

July 13, 1965

R. D. THOMAS

3,194,898

SELECTOR SWITCHES OF THE TRIGGER ACTUATED TYPE

Filed May 28, 1962

3 Sheets-Sheet 1

Fig. 1

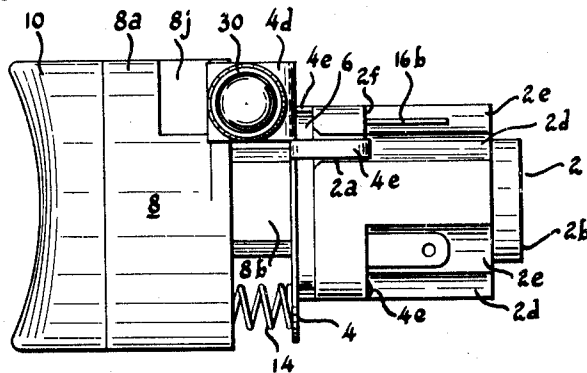


Fig. 2

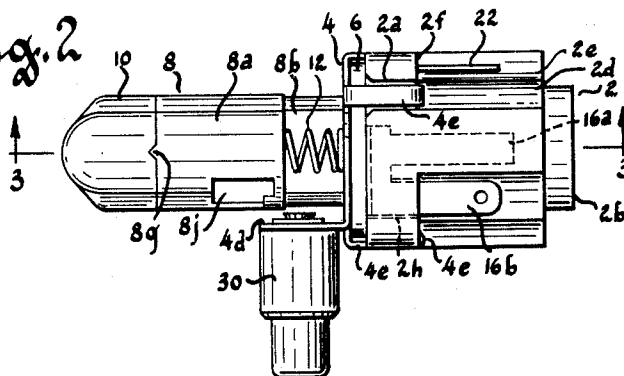
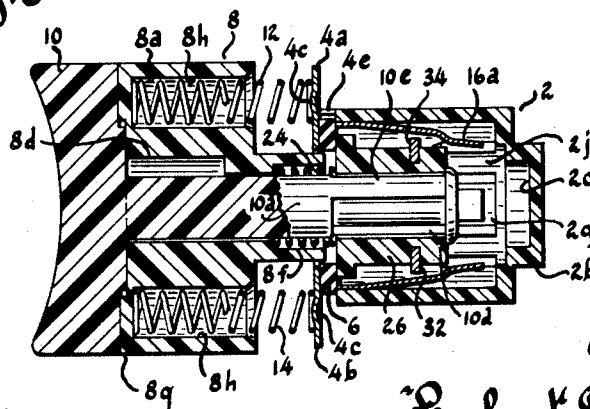


Fig. 3



Inventor
Robert D. Thomas
By *Wm. A. Antio*
Attorney

July 13, 1965

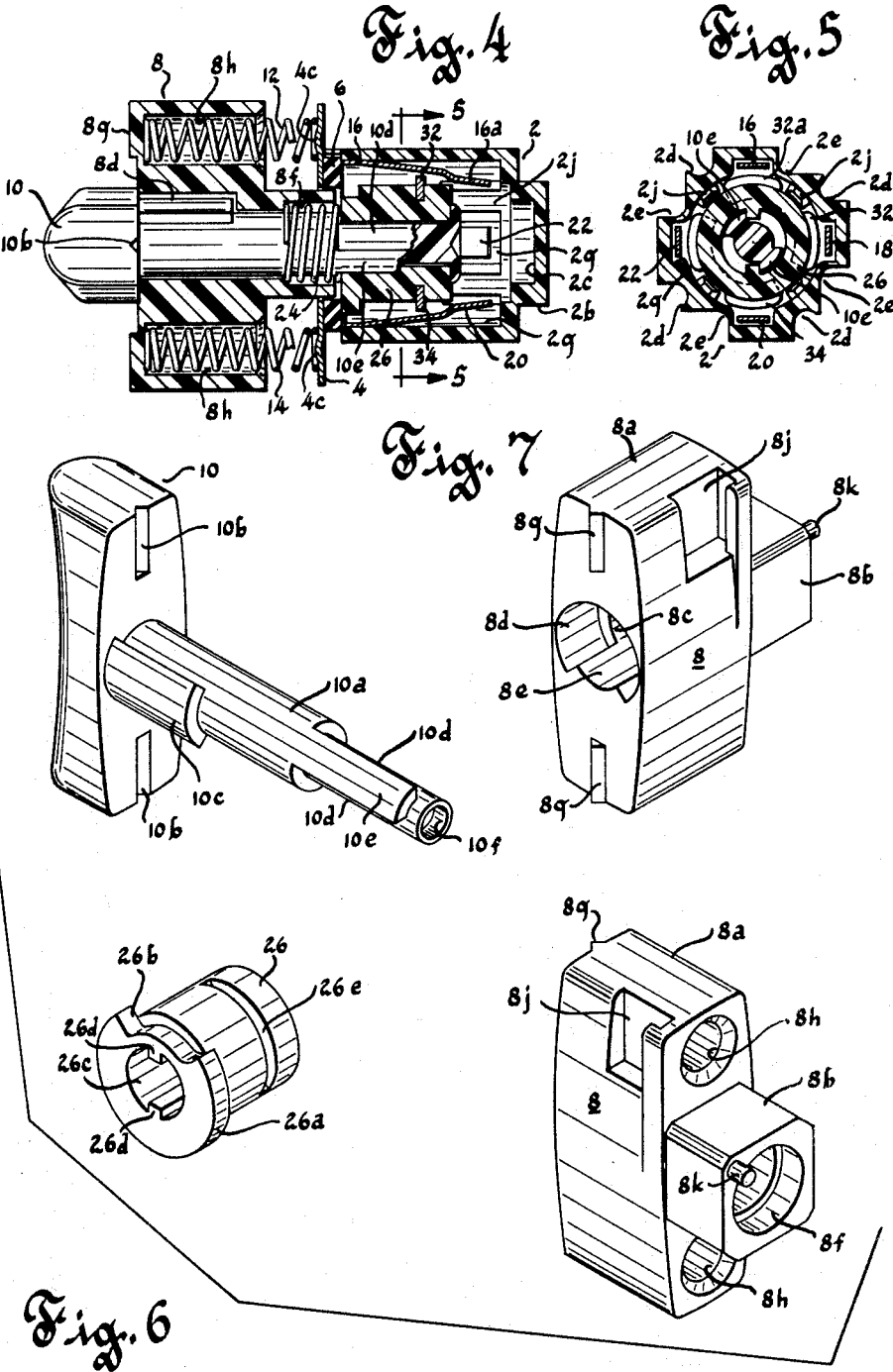
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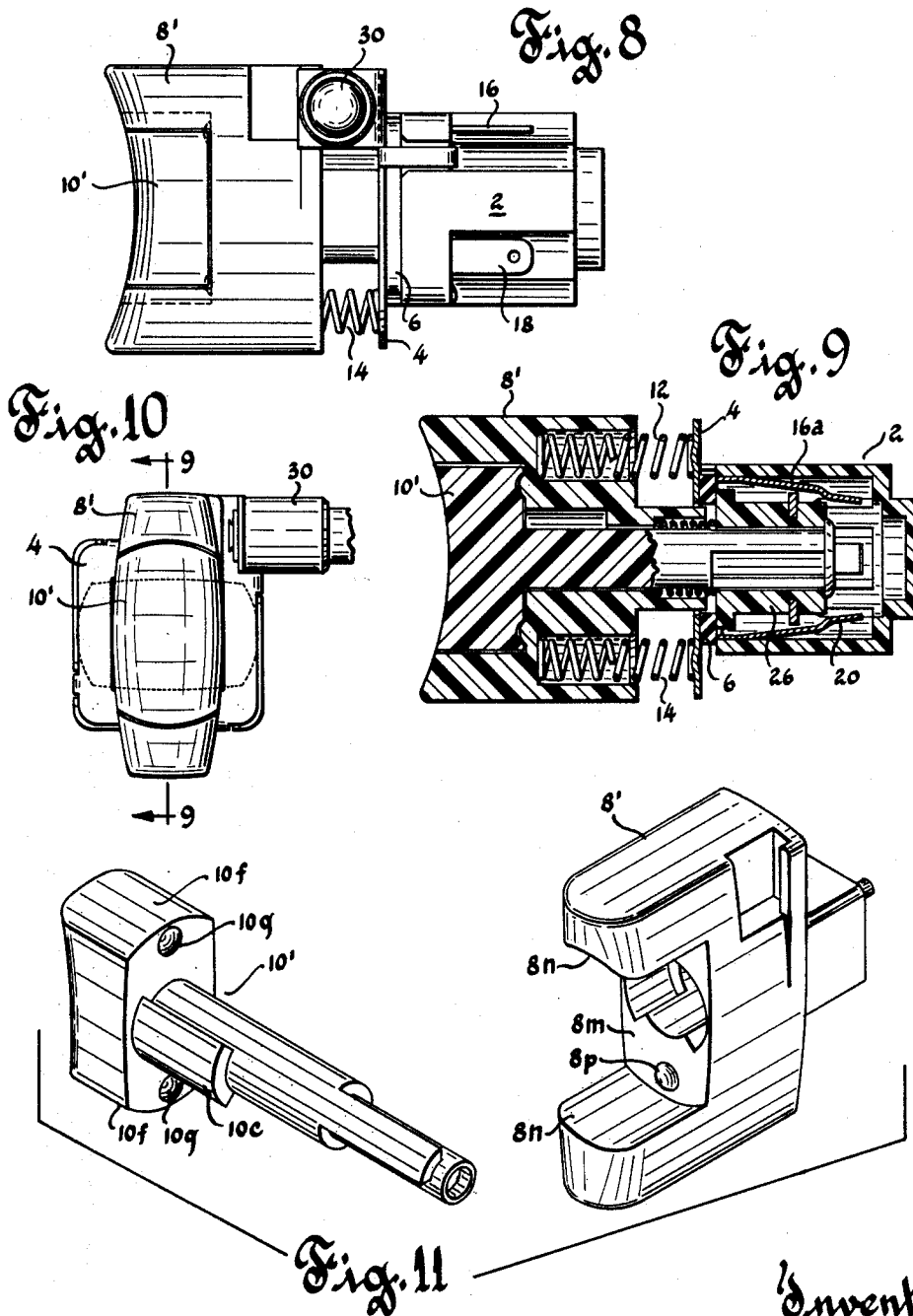
R. D. THOMAS

3,194,898

SELECTOR SWITCHES OF THE TRIGGER ACTUATED TYPE

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3 Sheets-Sheet 3



Inventor
Robert D. Thomas
By *Wm. A. Curtis*
Attorney

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SELECTOR SWITCHES OF THE TRIGGER ACTUATED TYPE

Robert D. Thomas, Fox Point, Wis., assignor to Cutler-Hammer, Inc., Milwaukee, Wis., a corporation of Delaware

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3 Claims. (Cl. 200—4)

This invention relates to selector switches and more particularly to electrical switches which are selectively adjustable from a first condition wherein they are operable to perform a first switching operation to a second condition wherein they are operable to perform a second or different switching operation.

While not limited thereto, the invention is especially applicable to depressible trigger switches for selectively controlling reverse energizations of portable tool motors or the like.

An object of the invention is to provide improved electrical switches.

Another object of the invention is to provide an improved reversible trigger switch which is especially adapted for use on a portable tool handle.

A more specific object is to provide an improved selector switch operating mechanism.

Another specific object of the invention is to provide a depressible switch operator with improved lost motion means for selecting different switch contacts for closure.

Another specific object of the invention is to provide trigger switches of the type adapted for mounting within the handle of a portable electric tool and having a trigger or actuator extending from such handle with improved contact preselector mechanism which permits rotation of a portion of the trigger 180 degrees in order to rotate the contact carrier 90 degrees whereby the rotatable portion of the trigger clears the hole in the handle to permit depression thereof.

Other objects and advantages of the invention will hereinafter appear.

According to the invention, there are provided trigger switches of the preselector type which are adapted for mounting in the handle of a portable electric tool or the like. When so mounted, the body of the switch is within the handle and the trigger projects from the handle so that it may be depressed by the finger of the operator to close the switch. The switch is provided with selectable contacts and a selector shaft is built into the trigger so that it may be rotated to select contacts which are thereafter closed when the trigger is depressed. The selection must first be made and then the trigger is pressed to close the selected contacts. For motor reversing connections, four stationary contacts are spaced from one another at 90 degrees, pairs of which are bridged by a pair of movable bridging contacts. Because the contact carrier must be rotated 90 degrees for reversing the connection, the selector mechanism is provided with 90 degrees lost motion to permit rotation of the front end of the trigger 180 degrees. In this manner, the rotatable portion of the trigger may be sufficiently large to afford easy gripping by the fingers, yet it will not interfere with depression of the trigger because it can be rotated 180 degrees to clear the symmetrical hole in the tool handle.

These and other objects and advantages of the invention and the manner of obtaining them will best be understood by reference to the following detailed description of embodiments of the invention taken in conjunction with the accompanying drawings, wherein:

FIGURE 1 is a right-side elevation view of a selector switch constructed in accordance with the invention;

FIG. 2 is a top plan view of the switch of FIG. 1;

FIG. 3 is a cross-sectional view taken along line 3—3 of FIG. 2 showing the selector in its clockwise position;

FIG. 4 is a cross-sectional view like FIG. 3 except that the selector has been rotated clockwise 90 degrees from its counterclockwise position;

FIG. 5 is a cross-sectional view taken along line 5—5 of FIG. 4;

FIG. 6 is an isometric view of the trigger, the selector and the contact carrier;

FIG. 7 is an isometric view showing the front and right side of the trigger;

FIG. 8 is a right-side elevation view of a modified selector switch;

FIG. 9 is a cross-sectional view taken along line 9—9 of FIG. 10 showing the selector in its clockwise position;

FIG. 10 is a front view of the switch of FIG. 8; and

FIG. 11 is an isometric view of the trigger and selector of the switch of FIG. 8.

Referring to FIGS. 1 and 2, there is shown a trigger switch of the selector type comprising a supporting member or base 2, a switch frame 4, an insulator 6 between the base and the frame, a plunger or trigger 8 for actuating the switch and a selector 10 for selecting different pairs of stationary contacts for bridging when the trigger and selector are depressed. The switch also comprises a pair of helical compression springs 12 and 14 for restoring the trigger and opening the switch contacts when it is released and for providing positioning bias between the selector and the trigger.

As shown in FIGS. 3, 4 and 5, base 2 is substantially cup-shaped having sides and a closed end and an open end. The open end of the base has a generally square configuration as shown in FIGS. 1 and 2 and the front or open end profile thereof is broken by four grooves 2a, one such groove being adjacent each corner, for receiving securing straps of the switch frame which are bent around the edges of the base at the corners thereof as hereinafter more fully described. Base 2 is provided with a projection 2b in its closed end which is illustrated as being round and which is provided within the cavity of the base with a flat round recess 2c to provide room for the rear end of shaft 10a of selector 10 when the trigger is pressed all the way in.

Base 2 is provided with a pair of grooves 2d and 2e on each corner thereof extending from the closed end to a point near the open end thereof leaving an overhanging edge 2f at each corner of the base. Groove 2d is deeper than and communicates with strap groove 2a to provide overhanging edge 2f on each corner of the base shown in FIGS. 1 and 2 to the rear undercut side of which the end of each frame strap can be bent to secure the frame to the base. Groove 2e is on the other side of each corner of the base from groove 2d. Groove 2e is wider than and as long as groove 2d to provide room for the contact terminals which extend through edge 2f of the base as hereinafter more fully described.

Base 2 is provided with an inner cavity having a generally round and elongated or cylindrical configuration as most clearly shown in FIGS. 4 and 5 and extending all the way from recess 2c to the open end of the base. The inner walls of this cavity are provided with four grooves 2g spaced 90 degrees from each other and extend toward the middle of each flat side of the base between groove 2d on one corner and groove 2e on the adjacent corner. These grooves 2g are provided to accommodate stationary spring contacts. Adjacent each groove 2g and between such groove and the clockwise corner of the base a narrow slot 2h (FIG. 2) extends all the way through overhanging edge 2f of the base into communication with exterior groove 2e for mounting a

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connector terminal which is integral with the stationary contact as hereinafter described.

Between grooves 2g within the cavity of base 2, there are provided inwardly projecting ridges 2j as shown in FIGS. 4 and 5 which prevent turning of the contact carrier when the trigger is in its depressed position. As shown in FIG. 4, ridges 2j extend from the closed end of the base about halfway toward the open end thereof and are each provided with a beveled end to prevent interference with movement of the bridging contacts when the trigger is pressed.

As shown in FIGS. 4 and 5, there are provided four, like stationary contact clips or springs 16, 18, 20 and 22. Each contact clip such as contact clip 16 is of generally U-shaped configuration. One leg 16a forms a stationary spring contact and is bent inwardly within the base cavity so that its free end extends out of groove 2g as shown in FIG. 4 to form a cam surface for cooperation with a movable contact bridge or contactor hereinafter described. The other leg 16b thereof extends through slot 2h, FIG. 2, to the exterior of the base to form an electrical terminal or connector member to which an electrical conductor may be connected. Confinement of connector leg 16b in its narrow slot 2h maintains the integral stationary contact leg 16a in the proper position to be engaged by the movable contact. The base is provided with a shallow groove between each groove 2g and the associated connector slot 2h at the open end of the base to receive the yoke or connecting portion of the contact clip which extends between contact leg 16a and connector 16b. Base 2 and stationary contact clips 16, 18, 20 and 22 are like those shown in Harry W. Brown copending application, Serial No. 194,811, filed May 15, 1962, now Patent Number 3,143,606, granted August 4, 1964, and reference may be had thereto for a more detailed illustration thereof.

Trigger 8 is provided with an enlarged front portion 8a having the form of a generally rectangular block with rounded sides. A square projection 8b extends from the mid-portion of the rear surface of enlarged portion 8a. A hole 8c extends through both such portions of the trigger. The forward end of hole 8c is provided with an enlarged portion 8d (FIG. 7) extending through the upper 270 degrees and extending axially almost through enlarged portion 8a of the trigger. As shown in FIG. 7, the enlarged portion of the hole leaves a lower portion 8e of reduced diameter through the lower 90 degrees of the forward end thereof to serve as a stop for selector 10 as hereinafter described. The rear end portion of hole 8c is provided with a slightly enlarged portion 8f of larger diameter as shown in FIGS. 4 and 6 to accommodate a positioning bias spring 24. Spring 24 is a helical compression spring surrounding shaft 10a between trigger 8 and a contact carrier 26 for maintaining the selector in either one of its two indexed positions. A pair of aligned ridges 8g are provided on the front surface of trigger 8, one on each side of hole 8c, for snapping engagement and retention in complementary grooves 10b in the rear surface of the enlarged handle portion of selector 10. It will be apparent that spring 24 adds to the bias between the trigger and selector supplied by springs 12 and 14.

The forward end of shaft 10a immediately behind the rear surface of the enlarged handle portion of selector 10 is provided with an enlarged arcuate 90 degree segment 10c extending partway along the shaft and being integral therewith. Segment 10c has a diameter to fit freely in the enlarged portion 8d of the hole in the trigger and to rotate therein 180 degrees until it stops against arcuate reduced portion 8e of the trigger.

As most clearly shown in FIGS. 5 and 6, the rear end of shaft 10a is provided on opposite sides thereof with keyways or a pair of arcuate grooves 10d extending from the rear end thereof a sufficient distance to receive the

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key-like ridges of contact carrier 26 hereinafter described. As shown in FIGS. 5 and 6, grooves 10d on opposite sides of the shaft leave a pair of enlarged portions 10e. Grooves 10d are each provided with an arcuate width sufficient to afford 90 degrees relative rotation between shaft 10a and contact carrier 26. As shown in FIG. 5, the sides of enlarged portions 10e are formed so as to lie flat against the sides of the ridges in the contact carrier when shaft 10a and contact carrier 26 are in their extreme rotary positions relative to one another and when the shaft rotates the contact carrier. As shown in FIG. 6, enlarged portions 10e stop short of the rear end of shaft 10a. The extreme rear end of shaft 10a is provided with a short tubular portion 10f which can be molded or riveted over to secure the contact carrier to the shaft as shown in FIGS. 3 and 4. A washer, not shown, may be placed against the rear end of the contact carrier before the end of the shaft is riveted over. Shaft 10a is preferably made of nylon or the like and may be cold riveted over the washer.

Frame 4 comprises a sheet metal stamping for securing the switch parts to one another and for supporting a spring-biased locking pin 30. Frame 4 is like the frame more specifically illustrated and described in the aforementioned Harry W. Brown copending application and reference may be had thereto for a more detailed description thereof. Generally, frame 4 has a square hole for slidably receiving projection 3b of the trigger. Frame 4 has a pair of ears 4a and 4b shown in FIG. 3 extending in opposite directions from opposite edges of the frame to overlies recesses 3h in the rear surface of the trigger. Ears 4a and 4b are each provided on the front surface with a rounded bead-like raised portion 4c shown in FIG. 3. These raised portions fit within the ends of springs 12 and 14, respectively, to retain the springs from slipping off the ears while the latter retain the springs in recesses 3h. A projection or arm 4d shown in FIG. 1 extends forwardly from frame 4 for mounting locking pin 30 of known type. A recess 3j is formed in portion 8a of trigger 8 to receive the end of the locking pin to retain the trigger in its depressed position. The locking pin is illustrated and described in more detail in the aforementioned Harry W. Brown copending application.

Insulator 6 is like the insulator illustrated and described in the aforementioned copending application. It comprises a square flat insulating member having a square hole therein for slidably accommodating projection 3b of the trigger. It is held in place by suitable projections on the edges of the base fitting into slots on the corners of the square hole in the insulator. The function of the insulator is to electrically insulate the stationary contacts and terminals from the switch frame. Frame 4 is provided with four straps 4e extending rearwardly from adjacent the corners thereof for securing the parts together as hereinafter described.

Contact carrier 26 shown in FIG. 6 comprises a generally cylindrical insulating member having an annular flange 26a at its forward end to overlies margins of the square hole in insulator 6. A portion of flange 26a of the contact carrier is cut away through an angle of slightly over 90 degrees to form a slot 26b for a round projection or stop 8k extending rearwardly from the upper right-hand corner of projection 3b of the trigger. As will be apparent, slot 26b allows rotation of contact carrier 26 ninety degrees relative to the trigger. Carrier 26 is provided with a bore 26c therethrough which is round except for a pair of opposed key-like ridges 26d extending toward one another from opposite sides of the bore 180 degrees apart and throughout the length of the bore. Bore 26c is of a diameter whereby the contact carrier slides onto the rear end of shaft 10a with ridges 26d in arcuate grooves 10d in the shaft. It will be apparent that ridges 26d and grooves 10d provide 90 degrees relative rotary movement between the shaft and the contact carrier, that is, 90 degrees lost motion when the selector is rotated. A pair

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of arcuate grooves 26e are provided adjacent the rear end of the contact carrier and extend partway around the opposite sides thereof through angles of over 90 degrees. These grooves 26e snugly receive a pair of arcuate bridging contacts or contactors 32 and 34. Each movable or bridging contact such as 32 is provided with a narrow center or midportion as shown in FIG. 5 for fitting fully within its associated groove 26e and wider end portions 32a which extend beyond the outer surface of carrier 26 for engaging and connecting together two of the stationary spring contacts 16, 18, 20 and 22 when the trigger is depressed. Grooves 26e and movable contacts 32 and 34 are like those more fully illustrated and described in the aforementioned Harry W. Brown copending application.

To assemble the switch, shaft 10a of the selector is inserted in the hole in the trigger. Then springs 12 and 14 are placed in recesses 8h in the trigger. Spring 24 is placed on the rear end of shaft 10a and dropped into hole 8f. Then frame 4 and insulator 6 are placed on reduced portion 8b of the trigger. Contact carrier 26 is placed on the shaft and the end of the shaft is riveted over to secure the subassembly together. A washer may be inserted on the rear end of the shaft after the contact carrier if desired and the end of the shaft riveted over the washer. The combined stationary contacts and connector terminals are then placed in base 2 and bridging contacts 32 and 34 are inserted in grooves 26e in the contact carrier. The contact carrier portion of the subassembly is then inserted inside the base so that the projections on the base enter the slots in the insulator. This causes straps 4e of the frame 4 to slide along respective grooves 2a in the base whereafter the ends of the straps are bent over and forwardly into the undercut ends of grooves 2d to rigidly secure the switch subassembly to the base.

In FIGS. 4 and 5, selector 10 is shown as having been rotated 90 degrees clockwise from its extreme counterclockwise position. During this first 90 degrees of rotation, only the selector rotates and contact carrier 26 remains in the position shown in FIG. 5 while 90 degrees of lost motion is taken up between raised portions 10e of the selector shaft and ridges 26d within the contact carrier bore. It will be apparent from FIG. 5 that depression of the trigger while the selector is in its extreme counterclockwise position causes bridging contact 32 to connect stationary contacts 16 and 18 and causes bridging contact 34 to connect stationary contacts 20 and 22. The narrow midportions of the movable contacts ride onto ridges 2j within base 2 to prevent the contact carrier from being turned while the trigger is in its depressed position. When the trigger is released, springs 12 and 14 return the same to its undepressed position. In this position, the movable contacts clear the beveled ends of ridges 2j as shown in FIG. 4 so that the contact carrier can be rotated.

In FIGS. 3 and 6, selector 10 is shown as having been rotated fully clockwise. When selector 10 is rotated another 90 degrees clockwise from the position shown in FIGS. 4 and 5 to the position shown in FIGS. 3 and 6, raised portions 10e of the selector shaft bear against ridges 26d as shown in FIG. 5 and the selector rotates the contact carrier 90 degrees therewith until V-shaped ridges 8g on the trigger snap into V-shaped grooves 10b in the selector. These V-shaped indexing ridges and grooves align the selector with the trigger in each of their relative positions so that the selector head or enlarged portion does not catch on the edge of the hole in the tool handle when the trigger and selector are depressed to close the contacts. When the selector is rotated fully clockwise, segment 10c of the selector stops against the clockwise end of enlarged hole 8d in the trigger to prevent further rotation of the selector. Also, the counterclockwise end of slot 26b on the contact carrier stops against stop pin 8k on the trigger to prevent further rotation of the contact carrier. In this connection, it will be apparent that

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slot 26b is given an arcuate length such that the clockwise end thereof stops against stop pin 8k when the selector is rotated fully counterclockwise. Referring to FIG. 5, it will be apparent that in the full clockwise position of the selector, movable contact 32 will have been shifted to bridge stationary contacts 18 and 20 and movable contact 34 will have been shifted to bridge stationary contacts 22 and 16 when the trigger is depressed.

From the foregoing, it will be apparent that there is provided a double-pole, double-throw switch which has many possible applications in electrical systems including the portable tool motor reversing application disclosed in the aforementioned copending application.

The modification shown in FIGS. 8, 9, 10 and 11 is like the switch shown in FIGS. 1-7 except that the trigger and selector have been modified. In this modification, the head or enlarged portion of selector 10' forms only a part of the forward end of trigger 8' rather than the entire forward end as in FIGS. 1-7. The trigger is provided with a suitable recess 8m to receive the selector head. To enable rotation of the selector relative to the trigger, the upper and lower surfaces 8n of recess 8m are made concave and the corresponding surfaces 10f of the selector are made convex in the form of complementary partial segments of a circle. Also, the bottom of recess 8m is provided with a pair of raised, partial spherical beads 8p, one on each side of the hole in the trigger. The rear surface of the enlarged head of the selector is provided with complementary recesses 10g for snap engagement with beads 8p to index or align the selector with the trigger in each selector position.

In each of the switches hereinbefore described, spring 24 could be omitted and hole 8f left unenlarged if desired. While spring 24 biases the trigger in the left-hand direction and biases the selector in the right-hand direction to provide snap action indexing, it will be apparent that springs 12 and 14 provide a similar bias and that these springs are slightly compressed when the selector is turned to force ridges 8g out of grooves 10b in FIG. 6 or to force beads 8p out of recesses 10g in FIG. 11. Therefore, if springs 12 and 14 are made strong enough for proper indexing, they could perform the function of spring 24.

While the switches hereinbefore described are effectively adapted to fulfill the objects stated, it is to be understood that I do not intend to confine my invention to the particular preferred embodiments of selector switches disclosed, inasmuch as they are susceptible of various modifications without departing from the scope of the appended claims.

I claim:

1. An electric switch of the self-enclosed trigger actuated type adapted for mounting in a housing so that the self-enclosed switch is within the housing and the actuator extends through an aperture for manual depression comprising:

- an insulating base;
- a plurality of stationary contacts mounted within said base;
- a movable contact carrier within said base having at least one contact mounted thereon;
- a contact selector extending into said base to support said contact carrier and being operable to rotate said contact carrier thereby to preselect another stationary contact for engagement by said movable contact;
- a spring-biased actuator through which said contact selector rotatably extends and being axially movable with said contact selector after said preselection has been made to close the selected contacts, said actuator having a narrow elongated cross-section and being slidable in the aperture in the housing in which the switch is used, and said contact selector having an enlarged head portion facilitating manual turning thereof and being coextensive with at least a portion of the sides of said actuator;

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and a limited lost motion connection between said contact selector and said contact carrier to allow rotation of said selector more than said contact carrier rotates thereby to afford alinement of the head portion of said selector with the head of said actuator after the movable contact has been alined with a stationary contact.

2. In an electric switch of the self-enclosed plunger actuated type adapted for mounting in a housing so that the self-enclosed switch is within the housing and the actuator extends through a confining aperture for manual depression, the combination comprising:

- an insulating base;
- a plurality of stationary contacts mounted within said base;
- a movable contact carrier within said base having at least one bridging contact mounted thereon;
- a contact selector extending into said base to support said contact carrier and having an enlarged head portion enabling manual rotation to rotate said contact carrier thereby to preselect a pair of stationary contacts for engagement by said movable contact;
- a spring-biased actuator through which said selector rotatably extends and being axially linearly movable with said selector to close the selected contacts, said actuator having a narrow elongated cross-section and being slidable in the aperture in the housing in which the switch is used, and the head portion of said selector being coextensive with at least a portion of the sides of said actuator;
- and means responsive to rotation of said selector 180 degrees into alinement with said actuator for rotating said contact carrier less than 180 degrees to align said movable contact with a pair of stationary contacts thereby to allow linear depression of said actuator and selector to close the contacts.

3. The invention defined in claim 2, wherein said means comprises cooperating portions on said selector and contact carrier providing ninety degrees lost motion therebetween, said contact carrier rotating ninety degrees in response to said selector rotating one hundred eighty degrees.

4. The invention defined in claim 3, wherein said cooperating portions comprise:

- (a) a bore in said contact carrier;
- (b) a shaft on said selector extending into said bore;
- (c) and ridges and grooves in said bore and shaft, said grooves having arcuate widths to allow ninety degrees free movement of said ridges therein.

5. The invention defined in claim 2, together with cooperating portions on said actuator and contact carrier restricting rotation of the latter to ninety degrees.

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6. The invention defined in claim 2, together with cooperating portions on said actuator and said selector restricting rotation of the latter to one hundred eighty degrees.

7. An electrical selector switch of the trigger actuated type adapted for mounting in the handle of a portable electric tool comprising:

- (a) a cup-shaped insulating base;
- (b) stationary contacts mounted within said base and angularly spaced ninety degrees apart from one another;
- (c) a rotary contact carrier within said base and having a pair of arcuate movable contacts mounted thereon for bridging pairs of said stationary contacts when said contact carrier is depressed further into said base;
- (d) a spring biased trigger member for depressing said contact carrier;
- (e) a contact selector having a shaft extending through said trigger member into a bore in said contact carrier and having an enlarged handle portion forming a part of the profile of said trigger member and whereby said shaft may be turned, said selector and trigger member having a narrow elongated cross-section and being symmetrical in such elongated direction;
- (f) and lost motion cooperating portions between said selector and said contact carrier effective when said contact carrier is rotated ninety degrees to select different pairs of stationary contacts for bridging by the movable contacts for allowing rotation of said selector another ninety degrees to one hundred eighty degrees into symmetrical alinement with said trigger member whereby said selector handle portion will not catch on the tool handle when it is depressed to close the contacts.

8. The invention defined in claim 7, together with means for preventing rotation of said contact carrier when said selector is held either in its clockwise position or its counterclockwise position one hundred eighty degrees from said clockwise position.

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ROBERT K. SCHAEFER, *Acting Primary Examiner.*

BERNARD A. GILHEANY, *Examiner.*