

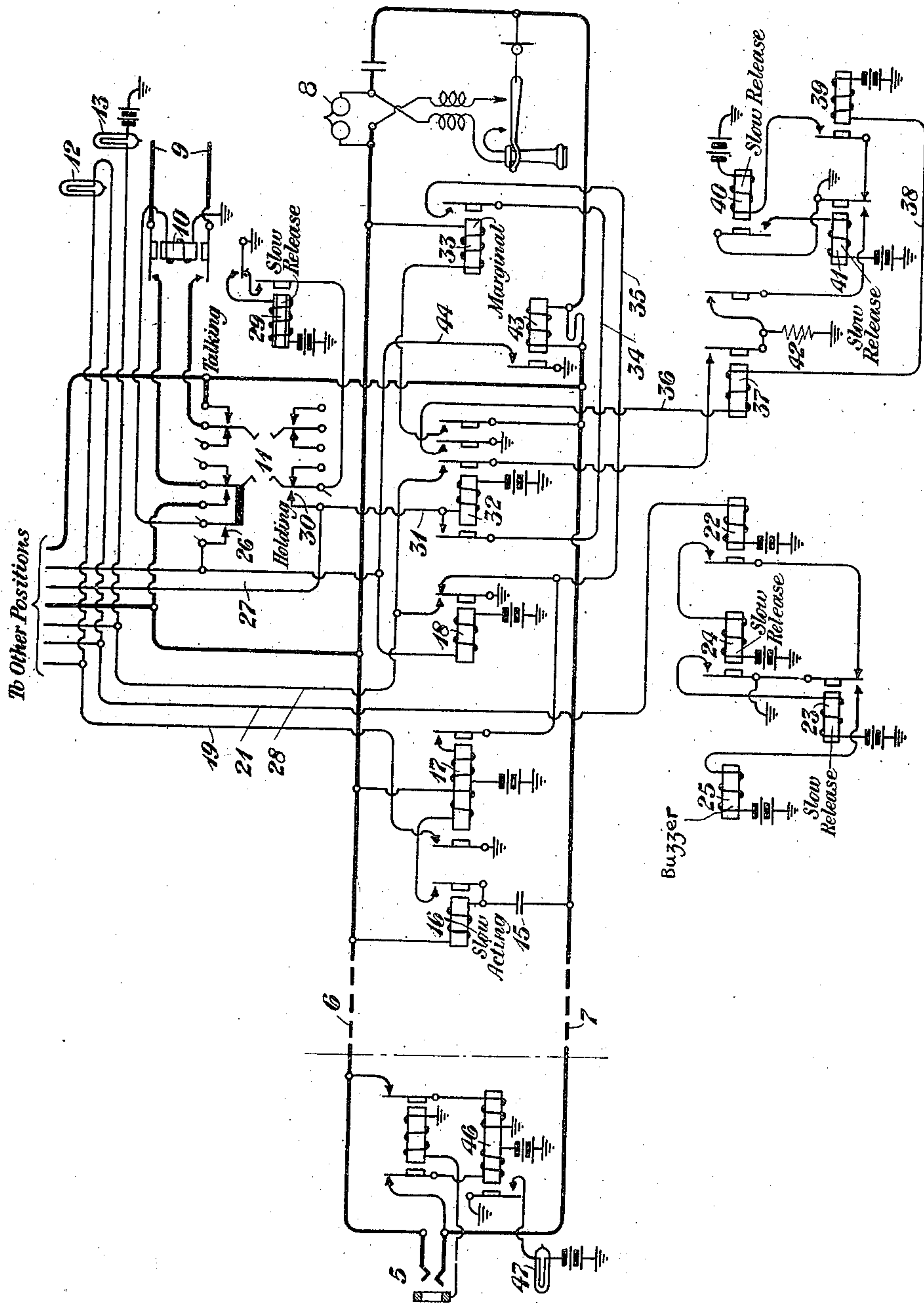
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TELEPHONE PRIVATE BRANCH EXCHANGE CIRCUITS

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TELEPHONE PRIVATE BRANCH EXCHANGE CIRCUITS.

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To all whom it may concern:

Be it known that we, JOHN F. TOOMEY and HENRY E. PHELPS, residing at New York, in the counties of New York and Bronx and State of New York, have invented certain Improvements in Telephone Private Branch Exchange Circuits, of which the following is a specification.

This invention relates to telephone systems, and more particularly to extension lines from central offices, especially lines terminating at private branch exchanges.

One of the objects of the invention is to provide a system of this character with a substation normally connected with the incoming trunk line, said trunk line extending to a plurality of operators' or attendants' positions, each of said positions having the same access to the trunk line.

Another object is to render the trunk line inaccessible to any of the operators' or attendants' positions when the substation is in talking connection with said trunk line, thus insuring privacy at the substation.

Another object is to provide for automatic holding circuits at each of the operators' or attendants' positions for the purpose of holding the trunk connection until the substation or another attendant answers.

Another object is to provide signaling means at the various operators' or attendants' positions for indicating the condition of the trunk line.

A further object is to provide for the obviation of false signals on the operators' or attendants' positions caused by condenser discharges, static impulses, Morse thumps or the like, as well as by dialing impulses when the private branch exchange is connected with a central office where machine switching apparatus is employed.

These objects, as well as other objects of the invention, may be attained by means of the apparatus set forth in the following description and illustrated in the accompanying drawing, the figure in which illustrates a circuit diagram of one embodiment of the invention.

Referring to the drawing, 5 represents a jack at a central office, which has the usual equipment associated therewith, including the line signal and also cut-off equipment. Connected with the jack 5 are line conductors 6 and 7, which lead to the private branch

exchange, the apparatus of which is indicated to the right of the dotted lines. The private branch exchange may be connected with manual or switching machinery controlled central offices. A substation set 8 and a plurality of attendants' positions, one of which is indicated at 9, are connected to the line or talking conductors 6 and 7. A relay 10 is provided at each attendant's position for the purpose of connecting the attendants' sets with the talking conductors 6 and 7. Each position is provided with a plurality of the customary keys adapted for talking and holding, one of which is illustrated at 11 at the attendant's position indicated at 9. A line lamp 12 and a holding and busy indicating lamp 13 are associated with each key at each position for the purpose of apprising the attendant thereof of the condition of the trunk.

Further details of the circuit and apparatus will now be clear from the following description of its operation.

Assuming that a connection is desired between a main central office and a private branch exchange such as illustrated in the drawing, the operator at said office will insert a plug connected with a cord circuit (not shown) into jack 5. The operator at said central office will then cause ringing current to be transmitted in the usual way over the trunk comprising conductors 6 and 7 and through the substation 8, causing the bell thereat to ring. Ringing current, when applied to the line conductors 6 and 7, will also pass through the condenser 15 and winding of ringing relay 16, which is bridged across the line, causing said relay to operate. The operation of relay 16 closes a circuit through its contact and left-hand winding of ringing relay 17, thereby energizing the latter relay and bridging it across the line in parallel with relay 16. Thus, when ringing current comes in over the trunk, it lasts for a comparatively long period, and relays 16 and 17 operate in turn, while, on the other hand, the transmission of momentary impulses, such as condenser discharges, static impulses, Morse thumps and dialing impulses, will not continue sufficiently long to operate both relays. It will be evident, therefore, that by this arrangement a guard is provided against false line signals at the attendants' positions, which will be described

presently. The operation of relay 17 closes a locking circuit through its right-hand winding and make contact, from battery and the back contact of relay 18 to ground. 5 The operation of relay 17 closes a circuit through its left-hand make contact from ground, conductor 19, through the filament of line lamp 12 at position 9, conductor 21, winding of relay 22 to battery. The closing 10 of this circuit causes the lighting of line lamp 12 at the position indicated at 9, as well as corresponding lamps at each of the other attendants' positions, and also causes the operation of relay 22. The operation of 15 relay 22 closes a circuit from ground, back contact of relay 23, make contact of relay 22, winding of relay 24 to battery. The closing of this circuit operates relay 24, which in turn operates relay 23, by a circuit 20 from battery, through the winding of relay 23, make contact of relay 24 to ground. The operation of relay 23 causes the operation of a device such as a buzzer 25, by a circuit from ground, make contact of relay 23, wind- 25 ing of buzzer 25 to battery. The operation of relay 23 also opens the operating circuit of relay 24, causing it to release and in turn causing the release of relay 23. Relays 23 and 24 are slow release relays and operate 30 and release alternately and cause the buzzer 25 to give a distinctive signal whereby the operators at each position are apprised of an incoming call.

In response to the lighting of lamp 12, an 35 attendant for instance at position 9 may answer the incoming call by operating key 11 to its talking position, thereby closing a circuit from ground, winding of relay 10, contact 26 of key 11, conductor 27, winding 40 of relay 18 to battery. The closing of this circuit causes the energization of relay 18, which, upon operating, opens the locking circuit previously referred to, whereby relay 17 was held energized. The de-energization 45 of relay 17 opens the circuit previously described whereby line lamp 12 was lighted and relay 22 was operated, thereby extinguishing line lamp 12 as well as corresponding lamps at the other positions and releasing relay 22. The operation of relay 18 50 closes a circuit through its front contact from ground, conductor 28, filament of lamp 13 to battery. The closing of this circuit causes the lighting of the busy (or hold) 55 lamp 13 and corresponding lamps at other positions. The closing of the circuit whereby relay 18 was operated, causes the energization of relay 10, which upon operating connects the attendant's telephone set at the po- 60 sition indicated at 9 with the talking conductors, in an obvious manner, and also causes the operation of relay 29 over a circuit from ground, lower make contact of relay 10, winding of relay 29 to battery.

65 If, after answering the call the attendant

desires to hold the connection, for instance until the subscriber at station 8 answers, the talking key 11 is released from its talking position and operated to its holding position. 70 The release of key 11 from its talking position causes the release of relays 10 and 18. Relay 29, which is provided for the purpose of preventing false signals caused by the accidental operation of the keys, operated 75 when relay 10 operated as just described. This relay is slow to release and remains energized momentarily and upon the operation of the key 11 to its holding position during this period a circuit is closed from ground, lower back contact of relay 10, make contact 80 of relay 29, make contact 30 of key 11, conductor 31, winding of relay 32 to battery. The closing of this circuit energizes relay 32, which upon operating closes a circuit 85 through its outer right-hand contact and through winding of marginal relay 33, thereby connecting said marginal relay across the line, thereby closing a circuit through said relay over the tip 90 and ring conductors of the line and connected cord circuit (not shown) in a well understood manner. The marginal relay is provided for the purpose of preventing false 95 line signals should the key 11 be operated to its holding position accidentally, and said relay will not operate unless a cord circuit is connected with the jack 5. Therefore said marginal relay will release in case of an abandoned call or when the cord circuit is 100 disconnected from the line. The marginal relay 33 under the present condition operates and closes a locking circuit from battery, winding and left-hand contact of relay 32, conductor 34, make contact of marginal re- 105 lay 33, conductor 35, back contact of relay 18 to ground, relay 18 having released when key 11 was operated to its holding position. The operation of relay 32 closes a circuit from ground through its right-hand middle 110 make contact, conductor 36, winding of relay 37, conductor 38, winding of relay 39 to battery. The closing of this circuit causes the operation of relays 37 and 39. The opera- 115 tion of relay 37 closes a circuit from ground, resistance 42, inner make contacts of relays 37 and 32, conductor 28, filament of lamp 13 to ground. The closing of this circuit will not cause the lamp 13 to light because of in- 120 sufficient current supply due to the inclusion of the resistance 42 in the circuit. The operation of relay 39 closes a circuit through its make contact from battery, winding of relay 40, make contact of relay 39, back con- 125 tact of relay 41 to ground, causing the operation of relay 40. Relay 40 upon operating causes the operation of relay 41 by a circuit from battery, winding of relay 41, make contact of relay 40 to ground on the arma- 130 ture of relay 41. The operation of relay 41 opens the circuit just described for relay 40

and it releases and in turn releases relay 41, at which time relay 40 again operates. Thus the relays 40 and 41 alternately operate and release and each time the latter relay operates, a circuit is closed through its front contact from ground, make contacts of relay 37, inner right hand contact of relay 32, conductor 28, filament of (busy or) hold lamp 13 to battery. The intermittent closure of this circuit shunts resistance 42 and causes the (busy and) hold lamp 13 to flash, thereby serving as an indication to the attendants at the various positions that the line is being held.

When the subscriber at station 8 responds to the incoming call, relay 43 will be operated by a circuit through its winding and through the switch hook at the substation, over the tip and ring conductors and through the tip and ring contacts of jack 5 and through the connected cord (not shown) at the main exchange in a well known manner. The operation of relay 43 closes a circuit from ground through its make contact, conductor 44, winding of relay 18 to battery. The closing of this circuit causes the operation of relay 18, and short-circuits relay 10 at position 9 as well as corresponding relays at the associated positions, and prevents the operators at any of the positions from obtaining access to the trunk at such time. The operation of relay 18 also closes a circuit over conductor 28 which causes the (holding or) busy lamp 13 to light, as previously described when the attendant first answered.

Should the substation 8 respond to the ringing of the bell thereat and answer an incoming call before an attendant at any of the positions answers said call, relay 43 will operate and cause the operation of relay 18 as just described, and the latter relay will function to short-circuit the relay 10 and corresponding relays at all the positions and also cause the deenergization of relay 17 and cause the substitution of the busy (or holding) lamp 13 in place of the line lamp 12 in a manner formerly indicated in connection with the operation of key 11.

At the termination of a call when the receiver at the substation 8 is returned to its hook, or when the attendant after answering a call has returned the key to normal, the relays release and the circuit returns to normal in an obvious manner. When the circuit returns to normal the supervisory lamp in the connected cord circuit at the central office will light in a well understood manner, and the operator thereat in response to the lighting of said lamp, will take down the connection.

Although this invention has been illustrated and described in connection with only one attendant's position, it will be understood that a plurality of attendants' po-

sitions may be connected with the incoming trunk line, and each position may have equal access to said trunk.

It will be obvious that the general principles herein disclosed may be embodied in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the appended claims.

What is claimed is:

1. A trunk line interconnecting a central office and a substation, ringing responsive apparatus associated with said line, signaling means controlled thereby, a second signaling means, a circuit including two relays connected in series, switching means adapted to be thrown in talking position or in holding position, operator's telephone apparatus, said switching means operating when thrown in talking position to close said circuit and to operate said relays whereby one of said relays will connect said operator's set to said line and the other of said relays will operate said second signaling means, and means associated with said line and operative when the subscriber at said substation responds for short-circuiting the portion of said circuit including said first relay.

2. A trunk line interconnecting a central office and a substation, ringing responsive apparatus associated with said line, signaling means controlled thereby, a second signaling means, a circuit including two relays connected in series, switching means adapted to be thrown in talking position or in holding position, operator's telephone apparatus, said switching means operating when thrown in talking position to close said circuit and to operate said relays whereby one of said relays will connect said operator's set to said line, and the other of said relays will operate said second signaling means, means operative when said switching means are thrown in said holding position for causing said second signaling means to operate intermittently, and means associated with said line and operative when the subscriber at said substation responds for short-circuiting the portion of said circuit including said first relay.

3. In a telephone system, a main exchange, a private branch exchange, a trunk line interconnecting said main exchange and private branch exchange, a substation at said branch exchange connected directly with said trunk line, a plurality of operators' positions associated with said trunk, a key at each position, means at each position responsive to the operation of said key for connecting that position with said trunk line, and means operable upon the removal of the receiver from its hook at said substation for short-circuiting said last mentioned means and permitting access of said

substation to said trunk line to the exclusion of said positions.

4. In a telephone system, a main exchange, a private branch exchange including
5 a substation and a plurality of operators' positions associated therewith, signaling means at each of said positions, a trunk line interconnecting said main exchange and
10 private branch exchange, means associated with said trunk line responsive to the application of ringing current thereto for operating said signaling means, a key at each position, means associated with each key and
15 responsive to the actuation thereof for connecting its position with said trunk, and means operable upon the removal of the receiver from its hook at said substation for permitting access of said station to said trunk line to the exclusion of said positions.

20 5. In a telephone system, a main exchange, a private branch exchange including a substation and a plurality of operators' positions associated therewith, a trunk line interconnecting said main exchange and
25 private branch exchange, ringing responsive apparatus bridged across said trunk line, signaling means controlled thereby, a second signaling means, switching means at each position, means at each position responsive to the operation of said switching
30 means for connecting that position to said trunk line, a relay in series with said last mentioned means for controlling said ringing responsive apparatus and operating said second signaling means, and means operable
35 upon the removal of the receiver from its hook at said substation for short-circuiting said last mentioned means and permitting access of said substation to said trunk line to the exclusion of said positions.

40 6. In a telephone system, a main exchange, a private branch exchange including a substation and a plurality of operators' positions associated therewith, a trunk
45 line for interconnecting said main exchange and said private branch exchange, a ringing responsive relay normally bridged across said trunk, a second ringing responsive relay bridged across said trunk line and in
50 parallel with the first mentioned relay upon the operation of the latter relay, signaling means controlled by said second relay, a second signaling means, and means common to said operators' positions and said substation and responsive to the connection
55 thereof with said trunk line for extinguishing the first mentioned signaling means and operating said second mentioned signaling means.

60 7. In a telephone system, a main exchange, a private branch exchange including a substation and a plurality of operators' positions associated therewith, signaling means at each of said positions, a trunk line interconnecting said main exchange and private

branch exchange, means associated with said trunk line responsive to the application of ringing current thereto for operating said signaling means, switching means at each operator's position adapted to be operated
70 to a talking or holding position, means at each operator's position responsive to the actuation of said switching means to a talking position for connecting that position with said trunk, a relay responsive to the operation of said switching means to a talking
75 position for extinguishing said signaling means, a second signaling means responsive in a distinctive manner upon the actuation of said switching means to a talking or holding position respectively, and means operable upon the removal of the receiver from its hook at said substation for permitting access
80 of said station to said trunk to the exclusion of said positions.

8. In a telephone system, a main exchange, a private branch exchange including a substation and a plurality of operators' positions associated therewith, signaling
90 means at each of said positions, a trunk line for interconnecting said main exchange and private branch exchange, ringing responsive apparatus associated with the said trunk line for controlling said signaling means, a second signaling means, switching means adapted to be operated to a talking or holding position, means responsive to the actuation of said switching means to a talking position for connecting said position with the
95 said trunk line and extinguishing said first mentioned signaling means and substituting said second signaling means, means responsive to the operation of said switching means to a holding position for establishing a holding bridge across said trunk and for operating
100 said second signaling means in a manner distinctive from that first mentioned, and means operative when the subscriber at said substation responds for permitting access of said substation to said trunk line to the exclusion of the said positions.

9. In a telephone system, a main exchange, a private branch exchange including a plurality of associated operators' telephone apparatus, a trunk line for interconnecting said
115 main exchange and private branch exchange, switching means adapted to be operated to a talking or holding position, a relay responsive to the actuation of the switching means to a talking position for connecting said telephone apparatus with said trunk line, and means controlled by said relay and responsive to the actuation of the switching means to a holding position for preventing accidental holding of said trunk line in busy condition.

10. In a telephone system, a main exchange, a private branch exchange including a plurality of operators' telephone apparatus, a trunk line for interconnecting
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said main exchange and private branch exchange, signaling means associated with each of said operator's apparatus for indicating the busy or holding condition of said trunk
5 line, switching means adapted to be operated to a talking or holding position, means responsive to the actuation of the switching means to a talking position for connecting said telephone apparatus with the trunk line,
10 and means including a marginal relay bridged across said trunk line controlled by

the operation of the switching means to a holding position for operating said signaling means, said means being responsive only when the trunk line is in talking connection
15 with the said main exchange.

In testimony whereof, we have signed our names to this specification this 6th day of July 1921.

JOHN F. TOOMEY.
HENRY E. PHELPS.