

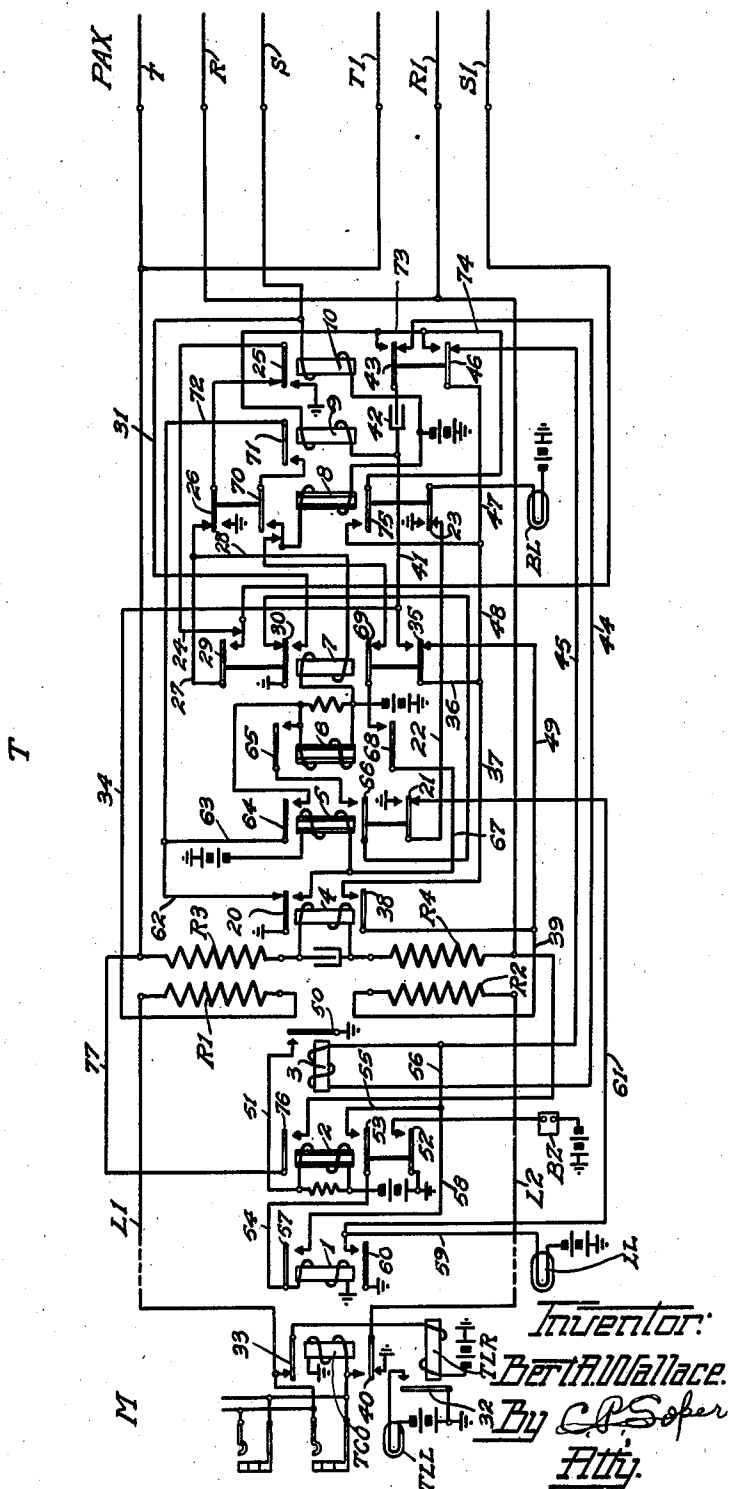
Feb. 9, 1943.

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2,310,481

TWO-WAY TRUNK CIRCUIT

Filed Oct. 5, 1940



UNITED STATES PATENT OFFICE

2,310,481

TWO-WAY TRUNK CIRCUIT

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Application October 5, 1940, Serial No. 359,838

12 Claims. (Cl. 179—43)

This invention relates to two-way trunk circuits and especially to those for interconnecting common battery or dial main exchanges and unattended automatic private branch exchanges.

One feature of this circuit is for an incoming trunk call from a main exchange to actuate a trunk line call lamp, which latter is installed in sight of so many local telephones as desired. A common signaling means is operated during the ringing period. Any local station may respond to the call. Another feature precludes ringing in the called station receiver if connection is established during the ringing period. Another feature precludes main exchange answer supervision until the private branch answers, to correctly time toll calls. Another feature permits holding a call while another extension is dialed.

Outgoing calls can be obtained by dialing a different assigned number for the trunk, with through supervision and dialing.

One object of this invention is to provide a two-way trunk circuit with any of the foregoing features or any combinations thereof.

The drawing comprises a single figure illustrating a preferred circuit diagram embodying features of this invention.

Considering the drawing in greater detail, a two-way trunk circuit is shown with a main exchange portion M, an intermediate trunk body portion T, and a portion connected to the local unattended private automatic exchange PAX. The main exchange may be a common battery or dial exchange, while the private automatic exchange can be of the switch or relay type.

The features of the trunk circuit will be explained more in detail by a description of operation. The operation of the circuit in sending an outgoing call from the unattended private automatic exchange will be described first.

A separate number is assigned to each trunk for incoming calls and another for outgoing calls. Any station may make an outgoing call by dialing one of the numbers assigned to each trunk for out calls only. The called trunk will test busy if it is in use on a previous out call, or if the trunk is in use on an incoming call, or if it is being held during a transferred call. The first type operation will be described first and the latter two operations will be described later. The calling party will hang up when the first called trunk tests busy, and will dial another trunk number. Through supervision and through dialing is provided on the outgoing connections.

Outgoing call

The local substation PAX dials its appropriate local exchange number assigned for out service to a trunk. On the assumption that the trunk illustrated is idle and the one called, the automatic private exchange connects the calling subscriber to the trunk circuit terminals T1, R1 and S1. Relay #4 is energized by the tip and ring circuit completed in the automatic exchange system. The circuit in the trunk is from tip T1 to repeater coil R3, the winding of relay #4, repeater coil R4, to the terminal of ring R1. Relay #4 in turn completes the circuit of relay #5 as follows: ground to armature 20 and front contact of relay #4 through winding of #5 to battery and ground. The operation of relay #5 operates the busy lamp BL by a circuit from ground through front contact and armature 21 of relay #5, conductor 22, back contact and armature 23 of relay #8, to busy lamp BL, battery and ground. This protects the trunk line from further incoming calls during its use. The lamp may be multiplied to different local substations if necessary.

The sleeve contact S1 connects a ground to the circuit of relay #7 as follows: sleeve S1 to back contact of relay #7, conductor 24, armature 25 and back contact of relay #10, armature 26 and back contact of relay #8, conductors 27 and 28, and winding of relay #7 to battery and ground. The operation of relay #7 opens its original operating circuit at the normal contact of terminal conductor 24 and completes a locking circuit for itself through armature 29 as follows: grounded battery, winding of #7, conductor 28, armature 29 and front contact of relay #7 to the sleeve terminal S1.

Relay #7 in turn completes the circuit of relay #10 which latter operates through a circuit: ground to armature 30 and front contact of relay #7, conductor 31 and winding of relay #10 to battery and ground. Relay #7 at the same time puts a ground on terminal S for busy test to prevent intrusion.

Upon operation of relays #7 and #4, their armatures 35 and 39, signal the main exchange by the trunk line lamp TLL, which latter has its circuit completed by the front contact and armature 32 of trunk line relay TLR. The circuit for the relay TLR is: grounded battery, winding TLR, armature 33 and back contact of trunk cutoff relay TCO, conductor L1, repeater coil R1, conductor 34, front contact and armature 35 of relay #7, conductors 36 and 37, front

contact and armature 38 of relay #4, conductor 39, repeater coil R2, line L2 to armature 40 and back contact of TCO, to ground. The operator at the common battery main exchange may insert an answering plug or, if a dial exchange, the automatic operation is carried through.

The answering plug operates the trunk line cutoff relay TCO, releasing the trunk line relay and trunk line lamp; while at the same time completing line L2 connection at armature 40.

After the calling party hangs up, to terminate the call, the circuit of relay #4 is broken at T1 and R1. The release of relay #4 in turn releases relay #5. The release of armature 38 of relay #4 breaks the circuit between the two repeater coils R1 and R2 to give the main exchange a disconnect signal. The broken circuit is: 39 to armature 38 to conductors 37 and 35, armature 35 to conductor 34.

The operation of relay #5 effaces the busy lamp BL. The removal of ground on sleeve S1 releases relay #7. Release of relay #7 releases relay #10 at armature 30 and removes the busy test from S. The trunk is now ready for further use by in or out calls.

Incoming calls

The operation of the trunk circuit will now be described in connection with an incoming call from the common battery or dial main exchange M. In this case, although the trunk may connect with a regular common battery local line at the main exchange, the line and cord batteries are reversed so as to provide supervision and release in case a call is not answered at the local automatic exchange.

The calling plug being in a jack at M causes the operation of relay TCO. The main exchange applies ringing current (A. C.) to the line conductors L1 and L2 to operate relay #3 over the circuit: tip to L1 to repeater R1, conductor 34, conductor 41, condenser 42, armature 43 and back contact of relay #10, conductor 44, winding of relay #3, conductor 45, back contact and armature 46 of relay #10, conductor 47, conductors 48 and 36, armature 35 and back contact of #7, conductors 49 and 39, repeater coil R2, L2, armature 40 to sleeve. Relay #3 operates. Relay #3 in turn operates relay #2, which is slow to release, through a circuit: ground to armature 50 and front contact of #3, conductor 51, winding of #2 to battery and ground. Relay #2 at its front contact and armature 25 operates the buzzer BZ located at the local automatic exchange to attract attention to the incoming call.

Relay #2 through its armature 53 connects relay #1 to the line L2 by circuit: ground to winding of #1, conductor 54, armature 53 and front contact of relay #2, conductors 55, 56 and 45, back contact and armature 46 of #10, conductors 47, 48 and 36, armature 35 and back contact of relay #7, conductors 49 and 39 and repeater coil R2 to line L2. Relay #1 operates, and locks itself through its armature 57 and front contact to conductor 58 and the circuit previously traced to battery of the cord at the main exchange. It is of high resistance and does not supervise to the main exchange cord. It energizes the trunk call lamp LL over conductor 59, front contact and armature 60. It also operates the busy lamp BL by circuit: ground to armature 60 and front contact of #1, conductor 61, back contact and armature 21 of relay #5, conductor 22, back contact and armature 23 of relay #8, to busy lamp BL, battery and ground. At

the end of the ringing, relay #3 releases and in turn relay #2 is released. The release of relay #2 terminates the ringing of the buzzer. Relay #1 remains locked in over the trunk circuit to the cord battery.

In answering, one of the subscribers at the unattended private automatic exchange dials the assigned number for answering the calling trunk. This connects the answering substation to the terminals T, R, and S of the trunk. Relay #4 is energized from the common battery over the T and R conductors by circuit: T to repeater coil R3, winding of #4, repeater coil R4, to terminal R. Relay #4 operates and completes a circuit for relay #5 as follows: ground, to armature 20 and front contact of relay #4, winding of slow relay #5, battery and ground. Relay #5 operates and completes a circuit to ground for the busy lamp BL through its armature 21 and front contact.

The sleeve circuit through terminal S operates relay #10 from ground on the link conductor. Relay #10, in operating, places ground on the sleeve S1 to provide a busy potential on the outgoing trunk, by a circuit: S1 to back contact of relay #7, conductor 24, armature 25 and front contact of relay #10 to ground. It also releases relay #1 by breaking its holding circuit to line L2 at armature 46. The release of relay #1 in turn releases line lamp LL, at armature 60. Relay #10 also bridges relay #9 across L1 and L2 to hold supervision at the main exchange M. This circuit is: L1 to R1, 34, 41, winding of #9, front contact and armature 46, 47, 36, armature 35 of relay #7, 49, 39 and R2 to L1. The circuit is now in talking condition.

Release

When the call is over, the answering station hangs up, breaking the circuit of relay #4 at T and R. Relay #4 releases, and in turn releases relay #5 at armature 20. Relay #6 operates and releases. Relay #5 releases and breaks the holding circuit of busy lamp BL. The circuit of relay #10 is also broken at S and it releases. It in turn breaks the supervision to the main exchange at armature 46 tripping relay #9 from across line L1 and L2 and gives a disconnect at M. It also breaks the busy test on S1 at armature 25 and the trunk line is ready for other use.

Transfer

If the subscriber that answered is not the party desired, then the call is transferred at PAX in the following manner. The answering subscriber dials digit "1." Relay #4 releases momentarily on digit "1," causing relay #6 to operate and lock to ground on relay #7, over the following circuits. First: ground to armature 20, conductors 62 and 63, armature 64 and front contact of relay #5 and winding of relay #6 to battery and ground. Relay #6 operates and locks over circuit: ground to battery, winding of #6, front contact and armature 65 of #6, front contact and armature 66 of slow relay #5 and back contact and armature 30 of relay #7 to ground. It operates relay #8. Relay #4 is again operated to hold relay #5. Relay #8 operates and locks to ground over relay #7. The operating circuit is: ground to armature 20 and front contact of relay #4, conductor 67, armature 68 and front contact of relay #6, armature 69 and back contact of relay #7, back contact and winding of #8 to battery and ground. The locking circuit is: grounded battery, winding of relay #8, front con-

tact and armature 70 of relay #8, front contact and armature 71 of relay #9, conductors 72 and 63, armature 64 and front contact of relay #5, front contact and armature 65 of relay #6, front contact and armature 66 of relay #5 and back contact and armature 30 of relay #7 to ground. The operation of relay #8 holds the busy lamp BL at armature 23.

The subscriber now hangs up breaking a circuit of relay #4 releasing it. Relay #8 is now locked to ground through relay #4 at armature 20. Relay #5 is released by relay #4. Relay #6 releases from relay #5 at armature 66. Relay #10 releases. Relay #8 remains holding relay #9 across the main exchange trunk by a circuit; L1 to R1, 34, 41, winding of relay #9, conductors 73 and 74, armature 75 and front contact of relay #8, conductors 48 and 36, armature 35 and back contact of relay #7, conductors 49 and 39, to R2 and L2. The first subscriber notifies the party wanted to call the trunk number.

The wanted party now dials the trunk answering number. Relay #10 operates as before holding the busy test ground on S1 at armature 25. Relay #4 again operates over the new T and R circuit, and in turn releases relay #8 by breaking its holding circuit at armature 20. This breaks the holding circuit of relay #9 at armature 75 but it is still held by the new circuit of relay #10 at armature 46, as before described. Relay #4 operates relay #5 which puts ground on the busy lamp. The winding of relay #9 holds the trunk through coil of relay #9 and armature 38 of relay #4. The new calling subscriber can now hold a conversation over the trunk.

Upon the second subscriber hanging up, the release of the trunk is the same as previously described.

For incoming calls, the operation of relay #2 at its front contact and armature 76, places a short circuit across the repeater coils R3 and R4. The repeater R is preferably of the non-ring through type so as to preclude the answering party from being rung in the ear if the answering connection occurs during the ringing period. Any induced current, which may exist, will not be large enough to operate relay #4 although it would be objectionable in the ear phone. The short circuit also assists in this feature by preventing any induced ringing current from reaching the local. If desirable, the short circuit path 77 can be arranged about only one of coils R3 and R4 in which case there could be no possibility of operation of relay #4 under any circumstances. This special feature precludes the answering party from receiving a ringing current in the earphone during the ringing period.

Relay #1 is of high resistance and will not allow enough current to flow for answer supervision at the main exchange M, until the local has answered and cut relay #1 off of the cord sleeve battery circuit.

This invention is adapted for use in connection with automatic systems of the type disclosed in copending application Ser. No. 350,222, Case 956, filed August 3, 1940. However, it is equally usable for other automatic systems. Although a preferred embodiment is illustrated and described, variations within the true spirit and scope of the same are to be determined by the appended claims.

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

1. A two-way trunk circuit for interconnect-

ing a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local subscriber to answer a call on said trunk in response to operation of said call lamp, and means operable by said answering private automatic exchange subscriber for effecting a holding circuit for said trunk call independent of all private automatic exchange apparatus.

2. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line signal means at the branch exchange to indicate an incoming call, relay means for operating said signal means, means arranged to permit any local station to answer a call on said trunk in response to operation of said signal means, and means responsive to opening and closing of the answering private automatic subscriber's line circuit for effecting a holding circuit for said trunk call.

3. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, and means responsive to opening and closing of the answering private automatic exchange subscriber's line circuit for effecting a holding circuit for said trunk call independent of all private automatic exchange apparatus.

4. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, means operable by said answering private automatic exchange subscriber for effecting a holding circuit for said trunk and means for retaining said holding circuit after said answering subscriber disconnects his line from said trunk.

5. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, and relay means to preclude answer supervision at the main exchange until a party at the branch exchange answers the incoming call.

6. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, and means to preclude answer supervision at the main exchange until a party at the branch exchange answers the incoming call.

7. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to

answer a call on said trunk in response to operation of said call lamp, and means rendered effective by the removal of the main exchange cord to disconnect the call lamp after failure of the local exchange to answer.

8. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, relay means to permit the local station to effect a holding circuit for the trunk call, and means arranged to permit a second station to release the holding circuit and receive the incoming call.

9. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, answering means for an incoming call, calling means for making an outgoing call, and relay means to put a busy test on either the answering or calling means whenever the other is in use.

10. A two-way trunk circuit for interconnecting a main exchange and an unattended private automatic branch exchange, a trunk line call lamp at the branch exchange to indicate an incoming call, relay means for operating said lamp, means arranged to permit any local station to answer a call on said trunk in response to operation of said call lamp, answering means for an

incoming call, calling means for making an outgoing call, relay means placing a busy test on either the answering or calling means whenever the other is in use, and means providing through supervision each way on said trunk.

11. In a trunk circuit for interconnecting a main exchange and an automatic branch exchange, a call lamp at the branch exchange, means for lighting said lamp incident to extending a call over said trunk, means permitting any branch exchange subscriber to connect his line to said trunk to answer a call thereon, a holding circuit in said trunk, means for effecting said holding circuit responsive to the opening and closing of the answering subscriber's line circuit, means whereby said answering subscriber may disconnect his line from said trunk, means whereby another local subscriber may connect his line to said trunk and means responsive thereto for releasing said holding circuit.

12. In a trunk circuit for interconnecting a main exchange and an automatic branch exchange, a call lamp at the branch exchange, means for lighting said lamp incident to extending a call over said trunk, means permitting any branch exchange subscriber to connect his line to said trunk to answer a call thereon, a holding circuit in said trunk, means for effecting said holding circuit responsive to the opening and closing of the answering subscriber's substation circuit, means whereby said answering subscriber may disconnect his line from said trunk, means for retaining said holding circuit after such disconnection and means controlled from said main exchange for releasing said holding circuit.

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