

Nov. 30, 1943.

H. P. BOSWAU

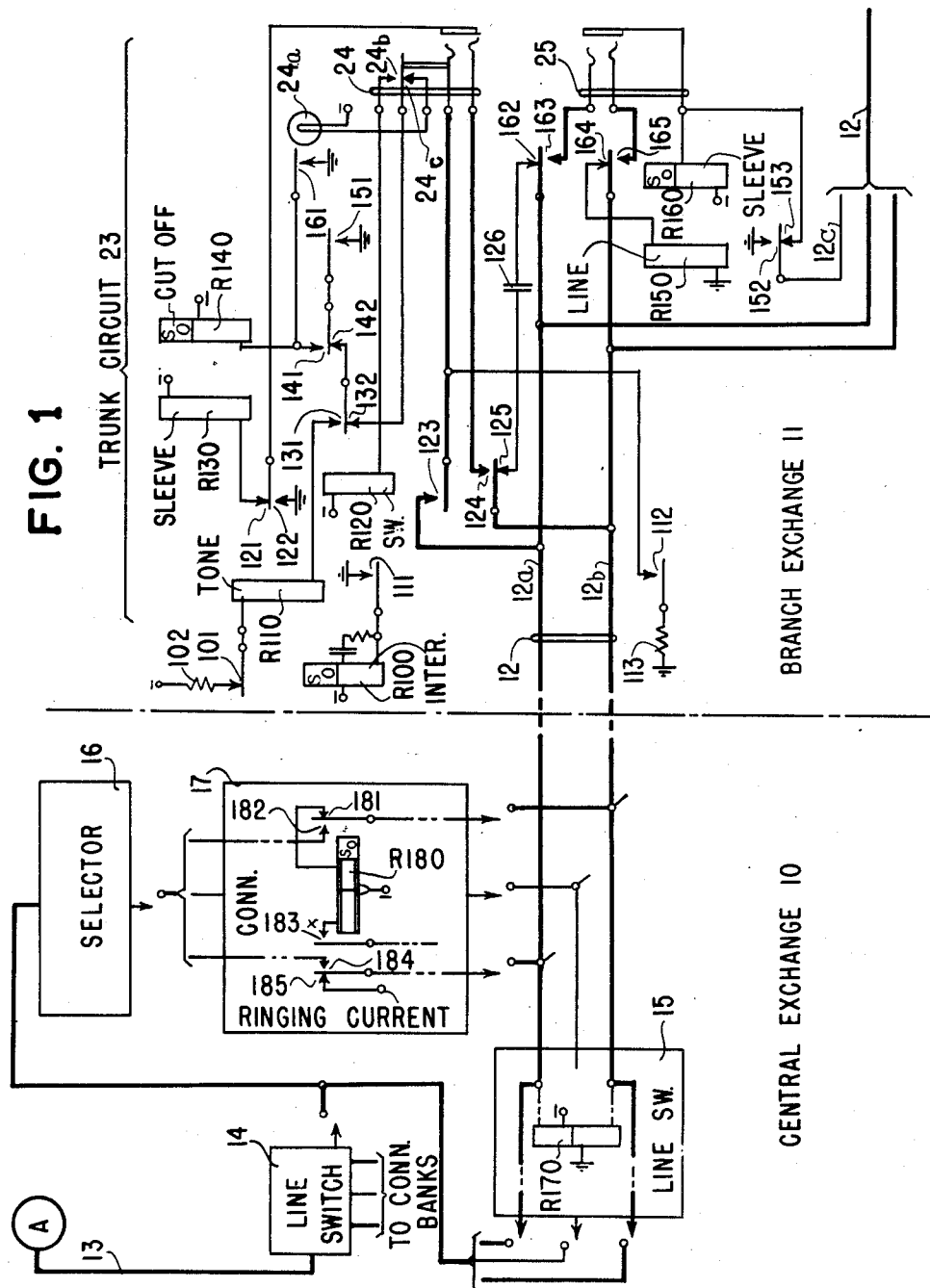
2,335,481

TELEPHONE SYSTEM

Filed March 16, 1942

2 Sheets-Sheet 1

FIG. 1



Nov. 30, 1943.

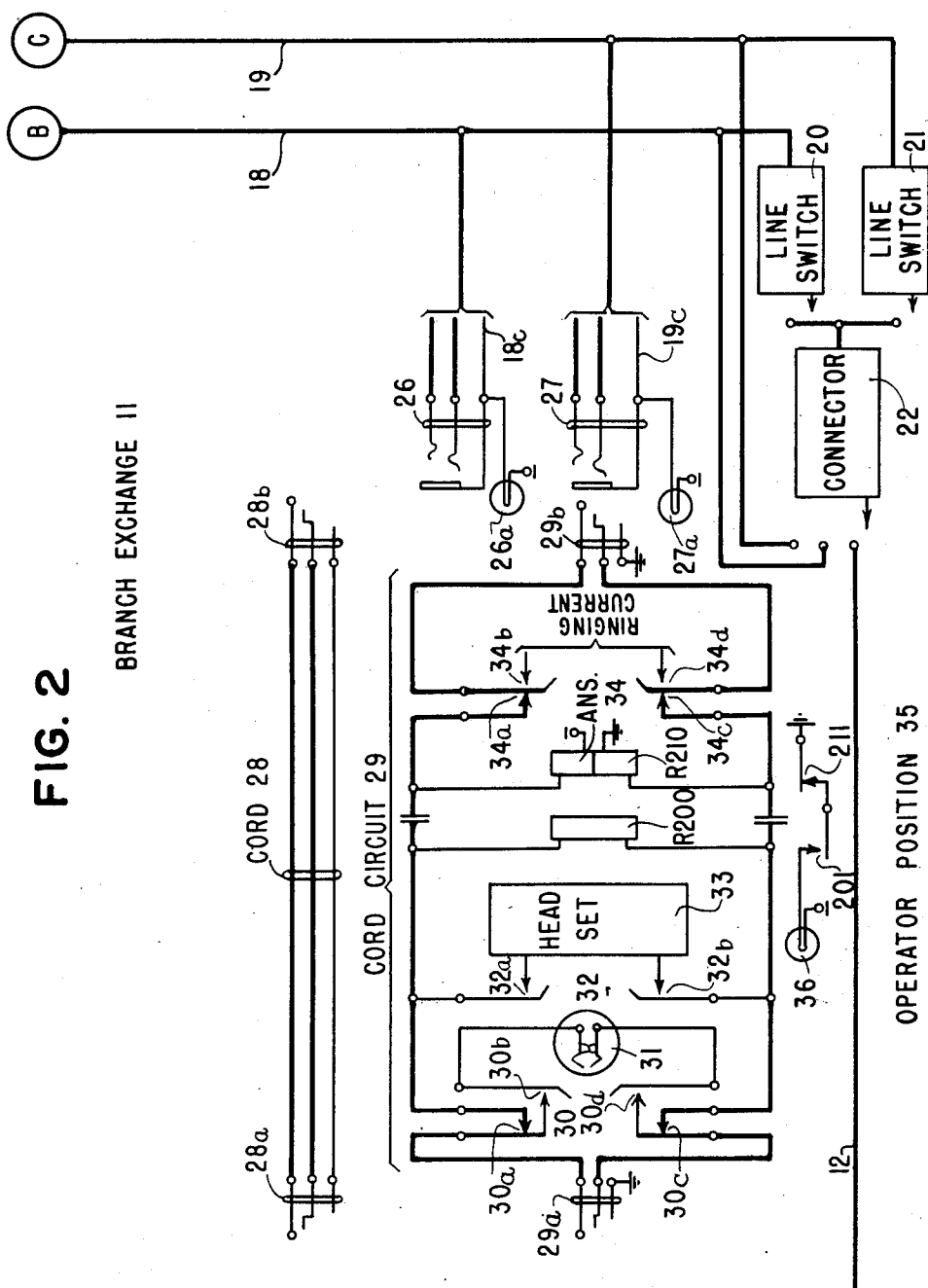
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2 Sheets-Sheet 2



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ATTORNEYS

UNITED STATES PATENT OFFICE

2,335,481

TELEPHONE SYSTEM

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20 Claims. (Cl. 179—27)

The present invention relates to telephone systems and, more particularly, to improvements in equipment for setting up night service connections at the attendant's switchboard of an automatic branch exchange.

In the usual automatic branch exchange the only calls that require the assistance of an operator in setting up the desired connections are incoming central exchange trunk calls. All other connections, including outgoing central exchange trunk calls, are handled by the automatic switching equipment of the branch exchange. In such installations, certain of the extension lines of the branch exchange may be used to receive incoming central exchange trunk calls during those periods when the attendant's switchboard of the branch exchange is unattended. The lines selected for such use are cord connected through the equipment at the attendant's switchboard to the jacks terminating the central exchange trunks. Incident to the setting up of night service connections of this type, the branch exchange extension lines used to handle incoming central exchange trunk calls are locked out of service insofar as the automatic switching facilities of the branch exchange are concerned. Normally this is not a serious difficulty. In certain installations, however, the extension lines of the branch exchange are not all confined to the branch exchange building. For example, branch exchanges serving the personnel of a public utilities organization may include lines extending to outlying power houses or substations. Moreover, the outlying power houses usually require twenty-four hour central exchange service and twenty-four hour service to certain of the substations served by the branch exchange. These service requirements cannot be provided with the night service arrangements available in the prior art without unnecessary duplication of the line and substitution facilities of the outlying stations.

It is an object of the present invention, therefore, to provide an improved arrangement of the character described, wherein the branch exchange substations which are assigned to receive incoming central exchange trunk calls are provided with both branch exchange and central exchange telephone service over a single line during those periods when the attendant's switchboard of the branch exchange is unattended.

It is another object of the invention to provide an improved arrangement of the character described, wherein the setting up of a night service connection to one of the extension lines of the branch exchange does not prevent the line from

receiving and originating branch exchange calls.

According to another object of the invention, provisions are made for automatically guarding the branch exchange line designated for night service against seizure by the automatic switching equipment of the branch exchange at a time when it is occupied with an incoming central exchange trunk call, for guarding the line against seizure over the central exchange trunk when it is occupied with a branch exchange call, and for guarding the central exchange trunk against seizure by the automatic switching equipment at a time when a call is present thereon.

It is a further object of the invention to provide an improved arrangement of the character described, wherein provisions are made for transmitting a special signal over the branch exchange line designated for night service in response to the origination of a call on the associated central exchange trunk at a time when the branch exchange line is occupied with another call.

It is still another object of the invention to provide for use in terminating a central exchange trunk in the branch exchange, an improved and exceedingly simple trunk circuit which is equipped to render the services just described without modification of the branch exchange switching equipment.

The invention, both as to its organization and method of operation, together with further objects and advantages thereof, will best be understood by reference to the specification taken in connection with the accompanying drawings in which Figs. 1 and 2, when laid end to end in the order named, illustrate a telephone system having incorporated therein the features of the invention briefly outlined above.

Referring now more particularly to the drawings, the system there illustrated comprises a central exchange 10 and a private automatic branch exchange 11, which are interconnected by a group of interoffice trunks including the trunk 12. The central exchange 10 may be of the semi-automatic type, in which case the switch directing operations required in setting up the different connections are effected with the assistance of an operator; or of the fully automatic type, wherein each subscriber substation is equipped with a dial-actuated calling device for effecting the required directive control of the automatic switches. In the illustrated embodiment of the system the central exchange 10 is shown as being of the fully automatic type. More specifically, the switching equipment provided in this exchange includes line switches

14 and 15 which individually terminate the subscriber line 13 and the trunk 12. These line switches each have access to a group of selectors, one of which is illustrated at 16. The selectors, in turn, have access to different groups of connectors through which connections may be set up to the line multiples of the various subscriber lines and trunks. The line switches 14, 15, etc., individual to the various lines terminating in the central exchange, may be of any desired commercial type, although preferably are of the well-known rotary type as disclosed; for example, in the book of Kempster B. Miller, "Telephone Theory and Practice, Automatic Switching and Auxiliary Equipment," first edition, at page 50. The selectors and connectors may also be of any desired commercial construction, although preferably are of the well-known Strowger type. More specifically, the selectors of the central exchange may be of the type disclosed at page 60 of the above cited book written by Miller, while the connectors may be of the type disclosed at page 99 of the book "Automatic telephony," written by Smith and Campbell and published in 1921. In order to facilitate the following explanation of the mode of operation of certain of the branch exchange circuits, the line relay R170 of the line switch 15 and the slow-acting ring cut-off relay R180 of the connector 17 have been shown in the drawings.

For control purposes described hereinafter, the conductors of each trunk extending from the central exchange 10 to the branch exchange 11 are arranged to be reversely connected to the terminals of central exchange battery through the relay windings of the line switches individual thereto and the relay windings of the various connectors. Thus, the conductors 12a and 12b are normally connected through the windings of the line relay R170 to the negative and positive terminals of the central exchange battery. When, however, this trunk is seized by the connector 17, for example, the conductors 12a and 12b are respectively connected to the negative and positive terminals of the central exchange battery, first through the windings of the ring cut-off relay R180 and then through the windings of the answer relay embodied in the connector 17.

The branch exchange 11 may be provided to serve the local communication requirements of a large organization such, for example, as the business and engineering offices of a public utilities company. In such case, the lines connected to the switching equipment of the exchange are not necessarily limited to a single office building but may include lines of substantial length which extend to outlying substations. For example, if the substation B is provided in the office building housing the branch exchange switching equipment, the line 18 extending to this substation will necessarily be a short line. On the other hand, the substation C may be provided in an outlying power house operated by the utilities company, in which case the line 19 extending thereto will necessarily be relatively long. All calls between the substations served by the branch exchange are handled exclusively by automatic switches. Moreover, calls outgoing to the central exchange lines from the extension lines of the branch exchange are handled exclusively by the automatic switches without any operator assistance. To this end automatic switching equipment is provided which includes line switches 20, 21, etc., individual to the var-

ious extension lines, and a plurality of connectors 22 having access to the extension lines and to the central office trunks. The line switches 20, 21, etc., and the branch exchange connectors are preferably of the character disclosed by Patent No. 1,468,078, granted September 18, 1923, to A. J. Ray and W. A. Chapin. Each of these connectors includes facilities for automatically selecting an idle central exchange trunk and for repeating switch directing impulses over a trunk seized thereby.

In accordance with conventional practice the branch exchange 11 is provided with an operator position or attendant's cabinet 35, through which all trunk calls incoming to this exchange from the central exchange 10 are extended to the extension lines. The extension lines 18, 19, etc., of the branch exchange are terminated at this operator position in jacks 26, 27, etc., which have line lamps 26a, 27a, etc. individually associated therewith. Each of the central exchange trunks is terminated in the branch exchange 11 in a trunk circuit, that terminating the trunk 12 being indicated generally at 23. Briefly considered, this trunk circuit comprises a regular service jack 25 and a night service jack 24 provided at the operator position 35, an incoming call signal lamp 24a and a group of control relays. More specifically, the relay equipment includes a line relay R150, a pair of sleeve relays R130 and R160 individual to the jacks 24 and 25, respectively, a switching relay R120, a tone relay R110 and a slow-to-operate cut-off relay R140. The several trunk circuits have commonly associated therewith an interrupter relay R100 which is arranged to cooperate with the tone relay of any of the trunk circuits to produce a distinctive signaling voltage.

For the purpose of setting up connections between the regular service trunk jacks and the extension line jacks provided at the operator position 35, a number of cord circuits are provided which are of identical arrangement. One of these cord circuits, indicated generally at 29, is illustrated as comprising an answer and dial plug 29a, a call plug 29b, a dial-operated calling device 31, a bridge relay R200, an answer relay R210, a dial key 30, a talk key 32, and a ringing key 34. The several cord circuits have commonly associated therewith a headset 33 which may be selectively connected to the talking conductors of any desired cord circuit through operation of the talk keys 32 respectively provided therein. Each of the cord circuits also includes a supervisory lamp 36 which is arranged to be controlled by the associated bridge and answer relays.

For the purpose of setting up night connections between the night jacks of the various trunk circuits and the extension line jacks as provided at the operator position 35, a plurality of night cords are provided. One of these cords, indicated generally at 28, is illustrated as comprising a pair of plugs 28a and 28b having the corresponding contacts thereof conductively connected free of any attachments.

In considering the operation of the system it will be understood that the manner in which the automatic switching equipment provided in the central exchange 10 may be controlled to set up connections between the lines served by this exchange is entirely conventional. Briefly considered, the line switch 14, the selector 16 and the connector 17 may be directly controlled over the line 13 from the substation A to extend a con-

nection to another subscriber line terminated by the central exchange switching equipment. In this case the line switch 14 operates to seize the selector 16 incident to the initiation of the call at the substation A, the first digit dialed at this substation is utilized to direct the selector 16 in its operation to seize the trunk extending to the connector 17, and the second and third digits dialed at the substation A are used to direct the connector 17 in its operation to select the called line. After the called line is thus selected, it is tested in the usual manner to determine the idle or busy condition thereof, and if busy, the usual busy signal is transmitted back over the calling end of the connection to inform the calling subscriber that the desired connection cannot immediately be obtained. On the other hand, if the called line is idle the control equipment of the connector 17 is automatically shifted to its ringing setting, thereby to establish a circuit for transmitting ringing current over the called line to signal the called substation and to establish a path for impressing ground potential upon the private conductor of this line to guard the line against seizure through the other connectors. When the call is answered at the called substation the control equipment of the connector 17 functions to arrest the ringing operation and to complete the desired talking circuit between the calling and called substations. Preferably, the connector 17 is of the last-party release type, such that when the connection is released at the calling and called ends thereof, this connector, the selector 16 and the line circuit 14 are all restored to normal.

The manner in which connections are set up through the automatic switching equipment provided in the branch exchange 11 between the extension lines served by this exchange is also entirely conventional. Briefly to consider a call of this character, it may be assumed that a call intended for the substation C is originated at the substation B and that the connector 22 is utilized in setting up the desired connection. When the call is initiated at the substation B, a calling loop circuit is completed which includes the conductors of the line 18 and extends to the line switch 20. When this circuit is completed, the line lamp 26a is energized to indicate the busy condition of the line 18 and the line switch 20 is operated successively to test the connectors to which it has access, until an idle connector is found. In the present case it is assumed that the connector 22 is the first idle connector tested by the line switch 20. Accordingly, when the line switch 20 positions its wipers on the conductors of the trunk extending to this connector, the operation of the line switch is arrested and the calling loop circuit is switched through to the connector. Incident to the switch-through operation, the control equipment of the connector 22 operates to provide a locking circuit for the cut-off relay of the line switch 20, to provide an alternative circuit for energizing the line lamp 26a, and to transmit the usual dial tone signal over the line 18 to the calling substation B. When the two digits of the directory number designating the called substation C are dialed into the connector 22 from the substation B, this connector operates to position its wipers on the contacts terminating the conductors of the line 19. Immediately this line is selected the control equipment of the connector 22 functions to test the idle or busy condition thereof, and if the line tests busy, operates to transmit the usual busy

signal over the line 18, thereby to inform the calling subscriber that the desired connection cannot be obtained. On the other hand, if the called line 19 tests idle, the control equipment of the connector 22 automatically shifts to its ringing setting to provide a circuit for energizing the line lamp 27a and the cut-off relay of the line switch 21, to mark the line 19 as busy, and to provide a circuit for transmitting ringing current over the conductors of the line 19 to energize the ringer provided at the substation C. When the call is answered at this substation, the control equipment of the connector 22 operates to open the ringing current transmission circuit and to complete the desired talking circuit between the calling and called substations. Assuming that the connector 22 is of the calling party release type, the operated switch train is released when the calling party at the substation B restores the receiver provided at this substation to its supporting hook or cradle to interrupt the calling loop circuit. The manner in which the operated switches 22, 20 and 21 are released and the lamps 26a and 27a are deenergized in response to the release of the connection is entirely conventional and will be readily understood by those skilled in the art.

Turning now to a consideration of the mode of operation of the equipment provided at the operator position 35, it may be assumed that a call intended for the substation B is originated at the substation A at a time when the operator position 35 is attended, and that the selector 16, the connector 17, the trunk 12 and the cord circuit 29 are utilized in setting up the desired connection. In this case the first digit dialed at the substation A is utilized to direct the selector 16 in its operation to seize the connector 17. The second and third digits are utilized to direct the connector 17 in its operation to seize the selected trunk 12. Assuming that this trunk is idle at the time it is selected, the private conductor thereof is marked as idle and the control equipment of the connector 17 is automatically shifted to its ringing setting. Incident to the operation of the switch-through relay of the connector, ground potential is applied to the private or test conductor of the trunk 12 to mark this trunk as busy and to operate the cut-off relay of the line switch 15. This relay, in operating, disconnects the windings of the associated line relay R170 from the trunk conductors 12a and 12b. In operating, the switch-through relay of the connector 17 also functions to complete a circuit for energizing the line relay R150 of the trunk circuit 23, this circuit extending from ground by way of the winding of R150, the contacts 164, the trunk conductor 12b, the negative line wiper of the connector 17, the contacts 181 and the upper winding of the ring cut-off relay R180 to battery. Since the winding of the line relay R150 is of relatively high resistance, the current traversing this circuit is insufficient to cause the operation of the ring cut-off relay R180 in the connector 17. The relay R150, however, is sufficiently energized to operate. In operating, this relay closes its contacts 151 to complete a circuit through the contacts 142, 132 and 24c for energizing the line lamp 24a, thereby to signal the attendant at the operator position 35 that an incoming call is present on the trunk 12 which should be answered. At its contacts 152, the relay R150 connects the private conductor 12c of the trunk 12 to ground, thereby to mark this trunk against seizure by the connectors provided in the branch exchange 11. At

its contacts 153, the relay R150 opens a path over which negative battery potential is normally impressed upon the private conductor 12c to mark the trunk 12 as idle in the bank contacts of the connectors provided in the branch exchange. Following the operation of the connector 17 to its ringing setting, ringing current is transmitted over this trunk. With the illustrated trunk circuit arrangement the ringing operation is without effect. It is noted, however, that a path including the contacts 125, the condenser 126 and the contacts 162 is provided between the conductors of the trunk 12 to complete the ringing current circuit. This path is only of utility in the event the arrangement of the connector 17 is such that the transmission of ringing current over a completed circuit is a prerequisite to the operation thereof to its call answered setting.

Upon observing the lighted condition of the lamp 24a, the attendant at the operator position 35 may answer the call by inserting the plug 29a in the jack 25. Incident to this operation, the sleeve relay R160 is energized in a circuit which includes the sleeve contacts of the jack 25 and the plug 29a. In operating, this relay opens its contacts 162 to interrupt the ringing circuit, and closes its contacts 161 to complete an obvious circuit for energizing the cut-off relay R140. At its contacts 164, the relay R160 interrupts the above-traced operating circuit for the line relay R150. In releasing, the latter relay opens its contacts 151 to deenergize the lamp 24a; opens its contacts 152 to disconnect the private conductor 12c of the trunk 12 from ground in the trunk circuit 23; and closes its contacts 153 to connect the private conductor 12c to ground over a path which includes the sleeve contacts of the jack 25 and the plug 29a. The cut-off relay R140, upon operating, opens its contacts 142 further to interrupt the circuit for energizing the signal lamp 24a and closes its contacts 141 to prepare a locking circuit for itself.

When the plug 29a is inserted in the jack 25 to cause the operation of the sleeve relay R160 in the manner explained above, a direct current bridge is established across the talking conductors of the trunk 12, this bridge extending from the conductor 12a by way of the contacts 163, the tip contacts of the jack 25 and the plug 29a, the contacts 30a, the winding of R200, the contacts 30c, the ring contacts of the plug 29a and the jack 25, and the contacts 165 to the conductor 12b. When this bridging path is completed, the winding of the relay R200 is energized in series with the upper winding of the ring cut-off relay R180 provided in the connector 17 and both relays operate. The bridge relay R200, upon operating, closes its contacts 201 to complete an obvious circuit for energizing the supervisory lamp 36. The ring cut-off relay R180, upon operating, locks to ground through its contacts 183; opens its contacts 181 and 185 to interrupt the ringing current circuit; and closes its contacts 182 and 184 to extend the answering loop circuit through the windings of the associated answer relay, not shown, of the connector 17. Following these relay operations a talking circuit is established between the substation A and the cord circuit 29. To complete this circuit it is only necessary for the attendant at the operator position 35 to actuate the talk key 32, thereby to bridge the headset 33 across the talking conductors of the trunk 12. After this operation is performed, the attendant may converse with the calling subscriber and ascertain the party desired by that

subscriber. When instructed by the calling subscriber that the substation B is desired, the attendant at the operator position 35 may extend the connection by inserting the plug 29b in the jack 26. Incident to this operation the sleeve contact of the jack 26 is connected to ground to mark the line 18 as busy in the bank contacts of the connectors provided in the branch exchange 11 and to complete a circuit for energizing the line lamp 26a in parallel with the cut-off relay of the line switch 20. This relay, in operating, disconnects the windings of its associated line relay from the talking conductors of the line 18. After establishing a connection between the cord circuit 29 and the line 18, the attendant at the operator position 35 may momentarily actuate the ringing key 34 to complete a circuit including the contacts 34b and 34d for transmitting ringing current over the line 18, thereby to energize the ringer provided at the substation B.

When the call is answered at the substation B a loop circuit including the tip and ring contacts of the plug 29b and the jack 26, and the contacts 34a and 34c of the ringing key 34, is completed for energizing the answer relay R210. This relay, in operating, opens its contacts 211 to deenergize the supervisory signaling lamp 36 and thus inform the attendant at the operator position 35 that the call has been answered. In this regard it will be noted that the attendant at this position, upon ascertaining the identity of the substation desired by the calling subscriber, may actuate the talk key 32 to its normal position in order to disconnect the headset 33 from the cord circuit 29 and thus free this headset for use in handling other calls. After the call is answered at the called substation B the desired talking circuit is established between this substation and the calling substation A, it being noted in this regard that talking battery is supplied to the called line 18 through the windings of the answer relay R210 and that talking battery is supplied to the calling line 13 through the windings of the line relay provided in the connector 17.

The release of the connection as set up between the substations A and B is partially under the control of the calling subscriber and partially under the control of the attendant at the operator position 35. In this regard it will be understood that when the called party at the substation B hangs up to interrupt the answering loop circuit, the answer relay R210 releases and closes its contacts 211 to again energize the supervisory signaling lamp 36. When this lamp is illuminated the attendant at the position 35 is informed that the connection is ready to be released. To take down the connection the attendant at this position simply withdraws the plugs 29a and 29b from the jacks 25 and 26, respectively. When the plug 29b is withdrawn from the jack 26, the line lamp 26a and the cut-off relay of the line switch 20 are deenergized, and guarding ground potential is removed from the private conductor 18c to permit seizure of the line 18 by the branch exchange connectors. When the plug 29a is withdrawn from the jack 25, the sleeve relay R160 is deenergized and the loop extending between the cord circuit 29 and the connector 17 is interrupted to deenergize the answer relay provided in the connector 17. In releasing, the relay R160 opens its contacts 161 to interrupt the operating circuit for the cut-off relay R140, and closes its contacts 164 to energize the line relay R150 in a circuit which also includes one winding of the answer relay provided in the con-

connector 17. The current traversing the latter circuit is insufficient to cause the reoperation of the answer relay of the connector 17. The line relay R150, however, reoperates and closes its contacts 151 to complete the prepared locking circuit for the cut-off relay R140. At its contacts 152, the relay R150 connects the private conductor 12c of the trunk 12 to ground, thereby to guard this trunk against seizure until the connector 17 is released.

In the event the call is cleared out at the substation A before the connection is taken down at the operator position 35, the release of the answer relay provided in the connector 17 causes the connector 17, the selector 16 and the line switch 14 to release in the exact manner explained above. Incident to the release of the connector 17 the locking circuit for the ring cut-off relay R180 is opened; the cut-off relay of the line switch 15 is deenergized; the trunk 12 is marked as idle in the bank contacts of the connectors in the central exchange 10; and the circuit for energizing the line relay R150 is interrupted. It will be understood that if the switch train is still being held from the substation A at the time the connection is taken down at the operator position 35 in the branch exchange 11, the operations just described only occur when the connection is subsequently released at the substation A. Regardless of this fact, when the line relay R150 is deenergized incident to the release of the connector 17 it opens its contacts 151 to deenergize the cut-off relay R140. Following the release of the latter relay the trunk circuit 23 is fully restored to normal.

To consider a call originating at the branch exchange 11 and intended for one of the central exchange subscribers, it may be assumed that a call intended for the substation A is originated at the substation B. It may be assumed further that the line switch 20 in responding to the initiation of a call seizes the connector 22. In response to this operation the calling loop circuit is extended from the line 18 to the connector 22; the control equipment of this connector is conditioned to respond to the impulses of the digit designating the central office trunks; and dial tone is returned over the calling line 18 to signal the calling party at the substation B that the dialing operation may be started. In this regard it is pointed out that each of the branch exchange connectors has access to the central office trunks through the bank contacts forming the tenth level of its contact field, and that each connector is provided with automatic trunk hunting facilities such that when the digit "0" is dialed thereinto the wipers thereof are elevated to a position opposite the tenth level of bank contacts thereof and are then automatically rotated until an idle central exchange trunk is found. It is pointed out further that each of the branch exchange connectors is equipped with facilities for repeating impulses over the central exchange trunks.

From the above explanation it will be understood than when the digit "0" is dialed at the calling substation B the connector 22 operates automatically to test the central exchange trunks until an idle trunk is found. It may be assumed that in the present case the trunk 12 is seized by the connector 22 during this trunk hunting operation. Incident to the seizure of this trunk the control equipment of the connector 22 functions to connect the test conductor 12c to ground and to set up circuits for repeating impulses over

the talking conductors 12a and 12b. When the conductor 12c is connected to ground the sleeve relay R160 is energized in an obvious circuit. Upon operating, this relay opens its contacts 164 to prevent the subsequent energization of the line relay R150, and closes its contacts 161 to complete an obvious circuit for energizing the cut-off relay R140. In operating, the relay R140 closes its contacts 141 to prepare a locking circuit for itself. At its contacts 142, the relay R140 opens a point in the previously traced circuit for energizing the signal lamp 24a.

When the connector 22 seizes the trunk 12, a loop circuit including the trunk conductors 12a and 12b is completed between this connector and the line switch 15 to cause the operation of the line relay R170. When this line relay operates, the line switch 15 functions to seize an idle one of the selectors accessible thereto. It may be assumed that the selector 16 is seized by the line switch 15 for use in extending the connection. Incident to the seizure of this selector, the line switch 15 operates to extend the loop circuit from the trunk 12 to the selector, and the control equipment of the selector is operated to return ground over the release conductor extending thereto, whereby the trunk is marked as busy and a locking circuit is established for the operated cut-off relay of the line switch.

The second digit dialed at the calling substation B is utilized to direct the selector 16 in its operation to select the group of connectors having access to the desired line 13. In this regard it will be understood that the impulse repeating relays of the connector 22 respond to the impulses of the second and succeeding digits by repeating these impulses over the loop circuit established by way of the trunk 12. It may be assumed that the selector 16 in its response to the impulses of the digit dialed at the substation B operates to select the group of connectors including the connector 17 and that, incident to the trunk hunting movement of this selector which occurs during the inter-digit pause between the second and third digits, it functions to seize the connector 17. Incident to this operation the selector 16 extends the loop circuit to the connector 17 and the control equipment of this connector is operated to establish locking circuits for the operated relays in the selector 16 and the line switch 15.

The third digit dialed at the substation B is utilized to direct the wipers of the connector 17 to a position opposite the level of bank contacts in which the desired line 13 is terminated. The fourth digit dialed at this substation is used to direct the wipers of the connector 17 into engagement with the particular set of contacts at which the conductors of the line 13 are terminated. Following the dialing of the fourth digit the line 13 is automatically tested to determine the idle or busy condition thereof, and if busy the usual busy signal is returned over the calling end of the connection to signal the calling party. On the other hand if the called line 13 is idle, ringing current is transmitted thereover from the connector 17 to energize the ringer provided at the substation A.

When the call is answered at the substation A, the control equipment of the connector 17 operates in the usual manner to reverse the direction of current flow over the loop circuit connecting this connector with the connector 22 in the branch exchange 11. More specifically,

the answer or back-bridge relay of the connector 17, in operating, functions to connect the negative terminal of the exchange battery provided in the central exchange 10 to the talking conductor 12b of the trunk 12. Following the operation of this relay the desired talking circuit between the substations A and B is fully established.

In the event the called subscriber at the substation A hangs up before the connection is released at the calling substation B, the answer relay of the connector 17 is deenergized. In releasing, this relay reverses the direction of current flow over the loop circuit connecting the connectors 17 and 22. More specifically, this relay, in restoring, connects the trunk conductor 12b to ground in the connector 17. When the connection is cleared out at the calling substation B the connector 22 and the line switch 20 are released. Incident to the release of the connector 22 the loop circuit extending from this connector to the connector 17 in the central exchange 10 is interrupted, whereby the connector 17, the selector 16 and the line switch 15 are released in the manner previously explained. Also incident to the release of the connector 22 the private conductor 12c is disconnected from ground to cause the deenergization and sequential release of the two relays R160 and R140. Following the release of these two relays the trunk circuit 23 is fully restored to normal.

In the event the connection is released at the substation B before the called subscriber at the substation A hangs up, the operated switch train in the central exchange 10 is held operated until the called subscriber hangs up and the trunk 12 is guarded against seizure in the branch exchange 11. Under these circumstances only the connector 22 and the line switch 20 are released when the connection is cleared out at the substation B. Incident to the release of the connector 22, the loop circuit extending to the connector 17 in the central exchange 10 is opened and the private conductor 12c is disconnected from ground to deenergize the sleeve relay R160. This relay, in restoring, closes its contacts 164 to energize the line relay R150 over a circuit which includes the trunk conductor 12b and one winding of the line relay provided in the connector 17. In operating, the relay R150 closes its contacts 151 to complete the prepared locking circuit for the cut-off relay R140, and closes its contacts 152 to impress guarding ground potential upon the private conductor 12c of the trunk 12. The two relays R150 and R140 are held operated until the switch train in the central exchange 10 is released under the control of the called subscriber. When this subscriber hangs up, the answering relay provided in the connector 17 restores to reverse the connections of the trunk conductors 12a and 12b to the terminals of the battery provided in the central exchange, whereby the line relay R150 and the series-connected winding of the line relay provided in the connector 17 are both deenergized. The line relay of the connector 17, upon restoring, causes the release of this connector, the selector 16 and the line switch 15 in a manner clearly apparent from the preceding explanation. The line relay R150, upon restoring, opens its contacts 152 to disconnect the private conductor 12c from ground, closes its contacts 153 to impress negative battery potential upon its private conductor, and opens its contacts 151 to deenergize the cut-off relay R140. Following the

release of the latter relay the trunk circuit 23 is fully restored to normal.

If the attendant at the operator position 35 desires to obtain a connection with one of the substations served by the central exchange 10, she may utilize the trunk 12 for this purpose by inserting the plug 29a of the cord circuit 29 in the jack 25. Incident to this operation, the sleeve relay R160 is energized over a circuit including the connected sleeve contacts of the jack 25 and the plug 29a, and the talking conductors of the cord circuit 29 are connected to the tip and ring contacts of the jack 25. In operating, the relay R160 closes its contacts 163 and 165 to connect the talking conductors of the trunk 12 to the talking conductors of the cord circuit 29. At its contacts 161, the relay R160 closes the operating circuit for the cut-off relay R140. At its contacts 164, the relay R160 opens a point in the operating circuit for the line relay R150. In operating to connect the talking conductors of the trunk 12 to the talking conductors of the cord circuit 29, the relay R160 completes a circuit including the winding of the bridge relay R200 for energizing the line relay R170 of the line switch 15. When this relay operates the line switch 15 functions in the manner explained above to seize an idle one of the selectors to which it has access. After the relay R160 operates, the attendant at the operator position 35 may actuate the key 32 to its talk position wherein the headset 33 is bridged across the talking conductors of the trunk 12 to establish a monitoring connection. After establishing this connection, the attendant may ascertain the idle or busy condition of the trunk. In the event the trunk 12 is idle, the attendant at the operator position 35 may restore the talk key 32 to normal and actuate the dial key 30 to its off-normal position in order to substitute the impulsing contacts of the dial 31 for the winding of the bridge relay R200 in the loop circuit as set up by way of the trunk and the line switch 15 to the particular selector that has been seized by this line switch. From this point on, the manner in which the connection may be extended to the desired substation under the control of the calling device 31 is exactly the same as explained above with reference to the interoffice trunk call originating at the substation B. The manner in which the connection may be released under the control of the attendant at the operator position 35 and the called subscriber is also exactly the same as explained above with reference to the central exchange trunk call originating at the substation B.

As indicated previously, when the operator position 35 is unattended, night cords 28 are used for the purpose of connecting the night jacks individual to the central exchange trunks to certain of the extension lines provided in the branch exchange 11. For example, the illustrated cord 28 may be used to connect the night jack 24, individual to the trunk 12, with the jack 27 terminating the conductors of the line 19 by inserting the plug 28a in the jack 24 and inserting the plug 28b in the jack 27. When the plug 28a is inserted in the jack 24, the contacts 24c are disengaged to open the circuit for energizing the lamp 24a, and the contacts 24b are closed to prepare the operating circuit for the switching relay R120. After these connections have been made, the automatic switching equipment of the branch exchange 11 may be controlled from the substation C to extend a connection to any of the other branch exchange substations or to any desired

substation served by the central exchange 10. In this regard it is noted that when a call is initiated at the substation C, and in response thereto the line switch 21 operates to seize an idle one of the connectors accessible thereto, ground potential is returned over the private conductor 19c of the line 19 from the switch train to energize the line lamp 27a and sleeve relay R130. More specifically, this relay is energized in a circuit which includes the sleeve contacts of the jack 27, the plug 28b, the plug 28a and the jack 24, and the contacts 121. In operating, the relay R130 opens its contacts 132 to interrupt the prepared operating circuit for the switching relay R120. At its contacts 131, the relay R130 prepares the operating circuit for the tone relay R100. It will be noted that the sleeve relay R130 is held operated for the duration of the call and that with this relay operated, the switching relay R120 cannot be energized to connect the conductors of the trunk 12 to the conductors of the line 19. Thus this line is guarded against seizure through the trunk circuit 23 on calls routed to this trunk through the automatic switching equipment of the central exchange 10.

After the call originating at the substation C has been extended to one of the connectors in the branch exchange 11 it may be further extended under the directive control of the calling device at the substation C to a desired substation in the branch exchange 11 or to a desired substation served by the central exchange 10, and then released in the exact manner explained above. Incident to the release of the connection the private conductor 19c is disconnected from ground in the branch exchange connector utilized in setting up the connection. When ground potential is removed from this conductor, the sleeve relay R130 is deenergized and restores to open the prepared operating circuit for the tone relay R110 and to reprepare the operating circuit for the switching relay R120.

It will be noted that if the call just considered is extended from the substation C over the trunk 12 and through the automatic switching equipment of the central exchange 10 to a substation served by this exchange, the sleeve relay R160 and the cut-off relay R140 are operated until the connection is released in the branch exchange 11. If the connection is released at the substation C before the called subscriber hangs up, the line relay R150 is energized over the trunk 12 from the operated connector in the central exchange 10 incident to the release of the sleeve relay R160, in the exact manner explained above. Upon operating, the relay R150 establishes a circuit through its contacts 151 for maintaining the energization of the operated cut-off relay R140. With the latter relay thus operated for the duration of the call, the tone relay R110 and the switching relay R120 are prevented from operating.

If the trunk 12 is seized from the substation B, for example, at a time when the line 19 is connected through the cord 28 to the trunk circuit 23, no busy marking is applied to the private conductor 19c to interfere with the use of the line 19. In this case, the two relays R160 and R140 are successively operated when the trunk 12 is seized by one of the branch exchange connectors. Moreover, for reasons pointed out above, the cut-off relay R140 is held operated until the trunk 12 is released at both ends thereof. With this relay operated, the switching relay R120 cannot be energized regardless of the

position of the line relay R150. Accordingly, ground potential cannot be applied to the private conductor 19c in the trunk circuit 23 so long as the trunk 12 is occupied with the call.

When the trunk 12 is seized by a connector in the central exchange 10 on a call intended for one of the substations of the branch exchange 11, and the connector is operated to its ringing setting, the trunk conductor 12b is connected to the negative terminal of the battery in the central exchange to energize the line relay R150 in the manner explained above. Upon operating, this relay closes its contacts 151 to complete a circuit through the contacts 142, 132 and 24b for energizing the switching relay R120. At its contacts 152, the relay R150 connects the private conductor 12c of the trunk 12 to ground, thereby to guard this trunk against seizure by one of the branch exchange connectors. The relay R120, upon operating, opens its contacts 121 to interrupt the prepared operating circuit for the sleeve relay R130 and closes its contacts 122 to complete a circuit for energizing the cut-off relay of the line switch 21. The latter circuit extends from ground by way of the contacts 122, the sleeve contacts of the jack 24, the plugs 28a and 28b, and the jack 27, the private conductor 19c of the line 19, and the winding of the cut-off relay embodied in the line switch 21 to battery. When this circuit is completed the private conductor 19c of the line 19 is obviously connected to ground to guard this line against seizure through the connectors of the branch exchange, the line lamp 27a is energized and the cut-off relay of the line switch 21 is operated to disconnect the windings of its associated line relay from the talking conductors of the line 19. In operating, the switching relay R120 also closes its contacts 123 and 124 to connect the talking conductors of the trunk 12 to the talking conductors of the line 19 through the connected tip and ring contacts of the jack 24, the plugs 28a and 28b, and the jack 27. After this connection is established the ringing current being transmitted over the trunk 12 from the operated connector of the central exchange 10 is further transmitted over the line 19 to energize the ringer provided at the called substation C. When the call is answered at this substation an answering loop circuit is established for successively operating the ring cut-off and answer relays of the operated central exchange connector, this loop including the talking conductors of the line 19, the tip and ring contacts of the jack 27, the plugs 28b and 28a and the jack 24, the contacts 123 and 124, and the talking conductors of the trunk 12. Following the operation of the answer relay in the operated connector of the central exchange 10, the desired talking circuit is established between the calling substation and the called substation C. When the connection is released at both the calling and called ends thereof to cause the release of the operated switch train in the central exchange 10, the line relay R150 is deenergized and restores. In releasing, this relay opens its contacts 151 to deenergize the switching relay R120, and opens its contacts 152 to disconnect the private conductor 12c of the trunk 12 from ground, whereby this trunk is rendered accessible to the branch exchange connectors. The switching relay R120, upon restoring, opens its contacts 122 to disconnect the private conductor 19c of the line 19 from ground and thus cause the deenergization of the line lamp 27a and the deener-

gization and release of the cut-off relay embodied in the line switch 21. Following the release of this relay and the two relays R150 and R120 of the trunk circuit 23, the branch exchange equipment utilized in handling the call is fully restored to normal.

In the event the line 19 is occupied with a branch exchange call at the time the above-described call is extended to the trunk 12 through one of the central exchange connectors, the sleeve relay R130 is operated in the trunk circuit 23. Accordingly the line relay R150, upon operating in response to seizure of the trunk 12 in the central exchange, closes its contacts 151 to complete the prepared operating circuit for the tone relay R110, this circuit extending from ground by way of the contacts 151, 142 and 131, the winding of R110, the contacts 101, and the resistor 102 to battery. When thus energized the relay R110 closes its contacts 111 to complete an obvious circuit for energizing the interrupter relay R100. The latter relay, upon operating, opens its contacts 101 to deenergize the tone relay R110. In releasing, the tone relay opens its contacts 111 to deenergize the interrupter relay R100. The interrelated operation of the two relays R110 and R100 continues until the call is abandoned by the calling central exchange subscriber or the branch exchange connection between the line 19 and another line of this exchange is released. Each time the tone relay R110 operates it closes its contacts 112 to connect the tip contact of the jack 24 to ground through the resistor 113 and thus change the potential of the tip conductor of the line 19. This path is obviously interrupted at the contacts 112 each time the tone relay R110 restores. Thus an alternating potential is produced on the tip side of the line 19 which causes a corresponding tone to be produced by the receiver provided at the substation C. This tone, which is of low volume, serves to signal the party using the substation C that an incoming central exchange trunk call intended for the substation C has been routed to the branch exchange.

In the event the call is abandoned at the calling central exchange substation before the branch exchange connection involving the line 19 is released, the relays R150, R110 and R100 are all deenergized when the switch train occupied with the call in the branch exchange 10 is released. The release of these three relays is obviously effected without deenergizing the sleeve relay R130.

In the event the branch exchange connection involving the line 19 is released before the central exchange trunk call intended for this line is abandoned, the relays of the trunk circuit 23 function automatically to extend the connection to the line 19. More specifically, when the switch train occupied with the branch exchange call is released, the private conductor 19c of the line 19 is disconnected from ground to deenergize the sleeve relay R130 in the manner pointed out above. This relay, upon restoring, opens its contacts 131 to arrest the interrelated operation of the tone relay R110 and the interrupter relay R100. At its contacts 132, the relay R130 completes the prepared operating circuit for the switching relay R120. From this point on, the manner in which the connection is extended to the substation C and is released when the calling and called parties hang up is exactly the same as explained above.

From the preceding explanation it will be understood that the arrangement of the trunk cir-

cuit 23 is such that the branch exchange lines designated for night service are in no way deprived of any of the regular services when the night service connections to the central exchange trunk circuits are established. Thus the substation C is capable of being used to originate and answer branch exchange calls or to extend connections over the central exchange trunks to the central exchange subscribers at any time when a night service connection to the trunk circuit 23 is established. In this respect the present arrangement is to be distinguished from those of the prior art wherein the provision of a night service connection to the branch exchange extension line, although permitting the substation connected to this line to be used in the answering and origination of central exchange trunk calls, does not permit this substation to be used in originating and answering branch exchange calls.

While one embodiment of the invention has been disclosed, it will be understood that various modifications may be made therein which are within the true spirit and scope of the invention.

What is claimed is:

1. In a branch exchange which includes automatic switching equipment controllable over the branch exchange lines to set up connections therebetween and to extend connections from the branch exchange lines to a central exchange trunk, an operator position including means for extending connections from said trunk to said lines in the handling of incoming central exchange trunk calls, a manually operable device at said operator position adapted to be preset by an operator before leaving said position and including conductors for providing a direct connection between said trunk and one of said lines when said operator position is unattended, whereby incoming central exchange trunk calls may be handled by said one line without the intervention of an operator, and means associated with said trunk for preventing said direct connection from rendering said one line non-usable in connections involving others of said branch exchange lines and which may be set up through said automatic switching equipment.

2. In a branch exchange which includes automatic switching equipment controllable over the branch exchange lines to set up connections therebetween and to extend connections from the branch exchange lines to a central exchange trunk, an operator position including means for extending connections from said trunk to said lines in the handling of incoming central exchange trunk calls, a manually operable device at said operator position adapted to be preset by an operator before leaving said position and including conductors for providing a direct connection between said trunk and one of said lines when said operator position is unattended, whereby incoming central exchange trunk calls may be handled by said one line without the intervention of an operator, and means associated with said trunk for preventing said direct connection from rendering said automatic switching equipment non-controllable over said one line to extend a connection from said one line to another of said branch exchange lines.

3. In a branch exchange which includes automatic switching equipment controllable over the branch exchange lines to set up connections therebetween and to extend connections from the branch exchange lines to a central exchange trunk, an operator position including means for

extending connections from said trunk to said lines in the handling of incoming central exchange trunk calls, a manually operable device at said operator position adapted to be preset by an operator before leaving said position and including conductors for providing a direct connection between said trunk and one of said lines when said operator position is unattended, whereby incoming central exchange trunk calls may be handled by said one line without the intervention of an operator, and means associated with said trunk for preventing said direct connection from rendering said one line non-accessible to said automatic switching equipment.

4. In a branch exchange which includes a number of lines, a central exchange trunk, an operator position including a presettable operator controlled device provided with conductors tying one of said lines directly to said trunk to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines both when said operator position is attended and unattended, and means for guarding said line against seizure only when it is occupied with a call regardless of whether said operator position is attended or unattended.

5. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means for guarding said one line against seizure through said trunk circuit only when said one line is occupied with a call which involves another of said lines.

6. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means controllable over said one line for guarding said one line against seizure through said trunk circuit only when said one line is occupied with a call which involves another of said lines.

7. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means

for guarding said one line against seizure by said automatic switching equipment only when said one line is occupied with a central office trunk call or a call involving another of said lines.

8. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means controllable over said trunk for guarding said one line against seizure when said one line is occupied with an incoming central exchange trunk call.

9. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines and to extend connections from said one line to said trunk when said one line is connected to said trunk circuit through the conductors of said operator position, means for guarding said one line against seizure by said automatic switching equipment only when said one line is occupied with a central office trunk call or a call involving another of said lines, and means for guarding said trunk against seizure when said trunk is occupied with an incoming or an outgoing call.

10. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and said other lines and to extend connections from said one line to said trunk when said one line is connected to said trunk circuit through the conductors of said operator position, and means controllable over said trunk for guarding said one line and said trunk against seizure when said one line is occupied with an incoming central exchange trunk call.

11. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means responsive to the seizure of said trunk at the

central exchange end thereof for guarding said one line against seizure by said automatic switching equipment and for rendering said automatic switching equipment non-controllable over said one line.

12. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means responsive to the seizure of said trunk at the central exchange end thereof for connecting the conductors of said trunk by way of the conductors of said operator position to the conductors of said one line, guarding said one line against seizure by said automatic switching equipment and for rendering said automatic switching equipment non-controllable over said one line.

13. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, a connector operative to seize said trunk at the central exchange end thereof and including means for transmitting ringing current over said trunk and means for connecting one side of said trunk to a source of current, a relay included in said trunk circuit and energized over said one side of said trunk from said source when said trunk is seized by said connector, means controlled by said relay for connecting the conductors of said trunk by way of the conductors of said operator position to the conductors of said one line, thereby to transmit ringing current from said connector over said one line, and means responsive to the operation of said relay for guarding said one line against seizure by said automatic switching equipment and for rendering said automatic switching equipment noncontrollable over said one line.

14. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, a connector operative to seize said trunk at the central exchange end thereof and including means for connecting one side of said trunk to a source of current, a relay included in said trunk circuit and energized over said one side of said trunk from said source when said

trunk is seized by said connector, and means responsive to the operation of said relay for guarding said one line against seizure by said automatic switching equipment and for rendering said automatic switching equipment non-controllable over said one line.

15. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, and means for marking said one line as busy in said trunk circuit only when it is occupied with a branch exchange call involving another of said lines.

16. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, means responsive to the seizure of said trunk at the central exchange end thereof for connecting the conductors of said trunk by way of the conductors of said operator position to the conductors of said one line, and means for rendering said last-named means non-responsive to the seizure of said trunk at the central exchange end thereof when said one line is occupied with a branch exchange call involving another of said lines.

17. In a branch exchange which includes a number of lines, a central exchange trunk circuit terminating a central exchange trunk in said branch exchange, an operator position including conductors tying one of said lines directly to said trunk circuit to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through the conductors of said operator position, means for marking said one line as busy in said trunk circuit only when it is occupied with a branch exchange call involving another of said lines, and means in said trunk circuit responsive to the seizure of said trunk at the central exchange end thereof when said one line is marked as busy in said trunk circuit for transmitting a signal over said one line.

18. In a branch exchange which includes a number of lines one of which may be connected to a central exchange trunk through a trunk circuit and the equipment of an operator position to receive incoming central exchange trunk calls when said operator position is unattended, automatic switching equipment controllable over said lines and operative to set up connections between said one line and the other lines when said one line is connected to said trunk circuit through

the equipment of said operator position, means for marking said one line as busy in said trunk circuit only when it is occupied with a branch exchange call involving another of said lines, means in said trunk circuit responsive to the seizure of said trunk at the central exchange end thereof when said one line is marked as busy in said trunk circuit for transmitting a signal over said one line, and means in said trunk circuit responsive to the seizure of said trunk at the central exchange end thereof when said one line is idle for guarding said one line against seizure by said automatic switching equipment and for transmitting a different signal over said one line.

19. In a branch exchange which includes a number of lines that may be interconnected through automatic switching equipment and one of which may be designated to handle calls incoming to said branch exchange over a central exchange trunk, a trunk circuit terminating said trunk in said branch exchange and including

means for transmitting a special signal over said one line in response to the seizure of said trunk at the central exchange end thereof during an interval when said one line is busy.

20. A trunk circuit for terminating a central exchange trunk at an operator position in a branch exchange comprising a jack including tip, ring and sleeve contacts, a sleeve relay adapted to be controlled over the sleeve contact of said jack, a line relay adapted to be controlled over said trunk, means responsive to operation of said line relay during an interval when said sleeve relay is not operated for connecting the conductors of said trunk to the tip and ring contacts of said jack, and means responsive to operation of said line relay during an interval when said sleeve relay is operated for producing a signal voltage on one of the tip and ring contacts of said jack.

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