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FIG. 1

FIG. 2

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TELEPHONE SYSTEM

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6 Claims. (Cl. 179—42)

This invention relates to telephone systems and more particularly to operators' cord circuits used at private branch exchange switchboards.

An annoying feature of private branch exchange operation is that when a call comes in on a trunk line from a central office to the private branch exchange while the private branch exchange operator is busy, she will often plug into the trunk jack in order to retire the signal but will delay answering the call. With the usual type of circuit now in use plugging into the trunk by the answering operator cuts off the ringing signal to the calling subscriber at the central office and, where automatic registration is used in the central office, charges up the call to the calling subscriber's line. The subscriber, however, has no indication that his call is receiving attention and the ringing signal is usually cut off so quickly in a case of this kind that he is likely not to notice it and may think that the call has not been completed to the private branch exchange and accordingly hangs up and calls again.

An object of the invention is to prevent effecting any operation of apparatus associated with the outgoing end of a trunk circuit extending from a central office to a private branch exchange switchboard until the private branch operator has plugged into the answering jack of the trunk and operated the listening key associated with the cord circuit employed.

Another object is to prevent retirement of the line signal, when the operator plugs into the answering jack, until the listening key is operated and the operator speaks into her transmitter.

Still another object is to give the operator at the private branch exchange a signal, independent of the line signal, when she plugs into a calling line and to maintain this signal displayed until she operates the listening key and speaks into her transmitter.

A feature of the invention resides in normally maintaining an open circuit between the answering plug of the private branch exchange cord and the remainder of the cord circuit apparatus, and closing this circuit only when the listening key is operated, and further, in locking this circuit closed independent of the listening key when the operator speaks into her transmitter.

Another feature resides in retiring the line signal of a calling line only when the listening key, of a cord connected to the line, has been operated and the operator has spoken into her transmitter.

Still another feature resides in displaying a pilot signal whenever the answering plug of a

cord is inserted in a calling line jack and retiring this signal only when the listening key is operated and the operator speaks into her transmitter.

The invention will be understood from the following description when read in connection with the accompanying drawing:

Fig. 1 of which represents one embodiment thereof in which a pilot signal, common to an operator's position, is lighted immediately upon the operator plugging into a calling line and which remains lighted until the operator has actuated her listening key and spoken into her transmitter; and

Fig. 2 represents an alternative modification of the arrangement of Fig. 1 in which the line lamp of the calling line is not extinguished when the answering plug is inserted in the jack, but instead remains lighted until the operator has actuated her listening key and spoken into her transmitter.

The operation of Fig. 1 is as follows: Let it be assumed that 1 is a calling line indicated by a line signal, not shown. When the operator notes the line signal she plugs an answering plug 2 of one of her cord circuits into the answering jack 3 of the calling line whereupon the line signal is retired in the well-known manner and pilot lamp 4 which is common to her position is lighted.

Pilot lamp 4 is controlled by the operation of relay 5, the circuit of which can be traced from battery, winding of relay 5, contact 6 of relay 7 and over the sleeve circuit of the plug and jack to the cut-off relay 8 of the line. Relay 5 in operating closes the circuit for lamp 4.

Pilot lamp 4 remains lighted, as a warning to the operator that she has plugged into a calling line but has not yet answered, until the operator is ready to answer the call at which time she actuates her listening key 9 which in addition to connecting her telephone set to the cord circuit in use also closes a circuit to operate relay 10 which can be traced from ground, winding of cut-off relay 8 associated with the calling line, sleeves of jack 3 and plug 2, contact 11 of the listening key 9, winding of relay 10, contacts 12 of relay 7 and the normal contacts of the voice frequency relay 13 to battery. It will be noted that another path to battery exists through the winding of relay 7, but insufficient current flows therein at this time, due to the direct path just traced, to cause this relay to operate.

Relay 10 in operating closes the tip and ring conductors 14 and 15 of the cord circuit through to the answering plug 2 thereby completing a con-

nection between the operator's telephone set and the calling line.

The connection of the cord circuit conductors 14 and 15 to the calling line set up the usual bridge condition on the line and in the case of a central office trunk line cause certain apparatus at the central office to perform such functions as "tripping" the ringing automatically, register the call on the calling subscriber's meter, etc.

It will be noted that due to the fact that relay 7 is still inert, pilot lamp 4 remains lighted due to the energized condition of relay 5.

When the operator responds by the usual salutation spoken into her transmitter the voice currents caused thereby and flowing in the circuit connecting her telephone set with the listening key cause the bridged voice frequency relay 13 to respond and break its normally closed armature contact thereby opening the direct path to battery previously traced for the operation of relay 10. This removal of the shunt path around relay 7 permits current to flow therethrough and causes it to operate which opens contacts 6 and 12 and closes contacts 16. When contact 6 opens relay 5 releases and extinguishes pilot lamp 4. The opening of contacts 12 introduces a break in the shunt path around relay 7 so that when the contacts of relay 13 are later closed, relay 7 will not be short-circuited and released. Closure of contact 16 of relay 7 completes a locking circuit whereby relays 7 and 10 are held up in series with each other under the sole control of the sleeve of the plug 2 and consequently the cord circuit is now permanently locked to the calling line at contacts of relay 10 independent of the listening key and can only be released by removing plug 2 from jack 3. From the foregoing it will be observed that the pilot lamp 4 was lighted when the operator plugged into the jack 3, that the cord circuit conductors were connected to the plug 2 when the operator actuated the listening key and that the pilot lamp was extinguished and the cord circuit locked to the calling line independent of the listening key when the operator responded by speaking into her transmitter.

The operation of Fig. 2 differs only slightly from that of Fig. 1. When the operator observes the lighted line lamp 17 caused by operation of line relay 13 she inserts the answering plug 19 into jack 20. This act performs no other function at this time as it will be observed that the sleeve circuit is open at the contact 21 of listening key 22. Cut-off relay 23, therefore, remains inert and contrary to the usual practice the line lamp 17 continues to glow as a warning to the operator that she has not yet handled the call.

When the operator actuates listening key 22 she connects her telephone set across the tip and ring conductors 24 and 25 of the cord and closes contact 21 which completes the following circuit: Ground, winding of cut-off relay 23, sleeves of jack 26 and plug 19, contact 21, winding of relay 27 and high resistance 28 to battery. Resistance 28 and the resistance of relay 27 are so chosen that the current flowing in this circuit is sufficient to operate relay 27, but insufficient to operate the usual low resistance cut-off or sleeve relay 23.

Operation of relay 27 closes at its contacts 29 and 30 the tip and ring conductors 24 and 25 of the cord due to the answering plug 19 thereby completing a connection between the operator's telephone set and the calling line exactly as described under Fig. 1.

The operator may now respond by the usual salutation thereby generating voice currents

which operate the voice frequency relay 31 connected across her telephone circuit.

Operation of relay 31 connects ground at its armature and contact to a circuit which can be traced through resistance 32, contacts 33 of relay 27 which were closed when this relay operated in response to actuation of the listening key, contact 34 and winding of relay 35 to battery. Relay 35 operates in this circuit thereby opening contacts 36 and closing contacts 37 which remove the high resistance from the circuit including relays 23 and 27 and substitute therefor the relatively low resistance winding of relay 35. This lowering of the resistance of the circuit from ground through relays 23, 27 and 35 permits sufficient current to flow through the cut-off sleeve relay 23 to cause it to operate thereby releasing line relay 18 and opening the circuit for line lamp 17 which is therefore extinguished.

When relay 35 operates in response to operation of relay 31 it closes its lower contact 38 thereby completing a locking circuit independent of the contacts 21 of listening key 22, for relays 23, 27 and 35. This circuit may be traced from ground, relay 23, sleeves of jack 26 and plug 19, contacts 38 of relay 35, winding of relay 27, contacts 37 of relay 35 and winding of that relay to battery.

This circuit it will be observed is under sole control of the sleeve contacts of plug 19 and jack 26 and these relays therefore remain operated and the cord circuit locked in the answering plug until the plug is removed from the line jack.

From the foregoing it will be understood that the circuit of Fig. 2 provides for keeping the line lamp of the calling line lighted until the operator has actuated her listening key and spoken into her transmitter whereupon the line lamp is extinguished and the cord circuit is locked to the answering plug and consequently to the calling line independent of the listening key and under sole control of the answering plug.

What is claimed is:

1. In an operator's cord circuit, means jointly controlled by insertion of the answering plug into an answering jack and operation of the operator's listening key to electrically connect the cord circuit with the answering plug thereof and means operated by voice current in the operator's circuit to lock said cord circuit connected to the answering plug independent of said listening key.

2. In a telephone system, a calling line, an operator's cord circuit including an answering plug normally disconnected therefrom but connected to said calling line, an operator's telephone circuit, switching means for connecting said operator's circuit to said cord circuit, relay means operated in response to operation of said switching means for connecting said plug and cord circuit, and means responsive to voice current in said operator's circuit for locking said relay means operated independent of said switching means.

3. In a telephone system, a calling line, an answering plug connected to said line, an operator's cord circuit associated with said plug but normally disconnected therefrom, an operator's telephone circuit, a listening key for connecting the operator's circuit to the cord circuit, a relay responsive to operation of said key for connecting said plug and cord circuit, a second relay adapted when operated to lock up in series with said first relay independent of said key and voice operated means responsive to voice frequency

current in said operator's circuit for initially operating said second relay.

4. In a telephone system, a calling line, an answering plug connected to said line, a signal
5 displayed responsive to such connection, an operator's cord circuit associated with said plug but normally disconnected therefrom, an operator's telephone circuit, a listening key for connecting
10 the operator's circuit to the cord circuit, a relay means responsive to operation of said key for connecting said plug and cord circuit, a second relay means adapted when operated to retire said signal and lock up in series with said first means
15 independent of said key and voice operated means responsive to voice frequency currents in said operator's circuit for initially operating said second relay means.

5. In a telephone system, a calling line, a line
20 signal cut-off relay in the sleeve circuit thereof, an answering plug connected to said line, an operator's cord circuit associated with said plug but normally disconnected therefrom, an operator's telephone circuit, a listening key for connecting
25 the operator's circuit to the cord circuit, a relay for connecting said plug and cord circuit responsive to actuation of said key, a second relay adapted when operated to operate said cut-off relay and to lock itself up in series with said
30 first relay independent of said key, and voice operated means responsive to voice frequency

currents in said operator's circuit for initially operating said second relay.

6. In a telephone system, a calling line, a line
80 signal cut-off relay in the sleeve circuit thereof, an answering plug connected to said line, an operator's cord circuit associated with said plug but normally disconnected therefrom, an operator's telephone circuit, a listening key for connecting
85 the operator's circuit to the cord circuit, a first relay for connecting said plug and cord circuit, a low resistance relay, a circuit for said first relay including a high resistance, a normal contact
90 of the low resistance relay, contacts of said listening key and the sleeve conductor of the cord circuit including said cut-off relay, said circuit
95 being closed to operate said first relay when said key is actuated and said resistance being of such value as to prevent operation of said cut-off relay in series therewith, said low resistance relay
100 being adapted when operated to substitute its winding for said high resistance and to lock itself and said first relay up in series with each other independent of the key thereby lowering
105 the resistance of the circuit including the cut-off relay to a point when said cut-off relay will operate, and voice operated means responsive to voice frequency currents in said operator's circuit for initially operating said second relay.

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