

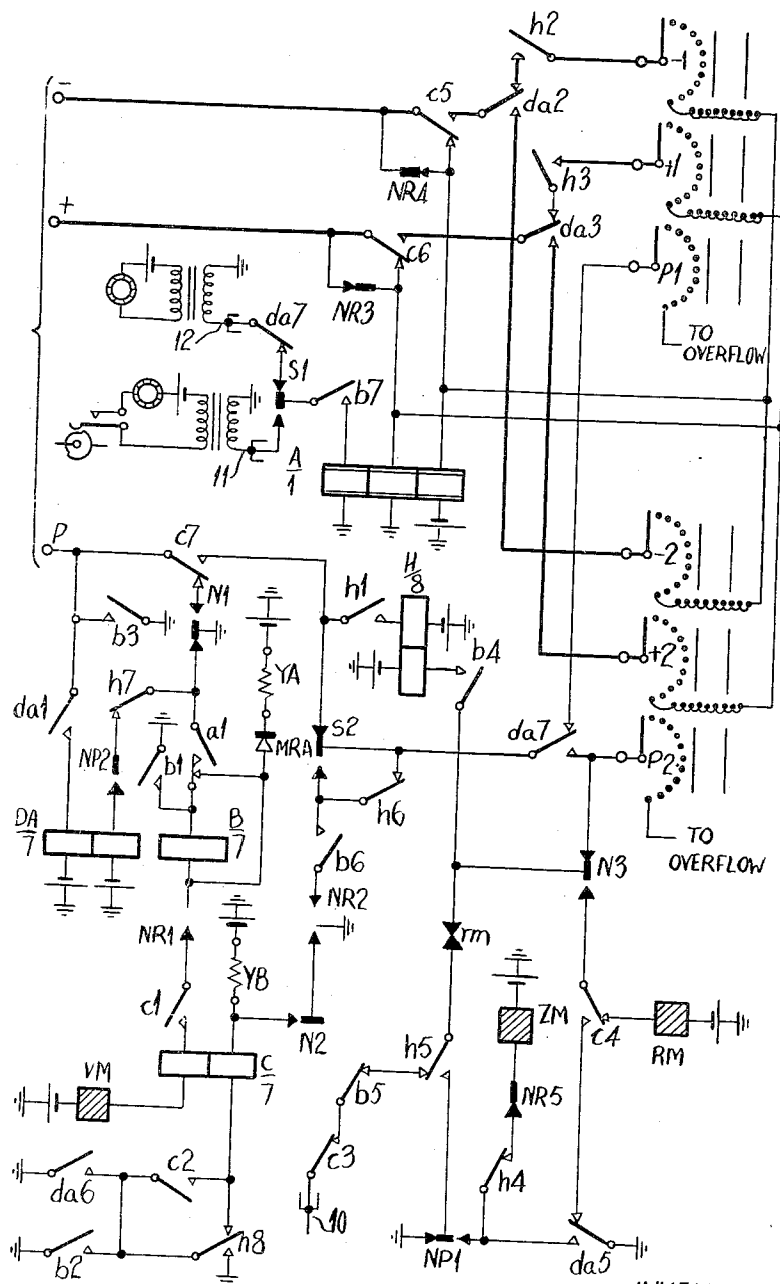
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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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AUTOMATIC SWITCH FOR USE IN TELEPHONE OR LIKE SYSTEMS

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The present invention relates to automatic switches for use in telephone or like systems and is more particularly concerned with electromagnetically-operated step-by-step switches of the two-directional type designed to have so-called rectangular motion, which means in the case of a vertical and rotary switch that release is normally effected by the advancement of the wipers beyond the end of the bank contacts after which they fall and are then rotated back to normal under the bank by spring tension. A switch of the above type is disclosed in the patent to Saxby, 2,028,689, granted Jan. 21, 1936.

Where the switch is required to absorb a digit, such a movement may not always be sufficiently rapid and it has therefore been suggested to provide an auxiliary release magnet which will restore the wipers vertically along the path over which they were set when digit absorption is required. The chief object of the invention is to provide suitable circuit arrangements for producing the proper operation of such switches when thus equipped.

According to the invention in a two-directional electromagnetically-operated step-by-step automatic switch arranged to have rectangular motion and to hunt automatically in the secondary direction, in response to a predetermined setting in the primary direction normal post springs are operated which open the circuit for the secondary magnet and effect the energisation of an auxiliary magnet which brings about the release of the switch wipers along the path over which they were set.

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 a circuit diagram of a so-called digit absorbing group selector of the vertical and rotary type provided with two sets of wipers each having access to 100 outlets. The operation is that after the switch has been stepped vertically to a particular level, it is prevented from cutting in and an auxiliary magnet is energised to restore the wipers to normal. At the same time the outgoing leads are changed over to the second set of wipers and thus in response to the second digit the switch again steps vertically and hunts automatically in the rotary direction for a free outlet in the appropriate group of the second set. If the wipers are operated by the first setting digit to any other level, the switch functions as an ordinary group selector and hunts for a free outlet in the appropriate group of the first set.

Considering now the circuit operation, on seizure of the switch from a preceding switch the loop extended across the negative and positive conductors operates relay A which pulls up relay B which then locks over armature b1. Relay B also at armature b2 operates relay C by way of its right-hand winding in series with resistance YB, at armature b3 applies guard earth to the incoming P conductor and, assuming that the switch is functioning as a subscriber's first selector, at armature b7 connects up a dial tone transformer over common lead 12 to the left-hand winding of relay A whereupon dial tone is extended by induction through the windings of relay A to the incoming speaking conductors in a balanced circuit. Relay C upon operating, at armature c1 prepares an impulsing circuit for the vertical magnet VM in series with its low resistance left-hand winding, the magnet however being non-operative in series with the winding of relay B.

On receipt of the first train of impulses, relay A responds and each time it releases an energising circuit is completed for the vertical magnet VM as follows: earth, armatures b1 and a1, contacts NR1, armature c1, left-hand low resistance winding of relay C, magnet VM to battery and accordingly the switch wipers are raised to the desired level. During the impulse train relay B is intermittently short-circuited by armature a1 but it remains operated due to the slugging effect of the short-circuiting. The presence of the metal rectifier MRA in the energising circuit of relay B prevents the slowing up of the magnet operation which would otherwise result by the direct connection of a comparatively low value non-inductive resistance YA in parallel with its winding. It will be readily understood that neither the magnet VM nor relay C will hold operated in series with relay B and moreover the inductance of the latter relay is such that it has no appreciable effect on the magnet performance. On the first vertical step the off-normal springs are mechanically operated and at contacts N2 an earth is extended to short-circuit the right-hand winding of relay C so that this relay will hold operated during the impulse train and will release a short interval afterwards while at contacts N3 relay H is operated over its lower winding, this relay having no function at this stage.

Assuming first that the wipers have been raised to an ordinary level, that is, a level not arranged for digit absorption, the normal post

springs will not be operated and the switch will function as an ordinary group selector.

At the end of the impulse train relay A remains operated and maintains relay B while after a short interval relay C releases and at armature *c7* disconnects the holding circuit for relay H over armature *h1* and its upper winding and at armature *c4* disconnects the initial energising circuit over its lower winding; relay H however remains held over this latter winding by way of armature *b4*, the rotary magnet interrupter contacts *rm*, armature *h5* and resting normal post contacts *NP1*. An energising circuit for the rotary magnet RM is also completed as follows: earth, normal post contacts *NP1*, armature *h5*, rotary interrupter contacts *rm*, off-normal contacts *N3*, armature *c4*, magnet RM to battery. The wipers are thereupon rotated into engagement with the first set of contacts in the level selected and the rotary magnet interrupter contacts *rm* are opened. The rotary off-normal springs are mechanically operated on the first rotary step and at contacts *NR1* disconnect the impulsing circuit to the vertical magnet VM. The switch now hunts for a free outlet in the selected group of the first set of outlets, access being had thereto over the *-1*, *+1*, and *P1* wipers.

If the outlet encountered by the test wiper *P1* is engaged as indicated by the presence of earth or booster battery potential, relay H will be held operated over its upper winding by way of armature *h1*, 11th step cam contacts *S2*, armature *da4* and the wiper *P1* and the disconnection of the holding circuit for its lower winding by contacts *rm* is therefore without effect. The rotary magnet de-energises however and on the closure of its interrupter contacts the magnet is re-energised to advance the wipers to the second set of contacts in the level selected. This stepping operation continues automatically until an idle outlet in the group is reached or alternatively the wipers are advanced to the 11th position.

If the *P1* wiper encounters a free outlet, that is, one unmarked by earth or booster battery potential, relay H will quickly restore and at armature *h5* further opens the magnet driving circuit while the selected outlet is immediately busied from earth over the rotary off-normal contacts *NR2*, armatures *b6*, *h6* and *da4* and the *P1* wiper. A circuit is now completed for re-operating relay C over its right-hand winding by way of armatures *b2* and *h8* since the short-circuiting earth has already been removed therefrom at contacts *NR2*. Thereupon at armature *c1* the incoming *P* lead is extended through by way of contacts *S2* and armature *da4* to the *P1* wiper while relay H is now re-operated over its lower winding from earth by way of armatures *da5* and *c4*, contacts *N3*, armature *b4* and the lower winding to battery. At armatures *c5* and *c6* the incoming speaking leads are disconnected from relay A and extended over armatures *da2* and *da3* and *h2* and *h3* to the first set of wipers. Relay A on releasing short-circuits relay B and during the release time of the latter relay the loop extended forward over the negative and positive wipers operates the A and B relays in the succeeding switch whereupon a guard earth is returned over the *P1* wiper to maintain relay H by way of armature *h1* and its upper winding when relay B subsequently releases after its slow period. After the release of relay B relay C remains held by way of its right-hand winding over armatures *h8* and *c2*.

In response to the dialling of the subsequent digits, trains of pulses are transmitted over the first set of negative and positive leads to route the call to the wanted party.

If all outlets in the level selected prove busy, the wipers are rotated to the 11th position where the cam springs are mechanically operated and at contacts *S2* the upper winding of relay H is disconnected from the *P* wiper so that on the opening of the interrupter contacts *rm* relay H releases as previously described, opens the magnet driving circuit and re-operates relay C which in turn re-operates relay H. The incoming speaking leads are extended as before through to the wipers, which however now connect by way of the multiplied 11th step contacts back again to the operating windings of relay A which therefore remains held over the incoming loop and maintains relay B. Cam contacts *S1* disconnect the dial tone transformer from the left-hand winding of relay A and connect up a busy tone transformer over common lead *11* to this winding whereupon busy tone is induced in the other two windings and is applied in a balanced circuit to the incoming speaking leads. Cam contacts *S2* extend earth from contacts *NR2*, armature *b6*, contacts *S2* and armature *da4* to the wiper *P1* to operate an overflow meter which may be connected to the 11th outlet of that level for traffic observation purposes.

Considering now the case in which the first digit dialled raises the switch wipers to a level on which discrimination takes place, the normal post springs are mechanically operated by the switch shaft when this level is reached.

On release of relay C in the usual manner, relay H now releases since the holding earth is removed at contacts *NP1* while for the same reason no energising circuit can be completed for the rotary magnet RM. On the release of relay H an energising circuit is now completed for relay DA from earth, armatures *b1*, *a1* and *h1*, contacts *NP2*, right-hand winding of relay DA to battery. In this case relay C does not now operate since the short-circuiting earth is maintained on its right-hand winding by way of contacts *NR2* and *N2*. Relay DA upon operating, at armature *da1* locks over its left-hand winding, at armatures *da2*, *da3* and *da4* connects up the second set of wipers in preparation for the next digit, at armature *da5* extends earth over armature *h4* and contacts *NR5* to energise the release magnet ZM and at armature *da7* disconnects the dial tone circuit. The release magnet is arranged on energising to disengage the vertical detent member from the vertical ratchet member so that the wipers drop vertically to normal. This arrangement reduces the release time to a minimum so that the switch may be satisfactorily released in an interdigital period. When the wipers reach the normal position, the off-normal springs are restored and at contacts *N2* the short-circuit is removed from the right-hand winding of relay C which re-operates. Earth is now extended over armatures *b3* and *c1*, contacts *S2*, armature *da4*, contacts *N3* and armature *b4* to re-operate relay H by way of its lower winding and this relay thereupon locks over armature *h1* and its upper winding and also over its lower winding by way of contacts *rm*, armature *h5* and contacts *NP1* to earth, the normal post springs having restored when the switch commenced to release vertically. The energising circuit for the release magnet ZM is also broken at armature *h4* while at armature *c1* the impulsing circuit is prepared for the magnet VM in readiness for the second train of pulses.

On the dialling of the second digit the switch steps vertically and then performs an automatic rotary search for a free outlet in the manner previously described but in this case hunting takes place over outlets in the selected group of the second set of lines. It will be noticed that any further operation of the normal post springs is made ineffective owing to the operation of armature *da5* and hence any digit may be dialled as the second digit.

On the release of the connection at the conclusion of conversation, earth is removed from the P conductor at the controlling succeeding switch in the train thereby releasing relay H and relay DA if it has been operated. The holding circuit for relay C over its right-hand winding is therefore opened and this relay upon releasing completes a self-interrupted driving circuit for the rotary magnet RM from earth supplied to common conductor 10 by way of equipment which is arranged to give a delayed alarm in case of failure to release, armatures *c3*, *b5* and *h5*, rotary magnet interrupter contacts *rm*, off-normal contacts N3, armature *c4* and magnet RM to battery. Accordingly the wipers are rotated clear of the banks after which they fall and rotate under the banks by spring tension back to their normal position where the off-normal contacts N3 open and disconnect the homing circuit. Preferably the rotary magnet is mechanically prevented from opening its interrupter contacts during the release movement so that there is no tendency for it to chatter.

At the commencement of release an unguard period on the incoming P conductor which is represented by the sum of the release times of relays H and C is provided to enable preceding switches to restore. On the release of relay C following the release of relay H, earth is applied by way of the operated off-normal contacts N1 and resting armature *c1* to the incoming P conductor to guard the switch against seizure during its release movement. When the switch reaches normal, the off-normal contacts N1 open and remove the guarding earth thus freeing the switch for further use.

We claim:

1. In a two-motion switch, wipers having a normal position, a bank of contacts accessible to said wipers, first and second stepping magnets operative in the order named, the first to move the wipers in one direction and the second to move the wipers in a different direction thereby to set the wipers upon a particular contact, means for thereafter reoperating the second stepping

magnet to restore said wipers to normal along a path different from the path travelled in setting the wipers, and an auxiliary restoring magnet operable at times to restore said wipers to normal along the same path travelled in setting the wipers.

2. In a drop back switch, wipers having a normal position, a stepping magnet for moving said wipers in one direction, a releasing magnet effective to restore said wipers to normal responsive to a predetermined movement of the same in said one direction, said stepping magnet thereafter again operative to move said wipers in said one direction if the same are restored to normal after said first movement, a second stepping magnet operative either after the first movement of said wipers if they are not restored to normal following said first movement, or, alternatively, after the second movement thereof if the wipers are restored to normal, said second stepping magnet effective to move said wipers in a direction different from said one direction thereby to finally position said wipers, and means including said second stepping magnet independent of said release magnet for thereafter restoring the wipers to normal from their final position.

3. In a drop back switch as claimed in claim 2, means for rendering said releasing magnet ineffective to restore the wipers to normal a second time even though the position to which they are moved upon the second operation of said first stepping magnet be the same as that causing their initial restoration to normal.

4. In a drop back switch as claimed in claim 2, two groups of lines accessible to said wipers, certain of the wipers having access only to the lines of one group and others of the wipers having access only to the lines of the other group, and a change-over relay for rendering either said certain wipers or, alternatively, said other wipers effective depending upon whether or not said wipers are restored to normal after their first movement in said one direction.

5. A drop back switch as claimed in claim 2, in which said wipers, when restoring to normal responsive to said predetermined movement in said one direction, retrace in the opposite direction the path over which they travelled in said one direction, and in which said wipers, when restoring to normal from said final position, trace a path different from that over which they travelled in arriving at said final position.

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