

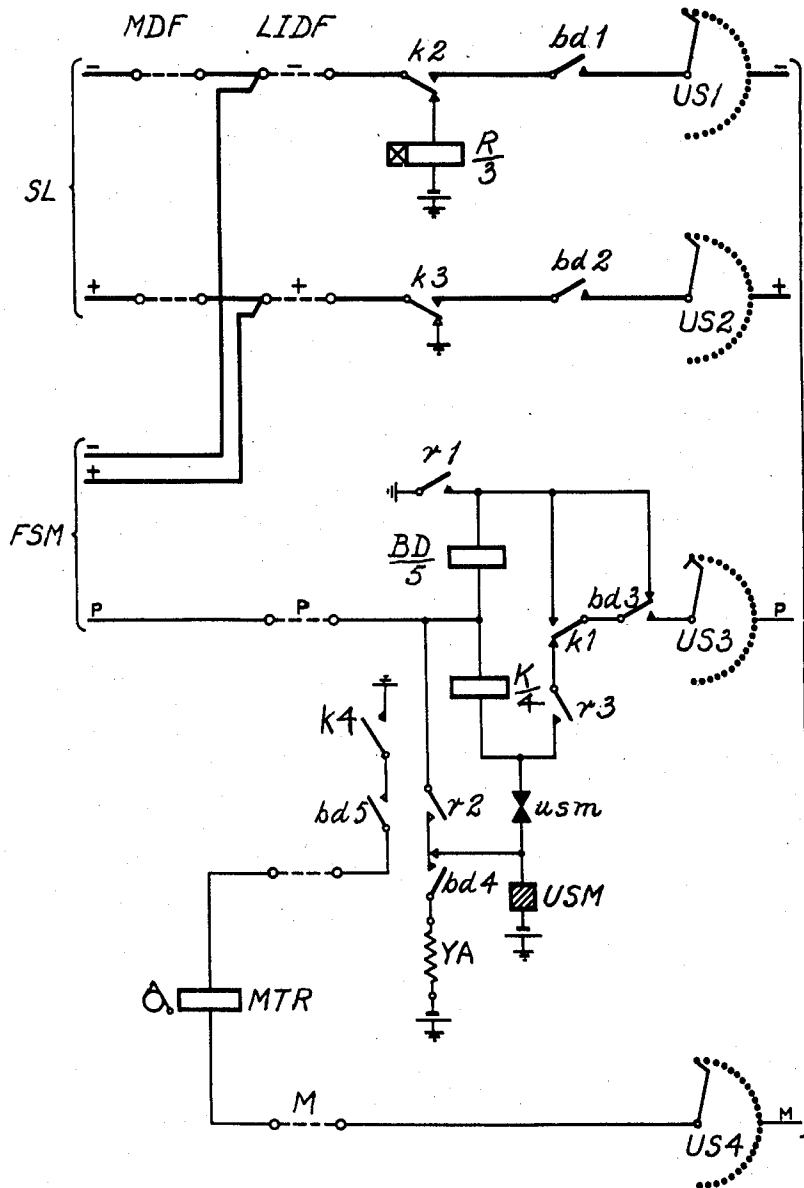
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TELEPHONE SYSTEM

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TELEPHONE SYSTEM

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The present invention relates to automatic telephone systems, and is more particularly concerned with systems in which a subscriber on removing his receiver to initiate an outgoing call gains access to a free first numerical switch over the wipers of a rotary switch individual to his line. The invention is moreover concerned with subscribers' or other line circuits employing rotary line switches of the so-called non-homing type in which on release at the end of a call the wipers remain in the position in which they were last used so that when another call is made they may be in association with either a busy or an idle line.

Owing to the simplicity of systems of this type, they find advantageous use in small unattended country exchanges, the maintenance of which is cared for by periodical visits of a maintenance officer, and it is therefore necessary to ensure that the equipment shall operate with maximum efficiency. One objection which has hitherto applied to this type of circuit is that if the line switch wipers are positioned on a set of outlets, the negative, positive or test conductor of which is disconnected, the subscriber will be isolated so far as outgoing calls are concerned, since the line switch will remain camped on the faulty line and will not move off even if repeated calls are made. The general object of the present invention is to provide an improved line switch circuit in which this possibility of trouble due to faulty lines is overcome.

According to one feature of the invention, in a line circuit suitable for use by a telephone subscriber including an individual rotary switch which is arranged to hunt automatically for a free outgoing line and on release to retain its wipers in the position last used, when a call is initiated on the line the hunting circuit for the operating magnet is only completed after a relay has been energised due to the operation of the magnet which operation serves to bring about the advance of the switch wipers one step regardless of the busy or idle condition of the outgoing line on which they are resting when the call is initiated.

According to another feature of the invention, in a line circuit suitable for use by a telephone subscriber including an individual rotary switch which is arranged to hunt automatically for a free outgoing line and on release to retain its wipers in the position last used, when the switch is taken into use a circuit is completed for the operating magnet independently of the wipers the magnet being de-energized to advance the

wipers one step due to the operation of a relay which serves to connect up the speaking wipers.

It has already been proposed to make use of a rotary line switch the wipers of which are advanced one step each time the switch is used, but the circuit arrangements according to the present invention involving an advance of the switch wipers one step immediately the switch is taken into use offer particular advantages as regards simplification of the circuit in circumstances such as when toll break down facilities are also to be provided.

The invention will be better understood from the following description of one method of carrying it into effect, reference being had to the accompanying drawing. This shows an improved line circuit which employs a 25-point reverse-drive uni-directional non-homing line switch and is adapted to provide a so-called "kick-on" feature on seizure and toll breakdown facilities with the use of three relays of the so-called minor type on which marginal contacts and marginal adjustments are not allowable and on which only a small number of spring set combinations can be provided. The incoming line SL, assumed to be a subscriber's line, is connected up to the line equipment via the main distribution frame MDF and the line intermediate distribution frame LIDF.

Considering now the operation of the circuit, when the subscriber removes his receiver to originate an outgoing call, he loops the conductors of the line SL and operates relay R which is provided with an armature end slug so as to enable it to be slow-to-release even if the circuit thereto is disconnected a very short time after the relay has operated. Relay R at armature *r1* provides an immediate guard on the incoming P lead extending from the final selector multiple FSM via the low resistance winding of relay BD, at armature *r2* prepares a locking circuit for relay BD and at armature *r3* completes an energising circuit for the uni-selector switch magnet USM from earth over armatures *r1*, *bd3*, *k1* and *r3*, magnet interrupter contacts *usm*, magnet USM to battery. Magnet USM energises immediately and opens its own operating circuit at its interrupter contacts *usm*, whereupon relay BD operates in series therewith, the magnet now holding in series with relay BD. Relay BD at armatures *bd1* and *bd2* prepares for the connection of the incoming negative and positive lines through to the wipers US1 and US2, at armature *bd3* the initial circuit for the magnet is opened and it is connected to the test wiper US3, which

is of the bridging type, in readiness for the selection of an idle outgoing line, and at armature *bd4* relay BD completes a locking circuit for itself via resistance YA, and at the same armature disconnects the holding circuit for the magnet USM. The magnet now releases and since the switch is of the reverse drive type, the wipers are now advanced one step on to the next set of outlets. Relay BD also at armature *bd5* prepares an earth connection via the M1 jumper to the meter MTR in readiness for subsequent metering.

If the set of outlets on which the wipers now stand is engaged, the test wiper US3 will encounter earth and this is extended over armatures *bd3*, *k1* and *r3* to prevent operation of the switching relay K and also to energise the magnet USM over the contacts *usm*. The magnet on operating breaks its own circuit at contacts *usm* and thereupon releases to advance the wipers to the next position.

Automatic rotation of the switch continues in this manner until a set of outlets extending to a free first selector is reached whereupon wiper US3 will fail to find earth so that relay K is no longer short-circuited and the switch is unable to advance further. Relay K now operates from earth, armature *r1*, winding of relay BD, winding of relay K, contacts *usm*, magnet USM (non-operative in this condition), to battery, and at armature *k1* extends earth from armature *r1* over armature *bd3* and wiper US3 to guard the selector seized. At armatures *k2* and *k3* the subscriber's line is connected through via armatures *bd1* and *bd2* and wipers and banks US1 and US2 to the first selector. The impulse receiving line relay therein now operates and dial tone is returned therethrough to the calling party to indicate that he may now proceed to set up his connection by dialling in the usual manner. This relay on operating brings up the release or guard relay, whereupon a guarding and holding earth potential is returned over the P wire and thence via armatures *bd3* and *k1* to hold relays BD and K on the release of relay R after its slow release period. It will be understood that the slow release period on relay R is adjusted to cover the operate times of the line and guard relays in the first selector.

After the connection has been set up and the called party replies, battery potential is applied to the M lead via bank and wiper US4 to operate the subscriber's meter MTR.

At the conclusion of the conversation when the parties hang up, the holding earth is removed from the P lead whereupon relays K and BD release. The various selectors in the train restore to normal, but the line switch retains its wipers on the set of outlets on which they have rested during the call.

On the origination of another call, relay R operates as before and relay BD is then operated to advance the switch wipers one step to the next set of outlets. Hunting thereupon takes place for an idle first selector in the manner already described.

It will thus be seen that if the switch comes to rest with its wipers on a faulty set of outlets the calling subscriber by simply hanging-up and then lifting off again can cause the switch to step on to another set of outlets and so gain access to a first selector.

It will be noted that the additional period required for the kick-on feature is very small and merely comprises the operate and release times

of magnet USM and the operate time of relay BD so that there should be no perceptible difference to the calling subscriber in the time he has to wait for dial tone as compared with a line switch not provided with the kick-on feature. Moreover the slight additional time involved presents the advantage that relay R will always receive an adequate magnetic saturation period and the size of slug required to cover the operate times of the line and guard relays in the first selector may therefore be reduced to a minimum, thereby making available the maximum winding space on the relay so as to enable long line limits to be met.

In the case of an incoming call to the subscriber connected to line SL, when the final selector switching relay operates, earth is applied over the final selector multiple P lead to operate relay K and so prevent the operation of the line relay R when the line is looped. A connection is at the same time extended through to the subscriber in well-known manner over the negative and positive conductors of the final selector multiple.

Consider now the case in which a connection is set up to the subscriber by a final selector equipped with a toll breakdown facility, and assumed that the subscriber connected to line SL is engaged in an outgoing call in which case relays BD and K will be held operated from the earth extended back over the private lead from the final selector taken into use by this party. When the intervening final selector wipers alight on the set of outlets corresponding to the calling line, the connection already set up may be broken down in known manner by causing this final selector to extend earth forward over the P conductor so as to short-circuit and release relay BD but maintain relay K operated. Relay BD on releasing disconnects the original connection at its armatures *bd1*, *bd2* and *bd3*, and when the toll breakdown earth is removed, relay K will remain operated in series with the intervening final selector switching relay and connection through to the subscriber on line SL will now be made.

It will be understood that the invention is not limited to the precise circuit arrangements shown and described, and the line circuit can be readily adapted to cater for other types of metering such as positive battery or earth metering instead of that described.

It will be seen that the circuit described provides a very simple solution to the problem of providing a kick-on feature on a line switch equipment, and it will be noted that though the line switch is of the non-homing type the use of interlocking line and cut-off relays has been avoided by the use of contacts on the relay BD which also serves for kick-on and toll breakdown purposes.

I claim:

1. In a telephone system, a line circuit, a rotary switch individual thereto with wipers having access to a plurality of lines, said switch having no normal position its wipers remaining in connection with the line last seized, an operating magnet for said switch, a line relay and an auxiliary relay therefor, said line relay operated in response to initiation of a call over said line circuit to complete an energizing circuit for said magnet independent of the busy or idle condition of the line on which the wipers stand, a multiple circuit for said auxiliary relay and said magnet completed at the same time, said aux-

iliary relay normally short circuited in said circuit, means operated by the energization of said magnet to open said short circuit to thereby cause energization of said auxiliary relay, said relay when operated causing deenergization of said magnet and consequent movement of the wipers to the next line accessible thereto.

2. In a telephone system an automatic switch individual to a subscriber's line and having an operating magnet, a line relay and a pair of auxiliary relays, wipers for the switch moved by operation of said magnet to test and seize an idle one of a plurality of trunks accessible thereto, means operated by said line relay upon initiation of a call over said line to close a circuit including said auxiliary relays and said magnet, said relays normally short circuited to cause immediate energization of said magnet, means responsive to the operation of said magnet to cause operation of one of said relays, means responsive to the operation of said one relay to close a point between the line and the wipers and complete a circuit for the magnet to cause its continued operation to select an idle one of said trunks, means responsive to the selection of an idle trunk to cause operation of the second relay to close another point between the line and wipers and stop operation of said magnet, both relays remaining energized to complete the connection.

3. A telephone system such as claimed in claim 2 in which there is means for seizing said line

when an incoming call is extended thereto, and means responsive to such seizure for causing deenergization of one of said relays to break the extended connection.

4. In a telephone system a subscriber's line having a switch individual thereto with wipers having access to a plurality of trunk lines, a line relay, an operating magnet and a pair of auxiliary relays for controlling said switch, means for energizing said line relay upon initiation of a call over said subscriber's line, means controlled by the operation of said line relay for causing energization of said magnet, means controlled by energization of said magnet to cause energization of one of said auxiliary relays, means controlled by the energization of said one relay to cause deenergization of said magnet to cause movement of the wipers over the trunk lines, and means controlled by the seizure of an idle one of said trunk lines for causing energization of the other of said auxiliary relays to extend the connection from the line to the idle trunk line, and means for holding both auxiliary relays energized to maintain said connection.

5. A telephone system having an individual switch such as claimed in claim 4 in which there is means for extending a connection to said line, and means controlled by the extension of such connection to the line for causing deenergization of only one of said auxiliary relays to break the connection extended therefrom.

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