

Sept. 16, 1969

B. H. MATTHEWS

3,467,801

REVERSING SWITCH

Filed May 1, 1967

3 Sheets-Sheet 1

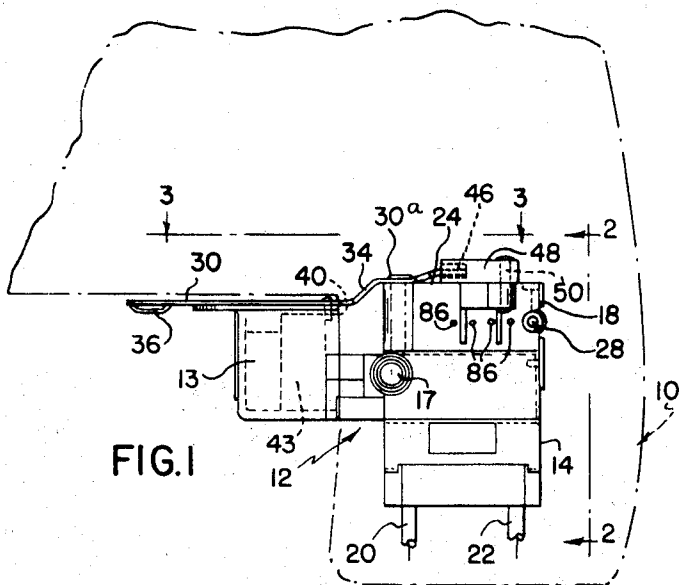


FIG. 1

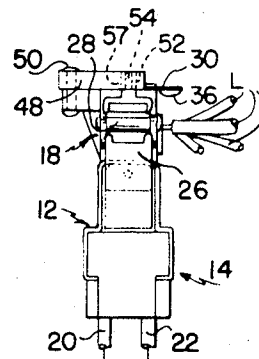


FIG. 2

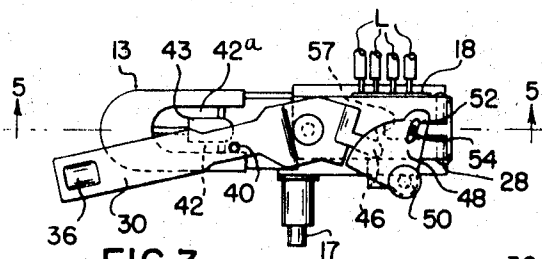


FIG. 3

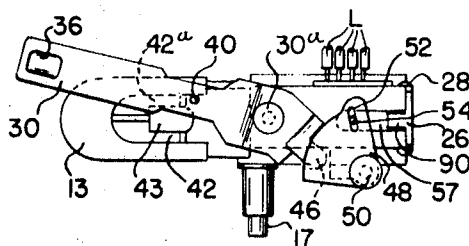


FIG. 4

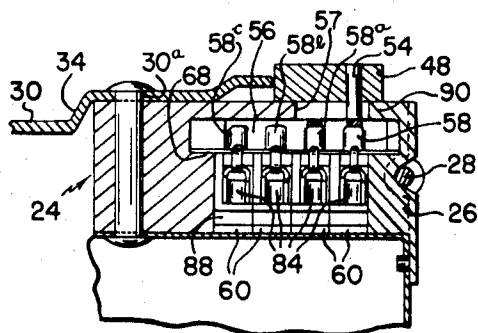


FIG. 5

INVENTOR.
BENJAMIN H. MATTHEWS
BY

Baldwin, Doran & Egan
ATTORNEYS

Sept. 16, 1969

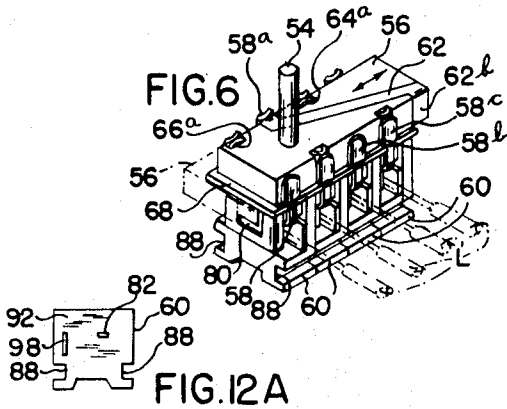
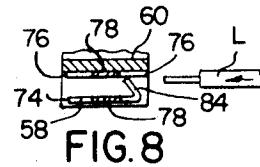
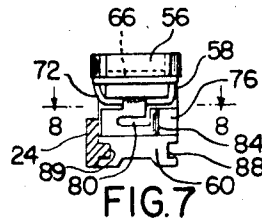
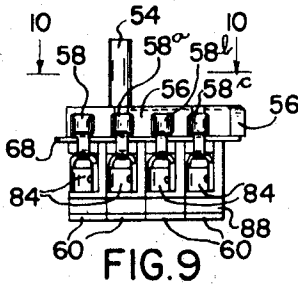
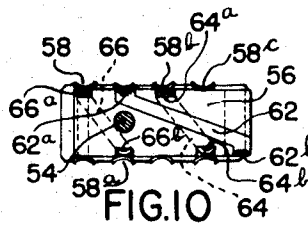
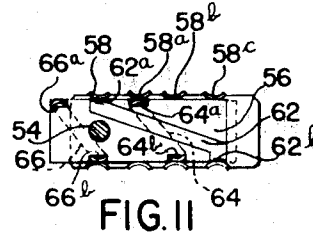
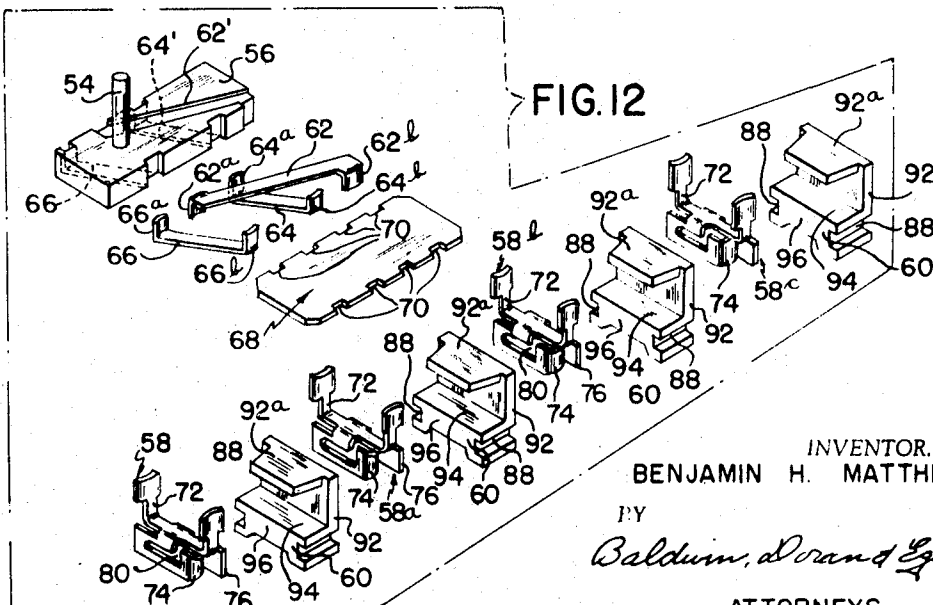
B. H. MATTHEWS

3,467,801

REVERSING SWITCH

Filed May 1, 1967

3 Sheets-Sheet 2



INVENTOR.
BENJAMIN H. MATTHEWS

BY

Baldwin, Doran & Egan

ATTORNEYS

Sept. 16, 1969

B. H. MATTHEWS

3,467,801

REVERSING SWITCH

Filed May 1, 1967

3 Sheets-Sheet 3

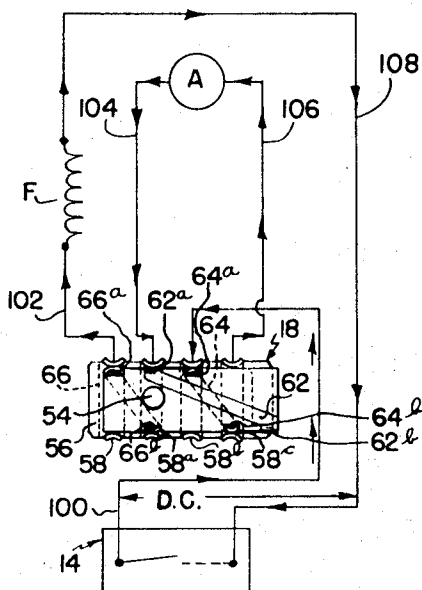


FIG. 13

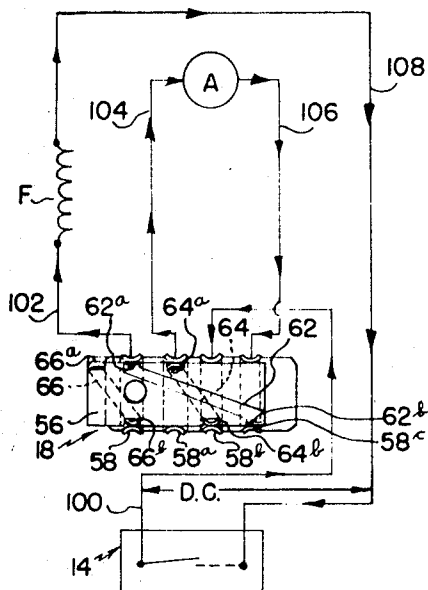


FIG. 14

INVENTOR.

BENJAMIN H. MATTHEWS

BY

Baldwin, Doran & Egan

ATTORNEYS

1

3,467,801

REVERSING SWITCH

Benjamin H. Matthews, Peninsula, Ohio, assignor to Luerne Products, Inc., Northfield, Ohio, a corporation of Ohio

Filed May 1, 1967, Ser. No. 635,128

Int. Cl. H01h 9/06, 13/08, 21/10

U.S. Cl. 200—157

20 Claims

ABSTRACT OF THE DISCLOSURE

The reversing switch is adapted for mounting in an electrically powered portable tool for selectively reversing the direction of rotation of an electric motor, such as a universal type motor, of the tool, such switch comprising a compact switch body formed of a plurality of individual insulating separator members and having a plurality of fixed electrical conducting contacts carried intermediate the separator members, and a reciprocal contact element having a plurality of electrical conducting contact points, slidably mounted on the switch body for movement into several operative positions. In one of the positions of the slidable contact element, the motor is driven in one direction and in another position of the contact element the motor is driven in the reverse or opposite direction. The contact element is adapted to be manually moved from one operative position to the other operative position by means of a pivotal lever mounted on the power tool, and coacting with an operator mounted on the switch, which in turn coacts with an actuator portion of the contact member for moving the contact member to either of its operative positions.

This invention relates in general to a compact electrical switch for a power tool, and more particularly to a compact reversing switch for reversing the direction of rotation of the electric motor of the tool.

U. S. Patent No. 3,260,827, issued July 12, 1966 in the name of C. J. Frenzel, discloses a motor reversing mechanism for electrically-powered portable tools in conjunction with a trigger and speed control switch assembly, and wherein such reversing mechanism comprises a pivotal reversing lever mounted in the housing of the tool for movement between two positions, and with such lever coacting with a reversing switch means connected with the motor, for reversing the direction of rotation of the motor.

The present invention provides a novel reversing switch mechanism which may be used in the environmental setting of the reversing mechanism disclosed in said Patent 3,260,827, as well as other environmental settings, for accomplishing reversal of the motor drive.

Accordingly, an object of the present invention is to provide an electrically-driven power tool having an operating trigger and a reversing mechanism including a reversing switch.

Another object of the invention is to provide a novel reversing switch for an electric motor.

A further object of the invention is to provide a switch of the above-mentioned type which is compact, eco-

2

nomically constructed, and capable of being mass produced.

A further object of the invention is to provide a slide type reversing switch which is of a compact construction for use in a portable electric tool for readily reversing the drive motor of the tool.

A still further object of the invention is to provide a novel compact reversing switch which includes a switch body having a series of fixed contacts carried on said body, and a movable contact element having a plurality of contact points, slidably carried on said body, with actuator means extending outwardly of said contact element and adapted for actuation by lever means, for expeditiously reversing the conductivity path through the switch.

A further object of the invention is to provide a switch for use with a universal type series-wound motor of a portable electric tool, for expeditiously reversing the motor, thus reversing the drive of the tool.

Other objects and advantages of the invention will be apparent from the following description taken in conjunction with the accompanying drawings wherein:

FIGURE 1 is a fragmentary side elevational, diagrammatic illustration of a portable electric tool embodying the present invention, with the tool being illustrated in phantom lines, and with the trigger assembly and reversing switch assembly of the present invention being illustrated in full lines.

FIGURE 2 is a rear end elevational view of the trigger-switch assembly illustrated in FIGURE 1, and taken generally along the plane of line 2—2 of FIGURE 1, looking in the direction of the arrows.

FIGURE 3 is a top plan view of the trigger-switch assembly of FIGURE 1, taken generally along the plane of line 3—3 of FIGURE 1, looking in the direction of the arrows.

FIGURE 4 is a view similar to FIGURE 3, but illustrating the reversing lever disposed in another of its positions, thereby actuating the switch operator and causing reversal of the drive of the electric motor powering the tool.

FIGURE 5 is an enlarged sectional view taken generally along the plane of the line 5—5 of FIGURE 3, looking in the direction of the arrows.

FIGURE 6 is a perspective enlarged view of the reversing switch mechanism per se as removed from its housing, and illustrating in phantom lines another of the operative positions of the slide contact element of the switch.

FIGURE 7 is an end elevational view of the reversing switch of FIGURE 6.

FIGURE 8 is a fragmentary sectional view taken along the plane of line 8—8 of FIGURE 7 looking in the direction of the arrows, and illustrating the clip arrangement on the fixed contacts of the switch body, for readily coupling a line conductor to the reversing switch.

FIGURE 9 is a side elevational view of the FIGURE 6 switch.

FIGURE 10 is a top plan view of the FIGURE 6 switch illustrating the slidable contact element thereof in an operative conducting position for driving the electric motor in one direction.

FIGURE 11 is a top plan view similar to FIGURE 10 but illustrating the operative conducting position of the

contact element for driving the motor in the opposite direction.

FIGURE 12 is an exploded view of the reversing switch showing the various parts thereof.

FIGURE 12A is a rear elevational view of one of the separator members of the switch.

FIGURE 13 is a schematic illustration of the switch as coupled to the series motor of, for instance, a power tool, for driving the tool in a clockwise direction, and with the contact element of the reversing switch being in the position illustrated in FIGURE 10, and

FIGURE 14 is a schematic illustration of the reversing switch coupled to a series motor of, for instance, a power tool, with the contact element of the reversing switch in the position illustrated in FIGURE 11, for reversing the drive of the motor.

Referring now again to the drawings, FIGURE 1 illustrates a power tool with which the present invention may be incorporated. The tool illustrated is of a portable type which may include a depending pistol grip-like handle 10 having a trigger-switch assembly 12 mounted therein, which is adapted to control the operation of the electric motor (not shown) of the portable tool. The trigger 13 may be of the conventional reciprocal, spring-loaded type and may coact with a speed control switch unit 14 to control the speed of the motor.

The trigger-switch assembly 12 may also include a locking mechanism including a pin 17, for locking the trigger 13 in its full inward or maximum on position. Speed control switch mechanism 14 is of known construction for varying the speed of the electric motor in accordance with the inward movement of the trigger from a completely off or outward position, to a completely on or inward position. Accordingly, a description of such speed control switch mechanism 14 will not be given here. Suffice it to say that the trigger-switch assembly 12 including trigger 13, speed control switch 14 and reversing switch 18, with which the present invention is particularly concerned, is of a compact packaged construction for ready installation in a portable tool.

Electrical leads 20-22 may extend from trigger-switch assembly 12 and form part of an electrical cord for coupling the tool to a suitable source of electrical power.

The reversing switch 18 may include a housing 24 formed of any suitable material, such as for instance moldable plastic material, suitably secured to the remainder of the trigger-switch assembly. Housing 24 may have an opening 24a at its rearward end for inserting the components of the reversing switch proper therein, with such opening 24a being closed by plug 26 held in closing position as by means of rivet 28.

The reversing mechanism may include an elongated lever 30 pivoted as at 30a to the housing 24 of reversing switch 18. Lever 30 has a downwardly bent or offset portion 34, and extends forwardly above the trigger 13 to be disposed forwardly thereof at its distal end. Such distal end may be provided with an embossment or projection 36 thereon for facilitating the pivotal movement of the lever by the tool operator's finger.

Lever 30 may be provided with a depending abutment or pin 40 which is adapted for coaction with the spaced slots 42-42a in the trigger, thereby necessitating movement of the lever to either one of the positions illustrated in FIGURES 3 and 4, in order for the trigger to be able to be squeezed or moved rearwardly. It will be seen that unless lever 30 is in one of said positions, then the abutment pin 40 will engage the center partition 43 of the trigger, and prevent rearward movement of the trigger. The lever 30 may have a generally rearwardly extending projection 46 thereon extending diagonally with respect to the lengthwise axis of the main portion of the lever, which is adapted to be received in coacting movable relation with operator member 48 which may be pivoted as at 50 to the reversing switch housing 24.

Operator member 48 has an elongated slot 52 therein receiving upwardly extending actuator portion 54 of the contact element 56 of the reversing switch 18 and in relatively movable relation therewith. It will be seen that actuator portion 54 extends through a slot 57 disposed in the upper surface of the housing 24 of reversing switch mechanism, so that the contact element 56 is reciprocally mounted or linearly movable in the housing 24 as actuated by pivotal movement of operator 48.

It will be seen, therefore, that upon pivotal movement of the lever 30 from one side of the trigger 13 to the opposite side thereof, the operator 48 is caused to pivot about pivot point 50, thereby moving the contact element 56 via the actuating portion 54 either in a forward or a rearward direction with respect to the housing of the switch. In the forward position of the contact element 56, or in other words, the position which is illustrated in FIGURES 4 and 10 of the drawings, the electric motor may be driven in a forward direction, while in the rearward position of the contact element, or in other words the position illustrated in FIGURES 3 and 11 of the drawings, the electric motor may be driven in a reverse direction.

Referring now in particular to FIGURES 6 through 12A illustrating the reversing switch elements removed from housing 24, the reversing switch may comprise a plurality of stationary or fixed contact members 58, 58a, 58b, and 58c separated by insulating separator members 60, and assembled to form the body of the reversing switch. The aforementioned contact element 56 has conducting paths or strips 62, 64 and 66, coacting therewith and forming at the ends thereof contact points 62a and 62b, 64a and 64b, and 66a and 66b respectively. An insulating plate 68 is provided on which contact element 56 is adapted for sliding movement and which separates the contact element 56 from the separator members 60 of the switch body, and defining in conjunction with the permanent or fixed contacts 58-58c a path in which contact element 56 is adapted for movement as actuated by actuator portion 54 thereof.

Contact element 56 is a block-like member formed, for instance, of a suitable electrical insulating plastic material, and which has a plurality of grooves 62', 64' and 66' formed therein, for receiving the associated conducting strips 62, 64 and 66, as can be best seen in FIGURE 12. Grooves 62', 64' and 66' are adapted to receive the respective conducting strip 62-66 therein, with the contact element being slotted at the ends of the grooves for receiving therein the respective contact points of the conducting strips. Such contact points preferably extend slightly outwardly of the defining side surface of the contact element, so that the contact points will positively engage the fixed contacts as the contact element 56 moves reciprocally between the fixed contact members 58-58c. The slots 62', 64' and 66' in the contact element are preferably of such dimensions that the associated conducting strip is held therein by merely pressing the strip into the slot. As can be best seen in FIGURE 12, the contact points 62a, 62b, 64a, 64b and 66a, 66b preferably have a convex surface configuration on their outer sides, for good sliding coaction with the corresponding convex configuration on the inner sides of fixed contact points 58-58c.

The dielectric or insulating plate member 68 has a plurality of recesses or slots 70 in the sides thereof, which are adapted to receive therein the fixed contact members, and thus hold the fixed contact members and the plate 68 in predetermined position in the reversing switch assembly.

The fixed contacts 58-58c each may comprise a member of electrically conducting material and formed into a generally U-shaped in elevation, upper portion 72 with leg portions 74, 76 depending from said upper portion. One (i.e. 76) of the depending leg portions, in the embodiment illustrated, comprises a flat, generally rectangular-shaped portion, with such leg being connected to the upper por-

tion 72 by means of a narrow neck 78 (FIGURE 8). The other leg portion 74 may likewise be connected to the upper portion by a narrow neck 78 and includes an elongated slot 80 therein which is adapted to receive therein a projection or embossment 82 (FIG. 12A) on one side of the adjacent separator member. Outwardly from the slot 80 there is provided a clip portion 84 (FIG. 7) which is reversely bent back toward the inner face of the other leg 76 for receiving therebetween line conductors L, thus providing an arrangement for readily connecting a conductor to the permanent or fixed contacts of the switch. The switch housing 24 has openings (not shown) therethrough aligned with the clip portions 84 of the switch, so that the bared ends of the conductor wires L to the motor can be readily inserted through the switch housing and into electrically coupled relationship with the fixed contacts. Openings 86 (FIG. 1) may also be provided on the opposite side of the switch housing for insertion of a thin rod or the like between the leg portions of the respective fixed contact member, to aid in releasing the line conductor from its associated clip portion if such becomes necessary during repair of the tool.

The upper portion 72 of the fixed contacts preferably have enlarged tab contact portions as best seen in FIGURE 12, with such tab portions being adapted to be received above the plate 68 to maintain the fixed contacts in assembled relationship with the plate. As aforementioned, the inner surfaces of the tabs are preferably convex for good sliding relation between the contacts on the contact element 56.

The separator members 60 are preferably formed of suitable molded plastic insulating material. Each of the separator members comprises a block-like base portion having slots 88 on opposite sides thereof which are adapted to be received in coacting relation with projecting means such as rib 89 (FIG. 7) in the housing 24 of the reversing switch, to lock the switch body in the switch housing. In this connection the switch housing may originally be formed open on the back side thereof as aforementioned, and then the reversing switch assembly is slid longitudinally into the housing, after which the closure member 26 is fitted in the open end and rivet 28 applied to hold such closure member in place. Also the slot 87 in the top wall of housing 24 extends through the rearward end thereof, with the closure member 26 having a portion 90 (FIG. 5) received in the open ended slot, to close the slot, and as shown, for instance in FIGURE 5.

Projecting upwardly from one end of the base portion of each separator 60 is a flange 92 which at its upper end has a forwardly projecting ledge portion 92a. The ledge portion 92a preferably is tapered in a forward direction as shown in FIG. 12. The distance or space defined between the ledge portion 92a and the upper surface 94 of the base portion is of such size as to readily receive therein the associated fixed contact 58-58c, and when the fixed contacts are in assembled relationship with the dielectric plate 68, the ledge portion 92a is received between the underside of the plate and the depending U-shaped portion of the associated fixed contact, thus interlocking the fixed contacts, the separating members 60 and the dielectric plate 68. The aforementioned tapered configuration of the ledge portion enables it to be readily received in the U-shaped portion and when fully pushed therein is received in relatively snug relationship.

With such a construction it will be seen that a switch of any selected number of fixed contacts could be readily provided by assembling the desired fixed contact members with the separator members in any desired number to provide the desired number of contacts. The width of the fixed contact members 58-58c is such that when such fixed contact members are received in the space between the ledge portion 92a and the base portion of the respective separator member, the outer leg 74 is disposed substantially in the plane of the surface 96 of the base member so that the lug 82 on the next adjacent separator member (FIG. 12A) will be received in the slot 80 in the con-

fronting fixed contact, and thus position the fixed contacts 58-58c with the separator members 60. The outer side of each flange 92 is also provided with a projection 98 (FIG. 12A) adapted for locating engagement with the outer end of the clip portion 84 of the adjacent fixed contact, thus further positioning the fixed contact member with respect to the separator members.

Referring now to FIGURE 13, there is schematically illustrated the flow of current from the speed control switch 14 to the reversing switch mechanism 18, and thence to the motor, with the control lever 30 being located in the position illustrated in FIGURE 4 of the drawings. A line 100 from one terminal of switch 13 is coupled to fixed contact 58b via its associated clip 84, with the field winding F of the universal electric motor being coupled by line 102 to fixed contact 58 via its associated clip, and with the armature A of the electric motor being coupled via lines 104, 106 to respectively fixed contact 58a and fixed contact 58c. Field winding F is coupled back to the other terminal of speed control switch 14 via line 108.

With the lever 30 in the position shown in FIGURE 4, the contact point 64a of conducting strip 64 is in engagement with fixed contact 58b on one end of strip 64 and contact point 64b is in engagement with fixed contact 58c on the other end of strip 64. The contact point 66a of strip 66 is in engaged relation with fixed contact 58 at one end of strip 66 while the contact point 66b on the other end of the strip is in engagement with fixed contact 58a. Contact point 62a of conducting strip 62 is in engagement with fixed contact 58a while contact point 62b is out of engagement with any of the fixed contacts 58-58c on the switch body and therefore does not provide a conducting path in the position illustrated in FIGURE 13. The D.C. current from the switch 14 flows to the stationary contact 58b, through conducting strip 64 to stationary contact 58c then through the line 106 to the motor armature and back through line 104 to stationary contact 58a, through conducting strip 66 to stationary contact 58 then via line 102 through the field winding F and then back via line 108 to the terminal of the speed control switch 14, thus completing the circuit for driving the electric motor in for instance a clockwise direction.

To reverse the motor drive, the lever 30 is pivoted to the position illustrated in FIGURE 3, thus moving or shifting the contact element 56 rearwardly with respect to the switch body and to the position illustrated in FIGURES 11 and 14. In such position, conducting strip 62 is in circuit between stationary contact 58 and stationary contact 58c and conducting strip 64 is in circuit between stationary contact 58a and stationary contact 58b. Thus the D.C. current flowing through line 100 enters the stationary contact 58b, flows through the conducting strip 64 to stationary contact 58a, then via line 104 through the armature A of the electric motor, then back through line 106 to the stationary contact 58c, through conducting strip 62 to stationary contact 58, and then through the field winding F of the motor and back via line 108 to the speed control switch 14, thus completing the circuit for driving the electric motor in a reverse or for instance, counterclockwise direction.

From the foregoing description and accompanying drawings, it will be seen that the invention provides a novel reversing switch adapted for mounting in a trigger assembly for conveniently reversing the drive of an electric motor and a switch which is of simple, compact construction, able to be mass produced and readily assembly in a limited space environment. The invention also provides a novel reversing switch-speed control switch and trigger assembly in conjunction with mechanism for actuating the reversing switch to cause reversal of the direction of drive of an associated electric motor.

The terms and expressions which have been used are used as terms of description and not of limitation, and

there is no intention in the use of such terms and expressions of excluding any equivalents of any of the features shown or described, or portions thereof, and it is recognized that various modifications are possible within the scope of the invention claimed.

I claim:

1. In an electrical reversing switch comprising a switch body, a series of fixed contacts carried on said body, a contact element having a plurality of contact points and slidably movable with respect to said body, means for moving said contact element into several operative positions wherein the contact points of said contact element engage with several of the fixed contacts in a predetermined pattern to conductively bridge several of the fixed contacts whereby the direction of current flow through the switch may be reversed depending upon the position of said contact element with respect to said fixed contacts and wherein said switch body comprises a plurality of individual contact members forming said fixed contacts and separated from one another by means of spaced insulating separator members, and means on said separator members and on said fixed contact members for holding the latter in assembled relation.

2. A switch in accordance with claim 1 wherein said separator members are of generally C-shaped configuration in side elevation, said fixed contact members being of generally U-shaped configuration and being received within a respective one of said separator members and projecting thereabove, and means on said fixed contact members for attaching said contact members to an electrical insulating means, said contact element being supported on said insulating means for movement with respect thereto.

3. A switch in accordance with claim 1 including clip means on each of said fixed contacts for attaching an electrical lead thereto.

4. A switch in accordance with claim 1 wherein said contact element is of block-like configuration having conducting strip means thereon, said contact points being disposed on the sides of said contact element with said strip means being in electrically conducting relation to respective of said contact points.

5. A switch in accordance with claim 1 wherein said contact element has an actuator portion thereon adapted for causing sliding movement of said contact element with respect to said fixed contacts on said switch body.

6. A switch in accordance with claim 1 including means on said separator members for assembling and maintaining said separator members in a housing.

7. A switch in accordance with claim 6 wherein said means on said separator members comprises an elongated slot extending from one end to the other end of each said separator members, and adapted for alignment with the other corresponding slots in the separator members to define a longitudinally extending channel in said switch body, said channel being adapted to coact with a complementary rib in said housing for holding and positioning said switch body in said housing.

8. A switch in accordance with claim 5 wherein said actuator portion comprises an upstanding projection secured to the top surface of said contact element and adapted for providing an abutment to cause linear movement of said contact element from one of said operative positions to another of said operative positions.

9. A switch in accordance with claim 1 including a housing in which said body and said contact element are disposed, said contact element having an actuator extending outwardly of said housing, and an operator mounted on said housing and coacting with said actuator for moving said contact element upon movement of said operator.

10. A switch in accordance with claim 2 wherein said fixed contact members each comprises an upper portion and spaced leg portions depending from said upper portion, one of said leg portions having an elongated slot formed therein, and locating means on each of said sepa-

rator members received in said slot in the adjacent of said contact members.

11. A switch in accordance with claim 2 wherein each of said contact members has enlarged tabs on the upper portion thereof, and recess means in said electrical insulating means mounting said contact members thereon with said tabs disposed above said electrical insulating means.

12. A switch in accordance with claim 4 wherein said contact element has diagonally extending grooves therein receiving said conducting strip means in substantially flush relation.

13. A switch in accordance with claim 9 including the combination therewith of a trigger assembly for a power tool, said trigger assembly including a movable trigger for controlling the energization of an electric motor of the power tool upon movement of the trigger, and means mounted on said housing in coacting relation with said operator and being disposed in close proximity to said trigger for actuating said operator to move said contact element to one or the other of its operative positions.

14. A switch in accordance with claim 13 wherein the last-mentioned means comprises a lever pivoted to said housing and having a projection extending therefrom and contacting with said operator to move said operator upon pivotal movement of said lever.

15. A switch in accordance with claim 14 including means on said lever coacting with means on said trigger to prevent movement of said trigger for actuation of the motor unless said lever and thus said contact element are in predetermined positions.

16. A switch in accordance with claim 13 including control means coacting with said trigger and said switch for varying the speed of the motor upon movement of the trigger.

17. A switch in accordance with claim 15 wherein said trigger has partition means interiorly thereof and said lever is disposed above said trigger and comprises dependent abutment means engageable with said partition means to prevent rearward movement of said trigger, and passage means on opposite sides of said partition means for receiving said abutment means therein upon predetermined pivotal movement of said lever to permit rearward movement of said trigger.

18. In combination, a power tool including an electric motor, a trigger for operating the motor of the power tool, and switch means for selectively reversing the drive of the motor, said switch means being mounted on a support for said trigger and comprising a body portion, a series of fixed contacts carried on said body portion, a contact element having a plurality of contact points thereon, said contact element being slidably movable with respect to said body portion, means for moving said contact element into several operative positions wherein the contact points of said contact element engage with several of the fixed contacts in a predetermined pattern to conductively bridge several of the fixed contacts whereby the direction of current flow through the switch may be reversed depending upon the position of the contact element with respect to said fixed contacts, and wherein said switch body portion comprises a plurality of individual contact members forming said fixed contacts and separated from one another by means of spaced insulating separator members.

19. The combination in accordance with claim 18 wherein said switch comprises a housing in which is disposed said body and said contact element, clip means on each of said fixed contacts receiving in holding relation line conductors coupling said switch to said motor, and said housing having openings therein in alignment with said clip means receiving said line conductors there-through.

20. In an electrical reversing switch comprising a

9

switch body, a series of fixed contacts carried on said body, a contact element having a plurality of contact points and slidably movable with respect to said body, means for moving said contact element into several operative positions wherein said contact points of said contact element engage with several of the fixed contacts in predetermined pattern to conductively bridge several of the fixed contacts, whereby the direction of current flow through the switch may be reversed depending upon the position of said contact element with respect to said fixed contacts, and wherein said switch body comprises a plurality of individual contact members forming said fixed contacts and separated from one another by means of insulating separator members.

5

10

10

References Cited

UNITED STATES PATENTS

1,187,586	6/1916	White.	
1,961,276	6/1934	Boisselier.	
3,260,827	7/1966	Frenzel	200—157
3,268,700	8/1966	Bury	200—157
3,376,402	4/1968	Bednarski	200—157

ROBERT K. SCHAEFER, Primary Examiner

D. SMITH, JR., Assistant Examiner

U.S. Cl. X.R.

200—1, 16, 166