

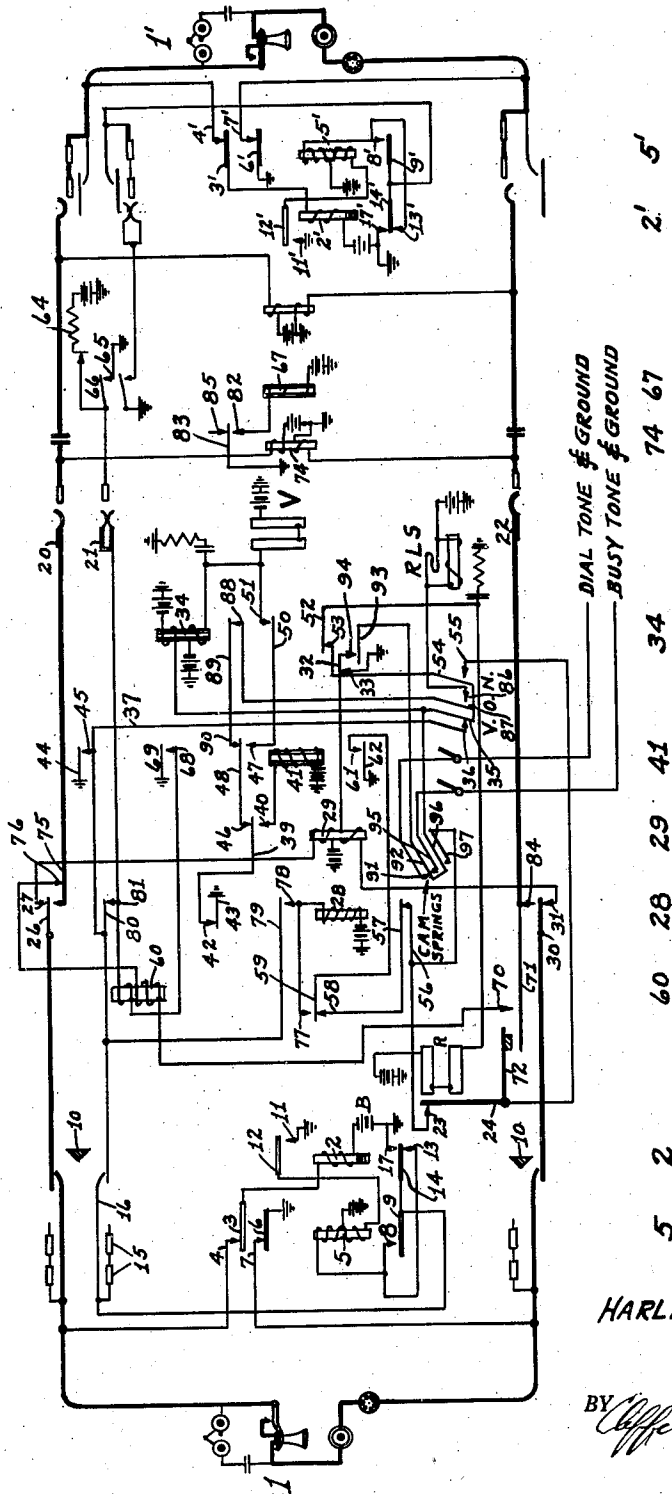
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SELECTOR SWITCH CIRCUIT FOR AUTOMATIC TELEPHONE SYSTEMS

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SELECTOR SWITCH CIRCUIT FOR AUTOMATIC TELEPHONE SYSTEMS

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This invention relates to a selector switch circuit for automatic telephone systems.

The object of my invention is to provide a selector which not only tests the private contacts of trunks to a connector or other selector to determine the idle or busy condition of the trunk, but also tests the talking circuit contacts. In accordance with my invention my selector switch automatically steps forward to the next available trunk if the private contact of the trunk is either open or grounded, or if either of the talking circuit wipers fail to complete a circuit.

My invention has been applied to a selector switch of the type which steps vertically under influence of impulses from a subscriber's station until the wipers of the selector switch are opposite a bank of trunks in which an idle trunk to the proper group of additional selector switches or connector switches is located and which then rotates or moves along the group of contacts until an idle and available trunk is found whereupon the rotary impulses cease and connection is completed to the available trunk. It is common practice to indicate the idle condition of a trunk by battery potential on the private contacts through a substantial resistance, say 500 ohms, and to indicate the busy condition of a trunk by ground potential on the private contact of the busy trunk. In accordance with this well-known and usual testing arrangement, if the talking contacts or the private contacts of a trunk are dusty or dirty so that an electrical connection is not completed between the brushes of the selector and the talking or private contacts of the next selector or the connector, the selector will nevertheless stop rotation with its wipers at the position of this trunk from which position it will ordinarily be released or upon which position it will remain until the calling subscriber, failing to secure the desired number, hangs up his receiver.

In accordance with my invention the selector switch wipers are passed over dirty contacts on which either of the talking circuit wipers or the private wiper fail to make connection and will stop upon the contacts of the first idle trunk to which all of the contacts, both talking and private, have made proper connection.

My invention is illustrated in the accompanying drawing in which all of the parts are diagrammatically illustrated in their normal or unactuated condition. In this diagrammatic illustration all relay contacts are positioned in vertical alignment with the electromagnet which controls them. Since my invention relates only

to the selector switch, the line circuits and connector circuit have been abbreviated to include only such parts as are essential to the operation of my selector circuit.

A conventional calling subscriber's station 1 and a conventional called subscriber's station 1' are located respectively at the left and right of the drawing. In the central office subscriber's station 1 is provided with a line relay 2 having its winding connected between the live side of battery B and one limb of the line through normally closed contacts 3 and 4 of cut-off relay 5. The other side of the calling line is connected to ground through another pair of normally closed contacts 6 and 7 of cut-off relay 5. Cut-off relay 5 is provided with two windings, one a high resistance winding which controls only contacts 3, 4, 6 and 7. The other winding is a low resistance winding which controls all of the contacts of relay 5 including normally open contacts 8 and 9. Line relay 2 is provided with a copper shield which makes it slow to release. The armature of relay 5 which controls contacts 8 and 9 also controls the plungers 10 of the Keith line switch. All plungers having moved to a position opposite an idle first selector switch, the particular plungers 10 are left in their inserted condition during the connection of the line with the trunk while all other plungers corresponding to 10 are moved, through common mechanism, to positions opposite an idle trunk, all of which is well-known in the art under the designation Keith line switch. The line relay 2 is provided with a pair of normally opened contacts 11 and 12 for completing the circuit from ground through a low resistance coil of cut-off relay 5 to battery. The line relay 2 is also provided with a pair of normally closed contacts 13 and 14 which serve normally to connect the high resistance coil of cut-off relay 5 with the private multiple contacts 15 and the private spring contact 16 of the Keith plunger switch. Line relay 2 is also provided with a normally opened grounded contact 17 which connects with the contact 14 when the line relay is operated and thus closes a locking circuit from ground to battery through the high resistance coil of cut-off relay 5.

The called subscriber's line 1' is provided with identical relays, magnets and contacts all of which are herein designated by the same numbers primed as have been used for designating similar devices associated with the calling subscriber's line.

The selector switch here illustrated is of the up and around type. An electromagnet V, serves

in a manner well-known in the art to step the selector wiper carrying shaft vertically until the wipers 20, 21 and 22 arrive opposite contacts of the group of trunks in which the desired idle trunk is located. The rotary magnet R is arranged in the well-known manner for rotating the shaft which carries the contacts 20, 21 and 22 through the making and breaking of its own pair of contacts 23 and 24. A group of contacts called vertical off-normal and marked V. O. N. on the drawing are so arranged that they change from the position shown on the drawing to their alternate position on the first vertical step of the selector shaft. The group of contacts set diagonally on the drawing and marked Cam Springs are controlled by the rotary movement of the selector shaft and change from the position illustrated to their alternate position when the wipers of the selector switch pass off of the last available trunk. This usually occurs at an eleventh rotary position.

The upper talking conductor of the selector switch is connected through normally closed contacts 26 and 27 of relay 28 through the upper coil of relay 29 to battery. The lower talking conductor of the selector circuit is connected through normally closed contacts 30 and 31 of relay 28 through the lower coil of relay 29 and the normally closed contacts 32 and 33 of relay 34 to ground. When the plunger 10 of the Keith line switch connects a calling line with an idle selector circuit, relays 29 and 34 are substantially simultaneously operated. The circuit for the operation of relay 29 is from battery through the upper coil of relay 29, contacts 27 and 26 of relay 28 over the calling subscriber's line contacts 30 and 31 of relay 28, the lower coil of relay 29 and contacts 32 and 33 of relay 34 to ground. The substantially simultaneous operation of relay 34 is over a circuit from battery through the upper coil of relay 34, closed contacts 35 and 36 of the vertical off-normal group, conductor 37 and private contacts 16 to ground through the now closed contacts 14 and 17 of line relay 2, this latter relay not having yet returned to normal due to its slow return characteristic. The operation of relay 29 closes contacts 39 and 40 completing a circuit from battery through the coil of slow acting relay 41 to ground through contacts 42 and 43 of relay 28. This operates relay 41, placing a direct ground connection on the private conductor of the selector switch through its contacts 44 and 45. This ground connection on the private completes a new circuit for the cut-off relay 5 through its upper coil and its own contacts 9 and 8 so that when slow acting relay 2 resumes its normal condition cut-off relay 5 will remain actuated so long as ground is maintained on the private conductor of the Keith line switch from the selector switch. When the calling subscriber dials the first number of the desired subscriber the line circuit is interrupted at the dial contacts of the calling subscriber's line. This causes interruptions of the circuit of relay 29 of the selector switch which relay falls to its normal position on each interruption. The closing of contacts 39 and 46 of relay 29 completes a circuit from ground through contacts 43 and 42 of relay 28, contacts 39 and 46 of relay 29, contacts 47 and 48 of the slow release relay 41, contacts 50 and 51 of the slow release relay 34, through the coils of the vertical magnet V to battery and also through the lower coil of slow release relay 34 to battery. Upon the first impulse through the vertical magnet the vertical off-normal contacts V. O. N. are changed to their

alternate positions thus interrupting the circuit through the upper winding of relay 34, that relay however remaining in its actuated condition by reason of impulses passing through it in parallel with coils of the vertical magnet. At the end of the series of impulses for stepping the wiper carrying shaft vertically, the line circuit remains closed while the subscriber is moving his finger to the next number to be called. During this lapse of time slow acting relay 34 now having no sustaining circuit through either its upper and lower windings falls back to its normal condition closing a circuit from battery through the coil of rotary magnet R, contacts 52 and 53 of relay 34, the now closed contacts 54 and 55 of the vertical off-normal group V. O. N., contacts 24 and 23 of the rotary magnet, closed contacts 56 and 57 of relay 28, contacts 58 and 59 of relay 60 and the now closed contacts 61 and 62 of slow release relay 41. Current in the path causes the wiper-carrying shaft to rotate moving the wipers 20, 21 and 22 successively over the contacts of the busy trunks. It is during this trunk hunting operation that my invention comes into play.

The private contacts which are connected to busy connector switches will either be grounded or open. The private contacts which are connected to idle connector switches will extend to battery through a 500 ohm resistance such as 64. So long as the private wiper 21 passes over busy and therefore grounded or open private bank contacts, no change will take place in the selector circuit relays. At this time ground placed on the private bank contacts through closed contacts 65 and 66 of relay 67 in the connector meets ground through the upper coil of relay 60 of the selector switch and contacts 68 and 69 of relay 41. So long as this condition occurs or so long as an open contact is encountered between the private wiper 21 and a private bank contact, the relay 60 remains unactuated and nothing occurs to stop the rotary movement of the selector. When a battery potential through the 500 ohm resistance 64 in the connector is encountered on the private contact, current flows from the battery through resistance 64, through the private bank contact and wiper 21 of the selector switch and upper coil of relay 60 to ground through contacts 68 and 69 of relay 41. The upper coil of relay 60 being of low resistance compared with the resistance 64, the relay 60 is only partially operated. This partial operation tends to close only its contacts 70 and 71 but even these contacts do not close until the armature of the rotary magnet has fallen back toward its normal position, the insulated lever arm 72 serving to prevent the contacts 70 and 71 from closing while the rotary magnet is taking its forward step. However, as the armature of the rotary magnet falls back towards its normal position the contacts 70 and 71 close completing a circuit through the lower coil of relay 60 which may be traced from battery in the connector switch through the upper coil of relay 74, the upper talking circuit bank contact of the selector, the wiper 20 contacts 75 and 76 of selector relay 28, lower coil of relay 60, the now closed contacts 70 and 71 of relay 60, lower talking conductor and wiper 22 and bank contact of the selector switch through the lower coil of relay 74 to ground. The current in this path completely energizes relay 60 opening its contacts 58 and 59 in the operating circuit of the rotary magnet thus stopping the rotary movement of the switch. If, however, the circuit just traced

through the lower coil of relay 60 is incomplete by reason of there being dirt on either the bank contact with which the brush 20 engages or the bank contact with which the brush 22 engages, no current passes through the lower coil of relay 60 and therefore its contacts 58 and 59 are not opened and the rotary magnet of the selector will consequently take another step or more until the wipers 20, 21 and 22 arrive upon the contacts connected to an idle connector and with which contacts all of the wipers make good connection.

The purpose of preventing the contacts 70 and 71 of relay 60 from closing during the advancing movement of the selector is to prevent the lower coil of relay 60 from being bridged across a talking circuit which is busy, as the wipers slide from a set of busy selector contacts to a set of idle selector contacts. In the absence of some comparable arrangement for preventing a test being made on the talking circuit before the talking circuit wipers had passed entirely off of a set of busy contacts, a slight click would be noticeable to the parties in conversation over the busy talking circuit.

When relay 60 pulls up completely its lower coil operated contacts 59 and 77 are closed completing a circuit from ground through contacts 62 and 61 of relay 41, contacts 59 and 77 of relay 60 and the coil of relay 28 to battery. This causes the operation of relay 28 and the reversal of all of its contacts. Relay 28 is immediately locked up through its own contacts 78 and 79 on a circuit extending from battery through its coil, contacts 78 and 79, its own contacts 80 and 81, private wiper 21 and contacts 66 and 65 to ground in the seized connector circuit, relay 67 of the connector now being operated through contacts 82 and 83 of relay 74 which latter relay is now operated over the calling subscriber's line through a circuit which includes contacts 75 and 26, and contacts 30 and 84 of the now actuated relay 28. The opening of contacts 56 and 57 of relay 28 severs the circuit of the rotary magnet so that it does not again start its rotary action when relay 60 falls back to its normal position which it does when the circuit of its lower coil is interrupted at contacts 75 and 76 of relay 28.

Although most of the operating circuits for the connectors have been omitted, it will be understood that the connector circuit may be of any one of several well-known types. The periodical falling off of relay 74 closes the circuit from ground through its contacts 83 and 85 which through suitable relays and magnets not shown first steps the wiper shaft vertically and then horizontally until the wipers arrive upon the contacts of the desired line. At this time a ground connection is placed upon the private bank of the desired line so that it will test busy to other connector circuits. However, the busy testing circuit of the connector switch, the ringing circuit and many other features are omitted from this disclosure since they form no part of my invention. Placing ground upon the private contact of the called line completes a circuit for the cut-off relay 5' of the called line, thus opening its contacts 3', 4' and 6' and 7' thus preventing the operation of its line relay 2' when the called subscriber answers his call.

When the calling subscriber hangs up his receiver at the end of a conversation, relay 74 of the connector circuit falls back opening the circuit of slow acting relay 67. When this relay returns to normal contacts 65 and 66 are opened

removing ground connection from the private conductor of the selector switch. The only relay of the selector switch which remained operated during conversation was relay 28 which now falls back to its normal position. In doing so the circuit of the release magnet RLS is completed from battery through release magnet RLS, the now closed contacts 86 and 87 of the vertical off-normal V. O. N. closed contacts 88 and 89 of slow release relay 34, contacts 90 and 48 of slow release relay 41, contacts 46 and 39 of relay 29 and contacts 42 and 43 of relay 28 to ground. The circuit of the release magnet remains closed until the switch shaft drops to its normal position whereupon the vertical off-normal contacts 86 and 87 are opened. The removal of the ground from the private conductor, through contacts 65 and 66 of relay 67 in the connector switch also breaks the locking circuit of cut-off relay 5 which during conversation had been completed through contacts 9 and 8. That relay therefore now falls back to its normal condition completing the circuit of the line relay 2 to the line and preparing the line circuit for another call.

If all of the connector circuits are busy, or if any of the contacts of an idle trunk are too dirty for good contact, then the rotary magnet of the selector will continue to operate until the wipers of the selector pass off of the last contacts extending to a selector circuit. Just as this happens the springs marked Cam Springs move to their alternate positions. In their new positions in which Cam Springs 96 and 97 are closed, relay 34 is operated by current through its upper winding, contacts 96 and 97 of the Cam Springs contacts 56 and 57 of relay 28 contacts 58 and 59 of relay 60 and contacts 61 and 62 of relay 41 to ground. The operation of relay 34 opens the circuit of the rotary magnet at the now opened contacts 52 and 53 of relay 34 which stops the rotation of the selector switch in what is usually its eleventh position. During the sending of impulses by the calling subscriber a so-called dial tone was impressed upon the calling line so that the calling subscriber would know that his call was proceeding regularly. The circuit of this dial tone may be traced from the common wire marked dial tone and ground through the normal contacts 91 and 92 of the Cam Springs, now closed contacts 93 and 94 of relay 34, the lower coil of relay 29, contacts 31 and 30 of relay 28, the calling subscriber's line, contacts 26 and 27 of relay 28 and the upper coil of relay 29 to battery and ground. In order that the calling subscriber may know that all of the trunks are busy when the selector switch has moved to its eleventh position, a circuit is closed substituting busy tone and ground for the usually heard dial tone and ground. This circuit may be traced from busy tone and ground through contacts 95 and 92 of Cam Spring, thence over the same circuit as heretofore traced for the dial tone and ground. When the calling subscriber hears the busy tone he hangs up his receiver thus opening the line circuit and causing the release of relay 29 of the selector circuit. When this relay falls back a circuit is completed for the release magnet RLS from ground through contacts 43 and 42 of relay 28, contacts 39 and 46 of the now released relay 29, contacts 48 and 90 of the slow acting relay 41 which now has returned to its normal position, contacts 89 and 88 of slow acting relay 34, the circuit of which has just been opened at the contacts 61 and 62 of relay 41, contacts 87 and 86 of the vertical off-normal V. O. N.

through the release magnet RLS. As soon as the vertical shaft falls to its normal position the vertical off-normal V. O. N. opens the circuit of the release magnet RLS and the entire selector circuit is again in its normal condition.

It will thus be seen that with the use of my invention, even though under normal conditions the rotary magnet of a selector switch continues to operate when the line wipers 20 and 22 pass onto an open circuit, this does not occur when the open circuit is brought about by the wipers passing off of the last trunk circuit in the bank and into the position in which the Cam Springs are operated.

Although I have shown and described my invention as applied to a particular type of circuit, it is to be understood by those skilled in the art that it may also be applied to other types of circuits. It will also be understood that it is applicable to either first selector switches or second selector switches and that the principles involved are applicable to line switches of the type wherein a switch per line seeks an idle trunk to a first selector and that therefore I do not wish to be unduly limited to the particular arrangement of parts herein shown and described.

I claim:

1. In an automatic telephone system, a selector switch circuit for completing a talking circuit between a calling subscriber's line and a trunk for furthering the circuit toward a desired subscriber's line, multiple private contacts for the trunk which are separate from the multiple talking circuit contacts, means for maintaining an identifying electrical condition on the multiple private contacts of the trunk to indicate the busy condition of the trunk and a different identifying electrical condition to indicate the idle condition of the trunk, a test relay for the selector switch circuit the energizing circuit and actuation condition of which is changed when the private wiper of the selector switch arrives upon one of the private multiple contacts of an idle trunk, another relay winding connected between the talking strands of said selector switch circuit by the changed condition contacts of said test relay, said other relay winding being energized over a circuit including both of the talking circuit wipers of the selector switch circuit and the multiple talking circuit contacts of an idle trunk, means for moving the wipers of the selector switch circuit successively over multiple contacts of busy trunks, contacts responsive to the energization of said other relay winding for stopping the movement of the selector switch wipers on the idle multiple contacts of a trunk, whereby the selector switch circuit wipers will continue movement past the multiple contacts of an idle trunk unless the talking circuit wipers of the selector complete connection with multiple talking circuit contacts of an idle trunk.

2. In a selector switch circuit for a selector of a type that moves its wipers in one direction under control of a calling subscriber and in another direction under its own influence step by step past the contacts of busy trunks to connect the wipers to the contacts of an idle trunk, a talking circuit testing circuit for the selector, a pair of normally open relay contacts in the talking circuit testing circuit, means to close said relay contacts only upon the arrival of the selector wipers on the contacts of an idle trunk, and means in said testing circuit rendered operative by the closure of said relay contacts to stop the trunk hunting movement of the selector switch

only when current flows through both of the talking circuit wipers of the selector and the talking circuit contacts of an idle trunk, said last means preventing the selector from switching through to an idle trunk in which the talking circuit is open and causing the selector to pass over such faulty trunks.

3. In a selector switch circuit for a selector of a type that moves its wipers in one direction under control of a calling subscriber and in another direction under its own influence step by step past the contacts of busy trunks to connect the wipers to the contacts of an idle trunk, a talking circuit testing circuit for the selector, a pair of normally open relay contacts in the talking circuit testing circuit, means to close said relay contacts only upon the arrival of the selector wipers on the contacts of an idle trunk, means in said testing circuit rendered operative by the closure of said relay contacts to stop the trunk hunting movement of the selector switch only when current flows through both of the talking circuit wipers of the selector and the talking circuit contacts of an idle trunk, said last means preventing the selector from switching through to an idle trunk in which the talking circuit is open and causing the selector to pass over such faulty trunk, and means to prevent the closure of said relay contacts while the talking circuit wipers are moving from one set of trunk contacts to another.

4. In a selector switch circuit for a selector of a type that moves its wipers in one direction under control of a calling subscriber and in another direction under its own influence step by step past the contacts of busy trunks to connect the wipers to the contacts of an idle trunk, a talking circuit testing circuit for the selector, a pair of normally open relay contacts in the talking circuit testing circuit, means to close said relay contacts only upon the arrival of the selector wipers on the contacts of an idle trunk, means to stop the trunk hunting movement of the selector switch only when current flows through both of the talking circuit wipers of the selector and the talking circuit contacts of an idle trunk, a step by step armature for moving the wipers of the selector switch in their hunting direction, and means operated by said armature for preventing the closure of said talking circuit relay contacts during movement of said armature in the stepping direction.

5. In an automatic telephone system in which a selector is provided with two talking circuit wipers and a private wiper for connecting respectively with stationary talking and private trunk contacts, a test circuit connected with the private wiper for conditioning the selector to stop upon contacts of an idle trunk, and a test circuit for the talking circuit wipers for stopping the selector only upon the completion of a circuit through both talking circuit wipers and both talking circuit stationary contacts of the idle trunk thus preventing the selector from switching through to an idle trunk in which the talking circuit is open and causing the selector to pass over such faulty trunks.

6. In an automatic telephone system in which a selector is moved vertically under the control of a calling subscriber and rotates step by step under automatic control to complete a connection with contacts of an idle connector switch circuit and in which there are two talking circuit wipers and a private wiper moved by the selector, a talking circuit test circuit, a private test circuit including the coil of a relay, contacts on said relay for connecting the talking circuit test circuit in

a bridge between the talking circuit wipers when an idle connector circuit private contact is reached, a winding in the talking circuit test circuit bridge energized over both talking circuit wipers and contacts of an idle trunk, and contacts controlled by said winding for stopping the rotary movement of said selector switch.

7. In an automatic telephone system in which a selector is moved vertically under the control of a calling subscriber and rotates step by step under automatic control to complete a connection with contacts of an idle connector switch circuit and in which there are two talking circuit wipers and a private wiper moved by the selector, a talking circuit test circuit, a private test circuit including the coil of a relay, contacts on said relay for connecting the talking circuit test circuit in a bridge between the talking circuit wipers when an idle connector circuit private contact is reached, a winding in the talking circuit test circuit bridge energized over both talking circuit wipers and contacts of an idle trunk, contacts controlled by said winding for stopping the rotary movement of said selector switch, and means to prevent the closure of the talking circuit test circuit bridge while the talking circuit wipers are still in contact with busy talking circuit contacts.

8. In a trunk hunting selector having two talking wipers and a private wiper, a test relay having two windings, one winding being connected in a circuit with the private wiper and energized thereover to cause the partial actuation of said relay when the private wiper completes its circuit to contacts of an idle trunk, the partial actuation of said relay closing the circuit of the second winding of said relay between the two talking circuit wipers of said selector, a source of current in bridge of the talking circuit conductors of an idle trunk connected across said second winding of said test relay when said talking circuit wipers connect with the contacts of the talking circuit conductors of said trunk, the current through the second winding of said test relay serving to complete the operation of said test relay, and contacts operated upon the complete operation of said test relay to interrupt the trunk hunting movement of said selector switch.

9. A selector switch having talking and private wipers and a step by step rotary magnet and armature, sets of stationary trunk talking circuit contacts, a source of current bridged between the stationary trunk talking circuit contacts, means to close the circuit of said rotary magnet to start the rotary movement of the selector switch, a test relay having contacts to open the circuit of said rotary magnet to stop the rotary movement of said switch, means to connect a winding of said test relay between the talking wipers of the selector upon the arrival of the private wiper of the selector upon the private contact of an idle trunk, and said test relay operating only when the talking circuit wipers make good contact with the contacts of an idle trunk so as

to cause the selector to rotate its wipers past faulty trunk talking circuit contacts.

10. A selector switch having talking and private wipers and a step by step rotary magnet and armature, sets of stationary trunk talking circuit contacts, a source of current bridged between the stationary trunk talking circuit contacts, means to close the circuit of said rotary magnet to start the rotary movement of the selector switch, a test relay having contacts to open the circuit of said rotary magnet to stop the rotary movement of said switch, means to connect a winding of said test relay between the talking wipers of the selector upon the arrival of the private wiper of the selector upon the private contact of an idle trunk, whereby said test relay is operated only when the talking circuit wipers make good contact with the contacts of an idle trunk, and means associated with the armature of the rotary magnet to prevent the closure of the test relay circuit while the talking circuit wipers are moving from one set of stationary contacts to another.

11. In a trunk hunting selector for use in a telephone system, a testing circuit for checking the continuity of the talking circuits of idle ones of the trunks with which the selector is successively associated during trunk hunting, said testing circuit preventing the selector from switching through to idle trunks in which the talking circuit is discontinuous and causing the selector to pass over such faulty trunks, and means for disabling said testing circuit during the advancement of the selector from one trunk to the next to prevent interference with the talking circuits of busy trunks.

12. In a trunk hunting selector for use in a telephone system, a testing circuit for checking the continuity of the talking circuits of the trunks with which the selector is successively associated during trunk hunting, means responsive to the association of the selector with an idle one of the trunks for causing said testing circuit to check the talking circuit thereof, and means controlled by said testing circuit for stopping the trunk hunting operation of said selector only if the talking circuit of said idle one of the trunks is continuous whereby the selector is enabled to pass over such faulty trunks without switching through to them.

13. In a telephone system, a selector switch, a plurality of trunk lines accessible thereto, each of said lines including a plurality of conductors, means causing said switch to be successively associated with different ones of said trunks in search of an idle trunk, a first test circuit in said switch controlled over one of the conductors of said trunks for causing said switch to pass over busy trunks, and a second test circuit in said switch controlled over another one of the conductors of said trunks for causing said switch to pass over idle trunks which are faulty without switching through to such faulty trunks.

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