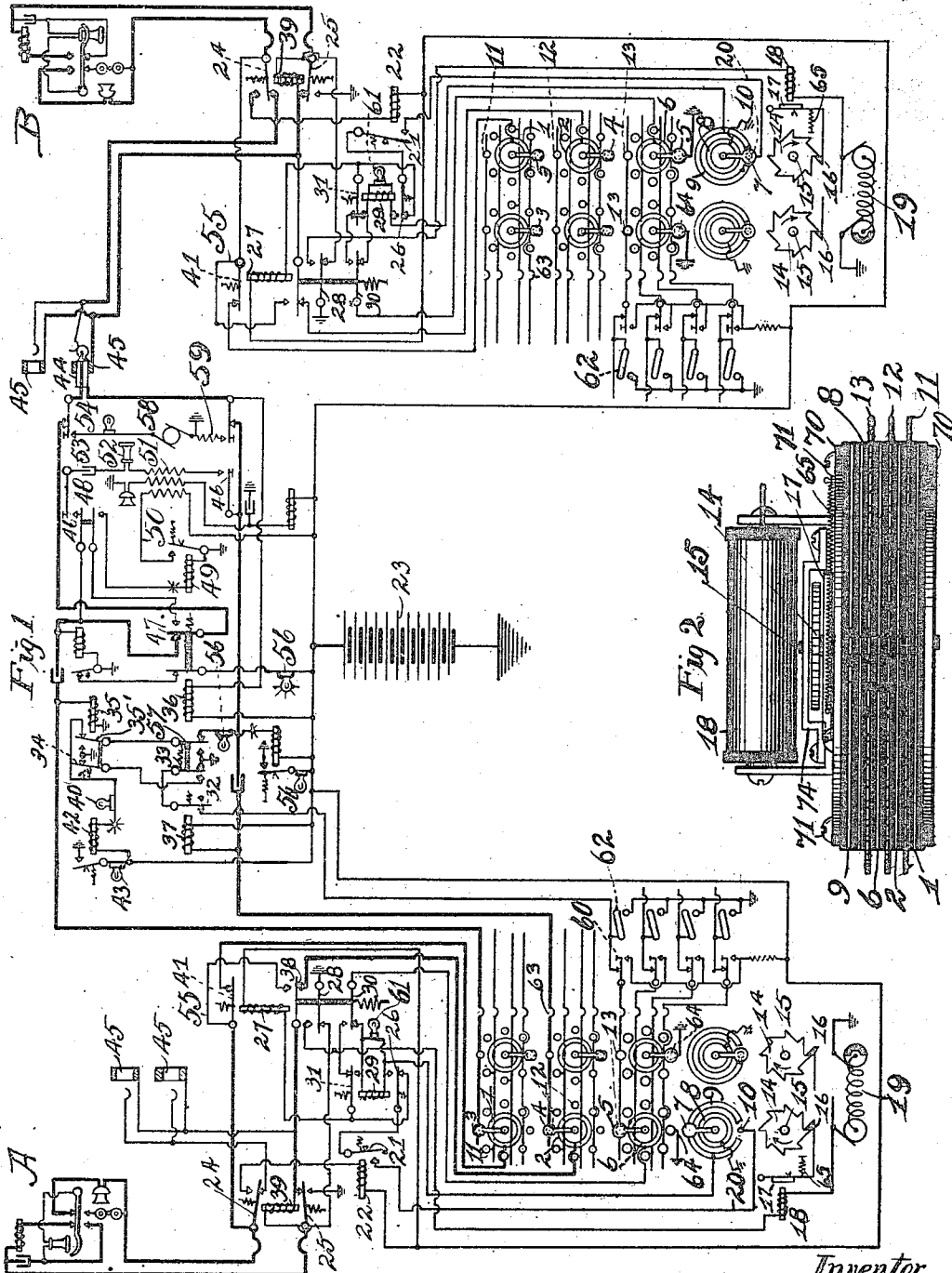


F. W. DUNBAR.
TELEPHONE EXCHANGE SYSTEM.
APPLICATION FILED JUNE 19, 1905.

1,211,689.

Patented Jan. 9, 1917.

2 SHEETS—SHEET 1.



Witnesses:
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1,211,689.

UNITED STATES PATENT OFFICE.

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TELEPHONE-EXCHANGE SYSTEM.

1,211,689.

Specification of Letters Patent.

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To all whom it may concern:

Be it known that I, FRANCIS W. DUNBAR, citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a certain new and useful Improvement in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description, reference being had to the accompanying drawings, forming a part of this specification.

My invention relates to that class of telephony in which the calling lines are automatically connected with the answering ends of link circuits while the called lines are connected with the link circuits by means of manually manipulated terminals such as plugs of said circuits.

As the invention will not be readily understood without reference to the accompanying drawings, I will point out the objects and advantages thereof by specific reference to one of the embodiments of the invention and the novelty of the invention herein disclosed will be particularly pointed out in the claims.

I will explain my invention more fully by reference to the accompanying drawings, showing a preferred embodiment thereof, in which—

Figure 1 is a diagrammatic view of a telephone exchange system equipped in accordance with the invention. Fig. 2 is a side elevation of the selecting motor mechanism. Fig. 3 is a vertical sectional view thereof on a larger scale. Fig. 4 is a plan view with parts broken away clearly to reveal features of construction. Figs. 5 and 6 are respectively plan and side elevations of some of the contacts. Fig. 7 is a partial view showing the wipers whose members are in separate relation, this view illustrating one step in the process of the formation of the wipers or contact arms.

Like parts are indicated by similar characters of reference throughout the different figures.

I have illustrated two telephone lines extending from sub-stations A—B to an exchange, where said lines are provided with contacts 1—2, desirably in the form of closed rings, over which sweep arms 3—4 when the selecting mechanism is put into operation. On the same shaft that carries the arms 3—4 is also disposed an arm 5 sweeping over a contact ring 6, these switch

parts 5—6 cooperating in performing certain functions of the selecting mechanism; also upon the same shaft with the switch arms 3—4—5 is mounted a switch arm 7 sweeping over a ring 8 and a partial ring 9, together with a button 10, interposed between the ends of said partial ring 9. The arms 3—4—5 on each shaft sweep over contact buttons associated with the answering ends of the link circuits, one link circuit being indicated somewhat fully, the buttons 11—12 constituting talking contacts at the answering end of the link circuit, while the buttons 13 are auxiliary contacts associated with the answering end of the link circuit. Each link circuit has as many buttons 11, as many buttons 12, and as many buttons 13, as there are telephone lines in the group to which the link circuits are assigned, the buttons given similar characters of reference being multiplied together. An actuating ratchet wheel 14 is mounted upon the same shaft 15 that carries the arms 3—4—5—7. A pawl 16 is provided for actuating each ratchet wheel 14 and is carried upon the armature 17 of an electro-magnet 18. Each subscriber has a magnet 18, a selecting switching mechanism including the arms 3—4—5—7, and the associate parts. When a subscriber calls, the magnet 18 is included in a closed circuit with a source of intermittent current 19, whereby the magnet 13 corresponding to such subscriber, is intermittently energized to cause the operation of the ratchet wheel 14. A closure of the circuit containing the source of current 19 is effected, when a subscriber calls, because the arm 7 normally rests upon the button 10 constituting one end of the conductor 20, whose other end is the anvil of the armature switch 21 operated by and belonging to the line relay 22, for when the calling subscriber removes his telephone from its switch-hook, circuit is thereupon established through the relay 22, that may be traced from the grounded battery 23, through the winding of magnet 22, the normal contact of armature switch 24, over the subscriber's line, to the armature switch 25, the normal contact of said latter switch, to ground. The switch 21, when thus actuated, establishes a circuit that includes the switch 7, which is grounded by reason of the grounded ring 8 put into connection with the said button by the arm 7, the switch 21, the normal contact of armature

switch 26, the governing magnet 27, to the grounded battery 23. This latter magnet thereupon operates the armature switches associated therewith, one of said armature switches 28 engaging its alternate contact anvil, whereby circuit is established for the motor magnet 18 and the source 19, that may be traced from the non-grounded terminal of said source, through the winding 18, to the grounded switch 28 and its alternate contact anvil. The corresponding ratchet wheel 14 is thereupon operated, its operation continuing until the arms 3—4 engage the contacts at the answering end of an idle link circuit, accomplished as will be set forth presently.

As a result of the first step of the ratchet wheel 14, the circuit including the magnet 27 through switch 21 is opened owing to the separation of the elements 7—10. If the arms 3—4 are upon this first step of the ratchet wheel 14 connected with buttons 11—12 corresponding to a busy circuit, circuit through the magnet 27 is maintained closed by the engagement of the armature 31 with its normal contact, the engagement of the switch 30 with its alternate contact, the ring 6 corresponding to the calling subscriber, the arm 5, the button 13 now engaged thereby, the armature switch 32 and its contact, the armature switch 33 and its alternate and grounded contact, or the armature switch 34 and its alternate grounded contact, said armature being in connection with the armature 33, when said latter armature or switch is engaged with its normal contact, the balance of the circuit for said magnet 27 being still maintained by the grounded battery 23 and the conductors connecting the same with said magnet; that is, conditions are imposed upon a busy link circuit either by the calling subscriber who energizes the magnet 35 to ground the armature switch 34 or the operator who on effecting connection with the called subscriber energizes the magnet 36 to attract the armature switch 33 to its grounded contact, so that a busy link circuit furnishes ground that is complementary to the ground at the battery, between which grounds the magnet 27 is included in the manner specified, so that the motor magnet 18 is still maintained in closed circuit by the engagement of the armature switch 28 with its alternate contact. When a link circuit is idle, the armature switch 32 is removed from its contact, so that the button 13 corresponding thereto is free of grounded connection at 33—34, the magnet 27 thereupon becoming deenergized when the arm 5 encounters such a button 13 from which these grounds at 33—34 have been removed. As a consequence, the circuit through the magnet 18 is opened at 28 to check the operation of the selecting mechanism, so that the calling line may re-

main in connection with the selected link circuit. As hitherto stated, this result is due to the operation of the armature switch 32. The magnet 37 controlling this switch, has a circuit established therefor, when free buttons 11—12—13 are encountered, which circuit may be traced from the grounded battery 23, to the sleeve side of the link circuit by way of the winding of said magnet 37, the selected button 12, the arm 4, the ring 2, the now released armature switch 38, the cut off relay 39, the normal contact of switch 28, to the ground upon said switch. The armature switches 24—25 are attracted by the magnet 39 when its circuit is thus established, whereby the line relay 22 is removed from line and circuit, the switch 25 separating from its normal contact that constitutes one grounded terminal for the line relay, while the switch 24 separates from its normal contact that opens a connection between the relay and its said grounded terminal, which connection is by the way of the telephone line. The calling signal 40 is now included in circuit by reason of the energization of the magnets 35 and 37, which magnet 35 is now included in circuit that may be traced from the grounded terminal of magnet 35 to the tip side of the link circuit, the engaged button 11, arm 3, armature switch 41 in connection with its normal contact, the subscriber's line, armature switch 25 and its alternate contact, armature switch 38 and its normal contact, ring 2, arm 4, selected button 12, magnet 37, to the grounded battery 23. The circuit for the call signal 40 may be traced from the battery 23, through the winding of magnet 42, the lamp 40, the attracted armature switch 35', the unattracted switch 57 and its grounded normal contact. The pilot lamp 43 is included in circuit when a lamp 40 is included in circuit, because of the attraction of the armature of magnet 42. The operator, in response to the signal conveyed at 40, connects the calling subscriber with the called subscriber by means of the manually manipulated terminals of the link circuit, which in this instance are in the form of the tip and sleeve contacts of a connecting plug 44, the telephone lines being equipped with jacks 45 for the reception of the connecting plugs belonging to the link circuits.

If the system be a multiple switch-board system, and I have illustrated a multiple switch-board system, the operator tests the called line to determine whether or not it is busy, such test being established in any suitable way. In the test system illustrated, the operator's telephone key 46 is depressed, whereafter the tip of the connecting plug is applied to the thimble of the jack of the called subscriber. If the called subscriber's line is busy, the battery 23 is connected with the thimbles of the different multiplied jacks

belonging to a line, this connection being established by way of the winding of relay 36 and the sleeve strand of the inserted plug. The tip of the plug applied to the jack located at the section where the plug is located, will (under the assumption that the called line is busy) establish a circuit that will be continued from the test thimble of the tested jack through the tip of the connecting plug, a portion of the tip strand, the now released armature switch 47, its normal contact, the switch 48, its contact (now in engagement therewith), the relay 49, to ground, the armature of said relay upon being attracted, closing a local circuit 50 in inductive relation with the secondary 51 in circuit with the operator's receiver 52, a condenser 53 being included in this circuit to prevent the flow of battery current through the receiver. If the line called for is not busy, the battery 23 is not in connection with the thimbles of the jack belonging to said line and distributed among the sections of the board, whereupon the operator may fully insert the connecting plug and thereafter operate the ringing key 54 to signal the called subscriber.

In systems of telephony hitherto devised where the link circuits are automatically connected at their answering ends with calling lines and are connected at their connecting ends with called lines by means of manually manipulated terminals, there is an unguarded interim between the beginning of the operation of the selecting mechanism by the calling subscriber and the connection of a link circuit with a calling line. When a link circuit has been automatically connected with a calling subscriber, the battery 23 is also connected with the thimble of the jacks 45 belonging to the calling subscriber and distributed among the sections of the multiplied switch-board system, by reason of the engagement of the switch 38 with its normal contact anvil, said switch being connected with the thimbles of the multiplied jacks. While this switch 38, however, is removed from its normal contact, the thimbles of the calling subscriber's jacks would (except for one feature of my invention hereinafter to be stated) be free of connection with battery, and, as this switch is removed from its normal contact until the calling subscriber's line has been connected with the answering end of the link circuit, there is a period in which the calling line would test free if at this period a connection with it is sought by another calling line. I avoid this difficulty by providing a test conductor 55 having permanent connection with the tip side of its line and terminating in the alternate contact of the switch 38, whereby, when said switch is attracted, battery 23 is connected with the thimbles of the multiplied jacks by a connection which may be traced

from the grounded battery 23, the line relay 22, the now unattracted armature switch 24 and its normal contact anvil, the supplemental test conductor 55, the armature switch 38, to the sleeves of the multiplied jacks. This is a broad feature of my invention and is herein broadly claimed.

While the invention is shown in connection with multiplied switch-board systems, it is not to be limited thereto.

After the called line has been duly tested and connected by means of the plug 44 and a jack 45, with the calling line, the magnet 36 is energized, this magnet controlling the operation of the supervisory and pilot signals 56, in a manner well understood and which need not here be explained. The magnet 36 also controls the switch 33 and permits of the engagement of the switch 57 with its grounded normal contact, when said magnet releases said switch. The operator having inserted the connecting plug, opens the circuit including the calling lamp 40 by the separation of the switch 57 from its normal contact, because of the energization of the magnet 36. When conversation has been finished, the switch elements 3-4-5-7 should be restored to their initial positions for which purpose the magnet 18 should, upon such conclusion of the use of the selected link circuit and the withdrawal of the connecting plug, be again brought into circuit to step said elements 3-4-5-7 in their original directions until the arm 7 engages the button 10 and the associate arms 3-4-5 are placed in corresponding positions. To accomplish this result, the switch 23 has to be operated by the magnet 27 and the circuit of the magnet 27 has to be closed by the operation of the releasing magnet 29. The armature switch 21 having been released, owing to the opening of the circuit of the relay 22, circuit through magnet 27 must now depend upon the armature switch 31 which is attracted by the magnet 29 when circuit through this magnet is closed upon the withdrawal of the connecting plug, which circuit may be traced from the grounded ring 8, the arm 7, the incomplete ring 9, the winding of magnet 29, the armature switch 30 and its normal contact, the ring 6, the arm 5, the button 13, the switch 32, the armature switch 33 and its normal contact, the switch 34 and its normal contact, the call signal 40 magnet 42 (both now desirably acting as protective resistance), to the grounded battery 23.

Circuit is established through the magnet 27 by the engagement of the switch 31 with its alternate contact, which circuit may be traced from the grounded battery 23, through the winding of magnet 27, the switch 31 and its alternate contact, the winding of magnet 29, the incomplete ring 130.

9, the arm 7, to the grounded ring 8, whereby the circuit through the motor magnet 18 and its operating source 19 is closed at 28. The magnet 18 will continue the operation of the elements 3—4—5—7 in their original direction until their zero positions are reached, wherein the arm 7 engages the contact button 10 and is disconnected from the partial ring 9 that forms a part of the circuit for the magnets 27—29, whereby this circuit is opened, permitting the elements 3—4—5—7 to remain in their zero positions until switch 21 is again attracted.

In order to prevent the interruption of a circuit including the winding 36 while the ringing key is being operated, one terminal of said magnet 36 is connected to the sleeve strand between the connecting plug and the ringing key.

In order to prevent the current from the calling generator 58 from operating the magnet 36 and the cut off relay 39 of the called subscriber, a non-inductive resistance 59, of, say, four hundred ohms, is included in the ringing circuit. As is customary, one terminal of the calling generator is grounded.

The release arrangements of the present invention and the related parts embody various important features of the system. It will be seen that, generally speaking, whenever the wiper 7 is off-normal thus bridging the rings 8 and 9, the winding of the release magnet 29 is, provided armature switch 30 of relay 27 engages its normal contact, connected from ground at the ring 8 and to the wiper 5 and contact 13 of any engaged cord-circuit, and thence over the conductor connected with said contact 13 with the front contact of armature 32 of relay 37. Thus, whenever armature 32 is attracted to engage its contact and has a connection to the active side of the battery 23, the release magnet 27 will be operated and the rotary release travel, as before described, will be initiated. From this it follows that if the calling subscriber A, after his line has been connected to a cord or link-circuit, replaces his receiver before the operator connects the plug 44 to a jack 45 of a called line, the release circuit for the selector of the calling line will be closed and the selector restored to normal. To explain this in detail, it will be remembered that when a cord-circuit has been selected, the relays 37 and 39 are energized in series by current from battery 23, the current flowing through relay 37, dividing as soon as relay 39 operates, passing through attracted armature 25, over the calling line A, through normal contact 41, contact 1—3—11, and through the tip relay 35. This latter relay therefore depends for its energizing current upon a conductive circuit through the substation A, while relays 37 and 39 are energized over a circuit not con-

trolled at the substation. If, now, before the operator inserts the plug 44 to actuate relay 36, the calling subscriber A replaces his receiver, the relay 35 has its circuit opened and its armature 34 falls back to engage its normal contact. Since relay 37 continues operated and relay 36 has remained unoperated, the attracted armature switch 32 is, on the falling back of armature 34, connected to battery 23 through normal contacts 33, 34, and via lamp 40. The circuit thus closed by the deenergization of relay 35 of course closed circuit for the release magnet 29 and the said relay is energized, its energization resulting in the operation of relay 27 and the consequent closure of circuit through operating magnet 18 which is actuated as before until the wipers complete a revolution to normal at which time the disengagement of wiper 7 from ring 9 deenergizes relays 27 and 29 and the switch comes to rest. Thus until the operator makes connection with a called-for line, there is a link-circuit relay 35 controllable from the calling substation to produce the restoration of the selecting switch. If, however, the operator inserts the plug 44 in a jack 45, the link-circuit relay 36 will be operated in series over the sleeve strand of the cord, the sleeve plug and jack contact and through the cut-off relay 39 of the called line to ground through normal contact 28. The link-circuit relay 36, by attracting its armature 33, then disconnects the armature switch 32 from armature switch 34 of relay 35 so that from this time on, the replacing of the receiver at the calling substation cannot of itself connect battery to the armature switch 32 to release the selector. From this time on, joint action of the calling subscriber and of the operator is required to secure the ordinary release of the selector of the calling line. The withdrawal of the plug 44 alone, which of course results in the deenergization of relay 36, will not restore the selector nor will the replacing of the receiver at the calling substation alone, deenergizing the relay 35, cause the restoration, but when both the plug is withdrawn and the receiver at the calling substation replaced, then the armature switch 32 will be connected to battery 23 as before mentioned and the release will proceed.

If the calling subscriber were to fail to replace his receiver at the conclusion of conversation, the operator may still cause the restoration of the selector of the calling line. Thus for each cord-circuit a manually operated switch 60 may be provided which, when depressed by the operator or the chief operator, will connect the battery 23, through the protective resistance shown, with the multiple contacts 13 of the associated link-circuit to operate the release magnet 29 to initiate release travel of the selective switch and so free the link-circuit for further use.

Under these circumstances, the selector of the calling line will not, however, come to rest when it has completed a revolution to its normal position nor will the said selector in its continued travel select an idle cord-circuit, but on the contrary, the said selector will continue to rotate until the calling subscriber replaces his receiver when the switch will stop as soon as it reaches its normal point, or the selector will continue to rotate until the calling line is disconnected by an attendant at the central office. Let it be assumed that the calling subscriber has left his telephone without replacing his receiver on the hook switch and the operator has depressed the button 60 for a moment thus operating the relay 29 which will initiate the release as before described, the relays 27 and 29 remaining operated as in the regular release through contact 9—7—8, until contact 10 is engaged by wiper 7. As soon as relay 27 energizes, it opens circuit through cut-off relay 39 whose armatures 24 and 25 retract and a conductive circuit being still closed by the hook lever at the substation A, the line relay 22 immediately energizes and will continue energized. Since contact 21 is now closed, the moving of the wiper 7 to engage the normal contact 10 will fail to open the circuit including the relays 27—29, circuit through said relays being traceable from the battery 23 through relay 27, alternate contact 31, relay 29, alternate contact 26, attracted armature 21, contacts 10, 7 and 8 to ground. Because of the closure of this circuit, another revolution of the wipers will be started, relays 27—29 being held energized to ground at contact 9—7—8, and successive revolutions will be made in a similar manner until the contact at 21 is opened by a de-energization of the line relay 22.

The lamp 61 is provided in the present instance connected in parallel with the release magnet 29 of a telephone line so as to be energized and displayed whenever the release magnet is energized, although obviously the particular relation of the lamp to the magnet, as herein shown, need not be adhered to since such a lamp may, if desired, be placed in a local circuit controlled by an armature switch of the magnet in the customary manner. Since the lamp 61 is displayed as long as magnet 21 is energized, it will serve, when displayed continuously as a signal, to indicate to the trouble department that the line of the calling subscriber A has trouble which should be cleared.

By the indicated arrangement of the magnet 29 and the lamp 61, an automatic indication will also be given should the conductors of a line become accidentally grounded. For instance, let it first be assumed that the tip side of the line of A, that side connected with the armature switch 24, is accidentally grounded between the hook switch and the

exchange. In such case, the line relay 22 will obviously be energized by current from battery 23 flowing through normal contact 24 to the accidental ground. The relay 27 will thereupon be energized and an idle link-circuit will be automatically selected in the manner hereinbefore described. Instantly, however, upon such selection, the selector of the calling line will be automatically released and will begin a continuous rotation without stopping when it reaches the normal point, the lamp 61 being displayed to indicate trouble on the line. This will be seen from the following considerations. As soon as the selector of the line whose tip side is grounded, selects an idle link-circuit, the relay 37 of said link-circuit will be operated by current through the cut-off relay 39 of the calling line to ground through the normal contact 28 of relay 27 as in the regular operation of the system. Upon such selection, however, the relay 35 will not be energized since there is no circuit through the substation of the selecting line and ground alone is connected to the tip side of such line, the attraction of armature 24 of relay 39 having disconnected battery through line relay 22 from the tip side of the line. Relay 37 is now operated and relay 35 remains inert, so that battery is connected to the armature switch 32 and the circuit through the release magnet 29 is closed. On the resulting energization of relay 27, relay 39 de-energizes and from this time on until the ground is removed from the line or the line is interrupted at the exchange, the relay 22 will continue operated and successive revolutions of the switch will take place with the accompanying continuous illumination of the trouble signal lamp 61.

If the sleeve side of a line, that side connected with the armature switch 25, should become accidentally grounded, nothing would occur until the calling subscriber initiated a call. Whenever the subscriber removes his receiver, a rotation of the selected selector would be initiated and would continue until the trouble was removed. In case of an accidental ground, the connection may be one of high resistance or one of very low resistance. If of sufficiently high resistance, it may not be indicated by the lamp 61. If, however, ground upon the sleeve side of the line is of low resistance, a continuous rotation of the selector of the line initiating the call will be produced. This will occur for the reason that when a link-circuit is selected, the relay 37 will be operated as before, but on account of the low resistance shunt from the sleeve side of the line to ground, sufficient current will not flow over the calling line to operate the cord circuit relay 35 which will remain de-energized and the automatic continuous rotation of the switch will result, displaying the trouble sig-

nal 61. This operation will however only continue as long as the calling subscriber leaves his receiver off the hook awaiting the response of the operator since, as soon as he replaces his receiver, the line relay 22 will be deenergized and the locking circuit of the relays 27—29 extending through contact 21 and contact 10—7—8 will be opened. For the normal operation of the system, it is of course apparent that the restoration will occur in a very short space of time not much more than a momentary flash of the signal 61 being given during the release so that the display of the signal for the length of time that the subscriber waits for the operator to answer his call will be adequate to indicate the condition of trouble. The lamps 61 being individual to the subscriber's line are preferably located in the trouble department and provided with caps bearing the number of the lines to which they are appropriated.

It will be seen that the releasing magnet 29 is maintained in closed circuit until the troubles that cause the attraction of the armature 21 of the line relay, are removed, or until the line has been opened or otherwise removed from operative association with the exchange. When the releasing magnet 29 has once been operated, the armature switch 26 by coming into engagement with its alternate contact, includes the switch 21 and its contact in series with the releasing magnet and the governor motor magnet 27, so that these magnets remain energized until the release of the switch 21, which occurs on the removal of the trouble or the operative disconnection of the troubled line from the exchange and until the switch elements 3—4—5—7 have been restored to their zero positions. By the inclusion of both magnets 27—29 in circuit with the switch 21, a continuous operation of the motor magnet may be had without constantly selecting link circuits.

In the releasing operation, as stated, both the magnets 27—29 are energized, and, in order to remove any grounded connection from the arm 5 as it is being restored or constantly rotated, the ring 6 is connected with the switch 30, which switch is now totally disconnected, because of its operation and the operation of the switch 31, the normal contact of the switch 31 and the alternate contact of switch 30 being connected.

Switches 62 are connected with the buttons 13 and may be thrown to connect ground with the buttons, so as to make idle link circuits correspond to busy link circuits in case the link circuits are broken down or to reduce the number of such circuits assigned to an operator. There may be one such switch 62 for each link circuit.

The semi-circular lines 63 indicate intermediate distributing boards, whereby the

link circuits may be suitably distributed among the operators.

In case the connection between the sides of the line is so short as to permit the opening of the circuit of the magnet 27 at 21 before the motor magnet 18 has accomplished the first step (which opening of the circuit of said magnet 27 would cause the stopping of the elements 3—4—5 on the first points), I provide zero position grounded contact buttons 64 that are normally connected with the arms 5 and also with magnet 27 after its initial energization by way of the switch 30 and its alternate contact, the switch 31, and the normal contact of that switch.

In Figs. 2, 3, 4, 5, 6 and 7 are shown the mechanical structure of the selecting mechanism, parts similar to those indicated in Fig. 1 being given similar characters of reference.

The arms or wipers are preferably formed of two distinct plates that tend to spring apart, so that the contacts of the line and of the link circuits are placed in firm electrical connection, this being an advantageous feature of construction in telephone apparatus of the class herein set forth.

The armature 17 is centrally pivoted and is attracted by both poles of the magnet when the selecting mechanism operates a step, the spring 65 restoring the armature preparatory to causing the selecting mechanism to operate another step.

In order that the springs forming the arms or wipers 3—4—5—7 may not spread an undue distance apart, a lug 66 is stamped up out of one member of each arm and projects through an opening in the companion member. A post 67 limits the extent to which the spring may restore the armature, while a post 68 limits the extent to which the rider 16 may operate the ratchet wheel 14. In order that this rider may perform the double function of a detaining dog and an actuating pawl, it is sloped forwardly at its free end so as to project underneath the post 68. This engagement of the rider with the post prevents the momentum of the ratchet wheel and associated parts from elevating the rider, so that the rider may act as a detaining dog while the engagement of the ends of the rider with the post permits the withdrawal of the rider by the armature, to enable the rider to engage a new tooth of the ratchet wheel, whereby said rider then acts as an actuating pawl.

In order that the area of contact between the end of the pawl and the engaging pin may be increased, to eliminate wear, a curved recess is provided in the pawl as illustrated.

The various stationary parts of the selective switching mechanism are mechanically assembled, there being indicated metal plates

70 united by screws 71, between which plates the switch parts are disposed as well as the insulating rings 72 that separate the same.

The contacts 11—12—13 may preferably have the structure illustrated in Figs. 5 and 6, where lugs 73 are stamped out of the contact plates and are forced into the rubber rings that separate the contact parts. The elements 3—4—5—7 surround the shaft 15, which is journaled to rotate in the bottom plate 70 and in the bridge piece 74 that is screwed to the top plate 70, as indicated most clearly in Fig. 2. The shaft is enlarged at 75 and the elements 3—4—5—7 are rigidly secured to a series of bushings 76 that surround said shaft, which bushings and metallic elements are forced against the enlargement 75 by means of a nut 77 having threaded engagement with the shaft 15. The arms or wipers 3—4—5—7 are provided with lugs 78 that are forced into the bushings 76 so as to secure a fixed relation between said arms, the bushings, the shaft 15, and wheel 14.

While I have shown separate magnets 27—29—22 and have given separate functions to these magnets, and have permitted these magnets to cooperate as herein specified, I do not wish to be limited to the number of magnets employed, nor to the functions given them. It is obvious that the line relay 22 may have functions added thereto, whereby the relay 27 may be dispensed with, for it is apparent that it is adapted to perform the combined functions of the line relay 22 herein specified and the governor motor magnet 27 herein specified.

It is obvious that many changes may be made in the embodiment of my invention herein shown and particularly described without departing from the spirit of the invention, and I do not, therefore, wish to be limited to the embodiment of the invention herein shown, but

Having thus described my invention, I claim as new and desire to secure by Letters Patent the following:—

1. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange and provided at the exchange with multiplied jacks upon different sections of a switch-board, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, a test system for the multiplied jacks, and relay mechanism and control circuits therefor governed by the selecting mechanism for placing a busy condition upon the jacks of a calling line while the selecting motor is operating.

2. A telephone system including telephone

lines provided with multiple spring-jacks at the exchange, link-circuits for connecting calling lines with called lines, selecting mechanisms for connecting calling lines with idle link-circuits, line relays for operation by currents over calling lines to initiate travel of said selecting mechanisms, a connection governed by a selecting mechanism for temporarily altering the normal electrical condition of the jacks of a calling line while said selecting mechanism is traveling to render them busy, and a relay for the calling line operated responsive to connection made by said mechanism to establish a second connection to said jacks to continue the altered electrical condition thereof.

3. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange and provided at the exchange with multiplied jacks upon different sections of a switch-board, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, a test circuit system for the multiplied jacks, a supplemental test conductor, and relay switching mechanism and control circuits therefor governed by the selecting mechanism and serving to connect said supplemental test conductor with the jacks of a calling line while the selecting motor is operating.

4. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate, line relays, and switching mechanisms controlled by the line relays and partially controlling the circuit of the releasing magnets, whereby said releasing magnets may effect continuation of the operation of the motors during the operation of the line relays.

5. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, releasing magnets for causing the selecting motors to operate, line relays, and switching mechanisms controlled by the releasing magnets and the line relays, serving to control the releasing magnets, whereby said releasing magnets may effect

continuation of the operation of the motors during the operation of the line relays.

6. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, and switching mechanisms controlled thereby for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased.

7. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, and switching mechanisms controlled by the line relays and the releasing magnets, for maintaining the circuits of the governor motor magnets, and the releasing magnets until the operation of the line relays has ceased.

8. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate, line relays, switching mechanisms controlled by the line relays and partially controlling the circuit of the releasing magnets, whereby said releasing magnets may effect continuation of the operation of the motors during the operation of the line relays, and apparatus in association with the link circuits for effecting the operation of the releasing magnets.

9. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets

for causing the selecting motors to operate, line relays, switching mechanisms controlled by the releasing magnets and the line relays, serving to control the releasing magnets, whereby said releasing magnets may effect continuation of the operation of the motors during the operation of the line relays, and apparatus in association with the link circuits for effecting the operation of the releasing magnets.

10. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled thereby for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased, and apparatus in association with the link circuits for effecting the operation of the releasing magnets.

11. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled by the line relays and the releasing magnets, for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased, and apparatus in association with the link circuits for effecting the operation of the releasing magnets.

12. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate, line relays, switching mecha-

sms controlled by the line relays and partially controlling the circuit of the releasing magnets, whereby said releasing magnets may effect continuation of the operation of the motors by the operation of the line relays, and signals jointly controlled by the releasing magnets and line relays.

13. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, releasing magnets for causing the selecting motors to operate, line relays, switching mechanisms controlled by the releasing magnets and the line relays, serving to control the releasing magnets, whereby said releasing magnets may effect continuation of the operation of the motors during the operation of the line relay, and signals jointly controlled by the releasing magnets and line relays.

14. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled thereby for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased, and signals jointly controlled by the releasing magnets and line relays.

15. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled by the line relays and the releasing magnets, for maintaining the circuits of the governor motor magnets and

the releasing magnets until the operation of the line relays has ceased, and signals jointly controlled by the releasing magnets and line relays.

16. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled thereby for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased, apparatus in association with the link circuits for effecting the operation of the releasing magnets, and signals jointly controlled by the releasing magnets and line relays.

17. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, motor governor magnets for setting the motors of the selecting mechanisms in operation upon the initiation of calls by calling subscribers, releasing magnets also governing the motor governor magnets to cause a continuation of the operation of the motors, line relays, switching mechanisms controlled by the line relays and the releasing magnets, for maintaining the circuits of the governor motor magnets and the releasing magnets until the operation of the line relays has ceased, apparatus in association with the link circuits for effecting the operation of the releasing magnets, and signals jointly controlled by the releasing magnets and line relays.

18. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate to restore the selecting mechanism, and signals associated with the releasing magnets to indicate a releasing operation of the selecting motors but not a selecting operation.

19. A telephone exchange system, including a plurality of telephone lines extending

from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate, signals associated with the releasing magnets to indicate operation of the selecting motors, and apparatus in association with the link circuits for effecting the operation of the releasing magnets.

20. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism including motors for connecting the answering ends of the link circuits with calling lines, releasing magnets for causing the selecting motors to operate, and automatically and manually operated apparatus in association with the link circuits for effecting the operation of the releasing magnets.

21. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, apparatus associated with the link circuits for effecting the operation of the selecting mechanism to release the same, and line relays serving, when operated, to effect continuation of the operation of the selecting mechanism after the releasing operation thereof has commenced.

22. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines, apparatus associated with the link circuits for effecting the operation of the selecting mechanism to release the same, line relays serving, when operated, to effect continuation of the operation of the selecting mechanism after the releasing operation thereof has commenced, and a signal for indicating said operation.

23. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link circuits with calling lines, the link circuits having manually controlled terminals for uniting the connecting ends thereof with called lines,

line relays, and distinctive trouble signal devices that are caused to manifest signals by said line relays, whereby the lines that have troubles may be distinguished.

24. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanisms for connecting the answering ends of the link circuits with calling lines, releasing mechanisms for effecting restoring movement of the motors of the selecting mechanisms, apparatus in association with the link circuits for effecting the operation of the releasing mechanisms, line relays, and apparatus jointly controlled by the line relays and the releasing mechanisms for effecting the continuation of the operation of the motors after the operation of said releasing mechanisms and during the operation of the line relays.

25. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanisms for connecting the answering ends of the link circuits with calling lines, motor controlling magnets for operating the selecting mechanisms and operated by calling subscribers, and supplemental contacts for the selecting switches of the selecting mechanisms for initially maintaining the circuit of the motor controlling magnets, to prevent the premature opening of the circuits of said motor controlling magnets.

26. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link circuits for connecting calling lines with called lines, selecting mechanisms for connecting the answering ends of the link circuits with calling lines, line relays, releasing mechanisms, signals and instrumentalities controlled by said line relays, and releasing mechanisms jointly effecting the operation of said signals when the releasing mechanisms and the line relays are operating at the same time.

27. A telephone system including a subscriber's line, a link-circuit, selecting switch mechanism for interconnecting said line and said link-circuit, an operating relay for the selecting mechanism in a circuit local to the exchange, said relay governing the operation of the selecting mechanism, a line relay for primarily controlling the circuit of the said operating relay to advance the switching mechanism, a link-circuit relay for connection with said line by the operation of the selecting mechanism to secondarily govern the circuit of said operating relay to produce a further advance of the mechanism for releasing purposes, and a manually operated switching device at the substation

of the line for governing said line relay and said link-circuit relay.

28. A telephone system including a calling subscriber's line, a called subscriber's line, a link-circuit for interconnecting the lines, a selective switch for automatic operation to connect said link-circuit and calling line, a motor for said switch, an operating relay governing said motor, a line relay for primarily controlling said operating relay, a link-circuit relay for secondarily controlling said operating relay, and an electromagnetically controlled switch operated over a circuit including a portion of said link-circuit and a switch contact of the selective switch to shift the control of said operating relay from the line relay to the link-circuit relay.

29. A telephone system including a calling subscriber's line, a called subscriber's line, a link-circuit for interconnecting the lines, a selective switch for automatic operation to connect said link-circuit and calling line, a motor for said switch, an operating relay governing said motor, a line relay for primarily controlling said operating relay, a link-circuit relay for secondarily controlling said operating relay, an electromagnetically controlled switch operated over a circuit including a portion of said link-circuit and a switch contact of the selective switch to shift the control of said operating relay from the line relay to the link-circuit relay, and a manually operated switch at the substation of the calling line for controlling said line relay and said link-circuit relay.

30. A telephone system including a calling subscriber's line, a called subscriber's line, a link-circuit for interconnecting the lines, a selective switch for automatic operation to connect said link-circuit and calling line, a motor for said switch, an operating relay governing said motor, a line relay for primarily controlling said operating relay, a link-circuit relay for secondarily controlling said operating relay, an electromagnetically controlled switch operated over a circuit including a portion of said link-circuit and a switch contact of the selective switch to shift the control of said operating relay from the line relay to the link-circuit relay, a manually operated switch at the substation of the calling line for controlling said line relay and said link-circuit relay, and means automatically effective on connection made with the called line to render said operating relay unresponsive to said line relay and said link-circuit relay.

31. A telephone system including a subscriber's line, a substation connected thereto having a hook-switch, a selective switch individual to said line, stationary contacts adapted to be engaged thereby, means for initially operating said switch controlled over a circuit including the substation hook-switch of said line, mechanism for releasing

said switch by causing further operation thereof in the original direction of operation, said mechanism being controlled over a circuit excluding said line but including a stationary contact of said switch substantially as described.

32. In a telephone system the combination with a selective switch and an associated telephone line, of a driving magnet therefor, an operating relay controlling the circuit of said magnet, a line relay for said line normally in circuit therewith for causing initial energization of said operating relay, a link-circuit capable of being connected with said line, said connection being automatically controlled by said switch, a relay for said link-circuit controlling said operating relay, a second relay for said line effective on connection with said link-circuit to shift the circuit of said line from said line relay to said link-circuit relay, and a circuit for said link-circuit relay thereon controllable by current over said line.

33. A telephone exchange system, including a plurality of telephone lines extending from substations to an exchange, link-circuits for connecting calling lines with called lines, selecting mechanism individual to said lines for connecting the answering ends of the link-circuits with calling lines, and including traveling arms or switch members serving to connect contacts of the lines and contacts at the answering ends of link-circuits, manual calling terminals for said link-circuits for completing the connections and means at said link circuits and controlled therefrom for restoring a connected mechanism.

34. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link-circuits for connecting calling lines with called lines, selecting mechanism for said lines for connecting the answering ends of the link-circuits with calling lines, apparatus associated with the link-circuits for effecting the operation of the selecting mechanism to release the same, and relays serving, when operated, to effect continuation of the operation of the selecting mechanism after the releasing operation thereof has commenced.

35. A telephone exchange system, including a plurality of telephone lines extending from sub-stations to an exchange, link-circuits for connecting calling lines with called lines, selecting mechanism for connecting the answering ends of the link-circuits with calling lines, apparatus associated with the link-circuits for effecting the operation of the selecting mechanism to release the same, relays serving, when operated, to effect continuation of the operation of the selecting mechanism after the releasing operation thereof has commenced, and a signal for indicating said operation.

36. A telephone system including subscribers' lines, link-circuits for connecting calling lines and called lines, selecting mechanism for said lines for connecting said link-circuits with calling lines, apparatus associated with the link-circuits for effecting actuation of the selecting mechanism to release the same, and a switch device controlled by a central office operator for actuating said apparatus.
37. A telephone system including telephone lines, multiple spring-jacks for said lines at the exchange, link-circuits for interconnecting said lines, traveling switch mechanisms for connecting the answering ends of link-circuits interchangeably with calling lines, line relays operable by currents over said lines to start said mechanisms, and circuit connections controlled by contacts of the line relay for rendering the spring-jacks of their respective lines busy when said relays are initially operated.
38. A telephone system, including a selective switch, means for adjusting said switch, mechanism for releasing said switch, a release signal for said switch, and means for automatically displaying said signal only during the operation of the release mechanism.
39. A telephone system including a selective switch for operation in completing connections, an electromagnet for restoring said switch to normal, a release signal, and means for automatically operating said signal only for indicating the condition of said magnet.
40. A telephone system including a selective switch, means for adjusting said switch by travel in one direction, apparatus for causing continuation of travel of said switch in the same direction to a normal point, and a signal automatically displayed while said apparatus is operating.
41. A telephone system including a calling subscriber's line, a link-circuit at the exchange, automatic selecting mechanism at the exchange, means at the substation for initiating travel of said mechanism to cause it to interconnect said link-circuit and said line, a switch at the exchange serving when operated to cause disconnection of said link-circuit and line, and means preventing subsequent interconnection of said link-circuit and line until after the subscriber's receiver has been replaced.
42. A telephone system including a subscriber's line, a plurality of link-circuits adapted for connection therewith, automatic traveling mechanism at the exchange to connect a link-circuit with said line when a call is initiated thereover, and operator's means for disconnecting said link-circuit and line and preventing re-connection of said line with any link-circuit while the substation of said line remains in calling condition.
43. A telephone system including a subscriber's line, a plurality of link-circuits adapted for connection therewith, automatic traveling mechanism at the exchange to connect a link-circuit with said line when a call is initiated thereover, operator's means for disconnecting said link-circuit and line and preventing re-connection of said line with any link-circuit while the substation of said line remains in calling condition, and a hook-switch at said substation adapted for operation to again render the line capable of being connected with a link-circuit.
44. A telephone system including a subscriber's line, a link-circuit at the exchange, automatic selecting means adapted to be started responsive to currents over said line to interconnect said link-circuit and line, releasing mechanism for said means, and apparatus adapted to operate said releasing mechanism by an accidental ground on the tip side of said line.
45. A telephone system including a subscriber's line, a link-circuit at the exchange, automatic selecting means adapted to be started responsive to currents over said line to interconnect said link-circuit and line, releasing mechanism for said means, and apparatus adapted to operate said releasing means by an accidental ground on the sleeve side of the line.
46. A telephone system including a subscriber's line, a link-circuit at the exchange, automatic selecting means adapted to be started responsive to currents over said line to interconnect said link-circuit and line, releasing mechanism for said means, apparatus adapted to operate said releasing mechanism by an accidental ground on the tip side of said line, and a trouble indicating signal displayed while such accidental ground continues.
47. A telephone system including a subscriber's line, a link-circuit at the exchange, automatic selecting means adapted to be started responsive to currents over said line to interconnect said link-circuit and line, releasing mechanism for said means, apparatus adapted to operate said releasing means by an accidental ground on the sleeve side of the line, and a trouble indicating signal displayed while such accidental ground continues.
48. A telephone system comprising a telephone line having multiple connection terminals, link-circuits, traveling switch mechanism for uniting said line and an idle link-circuit, other means for connecting to said line through said multiple terminals, a relay for controlling the starting of said mechanism over said line, a busy test connection for said multiple terminals established upon the operation of said relay, and mean for de-energizing said relay and retaining said busy test connection.
49. A telephone system comprising a tele-

phone line having multiple connection terminals, link-circuits, a selecting switch individual to said line for uniting said line to an idle link-circuit, other means for connecting

5 to said line through said multiple terminals, a relay for controlling the starting of said switch over said line, a busy test connection for said multiple terminals established upon the operation of said relay, and means for
10 deenergizing said relay and retaining said busy test connection.

50. A telephone system comprising a telephone line having multiple connection terminals, link-circuits, a selecting switch individual to said line for uniting said line to
15 an idle link-circuit, other means for connecting to said line through said multiple terminals, a line relay, a private relay controlled by said line relay, driving means for said
20 switch controlled by said private relay, and a busy test connection for said multiple terminals established upon the operation of said private relay.

51. A telephone system comprising a telephone line having multiple connection terminals, link-circuits, a selecting switch individual to said line for uniting said line to
25 an idle link-circuit, other means for connecting to said line through said multiple terminals, a line relay, a private relay controlled by said line relay, driving means for said
30 switch controlled by said private relay, a busy test connection for said multiple terminals established upon the operation of said private relay, and means for subsequently maintaining a busy test connection
35 for said terminals.

52. A telephone system comprising a telephone line having multiple connection terminals including spring-jacks, link-circuits, traveling switch mechanism for uniting said
40 line and an idle link-circuit, other means for connecting to said line through said multiple spring jack terminals, a relay for controlling the starting of said mechanism over
45

said line, and means responsive to the operation of said relay to establish a busy test connection for said multiple spring jack terminals.

53. A telephone system comprising a telephone line having multiple connection terminals including spring-jacks, link circuits, a selecting switch individual to said line for
50 uniting said line to an idle link-circuit, other means for connecting to said line through said multiple spring jack terminals, a relay for controlling the starting of said
55 switch over said line, and means responsive to the operation of said relay to establish a busy test connection for said multiple spring
60 jack terminals.

54. A telephone system comprising a telephone line having multiple connection terminals including spring-jacks, link-circuits, a selecting switch individual to said line for
65 uniting said line to an idle link-circuit, other means for connecting to said line through said multiple spring jack terminals, a line relay, a private relay controlled by said line
70 relay, driving means for said switch controlled by said private relay, and a busy test connection for said multiple spring jack terminals established upon the operation of said private relay.

55. A telephone system comprising a telephone line, manual connection terminals for said line, link circuits, traveling switch mechanism for uniting said line and an idle
75 link circuit, other means for connecting to said line through said manual terminals, a relay for controlling the starting of said mechanism over said line, and a busy test connection for said manual terminals established responsive to operation of said relay.

In witness whereof, I hereunto subscribe my name this 17th day of June, A. D. 1905.

FRANCIS W. DUNBAR.

Witnesses:

LEON STROH,
CHAS. F. BASSETT.