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SELECTOR SWITCH

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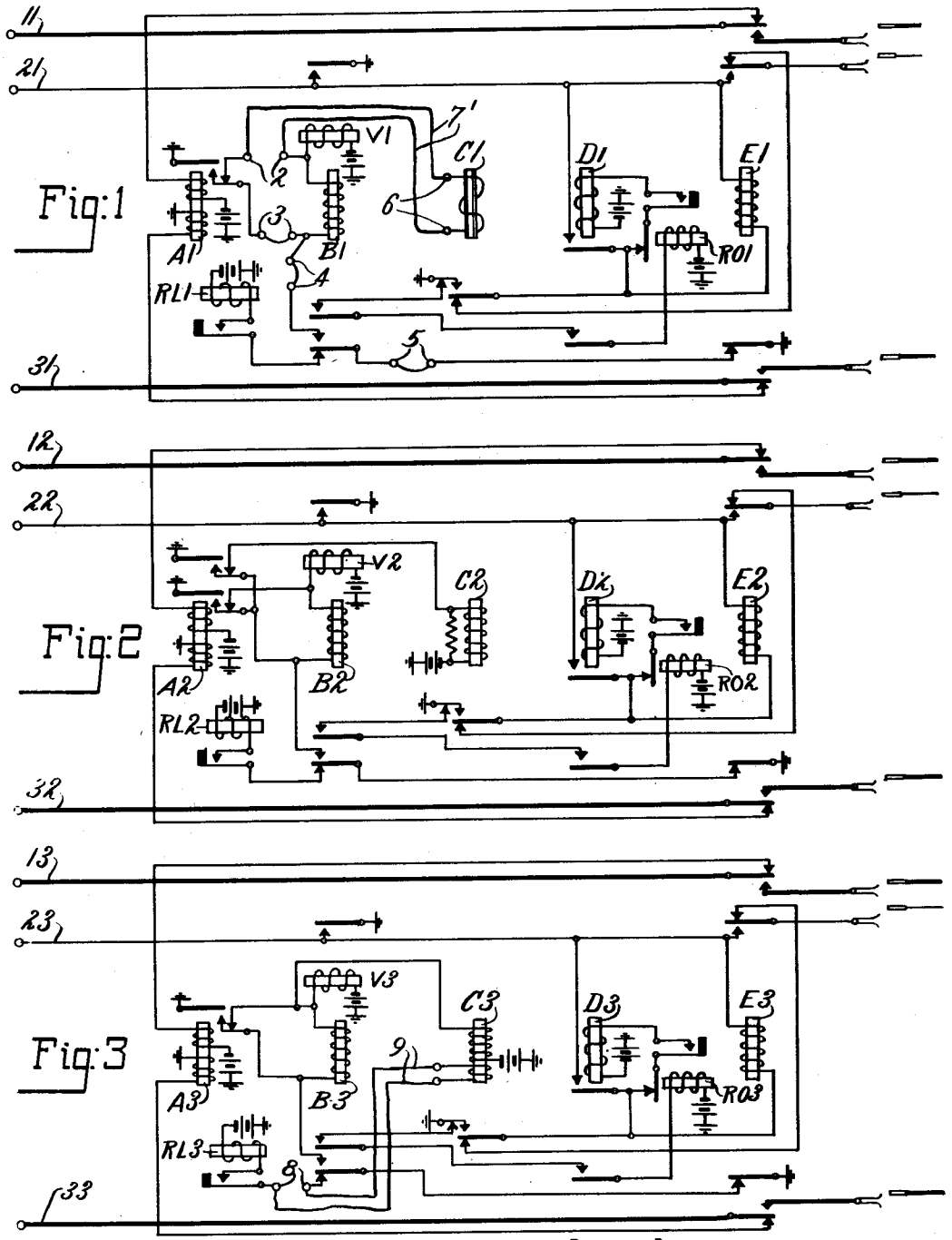


Fig. 1

Fig. 2

Fig. 3

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SELECTOR SWITCH

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The present invention relates to new and improved selector switches for use in telephone systems, but is concerned more particularly with selector switches of the so-called two-wire type in which at least one of the slow-acting control relays is shunted to secure its deenergization.

The broad general object of the invention is the production of a new and improved selector circuit in which the change-over relay may be operated either in series with the primary operating magnet or in multiple with the said magnet, and whereby the position and manner of connecting of the change-over relay may be varied according to the specific characteristics desired in any given instance.

Referring now to the drawings comprising Figs. 1–3, which show by means of the usual circuit diagrams three selectors embodying the features of the invention, Fig. 1 shows a selector containing the usual line, release, change-over, stepping, and switching relays. In this drawing the relay C^1 is the series change-over relay, and arrangements are provided for connecting this relay in the operating circuit of the switch at any one of several points depending upon the requirements.

Fig. 2 shows a similar selector in which the change-over relay is arranged to operate in a circuit independent of the operating and release magnets, being of the shunted type.

Fig. 3 shows a similar selector in which the change-over relay has its main winding connected in parallel with the primary operating magnet and in which an auxiliary winding is provided for reoperating the change-over relay during the releasing operation.

As regards certain features, this application may be considered an improvement on the following copending applications:

Serial No.	Filing date	Inventor
64,301	Oct. 23, 1925	John I. Bellamy.
582,333	Aug. 17, 1922	Rudolph F. Stehlik.
710,577	May 29, 1924	Rudolph F. Stehlik.
744,119	Oct. 17, 1924	Rudolph F. Stehlik.

Referring now to the selector shown in Fig. 1, this selector has a line relay A^1 normally bridged across the incoming conductors 11 and 31. The relay B^1 is the release relay, and it is arranged to ground the release trunk conductor 21 so as to guard the associated trunk line from seizure and to maintain operated any previous switches. This relay is used also to shift the operating circuit from the vertical magnet to the release magnet. The relay C^1 is the change-over relay and it is used primarily to initiate the rotary trunk hunting movement at the end of the vertical group-selecting movement. Relay D^1 is the usual stepping relay and it is arranged to control the stepping action of the rotary magnet RO^1. Relay E^1 is the switching relay and it operates to switch the connection through to a seized trunk line when an idle trunk line is found. The magnets V^1, RO^1, and RL^1 are the vertical, rotary, and release magnets, respectively. It will be noted that terminals 2, 3, 4, and 5 are provided at various points in the operating circuits. These terminals are connected together by jumpers in the manner shown with the exception of one pair, and this pair of terminals is connected by the jumpers 7′ with the terminals 6 of the change-over relay C^1. When desired, the relay C^1 may be shifted to another portion of the circuit for purposes which will become apparent upon a further perusal of the specification.

The operation of the selector shown in Fig. 1, with relay C^1 connected as shown, will now be explained.

When the selector is seized over the conductors 11, 21, and 31, a circuit is closed over conductors 11 and 31, in series for line relay A^1. Relay A^1 operates and closes a circuit for relay B^1 and magnet V^1 in series. It will be noted that, while all three contacts of the line relay are together, a circuit for C^1 and V^1 is established independent of relay B^1, but the duration of this circuit is only momentary and magnet V^1 and relay C^1 do not have time to operate before the circuit is opened upon the completion of the stroke of relay A^1. Relay B^1 operates in series with magnet V^1, but the magnet does not operate on account of the relatively high resistance of the relay. At its upper armature, relay B^1 places a ground potential on the release

trunk conductor 21 for guarding and holding purposes. At its lower armature, relay B^1 opens a point in the circuit of release magnet RL^1 and closes a locking circuit for itself, thereby preparing an operating circuit for relay C^1 and magnet V^1. At its inner lower armature, relay B^1 prepares a circuit for magnet RO^1.

Subsequent to the seizure of the selector, a series of interruptions is produced in the circuit of the line relay by the calling device at the calling substation. Each time the circuit is interrupted, relay A^1 falls back and opens the initial circuit of relay B^1, at the same time completing a circuit for vertical magnet V^1 and change-over relay C^1 in series through normal contacts of A^1, operated contacts of B^1, and normal contacts of E^1. Magnet V^1 operates each time this circuit is closed and restores each time the circuit is opened. Relay C^1 operates upon the first closure of the circuit, but being slow-acting due to the copper sleeve placed on its core, it remains operated throughout the series of impulses. By the operation of the vertical magnet V^1, the wipers of the switch (shown to the right of relay E^1) are raised step-by-step until they come to rest opposite the desired level of contacts, only one contact set being shown (to the right of the wipers). Although the low-wound relay C^1 is connected in shunt of relay B^1 each time relay A^1 falls back, relay B^1 does not fall back due to self-induced circulating current.

Relay C^1, upon operating, short circuits relay E^1, preparing a circuit for relay D^1, which circuit is completed through the interrupter contacts of magnet RO^1 as soon as the associated off-normal contacts close, which they do upon the first upward movement of the switch. When relay D^1 operates, it locks itself to the grounded release trunk conductor 21 at its inner armature, and prepares a circuit for rotary magnet RO^1 at its outer armature.

When relay C^1 falls back shortly after the termination of the series of impulses, it opens the initial circuit of relay D^1, leaving relay D^1 locked to conductor 21. At the same time, the circuit of magnet RO^1 is completed through normal contacts of C^1, and operated contacts of B^1 and D^1. Upon operating in this circuit, magnet RO^1 advances the wipers one step into engagement with the first set of bank contacts in the selected level. Near the end of its stroke, magnet RO^1 opens the circuit of stepping relay D^1, whereupon relay D^1 falls back and opens the circuit of the rotary magnet and opens a further point in its own locking circuit. Rotary magnet RO^1 thereupon falls back and again closes its interrupter contacts.

If the trunk line connected to the first set of bank contacts is busy, a ground potential is encountered on the test contact by the test wiper, and a circuit is closed through normal contacts of relays E^1 and C^1 and through the rotary-interrupter and off-normal contacts for reoperating the stepping relay D^1. Relay D^1 again locks itself to the release trunk conductor 21 and again closes the rotary magnet circuit, whereupon the wipers are advanced another step.

The alternate operation of the stepping relay and the rotary magnet continues until an idle trunk line is reached, whereupon the rotary movement stops because the stepping relay does not again operate. At this time, relay E^1, which has previously been short circuited continuously, in a circuit from the grounded release trunk conductor 21 and including the relay D^1 and the associated interrupter and off-normal contacts. Relay D^1 does not operate in this circuit because of the relatively high resistance of relay E^1. Upon operating, relay E^1 at its inner upper armature disconnects the test wiper from the test circuit and connects it to the grounded release trunk conductor 21, thereby making the seized trunk busy immediately. At its inner lower armature, relay E^1 disconnects ground from the lower armature of relay D^1 so as to prevent further operation of the vertical magnet V^1 and the change-over relay C^1 and to prevent a premature releasing operation when relay B^1 subsequently falls back. At its upper and lower armatures, relay E^1 disconnects relay A^1 from across conductors 11 and 31 and connects the said conductors to the corresponding wipers. Line relay A^1 falls back responsive to this operation, but the vertical magnet is not reoperated at this time because relay E^1 is operated. The initial circuit of relay B^1 is opened by line relay A^1, but relay B^1 does not fall back immediately because it is shunted through relay C^1 prior to the opening of its initial circuit. The result is that relay B^1 remains operated for an interval due to the self-induced circulating current, after which it falls back.

The usual relay action takes place in the seized trunk line, with the result that a ground potential is placed on the release trunk conductor thereof so as to maintain the connection established after relay B^1 falls back as above described.

When the receiver is replaced at the calling substation, the ground potential is removed from the release trunk conductor of the established connection, whereupon relay E^1 falls back and reconnects the test wiper to the test circuit, at the same time closing the release magnet circuit through normal contacts of relay B^2 and the associated off-normal contacts of the switch. Relay D^1 is reoperated in case the test wiper encounters busy test contacts in releasing. This, however, does not result in a closure of the rotary magnet circuit on account of the fact that the rotary magnet circuit includes open contacts of the

relay B^1. When the normal position is reached, the release magnet circuit is opened at the associated off-normal contacts.

It will now be assumed that a selector is desired having different characteristics, and that these characteristics can be met by including the series relay C^1 in a circuit between the terminals 3 instead of between the terminals 2. In this case, the jumpers 7' are removed from terminals 2 and are transferred to terminals 3, and the jumper shown between terminals 3 is moved to terminals 2. In this case, when relay A^1 operates upon the seizure of the switch, relay B^1 energizes in series with relay C^1, but relay C^1 and the operating magnet are not operatively energized. As soon as relay B^1 operates relay C^1 is short circuited because ground potential is applied to both terminals. Each time relay A^1 falls back, relay C^1 is placed in multiple with relay B^1, whereupon magnet V^1 operates, relay C^1 operating upon the first impulse and remaining operated throughout the series of impulses. Relay C^1 is short circuited again each time relay A^1 operates, being at the same time removed from in shunt of relay B^1. When relay C^1 is used in this position, it is not essential that a copper sleeve be employed on the relay, as it is then slow-acting due to being short circuited when removed from the main circuit.

If it is found more convenient, relay C^1 may be inserted between the terminals four instead of between the terminals three, with much the same effect. There is one difference that may be pointed out. The shunt placed around relay B^1 upon the falling back of relay A^1 does not include a relay winding. There is a possibility that a selector may become mechanically defective so that it does not release when it otherwise would. For this reason, it is often desirable to prevent a selector from being seized for use in another connection until it has reached its normal position. If this action is desired, relay C^1 is connected into the circuit at the terminals 5 instead of at any of the other terminals. In this case, the relay C^1 is in the circuit of magnet V^1 as before, and it is also in the circuit of magnet RL^1 during the releasing operation. When relay C^1 reoperates during release, it recloses the circuit of relay D^1, whereupon relay D^1 extends a ground potential to conductor 21, thereby guarding the switch against seizure. When the switch reaches its normal position, the associated off-normal contacts open the circuit of D^1, whereupon D^1 falls back and removes the guarding potential. As the release magnet circuit is opened at this time, relay C^1 falls back and opens a further point in the circuit of relay D^1. In this position of relay C^1 the copper sleeve is not required to make it slow acting, as C^1 is short circuited during impulsing when it is not in series with magnet V^1.

Referring now to Fig. 2, this modification will be described. It will be noted that the selector shown in Fig. 2 is substantially the same as that shown in Fig. 1 except that relay C^2 is a multiple relay instead of a series relay as is the corresponding relay in Fig. 1. Upon the seizure of the selector, relays A^2 and B^2 operate in the described manner, whereupon relay B^2 closes a locking circuit for itself at its lower armature. Each time relay A^2 falls back a circuit is closed at the lower normal contacts of relay A^2 for vertical magnet V^2. A circuit is also closed each time relay A^2 falls back at the upper normal contacts for relay C^2. Each time the relay A^2 reoperates, the vertical magnet V^2 falls back, but the change-over relay C^2 remains operated during impulsing on account of the fact that its winding is shunted by the associated resistance which allows a self induced circulatory current to be set up through the winding and resistance in series to maintain the relay operated for an interval after the last impulse.

Referring now to Fig. 3, the selector shown in this drawing is similar generally to the ones in Figs. 1 and 2, being more nearly like the selector in Fig. 2 in that a multiple change-over relay is used. Unlike the selector in Fig. 2, the selector in Fig. 3 contains a change-over relay connected directly in multiple with the vertical magnet at all times. When the line relay A^3 falls back after the selector has been prepared for operation by the energization of relay B^3, a circuit is closed for the vertical magnet, and relay C^3 operates in multiple with it, but, when the line relay reoperates and removes the shunt from around relay C^3, relay C^3 does not fall back, (although vertical magnet V^3 does). Instead, there is a self-induced circulatory current set up in relay C^3 which flows between battery and the junction of relay B^3 and magnet V^3. This current joins the energizing current of relay B^3, and shortly dies away. The circulatory current through relay C^3 does not have time to die away sufficiently to permit the relay to fall back during the vertical movement of the selector, but, when no further impulses are received after the end of the vertical movement, relay C^3 falls back, as it is adjusted so as not to hold up in multiple with the magnet V^3 when the two are in series with relay B^3.

When the release of the selector occurs, relay C^3 reoperates, as its lower winding is in series with release magnet RL^3. Relay C^3 guards the selector during the releasing operation. If this is not desired, the jumpers 9 connecting the lower winding of the relay with the terminals 8 may be omitted, in which case the terminals 8 are jumpered together.

It will be understood, of course, that, if desired, a second winding may be similarly placed on relay C^2, Fig. 2, and connected in a similar point in the release magnet circuit.

What is claimed is:

1. In an automatic selector switch containing a release relay and an operating magnet, a permanent connection between one terminal of the operating magnet and one pole of the exchange battery, a permanent connection between the other terminal of the magnet and one terminal of the release relay, normally-open contacts controlled by the release relay for closing a connection between the other terminal of the release relay and the other pole of the exchange battery, and contacts controlled by the line relay for shunting the release relay to operate the magnet through the said contacts of the release relay.

2. In an automatic switch, a line relay, a release relay, an operating magnet, a connection between one pole of the exchange battery and one terminal of the operating magnet, a connection between the other terminal of the operating magnet and one terminal of the release relay, means for closing a circuit path between the other pole of the exchange battery and the other terminal of said release relay to energize said release relay, contacts on said release relay closed when the relay operates for closing another connection between the said other pole of the exchange battery and said other terminal of said relay, and contacts on the line relay closed when the line relay is normal for shunting the release relay to bring about the operation of said magnet.

3. In an automatic switch, a line relay, a release relay, an operating magnet, a connection between one pole of the exchange battery and one terminal of the operating magnet, a connection between the other terminal of the operating magnet and one terminal of the release relay, means for closing a circuit path between the other pole of the exchange battery and the other terminal of said release relay to operate said release relay, contacts on the line relay for shunting the release relay to bring about the operation of said magnet, and a low-resistance control relay included in said shunt circuit.

4. In an automatic switch, an operating magnet and a release magnet, a release relay of relatively high resistance connected in series with the operating magnet, a change-over relay of relatively low resistance, means for periodically connecting said change-over relay in parallel with said high resistance relay, said operating magnet being inoperative in the first-mentioned circuit and operative in the second-mentioned circuit, and a circuit for said release magnet including normally-closed contacts of the said release relay and excluding the change-over relay.

5. In a telephone system wherein the release relay of an automatic switch is energized in series with the operating magnet of the switch and wherein a control relay is periodically connected in parallel with said release relay to effect operations of said operating magnet, a release magnet for said switch, and an operating circuit for said release magnet including contacts closed by the release relay upon deenergization and excluding said control relay.

6. In a selector, an impulse relay, a release relay, a contact pair on said impulse relay, a contact pair on said release relay, a current source, an operating magnet, and an operating circuit for said magnet including a connection from one pole of said source to the contact pair of said release relay and extending through said pair to said magnet by way of the contact pair of said impulse relay.

7. In a selector, a release relay and an operating magnet connected together, a line relay, a front contact on said line relay for closing a circuit through said release relay and magnet, and a back contact on said line relay for shunting said release relay.

8. In a selector, a release relay, an operating magnet, a line relay for closing a circuit through said release relay and magnet in series, said circuit including front contacts on said line relay which directly connect one side of the exchange battery to said release relay, and locking contacts on said release relay connected in parallel with said line relay contacts.

9. In a selector, a release relay, a magnet, and a grounded battery, all connected in series, a line relay for connecting ground to said release relay to energize the same, and a locking circuit for said release relay.

10. In a selector, a line relay, a release relay energized by said line relay, an operating magnet to which said line relay delivers ground impulses on deenergizing, and a circuit including contacts on said release relay for supplying ground to the armature of said line relay.

11. In a selector, an impulse relay, a release relay, an operating magnet, a current source, a connection from one pole of said source to one terminal of said magnet, the free terminal of said magnet and one terminal of said relay being connected together, and contacts on said impulse relay for connecting the other terminal of said release relay to the other terminal of said current source.

12. In a selector, a self-locking relay having a locking contact for connecting one pole of the exchange battery directly to one of its terminals, a connection from the other terminal of said relay to the other side of the exchange battery through an operating magnet of the selector, and contacts for periodically shunting said relay to operate said magnet.

13. In a selector, a self-locking relay hav-

ing a locking contact for connecting one pole of the exchange battery directly to one of its terminals, a connection from the other terminal of said relay to the other side of the exchange battery through an operating magnet of the selector, and contacts for periodically shunting said relay to operate said magnet in a circuit path including said locking contact and excluding said relay.

In witness whereof, I hereunto subscribe my name this tenth day of January, A. D. 1927.

JOHN I. BELLAMY.

In witness whereof, I hereunto subscribe my name this 25th day of January, A. D. 1927.

RUDOLPH F. STEHLIK.