flows through relay S R^3 as before described, which relay energized side switch magnet S S M^3, a circuit for release magnet R M^3 of the connector will be completed extending from battery through said magnet, normal contact 80, attracted armature 77, side switch arm 84 then engaging its intermediate contact, through wiper 105 and to ground through the busy multiple contact 40 of the called-for line. The energization thereby produced of magnet R M^3 restores the connector and the side switch arms. When, therefore, the calling subscriber C depresses ringing key 8, the grounding of limb P thereby produced is effective merely to step the shaft of the connector upward one step, inasmuch as switch arm 83 has been restored. The subscriber at C on releasing the button, listens and receives from the busy back device B B, the busy signal, the off normal contact O N^1 having been shifted on the upward step to inductively connect the said device with the calling subscriber's line over circuit extending through normal side switch contact 85, through condenser 81, over the talking circuit and through the calling substation, returning to battery through secondary relay S R^3 and armature 78. Hearing the signal, the calling subscriber replaces his receiver, and this act is effective to again restore to normal the line D connector L by closing the circuit of release magnet R M^3, before described, and also

effective, as before described, to restore the other switches used in the connection to normal.

If the calling subscriber has removed his receiver and a line has been selected by line selector F, and said subscriber then determines that he does not desire to put through the contemplated call, the replacing of the receiver and the consequent simultaneous grounding of limbs P and S will be effective to energize simultaneously relays P R^1 and S R^1 of the first selector, the energization of relay S R^1, in turn, energizing magnet S S M^1, whereupon a circuit will be completed from ground through attracted armature of relay P R^1, alternate contact of armature of magnet S S M^1, through release magnet R M of line selector F, to battery, actuating the said release magnet and restoring the line selector to normal. If the calling subscriber changes his mind after transmitting a portion of the impulses required to complete a contemplated connection, and replaces his receiver, the operating relays of whatever selector is then connected with his line will be simultaneously energized and will complete restoring circuits for all switches to that time moved off normal. Thus if the calling subscriber replaces his receiver while relays P R^2 and S R^2 of second selector H are connected with the limbs of his line, the simultaneous energization of said relays will produce a circuit extending from battery through release magnet R M^2, attracted armatures 65—63, through contact 55—52, side switch arm 49 and its third contact, through release relay R R^1 of switch G, to ground, whereupon the restorations of switches H, G and F will proceed, as before described.

As hereinbefore indicated, one hundred lines depend for their connections as calling lines upon the master switch K. While by locking up of the line relays I have prevented the mischievous effects produced by flash signals, I, yet, deem it advisable to provide additional safe-guards against the possibility of a flash signal being sent and the locking circuit proving ineffective by some mischance or defect in the line relay apparatus. Under these circumstances the group wiper 93 will, of course, not find any contact 28 grounded and will proceed to its extreme operative position. When it reaches this position, which is a step beyond the last group contact, the downwardly extending arm of wiper 93 will be in a position engaging spring 22 and closing said spring to connection with its associated contact, whereby release control relay R C R will have its circuit closed, and by becoming energized, will open the locking circuit including relay 100 and solenoid 18, and the master switch K will be restored to normal and be available for use in putting through other connections. The spring 22 may for purposes of identification be called an over-run switch, being only actuated when the spring overruns, whereas the spring 22 may conveniently be called an off normal switch, being actuated as soon as the switch leaves normal.

To further protect the dependence of a calling line group upon its single master switch K and for the further purpose of preventing any of the ten line selectors upon which such a line group depends from being by accident put out of service, I provide in the mechanism of the line selector F the primary or vertical subnormal or over-run switch P S N, which engages its contact on an eleventh vertical step of the line selector, it being understood that the connector of the patent referred when used for line selecting purposes, has preferably eleven vertical ratchet teeth and an arm on its shaft to actuate spring P S N on an eleventh step. Thus should armature 14 of an actuated calling line relay fail to make its contact, line selector F would make eleven vertical steps and close contact P S N to energize magnet R M to restore the line selector, wiper 93 of K being restored in the manner already mentioned.

It might happen that armature 15 of an actuated line relay would fail to make its alternate contact, in which case, supposing armature 14 to have acted properly, line selector F would turn its wipers in on the proper level and would find no terminal 43 of a line connected to battery through release control relay R C R, and the line selector would go to an extreme rotary position and there remain "hung up", the master switch with 93 being also hung up on the fifth contact 28, were it not for the secondary or rotary subnormal or over-run springs S S N, and S S N^1. These are shifted, S S N to disengage its contact and S S N^1 to engage its contact on an eleventh rotary step of the line selector by a suitable arm on the shaft of the line selector, which will have eleven rotary ratchet teeth instead of the usual ten.

Should the line selector, on account of the contingency referred to, or some other, make an eleventh rotary step, the shifting of contact S S N will open the circuit of relay 100 and solenoid 18, the deënergization of the latter restoring wiper 93, while spring S S N^1 engaging its contact, will energize release magnet R M to restore the line selector.

The contact P O N is the ordinary off normal shifted to engage its contact on a first vertical step, and restored to disengage its contact when the line selector reaches normal. Thus, when magnet R M is energized, it will, by its right armature, remain locked until the line selector reaches normal and relay 44 will also continue energized

till such time, holding wipers 45, 46 on open circuit.

When spring P O N is employed, obviously, it is unnecessary to render the relay 44 slow to release its armatures as before described. Either method for keeping wipers 45 and 46 on open circuit during restoration may be employed.

While I have used a plurality of battery symbols in Fig. 1, wherever convenient for simplicity of illustration, it will be understood that they preferably indicate a single centralized source of electrical energy.

I claim:

1. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, apparatus controlled by said relay for determining the travel of said second member, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

2. A telephone system including telephone lines, a line relay for each said line, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operative, said means including the line's line relay, apparatus controlled by said relay for determining the travel of said second member, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

3. A telephone system including telephone lines, a line relay for each said line, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, said member also serving as part of a circuit to render the selected switch operable, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operative, said means including the line's line relay, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

4. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, apparatus controlled by said relay for determining the travel of said second member, circuit connections for stopping a selective switch when engaging the terminals of a line rendered selectable, means effective on selection made of a calling line, to restore said mechanism to common use of said lines, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

5. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, means effective on selection made of a calling line, to restore said mechanism to common use of said lines, and a locking cir-

cuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

6. A telephone system including telephone lines, a line relay for each said line, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operative, said means including the line's line relay, apparatus controlled by said relay for determining the travel of said second member, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

7. A telephone system including telephone lines, a line relay for each said line, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operative, said means including the line's line relay, apparatus controlled by said relay for determining the travel of said member, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

8. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, apparatus controlled by said relay for determining the travel of said member, and a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected.

9. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select salling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, apparatus controlled by said relay for determining the travel of said second member, circuit connections for stopping a selective switch when engaging the terminals of a line rendered selectable, a locking circuit for each line relay serving, after initial operation, to continue the relay energized until its line is selected, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, and means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line.

10. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, line relays for said lines at the exchange, each relay serving, when energized, to temporarily individualize said master switch mechanism to its calling line, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, apparatus controlled by said relay for determining the travel of said member, circuit connections for stopping a selective switch when engaging the terminals of a line rendered selectable, a locking circuit for each line relay serving, after initial operation, to continue the relay energized until

its line is selected, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, said circuit also including the selective switch in connection with the calling line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line, and a circuit connection for thereafter holding said connector busy until restored by current over the called line.

11. A telephone system including telephone lines, a line relay for each said line, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the sub-station of a calling line to render an idle selective switch operative, said means including a line relay, apparatus controlled by said relay for determining the travel of said member, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render its line's terminals selectable at said switches, circuit connections for stopping a selective switch when engaging the terminals of a line rendered selectable, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, and means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line.

12. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the sub-station of a calling line to render an idle selective switch operable, said means also serving to control the travel of said member, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line.

13. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the sub-station of a calling line to render an idle selective switch operable, said means also serving to control the travel of said member, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line, and a circuit connection for thereafter holding said connector busy until restored by current over the called line.

14. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the sub-station of a calling line to render an idle selective switch operative, said means in-

cluding a line relay, apparatus controlled by said relay for determining the travel of said second member, terminals of said lines at said selective switches normally unselectable in character, switching means controlled by the operated line relay of a calling line to render the line's terminals selectable at said switches, circuit connections for stopping a selective switch when engaging the terminals of a line rendered selectable, other link circuits and selective switches therefor including connectors for connecting directly with called lines, means for electrically adjusting automatically selected ones of said switches, including a connector, to establish a talking circuit between a selected calling line and a desired called line, said circuit also including the selective switch in connection with the calling line, mechanism responsive to currents over the calling line to restore said switches to normal prior to a response at the called station, and means controlled on response at the called station to remove the control of restoration of the connector from the calling line and turn it to the called line.

15. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, and means for automatically restoring said second member to normal when it travels to an extreme operative position.

16. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, and means for automatically restoring said member to normal when it travels to an extreme operative position.

17. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, electro-magnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operable, said means also serving to control the travel of said second member, and means for automatically restoring said second member to normal when it travels to an extreme operative position.

18. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, electromagnetic means at the exchange operated responsive to current controlled at the substation of a calling line to render an idle selective switch operable, said means also serving to control the travel of said member, and means for automatically restoring said second member to normal when it travels to an extreme operative position.

19. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, multiple terminals for said lines at said switches divided into groups, means for adjusting an idle selective switch to select a group of terminals including those of a calling line, an over-run switch for said switch actuated when said switch passes its extreme group selecting position to automatically restore the switch, and means for automatically restoring said second member to normal when it travels to an extreme operative position.

20. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, multiple terminals for said lines at said switches divided into groups, means for adjusting an idle selective switch to select a group of terminals including those of a calling line, and an over-run switch for said switch actuated when said switch passes its extreme group selecting position to automatically restore the switch.

21. A telephone system including telephone lines, link circuits at the exchange,

selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism, common to said switches and lines including a traveling member to select an idle switch, a second traveling member for said mechanism operated independently of said first member and serving to control travel of the selected selective switch, multiple terminals for said lines at said switches divided into groups, means for adjusting an idle selective switch to select a group of terminals including those of a calling line, means for thereafter adjusting said switch to seek connection with the terminals of the calling line, and an over-run switch actuated when said switch passes its extreme terminal selecting position to automatically restore said switch and also cause restoration of said second traveling member of said master switch mechanism.

22. A telephone system including telephone lines, link circuits at the exchange, selective switches less in number than the lines to select calling lines to connect idle link circuits therewith, a master switch mechanism common to said switches and lines, a traveling member included in said mechanism serving to control the extent of travel of an idle selective switch, multiple terminals for said lines at said switches divided into groups, means for adjusting an idle selective switch to select a group of terminals including those of a calling line, said adjustment being controlled by said traveling member, means for thereafter adjusting said switch to seek connection with the terminals of the calling line, and means actuated when said switch passes its extreme terminal selecting position to automatically restore said switch and also cause restoration of said traveling member of said master switch mechanism.

23. A telephone system including telephone lines, switch pairs common to said lines, each pair including a line selector, master-switch mechanism common to said switch pairs and lines, said mechanism including means for selecting an idle switch pair and means for transmitting a series of impulses to the line selector of the selected pair, a line relay for each line adapted for energization to operate said mechanism, and a locking circuit for each said line relay.

24. A telephone system including telephone lines, switch pairs common to said lines, each pair including a line selector, master-switch mechanism common to said switch pairs and lines, said mechanism including means for selecting an idle switch pair and means for transmitting a series of impulses to the line selector of the selected pair, a line relay for each line adapted for energization to operate said mechanism, means at the substation of each line to energize its respective line relay, a locking circuit for each said line relay.

25. A telephone system including telephone lines, switch pairs common to said lines, each pair including a line selector, master-switch mechanism common to said switch pairs and lines, said mechanism including means for selecting an idle switch pair and means for transmitting a series of impulses to the line selector of the selected pair, a line relay for each line adapted for energization to operate said mechanism, means at the substation of each line to energize its respective line relay, and means rendering the operation of said mechanism thereafter independent of changes in the condition of said substation means.

26. A telephone system including telephone lines, line selectors to select said lines, master-switch mechanism common to said switches and lines, a wiper member for said mechanism adapted to select an idle selector, a second and independently adjustable wiper member for said mechanism adapted to control the adjustment of the selected selector, line relays for said lines individual thereto and operable by currents thereover, means for operating the wiper members of said mechanism in succession when any line relay is energized, and locking circuits for said line relays respectively.

In witness whereof, I hereunto subscribe my name this 1st day of August, 1907.

ALFRED H. DYSON.

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