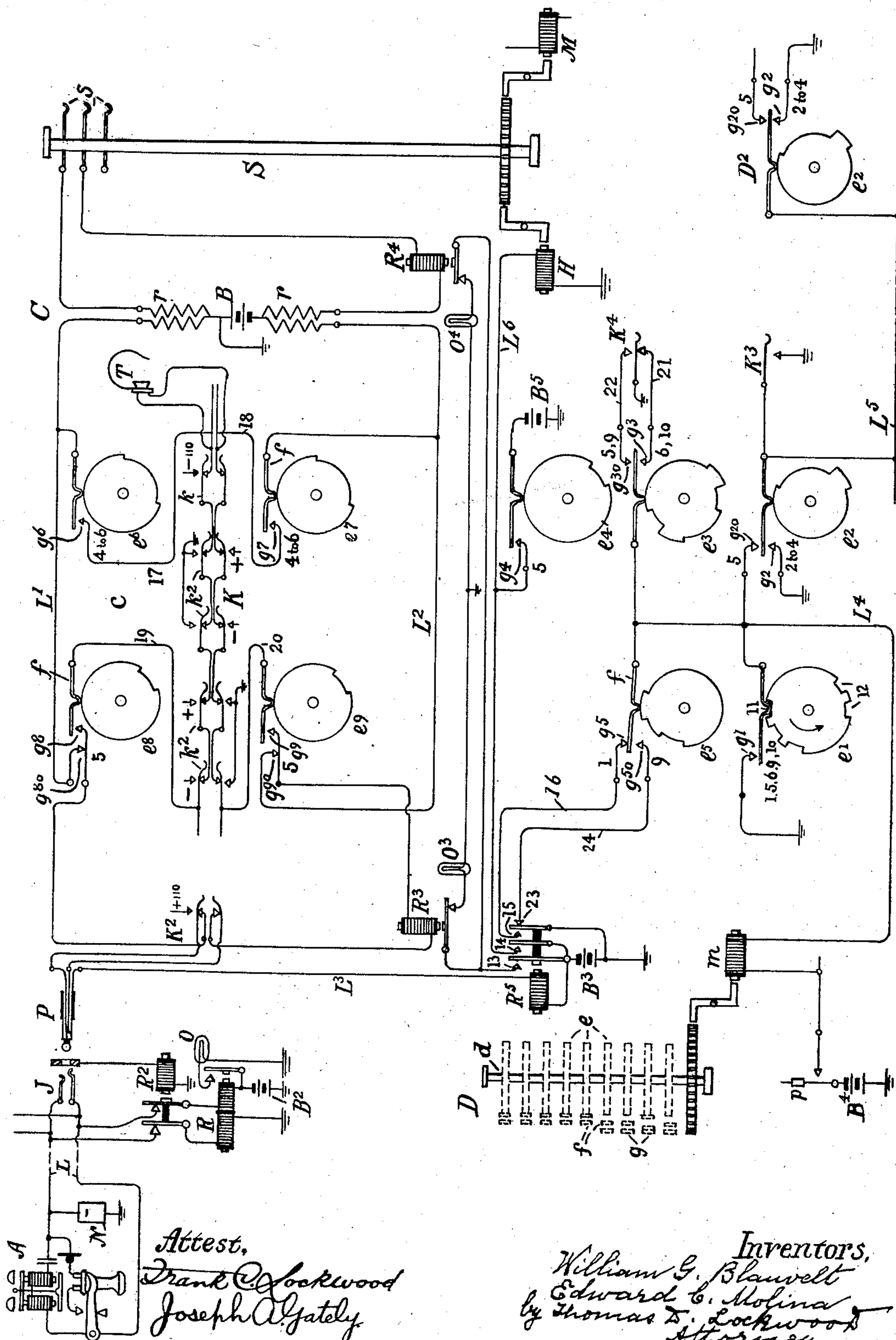


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TELEPHONE OPERATOR'S EQUIPMENT.
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TELEPHONE-OPERATOR'S EQUIPMENT.

1,104,956.

Specification of Letters Patent.

Patented July 28, 1914.

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To all whom it may concern:

Be it known that we, WILLIAM G. BLAUVELT and EDWARD C. MOLINA, respectively residing at New York, borough of Manhattan, and Bloomfield, in the county of New York and county of Essex, respectively, and State of New York and State of New Jersey, respectively, have invented certain Improvements in Telephone-Operators' Equipment, of which the following is a specification.

Our invention relates to the equipment of telephone operators, its chief objects being to reduce the number of acts and the mental effort required in effecting and supervising a connection between calling and called telephone lines. A saving is also made in the number of manually actuated controlling devices comprised in the operator's equipment.

The invention is especially applicable to, and in the single diagrammatic figure of the drawing is illustrated in connection with, a telephone system in which both manual and automatic switching apparatus is employed.

At A is indicated one of a number of telephone substations joined by its line L to a central station C, at which it terminates in an answering jack J and has associated with it the usual line relay R controlling the line lamp O, together with a cutoff relay R². It also extends to the fixed contacts of a selecting switch, not here illustrated, which may be the last of a chain of similar automatic apparatus, the first of which is shown conventionally at S with contact brushes s driven by motor mechanism M and temporarily retained against restoration to the normal position by a magnet H. The structure and manner of control of such automatic switches is well understood, and, since our invention is not concerned with these details, they need not be more particularly described. The jack J is situated at a particular operating position, which will be provided with a suitable number of connecting or cord circuits c, one of which is here illustrated, having at one end an answering plug P for coöperation with the jacks J and extending to the brushes of one of the selec-

tors S. Across the main or transmission conductors L¹ and L² of each cord circuit is bridged the central station battery B, between the windings of the repeating coil r. This battery, though it may supply current to all the apparatus of the system, appears in the drawing at various points and is designated by different reference characters for convenience in description. In the conductor L² of the cord circuit are the calling and called line supervisory relays R³ and R⁴ controlling, respectively, supervisory lamps O³ and O⁴, and in the third conductor L³ is a relay R⁵, the purpose of which will later appear.

Common to all the cord circuits at an operating position is the operator's telephone set T and a group K of master keys or like manually operable circuit controlling devices, of which five are illustrated, connected with one another in series through their resting contacts. One of these keys k may be used to apply at its active contacts current from a source of relatively high potential to one side of the line, to effect in the customary manner the return of a coin deposited in a coin-box N at a substation. When such a key is used, each cord circuit will include a suitable key K² for the purpose of opening said cord circuit and applying to the coin-box mechanism current from a source of opposite polarity to cause the deposit of a coin. The remaining keys k² of the group K may serve to impress ringing current upon a calling line, whereby a subscriber may be signaled for the purpose of receiving information, for example, of the establishment of a desired connection previously impossible. To permit selective ringing over four-party lines four of the keys k² are shown, these uniting sources of ringing current of opposite sign to both sides of the line.

The operator's set, in accordance with the usual practice, is to be joined through a particular cord with one calling line at a time to enable the subscriber's order to be received, and then separated therefrom and connected to another calling line. It must

also be possible at any time to unite the set with any cord of the operator's equipment for the purpose of supervision and to dis-unite it at will. The master keys K must
 5 be actively associated with one of the operator's cord circuits at a time, this being the one upon which she is "listening-in", but these should only apply the high potential currents to the calling line and not to
 10 the operator's telephone or called line. Therefore, the cord should be severed and the keys united only to the answering plug end. To produce an automatic connection and disconnection of the operator's set and
 15 master keys with respect to the proper cord circuit, they are joined to electromagnetic switching mechanisms, of which there is one for each cord, these being adapted to assume a series of circuit controlling positions in
 20 regular sequence.

The switch D belonging to the cord c is illustrated quite fully in the drawing, while a portion of another switch associated with a cord at the same operating position ap-
 25 pears at D^2 . The form of switching mechanism employed is not important; that which is here shown diagrammatically may include a shaft d suitably journaled and carrying fast upon it a series of cams e , the irregular
 30 peripheries of which coöperate with springs f to separate them from and force them against contacts g . These cams, springs and contacts all appear in two places in the drawing, in dotted lines in their actual rela-
 35 tion to the shaft d and in full lines at points most clearly developing the circuit organization. In the latter case, the cams and contacts are distinguished from one another by numerals affixed to their reference letters.
 40 The switch shaft with its cams may be moved from position to position by a motor magnet m actuating ratchet mechanism. A pulsator p supplies intermittent current from battery B^4 through a conductor L^4 to
 45 energize the magnet m and thus rotate the shaft, whenever its circuit is completed at one of the contacts of the switch D to ground or other return conductor. This ground con-
 50 nection may be at some external point or local to the switching mechanism itself, the cam e^1 controlling the latter condition and determining the correct stopping points of the switch shaft. When the spring coöper-
 55 ating with this cam is separated from the contact g^1 , this being in the positions indicated by the numerals placed at the opposite side of the spring from the contact, the pro-
 60 jection 11 upon said spring lies in a depression 12 in the periphery of the cam, and the shaft with the associated cams is properly positioned. Upon the completion of the cir-
 65 cuit of motor magnet m at some point in the system the projection rides out of the depression, and when resting upon the cir-
 cular portion of the cam e^1 closes the local

circuit for the motor magnet, which insures the rotation of the shaft to the next position at which the cams are to stop, regardless of external conditions. The numerals applied to the contacts of the other cams show the
 70 positions in which said contacts are closed.

The springs belonging to the cams e^2 of all the switching mechanisms D, D^2 , etc., at an operating position are joined to a com-
 75 mon conductor L^5 , which also has a branch leading to a master release or "listening-out" key K^3 , the contact of which is grounded. Each cord has individual to it a com-
 80 bined listening-in and listening-out key K^4 , the spring of which is grounded, while its opposite contacts are connected to similar contacts g^3 and g^{30} of the switch cam e^3 . The contact g^4 of cam e^4 , when engaged by its spring, applies battery to the retaining
 85 magnet H of the selector S through the conductor L^6 . The other circuit connections will appear in the following statement of operation of the system.

The subscriber at A, desiring to call an-
 90 other subscriber, removes the receiver from its hook, and the closure of the line from battery B^2 energizes the relay R, lighting the line lamp O. The operator at whose po-
 95 sition said lamp is situated responds by inserting the plug P of an unused cord circuit in the subscriber's answering jack J. The coöperation of the sleeve of the plug and thimble of the jack completes the circuit of the third conductor L^3 of the cord from bat-
 100 tery B^3 , energizing the cut-off relay R^2 to extinguish the line lamp and also causing cord relay R^5 to close its three front contacts. Of these, contact 13 applies battery B^3 to the supervisory lamps, illuminating O^4 but not O^3 , since the calling supervisory relay
 105 R^3 has been energized by the closure of the line at substation A, breaking its circuit. It will be evident that the usual action of both supervisory signals is secured. Contact 14 of relay R^5 connects battery B^3 to con-
 110 ductor L^6 , thus exciting the retaining magnet H and preparing the selector S for operation. Contact 15 grounds conductor L^4 , leading to the motor magnet m , pulsator p , and battery B^4 , through conductor 16 and
 115 contact g^5 of switch cam e^5 , closed in the first position. The current impulses through the motor magnet rotate the switch shaft, and the travel of switch D is thus started as an incident to an act of the operator (the in-
 120 serting of plug P in the answering jack J) in connection with the connecting circuit for an independent purpose. Before switch D leaves its first or normal position, after which the contact g^5 is opened, the cam e^1
 125 closes contact g^1 , and this locally maintains the stepping circuit until the fifth position is reached, at which contact g^1 opens and the switch stops. In this, the listening position, and in the fourth position, during which
 130

the switch is traveling the operator's set T is bridged across the cord conductors L^1 and L^2 , through conductors 17 and 18 and contacts g^6 and g^7 of the cams e^6 and e^7 . In the fifth position the cams e^8 and e^9 cut into the cord the entire group K of the master keys, their contacts g^8 and g^9 making the circuit to the keys by way of conductors 19 and 20 before they sever the calling from the answering end of the cord at the contacts g^{80} and g^{90} . The operator's set is now, as an incident to her act in connecting the cord circuit with the calling line, in circuit with the calling line through the resting contacts of the master keys K, and upon learning the desired number she manipulates some suitable apparatus (not here shown) to control the actuation of the motor magnets of selector S and others of the system.

The operator's ordinary duties in connection with the call just described are now completed until the condition of the supervisory signals shows that the conversation is at an end; therefore her telephone set may at any time be separated from active association with the cord circuit c . This is automatically effected when the succeeding call is answered. Upon the insertion of the plug of another cord circuit in the answering jack of a new calling line, similar operations to those just outlined take place in this cord equipment, which includes the switch D^2 . As soon as this switch leaves its first position, its cam e^2 by the contact g^2 and common conductor L^5 places ground upon the conductor L^4 of the switch D of the first mentioned cord, by way of its contact g^{20} which is closed in the fifth position. The resultant intermittent current through the motor magnet m starts the switch D, and its cams e^8 and e^9 at once disconnect the master keys K and close conductors L^1 and L^2 of the cord. In the sixth position the contact g^{20} is opened, but ground is now found for the motor magnet through contact g^3 of cam e^3 , conductor 21 and the resting contact of key K^4 . In this position the operator's set is cut out of the cord c before the switch D^2 reaches its fifth or listening-in position. Through positions 7 and 8 the switch D travels under the control of the cam e^1 and stops in the ninth or listening-out position.

If the operator wishes to supervise the connection and to again unite her telephone set with some one of the cords from which it has been automatically separated, she presses key K^4 . In the ninth position the contact g^{30} is closed, and when the key co-operates with its alternate contact a circuit to ground is provided for the motor magnet m by way of conductors L^4 and 22. The switch is thereby carried to its tenth position, in which the contact g^3 of cam e^3 is closed, and consequently when K^4 is released

and returns to its normal contact the ground for the motor magnet circuit is secured through conductor 21 and the switch advanced to position one. Since the plug is in the jack, the conditions are as at the time of answering a call, and the switch continues on to the listening-in position, as already described.

If the operator desires to separate her set from active association with the cord circuit with which it was last connected, either automatically or manually, before answering a succeeding call, she may follow either of two courses. If she has in mind the particular cord, as might be the case had she just listened-in by means of the key K^4 , she may actuate the same key. The switch D being in a different position from that at which the switch K^4 was previously used, this will produce a different effect. Contact g^{30} is closed by the cam e^3 in the fifth position, and the completion of the motor magnet circuit to ground through conductor 22 and actuated key K^4 moves the switch to the sixth position. There the making of contact g^3 and the resting contact of the released key causes the switch to travel to the seventh position, at which it comes under the influence of the cam e^1 and is carried to the listening-out position. If the operator has forgotten to which cord her telephone is united she presses the master release key K^3 . But one switching mechanism of the operator's equipment will be in the fifth position, at which the cam e^2 joins the conductors L^4 and L^5 through contact g^{20} . The depression of the key K^3 grounds L^5 , starting the switch, and through the sixth, seventh and eighth positions the advance is continued by the cams e^3 and e^1 to the listening-out position.

As in the case of the key K^4 , different positions of the switching mechanism lead to different results when the plug P is removed from the answering jack. First, when the condition of the supervisory signals shows that the subscribers have finished their conversation, the operator withdraws the plug from the jack when the switch is in its ninth position. Relay R^5 is deenergized by the opening of the third conductor circuit, extinguishing the supervisory lamps at contact 13, releasing the selecting apparatus at contact 14 and causing it to be restored to normal, and giving ground for the motor magnet of the switching mechanism through its back contact 23, conductor 24 and contact g^{50} of cam e^5 . As a result of the last mentioned circuit change the switching mechanism assumes the tenth position, where ground is applied to conductor L^4 through the switch contact g^3 , conductor 21 and the resting contact of the key K^4 . This restores the mechanism to its normal condition for a new operation. Second, suppose

the operator has selected and rung a wrong substation, she should then communicate with the called subscriber only, apologizing for the error. With the switching mechanism in the listening-in position she withdraws the plug from the answering jack. The circuit of relay R^5 is thus broken, and as its contact 14 opens, the supply of current for the retaining magnet H of the selector S from battery B^3 is lost, but in the fifth position contact g^4 of the cam e^4 joins battery B^5 to the conductor L^6 , keeping the retaining magnet energized. Therefore, the controlling effect of the jack and plug is nullified, and the continuity of the selective chain is thus maintained. Though relay contact 23 is now closed, switch contact g^{50} is open, and the switching mechanism remains inactive and the operator's set connected to the called line. Having spoken with the subscriber, the operator may disconnect her set from the cord by use of the keys K^3 or K^4 as already described, but when the ninth position is reached, since relay R^5 is still deenergized, the switch travels on through the ninth and tenth positions, controlled by the cams e^6 and e^7 to normal. The operator then inserts the plug of a cord in the answering jack of the subscriber who had previously called and her set is automatically reconnected, enabling her to again attempt to secure the desired line.

If the operator finds it necessary, because of some defect, to hold the selective apparatus for inspection by the wire chief, she may place the plug in an extra jack having ground connection to its thimble. This operates relay R^5 and the magnet H therefore remains energized; the operator may then listen-out manually and employ a fresh cord circuit to complete the call. The automatic retention of the connection with the called line, when the answering plug is removed with the switching mechanism in the listening-in position, not only relieves the operator of a very appreciable drag upon her work, but also reduces her equipment to the extent of a holding key for each cord circuit.

If the operator, after answering a call and endeavoring to secure a wanted line, finds that it is busy, she may so inform the calling subscriber, with the statement that a further attempt to complete the connection will be made. The plug is then removed from the jack of the calling line. Later when the operator obtains the called line, she plugs into the jack of the calling subscriber with the cord through the selector S of which the desired line has been obtained, and uses the proper master key k^2 to "ring-back" or again summon to the telephone said calling subscriber. The key at its resting contacts opens the connection to the operator's telephone set and through the conductors 17 and 18 to the called line, the path through the

cord conductors L^1 and L^2 having been already broken at the switch contacts g^{80} and g^{90} . Therefore, neither the called subscriber nor the operator suffers from the effect of the high tension ringing current upon their receivers. The master coin-return key k is included in the cord circuit at all times the operator will find it necessary to employ it, and its manner of use is in accordance with ordinary practice. The thing which is to be particularly noted is that by thus employing a set of master keys common to all the cords of an operating position, the number of such keys is reduced to but a small part of what would be necessary were there a set individual to each cord, as has heretofore been the case. That is, instead, for example, of one hundred ring-back and coin-return keys at each operating position there need be but five.

We claim:

1. In a telephone system, a telephone central station, a connecting circuit thereat, an operator's telephone set normally disconnected from the connecting circuit, automatic switching mechanism interposed between the connecting circuit and telephone set and adapted when started to assume a series of circuit controlling positions, in one of which said telephone set and connecting circuit are connected, and means for starting the travel of the switching mechanism, said means being operable as an incident to an act of the operator in establishing a connection with the connecting circuit.

2. In a telephone system, telephone lines, a telephone central station, a connecting circuit thereat, an operator's telephone set, automatic switching mechanism interposed between the connecting circuit and telephone set and adapted when started to assume a series of circuit controlling positions, and means for starting the travel of the switching mechanism, said means being operable as an incident to an act of the operator in establishing a connection with the connecting circuit said act being prior to the joining of the operator's telephone and the telephone line of a calling subscriber.

3. In a telephone system, telephone lines, a telephone central station, a connecting circuit thereat, an operator's telephone set, automatic switching mechanism interposed between the connecting circuit and telephone set and adapted when started to assume a series of circuit controlling positions, and means for starting the travel of the switching mechanism, said means being operable as an incident to the act of the operator by which the connecting circuit is joined to the line of a calling subscriber.

4. A telephone system comprising telephone lines and their telephones, connecting circuits therefor, a telephone other than those of said telephone lines, switching

mechanisms one individual to each connecting circuit and interposed between its said circuit and said other telephone and having a traveling member adapted to assume a series of circuit controlling positions, and means controlled by the association of a telephone line and a connecting circuit for starting the switching mechanism.

5. A telephone system comprising telephone lines and their telephones, connecting circuits therefor, a telephone, other than those of said telephone lines, switching mechanism interposed between the connecting circuits and said other telephone, means controlled by the association of a telephone line and a connecting circuit for starting the switching mechanism from its normal position, and means controlled by the switching mechanism for stopping its movement in a position to unite said other telephone and connecting circuit.

6. A telephone system comprising telephone lines, connecting circuits therefor, a telephone, switching mechanism interposed between the connecting circuits and telephone, means controlled by the association of a telephone line and a connecting circuit for starting the switching mechanism from its normal position, means controlled by the switching mechanism for stopping its movement in a position to unite the telephone and connecting circuit, means for again starting the switching mechanism to disunite the telephone and connecting circuit, and means for stopping the switching mechanism before it reaches its normal position.

7. A telephone system comprising telephone lines, connecting circuits therefor, a telephone, switching mechanisms interposed between the connecting circuits and telephone, means controlled by the association of a telephone line and a connecting circuit for starting a switching mechanism from its normal position, means controlled by the switching mechanism for stopping its movement in a position to unite the telephone and connecting circuit, and means controlled by another switching mechanism for again starting the previously mentioned switching mechanism.

8. A telephone central station, cord circuits thereat, an operator's set for association with said cord circuits, electromagnetic switching mechanisms for the cord circuits respectively each operable to assume a series of circuit controlling positions and in one or more of said positions to associate its cord circuit with said operator's set, and a relay energized upon the putting of a cord circuit into use and thereby controlling the corresponding switching mechanism.

9. A telephone central station, cord circuits thereat, an operator's connecting set for association with said cord circuits, an electromagnetic switching mechanism for

each cord circuit; a relay included in each cord circuit and energized upon the putting of said cord circuit into use, and circuits for actuating the switching mechanism closed by said relay and by the switching mechanism of another cord circuit.

10. In a telephone system, a central station, telephone lines extending thereto, connecting circuits for the lines, an operator's telephone set, switching mechanism for the operator's set movable through a series of circuit-controlling positions, means for actuating the switching mechanism to advance the same when a connecting circuit is put into use, and manually operable means for actuating the switching mechanism to further advance the same.

11. In a telephone system, a central station, telephone lines extending thereto, connecting circuits for the lines, an operator's telephone set, switching mechanism for the operator's set, said switching mechanism being individual to a connecting circuit, means for automatically actuating the switching mechanism when the connecting circuit is put into use, and manually operable means common to a plurality of connecting circuits for further actuating the switching mechanism.

12. In a telephone system, a central station, telephone lines extending thereto, connecting circuits for the lines, an operator's telephone set, switching mechanism for the operator's set, said switching mechanism being movable into a plurality of positions, and means for controlling the movement of the switching mechanism, said means when operated in different positions of the switching mechanism causing its movement to other different positions.

13. A central station and telephone lines extending thereto, cord circuits for switching the lines at the central station, an electromagnetic switch associated with each cord circuit, said switch having a normal position, a position in which it connects the operator's set with its cord circuit, and a position in which it disconnects the operator's set from said cord circuit, a key, circuits closed by the key in the disconnecting position of the switch for starting the movement of said switch toward its connecting position, and circuits closed by the key in its connecting position for starting its movement toward the disconnecting position.

14. The combination with a central station and telephone lines extending thereto, of a plurality of cord circuits for said lines each having at opposite ends means for connecting it to circuits to be joined thereby, a manually operable controlling device at the central station common to but disassociated from said cord circuits and adapted in its operation to apply current impulses to a calling telephone line, and other automatic

means individual to each of said cord circuits for associating the circuit controlling device with its cord circuit.

15. The combination with telephone lines and a plurality of connecting circuits therefor, each having at opposite ends means for connecting it to circuits to be joined thereby, of a manually operable device accessible to a central office operator for controlling the current in said telephone lines, such manually operable controlling device being common to but normally disassociated from said connecting circuits, and other automatic means individual to each connecting circuit and adapted to perform a series of circuit controlling operations in conjunction therewith one of said operations being the associating of the manually operable device and connecting circuit.

16. In a telephone system, telephone lines, automatic selecting apparatus associated therewith, means for connecting the selecting apparatus with a telephone line, a telephone set, means for connecting the telephone set with a telephone line, means controlled by one of said connecting means for causing the restoration of the selecting apparatus, and means governed by the other connecting means for nullifying said control.

17. The combination with telephone lines, of a connecting circuit and automatic selecting apparatus, an operator's telephone set, switches for uniting the connecting circuit with a line and for uniting the operator's set with the connecting circuit, means controlled by the line switch for effecting the restoration of the selecting apparatus, and means controlled by the switch for the operator's set for preventing the restoration.

18. The combination with telephone lines terminating in jacks, of operators' cord circuits provided with plugs for coöperation with the jacks, automatic selecting apparatus, an operator's set, a sequence switch for connecting the operator's set to the cord circuits, means controlled by a jack and plug for causing a movement of the selecting apparatus to normal, and means controlled by the sequence switch for nullifying the effects of the jack and plug.

19. The combination with telephone lines terminating in jacks, of operators' cord circuits provided with plugs for coöperation with the jacks, automatic selecting apparatus, an operator's set, a sequence switch for connecting the operator's set to the cord circuits, means controlled by a jack and plug for causing a movement of the selecting apparatus to normal, and means controlled by the sequence switch in its said connecting position for nullifying the effect of the jack and plug.

20. The combination with telephone lines, of a connecting circuit therefor, automatic selecting apparatus associated with the con-

necting circuit and including retaining mechanism, means dependent upon the putting of a connecting circuit into use for actuating the retaining mechanism, and independent means for continuing the actuation of the retaining mechanism.

21. The combination with telephone lines, of a connecting circuit therefor, call answering means associated with the connecting circuit, automatic selecting apparatus including retaining mechanism, means for actuating the retaining mechanism upon the connection of the answering means with a calling line, and means for continuing the actuation of the retaining mechanism after the disconnection of the answering means from the calling line.

22. The combination with telephone lines, of a connecting circuit therefor, automatic selecting apparatus associated with the connecting circuit and including retaining mechanism, means dependent upon the putting of a connecting circuit into use for actuating the retaining mechanism, a telephone, switching means between said telephone and the connecting circuit, and means controlled by the switching means for continuing the actuation of the retaining mechanism.

23. The combination with telephone lines and answering jacks at which the lines terminate, of a cord circuit provided with an answering plug and with a selecting switch having a retaining magnet, an operator's telephone set, means for connecting the operator's set to the cord circuit, a circuit for the retaining magnet closed upon the insertion of the answering plug into the jack of the calling line, and another circuit for the retaining magnet closed by the connecting means.

24. The combination with telephone lines and answering jacks at which the lines terminate, of a cord circuit provided with an answering plug and with a selecting switch having a retaining magnet, an operator's telephone set, automatic switching mechanism for the operator's set, said switching mechanism being capable of assuming a plurality of positions, a circuit for the retaining magnet closed upon the association of the answering plug and jack, and another circuit for the retaining magnet closed by the switching mechanism in one of its positions.

25. The combination with a central station and telephone lines extending thereto, of cord circuits, an automatic selector having a retaining magnet, an operator's telephone set, automatic switching mechanism for uniting the operator's set and cord circuits, and a circuit for the retaining magnet controlled by said switching mechanism.

26. The combination with a central station and telephone lines extending thereto, of cord circuits, an automatic selector hav-

ing a retaining magnet, an operator's telephone set, automatic switching mechanism having a plurality of positions in one of which it connects the operator's set and a
5 cord circuit, and a circuit for the retaining magnet closed by the switching mechanism in said connecting position.

In testimony whereof, we have signed our

names to this specification in the presence of two subscribing witnesses, this ninth day 10 of March, 1910.

WILLIAM G. BLAUVELT.
EDWARD C. MOLINA.

Witnesses:

ROBT. S. SURLIFFE,
SYLVANUS H. COBB.