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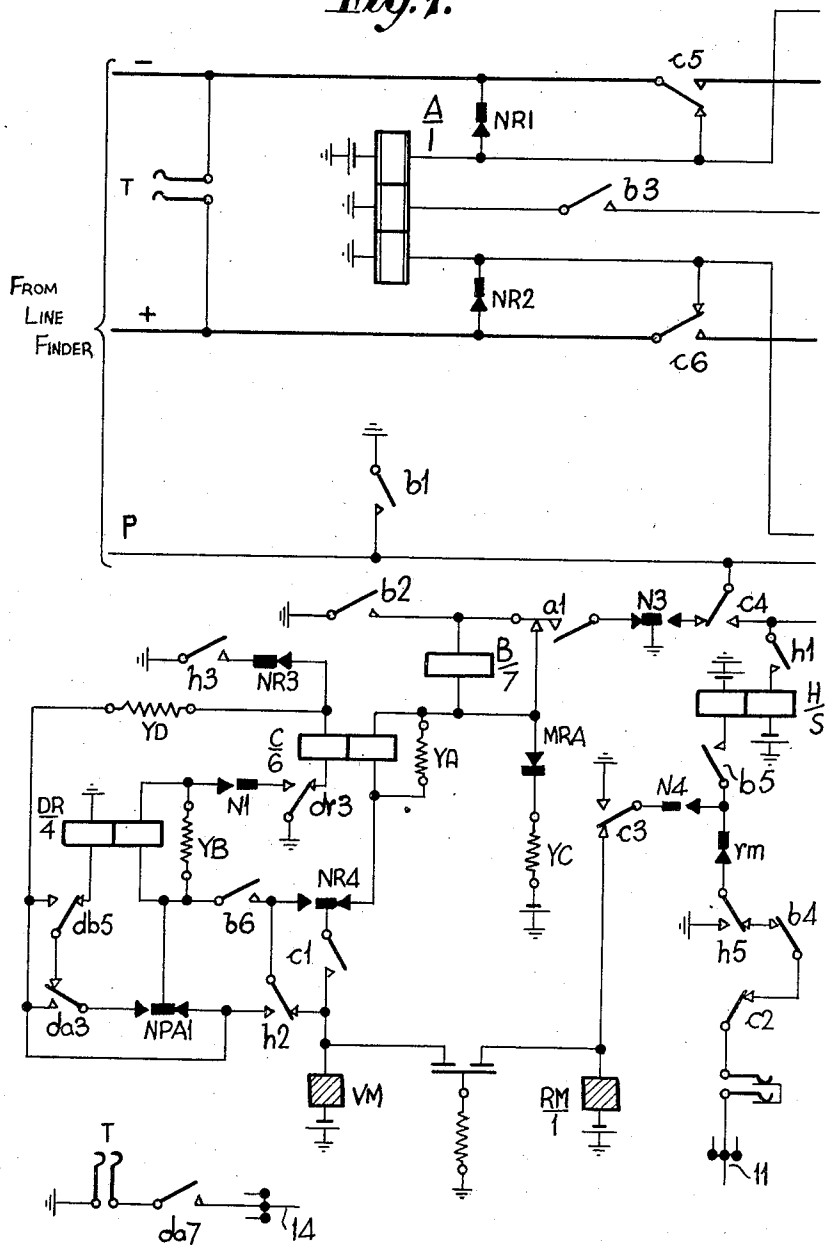
2,183,030

TELEPHONE SYSTEM

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2 Sheets-Sheet 1

Fig. 1.



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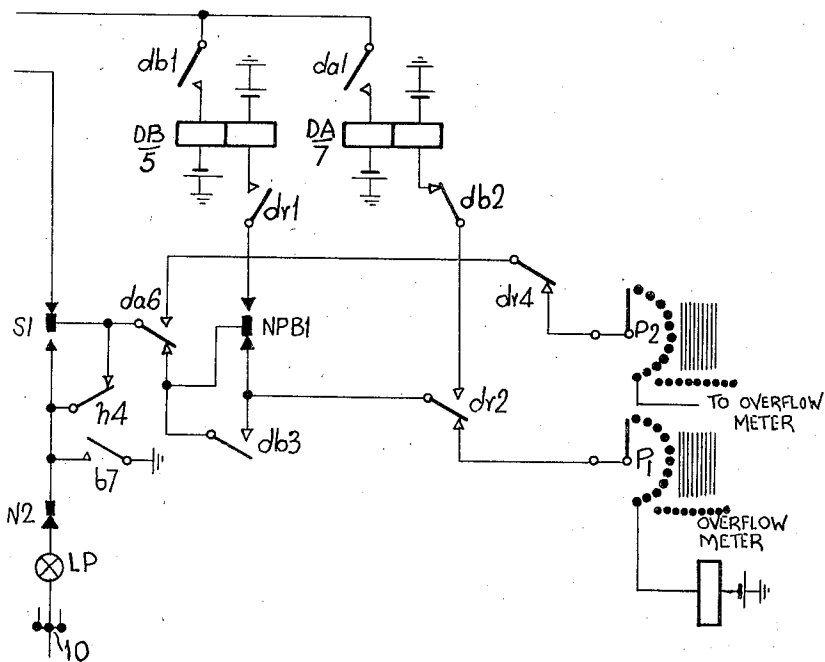
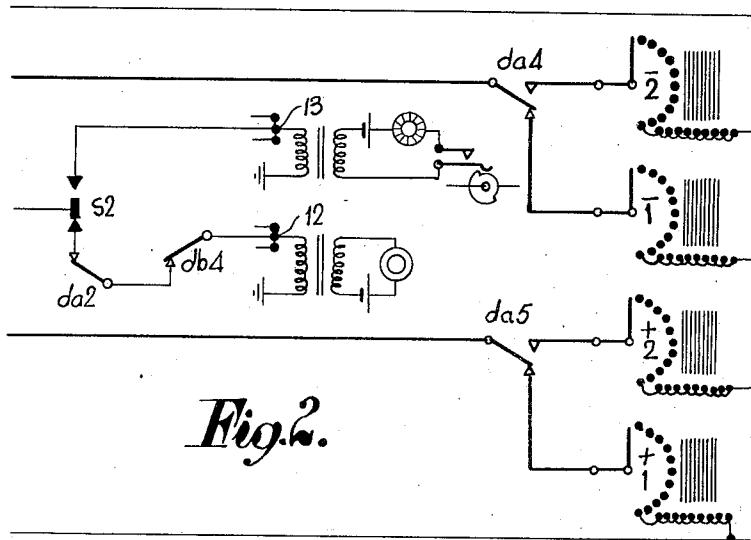
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TELEPHONE SYSTEM

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The present invention relates to automatic switches for use in automatic telephone or like signalling systems and while more particularly concerned with the provision of additional facilities on group selector switches, the invention is also applicable to final selector switches and other switches responsive to series of impulses.

Arrangements have already been made in which a group selector has access to either of two sets or groups of outlets. After stepping the switch vertically to particular levels the switch is caused to release thereby absorbing the first digit whilst at the same time outgoing leads in the switch are changed over to a second set of wipers so that after receiving the second digit the switch again steps vertically and then hunts automatically in a rotary direction for a free outlet in a group of the second set. Should the first digit dialled step the switch to any other level the switch will hunt automatically for a free outlet in a group of the first set only.

According to one feature of the invention a switch having access to two different sets of lines is provided with circuit arrangements which cause access to be had to a line of one set in response to one or more series of impulses of a predetermined number or numbers respectively and also in response to a series of impulses of another predetermined number different from that of the first of these series followed by the aforementioned one or more series of impulses and cause access to be had to a line of the other set in response to a series of impulses of a further predetermined number different again from said other predetermined number followed by one or more further series of impulses.

According to another feature of the invention a switch having access to two different sets of lines is provided with circuit arrangements which cause access to be had to a line of one set in response to two series of impulses of predetermined numbers and also in response to a series of impulses of a different predetermined number from the first of these series followed by two further series of impulses corresponding to the aforesaid numbers and cause access to be had to a line of the other set in response to a series of impulses of a third predetermined number different again from said different predetermined number followed by two further series of impulses.

According to a further feature of the invention a group selector switch having access to two sets of groups of lines is provided with circuit arrangements which in response to a series of impulses of a predetermined value or values cause

the switch to hunt for an idle line in a group of one set, in response to a series of impulses of another predetermined value followed by a second series of impulses corresponding to the said first mentioned series of impulses also cause the switch to hunt for an idle line in the same group of the same set while in response to a series of impulses of a third predetermined value different from said aforementioned predetermined values followed by a second series of impulses cause the switch to hunt for an idle line in a group of the other 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 drawings which illustrate the circuits of a group selector and comprise Figs. 1 and 2 which should be arranged side by side to form a complete circuit diagram. The diagram shows a circuit employing a switch of the two-directional type arranged to have so-called rectangular motion.

For the purpose of the description it will be assumed that on dialling "7" as a first digit the switch performs a digit absorbing and wiper switching function while on dialling "5" as a first digit the switch performs a digit absorbing function only, while on other digits the switch functions as an ordinary group selector.

When the calling subscriber's loop is extended across the incoming negative and positive conductors by way of a line finder or other non-numerical switch relay A operates over its outer windings in series and at armature *a1* operates relay B. Armature *b1* thereupon extends a guard earth on the incoming P conductor, armature *b2* completes a locking circuit for relay B, armature *b7* completes a circuit to light the supervisory lamp LP which is connected to battery over common conductor 10 by way of equipment which is arranged to give an alarm if the switch fails to step off normal and open springs N2 within a predetermined period while armature *b6* completes an operating circuit for relay C on its left-hand winding by way of resistance YD, contacts NPA1, armatures *b6* and *b2*, magnet VM (non-operative in this condition) to battery. If the switch is functioning as a first selector the middle winding of relay A is connected to earth at armature *b3* by way of a dial tone transformer over common conductor 12 so that dial tone is applied to the incoming speaking leads in a balanced circuit by induction from the middle winding of relay A to the two outer windings so as to inform the calling subscriber that he may com-

mence dialling. Relay C in operating at armature *c1* prepares a circuit for the vertical magnet VM which however is non-operative in series with the winding of relay B.

5 When the first series of impulses is received relay A responds and each time it releases a circuit is completed to energise the magnet VM as follows: earth, armature *b2*, resting armature *a1*, low resistance righthand winding of relay C
10 in parallel with resistance YA, contacts NR4, armature *c1*, magnet VM to battery, and accordingly the switch wipers are raised to the level dialled. During the impulse train it will be noticed that relay B is intermittently short-circuited by the resting armature *a1* but this relay
15 will remain held due to the slugging effect of the short-circuited winding. The presence of the metal rectifier MRA in the energising circuit of relay B prevents the slowing down of the vertical magnet operation which would otherwise result
20 by the direct connection of the comparatively low value non-inductive resistance YC in parallel with its winding. It will be readily understood that neither the vertical magnet nor relay C will
25 hold in series with relay B and moreover the inductance of the latter relay is such that it has no appreciable effect on the performance of the magnet.

On the first vertical step the off normal springs
30 N are mechanically operated and at contacts N2 the supervisory lamp LP is extinguished whilst at contacts N4 an operating circuit for relay H is completed on its lefthand winding. Armature *h1* thereupon connects the righthand winding of
35 relay H to the test wiper P1, armature *h2* disconnects the energising circuit of relay C over its lefthand winding while armature *h3* extends an earth to short-circuit this winding and the slugging effect thus produced enables relay C to
40 hold satisfactorily during the train of impulses received.

Assuming now that any digit except "5" or "7" has been dialled, at the end of the impulse train relay A remains steadily operated and holds
45 relay B. After a short interval relay C releases and completes an energising circuit for the rotary magnet RM from earth, armature *h5*, rotary magnet interrupter contacts *rm*, off normal contacts N4, armature *c3* and the magnet RM to battery whereupon the wipers are advanced into
50 engagement with the first set of contacts in the level selected. The rotary off normal springs NR are mechanically operated on the first rotary step and at contacts NR4 disconnect the vertical magnet VM from the impulsing circuit to
55 prevent any further actuation. On energisation of the magnet the rotary interrupter contacts *rm* are opened also.

If the test wiper P1 encounters an engaged outlet which is indicated by an earth or booster
60 battery potential, relay H will be held operated over armature *dr2*, contacts NPB1, armature *da6*, contacts S1 and armature *h1* on its right hand winding and the disconnection of its original
65 holding circuit by the interrupter contacts *rm* is therefore without effect. However the rotary magnet RM is de-energised and on closure of the interrupter contacts the magnet is re-energised to advance the wipers on to the second set
70 of contacts. This stepping operation continues automatically until an idle outlet in a group of the first set of lines is found or alternatively the wipers are advanced to the 11th position.

If the P1 wiper encounters a free outlet, that
75 is, one unmarked by earth or booster battery po-

tential, relay H will quickly restore and at armature *h5* opens the magnet driving circuit while the selected outlet is immediately busied from earth, armatures *b7*, *h4* and *da6*, contacts NPB1, armature *dr2* and the P1 wiper. A circuit is now
5 completed to re-energise relay C on its lefthand winding in series with resistance YD, contacts NPA1, armatures *b6* and *h2* and the vertical magnet to battery and this relay in operating at armatures *c5* and *c6* switches the incoming
10 speaking leads through resting armatures *da4* and *da5* to the first choice negative and positive wipers. Armature *c3* disconnects any circuit to the rotary magnet and at the same time re-operates relay H over its lefthand winding whereupon it holds on its other winding by way of
15 armatures *h1* and *c4* to the earthed P conductor. Relay C in operating at armatures *c5* and *c6* also releases relay A which in turn at armature *a1* short-circuits and releases relay B. Meanwhile, however, the loop extended over the negative and positive wipers operates the A and B relays in the
20 succeeding selector whereupon a guard earth is returned over the P lead to maintain relay H when subsequently relay B releases after its slow release period. Relay B in releasing at armature *b5* disconnects the lefthand winding of relay H which remains held on its righthand high
25 resistance winding to the earthed P lead.

On dialling the second and subsequent digits,
30 trains of impulses are extended over the negative and positive leads to succeeding switches to route the call to the wanted subscriber.

Assuming now that all outlets in the level selected prove busy the wipers are rotated to the
35 11th position where the cam springs S are mechanically operated. Since the P1 wiper fails to encounter any earth potential relay H will release quickly as described in the previous paragraph and open the driving circuit and re-operate
40 relay C. Armatures *c5* and *c6* switch the incoming leads as before through to the negative and positive wipers which connect by way of the multiplied 11th step contacts to the outer
45 windings of relay A. Relay A therefore remains held to the incoming loop and maintains relay B while relay H is re-operated at armature *c3*. Cam contacts S2 connect up the busy tone transformer over common lead 13 to the middle winding of relay A whereupon busy tone
50 is induced in the outer windings and is applied in a balanced circuit to the incoming speaking leads. Cam contacts S1 extend an earth over armature *b7*, contacts S1, armature *da6*, contacts NPB1 and armature *dr2* on to the test wiper P1
55 to operate an overflow meter which may be connected to the 11th outlet of that particular level for traffic observation purposes.

Assuming now that "7" is dialled as a first digit thus raising the switch vertically to a discriminating level, giving both wiper switching and digit absorbing facilities, the normal post
60 springs NPA are operated by the switch shaft when the switch is set to the seventh level. At the end of the impulse train relay C releases after a short interval and completes an energising
65 circuit for the rotary magnet at armature *c3* in the normal manner and as a result the wipers are advanced into engagement with the contacts of the first outlet in the level selected. On this
70 particular level the P contacts are left disconnected and since the P1 wiper picks up no potential relay H quickly releases and at armature *h5* disconnects the magnet driving circuit. It should be stated here that this particular level
75

of outlets in the first set of lines in the particular arrangement described cannot be utilised for routing to succeeding selectors since it is necessary to disconnect the first P contact in order to enable the switch to be released over the same path as it has been set in a manner to be described. Relay H in releasing completes a circuit to operate relay DR from earth, lefthand winding of relay DR, armatures *db5* and *da3*, operated contacts *NPA1*, armatures *b6* and *h2* and the vertical magnet to battery whereupon armature *dr3* extends an earth over off normal contacts *N1*, right-hand low resistance winding of relay DR which is shunted by resistance YB for spark quench purposes and armatures *b6* and *h2* to operate the vertical magnet VM. The vertical magnet pawl when operated is arranged to engage with an extension arm of the rotary dent and move it out of engagement with the rotary ratchet member to initiate the full release of the switch along the path over which it has been set. This arrangement reduces the release time to a minimum and enables the switch to be satisfactorily released in an interdigital period. On operation of relay DR a circuit is also completed from earth, armatures *b7*, *h4* and *da6*, contacts *NPB1* and armatures *dr2* and *db2* to operate relay DA over its righthand winding. This relay in operating at a "make-first" light armature *da1* locks over its other winding to the earthed P conductor, at armature *da2* disconnects dial tone, and at armatures *da4*, 5 and 6 switches over the negative, positive and P leads through to the second set of wipers, i. e. the wipers having access to the groups of lines of the second set.

When the switch commences to release vertically the normal post springs restore and when it releases completely the off normal and rotary off normal springs will be restored to the normal condition. Contacts *N1* thereupon open the vertical magnet energising circuit and at the same time release relay DR since its other winding is disconnected at armature *da3*. Relay C now re-operates on its lefthand winding in series with resistance YD, contacts *NPA1*, armatures *b6* and *h2*, and the magnet VM to battery in order to prepare the switch for receiving further dialled impulses.

On dialling the second digit the switch steps vertically and then performs an automatic rotary search for a free outlet in the manner described at the commencement of the specification but in this case however the search takes place over contacts of lines of a group of the second set of outlets only. It will be noticed that any further operation of the normal post springs NPA or NPB is made ineffective at armatures *da3* and *da6* and it will be appreciated that any digit from "1" to "0" may thus be dialled as a second digit.

Assuming now that "5" is dialled as a first digit the switch will be raised to the digit absorbing level whereupon the normal post springs NPA and NPB will be mechanically operated. At the end of the digit relay C releases after its slow release period and energises the rotary magnet which causes the switch to make one rotary step in the normal manner whereupon relay H quickly releases since a circuit to the test wiper P1 is disconnected at contacts *NPB1*. Relay H releasing opens the driving circuit and at armature *h2* operates relay DR over its lefthand winding as before whereupon at armature *dr3* the vertical magnet is energised in series with the righthand winding of relay DR. On operation

of relay DR a circuit is also completed from earth, armature *b7*, *h4* and *da6*, operated contacts *NPB1* and armature *dr1* to operate relay DB on its righthand winding. This relay in operating at armature *db1* locks to the earthed P conductor, at armature *db3* prepares an alternative circuit to the *NPB1* contacts, at armature *db4* disconnects dial tone while at armature *db5* the lefthand winding of relay DR is disconnected. On energisation of the vertical magnet as previously described the switch restores to normal over the path over which it has been set whereupon all mechanically operated spring sets are restored to the normal condition and at off normal contacts *N1* the vertical magnet and relay DR are released. A circuit is now completed to operate relay C over its lefthand winding in the normal manner in order to prepare for the second digit.

On reception of the second digit the switch steps vertically and hunts in a self-interrupted circuit for an idle line in a group of the first set. Since relay DB remains locked, any further operation of the normal post springs will be ineffective and any digit except "7" may thus be dialled as a second digit.

On release of the connection at the end of the conversation, earth is removed from the release trunk conductor P thus releasing relay H and either relay DA or DB whichever is operated and thereupon relay H in releasing at armature *h2* disconnects the holding circuit for relay C on its left-hand winding. On release of relay C a self-interrupted driving circuit is completed for the rotary magnet RM from earth supplied to common conductor 11 by way of equipment which is arranged to give a delayed alarm in case of failure to release, contacts *N4*, armature *c3*, rotary magnet RM to battery and accordingly the wipers are rotated clear of the banks after which they fall and rotate under the banks under spring tension back to their normal positions where the off normal contacts *N4* 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 initial 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 release of relay C following the release of relay H earth will be extended by way of operated off normal contacts *N3* and resting armature *c4* on to the P conductor to guard against premature seizure during release. When the switch reaches normal, contacts *N3* open and remove the guarding switch thus freeing the switch from further use.

A test buzzer connected to test jack T over common lead 14 and armature *da1* enables the set of wipers in use to be determined without removing the dust cover from the switch.

It will be appreciated that while numerous facilities are offered by this switch, the number of levels which cannot be extended to succeeding switches is reduced to a minimum. In the example described in this specification level 7 of the first set of groups of lines will be the only level which cannot be utilised.

I claim:

1. In an automatic switch, a plurality of sets of wipers, means for causing a connection to be extended over one of said sets of wipers responsive to the receipt of impulses comprising a pre-

determined digit followed by impulses comprising any digit, and means for causing a connection to be extended over another of said sets of wipers responsive either to the receipt of impulses comprising a predetermined digit different from first said predetermined digit followed by impulses comprising any digit except first said predetermined digit, or to the receipt of impulses comprising any one of a plurality of predetermined digits different from first said predetermined digit and second said predetermined digit.

2. In an automatic switch having access to the lines of each sub-group of a plurality of groups of lines, means for operating said switch to extend a connection to an idle line of any desired sub-group of one group responsive to a train of impulses comprising a predetermined digit followed by a second train of impulses designating the desired sub-group, and means for operating said switch to extend a connection to an idle line of any desired sub-group of another group responsive either to a train of impulses comprising a predetermined digit different from first said predetermined digit followed by a second train of impulses designating the desired sub-group or to a single train of impulses designating only the desired sub-group.

3. In an automatic switch having access to a plurality of groups of lines, means for operating said switch to extend a connection to any line of one of said groups responsive to the receipt of a train of impulses comprising a predetermined digit followed by a second train of impulses designating said one line, and means for operating said switch to extend a connection to any line of another of said groups responsive either to the receipt of a train of impulses comprising a predetermined digit different from said first predetermined digit followed by a second train of impulses designating last said line or to a single train of impulses designating only last said line.

4. In an automatic switch having access to a plurality of lines, means for operating said switch to extend a connection to any one of said lines responsive to the receipt of impulses characterizing said one line, means for also operating said switch to extend a connection to said one line responsive to the receipt of a train of impulses comprising a predetermined number followed by said impulses characterizing said one line.

5. In an automatic switch, primary wipers and

secondary wipers having a normal position, a primary group of lines accessible only to said primary wipers, a secondary group of lines accessible only to said secondary wipers, means for extending a connection to any line of said primary group responsive either to a single digit directed movement of said wipers or to two digit directed movements of said wipers wherein a predetermined first digit causes said wipers to be returned to said normal position following the first of said two movements, and means for extending a connection to any line of said secondary group responsive only to two digit directed movements wherein a predetermined first digit different from last said first digit causes said wipers to be returned to said normal position following the first of said two movements and also causes said secondary wipers to be effective.

6. In an automatic switch for absorbing certain digits, first-choice wipers and second-choice wipers having a normal position, a group of lines accessible to each set of wipers, means responsive to impulses for moving said wipers from said normal position, means effective if said impulses comprise any one of a plurality of predetermined digits for causing said first-choice wipers to be effective in searching for an idle line designated by said one digit, means effective if said impulses comprise a predetermined digit different from first said predetermined digits for causing said wipers to be returned to said normal position and for preparing for further impulse directed movement of said wipers in which said first-choice wipers will be effective, means effective if said impulses comprise a predetermined digit different from first said predetermined digits and different also from second said predetermined digit for causing said wipers to be returned to said normal position and for preparing for further impulse directed movement of said wipers in which said second choice wipers will be effective.

7. In an automatic switch as claimed in claim 6, wherein said third means and said fourth means also prevent a second return of said wipers to said normal position after said further impulse directed movement of said wipers even though said further movement is responsive to impulses comprising either of last two said predetermined digits.

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