

March 17, 1942.

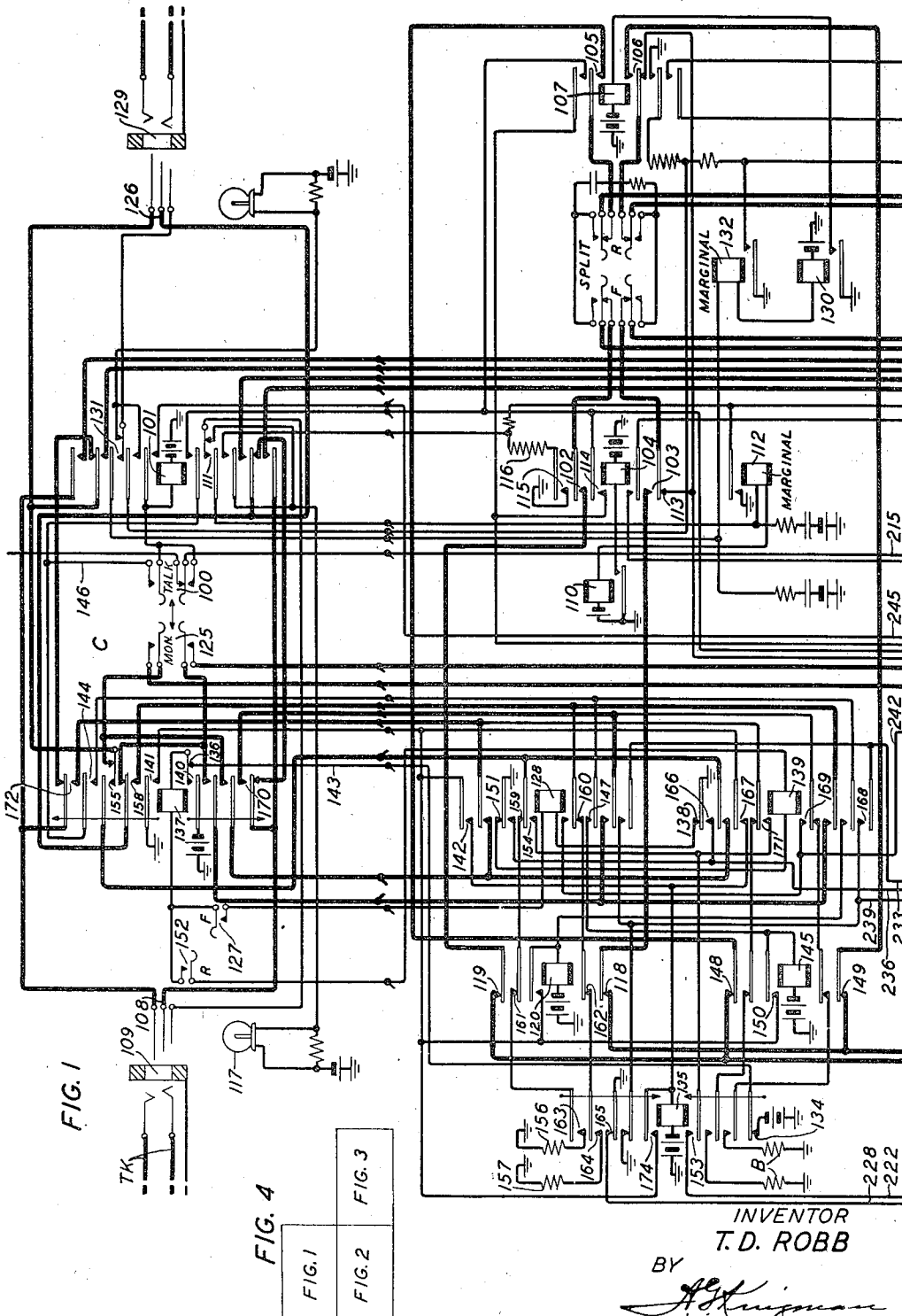
T. D. ROBB

2,276,515

TELEPHONE SWITCHBOARD

Filed Dec. 30, 1939

3 Sheets-Sheet 1



INVENTOR
T. D. ROBB

T. D. ROBB

BY

ATTORNEY

March 17, 1942.

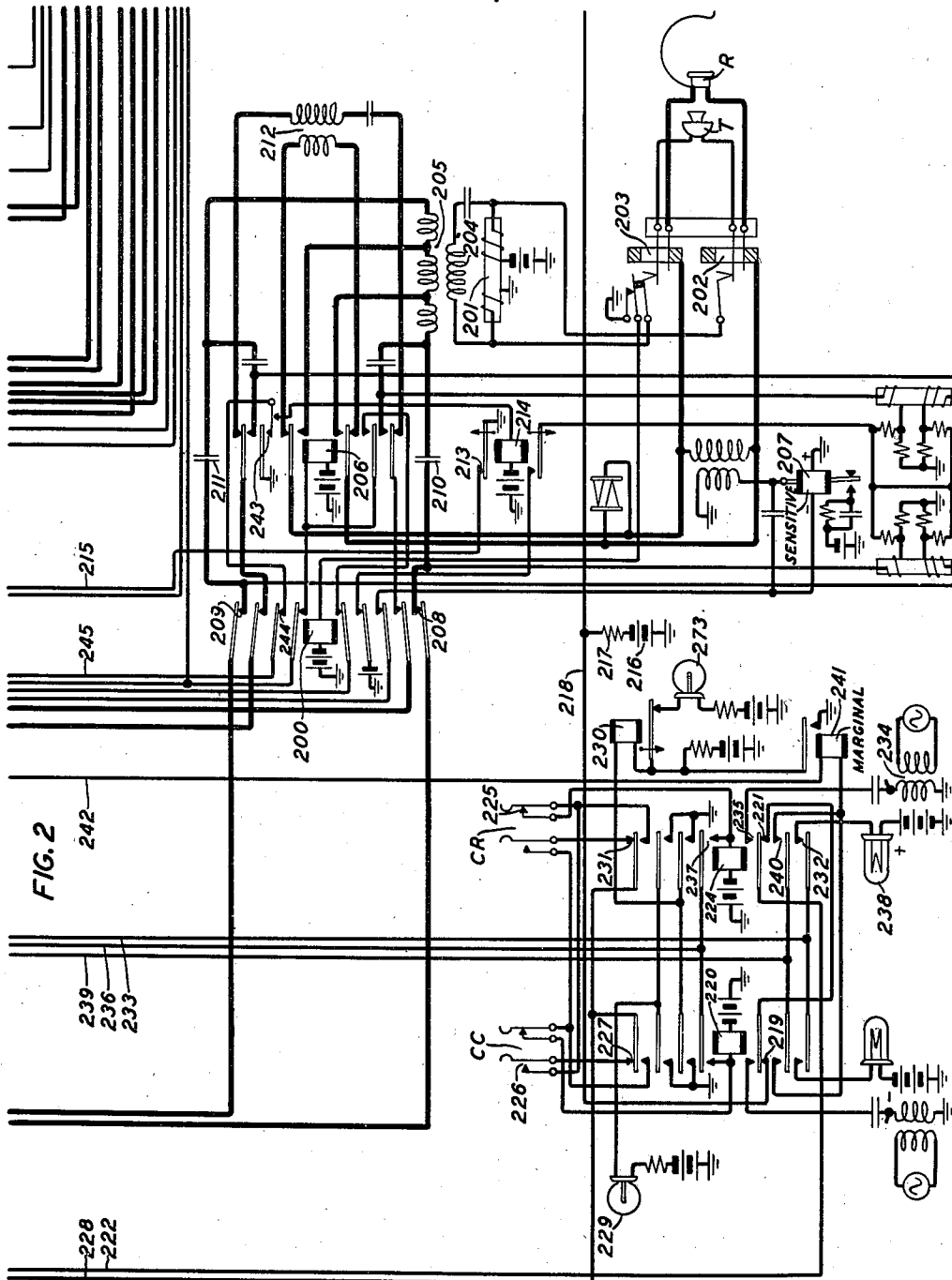
T. D. ROBB

2,276,515

TELEPHONE SWITCHBOARD

Filed Dec. 30, 1939

3 Sheets-Sheet 2



INVENTOR
T. D. ROBB

BY

A. S. Krugman
ATTORNEY

March 17, 1942.

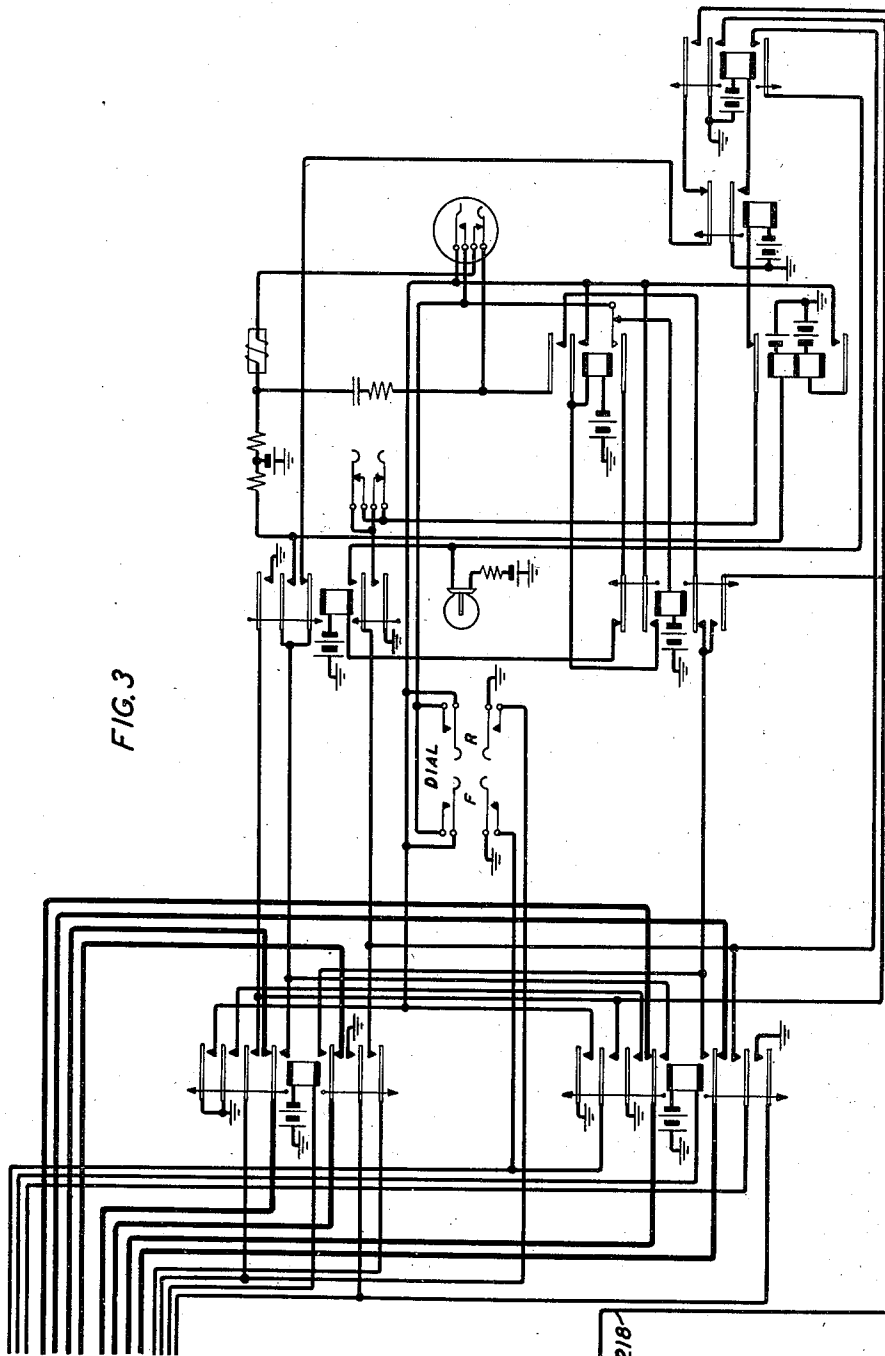
T. D. ROBB

2,276,515

TELEPHONE SWITCHBOARD

Filed Dec. 30, 1939

3 Sheets-Sheet 3



INVENTOR
T. D. ROBB
BY
A. H. Haiman
ATTORNEY

UNITED STATES PATENT OFFICE

2,276,515

TELEPHONE SWITCHBOARD

Theodore D. Robb, Ridgewood, N. J., assignor to
Bell Telephone Laboratories, Incorporated,
New York, N. Y., a corporation of New York

Application December 30, 1939, Serial No. 311,738

4 Claims. (Cl. 179—51)

This invention relates to telephone systems and more particularly to toll switching systems.

An object of the invention is to provide an improved circuit arrangement for toll switchboards of the type disclosed and claimed in U. S. Patent 1,608,524 to L. F. Porter, whereby more flexible operation is obtained.

A feature of the invention resides in an arrangement of the circuits whereby the operator's telephone set is normally conditioned for monitoring, i. e., listening, on the cord circuits, under control of monitoring keys, and can be conditioned for talking and connected to a cord by operation of a talk key only when the associated cord is connected to a line. This permits the operation of the talk key on any cord prior to its connection to a line without sounds affecting the operator's transmitter being heard in the receiver.

The invention will be understood from the following description when read in connection with the accompanying drawings, Figs. 1, 2 and 3 of which, when joined as shown in Fig. 4, disclose a complete cord, position, dial and operator's telephone circuit.

In describing the operation of the circuit it will be assumed that a call from a coin box station has arrived over a trunk circuit TK (Fig. 1) and is indicated by a line signal (not shown). It will further be assumed that the operator is idle at the moment but has the talk key 100, on cord C, in an operated position in readiness to talk over any line with which she may associate the cord. At this time, it will be noted that relay 200 is operated due to the connection of the operator's telephone and that the transmitter is energized in the following circuit, battery, right winding of impedance coil 201, tip of jack 202 and the operator's telephone plug, transmitter T, tip spring of jack 203 and left winding of impedance coil 201 to ground and therefore sounds affecting the transmitter will cause voltage fluctuations in the primary winding 204 of the induction coil 205 bridged across the circuit. It will be noted, however, that at this time the secondary winding of coil 205 is open at the contacts of relay 206 and hence the voltage fluctuations in coil 205 have no effect on the operator's receiver R regardless of the fact that the talk key 100 is operated which in turn causes the operation of relay 101 to connect the cord into the position circuit where it is open at contacts 102 and 103 of relay 104 and contacts 105 and 106 of relay 107 and therefore disconnected from the operator's telephone. When the operator

answers the calling trunk by inserting the rear or answering plug 108 in jack 109, ground through an 1,800 ohm resistance (not shown) on the sleeve of the trunk operates sleeve relay 110 in a circuit which can be traced from ground, sleeve of jack 109 and plug 108, contacts 111 of operated relay 101 and windings of relays 112 and 110 to battery. Relay 112 is marginal and does not operate in series with the high resistance of the trunk sleeve.

Relay 110 in operating operates relay 104 which latter relay disconnects, at its contacts 113, the busy test relay 207 from the tip conductor of the cord, connects the tip and ring conductors of the cord to the telephone circuit over its contacts 103 and 102, closes at its contacts 114, a circuit to operate relay 206 and at contacts 115 connects ground through high resistance 116 to the rear supervisory lamp 117 which lamp, however, does not receive sufficient current through this high resistance circuit to light.

As mentioned above, with the operation of relay 104, the tip and ring conductors of the rear cord, which are connected to the calling trunk, were extended to the operator's telephone circuit, at the right side of Fig. 2, over contacts 103 and 102 of relay 104, contacts 118 and 119 of relay 120 and contacts 208 and 209 of relay 200 and thence through condensers 210 and 211 to the outside terminals of the secondary winding of induction coil 205; and by the operation of relay 206, the operator's receiver R is connected to a portion of the secondary winding of coil 205. It will therefore be noted that whereas the operator's transmitter T was energized as soon as the operator's set was plugged into the telephone jacks 201 and 203, the secondary winding of the coil 205 was not connected to either the cords or operator's receiver until a cord was connected to a line on which a talk key was operated.

It will be noted further from the drawings that prior to the operation of relay 206, the operator's receiver was connected through the monitoring coil 212 to the normally opened contacts of the monitoring key 125, thus enabling the operator to monitor, i. e., to listen on any cord in her position, whose talk key is not operated, by operating the corresponding monitoring key.

Upon being connected with the calling subscriber the operator obtains the details of the call and proceeds to set up the desired connection by inserting plug 126 in the jack of a line over which a call is to be extended which line may be either ringdown to a manual operator or dialed to an automatic office.

Assuming that the line over which the call is to be extended is a ringdown line, the operator will insert the plug 126 in jack 129 whereupon ground through a high resistance (in practice of the order of 1,800 ohms) on the sleeve of jack 129 (not shown), will cause operation of relay 130 in a circuit traced from the sleeve of the jack and plug, contacts 131 of relay 101, assuming that the talk key 100 is still operated, and windings of relays 132 and 130 to battery. Relay 132 is marginal and does not operate in this circuit, but relay 130 does operate thereby operating relay 107 to connect the tip and ring conductors of the front cord in parallel with the corresponding conductors of the rear cord which are connected to the calling line and also with the operator's telephone set as previously described.

The operator then proceeds to signal the distant operator by actuating front ringing key 127 which causes relays 128 and 137 to operate in series in a circuit which can be traced from battery, contacts 134 of relay 135, conductor 143, contacts 136 and winding of relay 137, contacts of key 127 and winding of relay 128 to ground over contacts 138 of relay 139. Relay 137 in operating closes its contacts 140 and opens its contacts 136 thereby closing a local holding circuit for itself and 128. Relay 137 also closes its contacts 141, and relay 128 closes its contacts 142, thereby completing a circuit to operate relay 135 which, in operating, opens its contacts 134 and removes battery from conductor 143 thus preventing any other cord relay corresponding to relay 137 from operating as long as key 127 remains operated. The effect of this is that the operator can ring on only one cord at a time. Relay 135 holds operated through its own contact 174 to ground over contacts 141 of relay 137.

If it is assumed that the talk key 100 is operated on the cord over which we desire to ring, then when relay 137 operated, it closed its contacts 144 thereby completing a circuit to operate relay 145 which can be traced from ground, contacts 243 of relay 206, contacts 244 of relay 200, conductor 245, contacts 175 of relay 101, upper contacts of the talk key 100, conductor 146, contacts 144 of relay 137, contacts 147 of relay 128 and winding of relay 145 to battery. Relay 145 operates in this circuit and opens its contacts 148 and 149 thereby disconnecting the tip and ring conductors of the front cord from the telephone set and also the corresponding conductors of the rear cord. Relay 145 also closes its contacts 150 thereby locking itself to the ground on contact 141 of relay 137.

Relay 128 in operating opens its contacts 151 thereby disconnecting ground from relay 139 and preventing its operation in case the rear ringing key 152 should be inadvertently operated.

With relays 137, 128 and 135 operated, ringing battery is now connected to the tip of the called line in a circuit which can be traced from 48-volt battery 216, resistance 217, conductor 218, contacts 219 of relay 220, contacts 221 of relay 224, conductor 222, contacts 153 of relay 135, contacts 154 of relay 128 and contacts 155 of relay 137 to the tip of the front cord and thence over the tip of the plug 126 and jack 129 to the called line where it causes ringing current to be extended to the distant exchange in a well-known manner which it is not necessary to describe here.

Release of the ringing key 127 deenergizes re-

lays 137 and 128. Relay 128 releases in normal time but relay 137 releases slowly so that when relay 128 releases and disconnects the ringing battery 216 from the tip conductor any charge which may have accumulated on the line due to the ringing current will be discharged to ground through resistance 156 and 157 over contacts 155 and 158 of relay 137 (still operated), contacts 159 and 160 of relay 128 (now released), contacts 161 and 162 of relay 120 and contacts 163 and 164 of relay 135 which relay is held operated at contacts 141 of relay 137. When relay 137 releases and opens its contacts, it releases relay 135, disconnects the cord from the ringing and coin control equipment in the position, and reconnects the respective tip and ring conductors of the rear and front cords.

The operator may now, or at the end of the conversation, collect or return coins at the calling subscriber's station by first operating one or the other of the common coin control keys, CC or CR, and then operate the ringing key associated with the particular cord connected to the line which in the present case is key 152.

If we assume that the operator desire to collect a coin over the trunk line TK, she will first actuate the common coin collect key CC, thereby operating relay 224 in a circuit from battery, winding of relay 224, normal contacts 225 of key CR, contacts 226 of key CC, contacts of 227 of relay 220, conductors 228, and contacts 165 of relay 135 to ground. It will be noted that operation of relay 224 is dependent on the released or non-operated condition of relay 135 and therefore if a ringing key is depressed at the time a coin controlled key is actuated, the coin control condition will not be established. If the CC key was operated in error, operation of the CR key will release relay 224 and operate relay 220. Operation of relay 224 lights the lamp 229 as an indication that the position circuit is set for coin control, operates relay 230, opens at its contacts 231 the path for operating relay 220, connects positive coin collect potential over its contacts 232 and conductor 233 to the lowermost armature of relay 139, opens its contacts 221 thereby disconnecting the ringing battery 216 from conductor 222, thus preventing the subsequent operation of relay 135 from connecting this potential to the line, and by closing its contacts 235, it substitutes a source of tone through transformer 234, on the conductor 222 which tone will be connected to the tip conductor of the cord when relay 135 operates in response to operation of key 152.

The operator now having the coin collect condition established in the position circuit, and desiring to collect a coin at the substitution calling over trunk key TK, operates the ringing key 152 thereby closing a circuit to operate relays 137 and 139 in a circuit which can be traced from ground, contacts 151 of relay 128, winding of relay 139, contacts of key 152, winding of relay 137, and contacts 136 thereof, to battery over contacts 134 of relay 135.

Relay 137 in operating connects the tip and ring conductors of the rear cord to the inner, upper and lower, armatures of relay 139. Relay 139 in operating opens, at its contacts 138, the operating ground for relay 128 thus preventing this relay from being energized should key 127 be accidentally operated, and by closing its contacts 166, connects ground to hold relay 224 operated. This holding path can be traced from ground, contacts 166 of relay 139, conductor

236, contacts 237 and winding of relay 224 to battery.

Operation of relays 137 and 139 jointly operate relay 135 in a circuit which can be traced from ground, contacts 141 of relay 137, contacts 167 of relay 139 and winding of relay 135 to battery. Relay 135 locks to ground at contacts 141 of relay 137. Relay 135 in operating opens its contacts 134 thereby disconnecting the operating battery for relays 137 and 139, but relay 137 in operating closes its contacts 140, thus providing a substitute battery to hold these two relays operated as long as the contacts of key 152 are closed. Relay 135 in operating also opens its contacts 165 thereby removing ground from keys CC and CR. With relays 137, 139 and 224 operated, positive coin potential is now connected to the ring conductor of the rear cord in the following circuit: battery, resistance lamp 238, contacts 232 of relay 224, conductor 233, contacts 168 of relay 139, conductor 239, contacts 240 of relay 224, winding of marginal coin pilot relay 241, conductor 242, contacts 169 of relay 139 and contacts 170 of relay 137 to the ring conductor of the line.

Simultaneously with application of positive coin potentials to the ring conductor, the tone transformer 234 is connected to the tip of the cord as an indication to a service observing operator, that may be listening on the connection, that a coin collect key has been operated. This patent can be traced from tone transformer 234, contacts 235 of relay 224, conductor 222, contacts 153 of relay 135, contacts 171 of relay 139 and contacts 172 of relay 137 to the tip of the cord and thence to the trunk.

If a coin is in the box at the substation, the resistance of the ring conductor to ground will be low enough to permit sufficient current to flow to operate the marginal relay 241 which in turn short-circuits the slow-release relay 230 which thereupon releases and lights the coin pilot lamp 273.

When the ringing key 152 is released, relays 137 and 139 release thereby disconnecting coin battery and tone from the ring and tip conductors respectively, releases relay 224, and due to the fact that relay 137 is slow to release, momentarily connects grounded resistances B across the tip and ring to dissipate any charge on the trunk due to the coin potential.

Relay 241 will release when the coin potential is removed from the trunk and the lamp 273 will be extinguished. Release of relay 224 extinguishes lamp 229. When relay 137 finally releases, the two ends of the cord are connected together again and relay 135 releases which reconnects battery, at its contacts 134, so that operation of another ringing key will be effective. In case either key CC or CR should be operated accidentally, thereby setting up a coin control condition in the position and lighting pilot lamp 229, this condition can be canceled by operating any ringing key on an idle cord whereupon the circuit goes through its cycle and restores to normal.

The circuit arrangement shown by Fig. 3 provides facility for dialing over either the front or rear cords but as this general arrangement has been in use for some time, and is well known, no further description is deemed necessary.

What is claimed is:

1. In a telephone switchboard, an operator's

position, lines terminating thereat in jacks, a cord circuit thereat adapted to be connected to said jacks, an operator's telephone set comprising a receiver and a transmitter, a monitoring transformer and an operator's repeating coil, a monitoring key and a talk key, said receiver being normally connected to one winding of said transformer and the other winding of said transformer being normally adapted to be connected to said cord upon the operation of the monitoring key, said transmitter being connected to the primary winding of the repeating coil, and means responsive to the joint operation of said talk key and the connection of said cord to a jack to disconnect said receiver from the transformer winding and connect the secondary winding of the repeating coil to the receiver and cord.

2. In a telephone system, an operator's position, a plurality of cord circuits thereat, an operator's receiver and an operator's transmitter, a monitoring transformer having primary and secondary windings, relay means normally connecting said receiver to the secondary winding of said transformer, a monitoring key individual to each cord circuit adapted when operated to connect the primary winding of said transformer, over normal contacts of said relay means, to the cord circuit with which the monitoring key is associated, an operator's repeating coil also having primary and secondary windings, said primary winding being connected to said transmitter and said secondary winding being adapted to be connected to said cord circuit and said receiver by the operation of said relay means, a talk key individual to each cord circuit, and means jointly responsive to operation of a talk key and the connection of the respective cord to a line to operate said relay means thereby disconnecting said receiver from the secondary winding of the monitoring transformer and the primary winding from the cord and connecting the secondary winding of the repeating coil to the receiver and cord.

3. In a telephone switchboard, an operator's position, a cord circuit and lines terminating thereat, an operator's telephone set comprising a receiver and transmitter, a talk key, and means jointly responsive to the operation of the talk key and connection of the cord to a line to inductively connect said transmitter to said receiver and cord.

4. In a telephone switchboard, an operator's position, lines terminating thereat, a cord circuit thereat adapted to be connected to said line, a monitoring key and a talk key associated with said cord circuit and arranged to prevent simultaneous operation thereof, an operator's receiver, an operator's transmitter, a monitoring transformer and an operator's set repeating coil each having primary and secondary windings, said transmitter being connected to the primary winding of said repeating coil and said receiver being normally connected to the secondary of said transformer, said monitoring key being adapted when operated to connect the primary winding of said transformer to the cord, and means jointly responsive to operation of said talk key and connection to said cord to a line to transfer said receiver connection from the transformer secondary to the induction coil secondary and to connect said induction coil secondary to the cord.

THEODORE D. ROBB.