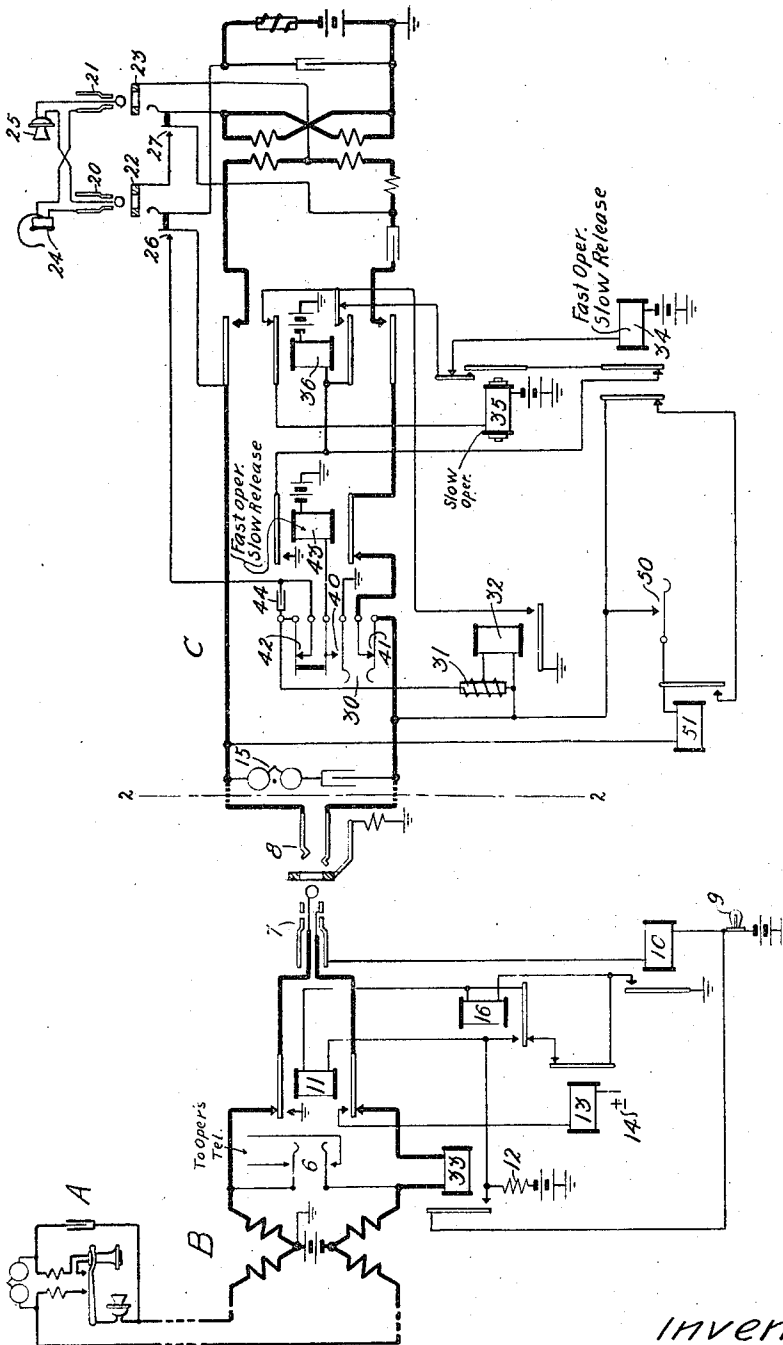


F. E. ANDERSON.
 TELEPHONE EXCHANGE SYSTEM.
 APPLICATION FILED JAN. 8, 1918.

1,279,489.

Patented Sept. 24, 1918.



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UNITED STATES PATENT OFFICE.

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TELEPHONE EXCHANGE SYSTEM.

1,279,489.

Specification of Letters Patent. Patented Sept. 24, 1918.

Application filed January 8, 1918. Serial No. 210,863.

To all whom it may concern:

Be it known that I, FREDERICK E. ANDERSON, a citizen of the United States, residing at Newark, in the county of Essex, State of New Jersey, have invented certain new and useful Improvements in Telephone-Exchange Systems, of which the following is a full, clear, concise, and exact description.

This invention relates to telephone exchange systems and more particularly to such systems employing trunk circuits extending from operators' positions of a switchboard to chief operators' desks, information and supervisory operators' positions and like positions.

The object of this invention is to provide improved signaling means for such systems.

In accordance with one feature of this invention, a trunk circuit equipped with a key at the desk end for opening and closing a direct current bridge of the talking circuit to cause the operation of a signaling device in the connected link circuit at the switchboard, is provided with a condenser, a relay and circuit connections which cooperate upon the actuation of the key to reduce to a minimum the usual disagreeable clicks to the desk operator whose telephone set is at the time connected with the trunk circuit and to the subscriber whose line, at that time, may be connected with the other end of the link circuit.

In accordance with another feature of this invention, the desk end of the trunk circuit is provided with a relay which in operating under control of a key, is bridged across and holds the trunk circuit while the desk operator's telephone set is disconnected therefrom to enable the operator to attend to other duties, and is disconnected from the trunk circuit when the desk operator's telephone set is again connected therewith.

For a more complete understanding of this invention, reference should be had to the following description considered in connection with the accompanying drawing illustrating one embodiment thereof.

There is shown in the drawing, a telephone line A extending to a central office where it may be connected in any suitable manner with a cord circuit B, which may be employed to connect the telephone line A with

a trunk circuit C extending from the answering operator's position of the switchboard at which telephone line A terminates, to an information operator's desk. The apparatus shown to the left of the dotted line 2—2 is associated with the answering operator's position, and that shown to the right of this dotted line is associated with the information operator's desk. It is thought that the nature of this invention is such that it can be well understood from a description of the operation of the system shown in the drawing; and it will be so described.

Subscriber A having initiated a call and the answering end of the cord circuit B having been connected therewith in any well-known and suitable manner, the operator actuates listening key 6 to connect the operator's telephone set with the calling line. Upon being advised that the calling subscriber desires to converse with the information operator, the switchboard operator restores the listening key 6 to normal position and inserts calling plug 7 into jack 8 of the trunk circuit C. Calling supervisory lamp 9 is thereupon lighted and relay 10 is operated. Relay 10, in operating, causes the energization of ringing relay 11 over a circuit from battery through resistance 12, the winding of ringing relay 11, normal contacts of relay 16 and trip relay 13, and the contact of relay 10 to ground. Ringing relay 11, upon being energized, connects a source of ringing current 14 through the winding of trip relay 13 to the trunk circuit for causing the operation of a call bell 15 located at the information operator's desk.

The information operator in response to the operation of the call bell 15, inserts plugs 20 and 21 into the jacks 22 and 23. To the sleeve contacts of the plugs 20 and 21 is connected the receiver 24, and to the tip contacts thereof is connected the transmitter 25 of the information operator's telephone set. These plugs may form a twin plug by being securely held together in the manner disclosed either in the Patent No. 1,039,156 to Lyng or in Patent No. 1,101,731 to De Vignier. When those two plugs form a twin plug, the jacks 22 and 23 should be mounted close together to be simultaneously engaged by the plugs. The insertion of the plug 20

into the jack 22 causes the closure of a local contact 26, and the insertion of plug 22 into jack 23 causes the closure of a local contact 27. The closure of local contact 27 after the engagement of the tip contacts of the plugs and jacks insures that the receiver circuit is established after the transmitter circuit is closed, thereby eliminating clicks to the operator. When withdrawing the plugs from the jacks, contact 27 opens before tip contacts of the plugs and jacks disengage, thereby insuring the opening of the receiver circuit before the transmitter circuit is opened to prevent any clicks to the operator. Upon the closure of the local contact 26, ringing current finds a path through the upper closed contact of a flashing key 30, retardation coil 31 and the winding of relay 32 connected in parallel with a portion thereof. This path is of sufficiently low impedance to permit the operation of trip relay 13. This trip relay 13 in operating opens the short-circuit about the winding of relay 16 which immediately operates, establishing a locking circuit for itself and a short-circuit about the winding of ringing relay 11, which thereupon releases, disconnecting the source of ringing current 14 from the trunk circuit. Upon the release of the ringing relay 11, supervisory relay 33 is operated to establish a shunt circuit including resistance 12 about the calling supervisory lamp 9, thereby extinguishing the lamp. Relay 32 may close its contact when traversed by ringing current from the source 14, but if it does not then close its contact, it becomes fully energized when the source of direct current is substituted for the source of ringing current. Relay 32 upon being fully energized, closes energizing circuits through a fast operating and slow releasing relay 34 and through a slow operating relay 35. The circuit for relay 34 may be traced from battery through the winding of relay 34, normal contact of relay 35, lower normal contact of relay 36 and the contact of relay 32 to ground. The energizing circuit of relay 35 may be traced from battery through the winding of relay 35, upper normal contact of relay 36 and the contact of relay 32 to ground.

Fast operating relay 34 in attracting its armatures opens its contacts, the right-hand contact being in the energizing circuit of relay 36. Slow operating relay 35 upon attracting its armature opens the circuit of relay 34 and closes a contact in the energizing circuit of relay 36, so that upon the release of slow releasing relay 34, relay 36 is operated over a circuit from battery through the winding of relay 36, right-hand contact of relay 34, alternate contact of relay 35, lower contact of relay 36 and contact of relay 32 to ground. Relay 36 in operating closes its middle alternate contact, thereby establishing a locking circuit for itself through the

contact of relay 32 to ground. The opening of the normal contacts of relay 36, opens the energizing circuits of both relays 34 and 35 so that these relays cannot be energized again until after the release of relay 36. Relay 36 in operating, also closes its upper and lower alternate contacts, thereby connecting the operator's telephone set with the trunk circuit. In this way by delaying the closure of the upper and lower alternate contacts of relay 36, until after ringing current has been disconnected from the trunk circuit and direct current has been substituted therefor, the usual severe clicks in the operator's receiver, due to the disconnection of the ringing current, are avoided.

After having conversed with the calling subscriber A, the information operator may desire to signal the operator at the switchboard in order to give the switchboard operator instructions for completing another connection for subscriber A. This signaling of the operator at the switchboard is accomplished by the repeated actuation of the flashing key 30 to cause the intermittent lighting of the calling supervisory lamp 9. This key is constructed so that when operated, its middle contact 40 is first closed, its lower contact 41 is then opened, and finally its upper contact 42 is opened. When the key is restored to normal position, contact 42 is first closed, then contact 41 is closed, and finally contact 40 is opened. Upon the actuation of this flashing key 30, the closure of its contact 40 causes the energization of a fast operating and slightly slow releasing relay 43, which opens its lower and closes its upper contact. The opening of the lower contact introduces a break in circuit of the operator's receiver 24, and the closure of the upper contact establishes a holding circuit for relay 36 in parallel with its middle alternate contact and the contact of relay 32. The opening of contact 41 of the key 30 introduces another break in circuit with the operator's receiver 24, and the opening of contact 42 opens the direct current bridge across the trunk circuit which includes the retardation coil 31 and the relay 32; relay 32 thereupon releases its armature.

The inductive discharge from the portion of the retardation coil 31 included in parallel with the winding of the relay 32, serves to render the relay quick in releasing. Upon the opening of contact 42, a condenser 44 is included in circuit with the retardation coil 31 and the relay 32. The inductive discharge from the impedance coil connected across the trunk circuit surges over the trunk circuit and would ordinarily cause, through the inductive action of the repeating coil in the cord circuit, a very severe click in the receiver of calling subscriber A. However, since condenser 44 is included in circuit with the retardation coil upon the opening of contact

42, this condenser, which is not at that time charged, becomes charged, due to the inductive discharge of the retardation coil, and thereby serves effectively to reduce the click to the calling subscriber.

Since the operator's receiver 24 is disconnected from the trunk circuit before contact 42 is opened, this inductive discharge from the retardation coil 31 does not find a path through the operator's receiver 24. The opening of the direct current bridge across the trunk circuit upon the opening of contact 42, causes the release of supervisory relay 33, whereupon the calling supervisory lamp 39 is lighted.

The restoration of key 30 to normal position causes the closure of contact 42, which reestablishes the direct current bridge across the trunk circuit and provides a discharge path for the condenser 44. Immediately upon the establishment of this bridge, supervisory relay 33 is energized to efface the lamp 9, and relay 32 is operated to close its contact. The closure of contact 42 is then followed by the closure of contact 41, and finally contact 40 is opened, thereby releasing relay 43, which opens its upper and closes its lower contact. Relay 32 is energized upon the reestablishment of the direct current bridge across the trunk circuit, and closes its contact before relay 43 releases, so that relay 36 is held operated. Since the lower contact of relay 43, which is in circuit with the operator's receiver 24 closes after the establishment of the direct current bridge, there is no surge of current through the operator's receiver when this lower contact of relay 43 is closed. In this way the clicks to the information operator are reduced to a minimum.

While the plugs 20 and 21 engage the jacks 22 and 23 and the flashing key 30 is in normal position, the switchboard operator may, by withdrawing the plug 7 from the jack 8 and immediately reinserting it therein, attempt to re-ring the information operator. When the plug 7 is withdrawn from the jack 8, the energized relays of the cord and trunk circuits are released. Reinsertion of the plug 7 into the jack 8, causes the operation of relays 10 and 11 of the cord circuit, followed by the immediate operation of the trip relay 13, whereupon locking relay 16 operates, short-circuiting the ringing relay and disconnecting ringing current from the trunk circuit. Relay 32 in the trunk circuit operates, whereupon relays 34, 35 and 36 operate as already described, and relay 36 locks up. Relays 34 and 35 are then maintained deenergized. It will be seen, therefore, that the information operator's telephone set remains disconnected from the trunk circuit until after ringing current has been disconnected therefrom and the source of direct current substituted therefor. There-

fore the usual severe clicks attending the tripping of the ringing current from an automatic ringing cord circuit are prevented.

The inductive discharge of the portion of the retardation coil 31 which is connected in parallel with the winding of relay 32 through that winding, serves to speed up the release of this relay when the plug 7 is withdrawn from the jack 8, thereby insuring that the information operator's telephone set will be disconnected from the trunk circuit when ringing current is connected to the trunk circuit upon the reinsertion of the plug 7 into the jack 8.

If while the plugs 20 and 21 are inserted in the jacks 22 and 23, and the cord circuit is connected with the trunk circuit, the information operator finds that she must disconnect therefrom and attend to other duties for the moment, the connection over the trunk circuit may be held and the supervisory lamp 9 may be maintained effaced while the information operator's telephone set is disconnected from the trunk circuit. This may be accomplished by the momentary actuation of the key 50, which in being operated connects a relay 51 across the talking strands of the trunk circuit. This relay 51 is thereupon energized and closes its contact, thereby establishing a locking circuit for itself, which includes the left-hand contact of the fast operating and slow releasing relay 34. After this key 50 has been momentarily actuated and the relay 51 locked up, the information operator's plugs may be withdrawn from the jacks. Relay 32 thereupon releases, followed by the release of relay 36 which opens its upper and lower alternate contacts, which are in circuit with the operator's telephone set. Later when the information operator reinserts the plugs within the jacks, the closure of contact 26 causes the operation of relay 32, whereupon relays 34, 35 and 36 operate in the manner hereinbefore described to connect the operator's telephone set with the trunk circuit. The operation of relay 34 opens the locking circuit of relay 51 which is thereupon disconnected from the trunk circuit and releases its armature.

What is claimed is:

1. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a telephone set, a link circuit connecting the telephone set with the trunk circuit, a signaling device for the link circuit, a direct current inductive bridge for the talking conductors, a manually operated switch at the second switchboard controlling the operation of the signaling device and adapted when actuated to interrupt the inductive bridge, and a condenser included in circuit with the inductive bridge upon the actuation of the switch to absorb the charge

of current resulting from the discharge of the inductive bridge upon the opening thereof.

2. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signaling device for the link circuit, an operator's telephone set at the second switchboard having the receiver thereof connected with the talking conductors, a direct current inductive bridge for the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device, and means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened.

3. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signaling device for the link circuit, an operator's telephone set at the second switchboard having the receiver thereof connected with the talking conductors, a direct current inductive bridge for the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device, and means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened and responsive to the restoration of the switch to normal position to close the opened talking conductor after the bridge has been reestablished.

4. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signaling device for the link circuit, an operator's telephone set at the second switchboard having the receiver thereof connected with the talking conductors, a direct current inductive bridge for the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device, means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened, and a relay responsive to the restoration of the switch to normal position to close the one talking conductor after the bridge has been reestablished.

5. A telephone exchange system comprising a trunk circuit including a pair of con-

ductors extending from a first to a second switchboard, a link circuit at the first switchboard, a signaling device for the link circuit, a direct current bridge for the talking conductors, inductive means in the bridge including a relay energized when the link circuit is connected with the trunk circuit, an operator's telephone set, a second relay energized while the first relay is energized to connect the receiver of the operator's telephone set with the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device and to deenergize the first relay, and means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened and to maintain the second relay energized.

6. A telephone exchange system comprising a trunk circuit including a pair of conductors extending from a first to a second switchboard, a link circuit at the first switchboard, a signaling device for the link circuit, a direct current bridge for the talking conductors, inductive means in the bridge including a relay energized when the link circuit is connected with the trunk circuit, an operator's telephone set, a second relay energized while the first relay is energized to connect the receiver of the operator's telephone set with the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device and to deenergize the first relay, a third relay responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is open, and a circuit completed upon the energization of the third relay for maintaining the second relay energized.

7. A telephone exchange system comprising a trunk circuit including a pair of conductors extending from a first to a second switchboard, a link circuit at the first switchboard, a signaling device for the link circuit, a direct current bridge for the talking conductors, inductive means in the bridge including a relay energized when the link circuit is connected with the trunk circuit, an operator's telephone set, a second relay energized while the first relay is energized to connect the receiver of the operator's telephone set with the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device and to deenergize the first relay, a third relay energized upon the actuation of the switch to open one of the talking conductors extending to

the operator's receiver before the bridge is opened and deenergized upon the restoration of the switch to normal position to close the one talking conductor after the bridge has been reestablished, and a circuit established while the switch is actuated for maintaining the second relay energized.

8. A telephone exchange system comprising a trunk circuit including a pair of conductors extending from a first to a second switchboard, a link circuit at the first switchboard, a signaling device for the link circuit, a direct current bridge for the talking conductors, inductive means in the bridge including a relay energized when the link circuit is connected with the trunk circuit, an operator's telephone set, a second relay energized while the first relay is energized to connect the receiver of the operator's telephone set with the talking conductors, a manually operated switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device and to deenergize the first relay, means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened, a circuit established while the switch is actuated for maintaining the second relay energized, and a relay responsive to the restoration of the switch to normal position to close the one talking conductor after the bridge has been reestablished.

9. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a telephone set, a link circuit connecting the telephone set with the trunk circuit, a signaling device for the link circuit, an operator's telephone set at the second switchboard having the receiver thereof connected with the talking conductors, a direct current inductive bridge for the talking conductors, a manually controlled switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device, means connected in circuit with the inductive bridge upon the actuation of the switch to absorb the charge of current resulting from the discharge of the inductive bridge upon the opening thereof, and means also responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened.

10. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a telephone set, a link circuit connecting the telephone set with the trunk circuit, a signaling device for the link circuit, an operator's telephone set at the second switchboard having the receiver

thereof connected with the talking conductors, a manually controlled switch at the second switchboard adapted when actuated to open the bridge thereby to cause the operation of the signaling device, a condenser connected in circuit with the inductive bridge upon the actuation of the switch to absorb the charge of current resulting from the discharge of the inductive bridge upon the opening thereof, means responsive to the actuation of the switch to open one of the talking conductors extending to the operator's receiver before the bridge is opened, and a relay responsive to the restoration of the switch to normal position to close the one talking conductor after the bridge has been reestablished.

11. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signal control relay in the link circuit energized when the link circuit is connected with the trunk circuit, an operator's telephone set at the second switchboard, means for connecting and disconnecting the operator's telephone set to and from the trunk circuit, a switch at the second switchboard, a relay thereat connected across the talking conductors by the momentary actuation of the switch and thereupon energized over a circuit including portions of the talking conductors and the connected link circuit, a locking circuit for the relay established upon the energization thereof for maintaining the signal control relay energized while the operator's telephone set is disconnected from the trunk circuit, and means responsive to the subsequent connection of the operator's telephone set with the trunk circuit to open the locking circuit.

12. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signal control relay in the link circuit energized when the link circuit is connected with the trunk circuit, an operator's telephone set at the second switchboard, means for connecting and disconnecting the operator's telephone set to and from the trunk circuit, a switch at the second switchboard, a relay thereat connected across the talking conductors by the momentary actuation of the switch and thereupon energized over a circuit including portions of the talking conductors and the connected link circuit, a locking circuit for the relay established upon the energization thereof for maintaining the signal control relay energized while the operator's telephone set is disconnected from the trunk circuit, and a relay momentarily energized when the oper-

ator's telephone set is being subsequently connected with the trunk circuit to open the locking circuit.

13. A telephone exchange system comprising a trunk circuit including a pair of talking conductors extending from a first to a second switchboard, a link circuit at the first switchboard connected with the trunk circuit, a signal control relay in the link circuit, an operator's telephone set at the second switchboard, means for connecting and disconnecting the operator's telephone set to and from the trunk circuit, an energizing circuit for the signal control relay established while the operator's telephone set is connected with the trunk circuit, a switch at the second switchboard, a relay thereat connected across the talking conductors by the momentary actuation of the switch and thereupon energized over a circuit including portions of the talking conductors and the connected link circuit, a locking circuit for the relay established upon the energization thereof for maintaining the signal control relay energized while the operator's telephone set is disconnected from the trunk circuit, and a relay momentarily energized when the operator's telephone set is being subsequently connected with the trunk circuit to open the locking circuit.

14. A telephone exchange system comprising a trunk circuit including a pair of talk-

ing conductors extending from a first to a second switchboard a link circuit at the first switchboard connected with the trunk circuit, a signal control relay in the link circuit energized when the link circuit is connected with the trunk circuit, an operator's telephone set at the second switchboard, means for connecting and disconnecting the operator's telephone set to and from the trunk circuit, a bridge for the talking conductors established while the operator's telephone set is connected with the trunk circuit, an energizing circuit for the signal control relay including the bridge, a switch at the second switchboard, a relay thereat connected across the talking conductors by the momentary actuation of the switch and thereupon energized over a circuit including portions of the talking conductors and the connected link circuit, a locking circuit for the relay established upon the energization thereof for maintaining the signal control relay energized while the operator's telephone set is disconnected from the talking conductors, and a relay momentarily energized when the operator's telephone set is being subsequently connected with the trunk circuit to open the locking circuit.

In witness whereof, I hereunto subscribe my name.

FREDERICK E. ANDERSON.