Oct. 14, 1941. L. L. EAGON ET AL 2,258,980

TELEPHONE SYSTEM

Filed April 18, 1940 4 Sheets-Sheet 1

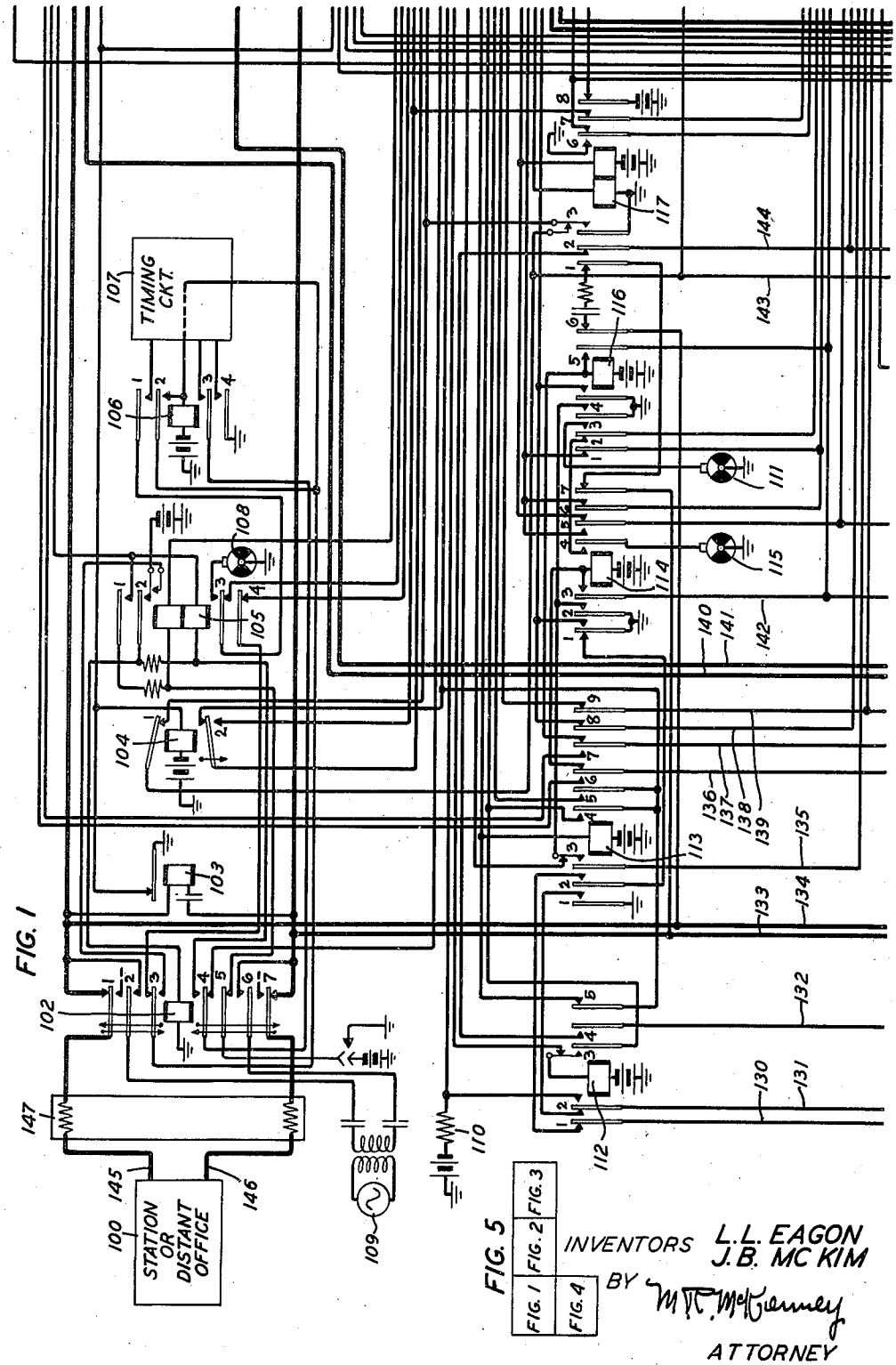


FIG. 1

FIG. 5

FIG. 1	FIG. 4
FIG. 2	FIG. 3

INVENTORS L. L. EAGON
J. B. MC KIM

BY M. T. McGarvey

ATTORNEY

Oct. 14, 1941. L. L. EAGON ET AL 2,258,980

TELEPHONE SYSTEM

Filed April 18, 1940 4 Sheets-Sheet 2

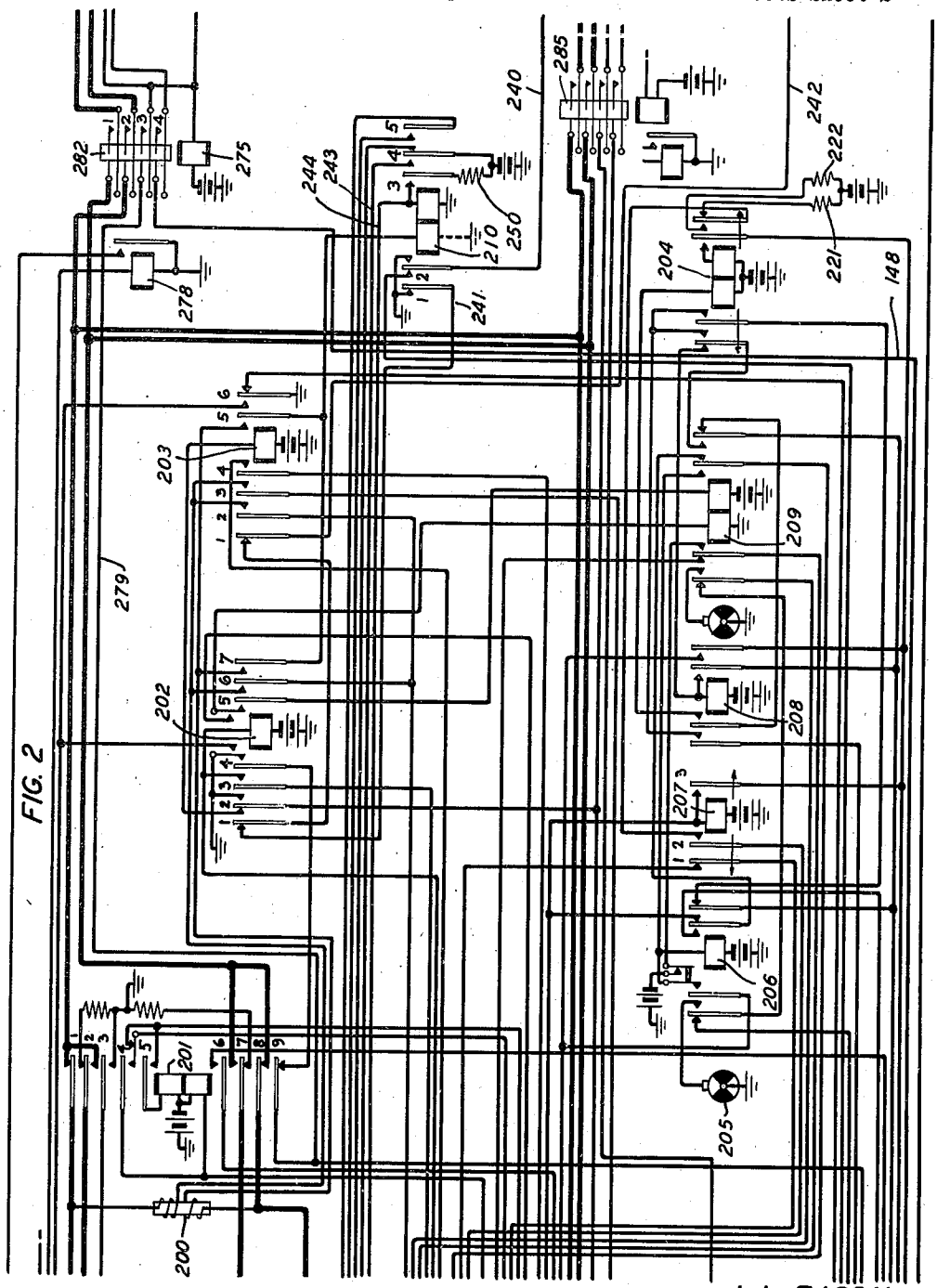


FIG. 2

INVENTORS L.L. EAGON
J.B. MC KIM

BY M.F. McGerney

ATTORNEY

Oct. 14, 1941. L. L. EAGON ET AL 2,258,980

TELEPHONE SYSTEM

Filed April 18, 1940 4 Sheets-Sheet 3

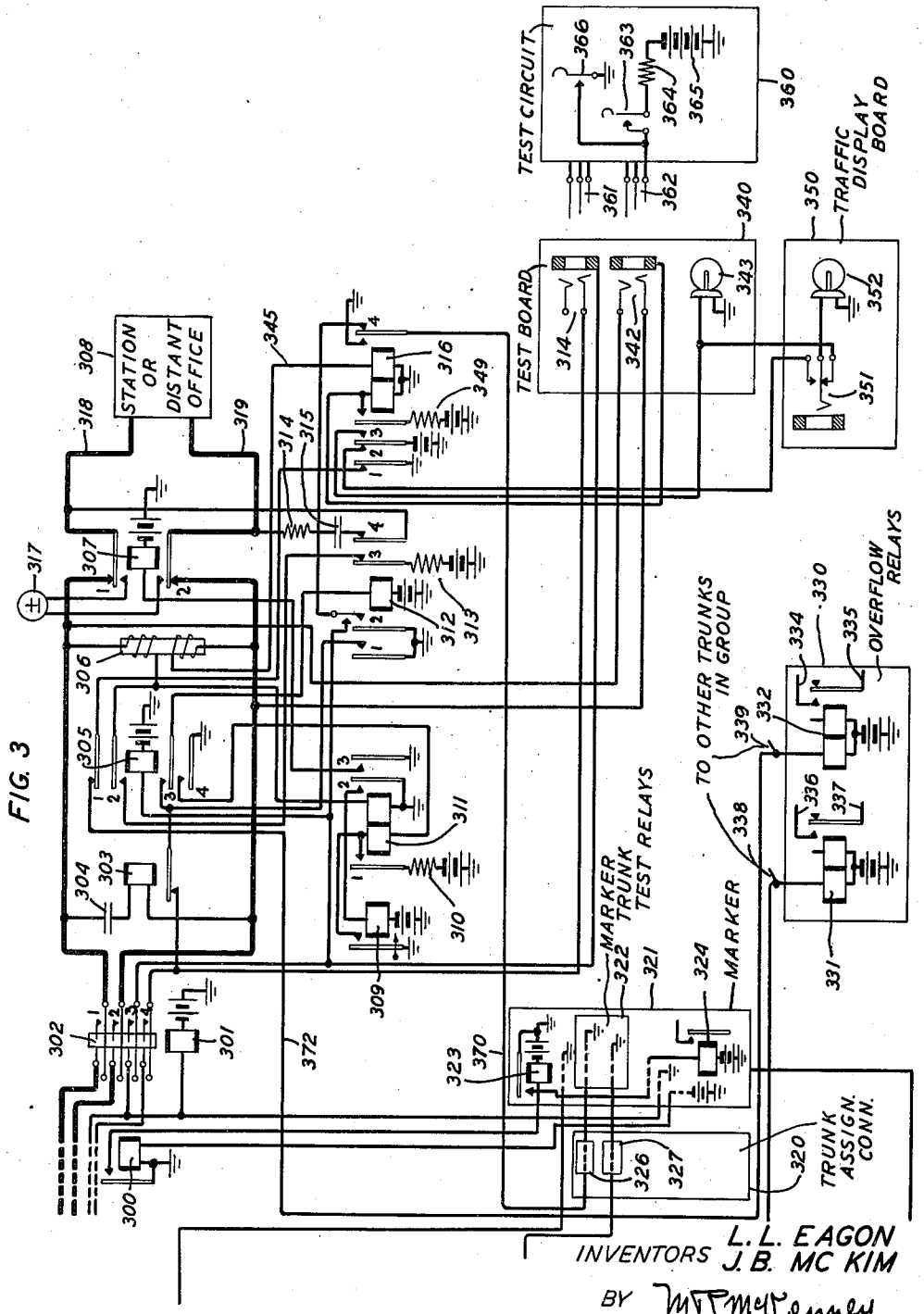


FIG. 3

INVENTORS L. L. EAGON
J. B. MC KIM

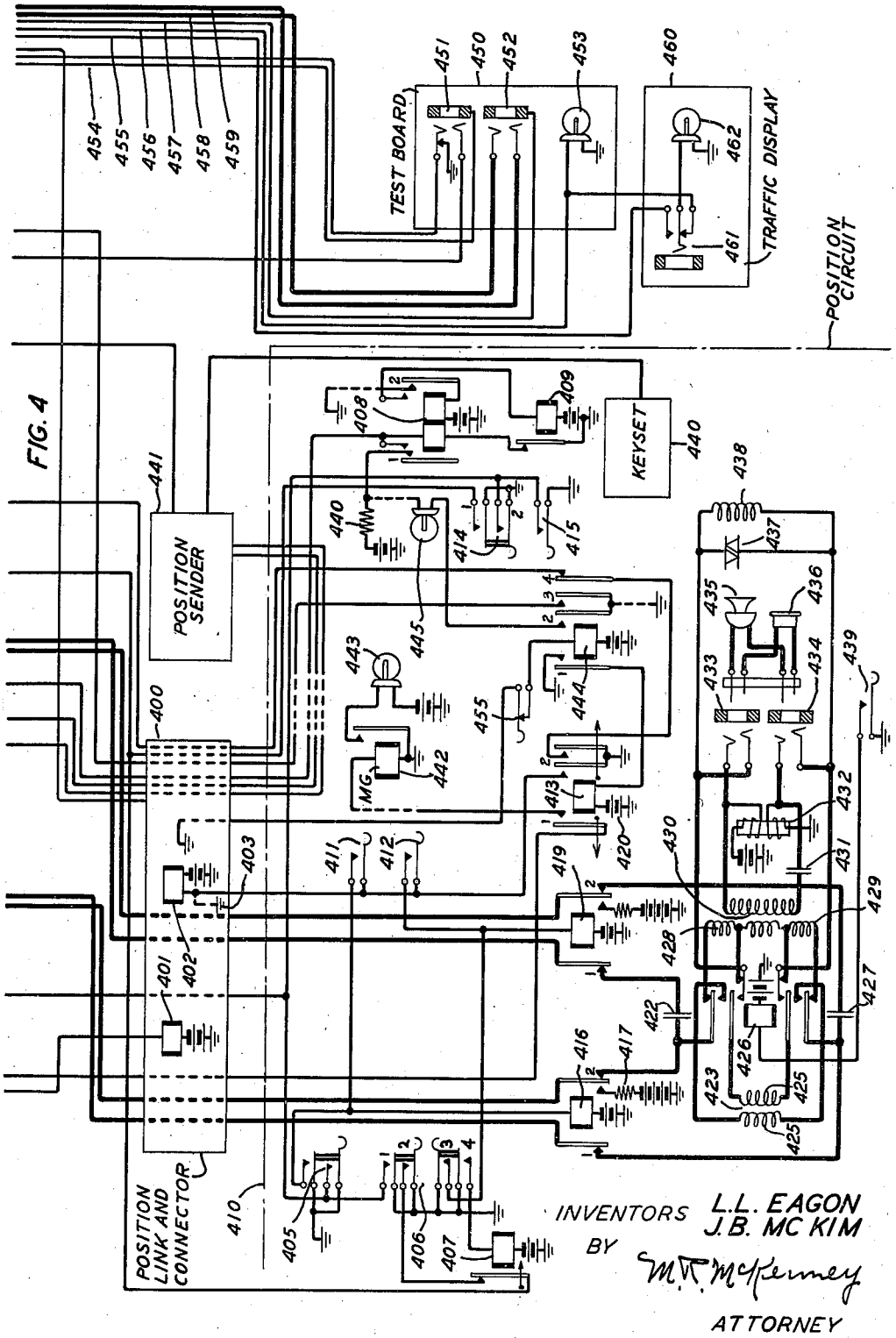
BY M. T. McTierney

ATTORNEY

Oct. 14, 1941. L. L. EAGON ET AL 2,258,980

TELEPHONE SYSTEM

Filed April 18, 1940 4 Sheets-Sheet 4



Patented Oct. 14, 1941

2,258,980

UNITED STATES PATENT OFFICE

2,258,980

TELEPHONE SYSTEM

Lloyd L. Eagon, Great Neck, and James B. McKim New York, N. Y., assignors to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application April 18, 1940, Serial No. 330,254

9 Claims. (Cl. 179—27)

This invention relates to telephone systems and more particularly to systems in which idle units of equipment are automatically selected for use in telephone connections.

In automatic switching telephone systems using line switching equipment and particularly those systems which automatically select an idle trunk from a group of trunks, no record is made or signal given to indicate the number or location of the trunks selected for telephone connections. Under circumstances, when for example, a faulty trunk circuit is encountered during the completion of a telephone connection the equipment involved in the connection may be held awaiting an alarm and the tracing of the fault by a test and repair man. This sometimes delays the completion of a telephone connection and maintains other equipment in an operated condition beside the unit of equipment having a fault therein. If an automatically selected trunk circuit having a fault is disconnected before a record is made of its number or location it is thereafter difficult to locate and could be again selected for a telephone connection.

According to the present invention, a device is included in automatically selectable circuits which may be operated by an observing telephone operator to immediately remove a faulty circuit from service and actuate a signal individual to the faulty circuit so that its location is given. The associated equipment may be released or a circuit of the same character may immediately be selected for replacing the faulty circuit in the telephone connection. The procedure in completing the telephone connection after the faulty circuit is removed from service may vary to some extent depending upon the character of the circuit having the fault therein but in any case the faulty circuit may be immediately disconnected from other equipment and connected with a testing device so that it cannot be again selected until the fault has been corrected.

A feature of the present invention is therefore an arrangement for increasing the efficiency of an automatic switching telephone system by diverting faulty circuits from a telephone connection for which they were automatically selected to a display and test board.

Another and related feature is a system in which trunk circuits having a fault therein may be made non-selectable and removed from service by means available to one operator not cognizant of the number or location of the trunk circuit, said means causing the connection of the trunk circuit conductors to another operator's position and causing the operation of a device in the latter operator's position for indicating the particular trunk having a fault therein.

These and other features will be discussed more fully in the following description.

To illustrate the features of the invention, reference may be had to the accompanying drawings in which:

Figs. 1 to 4, inclusive, when arranged as indicated in Fig. 5 show the operating advantages of equipment arranged according to this invention;

Figs. 1 and 2 illustrate a distant office, an intertoll trunk circuit and automatic switches for interconnecting this trunk circuit to other trunk circuits;

Fig. 3 shows another intertoll trunk circuit, a distant office, a trunk assignment connector, a marker, overflow circuits and testing and trunk display switchboard equipment individual to the intertoll trunk circuit;

Fig. 4 illustrates a cordless operator's position circuit, a link circuit and testing and display switchboard equipment individual to the intertoll trunk, Figs. 1 and 2.

The trunk circuit, Figs. 1 and 2, may be used as an incoming trunk circuit from the distant office 100 or as an outgoing trunk circuit to this office. When used as an incoming trunk circuit it is actuated by calling equipment in the distant office 100 for selecting a cordless operator's position having an operator for setting up a connection to another call station as hereinafter described. When used as an outgoing trunk circuit it is automatically selected by a marker 321 over test lead 240 and associated with a calling trunk circuit through the actuation of switch 285 by this marker. This trunk circuit is energized for an incoming call by ringing current from office 100 transmitted over trunk conductors 145 and 146 through trunk line equipment 147 to the trunk circuit relay 103. Ringing current may be applied automatically or manually depending upon the equipment in the distant office 100 and is transmitted as a calling signal to actuate the trunk circuit equipment. The energization of relay 103 releases relay 104 which, as may be noted, is normally energized from battery through its winding to ground on the contact of relay 103. The release of relay 104 establishes a circuit for operating the incoming trunk relay 202 over a circuit from battery through the winding of relay 202, contact 2 of relay 104, contact 7 of relay 117, contact 6 of relay 203 to ground. Relay 202

in operating establishes a locking circuit for itself through its contact 3, contact 7 of relay 117, contact 6 of relay 203 to ground. When ringing current is disengaged from the trunk conductors 145 and 146 relay 103 releases, which reenergizes relay 104. A circuit is thus established for relay 113 from battery through its winding, contact 5 of relay 112, contact 2 of relay 104, contact 3 of relay 202, contact 7 of relay 117, contact 6 of relay 203 to ground. Relay 113 is locked through contact 4 of relay 201, contact 5 of relay 113 through its operating ground on contact 6 of relay 203.

Cordless operator's position

The operation of relay 113 establishes a start circuit for a link 400 which associates the incoming trunk and the operator at office 100 with an idle cordless operator's position shown in Fig. 4. This link start circuit may be traced from ground on contact 1 of relay 114 through contact 2 of relay 113, contact 1 of relay 112, lead 130, winding of start relay 401 to battery. The link circuit is shown diagrammatically and reference is made to the patent application of King et al., Serial No. 295,010, filed September 15, 1939, issued as Patent 2,236,246, March 25, 1941, or the patent application to Busch et al., Serial No. 295,012, filed September 15, 1939, for complete disclosures of this link structure. There are ordinarily a plurality of tool operators' positions, such as 410, with the plurality of channels entering each position to which incoming trunks may be connected when actuated by an incoming call. The structure of link 400 is such that the channels of a plurality of positions are tested to quickly find an idle channel in a position occupied by an operator. When an idle channel has been selected, a relay, such as relay 444, is energized to engage this channel for the particular incoming call which has energized a trunk circuit. This position equipment and circuit may be the same as shown in the aforementioned Patent 2,236,246 to King et al., or the patent application to J. B. McKim Serial No. 312,468, filed January 5, 1940. Only sufficient of the position circuit is shown to properly illustrate the invention. Relay 444 lights the position signal lamp 445 and establishes a circuit for relay 112 to signal the incoming trunk equipment, Figs. 1 and 2, that a cordless position channel has been selected and is ready to receive the incoming call. The latter circuit may be traced from ground through contact 3 of relay 444, link 400, lead 144, contact 2 of relay 117, contact 3 of relay 112, winding of relay 112 to battery, causing the operation of relay 112. The latter relay in operating establishes a locking circuit for itself through its winding and contact 3, contact 4 of relay 113, contact 2 of relay 104, contact 3 of relay 202, contact 7 of relay 117, contact 6 of relay 203 to ground. The operation of relay 112 removes the link start ground from lead 130 which extended through its contact 1 and causes the release of the link control apparatus, with the exception of link switches through which the incoming trunk is connected to the position apparatus. Switch hold magnets, such as 402, are operated by a link control circuit for closing contacts shown as dotted lines. The operation of the previously described relay 444, in addition to operating relay 112, also establishes an energizing circuit for relay 413 which connects ground to keys 312 and 411 and the link switch hold magnet 402 and also completes a signaling circuit for indicating the type of call coming into the position. Only one marginal relay 442 has been shown to diagrammatically illustrate this signal arrangement which is fully disclosed in the patent application Serial No. 312,468 to J. B. McKim, filed January 5, 1940. The operation of relays 413 and 112 establishes a signaling path from battery through resistance 110, contact 2 of relay 112, contact 1 of relay 413, winding of marginal relays represented by relay 442 to ground. The circuit just traced is for a new call incoming from a distant operator which would light a lamp such as 443. Other signaling circuits for lighting other lamps include either incoming trunk circuit resistances 221 or 222 in multiple with resistance 110 for establishing a different margin for the position signaling apparatus, as explained in the aforementioned patent application to McKim. The operator in position 410 now challenges the calling operator at the distant office 100 and receives the call designation or code of the wanted office or party. The operator in position 410 accordingly manipulates the key-set 440 which operates the registering apparatus of the position sender 441, causes the selection of a marker, such as 321 and the operation of registers and trunk routing equipment in the selected marker. The operation of this key-set, sender and marker is fully disclosed in the Patent 2,236,246 to King et al. and it is thus deemed unnecessary to encumber this disclosure with a detailed description of these units of equipment.

Outgoing trunk

Registers in the marker 321 are set according to code digits representing a particular outgoing trunk group extending to the wanted office and a route relay is accordingly operated which controls the test of the trunks in this group. At this time a ground is supplied by the marker for operating the incoming trunk switch select magnet 278. The marker is equipped with a group of testing relays 322 equivalent to the maximum number of trunks in a group to be tested, which applies a test to the trunk circuits of a group. The trunk circuits of a group have test leads connected to the contacts of assignment connector trunk group multicontact relays such as diagrammatically shown at 326 and the test is made at this point by the marker. When an idle trunk is found in the desired group a ground is placed on the test lead of this trunk circuit by the marker 321 to prevent other markers from seizing the trunk. This ground applied to the trunk circuit, Fig. 3, energizes trunk relay 305 as traced from the marker through a contact on group relay 326, over lead 370, contact 4 of relay 316, contact 2 of relay 312, winding of relay 305 to battery. The marker also operates select magnet 300 and makes a test of junctor channels extending between the calling incoming trunk switch 282 and the selected outgoing trunk switch 302 to find a channel which may be used for connecting these two trunks together as fully described in the aforementioned patent to King et al. As soon as this channel has been found, the switching apparatus is operated which includes the hold magnets, such as 301 and 275, and hold magnets of intermediate switches associated with the selected junctor channel which closes the cross-points of the cross-bar switches and connects the conductors of the incoming trunk, Figs. 1 and 2, to the outgoing trunk, Fig. 3. The hold magnets for maintaining the switch contacts in position originally energized by the marker have a second

circuit extending through the switch contacts from the incoming trunk circuit and an auxiliary circuit from the cordless position circuit, Fig. 4. This second circuit may be traced from ground on contact 4 of the calling trunk circuit relay 202, contact 9 of splitting relay 201, conductor 279, contact 3 of switch 282, windings of all hold magnets to battery. This circuit also extends through contact 3 of switch 302, winding of outgoing trunk relay 305 to battery. An auxiliary circuit for the hold magnets is used whenever the operator in the toll position 410 wishes to operate the splitting relay 201. This circuit may be traced from ground on key 414 or key 406 to conductor 142, conductor 279, thence to the hold magnets and winding of relay 305. Key 414 or key 406, when operated, establishes circuits for operating relay 201 and at the same time placing ground on the hold magnets and relay 305.

The apparatus of the outgoing trunk, Fig. 3, is further energized to associate ringing current with the equipment of the distant office 308 and to establish a connection between that distant office and the office 100. Relay 305 establishes a circuit for relay 311 from ground through the right winding of relay 311, contact 2 of relay 305, contact 3 of relay 312, resistance 313 to battery. Relay 311, in operating, establishes a locking circuit for itself and connects ground through its contact 3, winding of relay 303 to battery. The alternating current source 317 is thus associated with trunk conductors 318 and 319 leading to the distant office 308. This ringing current is associated with conductors 318 and 319 for a time period regulated by the slow operating relay 309. The locking circuit for relay 311 may be traced from battery through resistance 310, contact 1 and left winding of relay 311 to ground on contact 4 of relay 305. An obvious energizing circuit for relay 309 is also established through contact 2 of relay 311. Relay 309 establishes the correct time period for the association of ringing current with the equipment of the distant office 303 before it operates to cause the release of relay 311. When relay 309 operates, it associates a ground with the left winding of relay 311 which places a shunt on this relay. During this time period, relay 312 has operated providing all circuit connections are properly established and, therefore, the original operating circuit for relay 311 is opened and the latter relay releases. The energizing circuit for relay 312 may be traced from battery through its winding, contact 3 of relay 305, contact of relay 303, contact 4 of switch 302 and similar contacts of intermediate switches, contact 4 of switch 282, thence over lead 148 through the link circuit 400, left winding and contact 2 of relay 408, contact of relay 409 to ground. Relay 312, in operating, disassociates battery through its contact 3 from the right winding of relay 311 and establishes a locking circuit for itself from ground through its contact 1, contact 3 of relay 305 through its winding to battery. Relay 312 also associates direct ground through its contact 2, contact 4 of relay 316, lead 370 through the trunk assignment connector 320 to the marker testing apparatus. This busy ground replaces a ground as previously traced which was applied by relay 202 to the hold magnets and relay 305 and is arranged to maintain ground on the apparatus of the trunk assignment connector until all of the outgoing trunk apparatus is later released. The trunk assignment connector 320 has trunk block relays therein represented diagrammatically as rectangles 326 and 327. Each block relay has contacts for each trunk of a group and consequently, a ground placed thereon makes any particular trunk busy to all markers so that this trunk will not be selected for a telephone connection. Relay 408 also operates in the circuit traced establishing a locking circuit for itself through its right winding. This relay also closes the signal circuit for lamp 445 and establishes an operating circuit for relay 409. Relay 409 opens the original operating circuit for relays 408 and 312 leaving the lamp circuit free to function with trunk signaling circuits. The locking ground for the outgoing trunk relay 312 now extends through the contact of relay 303, contact 4 of the switches, thence over lead 148 through the link 400, contact 1 of relay 408, resistance 466 to battery, which shunts lamp 445 to extinguish this lamp. This indicates to the cordless toll operator that an idle outgoing trunk has been selected for the connection and that the equipment of the outgoing trunk circuit has satisfactorily operated.

The marker 321 and the sender 441 may be released in the manner fully described in the Patent 2,236,246 to King et al. Relay 324 has been shown diagrammatically associated with other apparatus of the marker for releasing this marker.

In the trunk circuit, Figs. 1 and 2, as previously stated, equipment is included for both incoming trunk and outgoing trunk operations. When this circuit is used as an outgoing trunk, relay 203 operates in the manner described for outgoing trunk relay 305 and relay 117 operates in the manner as described for relay 312. When this circuit is taken for use either as an incoming trunk or an outgoing trunk, a busy ground indication is immediately placed on lead 240 extending to a contact on the trunk block relay 327, shown in the trunk assignment circuit 320, so that this circuit will not be selected by another marker making a test for an outgoing trunk. It will be remembered that relay 202 is immediately operated by the initiation of a call from the distant operator at office 100 when this circuit is taken for use as an incoming trunk. The operation of relay 202 places ground on its contact 2 and the busy circuit extends through contact 6 of relay 117, contact 2 of relay 210, conductor 240 to a contact on the trunk block relay 327. Assuming that this circuit is selected as an outgoing trunk circuit extending to office 100, a ground is placed on conductor 249 when this trunk is chosen by the marker. This ground extends through contact 6 of relay 117, contact 2 of relay 210 over conductor 240 to a contact on the trunk block relay. This ground also extends through the winding of relay 203 which operates relay 203 in the same manner as described for the operation of relay 305. When relay 117 is operated in the manner described for relay 312, ground is associated through its contact 6 through contact 2 of relay 210, to conductor 240 and a contact on the trunk block relay 327. Thus, under all conditions a busy ground is placed on a conductor as soon as either an incoming trunk or an outgoing trunk is chosen for service so that any markers in the office will not attempt to select this trunk.

Overflow trunk

Overflow trunk circuits are associated with each group of trunks in an automatic telephone exchange of this character which is arranged to signal the cordless operator when all trunks of a group are busy. The overflow circuit diagram-

matically shown in Fig. 3 represents an overflow trunk of the character fully disclosed in the Patent 2,236,246 to King et al. The overflow trunks 330 illustrate relay 331 associated with one group of trunks and relay 332 associated with another group of trunks. The individual trunks of the groups have leads, such as 242 and 372 extending to these relays. One circuit, as shown, extends from battery through one winding of relay 331 over lead 242, contact 1 of relay 203, contact 1 of relay 202 to ground on relay 210. Circuits of this character maintain relay 331 operated until all of the trunks in the group are busy. Relay 331 releases when these ground circuits of all trunks in a group have been removed. When all the outgoing trunks in a group are found busy by a marker, the calling incoming trunk is routed to an overflow trunk associated with this group of outgoing trunks and apparatus is associated with the calling incoming trunk giving typical interrupted ground circuit. The interrupted ground circuit of the overflow interrupter is connected through contact 4 of switch 282 to lead 148 for flashing lamp 445 in the cordless position circuit. If a trunk becomes idle during this period of flash, relay 331 is again energized which changes the interruptions to a different period, thus changing the period of flash of lamp 445 to indicate to the cordless operator that an idle trunk is available in this group. It should be noted that the operating circuit for relay 331 extends through contact 1 of relay 203 which is energized when this circuit is selected as an outgoing trunk circuit and also through relay 202 which is energized when this circuit is used as an incoming trunk circuit. In each case the circuit is indicated as busy as hereinbefore described and, therefore, in either case the circuit to the overflow relay is opened. Relay 332 is associated with the trunk group having the outgoing trunk, Fig. 3, therein. This circuit extends from battery to the left winding of relay 332, over conductor 372, contact 1 of relay 305 to ground on contact 1 of relay 316. When the outgoing trunk is taken for use, relay 305 is operated and thus the circuit for relay 332 is opened. The multiple straps 338 and 339 indicate leads to the other trunks of each group. Leads 334 and 335, as well as 336 and 337, indicate the circuit for actuating the overflow interrupter.

Faulty circuits

The cordless operator in position 410 is provided with means of supervising such telephone connections either through visual signaling means or by aural signaling means by monitoring or listening during conversation with the calling party. The operator may monitor on a telephone connection by operating key 439 to energize relay 426 which connects receiver 436 with the talking conductors by induction through high impedance coil 423. It is obvious that, when trouble occurs in equipment associated with a trunk circuit or in a trunk circuit, a telephone connection cannot be properly completed. Some troubles may develop unsatisfactory transmission, of which the operator is immediately aware when conversing with the calling party or monitoring upon a completed connection. Other faults may occur, such for example as a singing repeater or a faulty contact in an associated simplex or signaling circuit. Under any of the foregoing conditions, a connection must be immediately broken down and a new connection established in order to obtain satisfactory transmission between stations or a satisfactory connection. A trunk circuit having a faulty condition may be immediately removed from service so that it is not again selected by the marker for completing telephone connections and a different trunk circuit selected for the connection. To bring about this result, apparatus is included in each trunk circuit which is under the control of the cordless operator for immediately removing the faulty trunk from service and associating this trunk with a testing switchboard.

Faulty incoming trunk

Returning now to the initiation of a call by the calling party or distant operator, such as the operator at telephone office 100, and the energization of the incoming trunk equipment and the equipment of the cordless toll operator's position 410, during the operation required by the position operator, she may find that the incoming trunk, for one of the reasons herein presented, is not in a serviceable condition. When this is the trunk shown in Figs. 1 and 2, in use as an incoming trunk, the operator immediately advises the calling operator at station 100 to extend her call to the office over a different trunk and energizes key 411 or key 405 to remove the trunk circuit from service. Key 411 energizes relay 416 which associates battery through resistance 417 with conductor 133. This establishes an operating circuit for relay 210 which may be traced from ground through its left winding, contact 7 of relay 202, lower winding of retardation coil 200, conductor 133, resistance 417 to battery. Relay 210, in operating, establishes a locking circuit for itself from ground through its right winding, contact 3, resistance 250 to battery. This relay is locked in this manner in order that other operations in the incoming circuit will not cause its release until the trunk circuit has been tested and again placed in condition for service. The operation of relay 210 removes ground from conductor 241 which, as previously described, extends to conductor 242 and the overflow circuit. Contact 2 connects ground to the trunk block relay 327 in order that all markers will find this trunk busy, which prevents the use of this trunk circuit until it is placed in serviceable condition. Contact 4 of relay 210 associates battery with conductor 456, filament of test board lamp 453 to ground. This circuit also extends through the contact of key 461, filament of lamp 462 to ground. This illuminates a lamp in the test board 450 and in the traffic display board 460, each switchboard having an attendant to maintain the equipment of the telephone office in a serviceable condition. Contact 5 of relay 210 connects ground from the test board jack 451 to the winding of relay 104 so that this relay cannot be released by a calling distant office. The operator in the cordless position 410 may then energize key 415 if the connection has proceeded to the point of operating switches 282 to 302. This circuit extends a ground over conductor 132 through contact 4 of relay 112, winding of the splitting relay 201 to battery, operating relay 201. It will be remembered that the hold magnets 275 and 301 of switches 282 and 302 were maintained operated from ground extending through contact 4 of relay 202, contact 9 of the splitting relay 201, contact 3 of switch 282 to battery through hold magnet 275 and to battery through hold magnet 301. This ground also extends through con-

tact 3 of switch 302 for maintaining the outgoing trunk relay 305 operated. The energization of relay 201, therefore, releases the switch hold magnets and the outgoing trunk relay 305, and disconnects the incoming trunk from the switching connection. Key 405 may be used to simultaneously operate relay 210 and release the switches 282 to 302. The operator may now actuate the position release key 455 which releases relays 444 and 413 and the hold magnets of the link switches 400 which disconnects the incoming trunk from the cordless position equipment.

A test circuit 360 is associated with the incoming trunk by the testing switchboard operator which associates testing equipment through the jack springs of jacks 451 and 452 with the trunk circuit. This removes the ground through the tip spring of jack 451 to place the trunk at the disposal of a test man in office 100 whose services may be required to complete the test of this trunk. The tip and ring springs of jack 452 are connected to the tip and ring conductors of the trunk. Other leads from the circuit, such as 454, 455, 456 and 457, associate the equipment of test board 360 with the apparatus of the trunk in order that various tests of the trunk may be made directly from the testing switchboard. This testing circuit is diagrammatically shown in Fig. 3 and only the circuit and apparatus concerned with this invention is disclosed. This comprises key 366 for releasing relay 210 when the incoming trunk has been again placed in serviceable condition and key 363 for operating relay 210, if required. Key 366 associates ground through the sleeve of plug 362 which is inserted in jack 452 extending to lead 457 through the right winding of relay 210 and its contact 3, resistance 250 to battery. This places a shunt around the right winding 210 and causes the release of this relay and places the incoming trunk in service. Key 363 is shown in the test circuit for enabling the test board operator to operate relay 210, if necessary. This circuit extends from battery through resistance 364, key 363, sleeve of plug 362, thence through the sleeve of jack 452, conductor 457, right winding of relay 210 to ground. Relay 210 locks in the manner previously described and remains operated until key 366 is actuated to cause its release.

Faulty outgoing trunk

Assuming again that a connection has been established and that the incoming trunk, Figs. 1 and 2, has been connected to the outgoing trunk, Fig. 3, through switches 282 and 302 and that, due to a fault in the outgoing trunk, Fig. 3, the telephone connection is not properly completed. The cordless operator may be aware of this fault through her signaling apparatus or she may be aware of a fault by monitoring after the connection has been completed. Under this condition, relay 316 is energized immediately by the cordless operator to remove the outgoing trunk circuit from service. The cordless operator may actuate key 412 which operates relay 419 for associating battery with conductor 140. The operator in this instance also energizes key 414 for operating the splitting relay 201. The circuit for energizing the splitting relay 201 may be traced from battery through its lower winding, contact 4 of relay 112, conductor 132 to ground on contact 2 of key 414. In this instance, a ground is also associated with conductor 132 through contact 1 of key 414 for holding the switches and the outgoing trunk energized. This circuit may be traced from ground through contact 1 of key 414, link 400, conductor 142, contact 3 of switch 282 to battery through the switch hold magnet 275 and to battery through the switch hold magnet 301, contact 3 of switch 302, winding of relay 305 to battery. The energizing circuit for lock-out relay 316 may be traced from battery through resistance 420, conductor 149, contact 2 of relay 201, contact 2 of switch 282, contact 2 of switch 302, lower winding of retardation coil 306, right winding of relay 316 to ground. Relay 316 locks through its left winding and contact 3, resistance 349 to battery. The operation of relay 316 disconnects ground from the overflow circuit at its contact 1. This overflow circuit extends through contact 1 of relay 305, conductor 372, left winding of overflow relay 332 to battery. Contact 2 of relay 316 associates battery with the filament of lamp 343 to ground and through key 351, filament of lamp 352 to ground, illuminating the lamp in the testing switchboard 340 and a lamp in the traffic display board 350. Contact 4 of relay 316 removes the outgoing trunk from service and renders it non-selectable by opening the operating circuit for relay 305 and extending ground over conductor 370 to the trunk block relay 326 to prevent the markers of the telephone office from selecting this trunk for service connections.

The procedure followed by a cordless operator when a faulty outgoing trunk has been discovered may be to operate key 414 to energize the splitting relay and hold the connecting switches, operate key 412 to energize the self-locking lock-out relay 316, release keys 414 and 412 and operate key 415 to release the switches 282 to 302, by opening the hold magnet circuit. This operator then immediately resets the position sender 441 and the marker 321 in the same manner as before to cause the selection of another trunk circuit in the same trunk group. Since the faulty trunk has been made non-selectable to markers there is no danger that this trunk will again be selected. There is therefore very little delay in completing the telephone connection between the calling station and the wanted station when a faulty trunk is encountered. In some instances, key 406 may be used in place of keys 414, 412 and 415 for removing a trunk from service and disconnecting the switches therefrom. Contact 1 of key 406 operates the splitting relay 201. Contact 2 connects ground through the contact of relay 407 to conductor 142 for maintaining the switch hold magnets energized. Contact 3 establishes an energizing circuit for relay 419 to operate the self-locking lock-out relay 316 as described. Contact 4 establishes an energizing circuit for the slow operating relay 407 which allows sufficient time for the operation of the lock-out relay 316 before it opens its contact. The opening of the contact on relay 407 removes the ground supply for the switch hold magnets causing the release of the switches permitting the operator to proceed with the setting of the marker for the selection of another outgoing trunk for completing the telephone connection for the calling station.

Tests of the outgoing trunk by a test and maintenance man may be made by associating the testing circuit 360 through plugs 361 and 362 with jacks 341 and 342. After the outgoing trunk circuit has been placed in a serviceable condition, key 366 is energized for connecting ground

through plug 362 and jack 342 and the left winding of relay 316. This shunts the current from the left winding of relay 316 and causes its release which places the outgoing trunk circuit in service for selection by the markers of the telephone office.

When the trunk circuit, Figs. 1 and 2, is selected as an outgoing trunk circuit, the lock-out relay 210 may be operated in the manner described for the operation of relay 316. In this instance, it is apparent that an incoming trunk circuit will be associated with the trunk circuit, Figs. 1 and 2, through switches, such as 262 and 302, and only the apparatus of the trunk circuit, Figs. 1 and 2, operated which is used for an outgoing trunk connection. When the trunk circuit, Figs. 1 and 2, is associated with the testing switchboard, all of its equipment and circuits may be tested regardless of whether it was in use as an outgoing trunk circuit or an incoming trunk circuit.

What is claimed is:

1. In an automatic switching telephone system, trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, means in a trunk circuit responsive to an incoming call for controlling the selection of an idle operator's position and for actuating equipment in said position, signaling means in said operator's position for indicating faulty operation of the equipment in an associated trunk circuit, lock-out means individual to each trunk circuit for removing said trunk circuit from service and rendering it non-selectable, and means in said operator's position for operating the lock-out means in a trunk circuit so connected with said position.

2. In an automatic switching telephone system, trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, means in a trunk circuit responsive to an incoming call for controlling the selection of an idle operator's position and for actuating equipment in said position, signaling means in said operator's position for indicating faulty operation of the equipment in an associated trunk circuit, lock-out means individual to each trunk circuit for removing said trunk circuit from service and rendering it non-selectable, connecting it to a testing device and operating a signal in said testing device, means in said operator's position for operating the lock-out means in trunk circuits so connected, and means for disconnecting said trunk circuit from said position.

3. In an automatic switching telephone system, selectable trunk circuits for incoming calls from call stations and outgoing calls to said call stations, operators' positions, automatic switches, means in a trunk circuit for controlling the selection of an idle operator's position, means in said position for controlling the selection of another trunk circuit and the operation of said switches for connecting said two trunk circuits together for a telephone connection between call stations, magnetically operable self-locking means individual to each trunk circuit for removing a trunk circuit from service and rendering it non-selectable, and means in said operator's position for operating said self-locking means.

4. In an automatic switching telephone system, selectable trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, automatic switches, means in a trunk circuit for controlling the selection of an idle operator's position, means in said position for controlling the selection of another trunk circuit and the operation of said switches for connecting said two trunk circuits together for a telephone connection between call stations, signaling means in said operator's position for indicating faulty operation of either trunk circuit so connected, magnetically operable self-locking means individual to each trunk circuit for removing a trunk circuit from service and rendering it non-selectable, and means in said operator's position for operating said self-locking means in either trunk circuit so connected.

5. In an automatic switching telephone system, selectable trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, automatic switches, means in a trunk circuit for controlling the selection of an operator's position, means in said position for controlling the selection of another trunk circuit and the operation of said switches for connecting said two trunk circuits together for connection between call stations, magnetically operable self-locking means individual to each trunk circuit for removing said trunk circuit from service, rendering it non-selectable, connecting it to a testing device and operating a signal in said testing device, and means in said operator's position for operating the self-locking means in either trunk circuit so connected and for disconnecting said trunk circuit.

6. In an automatic switching telephone system, groups of selectable trunk circuits for completing telephone connections from one call station to another, operators' positions, automatic switches, markers, means in one of said trunk circuits responsive to an incoming call from a station for controlling the selection of an idle operator's position, means in said position for setting one of said markers for the selection of a trunk in a particular trunk group, means in said marker for testing the trunks of said group, for selecting an idle trunk and for operating certain of said switches to connect the calling trunk with the selected idle trunk, signaling means in said operator's position for indicating faulty operation of either trunk circuit so connected, lock-out means individual to each trunk circuit for removing either trunk circuit so connected from service and rendering it non-selectable by markers, and means in said operator's position for operating said lock-out means in either trunk circuit so connected.

7. In an automatic switching telephone system, selectable trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, automatic switches, means in a trunk circuit for controlling the selection of an idle operator's position, means in said position for controlling the selection of another trunk circuit and the operation of said switches for connecting said two trunk circuits together for a telephone connection between call stations, magnetically operable self-locking means individual to each trunk circuit for removing said trunk circuit from service and rendering it non-selectable for telephone connections, and a single means in said operator's position for operating said self-locking means in either trunk circuit and releasing said trunk circuit from said telephone connections.

8. In an automatic switching telephone system, groups of trunk circuits for incoming calls from call stations and outgoing calls to call stations,

operators' positions, automatic switches, means in a trunk circuit responsive to an incoming call for controlling the selection of an idle operator's position and for actuating equipment in said operator's position, means in said position for controlling the selection of an idle trunk circuit of a group outgoing to a particular station and the operation of certain of said switches for connecting the calling incoming trunk circuit to the selected outgoing trunk circuit, signaling means in said operator's position for indicating faulty operation of a trunk circuit, magnetically operable self-locking means individual to each trunk circuit for removing a trunk circuit from service, rendering it non-selectable and connecting it to a test switchboard, means in said operator's position for operating the self-locking means in the outgoing trunk circuit and for disconnecting this trunk circuit from the telephone connection, and means for selecting another outgoing trunk circuit for connection to said calling incoming trunk circuit.

9. In an automatic switching telephone system, trunk circuits for incoming calls from call stations and outgoing calls to call stations, operators' positions, means in a trunk circuit responsive to an incoming call for controlling the selection of an idle operator's position and for actuating equipment in said position, signaling means in said operator's position for indicating faulty operation of the equipment in an associated trunk circuit, lock-out means individual to each trunk circuit for removing said trunk circuit from service and rendering it non-selectable, connecting it to a testing device and operating a signal in said testing device, means in said operator's position for operating the lock-out means in trunk circuits so connected, means for disconnecting said trunk circuit from said position, and means in said testing device for releasing said lock-out means for placing said trunk circuit in service.

LLOYD. L. EAGON.
JAMES B. McKIM.