May 22, 1962 V. H. ARDIA ETAL 3,036,174

MANUALLY OPERABLE ROTARY SWITCH WITH ELECTROMAGNETIC ON-OFF ACTION AND RETURN ACTION UPON FAILURE OF ENERGIZING CIRCUIT

Filed Aug. 31, 1959

3 Sheets-Sheet 1

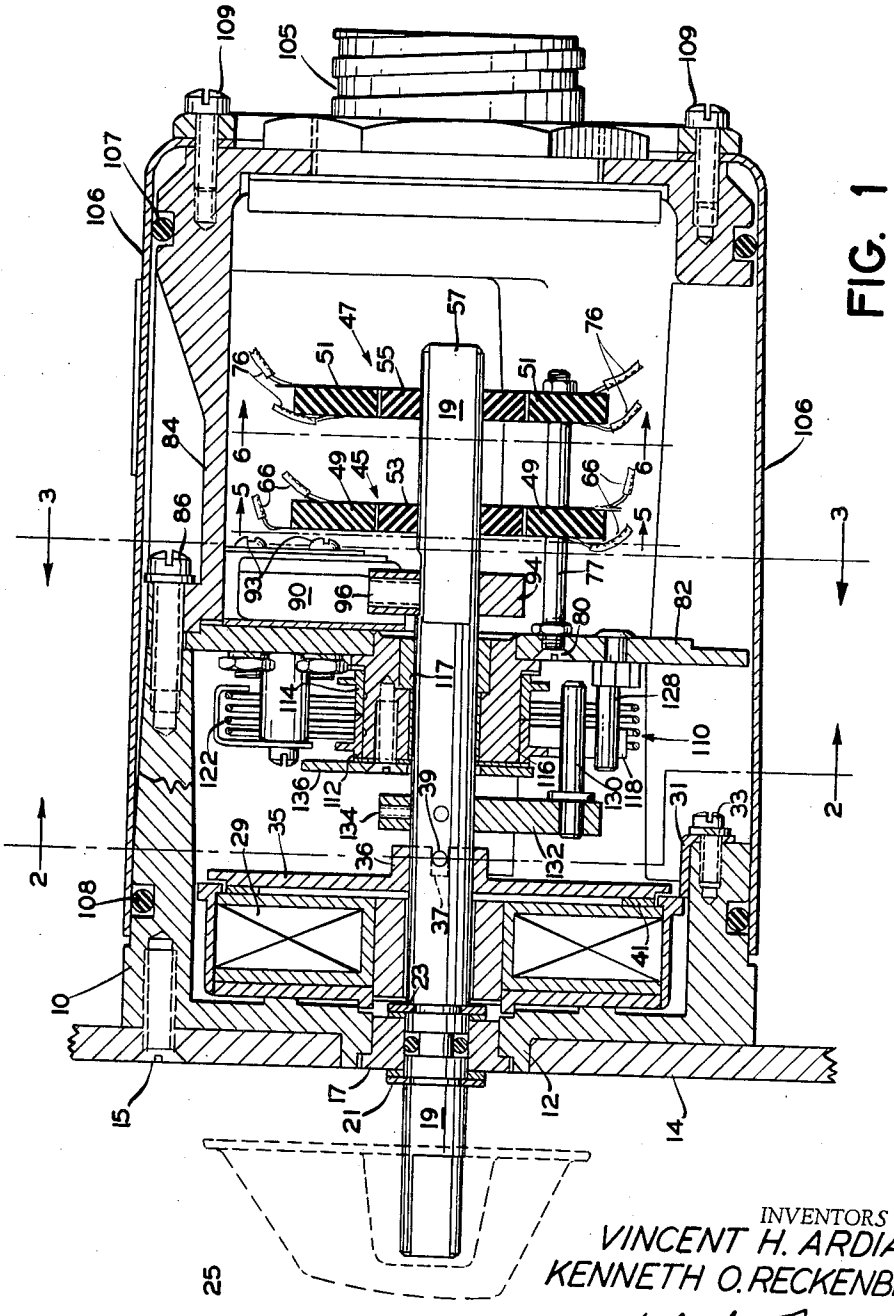


FIG. 1


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3 Sheets-Sheet 2

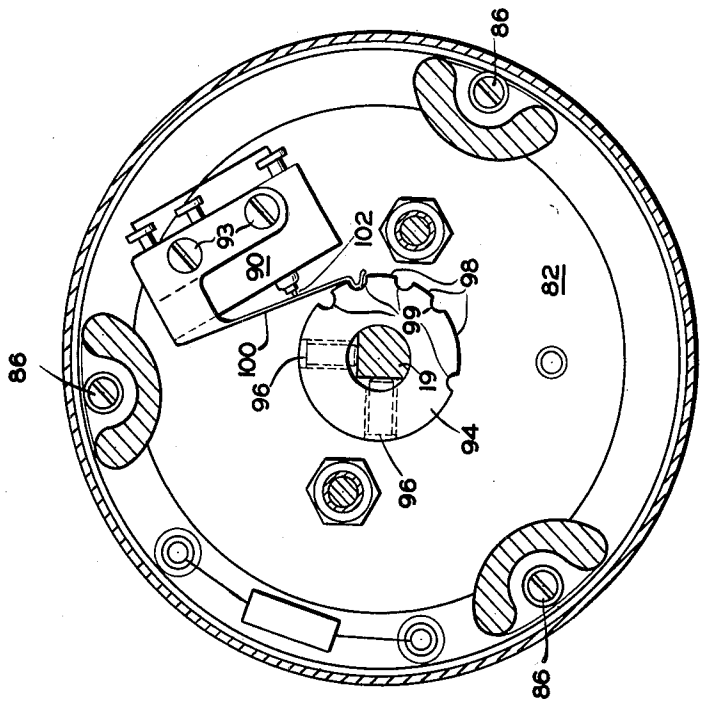



FIG. 3

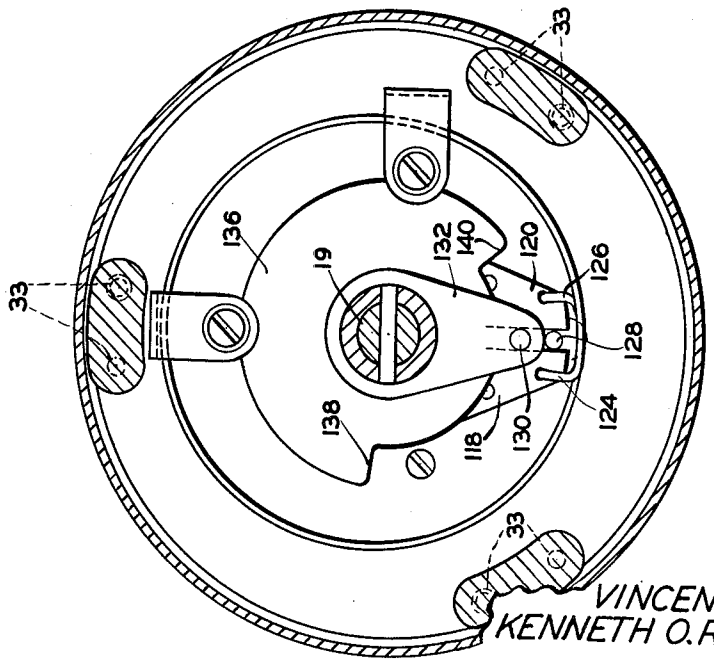



FIG. 2


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3 Sheets-Sheet 3

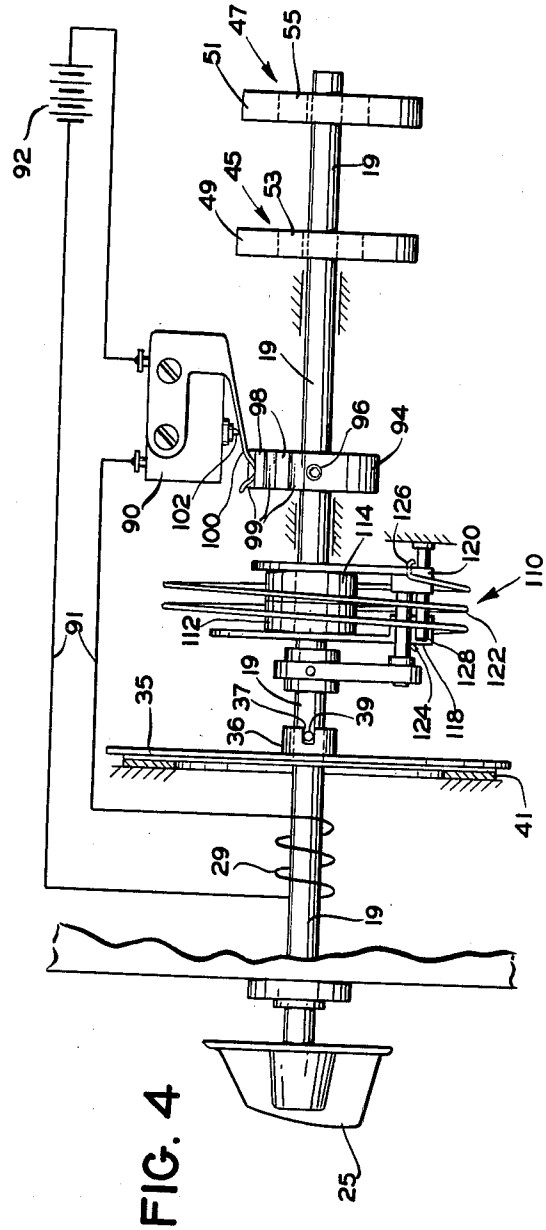



FIG. 4

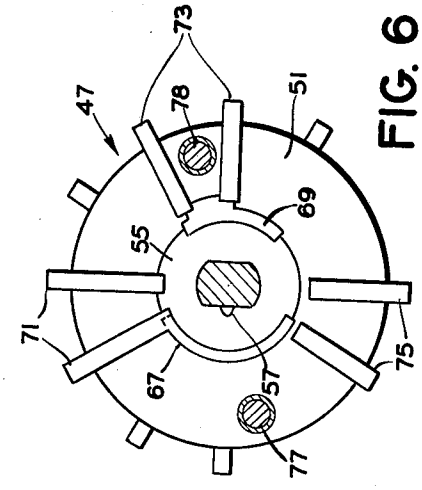



FIG. 6

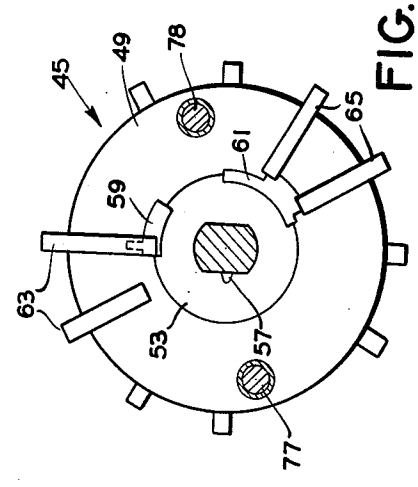



FIG. 5

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3,036,174

# MANUALLY OPERABLE ROTARY SWITCH WITH ELECTROMAGNETIC ON-OFF ACTION AND RETURN ACTION UPON FAILURE OF ENERGIZING CIRCUIT

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7 Claims. (Cl. 200—87)

The present invention relates to a novel rotary switch, including means operable by a manual turn knob to select various switching functions and more particularly to such a rotary switch including novel means to brake or hold the switch in respectively selected positions of the turn knob, together with biasing means to return the rotary switch and turn knob to a neutral position upon a failure or interruption of a supply of electrical energy.

An object of the invention is to provide a novel rotary switch in which there is provided means to effect an on-off action which may be physically sensed by the operator of the switch, together with means to return the switch to a neutral position upon failure of an energizing circuit.

Another object of the invention is to provide a novel rotary switch having a manually operable turn knob to select various switching functions, together with a cam operated switch arrangement to provide a positive braking action at each selected position of the turn knob through energization of a solenoid and floating brake armature controlled thereby at the precise position of the selected function.

Another object of the invention is to provide a manually operable switch arrangement for selecting a plurality of switching functions, together with braking means to hold the switch at each selected position thereof including electromagnetic means to operate the brake means in such a manner that there is provided an on-off action which may be physically sensed by the operator in actuating the turn knob to select the switching functions and means to bias the switch to a neutral position upon a failure or interruption in the supply of electrical energy for the electromagnetic means.

These and other objects and features of the invention are pointed out in the following description in terms of the embodiment thereof which is shown in the accompanying drawings. It is to be understood, however, that the drawings are for the purpose of illustration only and are not a definition of the limits of the invention, reference being had to the appended claims for this purpose.

In the drawings:

FIGURE 1 is a longitudinal sectional view of the novel rotary switch showing the mechanical arrangement of the several parts thereof and with the manually operable turn knob in dotted lines.

FIGURE 2 is a sectional view taken along the lines 2—2 of FIGURE 1 and looking in the direction of the arrows.

FIGURE 3 is a sectional view of FIGURE 1 taken along the lines 3—3 and looking in the direction of the arrows.

FIGURE 4 is a diagrammatic showing of the mechanical arrangement of the device of FIGURE 1 and circuit diagram of the energizing circuit for the electromagnet controlling the floating brake armature thereof.

FIGURE 5 is a view taken along the lines 5—5 of FIGURE 1 and illustrating one of the switch function selecting mechanisms.

FIGURE 6 is a view taken along the lines 6—6 of FIGURE 1 and illustrating another switch function selecting mechanism.



Referring to the drawing of FIGURE 1, there is indicated by the numeral 10 a main mounting base of the novel rotary switch having a central portion 12 which may project from an end surface of the mounting base 10 and through an opening in a mounting plate 14, together with fastening screws 15 for securing the rotary switch to the mounting plate 14. A bearing member 17 of a suitable, self lubricating material such as "Teflon" is positioned in the portion 12 and has mounted therein a main actuating shaft 19 of the switch mechanism. The bearing member 17 is locked on the shaft 19 by suitable lock washers 21 and 23 engaging in suitable channels provided therein. The lock washers 21 and 23 are positioned at opposite sides of the bearing member 17.

At the free end of the shaft 19 there is provided a manually operable turn knob 25 indicated in FIGURE 1 by dotted lines while the shaft 19 further extends through an electromagnetic mechanism or solenoid 29 secured within the main mounting base 10 by bracket elements 31 fastened to the main mounting base by the bolts 33.

*On-Off Braking Mechanism*

Cooperating with the electromagnetic element 29 is a floating brake armature 35 having a collar 36 and slots 37 at opposite sides thereof into which slideably fit pins 39 projecting from the shaft 19 at opposite sides thereof so that upon energization of the electromagnetic member 29 the floating brake armature 35 is drawn inwardly toward electromagnetic element 29 and into engagement with braking material 41 carried by the electromagnetic element 29 so that the armature 35 applies a braking force through the collar 36 and pins 39 to the shaft 19 tending to retard rotary movement thereof under force of the manually operable turn knob 25.

At the inner end of the shaft 19 there are rotary switch mechanisms 45 and 47 of conventional type and including fixed stator members 49 and 51 respectively within which are rotatably mounted rotary switch members 53 and 55 affixed to the shaft 19 by a suitable spline 57 so that rotation of the shaft 19 imparts a rotary movement to the members 53 and 55 relative to the stator members 49 and 51 respectively for effecting a selective switching function.

As shown in FIGURE 5, the rotary switch member 53 has affixed thereto switching members 59 and 61 arranged to selectively cooperate with switch strips indicated generally by the numerals 63 and 65 and carried by the stator member 49. The switching members 59 and 61 are selectively positioned by rotary movement of the switch member 53 to open and close the contact strips so as to perform selected switching functions. As shown in FIGURE 1, suitable electrical conductors 66 lead from the contact strips of the switch mechanism 45 to devices, not shown, electrically controlled thereby.

Similarly, as shown in FIGURE 6, the rotary switch member 55 includes switch members 67 and 69 affixed thereto and arranged to coperate with switch contact strips indicated generally by the numerals 71, 73 and 75 carried by the stator member 51. Thus by rotation of the member 55, the switch members 67 and 69 may selectively open and close the respective switch contact strips 71, 73 and 75 to perform selected switching functions. As shown in FIGURE 1 suitable electrical conductors 76 lead from the contact strips of the switch mechanism 47 to devices, not shown, electrically controlled thereby.

The switch stator members 49 and 51 are fixedly mounted relative to the main mounting base 10 by suitable supporting posts 77 and 78 fastened by screws 80 to a supporting plate 82 which is in turn fastened between the main mounting base 10 and an auxiliary mounting member 84 by bolts 86, as shown in FIGURE 1.

Thus, the stator members 49 and 51 are fixedly mounted relative to the main mounting base 10 by posts 77 and 78, while the rotary switch members 53 and 55 may be selectively adjusted relative to the stator members 49 and 51 respectively by rotation of the shaft 19. Further, the arrangement is such that upon rotary movement of the turn knob 25 and thereby the shaft 19 so as to position the rotary switch members 53 and 55 to a predetermined selected position at which one or the other of the various selected switching functions are effected, an energizing circuit of the electromagnet 29 is selectively closed so as to cause the brake armature 35 to apply a braking force to the shaft 19 tending to retard further rotary movement of the shaft by manual operation of the turn knob 25, while upon further movement of the knob 25 tending to overcome this braking force the electromagnet 29 may be deenergized so as to permit free adjustment of the knob 25 to the next selected position whereupon reenergization of the electromagnet 29 is effected.

As shown schematically in FIGURE 4, the aforenoted selective operation of the electromagnet 29 is effected through the opening and closing of a suitable switch mechanism, such as a miniature switch indicated by the numeral 90, for opening and closing a circuit 91 from a source of electrical energy 92 to the electromagnet 29. The switch 90 is fastened to the supporting plate 82 by bolts 93 and the selective operation of the switch 90 is controlled by a cam 94 affixed to the shaft 19 by a suitable fastening screw 96. The cam 94 has raised and recessed portions 98 and 99 cooperating with a spring arm 100 for actuating an operating button 102 of the switch 90 so that, as shown in FIGURES 3 and 4, upon the spring arm 100 resting in a recessed portion 99, the switch 90 may be effectively closed causing energization of the electromagnet 29, while upon the spring arm 100 resting upon a raised portion 98 of the cam 94, the switch 90 may be effectively opened causing deenergization of the electromagnet 29.

The raised and recessed portions 98 and 99 of the cam 94 are arranged so as to operatively control the spring arm 100 and thereby the switch 90 in synchronized relation with the respective switch mechanisms 45 and 47 so as to effect operation of the switch 90 to cause energization of the electromagnet 29 upon the switch mechanisms 45 and 47 being in a predetermined selected position for closing one or the other of the several switch contact strips for effecting a switching function, while upon switch mechanisms 45 and 47 being adjusted into a transient position between one or the other of the selected switch positions, the spring arm 100 is adjusted by the raised portion 98 of the cam 94 so as to effectively deenergize the electromagnet 29. Such on-off operation of the electromagnet 29 tends to hold the switch in the selected position and provides an on-off action which may be physically sensed by the operator of the rotary control knob 25, in that there is provided a positive braking action at each selected position of the turn knob 25 through the energization of the electromagnet 29 and operation of the floating brake armature 35 controlled thereby at the precise position of the selected switching functions. The electrical conductors 66 and 76 from the rotary switch mechanisms 45 and 47 may lead to a suitable electrical connector plug 105 carried by the auxiliary mounting member 84. A cover 106 slips over the connector plug 105 onto the auxiliary mounting member 84 and main mounting member 10 in cooperation with sealing rings 107 and 108 thereon and is secured in position on the auxiliary mounting member 84 by fastening bolts 109.

*Fail-Safe Feature*

Further, opposing rotary adjustment of the manually operable knob 25 from a predetermined neutral position in selecting the aforenoted switching functions, there is provided a spring biasing mechanism indicated generally by the numeral 110. The spring biasing mechanism 110,



as shown in FIGURES 1 and 4, includes collars 112 and 114 rotatably mounted on a bearing member 116 projecting axially from the plate 82. The shaft 19 projects through the member 116 and is rotatably supported therein by a bearing member 117. As best shown in FIGURE 4, the collar 112 has projecting therefrom a flange-like arm 118, while the collar 114 has projecting therefrom a similar flange-like arm 120. Between the arms 118 and 120 there is mounted a coil spring 122 having the opposite ends thereof 124 and 126 affixed to the arms 118 and 120, respectively, so that the arms 118 and 120 are biased in counterclockwise and clockwise directions respectively, as best shown in FIGURE 2, into contacting relation with a stop pin 128 projecting from plate 82, as shown in FIGURE 1.

Further, selectively cooperating with the arms 118 and 120 is a pin 130 projecting from an arm 132 affixedly mounted on the shaft 19 by a fastening screw 134. Further, secured to the free end of the bearing member 116 is a limit plate 136 having, as shown in FIGURE 2, stop portions 138 and 140 for limiting at predetermined points rotary movements of the arm 132 and pin 130 in either clockwise or counterclockwise directions from the neutral position shown.

Further, such rotary movement of the arm 132 and pin 130 in either direction by operation of the turn knob 25 will be opposed by the biasing force of the spring 122 acting upon the arm 118 or 120 as the case may be and thereby on the pin 130 in the movement thereof to effect the selected positions of the switch mechanisms 45 and 47, as heretofore described, so that upon the manually operable turn knob 25 being adjusted to one or the other of the selected positions from the neutral position, the failure or interruption in the electrical energy supplied to the electromagnet 29 will cause the spring 122 to bias the pin 130 and arm 132 in a clockwise or counterclockwise direction, as the case may be, to return the knob 25 and the selectively operated switch mechanisms 45 and 47 to the predetermined neutral position, shown in FIGURE 2.

However, normal energization of the electromagnet 29 causes the float brake armature 35 to hold the shaft 19 and thereby the turn knob 25 and rotary switch mechanism 45 and 47 in any one of the predetermined positions for selecting one of the various switching functions and against the biasing force of the spring 110 until such time as the braking force of the armature 35 and electromagnet 29 may be overridden by manually actuating the turn knob 25 out of such selected position or there is an interruption in the energizing circuit to the electromagnet 29.

*Operation*

The herein described rotary switch mechanism provides novel means to manually select various switching functions upon rotation of a turn knob 25. The arrangement is such that the knob 25 will remain at any selected function position through the operation of a floating brake armature 35 controlled by an electromagnet 29 and effective to hold the knob 25 and operated switch mechanisms 45 and 47 in a selected position until overridden by manual force applied to the knob 25 and the knob 25 returned to a neutral position. Similarly a failure or interruption of the voltage to the solenoid or electromagnet 29 will cause a spring 110 to return the turn knob 25 to the neutral position.

Thus the switch mechanism provides a fail safe operation at all times and a positive holding action at each switch function selecting position for the turn knob 25 through operation of the electromagnet 29 and brake 35 at the precise position of a selected function so that there is provided an on-off action which may be physically sensed by the operator of the turn knob 25, together with a "fail safe" feature effective at all times.

Although only one embodiment of the invention has been illustrated and described, various changes in the form and relative arrangements of the parts, which will

now appear to those skilled in the art may be made without departing from the scope of the invention. Reference, therefore, is to be had to the appended claims for a definition of the limits of the invention.

What is claimed is:

1. In a rotary electromagnetic switch mechanism, a main shaft, means for rotatably supporting the main shaft, means for rotatably positioning said shaft, switch means carried by the supporting means and operable at predetermined angular positions of the shaft, an armature mounted on said shaft, electromagnetic means carried by the supporting means for releasably holding the armature and thereby the shaft from rotary movement relative to the supporting means, an electrical circuit for energizing said electromagnetic means, another switch means to selectively open and close said circuit, control means operable by rotation of the shaft to actuate said other switch means to close said circuit for effecting energization of the electromagnetic means at said selected angular positions and to open said circuit at angular positions of the shaft other than said selected angular positions.

2. In a rotary electromagnetic switch mechanism, a main shaft, means for rotatably supporting the main shaft, means for rotatably positioning said shaft, switch means carried by the supporting means and operable at predetermined angular positions of the shaft, spring means for rotatably biasing the shaft to a predetermined neutral position, an armature mounted on said shaft, electromagnetic means carried by the supporting means for releasably holding the armature and thereby the shaft from rotary movement relative to the supporting means, an electrical circuit for energizing said electromagnetic means, another switch means to selectively open and close said circuit, control means operable by rotation of the shaft to actuate said other switch means to close said circuit for effecting energization of the electromagnetic means at said selected angular positions and to open said circuit at angular positions of the shaft other than said selected angular positions.

3. In a rotary electromagnetic switch mechanism, a main shaft, means for rotatably supporting the main shaft, means for rotatably positioning said shaft, switch means carried by the supporting means and operable at predetermined angular positions of the shaft, an arm projecting radially from the shaft, spring means acting on the arm in opposite directions for biasing the shaft to a predetermined neutral position relative to said switch means, an armature mounted on said shaft, electromagnetic means carried by the supporting means for releasably holding the armature and thereby the shaft from rotary movement relative to the supporting means, an electrical circuit for energizing said electromagnetic means, another switch means to selectively open and close said circuit, control means operable by arcuate movement of the shaft to actuate said other switch means to close said circuit for effecting energization of the electromagnetic means at said selected angular positions and to open said circuit at angular positions of said shaft other than said selected angular positions.

4. In an electromagnetic switch, a rotary brake armature, a shaft drivingly connected to said armature, manually operable means to selectively position said shaft, an electromagnetic winding to bias said armature so as to releasably hold said armature and thereby said shaft from rotary movement, main contact means movable by said shaft, main fixed contact means selectively engageable by said movable contact means at predetermined adjusted angular positions of said manually operable means, switch means for controlling energization of said electromagnetic winding, means actuated by arcuate movement of said shaft for causing said switch means to close an energizing circuit for said electromagnetic winding at each of said predetermined adjusted positions of said manually operable means, and said actuated means being effective for causing said switch means to open the energizing circuit for said electromagnetic winding at other adjusted positions of said manually operable means.

5. In a switch mechanism, the combination comprising a main supporting member, an auxiliary supporting member, a supporting plate mounted between said main and auxiliary supporting members, a control shaft, a manually operable control knob to rotatably adjust the control shaft, a first bearing member carried by the main supporting member, a second bearing member, a third bearing member projecting axially from the supporting plate into the main supporting member and carrying therein said second bearing member, said first and second bearing members rotatably supporting the control shaft, main switch contact means positioned within said auxiliary supporting member, means for fixedly mounting the main switch contact means on the mounting plate, rotary switch contact means cooperating with said fixedly mounted main switch contact means, said rotary switch contact means being movable by said control shaft to selectively engage said main switch contact means at predetermined adjusted positions of said manually operable control knob, an electromagnetic winding carried by the main supporting member, a brake armature operably connected to the shaft and positioned in cooperative relation to the electromagnetic winding, an electrical switch means affixed to the mounting plate and operable to selectively open and close an electrical circuit for energizing said electromagnetic winding, a rotatable cam affixed to the control shaft, a spring arm to control the switch means, said spring arm arranged in cooperative relation with said cam so as to cause the switch means to close the circuit for said electromagnetic winding at said predetermined adjusted positions of the manually operable control knob and to cause the switch means to open the energizing circuit for said electromagnetic winding at other adjusted positions of said manually operable control knob, a main arm affixed to the control shaft and projecting radially therefrom, a pair of auxiliary arms rotatably mounted on the third bearing member and positioned at opposite sides of said main arm, a coil spring positioned about said shaft and third bearing member, one end of said coil spring being attached to an end portion of one of said auxiliary arms and the other end of said coil spring being attached to an end portion of the other of said auxiliary arms so as to bias said end portions of the auxiliary arms in opposing relation, a fixed stop pin projecting from said supporting plate into cooperative relation with said opposing end portions of the auxiliary arms so as to limit movement of the end portions of said auxiliary arms under the biasing force of said spring to a predetermined neutral position, an actuating pin projecting from said main arm into cooperative relation with said opposing end portions of the auxiliary arms, said auxiliary arms being arranged so as to selectively contact said actuating pin so that said coil spring may effectively bias the main arm and thereby said shaft to a position corresponding to said neutral position upon an interruption in the energization of said electromagnetic winding.

6. In a multipositional control means, a main shaft, means for rotatably supporting the main shaft, main control means operable at predetermined angular positions of the shaft, brake means for holding said shaft in an adjusted position, means for operating said brake means, other control means operable by arcuate movement of said shaft for actuating said operating means to render said brake means effective at said predetermined angular positions of the shaft and ineffective at other angular adjusted positions of the shaft.

7. In an electromagnetic switch, a rotary brake armature, a shaft drivingly connected to said armature, manually operable means to selectively position said shaft, an electromagnetic winding to bias said armature so as to releasably hold said armature and thereby said shaft from rotary movement, main contact means movable by said

shaft, main fixed contact means selectively engageable by said movable contact means at predetermined adjusted positions of said manually operable means, switch means for controlling energization of said electromagnetic winding, means actuated by said shaft for causing said switch means to close an energizing circuit for said electromagnetic winding at each of said predetermined adjusted positions of said manually operable means, said actuated means being effective for causing said switch means to open the energizing circuit for said electromagnetic winding at other adjusted positions of said manually operable means, a main arm projecting radially from the shaft, a pair of auxiliary arms movably mounted relative to said main arm, a coil spring positioned about said shaft, one end of said coil spring being attached to an end of one of said auxiliary arms and the other end of said coil spring being attached to an end of the other of said auxiliary arms so as to bias said ends of the auxiliary arms one toward the other, a fixed stop means to limit movement of the ends of said auxiliary arms under the biasing force of said spring to a predetermined neutral position, an actuating pin projecting from said main arm and positioned between said auxiliary arms, said auxiliary arms being arranged so as to selectively contact said actuating pin so that said coil spring may effectively bias the main arm and thereby said shaft to a position corresponding to said neutral position upon an interruption in the energization of said electromagnetic winding.



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