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Frost et al.

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[54] **MULTIDIRECTIONAL SWITCH WITH UNIVERSALLY PIVOT ACTUATOR FOR ACTIVATING PLURAL CIRCUITS**

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[52] **U.S. Cl.** ..... **200/6 A;** 200/17 R; 200/153 K

[51] **Int. Cl.**[2] **H01H 21/24;** H01H 25/00

[58] **Field of Search** ..... 200/1 R, 1 A, 1 TK, 1 U, 200/5 R, 6 R, 6 A, 6 B, 6 BA, 6 BB, 6 C, 17 R, 18, 244–247, 250, 275, 329, 335, 336, 339, 153 K; 74/471 R, 471 XY

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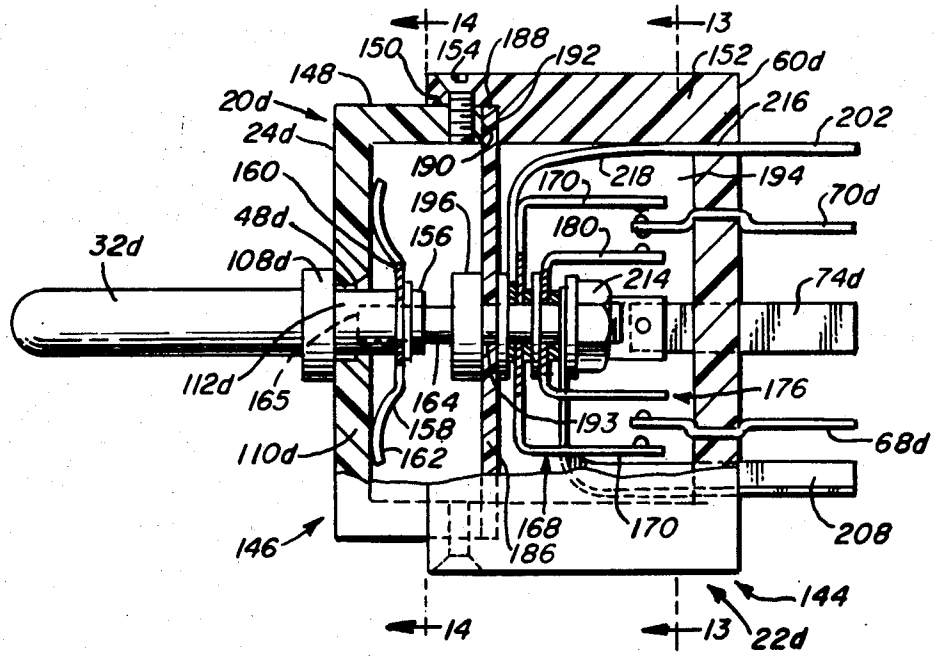
Primary Examiner—James R. Scott

Attorney, Agent, or Firm—Barnes, Kisselle, Raisch & Choate

[57] **ABSTRACT**

A pair of radially spaced concentric electric terminal rings are mounted on a lever having a universal joint fulcrum mount on a housing. The lever-terminal assembly is biased toward a centered position. A plurality of pairs of contact rods have free ends which project into the annular space between the rings. Movement of the lever in different directions effects circuit-closing contact of alternate rings with (1) Any single pair of contacts for reversing the direction of a motor connected with the pair or (2) A plurality of pairs of the contacts for simultaneously reversing the direction of a plurality of motors. In one embodiment each ring is replaced by a group of four terminal fingers spaced 90° apart and supported by a diaphragm.

71 Claims, 15 Drawing Figures



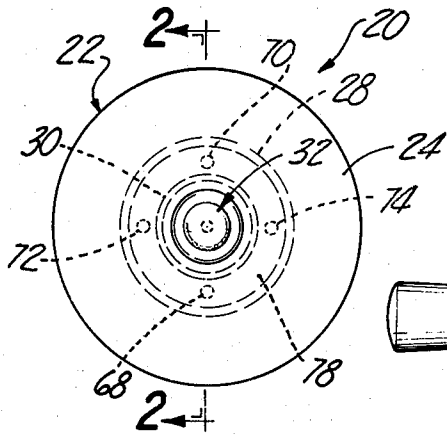


Fig-1

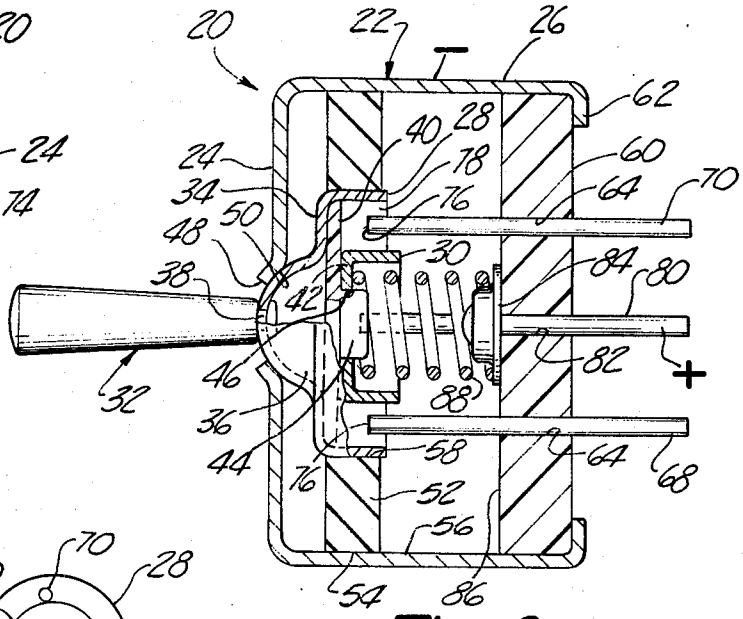


Fig-2

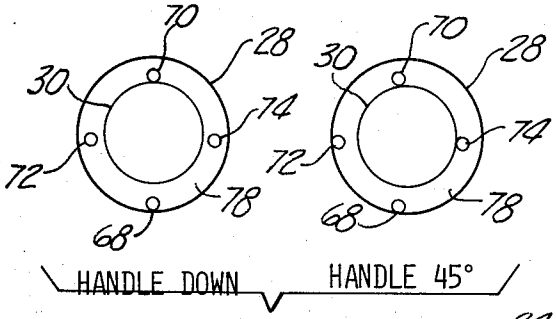


Fig-3

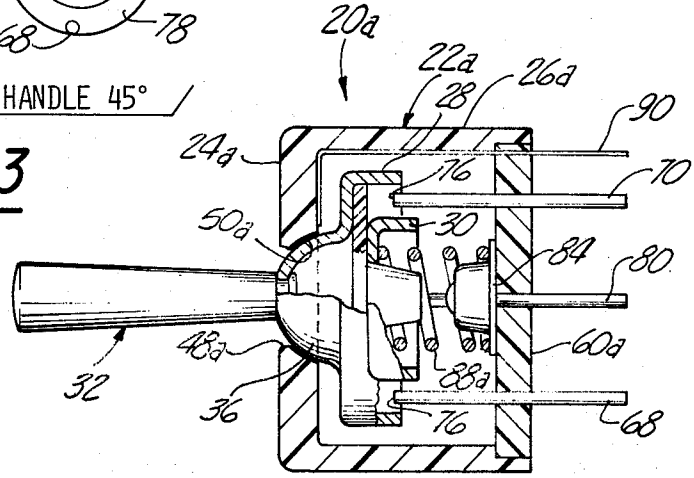


Fig-4

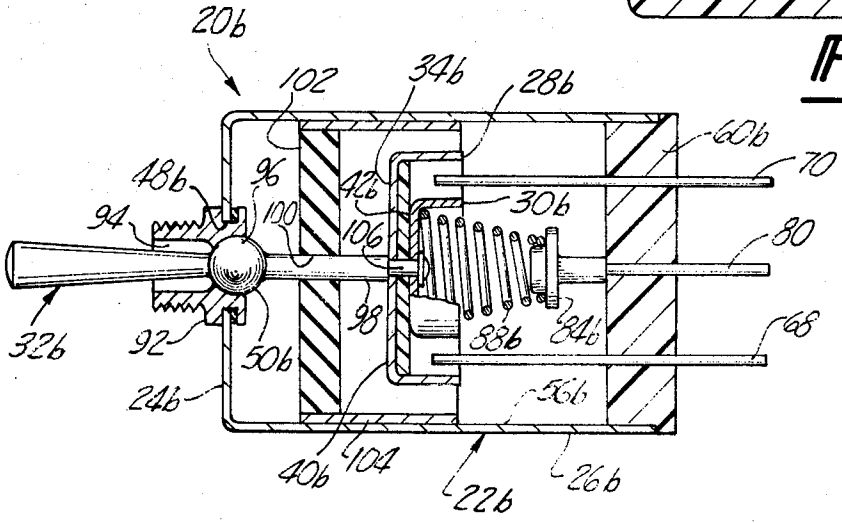


Fig-5

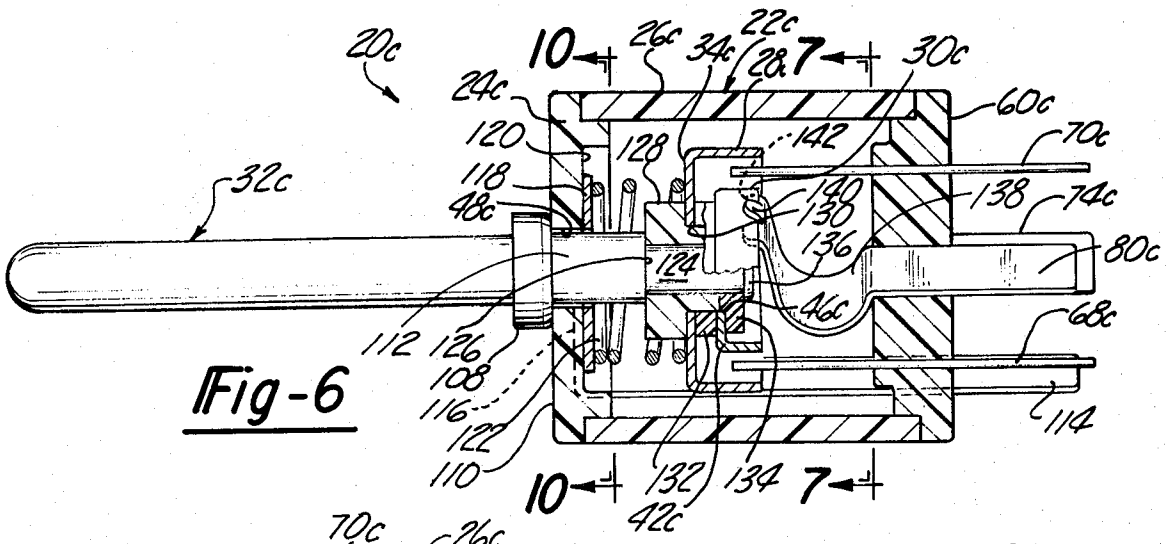


Fig-6

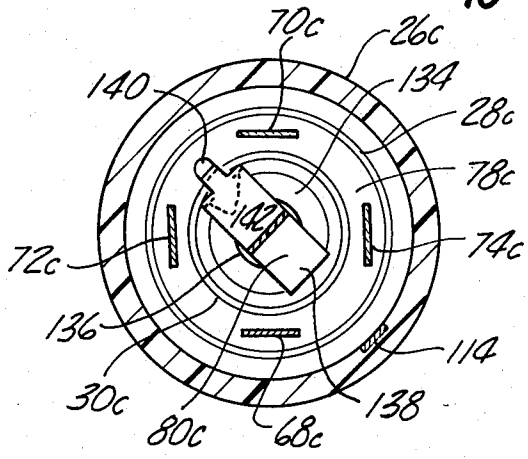


Fig-7

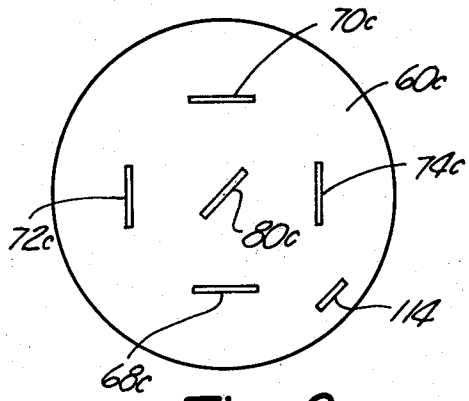


Fig-8

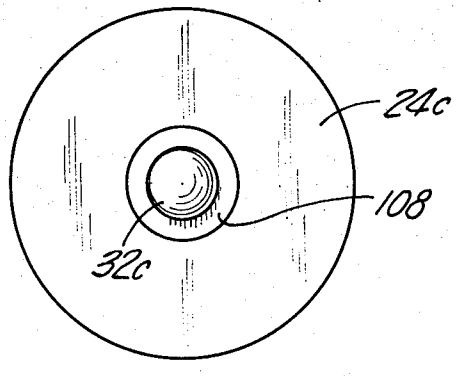


Fig-9

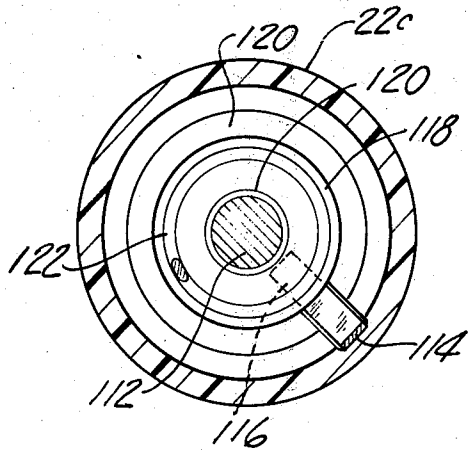
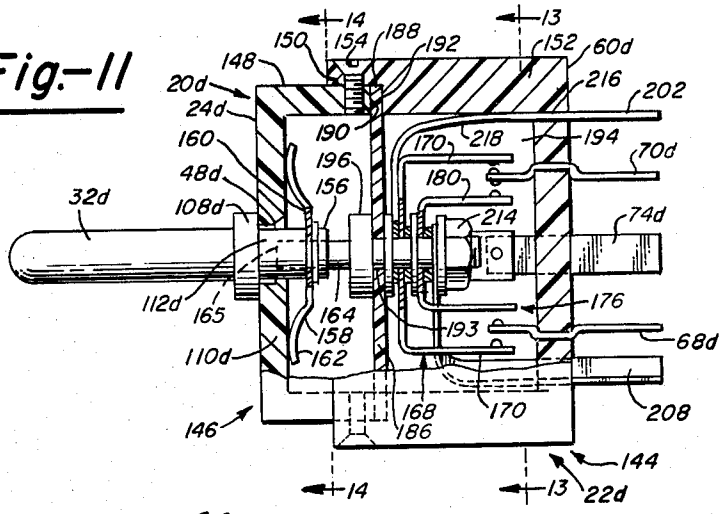


Fig-10

Fig-11



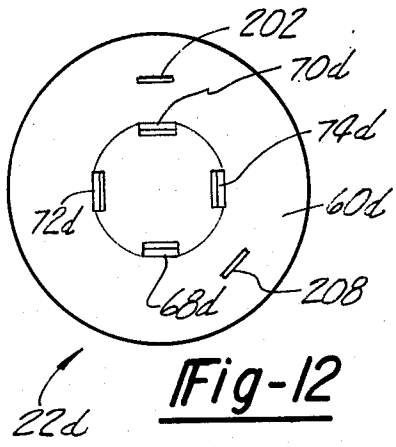


Fig-12

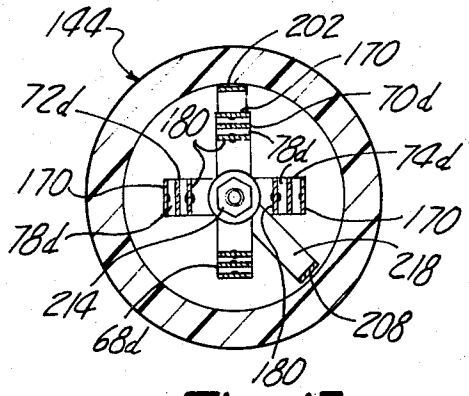


Fig-13

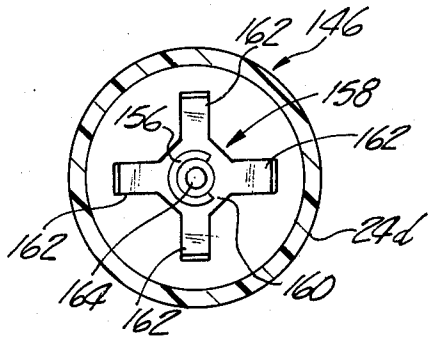


Fig-14

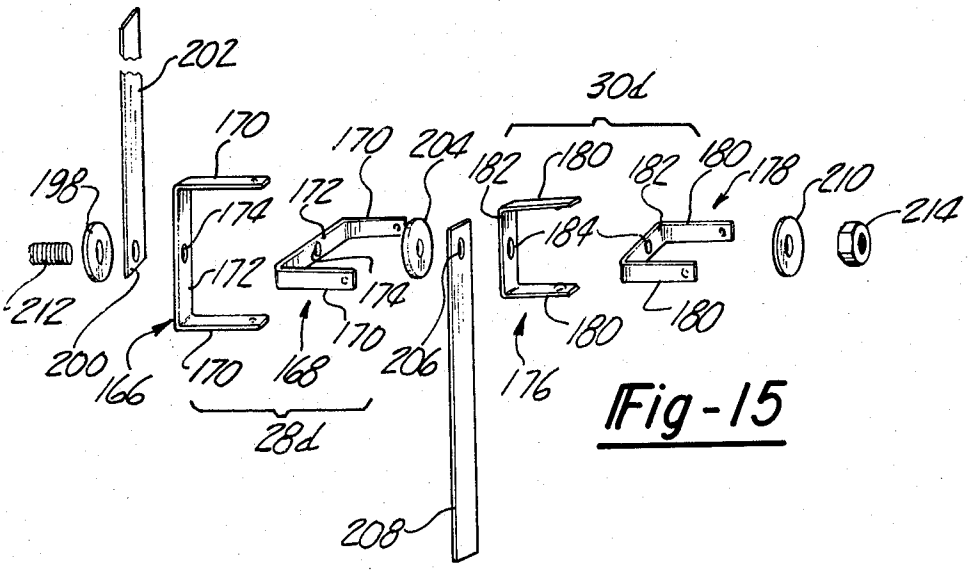


Fig-15

MULTIDIRECTIONAL SWITCH WITH UNIVERSALLY PIVOT ACTUATOR FOR ACTIVATING PLURAL CIRCUITS

This invention relates generally to a switch of the type used in circuitry for operating a motor selectively in forward and reverse directions. More particularly, the invention involves a switch which can be manipulated to a number of positions for selectively controlling the direction of operation of one of a plurality of direct current motors or simultaneously controlling the direction of operation of at least a pair of direct current motors.

To reverse the direction of operation of a direct current motor it is necessary to reverse the positive and negative connections to the motor windings. This requirement has lead to mechanical complications in conventional switches particularly those used for selective control of a plurality of motors. Such complications add to the cost and bulk of the conventional switch and tend to decrease its reliability and durability.

The object of the present invention is to provide a switch structure for controlling the direction of operation of a plurality of direct current motors individually or simultaneously, the switch structure being improved in simplicity, compactness, reliability, durability and low cost over conventional switch structures. Certain embodiments of the invention are illustrated in the accompanying drawings wherein:

FIG. 1 is an end elevational view of a switch according to the invention with parts shown in phantom to illustrate structural details.

FIG. 2 is an enlarged scale sectional view on line 2—2 of FIG. 1.

FIG. 3 is a composite diagrammatic view illustrating two typical positions of the switch.

FIG. 4 is a view similar to FIG. 2 but illustrating a modified form of the invention.

FIG. 5 is a view similar to FIG. 2 but illustrating another modified form of the invention.

FIG. 6 is a view similar to FIG. 2 but illustrating another modified form of the invention.

FIG. 7 is a sectional view on line 7—7 of FIG. 6.

FIG. 8 is an elevational view of one end of the switch shown in FIG. 6.

FIG. 9 is an elevational view of the opposite end of the switch shown in FIG. 6.

FIG. 10 is a sectional view on line 10—10 of FIG. 6.

FIG. 11 is a view generally similar to FIG. 2 but illustrating another modified form of the invention.

FIG. 12 is a reduced scale end elevational view of the switch shown in FIG. 11.

FIG. 13 is a reduced scale sectional view on line 13—13 of FIG. 11.

FIG. 14 is a reduced scale sectional view on line 14—14 of FIG. 11.

FIG. 15 is an exploded perspective view of several components of the switch shown in FIG. 11.

Shown in FIGS. 1 and 2 is a switch 20 according to the present invention. This switch has a cup-shaped housing 22 having an end wall 24 and a side wall 26. Housing 22 is made of an electrically conducting material such as steel or brass. A pair of radially spaced outer and inner terminal rings 28, 30 respectively are assembled on a lever 32 mounted on end wall 24. For this purpose ring 28 has a generally radial base 34 with

a central protuberance 36 secured to lever 32 as by a riveted connection 38; a disc 40 of insulating material is fitted within ring 28 against base 34 and a generally radial base 42 on ring 30 seats against disc 40, the disc having a central boss 44 which fits within a central opening 46 in base 42.

End wall 24 of housing 22 has a central opening 48 through which lever 32 extends. End wall 24 has a portion which surrounds opening 48 and which is fashioned to provide a socket having a generally spherical surface 50 which faces the interior of housing 22. Protuberance 36 has a surface generally complementary to and engaged against socket surface 50. Interengaged protuberance 36 and socket 50 cooperate to form a universal joint type fulcrum between lever 32 and housing 22.

Means are provided for yieldably centering the position of lever 32 and of rings 28, 30 with respect to housing 22. In the form of the invention illustrated in FIG. 2 this means comprises a ring of elastomeric material 52 having its outer periphery 54 engaged against the interior 56 of side wall 26 and having its inner periphery 58 engaged around ring 28.

A disc 60 of nonconducting material fits within side wall 26 and forms an end wall of housing 22 opposite from end wall 24. Disc 60 is retained in place by such means as an inwardly turned flange portion 62 at the end of side wall 26.

A plurality of pairs of contact rods pass through openings 64 in end wall 60. In the illustrated form of the invention, two pairs are shown, one pair comprising rods 68 and 70, the other pair comprising rods 72 and 74. The rods are secured within openings 64 by suitable means such as an adhesive or by press fitting. The rods are generally parallel. The pairs are disposed at about 90° to each other and the rods are distributed at about 90° to each other around a common center which is generally concentric with the common center of rings 28 and 30. Each rod 68–74 has a free portion 76 which projects axially into the annular space 78 defined by rings 28, 30.

An electrical conductor 80 passes through an opening 82 in end wall 60 and is secured within the opening by such means as an adhesive or press fitting. Conductor 80 has a head 84 engaged against inner surface 86 of end wall 60. The conductor continues in a compressed coil spring 88, one end of which is engaged against head 84 and the other end of which is engaged against base 42 of ring 30. In addition to serving as a conductor, spring 88 urges protuberance 36 into engagement against socket surface 50.

If desired, the portions of rods 68–74 and conductor 80 projecting exteriorly of end wall 60 may serve as prongs for insertion into a female electrical plug. Current of one sign, say negative, is furnished to ring 28 through housing 22, protuberance 36 and ring base 34. Current of the opposite sign is furnished to ring 30 through conductor 80, head 84, spring 88 and ring base 42.

In use, housing 22 and conductor 80 are connected to a source of direct current; rods 68, 70 are connected with one direct current electric motor and rods 72, 74 are connected with a second direct current electric motor. When no control pressure is applied to lever 32, elastomer ring 52 centers control rings 28, 30 and free ends 76 of rods 68–74 are out of contact with rings 28, 30 as shown in FIGS. 1 and 2.

To operate one motor individually in one direction, nominally forwardly, lever **32** is pushed downwardly causing protuberance **36** to pivot in socket **50** thereby shifting rings **28, 30** upwardly against the bias of ring **52.** This causes the uppermost portion, as the drawings are viewed, of ring **30** to engage contact rod **70** and causes the lowermost portion of ring **28** to engage rod **68** to close the circuit to one of the motors. This position of the parts is represented in the left view of FIG. **3.**

To reverse the direction of this motor lever **32** is pushed upwardly which shifts the rings in a downward direction so that the uppermost portion of ring **28** engages rod **70** and the lowermost portion of ring **30** engages rod **68.** To deactuate the motor, lever **32** is released and elastomer ring **52** returns terminal rings **28, 30** to the centered position of FIG. **2** wherein the rings are out of engagement with rod ends **76** thereby opening the circuit to the motor.

Similarly, to operate the other motor individually in opposite directions, lever **32** is pushed to the right or left as FIGS. **1** and **3** are viewed to bring opposite portions of rings **28, 30** into engagement alternatively with rods **72, 74.** To deactuate this motor, lever **32** is released permitting elastomer ring **52** to center terminals **28, 30** for opening the circuit thereto.

To operate both motors simultaneously in one direction, nominally forwardly, lever **32** is pushed downwardly and to the left causing rings **28, 30** to swing upwardly and to the right. This causes upper and right hand portions of ring **30** to engage rods **70** and **74** and causes lower and left portions of ring **78** to engage rods **68** and **72** as illustrated in the right hand view of FIG. **3.** To operate both motors simultaneously in the reverse direction, lever **32** is pushed upwardly and to the right causing upper and right hand portions of ring **28** to engage rods **70** and **74** and causing lower and left hand portions of ring **30** to engage rods **68** and **72.** To deactuate both motors lever **32** is released allowing elastomer ring **32** to center rings **28, 30** to open the circuits to the motors.

Forward and reverse simultaneous operation of the motors can also be achieved by pushing lever **32** downwardly and to the right and upwardly and to the left as will be apparent from the drawings. Lever **32** can be moved directly from one angular position in which both motors are simultaneously operated to an adjacent annular position in which one motor only is operated and vice versa.

The modified form of the invention shown in FIG. **4** is in general similar to the form of FIGS. **1** and **2** and analogous elements, where modified, are indicated by the same reference numerals with the suffix *a.* In this switch, **20***a*, housing **22***a* is made of an electrical nonconducting material such as a plastic. Current is furnished to protuberance **3**[illegible] by an electrical lead **90** which passes through a wall of the housing such as end wall **60***a.* This lead has an annular portion which provides the surface **50***a* of the socket in end wall **24***a.* Surface **50***a* is in electrical contact with protuberance **36.** Elastomer ring **52** is omitted and instead spring **88***a* is utilized to bias the assembly of lever **32** and terminal rings **28, 30** toward centered position wherein they are out of engagement with rods **68–74.** End wall **60***a* may be secured to side wall **26***a* by such means as an adhesive. The portion of lead **90** outside of the housing may be utilized as a prong for insertion into a female electrical plug. Switch **20***a* functions in a manner similar to that of switch **20.**

The form of the invention illustrated in FIG. **5** is in general similar to the forms described above and analagous elements, where modified, are given identical reference numerals suffixed *b.* In this form of the invention switch **20***b* has a housing **22***b*, is made of an electrically conducting material and a fitting **92** is mounted within opening **48***b* in end wall **24***b.* This fitting has a central opening **94,** a portion of which is generally spherical and provides socket surface **50***b.* Lever **32***b* has a ball portion **96** pivotally engaged within socket **50***b.* The lever has a shank portion **98** which passes through an opening **100** in a disc **102** of elastomer material attached at its outer periphery to a sleeve **104** engaged against the interior **56***b* of side wall **26***b.* Bases **34***b* and **42***b* of terminal rings **28***b*, **30***b* and insulation disc **40***b* are mounted on lever shank **98** by a rivet connection **106.**

Elastomer disc **102** yieldably centers shank **98** and terminal rings **28***b*, **30***b* in the off position of the switch. The centering force can be adjusted by varying the axial position of sleeve **104** and disc **102** in housing **22***b.* To diminish the centering force disc **102** is moved closer to ball **96** and to increase this force the disc is moved further from ball **96.** Functioning of switch **20***b* is similar to that of switches **20** and **20***a.*

The form **20***c* of the switch shown in FIGS. **6–10** is in general similar to the forms described above and analagous elements, where modified, are identified by reference numerals identical to the above forms suffixed *c.* In switch **20***c* housing **22***c* is formed of nonconducting material such as a plastic. End walls **24***c* and **60***c* are formed separately from side wall **26***c* and are secured thereto by such means as an adhesive. Lever **32***c* has an enlargement **108** which is engaged against the outer surface **110** of end wall **24***c* around opening **48***c.* Lever portion **112** which passes through opening **48***c* has a diameter smaller than opening **48***c.* Lever **36***c* can thus be rocked universally with respect to housing **22***c* about the fulcrum joint provided by interengagement of enlargement **108** and wall end **110.**

A lead **114** is provided for furnishing current to outer terminal ring **28***c.* This lead passes through one wall of housing **22***c* such as wall **60***c* and has a portion **116** which is in electrical contact with a washer **118** which surrounds lever portion **112** and is engaged against the inner surface **120** of end wall **24***c.* A compressed coil spring **122** has one end engaged against washer **118** and its other end engaged against base **34***c* of ring **28***c.* This spring serves to urge enlargement **108** against wall end **110,** to bias rings **24***c*, **30***c* and lever **32***c* toward centered relation and to conduct current from washer **118** to ring **28***c.*

Lever **38***c* has a portion **124** of reduced diameter which adjoins lever portion **112** at a shoulder **126.** A sleeve **128** of insulating material surrounds lever portion **124** and abuts shoulder **126.** Sleeve **128** also abuts the outer surface of ring base **34***c* as shown and has a portion of reduced diameter which fits within central openings **130** and **46***c* respectively in ring bases **34***c* and **42***c.* These bases are insulated from each other by a washer **132** and a washer **134** of insulating material which seats against the inner side of base **42***c.* Shank portion **124** extends through sleeve **138,** the terminal ring bases and washers **132, 134.** Lever portion **124** has a head **136** at its end which cooperates with shoulder

126 to secure these elements in assembled relation on the lever.

Contact rods 68*c*–74*c* have a thin wide flat configuration rather than the round configuration illustrated in the above described forms of the invention. As best shown in FIG. 7, the thin dimension of the rods is in a direction radial of rings 28*c*, 30*c* while the long dimension of each rod extends in a direction which is chordal with respect to annular space 78*c* between the rings. The purpose of this feature is described below. Conductor 80*c* also has thin wide strap-like configuration and the portion of this conductor within housing 22*c* is bent to provide a partial loop or bight 138. The free end of bight 138 is slit and deformed to provide a central finger 140 and two flanking fingers 142. Finger 140 engages the rim of terminal ring 30*c* and is hooked over the outer periphery of this ring. Inner fingers 142 engage a radially inner surface portion of ring 30*c*. The purpose of this arrangement is described below. Bight portion 138 is compressed so that fingers 140, 142 remain firmly engaged against ring 30*c*.

In general, switch 20*c* functions in a manner similar to that of the switches described above. When lever 30*c* is pressed straight downwardly or upwardly or straight horizontally in one direction or the other as the drawings are viewed, one or the other of two motors is operated in forward or reversed directions. When lever 32*c* is pushed downwardly and to the right or left and upwardly to the right or left both motors are operated simultaneously in one direction or the other.

However, because of the increased width and chordal extent of contact rods 68*c*–74*c*, rings 28*c* and 30*c* will make contact with the rods upon movement through a distance which is appreciably smaller than the distance required for the rings to make contact with the round rods of switches 20, 20*a* and 20*b*. Moreover, the thin flat wide configuration of the contact rods and of conductor 114 as well adapts them more readily as prongs for insertion into conventional female electrical plugs.

Fingers 140, 142 insure that the end of conductor bight 138 will remain in electrical contact with ring 30*c* during movement of this ring in any direction. Bight 138 faces in a direction which is angled between two of the contact bars such as bars 70*c*, 72*c* as shown. This orientation of the bight assures adequate clearance with respect to other elements of the switch as it follows movement of ring 30*c*.

It is believed that the form of the invention shown in FIGS. 6–10 will be preferred over the FIGS. 1–6 forms in commercial exploitation of the invention.

The form 20*d* of the switch shown in FIGS. 11–15 is in general similar to the forms described above and analagous elements where modified are identified by reference numerals identical to the above forms suffixed *d*. In switch 20*d* housing 22*d* is formed by two generally cup-shaped sections 144, 146 made of a nonconducting material such as plastic. Section 146 has a side wall 148 which fits within a socket 150 in the side wall 152 of section 144. The overlapping side wall portions are secured together by suitable means such as adhesive or screws 154 as shown.

Sections 144, 146 respectively define end walls 60*d* and 24*d* of switch housing 22*d*. Lever 32*d* has an enlargement 108*d* which engages the outer face 110*d* of end wall 24*d*. Lever portion 112*d* which passes through opening 48*d* in end wall 24*d* has a diameter smaller than opening 48*d*. Lever 32*d* can thus be rocked universally with respect to housing 22*d* about the fulcrum joint provided by interengagement of enlargement 108*d* and wall end 110*d*.

Lever portion 112*d* is grooved for reception of a snap ring 156. A 4-pronged leaf spring 158 has a central portion 160 engaged against snap ring 156 and has axially offset feet 162 engaged against the inner surface of end wall 24*d*. The prongs of spring 158 are stressed between ring 156 and wall 24*d* and yieldably bias lever 32*d* in its centered position. Lever 32*d* has an axial extension which comprises a pin 164 secured to lever portion 112*d* by such means as press fitting or cementing into a socket 165.

The outer terminal rings 28 (*a*, *b*, *c*) of the previously described forms of the invention are replaced by a pair of U-shaped metal straps 166, 168 each having a pair of fingers 170 interconnected by a base portion 172 each apertured at 174. Similarly, inner contact terminals 30 (*a*–*c*) are replaced by a pair of U-shaped metal straps 176, 178 having fingers 180 and an interconnecting base portion 182 apertured at 184.

Terminal bases 172 extend laterally of each other with their apertures 174 aligned and terminal bases 182 extend laterally of each other with their apertures 184 aligned. In the assembled relation of the terminals described more fully below, fingers 170 and 180 are disposed in spaced apart pairs to define spaces 78*d* into which the end portions of metal contact straps 68*d*–74*d* project.

A thin, flexible, moisture impervious diaphragm 186 of such a material as nylon extends diametrically across the interior of housing 22*d*. The diaphragm has peripheral edge portions 188 opposite faces of which are clamped between shoulders 190, 192 on interfitting side wall portions 148, 152 respectively to form a substantially moisture tight seal. The diaphragm has a central opening 193 (FIG. 11) through which pin 164 projects into a chamber 194 defined by the diaphragm and housing section 144. Pin 164 has an enlargement 196 engaged axially against the outer face of the diaphragm.

The portion of pin 164 projecting into chamber 194 passes successively through a washer 198, an opening 200 in a conductor 202, aligned terminal openings 174, an insulating washer 204, an opening 206 in a conductor 208, aligned terminal openings 184 and a washer 210. The free end of pin 164 is threaded as at 212 and a nut 214 thereon clamps the parts in assembled relation on pin 164 between enlargement 196 and the nut. Enlargement 196 and washer 198 by snug engagement against opposite faces of diaphragm 186 form substantially moisture proof seals.

Conductors 202, 208 are relatively thin flexible straps of metal and pass through openings 216 in end wall 60*d* to the exterior of housing 22*d*. The conductors are affixed within openings 216 by suitable means such as cement or press fitting which also provides a substantially moisture proof seal between chamber 194 and the exterior of the housing. Contacts 68*d*–74*d* are similarly provided with substantially moisture proof seals with respect to the openings through which they project from chamber 194 to the housing exterior. As in the previous described forms of the invention the outwardly projecting portions of the terminals and contacts provide prongs for insertion into a female electrical plug.

Conductor 202 furnishes current of one sign to outer terminal 28*d* formed by elements 166, 168 and conductor 208 furnishes current of the opposite sign to the

inner terminal **30***d* formed by elements **176, 178.** The two terminals are insulated from each other by washer **204.** Pin **164** is made of a nonconducting material such as nylon. Terminal fingers **170, 180** and contacts **68***d*–**74***d* may be provided with electrical contact pads as illustrated. Each conductor **202, 208** has a free portion **218** between pin **164** and opening **216** which is curved for a purpose to be described.

In general, switch **20***d* functions in a manner similar to that of the switches described above. When lever **32***d* is pressed straight downwardly or upwardly or straight horizontally in one direction of the other as the drawings are viewed, one or the other of two motors is operated in forward or reverse directions. When lever **32***d* is pushed downwardly and to the right or left or upwardly and to the right or left both motors are operated simultaneously in one direction or the other.

Diaphragm **186** flexes to facilitate these movements of the lever and of terminals **28***d*, **30***d*. The diaphragm is resilient and tends to support the terminals in their centered, "off" position. Leaf spring **158** yieldably biases the terminals toward their off position. The curved free portions **218** of conductors **202, 208** flex readily to permit their inner end portions to follow movements of pin **164** and the terminals.

The seals provided at the peripheral and central portions of the diaphragm and between end wall **60***d* and contact straps **68***d*–**74***d* and conductors **202, 208** renders substantially moisture proof the chamber **194** which contains the contacting portions of terminals **28***d*, **30***d* and the contact straps. Thus, this form of switch is preferred where it is to be used in relatively wet or moist environments such as on boats and outdoor equipment.

Switches according to the invention can be utilized in any mechanism which requires reversing operation of a plurality of motors simultaneously or individually. One example of such a mechanism is a motorized control for positioning the front seat of an automobile. One motor could be used to raise and lower the seat while another motor could be used to move the seat forwardly and rearwardly. Both motors could be used to effect such movements simultaneously. Another example is a motorized control for a search light. One motor could be used to swing the search light vertically, the other motor to swing the search light horizontally, and both motors to swing the search light in intermediate angled directions.

In the illustrated forms of the invention the pairs of contact rods are stationary while the terminal rings or fingers are mounted for universal movement for engagement therewith. It will be appreciated that similar functioning of the switch could be effected by mounting the pairs of rods on a universally movable member, the terminal rings or fingers remaining stationary. Generally, it is within the invention to provide the terminals and contact rods with any mounting by which the above described relative movement therebetween can be effected.

The specific switches disclosed herein are designed for relatively small motors, for example motors operating on a maximum current of one ampere. However, the switch can be designed for controlling larger motors.

A typical switch according to the present invention is very simple and compact, being less than half the size, for example, of FIG. 4 of the drawings. The switches are very inexpensive with little to go wrong with them and simple to operate for effecting single or simultaneous operation of motors by manipulation of a single lever.

We claim:

1. Switch structure for controlling the direction of operation of a plurality of electric motors which comprises,

support means, a plurality of pairs of electric contacts on said support means,

the contacts of each pair being adapted to be connected in current conducting relation to an electric motor,

a control member on said support means selectively movable in a plurality of directions relative to said pairs of contacts,

a positive and a negative terminal mounted for movement with said member and being electrically insulated from each other,

conductors on said support means electrically connected with said terminals and being adapted for connection with a source of electric current,

each of said terminals having a portion adjacent to but spaced from each of said contacts in one position of said control member,

first and second of said portions of each of said positive and negative terminals being engageable respectively with alternate ones of one pair of said contacts responsive to movement of said member in first and second directions with respect to said one position,

third and fourth of said portions of each of said positive and negative terminals being engageable respectively with alternate ones of another pair of said contacts responsive to movement of said member in third and fourth directions with respect to said one position,

said first and third portions being engageable respectively with the contacts of said one pair and other pair responsive to movement of said member in a fifth direction with respect to said one position,

said second and fourth portions being engageable respectively with the contacts of said one pair and other pair responsive to movement of said member in a sixth direction with respect to said one position.

2. The structure defined in claim **1** wherein said portions of said positive and negative terminals are located adjacent opposite sides of the respective contacts.

3. The structure defined in claim **2** wherein said first and second directions are generally opposite linear directions and said third and fourth directions are generally opposite linear directions.

4. The structure defined in claim **3** wherein the lines of said linear directions are angled to each other.

5. The structure defined in claim **4** wherein said fifth and sixth directions are angled to each other and to said lines.

6. The structure defined in claim **4** wherein said lines are substantially perpendicular to each other and said fifth and sixth directions are angled to said lines at about 45°.

7. The structure defined in claim **2** wherein one of said terminals is disposed within a space defined by lines extending between said contacts, the other of said terminals being disposed outside of said space.

8. The structure defined in claim **7** wherein said lines define a substantially square-section and said contacts are disposed at the corners thereof.

9. The structure defined in claim 1 wherein one of said terminals is disposed substantially concentrically within the other.

10. The structure defined in claim 9 wherein said portions of the inner and outer of said terminals are arranged in spaced apart opposed pairs distributed around the common center of said terminals, each of said contacts projecting into the space between a said opposed pair.

11. The structure defined in claim 10 wherein said portions extend generally parallel to an axis through said common center, said contacts having free end portions which project generally axially into said spaces.

12. The structure defined in claim 11 wherein said terminals have bases which extend laterally of said axis and which are mounted on said member, said bases being provided with flanging adjacent their edges to provide said terminal portions.

13. The structure defined in claim 12 wherein said terminals have the shape of cups, the bottoms of which comprise said bases, said cups having side walls which form said flanging, said side walls extending continuously around said common center, portions of said side walls forming said terminal portions.

14. The structure defined in claim 11 wherein said terminals have bases which extend laterally of said axis and which are mounted on said member, said bases being provided with a plurality of fingers which form said terminal portions.

15. The structure defined in claim 14 wherein each of said terminals comprises a pair of generally U-shaped elements, each element having a base portion flanked by said fingers, said base portions of each element being interengaged and extending laterally of each other.

16. The structure defined in claim 1 wherein said control member comprises a lever having a universal joint fulcrum mount on said support means,

said terminals comprising a pair of substantially concentric radially spaced rings mounted on said lever, circumferentially spaced portions of said rings forming said terminal portions,

said contacts comprising rods having free end portions which project into the space between said rings.

17. The structure defined in claim 16 wherein said lever is yieldably secured in said one position by resiliently distortable means on said support means.

18. The structure defined in claim 17 wherein said resiliently distortable means comprises a body of elastomeric material engaged with said support means and with a part of the assembly comprised of said lever and terminals.

19. The structure defined in claim 18 wherein said body of elastomeric material is engaged around the outer of said rings.

20. The structure defined in claim 18 wherein said body of elastomeric material is engaged around a portion of said lever.

21. The structure defined in claim 17 wherein said rings have generally radial bases mounted on said lever, said resiliently distortable means comprising a coil spring stressed between said support means and one of said bases.

22. The structure defined in claim 21 wherein said coil spring comprises a portion of one of said conductors.

23. The structure defined in claim 21 wherein said one ring is said inner ring.

24. The structure defined in claim 21 wherein said one ring is said outer ring.

25. The structure defined in claim 16 wherein said rings have generally radial bases which are mounted on said lever, said terminals being insulated from each other by insulating material between said bases.

26. The structure defined in claim 25 wherein at least one of said conductors includes a stressed spring having a portion urged into engagement against one of said terminals.

27. The structure defined in claim 26 wherein said one terminal is the inner of said terminals.

28. The structure defined in claim 27 wherein said spring is a coil spring one end of which is engaged against said base of the inner of said rings.

29. The structure defined in claim 27 wherein said spring has the form of a curved strap having a free end portion engaged against the inner of said rings.

30. The structure defined in claim 26 wherein said one terminal is the outer of said terminals.

31. The structure defined in claim 30 wherein said spring is a coil spring one end of which is engaged against said base of the outer of said rings.

32. The structure defined in claim 25 wherein said support means comprises a housing which has a side wall and two end walls, said joint comprising interengaged means on said lever and one of said end walls, said rods being supported by the other of said end walls and projecting to the exterior of said housing.

33. The structure defined in claim 32 wherein one of said conductors comprises a coil spring compressed between the base of one of said rings and a said end wall, said joint means being urged toward interengagement by said spring.

34. The structure defined in claim 33 wherein said spring is compressed between the base of said outer ring and said one end wall.

35. The structure defined in claim 34 wherein said spring is effective to yieldably bias said lever toward said one position.

36. The structure defined in claim 35 wherein said one end wall has an opening, said lever having a portion which extends from the interior of said housing through said opening to the exterior of said housing,

said lever having an enlargement urged against the exterior of said end wall by said spring to provide said interengagement means,

said opening having a diameter greater than that of said lever portion to facilitate universal rocking movement thereof relative to said end wall.

37. The structure defined in claim 36 wherein said free end portions of said rods are relatively narrow in a direction radial of said rings and are relatively wide in a direction chordal of the annular space between said rings.

38. The structure defined in claim 37 wherein the other of said conductors passes through said other end wall,

said other conductor having a bight shaped portion within said housing, said bight portion having a free end portion engaged against said inner ring,

said bight portion being compressed between said inner ring and said other end wall so that said free end portion thereof is urged against said inner ring.

39. The structure defined in claim 38 wherein the portion of said other conductor within said housing has

the form of a relatively wide thin strap which is bent to form said bight portion, said bight portion facing in a direction which passes between a circumferentially adjacent pair of said rods.

40. The structure defined in claim **39** wherein said free end portion is fashioned into a plurality of fingers one of which engages the rim of said inner ring and is hooked over the outer periphery of said inner ring, the other of which engages the inner periphery of said inner ring.

41. The structure defined in claim **39** wherein said rods and other conductors have generally flat strap configuration throughout their lengths from the interior to the exterior of said housing, the exterior portions of said rods and other conductors forming prongs adapted to be inserted into a female electrical plug.

42. The structure defined in claim **41** wherein said walls are made of electrically nonconductive material, said one conductor including a lead passing through a said wall and having a portion engaged between said spring and said one end wall.

43. The structure defined in claim **42** wherein said lead passes through said other end wall and defines a prong adapted for insertion into a female electrical plug.

44. The structure defined in claim **33** wherein said spring is compressed between the base of said inner ring and said other end wall.

45. The structure defined in claim **44** wherein said lever has a shank with a ball thereon, said one end wall being provided with means defining a socket having a generally spherical surface within which said ball is engaged to provide said interengaged means.

46. The structure defined in claim **45** wherein said one end wall has an opening with a fitting therein which provides said socket.

47. The structure defined in claim **46** wherein said shank passes through a body of elastomeric material which is supported around its periphery by said side wall, said elastomeric material being effective to yieldably bias said lever toward said one position.

48. The structure defined in claim **44** wherein portions of the other of said conductors comprise said one end wall, said interengaged means and a portion of said lever.

49. The structure defined in claim **48** wherein said side wall and said one end wall comprise an electrically conducting metal cup, said other end wall comprising a body of electrically nonconducting material fitted within an open end of said cup.

50. The structure defined in claim **44** wherein said one end wall is provided with a socket having a generally spherical surface, said base of said outer ring being formed to provide a protuberance having a generally spherical surface, said surfaces providing said interengaged means.

51. The structure defined in claim **50** wherein said socket has a central opening into which said lever extends for attachment to said protuberance.

52. The structure defined in claim **51** wherein a body of elastomeric material engages said side wall and the periphery of said outer ring, said elastomeric material being effective to yieldably bias said rings toward said one position.

53. The structure defined in claim **51** wherein said spring is effective to yieldably bias said rings toward said one position.

54. The structure defined in claim **50** wherein said walls are electrically nonconducting, said other conductor comprising a lead having a portion which passes through a said wall and a portion disposed between said interengaged means.

55. The structure defined in claim **33** wherein said rods and said one conductor have portions which extend to the exterior of said housing and define prongs adapted for insertion into a female electric plug.

56. The structure defined in claim **50** wherein said walls are electrically nonconducting,

said other conductor comprising a lead having a portion which passes through said other end wall and a portion disposed between said interengaged means,

said rods and conductors having portions which extend to the exterior of said housing and define prongs adapted for insertion into a female electrical plug.

57. The structure defined in claim **44** wherein said one conductor also includes a stud which passes through said other end wall, said stud having a head within said housing against which an end of said spring engages.

58. The structure defined in claim **20** wherein said body of elastomeric material is selectively longitudinally positionable relative to said lever to adjust the force on said lever necessary to distort said material.

59. The structure defined in claim **1** wherein said control member comprises a lever having a universal joint fulcrum mount on said support means, a resiliently distortable diaphragm secured to means on said support means and lever, said lever being yieldably supported in said one position by said diaphragm.

60. The structure defined in claim **59** wherein a leaf spring has a central portion secured to said lever and peripheral portions engaged against said support means, said leaf spring yieldably biasing said lever toward said one position thereof.

61. The structure defined in claim **59** wherein said support means and diaphragm cooperate to define a chamber within which said contacts and terminal portions are disposed.

62. The structure defined in claim **61** wherein said diaphragm and said means on said support means and lever have portions which are interengaged to form substantially moisture proof seals.

63. The structure defined in claim **62** wherein each of said conductors has one portion connected to follow movements of said terminals and another portion which is fixed with respect to said support means,

each conductor having a free curved length between said portions thereof which is disposed within said chamber, said length being flexible to facilitate movements of said one conductor portion.

64. The structure defined in claim **63** wherein said chamber has wall portions through which said conductors and contacts pass to the exterior thereof, and means forming substantially moisture proof seals between said wall portions and said conductors and contacts.

65. The structure defined in claim **62** wherein said support means has a pair of opposed shoulders, said diaphragm having opposite peripheral face portions engaged by said shoulders to form one of said seals.

66. The structure defined in claim **65** wherein said lever projects through a central opening in said diaphragm, and washer means on said lever engaged

against opposite face portions of said diaphragm around said opening therein form another of said seals.

67. The structure defined in claim **66** wherein said washer means which engages the face of said diaphragm outside of said chamber is substantially fixed on said lever,

said terminals having apertured base portions through which an end portion of said lever projects,

and clamp means on said end portion cooperable with said substantially fixed washer means to clamp said base portions and the other of said washer means into assembly with said diaphragm.

68. The structure defined in claim **67** wherein said end portion of said lever is threaded and said clamp means comprises a nut thereon.

69. The structure defined in claim **68** wherein each of said terminals comprises a pair of generally U-shaped elements defining fingers which are generally parallel to said lever and an interconnecting portion,

the interconnecting portions of each pair extending laterally of each other and forming said base portion of a said terminal, said fingers forming said terminal portions.

70. The structure defined in claim **69** wherein said support means comprises a housing having two parts which are fitted together, each housing part having a said shoulder so engaged against said diaphragm,

one housing part having a side wall and an end wall which cooperate with said diaphragm to form said substantially moisture proof chamber,

the other housing part having side portions adjoining another end wall spaced axially from said diaphragm and on which said lever has said universal joint fulcrum means,

a leaf spring having a central portion secured to said lever and peripheral portions engaged against said other end wall, said spring yieldably biasing said lever toward said one position thereof,

each of said conductors having one portion connected to follow movements of said terminals and another fixed portion which extends through said end wall of said chamber,

each conductor having a free curved length between said portions thereof which is flexible to facilitate movements of said one conductor portion,

said contacts passing through said end wall of said chamber, and means forming substantially moisture proof seals between said end wall of said chamber and the portions of said conductors and contacts extending therethrough.

71. Switch structure for controlling the direction of operation of a plurality of electrical motors which comprises,

support means, a plurality of pairs of electric contacts on said support means,

the contacts of each pair being adapted to be connected in current conducting relation to an electric motor,

a positive and a negative terminal on said support means and being electrically insulated from each other,

conductors on said support means electrically connected with said terminals and being adapted for connection with a source of electric current,

each of said terminals having a portion adjacent to but spaced from each of said contacts in one position thereof relative to said contacts,

control means on said support means operable to effect relative movement between said terminals and said contacts in at least six different directions,

first and second of said portions of each of said positive and negative terminals being engageable respectively with alternate ones of one pair of contacts responsive to said relative movement in first and second directions with respect to said one position,

third and fourth of said portions of each of said positive and negative terminals being engageable respectively with alternate ones of another pair of contacts responsive to said relative movement in third and fourth directions with respect to said one position,

said first and third portions being engageable respectively with the contacts of said one pair and other pair responsive to said relative movement in a fifth direction with respect to said one position,

said second and fourth portions being engageable respectively with the contacts of said one pair and other pair responsive to said relative movement in a sixth direction with respect to said one position.

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