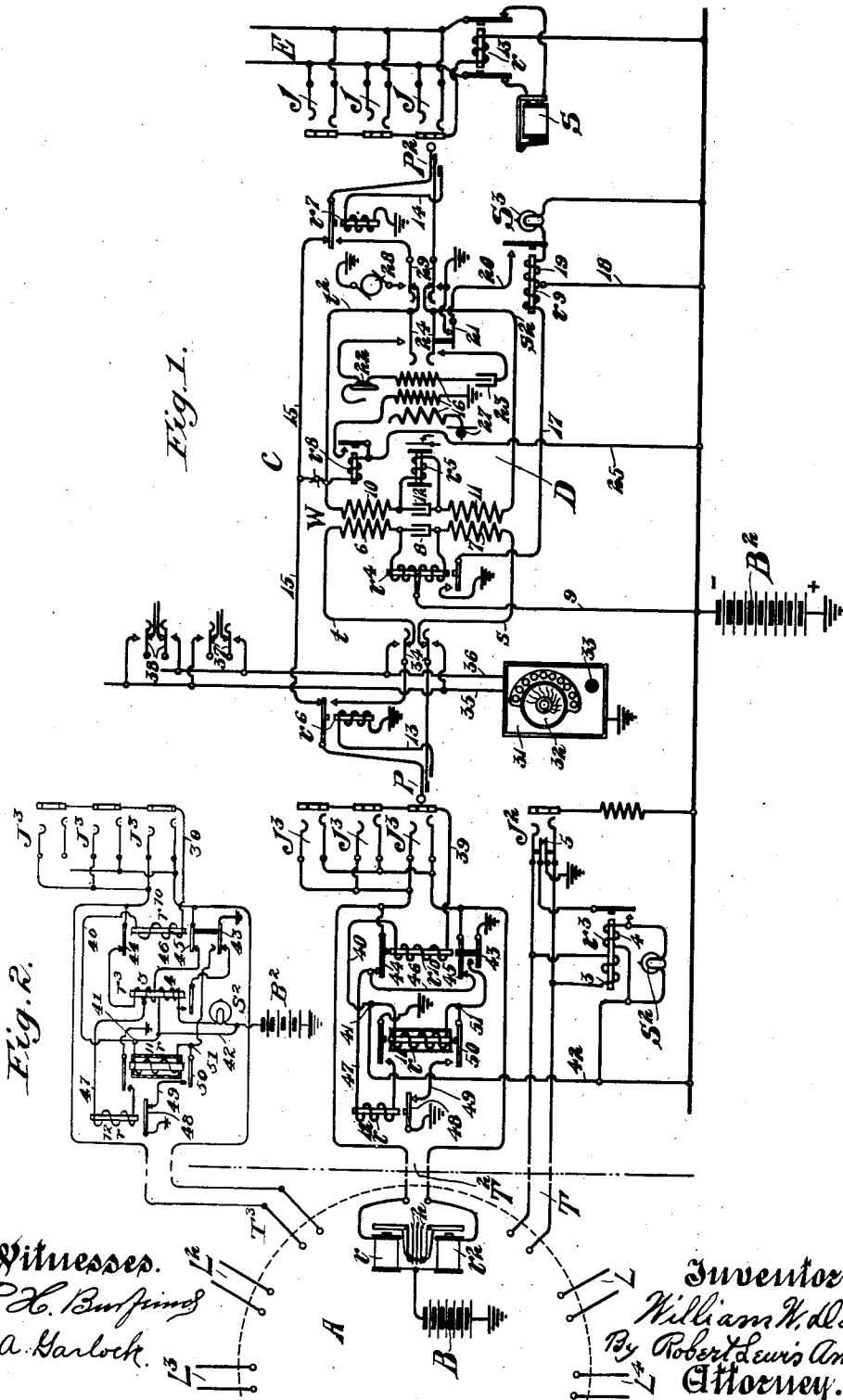


W. W. DEAN.
TELEPHONE SYSTEM.

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UNITED STATES PATENT OFFICE.

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TELEPHONE SYSTEM.

1,403,671.

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To all whom it may concern:

Be it known that I, WILLIAM W. DEAN, a citizen of the United States of America, and resident of Elyria, county of Lorain, and State of Ohio, have invented a new and useful Improvement in Telephone Systems, of which the following is a specification.

My invention relates to improvements in telephone systems whereby telephone lines connected with so-called automatic exchanges and manual exchanges may be interconnected for conversational purposes. As is well understood, the lines radiating from an automatic exchange are provided with switching mechanism at the central office, which is so controlled from the subscribers' stations that any line may be connected with any other for conversation; in manual exchanges it is likewise understood that the assistance of human operators is required in order to inter-connect the subscribers' lines. My present invention therefore contemplates the provision of means whereby the ready connection of these two classes of telephone lines may be accomplished in an expeditious and simple manner in order that conversation may be conveniently carried on between them.

In carrying out my invention which has been worked out for commercial purposes, I provide a suitable number of trunk circuits extending between the automatic exchange and the manual exchange, said trunks being provided with suitable switching mechanism at the automatic exchange to enable them to be connected with any of the subscribers' lines, and with suitable signals and connection terminals, preferably in the form of spring jacks, at the manual exchange, the operators at the latter exchange having suitable cord circuits, or other connective means to connect said trunks with the telephone lines terminating in that exchange and in addition having means to effectively control the switching or connecting mechanism at the opposite ends of said trunks. Thus in this practical arrangement the automatic subscribers may connect with the said trunks and signal the manual switchboard and be thence connected by the operators with the subscribers' lines of said board; and conversely the manual subscribers may be connected by the operators with the said trunks and thence by proper manipulation of the

automatic mechanism of the trunks with any of the automatic subscribers' lines.

This invention is useful between ordinary automatic and manual exchanges in the same or neighboring localities, but finds its most frequent field of usefulness in connection with automatic and toll boards, since it is essential in such automatic exchanges to provide means for connecting the automatic subscribers with toll lines; that is, with telephone lines extending for a long distance to the other cities or to other remote points. It is inconvenient and practically impossible to provide such toll lines with the automatic connecting mechanism, such as is furnished the other subscribers of the automatic exchange, not only by reason of the mechanical and electrical difficulties that would be encountered but also by reason of the method of handling toll business, which precludes any such arrangement. For instance, when a subscriber desires a toll connection, the service must be charged for in a different manner from that of the ordinary service, so that the assistance of some person, such as a recording operator at the automatic exchange, is required. Again, on account of the traffic imposed upon such toll lines, it is the practice to place them in charge of operators whose duty it is after being informed that a toll connection is desired, to first secure the desired toll connections and then notify the subscriber that the connection is established. It is some times necessary to wait for several hours before the connection can be completed between the desired points, so that it is not feasible to connect with such toll lines by the ordinary automatic apparatus controlled by the subscriber.

I therefore provide a manually operated board for the toll lines and connect this by trunk lines with the automatic board, all in accordance with my invention, whereby the business may be handled in the desired manner and with complete success from all points of view.

My invention is illustrated in the accompanying drawing in which is shown a diagram of a telephone system embodying an automatic exchange and a manual exchange with means for interconnecting them.

In Fig. 1 A indicates an automatic switchboard or central office at which the various subscribers' lines L , L^2 , L^3 , etc., terminate,

each line as is common being provided with switches and mechanism at the said switchboard or central office under the control of the subscriber to enable it to be connected with any other line of the exchange. This connecting mechanism at the central office I have not shown in detail as in its individual capacity it forms no part of my invention, and while such mechanism may be of any desired type so far as certain features of the invention are concerned I have indicated the mechanism of the well-known Strowger automatic system.

C indicates the manual switchboard at which the various telephone lines such as line E terminates in the usual line signals S and spring jacks J, J, etc., in multiple. Suitable cord circuits D are provided at the latter board in any desired number to variously connect the lines together or to connect such lines with the subscribers' line of the automatic exchange through the medium of a suitable number of trunk lines extending between the automatic board and the manual board such for instance as the trunk lines T and T² or T³ in any number, these trunks being either divided into outgoing and incoming trunks according to whether they are adapted for use in connecting from the automatic to the manual exchange, or vice versa, the trunk T being shown of the former variety and the trunk T² as of the latter or combined for use in either direction, the trunk T³ being of this type.

The subdivision of the service required of the trunks makes the arrangement particularly adaptable to toll service in connection with automatic boards, that is to the connection of the automatic system with lines extending to remote cities or points and known as long-distance lines, and it is to this latter service that my system and arrangement throughout is especially adapted, though it will be understood that in many of its features the invention is in no wise so limited but may be utilized for ordinary trunking between automatic and manual exchanges as well as for other purposes. For instance, in one of its broad aspects my invention consists of an automatic telephone system in which the automatic apparatus or switches are "cleared out" or returned to normal condition after a connection by the conjoint action of quick and slow acting relays. In the specific embodiment shown, the lines E shown centering at switchboard C are of the toll type and the cord circuits D are arranged to suitably cooperate therewith, but it will be understood that the lines may be of a different type and the cord circuits suitably modified to co-operate therewith.

Referring again to the trunks, they are each provided with suitable automatic switching mechanism at the office A and

which may be the same as is provided for each of the subscribers' lines of that same office or modified to meet the limited requirements of the special service to which such trunks are put to enable said trunks to be connected with any of the subscribers' lines of the automatic office. That is, with the special arrangement shown any of the subscribers of lines L, L², L³, etc., must be able to automatically connect with the trunks T or T³ leading to the manual or toll board where his wants can be made known to an operator and conversely the operator at the manual or toll board must be able to automatically connect the trunks T² and T³ with any of the said subscribers' lines of exchange A.

I have indicated this switching mechanism in connection with the trunk line T² only, and which includes relays r and r² bridged across the trunk line with the middle point of the bridge connected with the live pole of a suitable source of current B whose other pole is grounded. These relays control suitable springs or contacts 2 and when suitably actuated over the line with which they are connected serve in a more or less direct manner to complete a connection with the desired line. As is well known each subscriber of the automatic exchange is provided with a dial or other switching means by which the said mechanism at the central office may be stepped around or suitably operated to connect the line to which it belongs with the desired party. A ringing button is also usually associated with said dial at the substation so that when the desired party is reached his bell may be rung by a simple pressure of the said button.

To enable the automatic subscriber to reach the toll or manual board with the arrangement shown, the outgoing trunks T and T³ are provided at the manual board with the signals S² which respond upon the usual ringing act of the subscriber, thus indicating a call at the operator's position. Thus, pressure of the subscribers' ringing button causes current from the ringing generator at the office A to flow over the trunk T and through the winding 3 of relay r³; the armature of relay r³ is thus attracted and closes a circuit through both the signal lamp S² and the locking winding 4 of the said relay in parallel, this circuit including the series contacts 5 of the answering jack J² in which the said trunk terminates at board C, though multiple jacks may be added. The trunks T² and T³ likewise terminate in jacks J³, J³, J³, shown multiplied in any number before the manual operators in office C.

The cord circuit D is provided with a pair of plugs P and P², each having three contacts, namely: tip, sleeve and ring contacts,

to co-operate respectively with the similar contacts of the spring jacks J, J² and J³, whenever inserted therein. The tip and sleeve strands *t* and *s* connected with the plug P are joined through the medium of windings 6 and 7 of a repeating coil W and a condenser 8, said condenser 8 being shunted by a relay *r*⁴, the middle point of whose winding is joined by a conductor 9 with the live pole of the central grounded and common battery B². The similar strands *t*² and *s*², connected with the tip and sleeve contacts of the plug P² are joined through similar windings 10 and 11 of said repeating coil W, which are inductively associated as shown with the windings 6 and 7 thereof. A similar condenser 12 is included between said windings 10 and 11, and is shunted by the clearing out drop *r*⁵, which is adapted in addition to its clearing out function to control suitable contacts of a pilot signal or night bell. The ring contact of the plug P is joined by conductor 13 with a relay *r*⁶ whose other terminal is grounded. A similar grounded relay *r*⁷ is connected by the conductor 14 with the ring contact of the plug P². The said relays *r*⁶ and *r*⁷ control normally open contacts in the strands *t* and *t*² respectively, the normal contacts of these serving to complete a connection from the tips of the plugs to conductor 15 which is joined to a suitable test relay *r*⁸, the opposite terminal of which is connected by branch 25 with the live pole of battery B². Said test relay *r*⁸ is provided with normally open contacts which are included in a branch circuit from the same battery and including the tertiary winding of the operator's induction coil 16. The relay *r*⁴ associated with the end of the cord circuit connected with the plug P is provided with normally open contacts included in a grounded conductor 17 connected with one terminal of a relay *r*⁹ whose other main terminal is connected by a suitable wire 18 with the live pole of the battery B². This relay is provided with a locking winding 19, and with normally open contacts which when closed complete a circuit from the live pole of the battery B² through the conductor 18, the locking winding 19 and branch conductor 20, which is grounded through the normally closed contacts 21 of the operator's listening key. A supervisory signal S³ has its circuit also completed by the contacts of said relay *r*⁹ when the relay is energized. The operator's head receiver 22, the secondary of her induction coil 16 and a suitable condenser 23 are adapted to be connected across the talking circuit of the cord through the medium of listening key springs 24, her transmitter 27 and the primary of her induction coil 16 being charged from the battery B² or other suitable source. A suitable ringing gener-

ator 28 having one pole grounded is adapted to be connected with the tip strand *t*² of the cord circuit by means of the ringing key springs 29, the sleeve spring being at the same time grounded.

As stated heretofore it is necessary for the operator to be able to operate the automatic connecting mechanism associated with the trunk T² at the office A, and for this purpose I associate with the cord circuit a suitable dial and ringing outfit 31, which may be of the same construction as is provided for each of the automatic subscribers, this dial being provided with an indicator, such as 32, and with a suitable mechanism to make the required circuit connections so that the operator by turning the indicator 32, or otherwise suitably operating said device, is enabled to send the proper current impulses over the trunk line to operate the switching mechanism *r*, *r*², at the other end of the trunk T² to thereby connect said trunk with any of the automatic subscribers. This dial or device is preferably also provided with a ringing button 33 in the usual manner which when depressed completes the proper circuit connections to impress ringing current upon the called subscriber's lines at the automatic exchange. The operator's cord circuit is provided with switching key springs 34 which normally complete the strands *t* and *s* thereof, but which when operated serve to sever said strands and connect the plug P with the said connecting dial 31 through the medium of the conductors 35 and 36. Thus in order for the operator to actuate the connecting mechanism at the opposite end of the trunk T², it is only necessary to insert the plug P in the jack of that trunk, operate the key 34 in the cord circuit and then suitably operate said dial mechanism to connect the trunk with the desired subscriber. As each operator is provided with a plurality of cord circuits it is preferred to arrange said dial so as to be common to a certain number or all of the cord circuits at each operator's position. This is accomplished by extending the conductors 35 and 36 to the other keys 37 and 38 of the other cord circuits at the operator's position, although it is obvious that a dial may be tied directly to each cord.

The automatic mechanism of the Strowger system with which my invention is particularly adapted for use, required for a suitable clearing out when the conversation has terminated, that a ground connection from both sides of the line be simultaneously and momentarily established and broken at the subscriber's station. This is achieved at the subscriber's station after the connecting dial has once been moved, by the switch hook in hanging up the receiver, but in connection with the trunk lines T² and T³ I provide

auxiliary means to accomplish it in case the subscriber's dial has not been moved before the conversation began, this means including the arrangement of the relays and circuits shown at the office C in connection with the jacks J³ thereof. The test rings of the said jacks are connected by means of a suitable conductor 39 with the relay r¹⁰, thence by conductor 40 to the point 41, from which the conductor 42 leads to the common lead of battery B². A second relay r¹¹ is connected upon one side with the point 41 and upon the other side with the forward contact of the grounded spring 43 of said relay r¹⁰. The relay r¹⁰ is provided with additional springs 44 and 45 connected respectively with the tip and sleeve sides of the trunk line T². The normal contacts of these two springs are tied together by the wire 46 and from this wire a branch conductor 47 leads to a third relay r¹², whose other terminal is connected with one of the normally open contacts of said relay r¹¹, the other of which normally open contacts is grounded. The relay r¹² is provided with a grounded spring 48 whose normal contact is joined by conductor 49 with the forward contact of a second spring 50 of said relay r¹¹, which in turn is tied to the forward contact of spring 43 of said relay r¹⁰. The relay r¹¹ is provided with a copper shell which as is well known retards its de-energization after the actuating current is cut off from the same, or it may be provided with any form of mechanical damper or retarding device which will produce the same result.

This clearing out mechanism operates in the following manner: When the plug P is inserted in one of the jacks J³, the test rings are grounded through the relay r⁶. This completes a path for current from the battery B² over wire 42, point 41, conductor 40, through winding of relay r¹⁰, conductor 39, strand 13 of the cord circuit, through relay r⁶ to ground. The current in this path is sufficient to energize the relay r¹⁰, which remains energized throughout the connection. The energization of this relay attracts springs 44 and 45 thereof so that the mechanism is entirely disconnected from the trunk wires during the connection. The spring 43 is also attracted which closes a circuit from said battery lead 42, point 41, through the winding of relay r¹¹, and thence through said spring 43 to ground. The relay r¹¹ is therefore also actuated when the relay r¹⁰ is energized. The operation of relay r¹¹ completes connection from the common tie 46 to conductor 47, the relay r¹² and the forward contact and spring of relay r¹¹ to ground. This forms the ground connection which is momentarily thrown upon the line for clearing out purposes. The actuation of relay r¹¹ also completes a ground connection through the normal contacts of

relay r¹², the conductor 49, spring 50 of relay r¹¹, from the point 51, thereby completing a locking circuit for itself through the normal contacts of the relay r¹² and independently of the spring 43 of relay r¹⁰.

When the plug P is removed from the jack J³ current is cut off from the relay r¹⁰ which immediately releases its springs 44 and 45 and thus connects both sides of the trunk with the common tie 46 and thence through the relay r¹² to ground. Current therefore flows from the battery B at the A office, over the trunk line to accomplish the clearing out. The relay r¹² is energized by this current and opens the locking circuit of the relay r¹¹ at its springs 48. Owing to the copper shell of the relay r¹¹, however, this relay is not de-energized instantly, but a moment elapses before it releases its springs, this moment being sufficient to permit current from the battery B to actuate the clearing out apparatus. As soon as the relay r¹¹ is de-energized and releases its springs, the ground branch from the two sides of the lines is opened, and current is cut off from the two sides of the line at the same instant.

The operation of my invention by the use of trunks T and T² is as follows: An automatic subscriber desiring a connection with a telephone line of the manual switchboard suitably operates his automatic mechanism to connect his line with the trunk T, and then depresses his ringing button which causes current from a suitable ringing generator at the automatic central office to be sent over the trunk line and thence through the winding 3 of the relay r³. This ringing current energizes the relay r³ which attracts its armature, thereby closing a path for current from the battery B² through the calling lamp S² associated with the trunk T in the manual board and also through the locking winding 4 of the said relay. The lamp is thus lighted and remains lighted until the operator at the board C inserts the answering plug P of her cord circuit into the jack J² which opens the contacts 5 in the jack to retire the said signal S². The operator is thus enabled to converse with the calling subscriber of the automatic exchange and upon learning the number of the manual subscriber wanted, the opposite end of the cord circuit may be connected with such line and the subscriber called by the ringing generator 28 in the usual manner.

As before stated, however, in the special arrangement of the circuits shown in the drawing, the line E is one of a number of toll lines and since a considerable time usually elapses before a connection is obtained on a toll line, instead of connecting directly from the trunk T to the toll line E, the trunk T preferably terminates at a recording operator's position, who makes

out the usual ticket as to the party wanted and the party calling, and then tells the automatic subscriber to hang up his receiver, at the same time withdrawing the plug P from said trunk T. Then when the long distance connection is obtained either by this same or another operator, usually the latter, the said plug P of the cord circuit is inserted in one of the jacks J³ of the trunk T² and the automatic mechanism at the A end of the trunk is suitably operated to complete connection with the automatic subscriber who had asked for the long distance party. Order wire circuits may be employed between the recording and connecting operators, but are not shown for the sake of clearness.

In making the connection with the toll line E, the plug P² of the cord circuit is utilized for testing the idle or busy condition of the telephone line by touching the tip of the plug P² to one of the test rings of the jacks of the line wanted; when the lines are idle the test rings are at the same potential as the tip of the plug P² since both are joined to the live pole of the battery B² and when the line is busy the said test rings are connected to ground through the relay r⁷ associated with the inserted plug, and therefore the application of the tip of the plug P² to one of the test rings provides a path for current from the battery B² through the test relay r⁸, the tip of the testing plug, the test ring of the jack, and thence through the wire 14 and relay r⁷ of the connected cord circuit to ground. This operates the test relay r⁸ and causes a click in the operator's receiver in the usual manner.

Upon finding the line idle, the plug P² is inserted in one of the jacks J and the ringing key 29 operated. The insertion of the plug closes a path for current through the cut-off relay r¹³ of the toll line and thence through strand 14 and the relay r⁷ of the cord circuit, thereby operating both relays, the former serving to disconnect the signal S of the toll line and the relay r⁷ serving to disconnect the test relay r⁸ of the cord circuit and to complete the strand t² thereof for conversation. The operation of the ringing key 29 permits the current to flow over the metallic line E and the desired party upon said line is thus called.

Assuming the party upon the line E to have answered, or assuming some party upon the said line to have called in by throwing the signal S and to have asked for a connection with an automatic subscriber, the plug P of the cord circuit is utilized to test the busy or idle condition of the trunk T² by touching its tip to one of the test rings thereof in the usual manner and if found idle, the said plug is inserted. This test is carried out in the manner above de-

scribed for the opposite end of the cord. The insertion of the plug puts ground upon the test rings through the relay r⁶, thus placing the trunk in condition to test busy, and results in the operation of the relay r⁶ to close the strand t of the cord circuit for conversation. Simultaneously the relay r¹⁰ is operated as before explained, which cuts off by means of springs 44 and 45 the clearing out mechanism associated with this end of the trunk. The operator's key or switch 34 is then operated to connect the automatic dial or connector 31 with the cord circuit then in use, and the said dial is suitably manipulated to cause the desired operation of the automatic switching mechanism indicated by r, r², at the opposite end of the trunk T² to cause the said trunk to be connected with the automatic subscriber whose line it is desired to connect with the long distance line at the office C. Having thus connected the trunk with the desired line, the ringing button 33 is depressed to cause the ringing generator at the A office to call the wanted automatic subscriber. When the called party responds, he is usually told to move his dial, so that on hanging up the clearing out mechanism and relay r⁴ will be operated.

The parties are now in conversation. In the arrangement of circuits and apparatus shown in the drawing, the lines are adapted for local battery transmission; that is, local batteries are employed at the subscriber's station to charge the transmitters, but it will be apparent that other methods of supplying such current may be employed without departing from the spirit or scope of the invention. Thus the voice currents coming in over the automatic telephone line are transmitted over the trunk line to the manual switchboard and are thence repeated through the medium of repeating coil W of cord circuit D into the toll line E, and vice versa, the condensers 8 and 12 serving to pass the voice currents by the relay r⁴ and drop r⁵.

At the termination of the conversation the toll subscriber sends in a clearing out signal usually by means of a magneto outfit at his end of the line which causes the clearing out drop r⁵ associated with the cord circuit D to be operated, thus indicating to the operator that the toll subscriber has finished talking. When the automatic subscriber hangs up his receiver as before explained a momentary ground is put upon both sides of the line at the subscriber's station, thereby causing current from the battery B² to flow through the windings of the relay r⁴, thence over the trunk line and the two sides of the subscriber's line to ground at the substation. This serves to temporarily actuate the relay r⁴ in the cord circuit D which permits current from the battery

B² to operate the supervisory relay *r*^o over wires 18 and 17 which attracts its armature and closes a local circuit through the supervisory clearing out signal S³ as well as through the locking winding 19 of said relay *r*^o. This supervisory signal is therefore operated which indicates to the operator that the automatic subscriber has hung up his telephone. The clearing out of the automatic mechanism is also accomplished by the subscriber's ground, which restores the same to normal condition, and the cord circuit is taken down thus bringing all parts to normal position. In case the subscriber had not moved his dial before hanging up his receiver, the arrangement is such in the Strowger system that no ground connection is made and therefore the supervisory signal S³ and the automatic clearing out mechanism would not be operated when the subscriber hangs up. In this case the auxiliary clearing out mechanism connected with the manual end of the trunks T² comes into play since the operator upon seeing the operation of the clearing out signal *r*^o, or upon listening in and finding the conversation terminated withdraws the plug P thereby causing the momentary ground connection of the trunk T² which clears out the automatic mechanism at the other end and prevents the said trunk and subscriber from being tied up.

The operation of the operator's listening key 24 in the cord circuit D serves to open the locking circuit of the relay *r*^o to thereby extinguish the signal S³.

The battery B and B² may be the same if the automatic and manual boards are in one office or closely associated.

In the claims of this specification, by the terms, "slow acting relay" is meant any relay electrically, magnetically or mechanically retarded in its action, and by the terms "quick acting relay" is meant any ordinary relay free from such retarding influence.

While I have thus described one method of carrying my invention into effect, I would have it understood that various arrangements and modifications may be made without departing from the scope and principle thereof. It will be understood that the trunks T² or the modification shown in Fig. 3 may have calling signals applied thereto in the board C, as shown in Fig. 2 which combines the signaling apparatus of trunk T and the other line apparatus of trunk T² in which like numerals are used to indicate parts similar to those shown in Fig. 1. It is to be further understood that the combination of slow and quick acting relays herein disclosed may be used for the release of automatic switches in purely automatic exchanges, and that the applicant does not wish to be limited to the specific applica-

tion of this generic feature of the invention.

The modification shown in Fig. 2 is a two-way trunk used for completing connections originated by either a subscriber of the automatic or the manual exchange, and serving the purpose of both trunks T and T² in completing the connection. It will be seen that when a subscriber of the automatic exchange operates his dial for connection with the trunk shown in Fig. 2 and then depresses his ringing button, current from the generator at station A will flow over the two sides of the trunk line through the contacts 44 and 45 of relay *r*¹⁰ and the winding 3 of relay *r*³, operating the last mentioned relay and permitting current from the battery B² to flow through the lamp s², the contacts of relay *r*³ and the contacts 43 of relay *r*¹⁰ to ground, thus notifying the operator of the call. A locking circuit is also closed for the relay *r*³ from battery B² over conductor 42 and the winding 4 of said relay. The operator will then insert the plug P of the cord circuit in the jack J³ of the trunk which will place her in communication with the calling subscriber at the automatic exchange. The connection with the called subscriber is completed as heretofore described. When the plug P is inserted in the trunk jack the relay *r*¹⁰ is energized from battery B² as described in connection with trunk T², over conductors 42 and 40, the winding of said relay, conductors 30 and 13, through the winding of relay *r*³ to ground. The locking circuit of relay *r*³ is opened at the contacts 43 of relay *r*¹⁰ when said relay *r*¹⁰ is actuated by the insertion of the plug, thus retiring the signal S². The operation of the trunk T³ is the same as the trunk T² with the addition of the signal S² and its actuating relay *r*³ just described. In a call originating with a subscriber of the manual exchange, the trunk shown in Fig. 2 would operate the same as trunk T², the signal S² and its actuating relay *r*³ would not be brought into operation, as the circuit of said signal and its relay would be opened at the contacts 43 of the relay *r*¹⁰ when the operator inserted her plug P in the trunk jack to call the subscriber of the automatic exchange.

As previously stated the generic feature of the invention by which the automatic switches or apparatus are cleared out or returned to normal condition by means of the cooperation of quick and slow acting relays, is not confined to the particular circuit arrangement or method of use shown and described herein, but may be adapted to control said automatic apparatus under many different circuit arrangements and conditions.

In the claims where I have referred to the function of the quick and slow acting

relays r^{10} and r^{11} in controlling the circuit by means of which a ground is placed upon the line for releasing the automatic apparatus, that is, restoring the automatic switches to normal condition, when I speak of one of said relays being adapted to close said release circuit and the other relay being adapted to open said circuit, or speak of the "operation" of said relays to control said release circuit, I wish to be understood as referring to the operation of said relays when they are de-energized, at which time the release circuit is made by the quick acting relay r^{10} , and opened a short time thereafter by the sluggish de-energization of relay r^{11} .

Having thus described my invention, what I claim and desire to secure by Letters Patent is:—

1. The combination with an automatic telephone exchange, of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk circuits connecting the automatic exchange with the manual exchange, means wherewith the automatic exchange subscribers can automatically connect with said trunks at the automatic exchange, a relay bridged between the two limbs of each of said trunk lines at the manual exchange capable of being actuated from any of the subscriber's stations of the automatic exchange, and a signal associated with said relay to notify the operator when said relay has been actuated, substantially as described.

2. The combination with an automatic telephone exchange of the metallic talking circuit type provided with mechanism at the central office to enable the subscribers of said exchange to automatically connect with each others' lines for conversation, of a manual telephone exchange, an operator's cord circuit at the central office thereof, trunk circuits extending between the automatic exchange and the manual exchange, springjacks in the manual exchange as terminals for said trunks, automatic switching mechanism associated with said trunks at the automatic exchange, an automatic switch operating or controlling device, an operator's key arranged to connect said device with said cord circuit whereby said cord circuit and its said device may be used in connection with any of the trunks for the purpose of connecting the latter with any of the subscribers of the automatic exchange, and means for temporarily placing a ground connection on each limb of the trunk line when the operator disconnects her cord circuit therefrom at the manual board, substantially as described.

3. The combination with an automatic

telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk circuits connecting the automatic exchange with the manual exchange, automatic switching mechanism associated with said trunks at the automatic exchange and an operator's cord circuit at the manual exchange, means for connecting said cord circuit with said trunks, an automatic switch operating device associated with said cord circuit, an operator's key adapted to place said switch operating device in electrical connection with said cord circuit, wherewith said automatic switching mechanism may be actuated to connect said trunk lines with any of the plurality of automatic subscribers' lines, and means associated with and individual to the trunk line at the manual exchange for sending an impulse over the trunk to restore said automatic switching mechanism to its normal condition when the connection between the trunk and said connective means is severed by the operator, substantially as described.

4. The combination with an automatic telephone exchange of the metallic talking circuit type provided with mechanism at the central office to enable the subscribers of said exchange to automatically connect with each other for conversation, of a manual telephone exchange with operators' cord circuits at the central office thereof to establish connections with the subscribers' lines of said exchange for conversation, trunk circuits extending between the automatic exchange and the manual exchange, springjacks in the manual exchange as terminals for said trunks, automatic mechanism associated with said trunks at the automatic exchange, an automatic mechanism controlling device at the manual switch board common to the cord circuits of an operator's position, whereby when any of the said cord circuits are connected with any of said trunks the operator is enabled to actuate the automatic switching mechanism of the said trunk to connect it with any of the automatic telephone lines, and means for temporarily placing a ground connection on each limb of the trunk line when the operator disconnects the cord circuit therefrom at the manual board, substantially as described.

5. The combination with an automatic telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish

lish connections between the lines for conversation, trunk lines extending between the automatic exchange and the manual exchange, operators' cord circuits in the manual exchange, means for connecting said cord circuits with said trunk lines, a double winding relay associated with one end of the operators' cord circuits adapted to be actuated when the automatic subscriber severs a connection established by him, and a signal associated with the contacts of said relay to notify the operator when said automatic exchange subscriber has severed the connection, substantially as described.

6. The combination with an automatic telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk lines extending between the automatic exchange and the manual exchange, automatic switching or connecting mechanism in the automatic exchange associated with said trunk lines, a springjack in the manual exchange associated with said trunk lines, operators' cord circuits in the manual exchange having connecting plugs associated therewith, relays associated with the manual exchange end of said trunk lines so arranged as to place a ground simultaneously on each limb of said trunk line for the purpose of restoring said automatic mechanism to its normal condition, when the manual operator removes the plug from said spring jacket, substantially as described.

7. The combination with an automatic telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk lines extending between the automatic exchange and the manual exchange, automatic switching or connecting mechanism in the automatic exchange associated with said trunk lines, springjacks in the manual exchange associated with said trunk lines, operators' cord circuits in the manual exchange having connecting plugs associated therewith, relays associated with the manual exchange end of said trunk lines so arranged as to place a ground simultaneously on each limb of said trunk lines for the purpose of restoring said automatic connecting mechanism to its normal condition when the operator removes a connection, one of said relays being provided with means for causing its action to be sluggish and allowing said ground connection to be maintained

until said automatic connecting mechanism has been restored to normal position, substantially as described.

8. The combination with an automatic telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk lines extending between the automatic exchange and the manual exchange, automatic switching or connecting mechanism in the automatic exchange associated with said trunk lines, spring jacks in the manual exchange associated with said trunk lines, operators' cord circuits in the manual exchange having connecting plugs associated therewith, means associated with the trunk lines whereby a ground is momentarily placed upon each limb of the trunk line to restore said automatic switching mechanism to its normal condition when said plug is removed from one of said jacks, substantially as described.

9. The combination with an automatic telephone exchange of the metallic talking circuit type in which the subscribers' lines are adapted to be automatically connected with each other for conversation, of a manual exchange with operator's connective means at the central office adapted to establish connections between the lines for conversation, trunk lines extending between the automatic exchange and the manual exchange and terminating in springjacks at the manual exchange, operators' cord circuits at the manual exchange, means associated with said cord circuits for testing the busy or idle condition of said trunk lines, and a relay for disconnecting the operator's testing apparatus from said cord circuits when said plug is inserted in said springjack, substantially as described.

10. The combination with an automatic telephone exchange having mechanism at the central office to enable the subscribers of said exchange to automatically connect with each other for conversation, of a manual telephone exchange with operators' cord circuits at the central office thereof to establish connections with the subscribers' lines of said exchange for conversation, outgoing trunks and incoming trunks extending between said automatic exchange and said manual exchange, signals associated with said incoming trunks at the manual exchange whereby the automatic subscribers are enabled to call the manual exchange and automatic switch mechanism connected with said outgoing trunks, whereby the operators at the manual exchange are able to connect said trunks with any of the automatic subscribers, means associated with the opera-

tor's cord circuit for receiving the disconnect signal over the incoming trunk from the automatic exchange and means associated with the outgoing trunks for disconnecting said trunks from the automatic subscriber's line and restoring said switching mechanism to its normal condition, substantially as described.

11. The combination with an automatic telephone exchange having switching mechanism at the central office thereof to enable the subscribers to automatically connect with each others' lines for conversation, of a manual switchboard provided with operators' cord circuits to establish connections with the various subscribers' lines thereof for conversation, trunk circuits extending between the automatic exchange and the manual switchboard, and provided with automatic switching mechanism at the first exchange and with connection terminals for said cord circuits at the latter exchange, the automatic switching mechanism at the first exchange requiring a ground connection with the calling line in order to effect a clearing out or a return to normal condition of said mechanism, and means depending upon the removal of the operator's plugs at the manual switchboard for establishing such momentary ground connection to clear out or restore said mechanism at the automatic exchange, substantially as described.

12. The combination with an automatic telephone exchange provided with switching mechanism at the central office thereof to establish connections between the subscribers' lines for conversation, of a manual telephone exchange with operators' connective means at its central office to establish connections with subscribers' lines of said exchange for conversation, trunk circuits extending between the two exchanges, automatic switching mechanism in the automatic exchange associated with said trunk, a signal at the manual exchange associated with said trunk, a relay normally bridged across said trunk line and controlling said signal, and means whereby the said relay is disconnected from the trunk when the connective means at the manual exchange is connected therewith, and further means whereby a current will momentarily pass through the coils of said relay and out upon the trunk line to restore said automatic switching mechanism to its normal condition when said connective means is disconnected from the trunk, substantially as described.

13. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a relay normally bridged between the limbs of the trunk line at the manual exchange and adapted to be actuated by current in the

trunk from the automatic exchange, a signal displayed by the actuation of said relay, a locking circuit for said relay, and means to sever said locking circuit when a connection is established with the trunk at the manual exchange end, substantially as described.

14. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a relay normally bridged between the limbs of the trunk line at the manual exchange and adapted to be actuated by current in the trunk from the automatic exchange, a signal displayed by the actuation of said relay, a locking circuit for said relay and means to disconnect said relay from the trunk when a connection is established with the trunk at the manual exchange end, substantially as described.

15. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a relay normally bridged between the limbs of the trunk line at the manual exchange and adapted to be actuated by current in the trunk from the automatic exchange, a signal displayed by the actuation of said relay, a locking circuit for said relay, and means to disconnect said relay from the trunk line and to sever the locking circuit of said relay when a connection is established with the trunk at the manual exchange end, substantially as described.

16. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a relay normally bridged between the limbs of the trunk line at the manual exchange and adapted to be actuated by current in the trunk from the automatic exchange, a signal displayed by the actuation of said relay, a locking circuit for said relay, and a relay with its coil associated with the terminal of the trunk adapted to be actuated to sever said locking circuit when a connection is established with the trunk at the manual exchange end, substantially as described.

17. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a line relay normally bridged between the limbs of the trunk line at the manual exchange and adapted to be actuated by current in the trunk from the automatic exchange, a signal displayed by the actuation of said line relay, a locking circuit for said

line relay, and a cut-off relay having its coil connected with the terminal of said trunk and adapted to be actuated to disconnect said line relay from the trunk and to sever the locking circuit thereof when a connection is established with the trunk at the manual exchange end, substantially as described.

18. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a slow acting relay associated with the trunk circuit at the manual exchange end and adapted by its retarded action to maintain a circuit connection for a short duration of time after a connection has been severed from the trunk at said end, substantially as described.

19. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a slow acting relay associated with the trunk circuit at the manual exchange end and adapted by its retarded action to maintain a ground connection on said trunk line for a short duration of time after a connection has been severed from the trunk at said end, substantially as described.

20. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a slow acting relay associated with the trunk circuit at the manual exchange end and adapted by its retarded action to maintain a ground connection on each limb of said trunk line for a short duration of time after a connection has been severed from the trunk at said end, substantially as described.

21. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, and means to maintain a ground connection on both limbs of the trunk line for a short duration of time after the connection has been severed from said trunk at the manual exchange end, substantially as described.

22. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, and means to automatically maintain a branch connection with the trunk line for a short duration of time after the connection has been severed between the cord and trunk

at the manual exchange end, substantially as described.

23. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, and means to make and maintain a connection with said trunk line for a short duration of time after the connection is severed at the manual exchange end, substantially as described.

24. In telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, and means to automatically make and maintain a branch connection with said trunk line for a short duration of time after the conversational connection has been severed at the manual exchange end, substantially as described.

25. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, and means to automatically make and maintain a ground connection upon each of the limbs of said trunk line by the severing of the cord connection therewith at the manual exchange end, substantially as described.

26. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay for said trunk adapted to be actuated when a connection is established at the manual exchange end, and a slow acting relay adapted to be energized by the actuation of said cut-off relay, contacts of said cut-off relay adapted to close a ground connection to both limbs of the trunk line immediately upon severing the connection with the trunk at the manual exchange end, and contacts of said slow acting relay adapted to sever said ground connection after a short duration of time, substantially as described.

27. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay adapted to be actuated when a connection is established with the trunk at the manual exchange end, a signaling relay having a coil normally connected between the limbs of the trunk line by contacts of said cut-off relay, a normally open ground connection to the coil of said signaling relay including the coil of a third re-

lay, a slow acting relay adapted to be actuated when a connection is established with the trunk at the manual exchange end to close said normally open ground connection, and to close a locking circuit for itself through normally closed contacts of said third relay, said third relay being adapted to be actuated to sever said locking circuit when the connection has been severed from the trunk of the manual exchange end, and after a current in the line and through the release mechanism has sufficiently grown to energize the coil of said third relay, substantially as described.

28. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay adapted to be actuated when a connection is established with the trunk at the manual exchange end, a relay having one terminal of its coil normally connected to both limbs of the trunk line through the contacts of said cut-off relay, and having the other terminal of its coil normally free, a slow acting relay energized by the actuation of said cut-off relay and adapted when energized to connect said free contact to ground, and a locking circuit for said slow acting relay adapted to be broken by current in the described path to ground over the trunk line and through the disconnecting apparatus at the automatic exchange when the connection is severed with the trunk at the manual exchange end, substantially as described.

29. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a relay adapted to have its coil placed between the two limbs of the trunk line and ground and having contacts controlling said ground connection, whereby said ground is maintained until the current through the coil of said relay has reached a predetermined value sufficient to actuate the disconnect mechanism of the automatic exchange, and to actuate its own contacts and disconnect said ground connection, substantially as described.

30. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay adapted to be actuated when a connection is established with the trunk at the manual exchange end, a slow acting relay also adapted to be actuated when a connection is established with the trunk at the manual exchange end and adapted to close a ground connection to the contacts of said

cut-off relay adapted to be connected with the trunk when the connection is severed with the line, said slow acting relay being adapted to maintain said ground connection for a short period of time after the connection has been severed with the line, substantially as described.

31. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay adapted to be actuated when a connection is established with the trunk at the manual exchange end, a slow acting relay adapted to be energized by the actuation of said cut-off relay to close a ground connection to the contacts of said cut-off relay adapted to be connected with the limbs of the trunk line by the de-energization of the cut-off relay when the connection is severed from the trunk at the manual exchange end, said slow acting relay being adapted to maintain said ground connection for a short duration of time after the connection has been established by the de-energization of said cut-off relay, substantially as described.

32. In a telephone system, the combination with automatic and manual subscribers' lines terminating in their respective central offices, of a trunk circuit adapted to connect the lines of the two systems for conversation, a cut-off relay adapted to be actuated when a connection is established with the trunk at the manual exchange end, and a slow acting relay adapted to be energized by the actuation of said cut-off relay, a branch conductor from each limb of said trunk to ground including normally closed contacts of said cut-off relay and normally open contacts of said slow acting relay, whereby the ground connection is broken at the cut-off relay before being closed by the slow acting relay when a connection is established with the trunk at the manual exchange end and closed by the contacts of the cut-off relay before being broken by the contacts of the slow acting relay when the connection is severed at said end, substantially as described.

33. In an automatic trunking system, automatic and manual exchanges connected for conversation, automatic switches at the automatic exchange, and a slow-acting relay at the manual exchange adapted to effect the release of the automatic switches, substantially as described.

34. In a telephone system, automatic and manual exchanges connected for conversation, automatic switches at the automatic exchange and a slow-acting relay at the manual exchange adapted by its retarded operation to remove a releasing connection from the manual end of the exchange, whereby the automatic switches are freed of operating current, substantially as described.

35. In a telephone system, automatic and manual exchanges connected for conversation, automatic switches at the automatic exchange and a slow-acting relay at the manual exchange adapted by its retarded operation to make and remove a releasing connection, substantially as described.

36. In an automatic telephone system, the combination of automatic switches for completing the connection, a releasing circuit for said switches, a pair of co-operating relays associated with said circuit, the contacts of one of said relays controlling the circuit through the coil of the other of said relays, said releasing circuit being closed by the de-energization of the first relay and again opened by the de-energization of the second relay, substantially as described.

37. In an automatic telephone system, the combination with automatic connecting switches, of a pair of relays, the contacts of one of said relays controlling the circuit through the coil of the other of said relays, and a release circuit for said automatic connecting switches controlled by the contacts of both of said relays, one relay being adapted to close said releasing circuit, and the other relay being adapted to open said circuit, substantially as described.

38. In an automatic telephone system, the combination with automatic switches, of quick and slow acting relays having contacts co-operating to momentarily close a circuit for the release of said automatic switches, and means to control the circuits through the coils of said relays, whereby one of said relays will operate slightly in advance of the other, substantially as described.

39. In an automatic telephone system, the combination with automatic switches, of a pair of relays having contacts co-operating to control the release circuit for said automatic switches, one of said relays being adapted to operate to close said releasing circuit, and the other being adapted to operate immediately thereafter to open said releasing circuit whereby a single impulse of current will be sent over the releasing circuit, substantially as described.

40. In a telephone system, the combination with automatic switches, of a release circuit for said switches, a pair of relays having contacts adapted to be serially included in said release circuit, the contacts of one of said relays being adapted to close the release circuit, and the contacts of the other of said relays being adapted to open the release circuit, and means whereby one of said relays will operate slightly in advance of the other, whereby the release circuit will be only momentarily closed, substantially as described.

41. In a telephone system, the combination of a switch, electromagnetic means for

controlling the restoration of said switch to its position of rest, a delay relay, and an energizing circuit for said electromagnetic means including a source of electric energy and contacts of said delay relay.

42. In a telephone system, the combination of a switch; electromagnetic means for governing the movement of said switch; a control relay; a delay relay; a control circuit for said electromagnetic means including a source of electric energy and contacts of said delay relay; and a circuit for said delay relay including a winding of said delay relay, a source of electric energy and contacts of said control relay.

43. In a telephone system, an automatic switch, a calling device, a manual switch operated to connect said calling device with said automatic switch, a source of current, a quick relay energized from said source through contacts of said manual switch upon its operation, a slow relay, a local energizing circuit therefor closed responsive to energization of the quick relay, a circuit for controlling the release of said automatic switch, said manual switch being adapted to interrupt the circuit through said quick relay whereby said release circuit for said switch is momentarily closed through contacts of said quick and slow relays.

44. A telephone system comprising an automatic switch, a quick acting relay, means for energizing said relay upon connection made with said switch, a slow acting relay and a circuit therefor controlled by said quick relay, and a release circuit for said switch jointly controlled by said relays.

45. A telephone system comprising an automatic switch, a trunk line leading thereto, a spring jack for the other end of said trunk line, and a normally closed connection across said trunk line between the jack and the automatic switch.

46. A telephone system comprising a trunk line, a jack therefor, an automatic trunking switch at which the trunk line terminates, a normally closed connection across the trunk line between the jack and the automatic switch, a relay controlling said connection, and means for energizing said relay by extending connection to said jack.

47. In an automatic and manual telephone exchange system having automatic switches, automatic releasing means comprising a quick-acting relay and a slow-acting relay for releasing automatic switches, as set forth.

48. In a telephone system, an automatic switchboard, lines terminating in said switchboard, switches and mechanism at said switchboard for connecting each line with every other line in the exchange, and automatic releasing means comprising quick-acting and slow-acting relays associated with one of said lines and operative to vary

the electrical condition of said line to release said switches.

49. A telephone system comprising an automatic switch operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a trunk line leading to said switch, a spring jack for the other end of said trunk line, and a normally closed connection across said trunk line between the jack and the automatic switch.

50. A telephone system comprising a trunk line, a jack therefor, an automatic trunking switch at which the trunk line terminates, operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a normally closed connection across the trunk line between the jack and the automatic switch, a relay controlling said connection, and means for energizing said relay by extending connection to said jack.

51. In an automatic and manual telephone exchange system having automatic switches, automatic releasing means comprising a quick-acting relay and a slow-acting relay for releasing automatic switches, said switches operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, as set forth.

52. In an automatic and manual telephone exchange system having automatic switches, automatic releasing means including quick and slow acting relays for releasing automatic switches, in combination with a trunking operator's cord equipment, said switches operative by vertical motion from one level to another to select groups, and by rotary motion in any selected level to connect with a line therein, as set forth.

53. In an automatic and manual telephone exchange system having automatic switches, automatic releasing means including quick and slow acting relays for releasing automatic switches, in combination with an operator's cord connecting apparatus, as set forth, said switches operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein.

54. In an automatic and manual telephone exchange system, a series of automatic switches including a plurality of selectors and a connector, operative by vertical motion from one level to another to select groups, and by rotary motion in any selected level to connect with a line therein, and an automatic releasing device therefor, comprising quick and slow acting relays, as set forth.

55. In a telephone system, an automatic switch, a trunk leading to said switch and

terminating in a jack, a pair of relays connected with a contact of said jack and to battery, means for grounding said contact to thereby energize said relays, means for controlling said switch over said trunk, and means controlled by said relays for controlling the release of said switch.

56. In a telephone system, an automatic switch, a trunk leading to said switch and terminating in a jack, a pair of relays connected with a contact of said jack and to battery, means for grounding said contact when connection is made with said trunk through said jack to thereby energize said relays, means for operating said switch over said trunk, and a bridge across said trunk controlled by said relays for controlling the release of said switch.

57. In a telephone system, an automatic switch, a trunk leading to said switch, said trunk terminating in a jack, a relay connected to the sleeve contact of said jack and to battery, means for grounding said sleeve contact when connection is made with said jack to thereby energize said relay, means for operating said switch over said trunk, and a release circuit for said switch controlled by said relay.

58. A telephone system comprising an automatic progressively movable switch, a trunk line leading thereto, a spring jack for the other end of said trunk line, and a normally closed connection across said trunk line between the jack and the automatic switch.

59. A telephone system comprising a trunk line, a jack therefor, an automatic trunking switch at which the trunk line terminates, a normally closed connection across the trunk line between the jack and the automatic switch, a relay controlling said connection, and a circuit for energizing said relay by extending connection to said jack.

60. A telephone system comprising a trunk line, a jack therefor, an automatic trunking switch at which the trunk line terminates, operative by vertical motion from one level to another to select groups and by rotary motion in any selected level to connect with a line therein, a normally closed connection across the trunk line between the jack and the automatic switch, a relay controlling said connection and a battery and circuits for energizing said relay when connection is extended to said jack.

61. A telephone system comprising an automatic switch, a quick relay, manually controlled means for opening and closing a circuit for said relay to operate the same, a slow relay controlled by said quick relay, and a switch operating circuit controlled by contacts of said quick and slow relays.

62. A telephone system comprising an automatic switch, a quick relay, manually controlled means for opening and closing a circuit for said relay to operate the same, a
5 slow relay controlled by said quick relay, and a release circuit for said automatic switch controlled by contacts of said quick and slow relays.
63. A telephone system comprising an
10 automatic switch, a quick relay, manually controlled means for opening and closing a circuit for said relay to operate the same, a slow relay controlled by said quick relay, an electromagnet, and a switch operating
15 circuit including a winding of said electromagnet and contacts of said quick and slow relays.
64. A telephone system comprising an automatic switch, a quick relay, manually
20 controlled means for opening and closing a circuit for said relay to operate the same, a slow relay controlled by said quick relay, an electromagnet, and a switch operating circuit including a winding of said electro-
25 magnet and contacts of said slow relay.
65. A telephone system comprising an automatic switch, a quick relay, manually controlled means for opening and closing a
30 circuit for said relay to operate the same, a slow relay controlled by quick relay, an electromagnet, and a release circuit for said automatic switch including a winding of said electromagnet and contacts of said
35 quick and slow relays.
66. A telephone system comprising an automatic switch, a quick relay, manually controlled means for opening and closing
40 a circuit for said relay to operate the same, a slow relay controlled by said quick relay, an electromagnet, and a release circuit for said automatic switch including a winding of said electromagnet and contacts of said
45 slow relay.
67. A telephone system comprising an automatic switch, a quick relay, manually controlled means for opening and closing
50 a circuit for said relay to operate the same, a slow relay controlled by said quick relay, and a release circuit for said automatic switch controlled by said slow relay.
68. A telephone system comprising an automatic switch, a pair of relays in said
55 switch, a release circuit for said switch controlled by said relays, a quick relay, means for making and breaking an energizing circuit for said quick relay, a slow
60 relay operative in response to the closing of said energizing circuit, and means dependent upon said slow relay to close circuits through said pair of relays to operate said
65 release circuit to release said automatic switch.
69. A telephone system comprising an automatic switch, a plurality of electro-
70 magnets for controlling movements of said switch, circuits for said magnets, quick and
75 slow relays operating conjointly to vary said circuits, and manual means for opening and closing a circuit to control the operation of said quick and slow relays.
70. A telephone system comprising an automatic switch, an electromagnet for use
80 in operating said switch, a circuit for said electromagnet controllable at two points, a quick relay for controlling said circuit at one of said points, a slow relay for control-
85 ling said circuit at the other of said points, and manually controlled means for varying electrical connections to operate said relays.
71. A telephone system comprising an automatic switch, an electromagnet for use
90 in operating said switch, a quick relay, a slow relay, a circuit for said electromagnet passing through normally closed contacts of one relay and normally open contacts of the
95 other relay, and manually controlled means for varying electrical connections to operate said relays.
72. In a telephone exchange system having automatic switching mechanism, control-
100 ling means for said mechanism comprising a quick-acting relay and a slow-acting relay for causing certain operations of said mechanism, and manually operable means operable at will to bring about the operation of said
105 controlling means.
73. In a telephone system, the combina-
110 tion with an automatic switch, of a pair of relays having contacts co-operating to control the release circuit for said switch, one of said relays being adapted to operate to
115 close said release circuit, and the other being adapted to operate immediately thereafter to open said release circuit whereby a single impulse of current will be sent over the re-
120 lease circuit to release said switch.
74. In a telephone system, the combina-
125 tion with an automatic switch, of a release circuit for said switch, a pair of relays having contacts adapted to be serially included in said release circuit, the contacts of one of
130 said relays being adapted to close the release circuit, and the contacts of the other of said relays being adapted to open the release circuit, and means whereby one of said relays
135 will operate slightly in advance of the other, whereby the release circuit will be only momentarily closed.
75. In a telephone system, an automatic
140 switch, a calling device, a manual switch operated to connect said calling device with said automatic switch, a source of current, a quick relay energized from said source
145 through contacts of said manual switch upon its operation, a slow relay energized from said source consequent upon the operation of said manual switch, and a circuit for con-
150 trolling the release of said automatic switch,

said manual switch being adapted to interrupt the circuit through said quick relay whereby said circuit for controlling the release is momentarily closed through contacts
5 of said quick and slow relays.

76. A telephone system comprising an automatic switch, a quick acting relay, a slow acting relay, means for energizing both of said relays upon connection made with
10 said switch, and a release circuit for said switch jointly controlled by said relays.

77. In a telephone system, automatic switching mechanism, two conductors extending to said mechanism, a manual terminal for said conductors, a plug for establishing connection with said terminal, operator's means associated with said plug for directing the advance of said mechanism, and means including quick and slow relays for
15 varying the electrical condition of both of said conductors in response to the withdrawal of said plug from said terminal to direct the release of said mechanism.

78. In a telephone system, automatic
25 switching mechanism, two conductors extending to said mechanism, a manual terminal

for said conductors, a plug for establishing connection with said terminal, operator's means associated with said plug for directing the advance of said mechanism, quick
30 and slow relays for simultaneously connecting said conductors to ground to release said mechanism, and connections for operating said relays in response to the placing of said plug in said terminal and the removal of the
35 plug therefrom.

79. In a telephone system, automatic switching mechanism, two conductors extending to said mechanism, means for varying the electrical condition of said conductors to direct the advance of said mechanism, and means including quick and slow relays and connections for varying the electrical condition of said conductors in a different way to direct the release of said mechanism.
40 45

Signed by me at Elyria, county of Lorain, State of Ohio, in the presence of two witnesses.

WILLIAM W. DEAN.

Witnesses:

F. S. STETSON,
ROBERT LEWIS AMES.