July 9, 1963 R. B. DENISON 3,097,271

ELECTRIC LIMIT SWITCH

Filed April 25, 1960 3 Sheets-Sheet 1

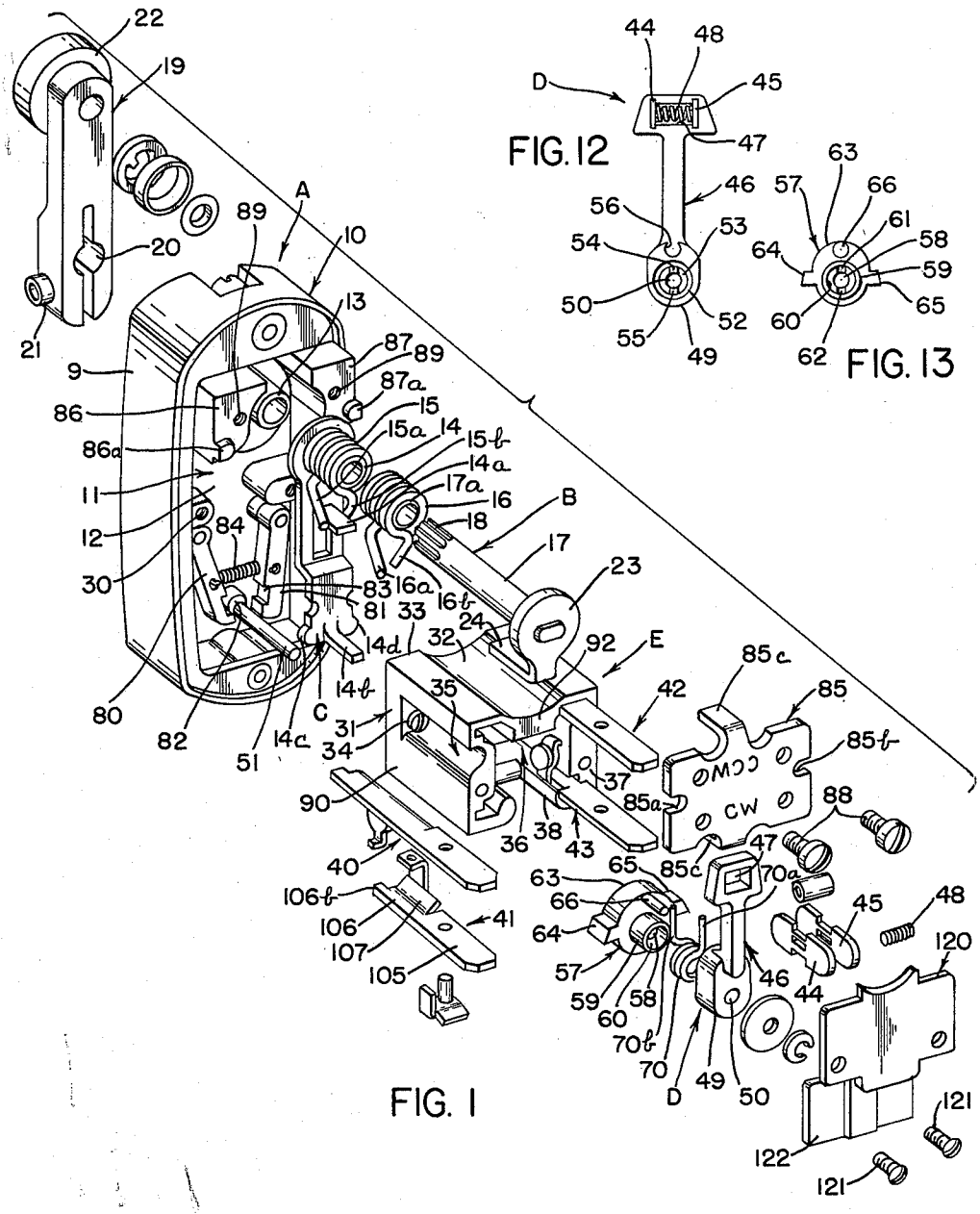

FIG. 1

FIG. 12 FIG. 13

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ELECTRIC LIMIT SWITCH

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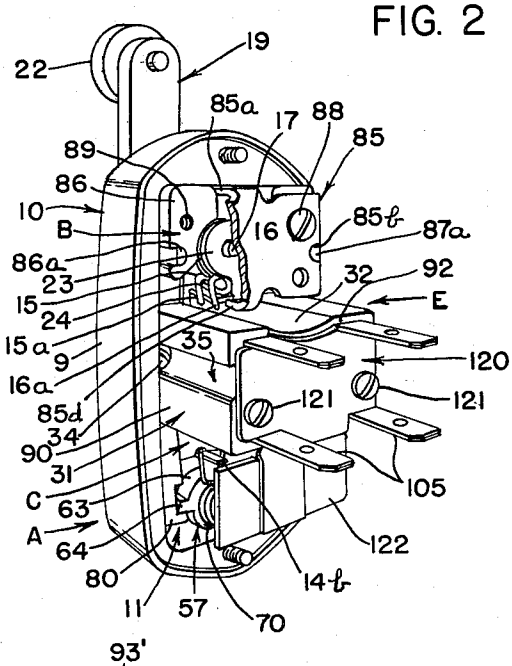
FIG. 2



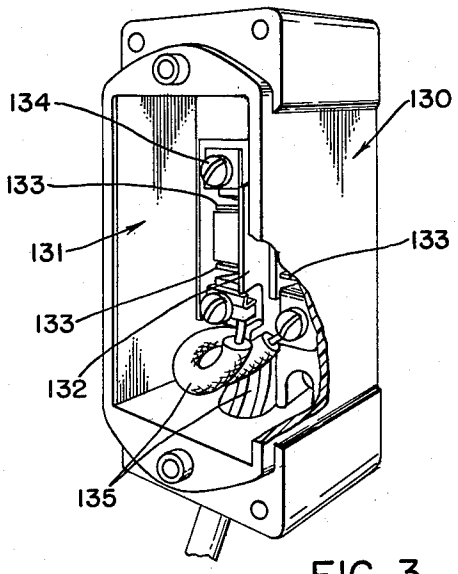


FIG. 3

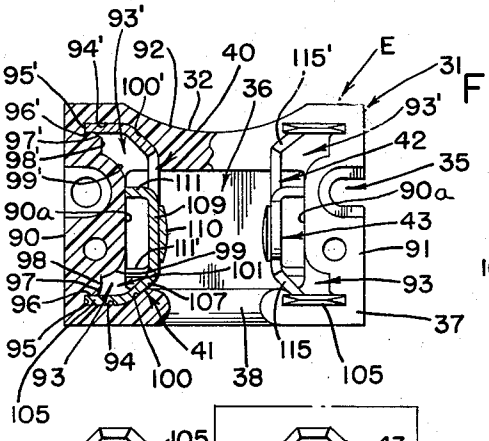


FIG. 5

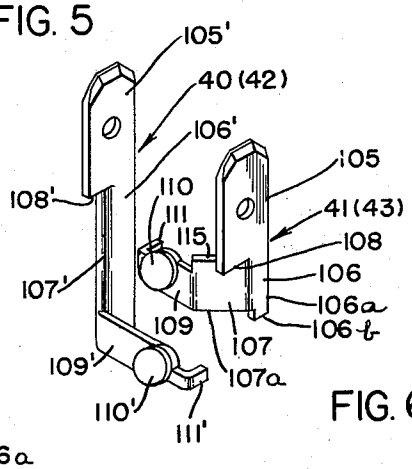


FIG. 6

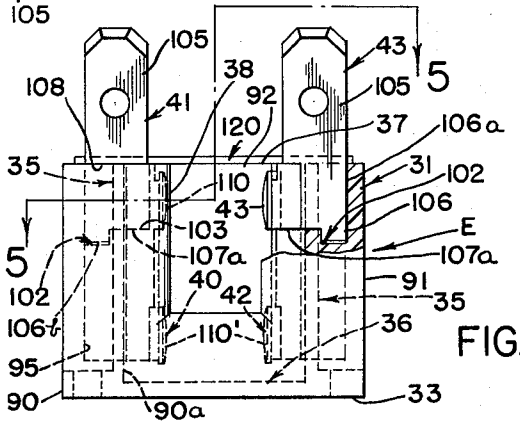


FIG. 4

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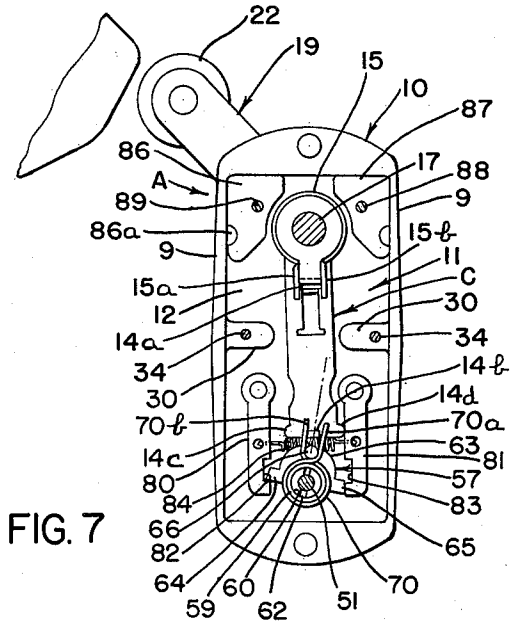

FIG. 7

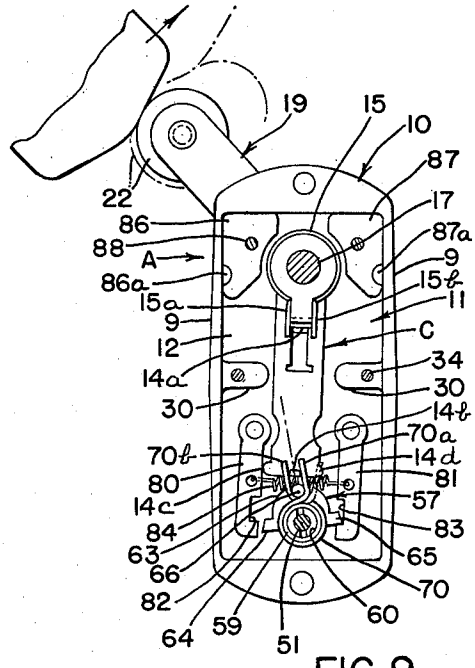

FIG. 9

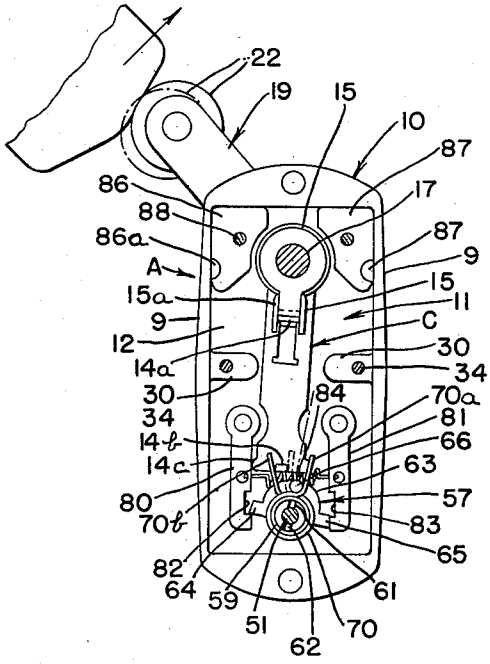

FIG. 8

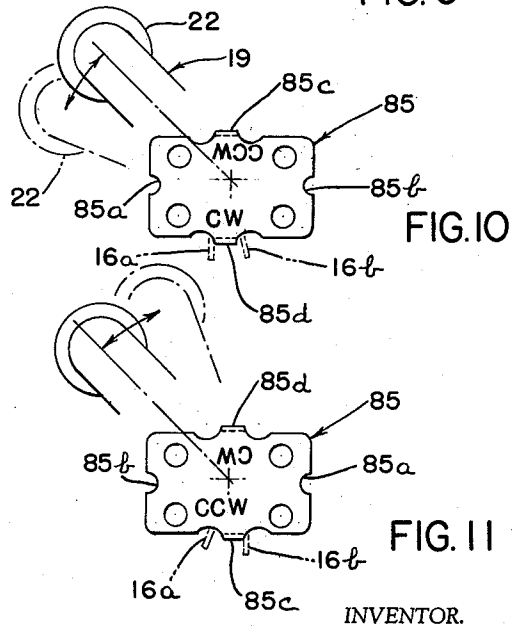

FIG. 10

FIG. 11

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ELECTRIC LIMIT SWITCH

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Filed Apr. 25, 1960, Ser. No. 27,238
8 Claims. (Cl. 200—47)

This invention pertains to the art of electrical switches and more particularly to a snap action type switch oftentimes known as a limit switch.

Limit switches of the type to which this invention pertains are for industrial use and are often required to operate for many millions of cycles over long periods of time and oftentimes under extremely adverse conditions such as the presence of machinery cutting oil, water, dirt and the like.

One of the problems in all of such switches has been to reduce the volume occupied by the switch while at the same time maintaining the high standards of dependability required by machine tool manufacturers and users. Thus, as parts become smaller, they become weaker and are unable to withstand the impact on the operating arm or rigorous forces imposed by the snap action. Also, the Underwriter's Laboratories Inc. and the National Electrical Manufacturer's Association have required for industrial switches that there must be a certain minimum linear distance along the surface of any insulating member and a minimum air space between any two electrical conductors. This limitation has made reducing the volume occupied by the switch a difficult matter.

Still another problem with limit switches of the type to which this invention pertains has been in the difficulty in assembling of new switches or in replacing worn or broken parts, particularly contacts. Heretofore it has been necessary to practically disassemble the switch in order to effect such repairs. This is expensive, time consuming and necessitates a shut-down of the machine in which the switch is mounted.

A still further problem with such switches has been the large number of small intricately shaped metal parts which are difficult to manufacture, difficult to assemble with the insulating parts, and difficult to repair.

A further problem of such switches has been in readily altering a switch so that it may operate either with a clockwise or a counterclockwise movement of the operating arm.

In accordance with the present invention, a switch of the general type referred to is provided having an improved construction whereby many of the operating parts may be formed of a molded plastic and yet have the required strength to stand up under repeated periods of operation.

Further in accordance with the invention the supporting member for the fixed electric contact members is a molded electrical insulating member forming a contact chamber open at one end and closed at the other, the contact members and the supporting member all being so arranged that the contact members may be inserted into the contact chamber all through the same open end and are held in operative relationship with each other and the movable contacts and the required minimum spacing over any insulating surface or through any air space is maintained.

Further in accordance with the invention the supporting member is mounted on a removable part of a two piece housing which also supports the switch operating mechanism and the electrical contact members are integral with blade portions extending from the supporting member in spaced parallel relationship which blades detachably engage a terminal block on the fixed part of the housing.

Further in accordance with the invention a movable contact carrier is provided comprised of a two piece molded base adapted to be pivotally mounted on a shaft, one piece having an arm supporting the contacts, the other piece having lugs to be engaged by dogs for holding the contact arm in either of two positions, the base being separable to receive an actuating spring, one piece having an integral pin to receive the force of the spring and the other piece having a socket to receive and support the free end of the pin.

The principal object of the invention is the provision of a novel and improved electrical switch which is relatively simple in construction, positive in operation, will operate for extended periods of times through many millions of cycles and which is small in size.

Another object of the invention is the provision of a plug in type limit switch wherein the plug in blades and fixed switch contacts are all integral.

Another object of the invention is the provision of a limit switch of the plug in type wherein the contacts, both fixed and movable, can be readily replaced without disassembling any other part of the switch.

Another object is the provision of a design of fixed contacts and insulating supporting member therefor wherein the fixed contacts may all be inserted into or removed from the member from the same end and are firmly held in place.

Another object is the provision of a new and improved movable contact carrier which takes up a minimum of space and has a maximum strength.

Still another object of the invention is the provision of a new and improved electrical limit switch wherein the direction of movement of the operating arm to actuate the switch may be readily reversed from clockwise to counterclockwise and vice versa.

Still another object of the invention is the provision of a new and improved electrical switch of a small size wherein the required spacing of members at different electrical potentials may be maintained while still having a switch of minimum size.

Another object is a limit switch which is readily assembled, repaired and disassembled.

The invention may take physical form in certain parts and arrangements of parts, a preferred embodiment of which will be described in detail in this specification and illustrated in the accompanying drawings which form a part hereof and wherein:

FIGURE 1 is an exploded perspective view of a switch illustrating a preferred embodiment of the invention;

FIGURE 2 is a perspective view of the portions of the switch which are carried by one housing member;

FIGURE 3 is a similar view of the portions of the switch on the other housing member;

FIGURE 4 is an elevational view of the contact block carrying the stationary contacts in the present switch;

FIGURE 5 is a view taken along the line 5—5 in FIGURE 4, partly in section and partly in plan, showing details of the arrangement of the stationary contacts and the contact block;

FIGURE 6 is an enlarged perspective view of a pair of stationary contacts which are arranged at one side of the contact block;

FIGURE 7 is a view showing the operating mechanism of the switch just prior to being actuated;

FIGURE 8 is a similar view showing the switch operating mechanism midway through its actuation;

FIGURE 9 is a similar view showing the switch operating mechanism at the end of its actuation;

FIGURE 10 is a view showing the return spring biasing plate arranged to bias the switch in one direction;

FIGURE 11 is a view showing the return spring biasing plate arranged to bias the switch in the opposite direction;

FIGURE 12 is an elevational view of the movable contact carrier in the switch; and

FIGURE 13 is an elevational view of the portion of the switch operating mechanism to which the movable contact carrier is detachably coupled.

Referring now to the drawings wherein the showings are for the purposes of illustrating a preferred embodiment of the invention only and not for the purposes of limiting same, the figures show a housing A supporting: an operating assembly B, an actuator arm C moved sidewardly by the operating shaft B through an overtravel spring arrangement; a movable contact carrier D in turn moved sidewardly by the actuator arm C through an energy storing spring arrangement and latched in either of two positions by a latching arrangement; and a fixed contact carrier assembly E.

Housing

The housing A is generally formed in two parts and includes a first housing member **10** having side walls **9** and a base wall **12** defining a generally rectangular chamber **11** which is closed by a second housing member **130** to completely enclose the switch operating mechanism to be described.

Operating Assembly

The operating assembly B includes generally an operating shaft **17** rotatably supported in a sleeve bearing **13** mounted on the base wall **12**. This shaft has a knurled portion **18** on its outer end which is disposed beyond the housing wall **12** outside the housing **10**.

An operating lever **19** is bifurcated at one end and presents a cylindrical opening **20** (FIGURE 1) which receives the knurled outer end **18** of the operating shaft **17**. A suitable locking screw **21** is provided on the operating lever **19** for clamping it tightly to the operating shaft **17**. At its opposite end the operating lever carries a roller **22**.

The sleeve bearing **13** may be of any suitable anti-friction material, such as "oilite" and extends into the chamber **11** perpendicular to the housing wall **12**.

Actuator Arm

The actuator arm C is generally elongated and has a sleeve **14** rigidly fixed thereto at one end which sleeve rotatably supports the actuator arm C on the bearing **13** inside the housing chamber **11** adjacent to the base wall **12**. Surrounding the sleeve **14** an operating spring **15** is loosely mounted. This spring **15**, in the embodiment shown, is in the form of a helical wire torsion spring, the ends of which cross and then extend radially outwardly to provide spaced end legs **15***a*, **15***b*. An offset lug **14***a* formed integral with the actuator arm C extends between these offset legs **15***a*, **15***b*. With this arrangement, it will be appreciated that a sideward force on either of the spring end legs **15***a*, **15***b*, away from the other spring end leg exerts a similar force through the spring **15** to the lug **14***a* and thence to actuator arm C.

A return spring **16** is rotatably mounted on the outside of a sleeve **17***a* on the shaft **17** just axially outwardly from the operating spring **15**. This return spring is also a helical wire torsion spring, the ends of which cross and then extend radially outwardly to provide spaced end legs **16***a*, **16***b*, the purpose of which will be described in detail hereinafter.

As its inner end, the operating shaft **17** carries a head **23** (FIGURE 1) formed with a lug **24** extending parallel to the shaft **17** in spaced relation thereto. This lug **24** extends between the end leg **16***a*, **16***b* on the return spring **16** and between the end legs **15***a*, **15***b* of the operating spring **15**. Thus when the operating shaft **17** is turned initially in either direction, such turning movement is imparted to the actuator arm C through the coupling provided by the operating spring **15**. However, when the actuating arm C reaches the limits of its movements as will appear, the operating shaft **17** may continue to turn through flexing of the spring **15** while at the same time exerting a turning force on the actuator arm C.

The actuator arm C extends longitudinally toward the opposite end of the recess **11** between a pair of shoulders **30** integral with the base wall **12** and under the contact carrier assembly E which rests on and is fastened to the shoulders **30**.

Fixed Contact Carrier Assembly

The fixed contact carrier assembly E forms an important part of the invention and includes a contact block **31** (FIGURES 1, 2 and 5) preferably of any suitable moldable insulation material, such as "nylon," "Delrin" or the like. The block is approximately rectangular in outline, having a rounded recess **32** at its periphery which faces toward, and extends parallel to, the operating shaft **17**. The inner end or base **33** of this contact block is completely closed across its entire extent. At either side the contact block has a thin lug at the base which receives a screw **34** which is threadedly received in the housing member **10** at the respective shoulder **30** thereon. Outwardly from this screw the respective side of the contact block is formed with a channel **35** to accommodate the shank of a screw driver when the contact block is being attached to the housing member **10**. It is to be noted that screw **34** is on the outside of the block **31** and the head is spaced a substantial distance from the open end of the block. The minimum surface and air distances from the screw to the electrical conductors is thus maintained. The width of the contact block **31** from side to side preferably is substantially equal to the width of the recess **11** at the shoulders **30**, so that the contact block has a snug sliding fit in this recess.

The contact block is formed with a central, generally rectangular chamber **36** (FIGURE 1) which is open at the end **37**. The side of the contact block remote from the operating shaft **17** is formed with a rectangular opening **38** which leads into this central chamber. This opening **38** accommodates a movable contact carrier, as described in detail hereinafter.

Two oppositely disposed pairs of stationary or fixed contacts **40**—**42** (FIGURE 4) are mounted on the contact block **31** at opposite sides of the central chamber **36** herein. These fixed contacts are removably mounted on the contact block **31** in a novel manner which constitutes one important aspect of the present invention and which will be described in detail hereinafter.

With the arrangement shown the surface distance on the block between members each at a different voltage is a maximum for a minimum volume of space required for the block and controls.

Movable Contact Carrier

The movable contact carrier D includes a pair of movable contacts **44**, **45** (FIGURE 1) disposed in the central recess **36** in the contact block and carried by the free end of a pivotally movable arm **46** (FIGURE 1). At its free end the contact carrier arm **46** is formed with a rectangular opening **47** which snugly, but slidably, receives the reduced diameter central portions of the respective movable contacts **44** and **45**. A coil spring **48** is engaged under compression between the central portions of the movable contacts to resiliently bias them against the opposite side edges of the recess **47**. The arrangement is such that in one extreme angular position of the contact carrier **46** the movable contact **44** bridges the fixed contacts **40** and **41** at one side of the contact block **31**, while the other movable contact **45** is spaced from the fixed contacts **42** and **43** at the opposite side of the contact blocks **31**. In the opposite extreme angular position of the contact carrier **46**, the movable contact **45** bridges the fixed contacts **42** and **43**, while the other movable contact **44** is spaced from the fixed contacts **40** and **41**.

At its pivotally mounted end, the contact carrier arm **46** is formed with an enlarged, oblong hub portion **49** (FIG-

URE 1) having a circular opening 50 therethrough. This opening receives a pin 51, which is fixedly mounted on the housing wall 12 and extends perpendicular thereto. Pin 51 extends parallel to operating shaft 17. At its inner face (toward the housing wall 12) this hub portion 49 is formed with a circular recess or groove 52 (FIGURE 12) which extends around the opening 50 concentric therewith. Between this groove 52 and the opening 50, the hub portion 49 of the contact carrier presents a solid annular portion 53. A pair of lugs or protrusions 54 and 55 are formed integral with this annular portion 53, these lugs projecting toward the housing wall 12. Preferably, these lugs are positioned diametrically opposite one another. Also, at the inner face of the hub portion 49 of the contact carrier arm 46, at the edge of this hub portion which is disposed toward the free end of the contact carrier, there is formed a recess 56 which is just slightly less than fully cylindrical. This recess 56 intersects and is open at the edge of the hub portion 49. Viewed in cross section, this recess 56 is approximately three-quarters of a full circle.

The contact carrier arm 46 forms part of a novel two-piece assembly which constitutes another important aspect of the present invention.

The other part of this two-piece assembly is a latch member designated in its entirety by the reference numeral 57 in FIGURES 1 and 13. This latch member 57 has a circular opening 58 therethrough which registers with the opening 50 in the contact carrier 46 and receives the fixed pivot pin 51. At its outer end (away from the housing wall 12) the latch member 57 presents an outwardly protruding annular hub 59 which extends toward the hub portion 49 on the contact carrier 46. This hub 59 is formed with an annular recess 60 (FIGURE 13) extending around the opening 58. This recess 60 is shaped and dimensioned to be snugly complementary to the annular portion 53 on the contact carrier. At the inner end of this recess 60 are located a pair of diametrically opposed recesses 61 and 62 which snugly receive the projecting lugs 54 and 55 on the contact carrier 46.

At its inner end (toward the housing wall 12) the latch member 57 presents a peripheral portion 63 which is substantially a half cylinder having its central axis offset laterally with respect to the opening 58. At the opposite ends of this semi-cylindrical portion 63 the latch member 57 has outwardly protruding cam segments 64 and 65.

A pin or projection 66 is formed integral with the latch member 57. This pin 66 is located just inward from the middle of the semi-cylindrical peripheral portion 63, being located at one side of the hub 59 and spaced therefrom. Pin 66 extends parallel to the axis of the opening 58. Preferably it is circular in cross-section. In the illustrated embodiment, this pin is aligned with a line centrally through the recesses 61 and 62 which receive the lugs on the contact carrier 46. The pin 66 is positioned to be received snugly in the recess 56 in the contact carrier 46 when the parts are assembled.

The free end of the actuator arm C is disposed a short distance beyond the semi-cylindrical peripheral portion 63 on the latch member 57 as shown in FIGURES 7–9. The lug 14*b* on the actuator arm C extends parallel to and a short distance away from the pin 66 on the latch member 57.

A helically wound wire spring 70 (FIGURES 1 and 7–9) encircles the hub 59 on latch member 57. The opposite ends of this spring cross and then extend outwardly to provide protruding legs 70*a*, 70*b* which are disposed on opposite sides of the pin 66 and on opposite sides of a lug 14*b* on the free end of actuator arm C. With this arrangement, when the actuator arm C is pivoted in one direction or the other, through the coupling provided by the spring 70, the latch member 57 is caused to pivot about its pivot pin 51 in the opposite direction. That is, if the actuator arm C pivots clockwise about its bearing 13, the latch member 57 pivots counterclockwise about its pivot pin 51, and vice-versa. The contact carrier 46 moves in unison with the latch member 57. As already pointed out, there is a three point coupling between the members 46 and 57 constituted by the pin 66 received in the recess 56, and the two lugs 54 and 55 received in the recesses 61 and 62. Due to this arrangement, the likelihood of breakage of any of the parts which are preferably of a molded electrically insulated material e.g. nylon or Delrin, is minimized because the stresses are distributed over three points of connection.

The arcuator arm C, its operating and return springs 15 and 16, the latch member 57 and spring 70 together constitute a switch operating mechanism to which the movable contact carrier arm 46 is detachably coupled so as to be operated thereby.

The latching dogs 80 and 81 are pivotally supported from the housing wall 12. These latching dogs are located on opposite sides of the latch member 57. The dogs at their inner faces (toward the cam member 57) are formed with rectangular grooves 82 and 83, respectively, which are adapted to receive the cams 64 and 65 on the cam member 57. A coil spring 84 is connected under tension between the respective latching dogs 80 and 81. This spring biases the free ends of the latching dogs against the latch member 57 disposed between them.

The actuator arm C presents another transverse lug 14*b* at its free end remote from its pivotal mounting on the sleeve bearing 13. On either side of this lug 14*b* the actuator arm C presents rounded side edges 14*c* and 14*d* for a purpose which will be explained hereinafter.

In the operation of this mechanism, in one extreme position of the actuator arm C shown in FIGURE 9, its rounded edge 14*c* at one side bears against the inner face of the latching dog 80 and forces the latching dog 80 outwardly toward the adjacent side wall of the housing 10. At this time the free end of the latching dog 80 is spaced laterally outward away from the cam segment 64 on the latch member 57. At the same time, the shoulder at the cam segment 65 on the opposite side of latch member 57 is seated in the recess 83 in the inner face of the other latching dog 81. In this position of the parts, the movable contact 45 carried by the contact carrier 46 bridges the fixed contacts 40 and 41 on the contact block 31.

When the operating lever 19 is displaced counterclockwise in FIGURE 9, the resultant counterclockwise movement of the actuator arm C causes its free end to move away from the latching dog 80 and into engagement with the inner face of the other latching dog 81. The rounded edge portion 14*d* on the actuator engages the inner face of the latching dog 81 and this latching dog is forced outwardly toward the adjacent side wall of the housing member 10. As the free end of the actuator arm C moves initially toward the latching dog 81, the latch member 57 remains locked against angular movement because of the locking engagement of its cam segment 65 in the recess 83 in latching dog 81. During such initial movement of the actuator arm C, its lug 14*b* forces the offset end 70*a* of spring 70 toward the latching dog 81, while the opposite offset end 70*b* of this spring remains in the same position as before, engaging the pin 66 on the now stationary latch member 57. Therefore, the spring 70 is wound up more tightly by this action and additional spring energy is stored in the spring at this time.

This action continues until the free end of the actuator arm C has moved the latching dog 81 laterally outward a sufficient distance to clear the shoulder on the cam segment 65 on latch member 57. When this action takes place, the latch member 57 now is free to turn about its pivot pin 51, and it does so due to the stored energy in spring 70. Accordingly, the latch member 57 turns clockwise as shown in FIGURE 7. The spring 84 biases the free end of latching dog 80 against the cam segment 64 on latch member 57, and this cam segment rides over the

inner face of latching dog 80 until it drops into the recess 82 therein. Such clockwise movement of the latch member 57 causes the contact carrier 46, which is coupled thereto, to move clockwise, bringing its movable contact 44 into bridging engagement with the fixed contacts 42 and 43 on the contact block 31. The switch now is in the opposite extreme switching condition, shown in FIGURE 7.

The same action takes place in reverse when the lever 19 is pivoted clockwise from the FIGURE 7 position.

Reversing Plate

A novel reversible plate 85 is provided for selectively controlling the operation of the return spring 16. As shown in FIGURE 1, this plate has recesses 85*a* and 85*b* in its opposite side edges which are positioned and dimensioned to snugly receive projections 86*a* and 87*a* on shoulders 86 and 87 which are located on opposite sides of the bearing 13 for the actuator arm C. Screws 88 are provided for detachably mounting the plate 85 on these shoulders. Screw-threaded holes 89 are formed in the shoulders 86 and 87 for receiving these screws.

At its opposite ends the plate 85 has integral depending fingers 85*c* and 85*d*, one of which is located between the offset ends 16*a* and 16*b* of the return spring 16 when the plate 85 is in place. Both fingers 85*c* and 85*d* are offset the same amount laterally from the end-to-end centerline of plate 85.

As shown in FIGURE 10, when the plate 85 is mounted with its finger 85*d* disposed between the ends of the return spring 16, it is engaged by the end 16*a* of the return spring. The laterally offset position of the finger 85*d* is such that it holds the spring end 16*a* to the left (in FIGURES 1 and 10) of the position which it would normally assume. That is, the plate 85 at this time biases the return spring 16 clockwise. This causes the operating lever to have a self-return action in a clockwise direction.

Alternatively, as shown in FIGURE 11, the plate 85 may be positioned with its finger 85*c* disposed between the ends of return spring 16. Since this finger 85*c* is offset to the other side of the axis of the return spring, it maintains the spring end 16*b* to the right in FIGURES 1 and 10. In this manner, the return spring is biased counterclockwise and the operating lever has a self-return action in a counterclockwise direction.

If the user wishes the switch to have no self-return in either direction, the plate 85 may be removed. Then, after the removal of the actuating force which operated the switch, the switch will stay in the position to which it was last actuated.

Fixed Contacts

The fixed contacts 40—43 are mounted in the contact block 31 in a novel manner which enables their ready insertion therein when the switch is being assembled or repaired. This novel mounting arrangement for the fixed contacts constitutes an important aspect of the present invention.

Referring to FIGURES 4–6, the contact block 31, viewed from its open end, presents opposite side walls 90 and 91 and a bridging wall 92, which is located opposite the opening 38. The bridging wall 92 joins the side walls 90 and 91, and the already-described recess 32 is formed in the outer face of this wall.

The side walls are provided with a plurality, one for each contact member of spaced parallel extending recesses 93 all opening through the free end of the block 31. These recesses are arranged to slidably receive and locate both longitudinally and laterally the contact members. These recesses may take a number of shapes, the arrangement shown facilitating the molding operation.

As best seen in FIGURE 5, the recess 93 is bounded by an outer flat edge 94 which extends parallel to the open side edge of the contact block, a relatively narrow end edge 95 which extends inward from the edge 94 and perpendicular thereto, a flat inner edge 96 which extends from the end edge 95 in spaced parallel relationship with respect to the edge 94, a narrow bevel edge portion 97 which extends from the inner end af the edge 96 inward at an oblique angle, a longer flat edge 98 which extends inward from the inner end of the bevel edge portion 97 and is disposed perpendicular to the edges 94 and 96, and a rounded edge 99 which extends inward from the inner end of the edge 98.

A rounded edge portion 100 extends inwardly from the laterally inward end of the outer edge 94. The edges 100 and 99 extend roughly parallel to each other, and together they define a relatively wide passageway 101 between the recess 93 and the central chamber 36 in the contact block.

The recess 93 is narrowest at its outer corner remote from passageway 101, as shown in FIGURE 1. This narrow portion of the recess 93 extends down into the block a short distance beyond the remainder of the recess, presenting a socket 102 (FIGURE 4) inward beyond the bottom wall 103 of the remainder of the recess.

The contact member 41 which fits in recess 93 has the configuration shown in FIGURES 6 and 4. This contact member comprises a flat, rectangular terminal portion 105 which is disposed outside of the contact block 31. The inner end of the terminal portion 105 is joined integrally to an elongated, narrower flat segment 106 which extends co-planar with the terminal portion 105 and constitutes a continuation of the latter. The width and thickness of the segment 106 are such that it has a snug fit between the walls 94 and 96 of the recess 93 in the contact block, with the outer edge 106*a* of segment 106 engaging the wall 95. At its lower end the segment 106 terminates in a projection 106*b* which has a snug fit in the socket 102.

A flat segment 107 is joined integrally to the inner edge of the segment 106 and extends therefrom at an angle approximately equal to the angle between the edges 100 and 94 of the recess 93. From Figure 6 it will be apparent that the angularly disposed segment 107 is offset from the inner end of the terminal portion 105, so that the inner edge 108 of the terminal portion 105 constitutes a shoulder for engagement with the end of the contact block when the contact member 41 is inserted into the recess 93, as shown in FIGURE 4. The lower edge 107*a* of the segment 107 in FIGURE 6 is positioned to engage the bottom wall 103 of the recess 93 in the contact block when the contact member 41 is positioned therein, as shown in FIGURE 4.

At the inner end of the segment 107 there is a flat segment 109 joined integrally thereto and extending perpendicular to the segment 106. An electrical conctact surface in the form of a button 110 is mounted on the segment 109. Obviously the button may be eliminated.

At the inner end of the segment 109 beyond the contact element 110 the contact member presents an inturned segment 111 which extends perpendicular to the segment 109 and parallel to the segment 106. The end of this segment 111 is positioned to engage the inner face 90*a* of the side wall 90 of the contact block when the contact member 41 is inserted therein.

The dimensions and the disposition of the various segments of the contact member 41 are such that it is snugly seated in the contact block when positioned therein. The engagement of the segment 111 with the inner face 90*a* of the side wall 90 of the contact block causes the segments 106 and 107 of the contact member to be forced snugly against the respective walls 94 and 100 of the recess 93 in the contact block. Preferably, the contact block is of a material having good electrical insulating qualities. The contact member is inserted into the contact block from the upper end in FIGURE 4, with the segment 106 being received between the walls 96 and 94, the segment 107 engaging the wall 100 and the segment 111 engaging the inner face 90*a* of the contact block side wall 90. The contact member is inserted until the inner edge 107*a* of the segment 107 engages the inner wall 103

of the recess in the contact block and the shoulder **108** engages the outer end of the contact block,. The projection **106***b* on the contact member seats in the recess **102**. When so positioned, the contact member is snugly seated in the recess and is prevented from turning therein due to its engagement with the walls of the recess.

The other contact member **40** of the pair at the left side of the contact block in FIGURES 4 and 5 is essentially a mirror image of the contact member **41**, except that it is substantially longer. The corresponding parts of the contact member **40** are designated by the same reference numerals as used for the contact member **41**, with a "prime" subscript added. From FIGURE 6 it will be apparent that the segments **106'**, **107'**, and **109'** of the contact member **40** are longer than the correspondingly numbered segments of the contact member **41**.

The recess in the contact block which receives the contact member **40** is substantially a mirror image of the recess **93** which receives the contact member **41**. This recess is designated in its entirety by the reference numeral **93'** in FIGURE 5. The corresponding walls of recess **93'** are designated by the same reference numerals as those of recess **93**, with a "prime" subscript added. Recess **93'** is formed at the corner between the side wall **92** and the end wall **90** of the contact block. The depth of recess **93'** is greater than that of recess **93** to an extent corresponding to the greater length of its contact member **40**.

The arrangement is such that the contact button **110'** on the contact member **40** is disposed inwardly and directly in line with the contact button **110** on the contact member **41**. Obviously, the contact member **40** must be inserted in its recess **93'** before the contact member **41** is inserted in its recess **93**. The contact member **40** fits snugly in its recess **93'** in the same manner that the contact member **41** fits in its recess **93**, as already described in detail.

At the opposite side of the contact block the contact members **42** and **43**, which are exact mirror images of the contact members **40** and **41**, respectively, are received in recesses in the contact block which are exact mirror images of the recesses **93'** and **93**, respectively.

With the arrangement described each of the contact members may be readily assembled on the contact block by sliding entrance through the open ends of the recesses. And, when in position, is snugly retained against lateral displacement.

A retaining plate **120** of suitable insulation material is provided (FIGURE 2). This retaining plate is fastened to the outer edge of the contact block **31** by screws **121** which extend only into the block **31** and engages the outer edges **115**, **115'** of the segments **107**, **107'** to positively retain the members **40**—**43** in place.

As best seen in FIGURES 1 and 2, the plate **120** has integral therewith an offset portion **122** which overlies the pivoted end **49** of lever **46**, the cam **57** and the cam-engaging ends of the latch arms **80** and **81**. This prevents wires from interfering with the operation of the mechanism.

The second housing member **130** is adapted to be mounted on a fixed support and has a rectangular chamber **131** of approximately the same size as the chamber **11** in the housing member **10**. A terminal block **132** of suitable insulating material is mounted in the recess **131**. Four terminals **133** are seated in the terminal block **132**. Each of these terminals has a U-shaped extremity which presents closely spaced, confronting legs between which the projecting terminal **105** of the corresponding fixed contact is adapted to be slidingly received. Each terminal **132** also has a fastening screw for connection to a lead-in-wire **135**. Each lead-in-wire **135** is completely separate from the first housing member **10** or any of the parts thereon.

With this arrangement, when the two halves **10** and **130** of the switch housing are assembled together, the projecting terminals **105** of the fixed contacts engage and make electrical contact with, the respective terminals **133**, thereby electrically connecting the fixed contacts in the switch to the lead-in wires **135** which are connected in the external circuit.

When it becomes necessary to inspect or repair the working parts of the switch, it is necessary only to take apart the two halves **10** and **130** of the switch housing. This automatically disconnects the fixed contacts **40**—**43** in the switch from the lead-in wires. Thus, there is no need to disconnect the lead-in wires themselves from the switch terminals. Also, such taking apart of the halves of the switch housing does not disturb any of the operating parts or the lead-in wires.

With the housing disassembled, the contacts, both fixed and movable, can be quickly replaced without otherwise disassembling the switch.

From the foregoing description, taken in conjunction with the accompanying drawings, it will be apparent that the illustrated embodiment is particularly well-suited for the accomplishment of the stated objects of this invention. However, while there has been described in detail herein and illustrated in the accompanying drawings a specific, presently-preferred embodiment of this invention, it is to be understood that various modifications, omissions and refinements which depart from the disclosed embodiment may be adopted without departing from the spirit and scope of this invention.

Having thus described my invention, I claim:

1. In an electrical switch, the improvement which comprises a contact block of insulation material having a chamber therein, said contact block having side walls at opposite sides of said chamber and having an opening between said side walls which leads into said chamber, one of said side walls of the block having a single recess therein which communicates with said chamber, said chamber and said recess being open at one end of the contact block, and a stationary contact having a first portion snugly received in said recess and shaped and dimensioned to be slidably inserted into and removed from said recess, said stationary contact having a second portion disposed in said chamber and extending substantially parallel to said one side wall, said second portion spaced from said block, and said stationary contact having a leg which extends transversely from said second portion into snug engagement with said one side wall in spaced relationship to said recess, and an electrical contact surface on said second portion of the stationary contact and facing away from said one side wall of the contact block, said surface located between said recess and said leg.

2. In an electrical switch, the improvement which comprises a contact block of insulation material, said contact block having a generally rectangular chamber therein for receiving a movable contact, said contact block at the four corners of said chamber having single recesses which communicate thereat with said chamber and which are open at one end of the contact block, and four stationary contacts received individually in said recesses and extending in said chamber at two opposite sides thereof, each stationary contact having a portion which is snugly received in the corresponding recess and is slidable into or out of said recess at said open end thereof, each stationary contact also having a second portion which is disposed in said chamber and engages the respective side of the chamber in spaced relation to the respective recess, said second portion spaced from said block, and an electrical switch contact surface on said second portion of each stationary contact facing toward the interior of the chamber, said surface located between said recess and the spaced engagement of said second portion with said side, the two contact surfaces at each of said opposite sides of the chamber being spaced apart in succession from said one end of the contact block and being aligned with each other said single recesses on each side having different depths to accommodate vertical spacing of said surfaces.

3. The switch of claim 2 wherein said stationary contacts are provided with integral rigid terminals which project beyond said one end of the contact block, said terminals of each contact being substantially parallel to each other and wherein there is provided a member of insulation material which is removably attached to said one end of the contact block, said member engageable with an upwardly facing shoulder on each of said contacts and said member being snugly engaged between said terminals and additionally holding said first portions of the stationary contacts apart from each other, said member being substantially perpendicular to all of said terminals.

4. In an electric limit switch comprising a latch member pivotally mounted on a first axis, a cam shoulder on said latch member, a latching dog engageable with said shoulder to block movement of said latch member, said dog pivotally mounted on a second axis, and means for disengaging said dog from said shoulder after energy has been stored in said latch member to shift said member, the improvement comprising: an arm extending from said first axis, electrical contacts carried by said arm and spaced substantially from said first axis, a releasable means at said first axis for coupling said arm with said latch member so that said arm and member pivot in unison as said dog is disengaged from said shoulder, said releasable means including a plurality of interfitting protrusions and recesses which detachably couple said arm onto said latch member.

5. The improvement as defined in claim 4 wherein said protrusions and recesses are offset only slightly from said first axis and extends parallel to said axis.

6. In an electrical switch, the combination of a switch operating mechanism including a latch member turnable about a predetermined axis, said latch member having an axially projecting hub which at its outer end presents an annular wall extending around said axis, an annular recess inside said annular wall and a pair of recesses at the bottom of said annular recess on opposite sides of said axis, said latch member at one side of said axis presenting an integral post extending in spaced parallel relation to said hub, and a mobile contact carrier detachably coupled to said latch member, said contact carrier presenting an annular recess which snugly receives said annular wall on the hub, an annular wall inside said last-mentioned recess which is snugly received in said annular recess in the hub, and a pair of protrusions which are snugly received in said pair of recesses in the hub, and said contact carrier having a recess which snugly receives said post on the latch member.

7. In an electrical switch, the combination of a switch operating mechanism, a return spring for returning said switch operating mechanism to a preset position after it has been actuated, and a control member adapted to be mounted in one of two positions with respect to said return spring and having spaced first and second protruding portions for engagement with the return spring, said first protruding portion in one mounted position of the control member engaging the return spring and biasing the latter in one direction, said second protruding portion being disengaged from the return spring in said one mounted position of the control member, said second mounted protruding portion in a second position of the control member engaging the return spring and biasing the latter in the opposite direction, said first protruding portion being disengaged from the return spring in said second mounted position of the control member.

8. The combination of claim 7 wherein said return spring is a coil spring having its opposite ends offset transversely, said control member is a reversibly mounted plate, and said first and second protruding portions are fingers connected to and extending transversely from the plate at opposite edges thereof, said first finger being received between said transversely offset ends of the return spring in said one position of the plate, said second finger being received between said transversely offset ends of the return spring in said second position of the plate.

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