Dec. 14, 1943. C. R. GRAY 2,336,861

SELECTOR SWITCH CIRCUIT

Filed Sept. 19, 1942

FIG. 1

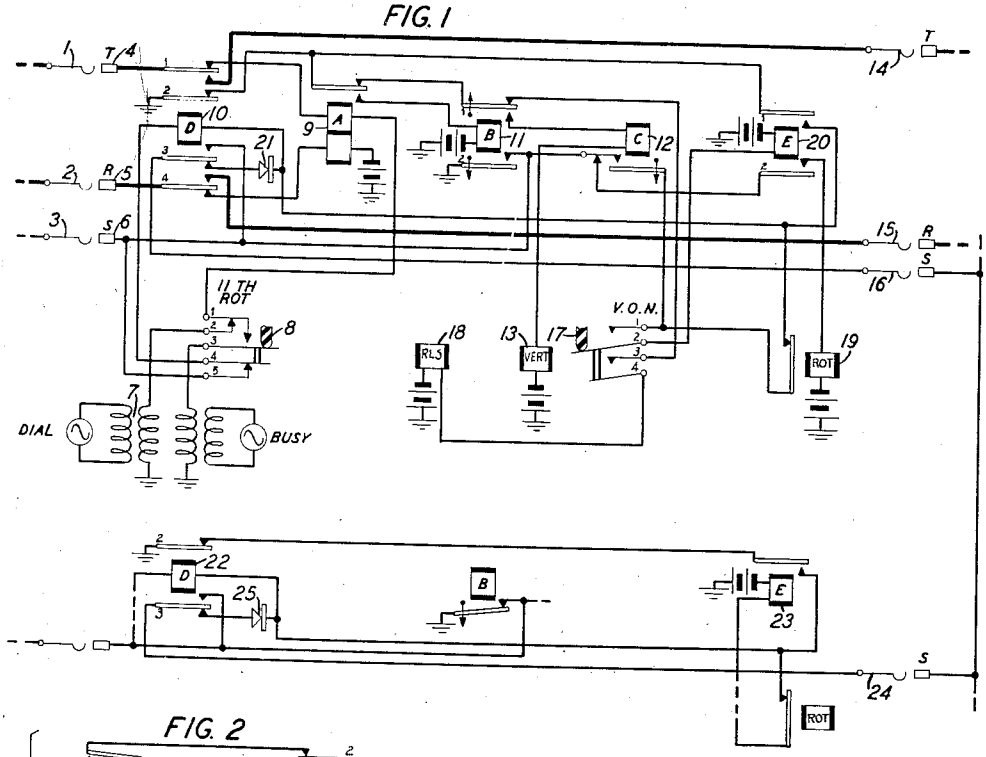


FIG. 2

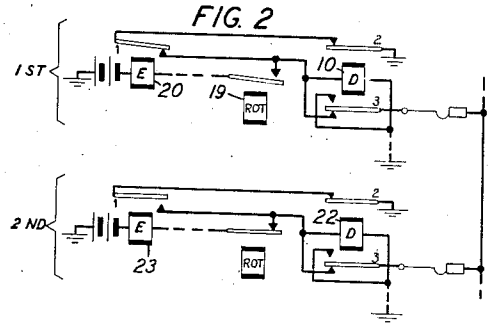


FIG. 3

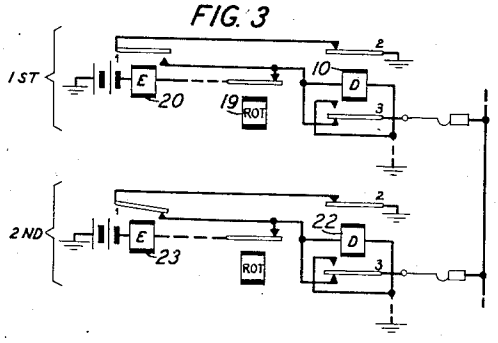
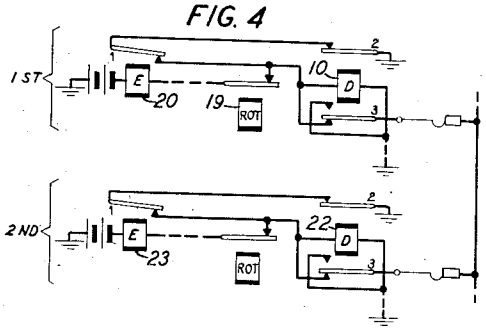


FIG. 4



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SELECTOR SWITCH CIRCUIT

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2 Claims. (Cl. 179—18)

This invention relates to circuit arrangements of machine switching devices particularly those used in communication systems.

The object of the invention is to provide means to eliminate a certain infrequently occurring interaction between two selector switches which results in double connections.

In the operation of the well-known step-by-step selector switch there is what is spoken of as an unguarded interval between the time the brushes of the selector are placed on the terminals of an idle line and the time the selector seizes such idle line. It is necessary to have such an unguarded interval in order to test for the busy or idle condition of the line, but it is likewise desirable to make this interval as short as possible to prevent the seizure of the line by another selector.

The circuits of a well-known type of selector are such that as the test brush of the selector reaches an idle line it has a ground connection thereto which however is almost immediately opened to allow the test to be made. If at this instant another selector should reach a multiple appearance of this line the ground which it first applies to the line will extend back over the multiple connection so as to make the line appear busy to the first selector. This first selector will then take another step and in doing so will apply ground over the multiple until the step is actually taken to make the line appear busy to the second selector. Hence the second selector also takes another step. This action is known as "chasing" and may continue for several steps during which time the two selectors tend to become synchronized with each other with the result that eventually the unguarded interval of both will occur at the same instant and the line appearing idle to both selectors, both will seize it and a double connection will be established.

In accordance with the present invention a unidirectional resistance is placed in the testing circuit of the selector so that the ground brought to the terminal of an idle line cannot be communicated over the multiple connection during the unguarded interval of and to the test relay of another selector which has previously reached such line.

A feature of the present invention is the use of a varistor or unidirectional resistance in the test circuit of a selector switch to prevent the connection of a low resistance ground to the test wire of a line which might otherwise be communicated over a multiple connection and cause an instandard operation of another selector which has reached the same line.

Other features will appear hereinafter.

The drawing consists of a single sheet having four figures as follows:

Fig. 1 is a circuit diagram of a pair of selector switches both placed in cooperative relationship with the same selected line, the upper one being shown in full and the lower one being shown only in part;

Fig. 2 is a schematic diagram showing the essential selector circuits of two selectors in which the means of the present invention is not incorporated at the instant that the first comes into cooperative relationship with a line to which the second has connected and while the second is in its unguarded interval;

Fig. 3 is a similar schematic showing the circuit condition an instant later as the first of the selectors goes into its unguarded interval and as the second of the selectors is impelled to move forward as the result of a false busy condition found under the conditions of Fig. 2; and

Fig. 4 is a similar schematic showing the circuit condition a slight interval thereafter as the first of the selectors returns a false busy condition and as both then prepare to step away from an idle line to the next terminal, practically simultaneously.

The operation of the selector may be understood by the following description of the upper selector circuit of Fig. 1. The selector is seized by the movement of the tip, ring and sleeve brushes 1, 2 and 3, respectively, engaging the terminals 4, 5 and 6. A circuit is then established from ground, secondary winding of transformer 7 acting as a source of dial tone, springs 2 and 1 of the eleventh rotary position springs 8, upper winding of the A relay 9, back contact and armature 1 of D relay 10, tip contact 4, tip brush 1, to the loop of the line which has controlled the brushes 1, 2 and 3, ring brush 2, ring contact 5, armature 4 and back contact of D relay 10, lower winding of A relay 9 to battery. Relay 9 responds and causes the energization of the first slow B relay 11 in a circuit from ground, armature 2 and back contact of D relay 10, armature and front contact of A relay 9, winding of B relay 11 to battery. Relay 11 responds and prepares a circuit for the second slow C relay 12 and the vertical magnet 13.

When dial pulses are transmitted from the loop holding the A relay 9, each pulse takes the form of a short interruption of the circuit of A relay 9 and this relay responds by releasing its armature

for a short interval. During this interval a circuit is established from ground, armature 2 and back contact of D relay 10, armature and back contact of A relay 9, armature 1 and front contact of B relay 11, winding of C relay 12 and the winding of the vertical magnet 13 to battery whereupon the brushes 14, 15 and 16 are stepped in a vertical direction.

On the first vertical step the vertical off-normal contacts 17 are operated and due to the operation of C relay 12 the circuits for the release magnet 18 and the rotary magnet 19 are prepared. A circuit may be traced from ground, armature 2 and front contact of B relay 11, front contact and armature of C relay 12, springs 1 and 2 of the vertical off-normal springs 17, winding of E relay 20 to battery. E relay 20 responds and prepares a circuit for the rotary magnet 19 which will become effective on the release of C relay 12. The D relay 10 is now short-circuited from ground on its own armature 2, through armature 1 and front contact of E relay 20, the winding of D relay 10, springs 4 and 5 of the combination 8, to ground supplied over the incoming sleeve terminal 6.

Shortly after the end of the dialing operation the C relay 12 will release whereupon the rotary magnet 19 will be energized. This will cause the brushes 14, 15 and 16 to move one step in a rotary direction. Magnet 19 opens the circuit of E relay 20 and this relay in turn opens the circuit of the rotary magnet. Just as the E relay 20 releases and the rotary magnet 19 releases a circuit may be traced from the sleeve brush 16, armature 3 and back contact of D relay 10, varistor 21 to a point leading in one direction through the winding of D relay 10 to ground and in the other direction through the back contact and armature of rotary magnet 19, springs 1 and 2 of the vertical off-normal springs 17, winding of E relay 20 to battery. During this, the unguarded interval, while the sleeve brush is on the terminal of an outgoing line and before ground is placed thereon by this selector switch a test is made of the selected line. If the line is busy ground will be on the sleeve terminal with a consequence that D relay 10 will be short-circuited and E relay 20 will become energized. This will result in another energization of the rotary stepping magnet. If the line is idle no ground will be connected to the junction point between the D and E relays. Thereupon the D relay 10 will become energized in series with the E relay 20. The resistances of these two relays are such that the D relay 10 will energize but the E relay 20 will remain released.

The D relay 10 now connects the incoming sleeve terminal 6 to the outgoing sleeve brush 16 to seize the selected line. Since the E relay 20 now remains released the rotary magnet is not again energized.

It is to be noted that the varistor 21 is a device which presents a low resistance to current from ground found by sleeve brush 16 but will present a high resistance to current from ground armature 2 and back contact of D relay 10, armature 1 and front contact of E relay 20, which circuit is closed as the brush 16 moves on to the terminal of the selected line.

As a part of Fig. 1, a skeletonized part of another selector is shown. This selector is in its unguarded interval so that the junction between relays 22 and 23 is connected to the brush 24. If at this instant the brush 16 should move on to a terminal multipled to the terminal on which brush 24 is resting a circuit will be extended from ground, armature 2 and back contact of D relay 10, armature 1 and front contact of E relay 20, varistor 21 (high resistance direction) back contact and armature 3 of D relay 10, brush 16 through the multiple terminals to brush 24, armature 3 and back contact of D relay 22, varistor 25 (low resistance direction) to the test circuit of the skeletonized selector. Due to the varistor 21 the ground placed on the multiple sleeve connection at this instant is of such high resistance that the test being made by the skeletonized selector is carried out without interference by the selector which has just arrived.

Figs. 2, 3 and 4 will explain the trouble that occurs when the varistors 21 and 25 are not included in the circuit. Fig. 2 shows the condition just described, with the lower of the two selectors in its unguarded interval and the upper of the two selectors just arriving on the multipled terminal. Thus the lower of the two selectors will apparently find a busy line, whereupon the E relay 23 will respond. This is indicated in Fig. 3 which represents the condition established immediately afterwards. Now as the upper of the two selectors goes into its unguarded interval it will find a ground returned through the armature of E relay 23 which has just been energized by the upper selector as in Fig. 2. Therefore, the condition of Fig. 4 will be established wherein each selector has tested a busy condition. This action tends to synchronize the two selectors after several steps so that if there are enough idle terminals before them they will eventually both go into their unguarded intervals at the same time and a double connection will be established. If there are not enough idle terminals to allow this synchronization to become effective then one will "chase" the other to the eleventh rotary step and a busy condition will be reported. Both of these results are undesirable as both represent failures to find an idle line.

By placing the varistors in the circuit as shown the arriving selector is prevented from placing a false busy on the multiple sleeve connection which might cause a false response in a selector which had previously arrived and had gone into its unguarded interval. Thus, no selector is driven from the terminals of an idle line because some other selector has just arrived at that point.

What is claimed is:

1. A circuit arrangement for a selector switch for preventing false operation of a like switch over a multiple connection, comprising a test wiper for cooperation with the multiple bank terminals of said switch, a relay E and a relay D in a normal series circuit, a connection to said series circuit midway between said relay E and said relay D leading in series therefrom through a unidirectional resistance element and a back contact and an armature of said relay D to said test wiper, said unidirectional resistance element being poled to present a high resistance in the direction from said series circuit to said test wiper.

2. A circuit arrangement for a selector switch for preventing false operation of a like switch over a multiple connection, comprising a test wiper for cooperation with the multiple bank terminals of said switch, a test circuit comprising a relay E and a relay D connected in a circuit from battery through the winding of said relay E to a circuit junction, through the winding of said relay D to ground and from said circuit junction through a unidirectional resistance element, a back contact and armature of said relay

D to said test wiper, said relay E being responsive to ground encountered by said test wiper and said relay D operating in series with the winding of said relay E without operating said relay E responsive to the failure of said test wiper to encounter a ground connection, a locking ground circuit for said relay E including an armature and front contact of said relay E, said unidirectional resistance element being poled to present a low resistance value to current flowing from a ground encountered by said test wiper and a high resistance value to current flowing from said locking ground for said relay E to said test wiper.

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