

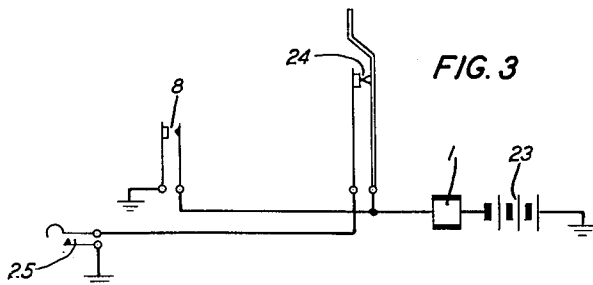
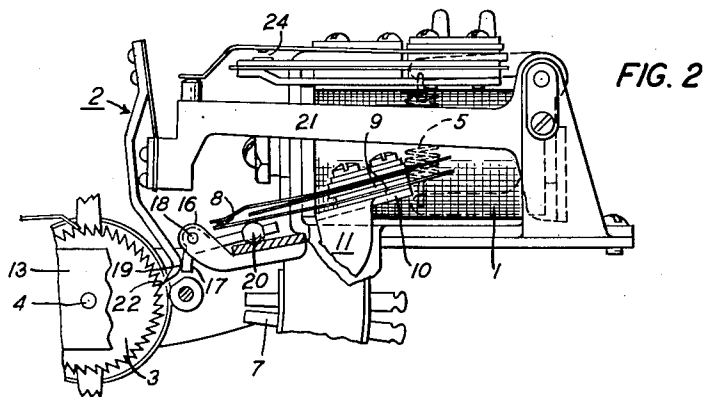
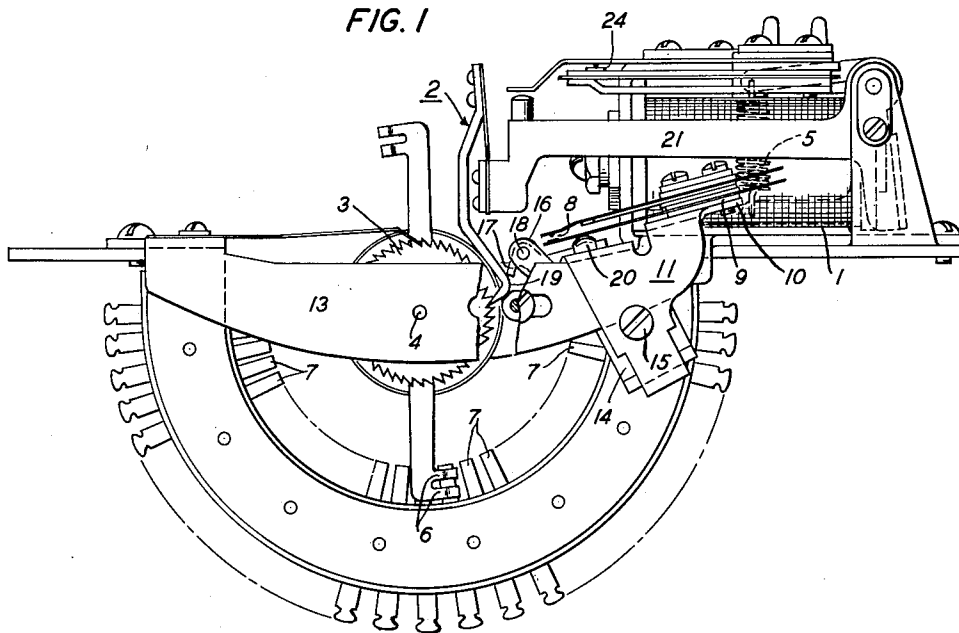
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2,630,465

CONTROL FOR STEPPING MECHANISM

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CONTROL FOR STEPPING MECHANISM

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This invention relates to a rotary switch mechanism and more particularly to one of a type commonly used in telephone switching systems.

An object of the invention is to improve the reliability of operation of the stepping mechanism of a rotary switch.

Another object is to provide a rotary switch that will operate reliably on voltage pulses of shorter duration than those required to operate rotary switch units heretofore known.

This invention is an improvement upon a rotary type of switch such as shown by Forsberg et al. in Patent 1,472,465 and which is incorporated by reference as a part of this specification. Since such switch units are well known today in the art, and since the structure and description of operation of the basic type rotary switch as illustrated by Forsberg is sufficiently described in his patent, the present application will not be encumbered with a description of such fundamentals.

Fig. 1 shows a side view of an exemplary form of the invention with a portion of the frame cut away.

Fig. 2 shows a cut-away view of a portion of Fig. 1 showing the pawl and toggle in detail.

Fig. 3 shows a wiring arrangement suitable for the arrangement of Figs. 1 and 2.

In the commercial use of rotary switches troubles have been encountered due to voltage pulses of such a short duration being applied to the electromagnet that insufficient magnetic force is built up to pull the pawl a sufficient distance to enable it to engage the next tooth on the ratchet wheel. At the end of each insufficient pulse the pawl merely slides back into the tooth from which it came rather than engaging the next tooth and imparting the desired rotation to the ratchet wheel on its return stroke.

Attempts in the past have been made to improve the reliability of operation of rotary switches and to reduce the possibility of a failure of operation due to voltage pulses of short duration. The patent to Hibbard 1,567,053 is an example of such an attempt.

Applicant's invention reduces the possibility of a defective operation on a short pulse by reducing the duration of a pulse necessary to insure complete operation of the pawl and ratchet mechanism. This is done by continuing the effect of the short pulse to a time equivalent to the effect which it would have had had it been a long pulse. Applicant's invention is unique in that it can readily be incorporated into the

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rotary switches now being manufactured with a minimum of redesign and retooling expense.

Briefly, applicant's invention comprises a pair of additional contact springs tensioned to a normally opened condition and a toggle mechanism assembled on a bracket that mounts on the frame of the selector switch. A cam surface on one leg of the toggle engages the underside of the pawl and the cooperation is such that the toggle closes the contact springs early in the operate stroke of the pawl, and opens them only when the pawl falls into the next ratchet tooth. The contact springs remain open on the back stroke of a pawl and do not reoperate until the beginning of the next cycle of operation is commenced. The contact springs are electrically connected in such a fashion that as they close, they furnish a second circuit path for the energization of the electromagnet. The first path is, of course, furnished by a control pulse source. The advantage of the additional contact springs is that the duration of the incoming control pulse need only be long enough to close these contact springs. Since this second circuit will not be opened until the pawl engages the next tooth, the complete energization of the electromagnet is assured once the additional contact springs are closed.

In conventional rotary switches the desired operation of the pawl and ratchet is not assured unless the control pulse is of duration long enough to maintain the electromagnet energized until the pawl engages the next tooth. It can readily be appreciated that the device disclosed herein will operate satisfactorily on pulses of much shorter duration than will conventional types of rotary switches heretofore known.

Each rotary selector switch comprises an electromagnet 1, which upon being energized, pulls the pawl 2 away from ratchet wheel 3 fixably mounted on shaft 4. The motion of pawl 2 stretches spring 5 thereby storing energy in it. When electromagnet 1 is deenergized spring 5 pulls pawl 2 toward ratchet wheel 3 thereby rotating it one step. Wheel 3 in rotating one step, causes shaft 4 and brushes 6 to rotate a corresponding amount. By means of this step-by-step movement, brushes 6 are caused to successively engage succeeding steps of contacts 7.

Contact springs 8 are tensioned to a normally open position and are positioned at one end between insulating members 9 which in turn are affixed by means of screws 12 to a right angle extension 10 of bracket 11. Bracket 11 which is on the top side of frame 13, as shown in Figs. 1

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and 2, and bracket 14, a portion of which is on the underside of frame 13, together form a clamp with frame 13 in the center. Screw 15 passes through brackets 11 and 14, and when tightened clamps both brackets rigidly to frame 13.

A portion of bracket 11 is bent 180 degrees around the magnet side of frame 13. An extension of this bent-around portion forms nose 16 to which toggle 17 is attached by pin 18. Toggle 17 cooperates with bend 19 of pawl 2 in such a fashion, that as pawl 2 moves upward and away from ratchet wheel 3, bend 19 rotates toggle 17 counter-clockwise. This counter-clockwise rotation of toggle 17 causes insulating stud 20 to force contacts 8 to a closed position.

As electromagnet 1 is energized, armature 21 rotates clockwise as shown in Fig. 2. This clockwise movement causes pawl 2 to move upward. As pawl 2 begins its upward travel, tip 22 of pawl 2 is forced outwardly from the center of ratchet wheel 3 by the slant edge of the tooth in which it is located. This outward travel of tip 22 causes bend 19 to rotate toggle 17 so that contacts 8 are closed as hereinbefore explained. The adjustment of toggle 17 is such that contacts 8 are forced closed the instant pawl 2 begins to move.

As pawl 2 continues its upward travel, tip 22 is forced further outwardly from the center of wheel 3 during which time contacts 8 remain in a closed condition. After pawl 2 has traveled a certain distance, tip 22 reaches the beginning of the next tooth, ceases its outward travel, and falls into the depression of the next tooth. In doing so, tip 22 moves towards the center of wheel 3, thus allowing toggle 17 to rotate clockwise and to release contacts 8.

Contacts 8 do not operate on the downward stroke of pawl 2 because tip 22 of the pawl is completely within the next tooth, thus positioning bend 19 of the pawl close enough to the center of wheel 3 so that on a downward stroke it will not engage toggle 17. Contacts 8 will not reoperate until the next cycle of operation is initiated.

Fig. 3 shows the circuit diagram of the wiring of the rotary selector switch. From this it is seen that a circuit may be traced from a battery 23, through an electromagnet 1, through contacts 24, to a key 25 which will supply a ground to the circuit when operated. A ground may also be supplied to electromagnet 1 by contacts 8 when they are operated. Key 25 is shown merely for convenience and explanatory purposes. In actual practice the contacts of a control relay or some pulsing device would furnish ground to this circuit.

The operation of the circuit will now be described. Initially contacts 24 are closed and contacts 8 are open. When key 25 is operated electromagnet 1 is energized. This energization causes armature 21 to rotate clockwise, as shown in Figs. 1 and 2, and causes pawl 2 to lift upwardly. At the instant pawl 2 commences its upward travel contacts 8 close for reasons described hereinbefore. An instant after contacts 8 close during the upward travel of pawl 2, contacts 24 are opened. By means of contacts 8 the circuit remains energized and pawl 2 continues its upward travel until tip 22 of the pawl slips into the next tooth. At such time contacts 8 will open, the circuit will be deenergized and pawl 2 in returning to its normal position will rotate wheel 3 one step. On the return stroke of pawl 2 and armature 21, contacts 24 will be closed and the circuit will be energized a short period of

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time before pawl 2 reaches the end of its return stroke. However, pawl 2 will still return to its normal position as the adjustment of contacts 24 is such that this period of time is so short that inertia of pawl 2 and armature 21, combined with the force stored in spring 5, easily overcome the small magnetic field that electromagnet 1 has been able to build up.

This stepping action of the selector switch will of course continue as long as key 25 remains in an operated condition thus supplying ground to the circuit.

Since the electromagnet 1 remains energized until pawl 2 has firmly engaged the next tooth there is no chance of the electromagnet deenergizing and the pawl returning to normal without causing the desired rotation of wheel 3.

It is obvious from an analysis of Fig. 3 that if the selector switch is to be operated from a pulsing device that the pulse need only be of a duration long enough to insure that contacts 8 have been made. Once contacts 8 have been made the full energization of the electromagnet is assured.

It is easily seen that a rotary switch without contacts 8 would require a pulse of many times greater duration than does applicant's switch, because in the common type rotary switch having only contacts 24 the electromagnet is energized solely by the incoming control pulse. The present invention will operate reliably with greater variations of voltage, current and friction load, than will the rotary switches heretofore known.

In this art switches are made to step one step per pulse or upon being supplied with a closed circuit path to step to a contact having a definite potential thereupon. Circuits for such purposes are known and may be and often are connected to the same switch; the features of the present invention are applicable to either the self-stepping or the step-per-pulse type.

It is to be understood that the hereinbefore described arrangements are but illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. Apparatus for controlling the movement of the driving pawl of a stepping mechanism comprising, an electromagnet for actuating said driving pawl, a source of voltage of one polarity connected to one terminal of said magnet, one contact of a pair of normally closed contacts connected to the second terminal of said electromagnet, the other contact of said pair of normally closed contacts connected to one terminal of a switch whose contacts are normally opened, the second terminal of said switch being connected to a source of voltage of opposite polarity from said first-mentioned source of voltage, one contact of a pair of normally open contacts connected to said second terminal of said electromagnet, the other contact of said pair of normally open contacts being connected to a source of voltage of the same polarity as said second-mentioned source of voltage, an operating lever, a cam surface on said operating lever, said cam surface cooperating with a surface on said driving pawl whereby the rotative position of the operating lever is controlled by the position of the driving pawl, means for causing the operating lever to control the condition of said normally open contacts, means for causing said operat-

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ing lever to momentarily close said normally opened contacts when said driving pawl is caused to move from its normal position to the extremity of its displacement in response to the energization of the electromagnet when said switch is momentarily closed, said pair of normally closed contacts being adjusted so that they open as said driving pawl is caused to move from its normal position to the extremity of its displacement, means for causing said pawl to return from its displaced position to its normal position, and means for preventing said pair of normally opened contacts from closing as said pawl moves from its fully displaced position to its normal position.

2. Apparatus for controlling the movement of the driving pawl of a stepping mechanism comprising, a set of normally closed contacts, a set of normally opened contacts, an operating lever, a cam surface on said operating lever, said cam surface cooperating with the surface on said driving pawl whereby the operating lever is controlled by the position of the driving pawl, means to cause said operating lever to control the condition of said normally opened contacts, the co-operation between said driving pawl and said normally opened contacts being such that the normally opened contacts are in an opened position when said driving pawl is in its normal position, means for causing said operating lever to momentarily close said normally open contacts when said driving pawl is caused to move

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from its normal position to the extremity of its displacement, means to cause said normally closed contacts to open when said driving pawl moves from its normal position to the extremity of its displacement, means for moving said driving pawl from the extremity of its displaced position to its normal position, said normally closed contacts closing as said driving pawl returns to a normal position, and means for opening said normally open contacts when said driving pawl is in the extremity of its displaced position and for preventing said normally opened contacts from closing as said pawl moves from its fully displaced position to a normal position.

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