

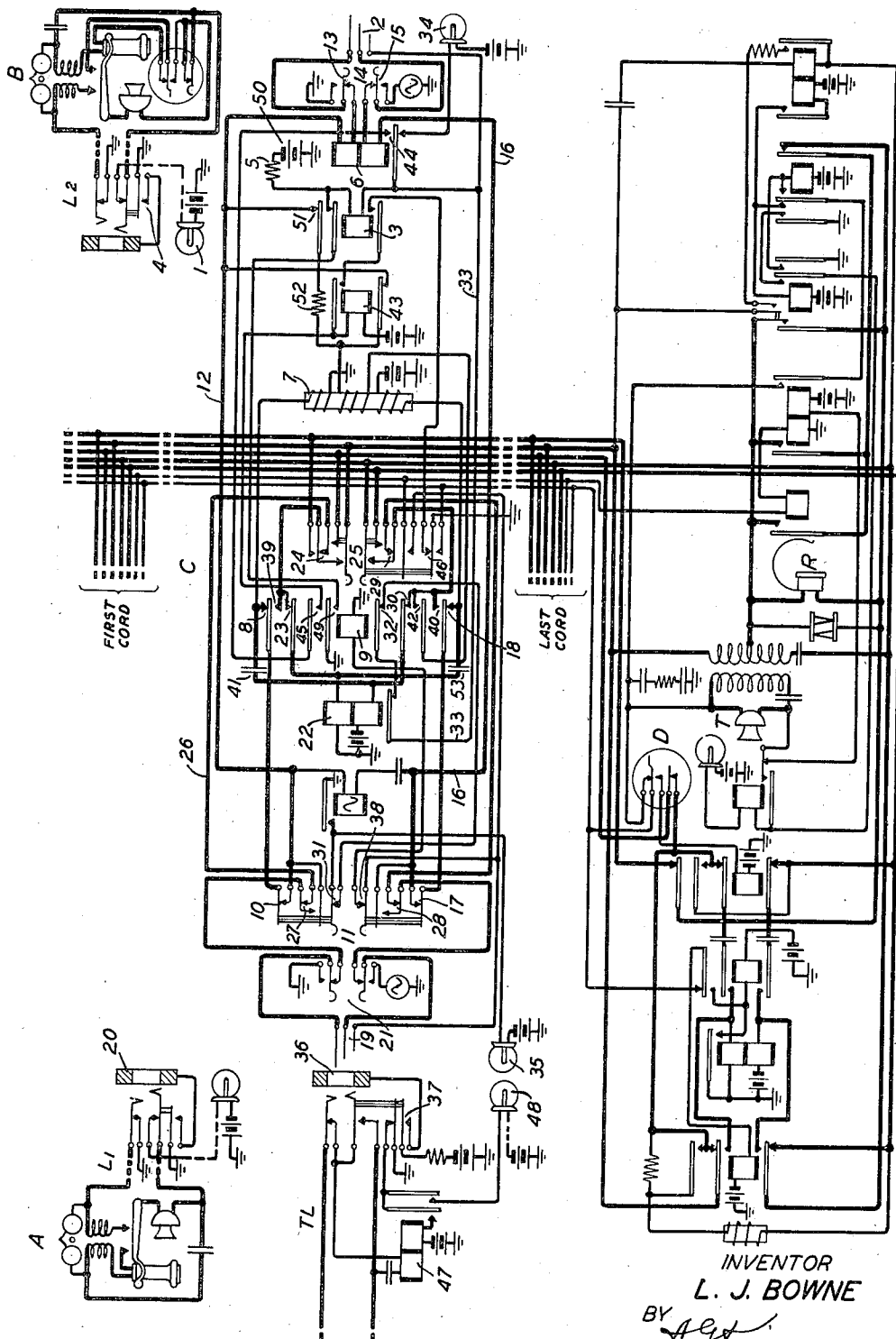
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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This invention relates to telephone exchange systems and more particularly to switchboard cord circuits for connecting telephone lines.

More specifically the invention relates to private branch exchange cord circuits used to connect local stations of the private branch exchange system with a central office trunk line, which cord circuits are arranged to provide through supervision in case the connection is one originating with a local station of the system, i. e., a call from a local station to the central office and to provide non-through supervision in case the connection is originated by a call over the trunk line from the central office.

An object of the invention is to automatically prevent any operation of a connected local station switchhook from affecting the supervisory apparatus at the central office in case the "front" or trunk plug of the cord circuit is connected to the central office trunk line before the "rear" or station end of the cord is connected to the local station line which would be the normal condition when a call is incoming from the central office to the local station. This method of operation is commonly known as "non-thru supervision". Further, the object is to permit through supervision, i. e. permit control of the supervisory signal apparatus at the central office by operation of the switchhook at a connected local station in case the rear plug of the cord circuit is connected to the station line first, and later the front plug is connected to the trunk, which would be the normal case if the call is outgoing from the station through the private branch exchange switchboard to the central office.

A feature of the invention consists in automatically conditioning the cord circuit for one class of supervision or the other by means of discriminating relays in the cord circuit which are differently controlled depending on whether the cord circuit is first connected to the trunk or to the subscriber's line.

More specifically the feature of the invention whereby the foregoing object is attained resides in a holding bridge circuit, relay means operated when the cord is connected to the trunk line to connect the bridge across the cord and other means operated responsive to answering a call on a station line prior to operation of said relay means to prevent connection of said bridge circuit when the relay means operates, said bridge being thereafter prevented from connection to the cord as long as the cord is connected to either line, said relay means being also adapted, when operated before the cord is connected to the local

line, to disable said other means and connect said bridge across the cord until the local station line is connected and the subscriber answers whereupon the operation of a supervisory relay in the cord opens said connected bridge as long as the subscriber's receiver is off the hook.

The invention will be understood from the following description and accompanying drawing which shows a cord circuit C arranged for interconnecting local private branch exchange lines, such as L1 and L2, or for connecting either of these lines to a central office trunk line TL.

Local to local connection

Assuming the local subscriber at station B desires to be connected with the local subscriber at station A, subscriber B calls in the usual manner by removing his receiver from the hook whereupon line lamp 1 is lighted in an obvious manner.

The private branch exchange operator upon noting the lighted lamp 1 inserts plug 2 of cord circuit C in the jack of line L2 thereupon extinguishing lamp 1 and closing a circuit to operate sleeve relay 3, which circuit can be traced from ground, contacts 4 of the jack, the sleeve conductors of the jack and plug, winding of relay 3 and resistance 5 to battery. Relay 3, however, performs no function at this time it only being effective on local to central office connections, next described. Supervisory relay 6 also operates in series with the subscriber's telephone in the following circuit: Ground, upper winding of retardation coil 7, contacts 8 of relay 9, contacts 10 of the night service (through dialing) key 11, tip conductor 12 of the cord, upper winding of relay 6, contacts 13 of ringing key 14 and tip of the plug 2, thence over the tip side of the subscriber's line L2 through the telephone set, back over the ring side of the line to the ring conductor of the plug, contacts 15 of the ringing key, lower winding of relay 6, ring conductor 16 of the cord, contacts 17 of key 11, contacts 18 of relay 9 and thence through the lower winding of retard coil 7 to battery. Talking battery is thus fed to the subscriber at station B and relay 6 operates.

The operator talks to the subscriber, after operating the talk key 25, and upon learning that he desires to be connected to station A inserts plug 19 at the other end of the cord into jack 20 of the line L1 extending to station A and actuates the ringing key 21 which applies ringing current to the line to operate the subscriber's bell in a well-known manner. It will be noted that

when the plug 19 is inserted in jack 29, of the local line L1, ground is connected to the sleeve conductor of the cord, but the associated sleeve relay 9 does not operate as the other end of the relay winding is also connected to ground.

When the called subscriber answers, the front supervisory relay 22 operates in the following circuit: Ground, upper winding of relay 22, contacts 23 of relay 9, contacts 24 of talking key 25, tip conductor 26, contacts 27 of the night (through dialing) key 11, contacts of the ringing key 21, tip of the plug 19 and jack 20, over the tip of the line and through the subscriber's telephone, back over the ring of the line, jack 20 and plug 19, contacts of ringing key 21, contact 28 of the night key 11, contacts 29 of key 25, contacts 30 of relay 9 and lower winding of the supervisory relay 22 to battery. This circuit supplies talking battery to station A. The through circuit for speech transmission involves condensers 41 and 53.

When a switchhook is depressed at either, or both, of the connected stations, the respective supervisory relays release thereby causing the associated supervisory lamps to be lighted. First, let us assume that station A hangs up, whereupon supervisory relay 22 will release, due to the previously traced circuit being opened at the station. Relay 22 in releasing closes its bottom back contact thereby closing a circuit to light supervisory lamp 35 which can be traced from battery, lamp 35, contacts 31 of key 11, contacts 32 of relay 9, normal contacts of supervisory relay 22 over conductor 33 to ground on the sleeve of plug 2 and the jack of line L2.

If the switchhook at station B is depressed, the line L2 will be opened and supervisory relay 6 will release thereby closing, at its lower back contact, an obvious circuit to light supervisory lamp 34.

The operator's telephone set including transmitter T and receiver R are associated with the cord sleeve by means of the talk key 25. Patent 1,882,753 issued October 18, 1932, to the present applicant, shows and describes an operator's telephone and dial circuit substantially the same as the present arrangement and hence a detailed description of the operation of such circuit will not be repeated here as it forms no part of the present invention.

Local to central office connection—thru supervision

It will now be assumed that the local subscriber at station B desires to be connected to a subscriber in a distant central office reached over the trunk line TL. When the subscriber at station B removes his receiver, the line lamp 1 is lighted as before whereupon the branch exchange operator inserts plug 2 in the jack of the calling line and operates talk key 25 thereby connecting her telephone set to the cord. When the plug was inserted in the jack, the line lamp 1 was extinguished, sleeve relay 3 was operated and supervisory lamp 35 was lighted. Supervisory relay 6 also operated in series with the talking battery fed to the calling station, all as before described.

Upon learning that a trunk connection is desired, the operator inserts plug 19 associated with the other end of the cord circuit in jack 36 whereupon relay 9 now operates due to battery which is connected to the sleeve of the jack over contacts 37 which were closed when the plug was inserted. This circuit may be traced from bat-

tery, contacts 37, sleeve of jack 36 and plug 19, contacts 38 of key 11 and winding of relay 9 to ground. Operation of relay 9 opens, at its contacts 23 and 30, the talking battery supply previously supplied when the plug 19 was connected to the local line L1 and consequently disconnects relay 22 from the cord, and closes its contacts 39 and 40 to connect the tip and ring conductors of the cord through from end to end in a normal manner, it being observed that when two local stations were connected the talking conductors of the cord were reversed, i. e., the tip of plug 2 was connected to the ring of plug 19 over contacts 10 of key 11, contacts 8 of relay 9, condenser 41, contacts 30 of relay 9 and contacts 29 of key 25 and similarly, the ring of plug 2 was connected to the tip of plug 19.

As the same time relay 9, in operating, opens its contacts 18 and 8 thereby disconnecting battery and ground, previously supplied through retard coil 7, from the rear or station end of the cord which is connected to line L2 and opens contacts 32 thereby extinguishing the supervisory lamp 35.

Talking battery for station B is now received over the tip and ring of the trunk line TL from the central office thereby holding supervisory relay 6 operated, assuming, of course, that the receiver is off the hook at the station.

Operation of relay 9 also closes, at its contacts 42, a holding bridge across the cord which can be traced from tip conductor 12, lower back contact of relay 43, middle winding of retard coil 7 and contacts 42 of relay 9 to the ring side of the cord and contacts 29 of the talk key 25.

Due to the fact, however, that supervisory relay 6 remains operated at this time an energizing circuit for relay 43 is also completed at contacts 45 of relay 9, which can be traced from ground on the sleeve of plug 2, contacts 44 of relay 6, contacts 45 of relay 9 and winding of relay 43 to battery and therefore relay 43 operates and immediately opens, at its lower contact, the previously traced holding bridge. Relay 43 in operating also closes a locking circuit for itself at its upper contact which can be traced from battery, winding and upper contacts of relay 43, lower contacts of relay 3 and contacts 46 of talking key 25 to ground.

If the distant end of trunk line TL terminates in a manually operated central office, the operator thereat will answer the call in the usual manner and after learning the number of the desired subscriber, either from the branch exchange operator, or from the calling subscriber at station B, will proceed to establish the connection. On the other hand, in case the trunk line terminates in a dial central office, the branch exchange operator will transmit the requisite number of dial pulses over the trunk line by means of her position dial D to automatically establish the desired connection at the distant exchange. As the means whereby the dial is connected to the cord, and the circuit operations incident thereto form no part of the present invention and are substantially the same as described in Patent 1,882,753, issued October 18, 1932, to the present applicant, no further reference will be made thereto.

A bridge-free circuit is now established from local station B through the windings of supervisory relay 6 and over the talking conductors of the cord C and trunk line TL to the central office battery. Relay 6 is consequently operated as previously described as long as the receiver

at station B is off the hook and the cord remains plugged into the trunk jack.

When the calling subscriber hangs up, thereby opening the circuit between the station and the central office, relay 6 releases thereby lighting the supervisory lamp 34 and displaying a supervisory signal (not shown) at the central office.

Under the condition just described, i. e., when the plug 2 was inserted in a local station jack before the plug 19 was inserted in the trunk jack, operation of the switchhook at the calling subscriber's station controls the supervisory signal apparatus at the central office thus permitting the central office operator to supervise both ends of the connection, this is termed "thru supervision".

The other condition will now be considered, i. e., when a call is originated over the trunk line for a local station of the private branch exchange, such as station B, and the trunk plug 19 of the cord circuit is inserted in jack 36 before the local or rear plug 2 is inserted in the local line jack.

Central office to local connection—non-thru supervision

On a call over trunk line TL to the private branch exchange, ringing current applied at the central office, operates the line relay 47 in the usual manner, which relay locks up over its innermost right contact and lights the line lamp 48.

Upon noting the line signal the private branch exchange operator answers the call by inserting plug 19 in jack 36 and, after operating talk key 25, ascertains from the calling subscriber what is wanted. When plug 19 is inserted in jack 36, a circuit is closed to operate relay 9, as previously described, which connects the talking conductors of the cord through from end to end, connects a holding bridge across the cord at contacts 42 and, at contacts 49, short-circuits battery 50 through resistance 5, over inner and upper contacts of relay 3, so that relay 3 will not operate when the other end of the cord is connected to the local line.

The above holding bridge can be traced from the tip conductor 12 of the cord over bottom contacts of relay 43, middle winding of retard coil 7 and contacts 42 of relay 9 to the ring side of the cord.

The operator next inserts plug 2 in the jack of the called line L2 and rings the station by operating ringing key 14. When the plug was inserted supervisory lamp 34 lighted over the back contacts of supervisory relay 6. As before mentioned, sleeve relay 3 is short-circuited and hence does not operate under the condition now being considered.

When the called station responds, supervisory relay 6 operates in series with the central office battery and the closed contacts of the station switchhook thereby extinguishing supervisory lamp 34.

Relay 6 in operating closes its contacts 44 thereby completing a circuit for operating relay 43 which can be traced from battery, winding of relay 43, contacts 45 of relay 9, contacts 44 of relay 6 to ground on the sleeve of the local station jack.

Relay 43 in operating opens its lower contact thereby increasing the resistance of the holding bridge previously connected across the cord by the series inclusion therewith of resistance 52 which latter resistance was short-circuited as

long as the lower back contacts of relay 43 were closed.

It should be noted that the original resistance of the holding bridge across the cord is so adjusted that sufficient current will flow in the line L2 when the called subscriber responds, to operate relay 6.

When station B hangs up, relay 6 releases, in turn releasing relay 43, which relay again closes its lower contact to short circuit resistance 52 thereby lowering the resistance of the bridge to its original value which holds the central office connection and prevents a disconnect signal being displayed at that point. The higher resistance bridge across the cords during the period the subscriber B has his receiver off the hook, has a small shunting effect on the current supplied to the transmitter of station B but permits sufficient current to flow through the transmitter for talking purposes and at the same time when the subscriber B hangs up will hold the central office connection until relays 6 and 43 can release.

Relay 6 in releasing closes its lower back contact and lights the branch exchange supervisory lamp 34.

It will be noted that due to the fact that relay 9 operates before a circuit was completed for relay 3, this latter relay was disabled and prevented from operating when plug 2 was connected to the jack of line L2. Hence, when relay 43 operated, its locking circuit was open at the lower contact of relay 3 and when relay 6 releases on the station disconnect, relay 43 immediately releases to restore the previous lower resistance holding bridge. This condition is known as non-thru supervision, i. e., the called local station B has no control of the supervisory signal at the central office, but must rely on the branch operator for supervision and is effected, as described, when the trunk plug is connected to the trunk jack before the other end of the cord is connected to the local line.

In case the local plug is inserted in the local line jack before the other end is connected to the trunk, relay 43 will lock itself operated when relay 9 operates, and therefore the holding bridge cannot be reconnected across the cord and therefore thru supervision results, i. e., the local subscriber B has control of the central office supervisory apparatus.

In the case of an established connection originating with the local subscriber B, for example, in which case the relay 43 is locked operated, should the branch exchange operator desire to call the central office operator in on the connection, she may do this, without removing the plugs from the jacks, by operating the talk and dial key 25 which opens contacts 46 and releases relay 43 thereby connecting the middle winding of retard coil 7 across the cord which will display the supervisory signal at the central office.

What is claimed is:

1. In a telephone exchange system, a trunk line, a subscriber's line, a cord circuit for interconnecting said lines, said cord circuit being so arranged that either end will function with the subscriber's line, but only one end with the trunk line, means for automatically providing through supervision over said cord circuit when said lines are connected together if the trunk end of the cord is not connected to the trunk until after the other end is connected to the subscriber's line, and means for providing non-through supervision over said cord if the trunk end of the cord is

connected to the trunk before the other end is connected to the subscriber's line.

2. In a telephone system, a trunk line, a subscriber's station line, a cord circuit for interconnecting said lines, a holding bridge circuit adapted to be connected across said cord, a relay operated when the cord is connected to the trunk line to connect said bridge, a second relay adapted to be operated when the cord is connected to the subscriber's line, said first relay being adapted, if operated before said second relay, to disable the second relay and prevent its

subsequent operation, a supervisory relay associated with said cord and operated when the cord is connected to the subscriber's line and the subscriber's station receiver is off the hook and a locking relay also associated with the cord and adapted to operate when said lines are connected and the supervisory relay is operated, to open the bridge, and circuit means for thereafter holding said relay operated independent of said supervisory relay if the second relay is operated.

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