March 27, 1956 A. T. PARKER ET AL 2,740,056

SELECTIVE ROTARY REVERSING SWITCHES

Filed April 5, 1955

FIG. 1.

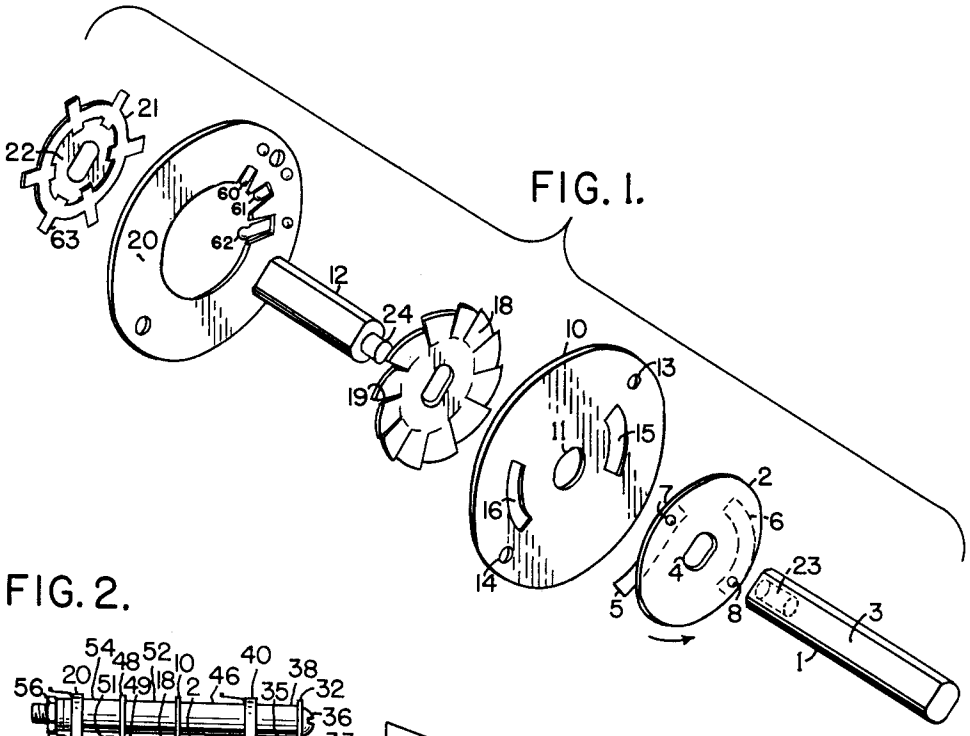


FIG. 2.

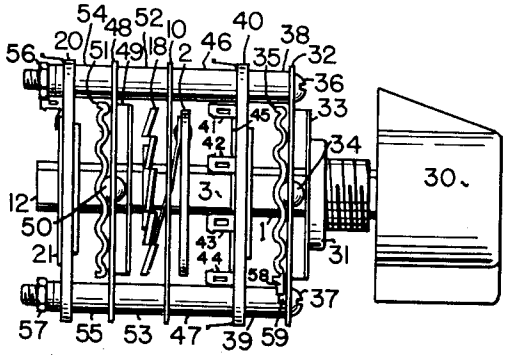


FIG. 3.

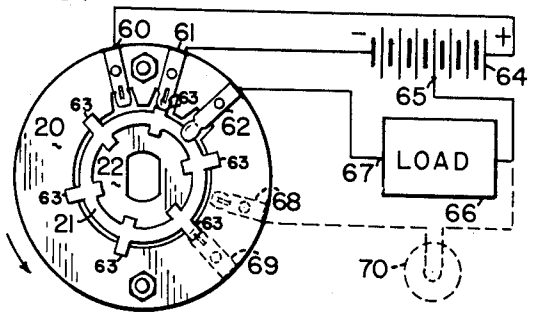
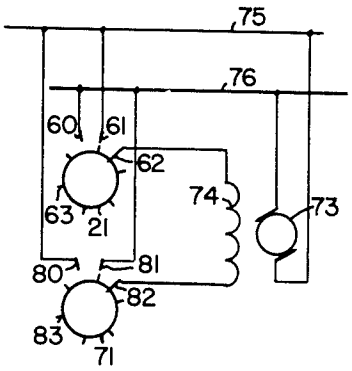


FIG. 4.



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SELECTIVE ROTARY REVERSING SWITCHES

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14 Claims. (Cl. 307—149)

This invention relates to a rotary reversing switch in combination with a rotary selector switch and is particularly characterized by automatic operation of the reversing switch upon completion of a cycle of operation of the selector switch.

In certain kinds of electrical apparatus requiring reversing switches the advantages of automatic operation are apparent. The operation of the apparatus is simplified. Simplicity of control is an accomplishment so well recognized that it has a tangible value in the market for such apparatus.

When the reversing switch is combined with another switch required to be turned in order to turn the apparatus off their can be no doubt that the reversing fraction will be performed. The possibility of damage or unwanted wear to the device required to be reversed is eliminated due to carelessness or lack of instruction on the part of the operator. Uncertainty as to which position the reversing switch occupied for the last operating interval is also removed.

Our reversing switch is of simple and sturdy construction. Being a part of a rotary switch space is saved in the apparatus in which it is used, as is labor in installation. In a typical embodiment the main rotary switch is used to change range or function of an apparatus and it includes an "off" position. The reversing element is preferably assembled in relation to the rotary switch such that the former is actuated when the latter is turned to the "off" position. However, the reversing element may be actuated at the opposite end of the arcuate range of the rotary switch by oppositely assembling the component parts.

One use for our automatic reversing switch is for reversing the polarity of the power supply to a moving-contact pulse oscillator, such as described in the copending application of Donald S. Radmacher for "Pulse Generators," Serial No. 407,890, filed February 3, 1954. Another use is for reversing the polarity of direct-current vacuum tube filaments. Another use is for the control of dual-vibrator power supplies, as found in aircraft, where each is protected from fault by a fuse and each is connected to opposite positions of our switch element. In case of a fault, the usual operation of turning the equipment off connects the unused and operative vibrator thereto and merely turning the equipment on again gives further operation. Similarly, when the use of standby equipment is involved, our element may be used to change from main to standby equipment each time the apparatus is turned off. Where the current and/or voltage demands of such equipment exceed the contact capabilities of the switch a suitable relay may be operated therefrom in the known manner. A still further application involves change of attenuation in some part of the apparatus with operation of the main rotary switch. In this instance different attenuator units are connected to each of the stationary contacts of the reversing element.

An object of our invention is to accomplish a reversing switch function automatically as the operator performs a necessary function in using the apparatus of which it is a part.

Another object is to provide a reversing switch element in a rotary switch which is of the same type of construction as the rotary switch.

Another object is to provide a switch which alters an electrical circuit each time a mechanically linked switch assumes a given position from a given direction of rotation.

Another object is to provide a reversing switch which is actuated each time the apparatus of which it is a part is turned off.

Another object is to provide a reversing switch which is actuated each time the rotary switch of which it is a part is turned to an extreme rotational position.

Other objects of our invention will become apparent upon reading the following detailed specification and upon examining the related drawings, in which:

Fig 1 shows the essentials of our invention in exploded perspective,

Fig. 2 is a side elevation of a typical switch, assembled,

Fig. 3 is an end elevation of a typical switch with an illustrative electrical circuit, and

Fig. 4 is a schematic electrical diagram of a two-wafer embodiment of the reversing switch element.

In Fig. 1 only the essentials of our invention are shown in an exploded view so that the mode of operation thereof may be most easily comprehended. Numeral **1** identifies the shaft, normally used for operation, which is common to the usual rotary portion of the switch and to the reversing element by virtue of plate **2** being fastened thereto. Shaft **1** is free to rotate in either direction within limits set by the number of contact positions on the rotary switch; two as a minimum and no limit within reason as a maximum, with five being a representative number. The shaft is provided with one or more flat portions **3**, which serve to drive plate **2** rotationally by means of non-circular hole **4**. Springs **5** and **6** are identically formed in circumferential shape and are held equispaced upon the rear of plate **2** by rivets **7** and **8**.

Aperture plate **10** is stationary, or essentially so, in the switch assembly. It is provided with a round center hole **11** to act as a bearing for second shaft **12** and two screw-holes **13** and **14** for fastening to the frame of the switch assembly. Most important are two circumferentially shaped slots **15** and **16**. These are on the same radius as similarly shaped springs **5** and **6**. Thus, when the aperture plate **10** is relatively close to spring plate **2**, as when assembled, springs **5** and **6** pass through the slots axially when the spring plate is rotated counter-clockwise.

Element **18** is an axially actuatable ratchet wheel or gear having a diameter equal to the outer extent of springs **5** and **6**. It is positioned relatively near aperture plate **10** and is therefore engaged by the springs when these pass fully through apertures **15** and **16**. The tilt of the teeth of the ratchet wheel are such that each of the springs press upon an edge **19** diametrically opposite, when engagement occurs. Engagement occurs only in the counter-clockwise direction of rotation for the fabrication of elements **2** and **18** as shown. The slant of the teeth are such that clockwise rotation transmits no action from spring to wheel, and beyond the first position clockwise the limits of the apertures cause the springs to start to disappear to the opposite side of the aperture plate.

Shaft **1** is hollow at **23** and shaft **12** has a projection **24** which enters therein with a sliding fit to provide a two bearing support for both shafts.

In a representative embodiment the last switch position when moving in a counterclockwise direction operates the reversing switch, the position before that one places the springs in position with respect to ratchet wheel **18** such that the next counterclockwise move operates the

reversing switch, the next prior position removes the springs from the plane of the wheel, the next prior position moves the springs completely back through the aperture plate and even with the initial edges of the holes therein, and any further prior positions cause the springs to retreat from the holes, the springs being restrained in axial position by the aperture plate on the side away from the ratchet wheel. The aperture plate and/or the edges of the holes therein restrain the springs axially in each position save the first two mentioned. In these, the teeth of the ratchet take over.

Insulating wafer **20** supports the stationary contacts of the reversing switch. Insulating piece **22** fits over flattened shaft **12** with a matching hole required for turning said piece by shift **12** and rotary ring **21** is attached to piece **22**. The several radial fingers of the ring coact with stationary contacts **60**, **61** and **62** to accomplish the reversing action as will be later described.

In Fig. 2 the reversing switch is shown assembled and in elevation view with a one-wafer multicontact rotary switch. In this view detent means for positively positioning the rotary members upon the switch contacts are shown for both the reversing switch and the rotary switch. These means and the rotary switch were omitted in Fig. 1 for sake of clarity.

In Fig. 2 shaft **1** is shown provided with a manual operating knob **30**. A threaded bushing **31** is affixed to front stationary plate **32**, which latter also supports the broad leaf front detent spring **33**. Through a hole in plate **32** a steel ball **34** is urged into depressions of a rotary wavy plate **35** rigidly affixed to shaft **1**.

In known wafer switch fashion two long bolts **36** and **37** extend from front stationary plate **32** through each of the other stationary plates to bind the switch into a rigid body. Spacers **38**, **39** position insulating wafer **40** a suitable distance from the front plate. Wafer **40** is provided with one or more stationary silver or silver-plated spring contacts, such as **41**, **42**, **43** and **44**, held in place by eyelet type rivets and contacting rotor ring contact **45** of the general type more fully shown as **21** in Figs. 1 and 3. One of the stationary contacts, **44**, maintains contact with the rotor ring at all times whereas the other stationary contacts make contact with one or more radial fingers extending to a greater radius than the ring as represented at **63** in Figs. 1 and 3.

It is to be understood that several wafer assemblies may be positioned one after the other to the left of the one, **40**, shown. In any event, to the left of the last one the spring plate **2** is rigidly fastened to shaft **1**. Next, and closely adjacent, is located aperture plate **10**; this being held stationary by virtue of bolts **36** and **37** passing through holes therein and spacers **46**, **47** placed between plates **40** and **10** on the bolts.

Closely adjacent to the aperture plate is axial ratchet wheel **18**, this being rigidly mounted on shaft **12** at essentially the right end thereof. Next to the left is a stationary plate **48**, essentially the same as front plate **32**, and this is fitted with broad leaf detent spring **49**, ball **50** and wavy plate **51** as was the front plate. The second detent assembly is required to give the reversing switch a positive contact-positioning means independent of the means for the wafer switch proper. Spacers **52**, **53** locate plate **48** the necessary axial distance from aperture plate **10**.

The final stationary piece is reversing switch insulating wafer **20**, which is suitably spaced from stationary plate **48** by spacers **54**, **55**. The final rotating piece is insulating piece **22**, holding rotor ring **21**. Locking type nuts **56** and **57** rigidly hold the stationary assembly together.

Rotational stop **58**, bent out from the material of wavy plate **35** and impinging upon stop **59** bent out of front plate **32**, is preferably provided to prevent rotation beyond the "off" position. Another stop for the other rotational extreme may be similarly bent out to coact with stop **58**.

In Fig. 3 the reversing portion of the switch is shown in somewhat greater detail than in Fig. 2. Wafter **20** is

provided with a minimum of three contacts; outer radial contacts **60** and **61** and inner radial contact **62**. The former alternately make contact with one of the six radial extensions **63** while the latter is in constant contact with the inner rotor ring **21**. With six extensions **63** on the ring each of the previously described detent assemblies is to have twelve positions of stable equilibrium; i. e., each 30°.

An example of a reversing circuit is shown in Fig. 3. One terminal of a battery **64** is connected to contact **60** and the opposite terminal thereof to terminal **61**. The battery is provided with a center tap **65**, which is connected to one terminal of a load **66**, while the other terminal of the load is connected to contact **62**.

With the position of the switch shown the negative terminal of the battery is connected to terminal **67** of the load. When the reversing switch is moved one detent (30°) counterclockwise the positive terminal of the battery would be connected through terminal **60** of the switch to terminal **67** of the load.

Two more stationary contacts **68** and **69** have been shown dotted on wafer **20**. Contact **68** is shown connected for energizing a lamp **70**, in which connection the lamp lights each time one of the two polarities is used. Other auxiliary circuits may be excited as will be understood by those skilled in the art.

Similarly, other reversing functions may be accomplished by adding reversing wafers to that element of the switch. With two wafers the capability of the usual double-pole double-throw knife blade reversing switch is obtained. A motor having armature **73** and field **74** may then be reversed in rotation by reversing the connections to the field, as shown in Fig. 4.

The upper wafer assembly **21**, **60**, **61**, **62**, **63** is the same as shown in Fig. 3. Constant contact **62** is merely connected to one terminal of the field rather than to the load and the alternate contacts **60**, **61** are connected to opposite sides **75**, **76** of the power line. In the same way in the lower wafer assembly **71**, **80**, **81**, **82**, **83**, constant contact **82** is connected to the other terminal of the field and alternate contacts **80**, **81** are connected to opposite sides **75**, **76** of the power line, but in the opposite relation as shown. When the two mechanically coupled wafers are in one position the line is connected to the field in one direction and when in the next position the connection is in the opposite direction. Four wafers in the reversing element of the switch would reverse two separate circuits, and so on, as will be understood.

While we have described a preferred form of our invention supra, it will be understood that numerous variations thereof are possible and may be preferred in certain situations.

Rather than two springs **5** and **6** and corresponding holes in aperture plate **10** only one spring may be used, particularly where the switch is small or the contact pressures light. Conversely, for heavy duty service three or four springs may be used.

Switch parts are often fastened and mechanically driven in wafer switches merely by non-circular holes engaging flats (**3**) on the shafts. This allows easy assembly. In such construction an even number of springs is of advantage in symmetrically driving the parts, such as the ratchet wheel (**18**).

A radial rather than an axial spring and ratchet wheel assembly may be used. In this instance the springs become tangential, the aperture plate becomes an aperture drum and the ratchet wheel has saw-tooth instead of fan-like teeth.

Any practical number of detent positions may be used as long as the relation between that number and the number of radial contacts (**63** of Fig. 3) remains in the ratio of two to one.

Should actuation of the reversing switch in a clockwise direction be desired the direction of the free ends of springs **5** and **6** is reversed and corresponding circum-

ferential alteration of spring plate **2** with respect to aperture plate **10** in assembly.

While the wafer type of construction of the switch per se is usually preferred this may be supplanted by the known tap switch with a spring contact arm, by a drum and rolling-contact construction, or by others. We prefer positive positioning by detent assemblies but these need not be employed if careful manipulation or other means are employed to insure proper contact relation in operation.

Rather than constant contact **62** a pigtail wire connection may be made from rotative contact **21** and others. The switch characteristically is restrained from repeated revolution of the control shaft.

Fluted shafts may be used at **1** and **12** rather than flats for driving the rotative members, in which case the holes in elements **2**, **18**, **22**, etc. are also fluted to match.

Likewise, battery **64** may be replaced with an equivalent power supply, or by two power supplies connected in series at tap **65**, or instead of a power source the outputs of a push-pull amplifier or other electronic circuit may be substituted.

Specific embodiments have been shown and described in this specification to most fully set forth how this invention may be practiced. Wide variations may be taken from these embodiments and changes in details, size and proportions made without departing from the spirit and domain of our invention.

Having thus fully described our invention and the manner in which it is to be practiced, we claim:

1. In a rotary switch, a reversing element comprising an operating shaft, a spring attached to said operating shaft, an essentially stationary member positioned to deflect said spring, said member having a hole through which said spring may pass upon rotation of said operating shaft, a second shaft, a toothed circular piece connected to said second shaft adjacent said member on the side thereof opposite said spring, a movable reversing switch conductor mechanically connected to said second shaft, and stationary reversing switch contacts coacting therewith; the recited structure proportioned so that rotation of said operating shaft in one direction urges said spring through said hole and revolves said toothed piece incrementally to circuitually reverse said reversing element.

2. In a rotary switch, a circuit reversing element comprising an operating shaft, two cantilever springs having axial tension attached to said operating shaft, a stationary plate having two elongated holes bearing against said springs, said holes located in said plate to allow said springs upon rotation of said operating shaft to pass through said holes, a second shaft colinear with said operating shaft, a ratchet wheel having axially disposed teeth coaxially attached to said second shaft and positioned adjacent said plate on the side opposite said springs, detent means coacting with said second shaft, a rotative contact attached to said second shaft, and a plurality of fixed contacts at least one thereof positioned to engage said rotative contact only at each rotative position determined by said detent means, said springs, plate and ratchet proportioned to advance said rotative contact by one of said plurality of fixed contacts each time said springs engage said ratchet wheel.

3. The circuit reversing element of claim 2 in which a second rotative contact and a second plurality of fixed contacts coactive therewith are circumferentially aligned with those correspondingly first mentioned and are adapted for actuation by said second shaft.

4. In a bidirectionally operable rotary switch a unidirectionally operable reversing element comprising an operating shaft common to said switch and to a strip spring attached thereto, an essentially stationary member positioned adjacent said spring, said member having a hole located to pass said spring upon rotation of said operating shaft, a second shaft, a circular toothed piece

attached to said second shaft adjacent said member on the side thereof opposite said spring, a rotative reversing conductor having radial contacts attached to said second shaft, and plural reversing element stationary contacts coacting with said conductor and circumferentially spaced half the separation of said radial contacts; the recited structure proportioned so that rotation of said operating shaft in one direction urges said spring through said hole and revolves said toothed piece an amount equal to the spacing of said stationary contacts to reverse the conductive relation of the contacts of said reversing element and also so proportioned that rotation of said operating shaft in the opposite direction does not revolve said toothed piece.

5. In a bidirectionally operable rotary switch a unidirectionally operable reversing switch means comprising a manually operable first shaft, said shaft adapted to actuate said rotary switch, a cantilever spring-like strip attached to said first shaft, an essentially stationary member positioned adjacent said strip, said member having a hole located to pass said strip upon rotation of said first shaft in one direction, a second shaft, a circular toothed element attached to said second shaft adjacent said member on the side thereof opposite said strip, a conductive ring having contacts, said ring mechanically attached to said second shaft, said contacts aligned with each second tooth of said toothed element, and at least two stationary contacts coacting with said ring contacts, said stationary contacts aligned with successive teeth of said toothed element; the recited structure proportioned and angularly related such that rotation of said first shaft in one direction urges said strip through said hole and revolves said toothed element one tooth, and so that rotation of said first shaft in the opposite direction does not revolve said toothed element.

6. In a rotary switch the combination of bidirectionally and unidirectionally operable elements comprising a plural position rotary switch element having a rotational stop, an operating shaft common to both said elements, an axially deformable spring attached to said operating shaft, a member axially adjacent said spring having an aperture positioned to allow said spring to pass through said member upon rotation of said operating shaft in one direction, a second shaft, a toothed piece attached to said second shaft adjacent said member, a second rotary switch element attached to said second shaft having operational positions angularly equal to the pitch of the teeth of said toothed piece; said stop, spring, member and piece proportioned and angularly related such that rotation of said operating shaft in said one direction engages said spring and a tooth of said toothed piece a circumferential distance equal to the pitch of one tooth thereof in advance of the limit of travel imposed by said stop, and rotation to said stop moves said second rotary switch element one operational position in the said one direction, while rotation of said operating shaft in the reverse direction is ineffectual in moving said second element.

7. In combination, a rotary multiposition switch and a rotary reversing switch actuated in common therewith comprising, a common operating shaft, a rotary multiposition switch means adapted for operation by said operating shaft, a spring attached to said operating shaft, an essentially stationary member bearing against said spring having a hole through which said spring may pass upon rotation of said operating shaft, a second shaft, a ratchet connected to said second shaft adjacent said member on the side thereof opposite said spring, movable reversing switch contacts connected to said second shaft, and stationary reversing switch contacts coacting therewith; said spring, member and ratchet so related that rotation of said operating shaft in one direction passes said spring through said hole and revolves said ratchet an increment to effect circuitual reversal of said reversing switch.

8. In combination, a rotary multiposition switch and a

rotary reversing switch comprising a common operating shaft, a rotative contact connected thereto, more than two fixed contacts positioned to coact with said rotative contact to form a multiposition switch; a cantilever spring driven by said operating shaft, a stationary plate having a hole positioned to axially deform said spring and to urge said spring through said hole upon rotation of said operating shaft, a second shaft colinearly disposed with respect to said operating shaft, a multitoothed gear attached to said second shaft positioned on the side of said plate opposite said spring, detent means coactive with said second shaft to urge it to discrete positions, a second rotative contact attached to said second shaft, a plurality of further fixed contacts positioned to coact with said second rotative contact at each said discrete position; said spring, plate and gear proportioned to advance said second rotative contact one said further fixed contact each time said spring engages said gear.

9. In combination, a rotary multi-position switch and a rotary reversing switch comprising a first operating shaft, a first rotative contact attached to said first shaft, more than two fixed contacts positioned to engage said first rotative contact to form a multi-position switch; two cantilever springs tangentially connected to said first shaft, stationary plate having two circumferentially shaped holes positioned to allow said springs upon rotation of said first shaft to pass through said holes, a second shaft colinear with said first shaft, an axially toothed ratchet coaxially positioned adjacent said plate on the side opposite said springs and attached to said second shaft, detent means coacting with said second shaft, a second rotative contact attached to said second shaft, a plurality of fixed contacts at least one thereof positioned to engage said second rotative contact at each rotative position determined by said detent means; said spring, plate and ratchet proportioned to advance said second rotative contact by one of said plurality of fixed contacts each time said springs engage said axially toothed ratchet.

10. In combination, a rotary multi-position switch and a rotary reversing switch comprising a first operating shaft, more than two fixed contacts positioned to engage said first rotative contact to form a multi-position switch; two cantilever springs tangentially connected to said first shaft, a stationary plate having two circumferentially shaped holes positioned to allow said springs upon rotation of said first shaft to pass through said holes, a second shaft colinear with said first shaft, an axially toothed ratchet coaxially positioned adjacent said plate on the side opposite said springs and attached to said second shaft, detent means coacting with said second shaft, second and third rotative contacts attached to said second shaft, two pluralities of fixed contacts, at least one of each of said pluralities positioned to engage said second and said third rotative contacts at each rotative position determined by said detent means; said springs, plate and ratchet proportioned to advance said second and third rotative contacts by one of said pluralities of fixed contacts each time said springs engage said axially toothed ratchet.

11. In a rotary switch system, in combination, manually operable circuit reversing means comprising an operating shaft, a spring attached to said operating shaft, a stationary member positioned to deflect said spring, said member having a hole through which said spring may pass upon rotation of said operating shaft, a second shaft, a toothed circular piece connected to said second shaft adjacent said member on the side thereof opposite said spring, a movable reversing switch conductor mechanically connected to said second shaft, said conductor having radially extending contacts, two stationary contacts coacting with said radially extending contacts, said stationary contacts circumferentially spaced half the distance between adjacent radially extending contacts, a third stationary contact in continuous contact with said movable conductor; a load circuit, said third contact connected to said load circuit, means having opposite electrical polarities, one of each of said two stationary contacts connected to one polarity of said means, rotation of said movable conductor an amount equal to the spacing between said stationary contacts reversing the polarity of said means with respect to said load.

12. In a rotary switch system, in combination, a multiposition bidirectionally operative rotary switch and a unidirectionally operative rotary reversing switch comprising a rotary switch having contacts, an operating shaft common to both said switches, an axially distended spring attached to said common shaft, an essentially stationary member positioned axially adjacent to said spring, said member having an arcuate hole located to pass said spring upon rotation of said common shaft in one direction, a second shaft colinearly related to said common shaft, an axially toothed gear attached to said second shaft adjacent said member on the side opposite said spring, a detent spring, detent means coacting with said detent spring and attached to said second shaft, said detent means restraining said second shaft in a number of rotational positions equal to the number of teeth on said gear, rotative reversing switch contacts connected to said second shaft spaced two teeth apart with respect to said gear, stationary reversing switch contacts coacting with said rotative contacts spaced half as far apart as said rotative contacts; the recited structure proportioned and angularly related such that rotation of said common shaft one contact of said rotary switch in one direction urges said spring through said hole sufficiently far to revolve said gear one tooth, and also so that rotation of said common shaft in the opposite direction does not revolve said gear.

13. A compound switch having two mechanical operative routines with a single operating shaft comprising, a bidirectionally rotatable multi-position switch structure, a stop to limit the rotation of said operating shaft, an axially deformable spring attached to said operating shaft, an essentially stationary member located axially adjacent said spring, said member having an aperture positioned to pass said spring axially through said member upon rotation of said operating shaft in one direction, a second shaft colinearly positioned with respect to said operating shaft, an axially toothed piece attached to said second shaft adjacent said member on the side thereof opposite said spring, movable contacts connected to said second shaft having a spacing equal to a multiple of the tooth spacing of said piece, essentially stationary contacts coacting with said movable contacts having a spacing equal to a different multiple of the tooth spacing of said piece; the recited structure proportioned and circumferentially related such that rotation of said operating shaft in one direction to the circumferential position limited by said stop revolves said piece one tooth and that rotation of said operating shaft in the opposite direction does not revolve said piece.

14. In combination, a rotary multi-position wafer switch and a rotary wafer reversing switch comprising an operating shaft, a first rotative contact attached to said operating shaft, a wafer having more than two fixed contacts positioned to engage said first rotative contact to form a multi-position wafer switch, first detent means coacting with said operating shaft, stops coacting with said operating shaft; a plate attached to the end of said operating shaft, two cantilever leaf springs attached to said plate adjacent the periphery thereof and deformed to project axially therefrom, a stationary aperture plate positioned to stress said springs and having two arcuate apertures located in the path of said springs adapted to pass said springs axially through said aperture plate upon rotation of said operating shaft in one direction, a second shaft colinear with said operating shaft, an axially toothed ratchet coaxially positioned adjacent said aperture plate on the side opposite said springs and rigidly attached to said second shaft, second detent means coacting with

said second shaft, a second rotative contact having half as many radially extending contacts as the detents in said detent means, a wafer having a plurality of fixed contacts at least one thereof positioned to engage a contact of said rotative contact at each rotative position determined by said second detent means; said springs, aperture plate and ratchet axially related to each other and to said stops that said springs advance said ratchet

one detent position upon rotation of said operating shaft from the detent position of said first detent means next to last to the last detent position as determined by said stops, said springs so related as to not alter said ratchet position upon opposite rotation of said operating shaft away from said last detent position.

No references cited.