United States Patent [19]

Hults

[11] **3,882,294**

[45] **May 6, 1975**

[54] **TOOL HANDLE SWITCH WITH INTERLOCK**

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[73] Assignee: **Cutler-Hammer, Inc.**, Milwaukee, Wis.

[22] Filed: **Mar. 27, 1974**

[21] Appl. No.: **455,383**

[52] **U.S. Cl.** ..... **200/157;** 200/77; 200/153 LA

[51] **Int. Cl.** **H01h 5/10;** H01h 13/08

[58] **Field of Search** ..... 200/77, 157, 153 LA, 676, 200/68

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Primary Examiner—Robert K. Schaefer
Assistant Examiner—William J. Smith
Attorney, Agent, or Firm—H. R. Rather; Wm. A. Autio

[57] **ABSTRACT**

A double-pole, reversing switch adapted to be mounted in the handle of a portable electric tool. The switch includes a trigger type pushbutton on-off switch and a slide button reversing switch electrically connectable for reversing shunt or series motors and mounted in a unitary housing, and having an external interlock preventing operation of the slide button while the trigger is depressed. The on-off switch is provided with double-pole butt contacts that have a controlled amount of wipe, very low bounce, are non-teasable, and have maximum contact pressure at the point of tripping open. The trigger has a considerable amount of movement between trip "on" and trip "off" positions. The slide button reversing switch is provided with spring biased "ball-bearing" movable contacts operating with snap-action to engage converging flat surfaces of pairs of stationary contacts.

8 Claims, 14 Drawing Figures

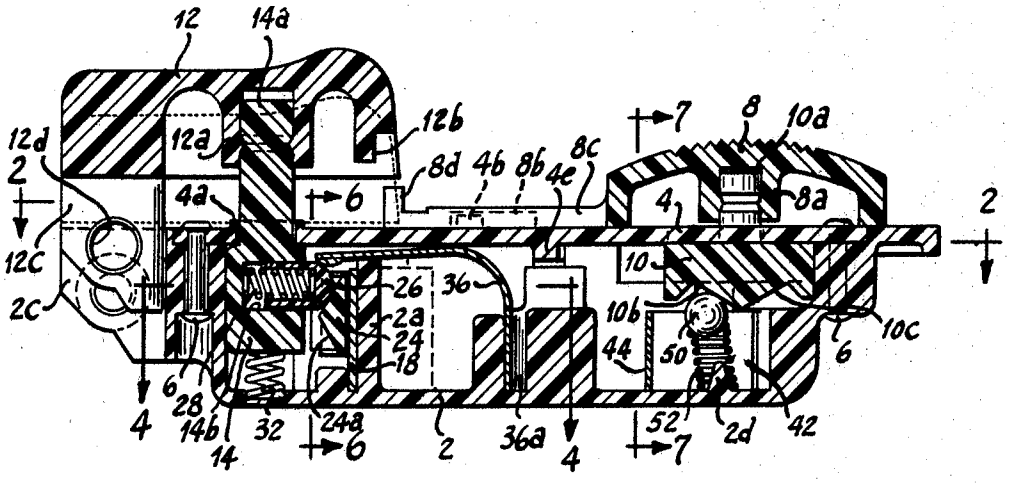


Fig. 1

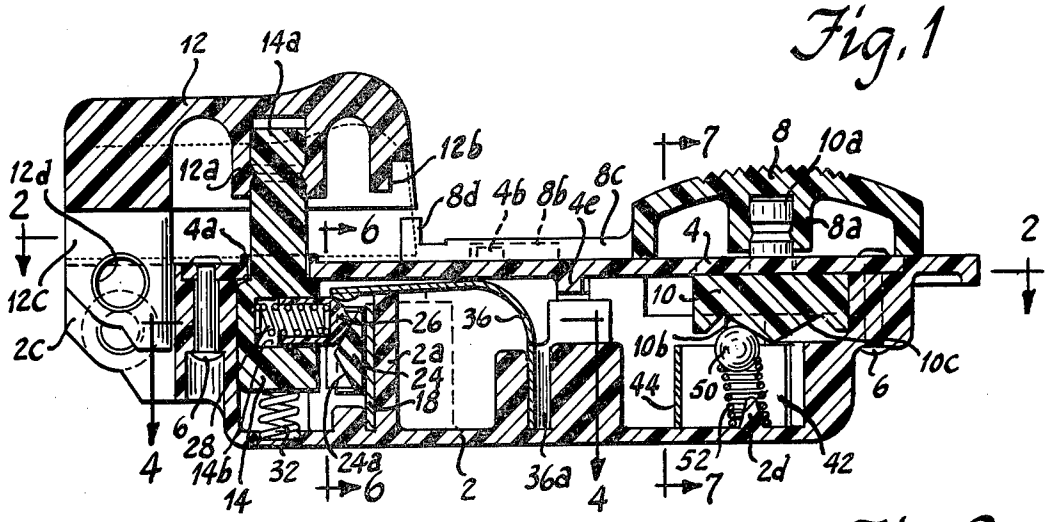


Fig. 2

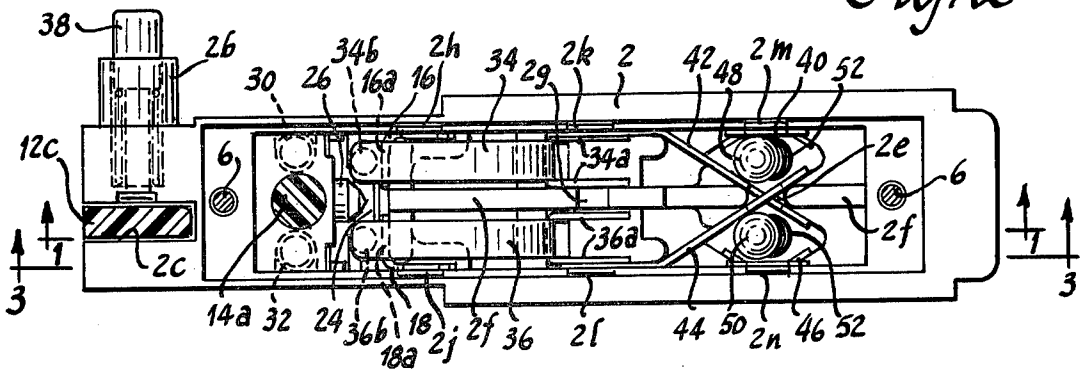


Fig. 3

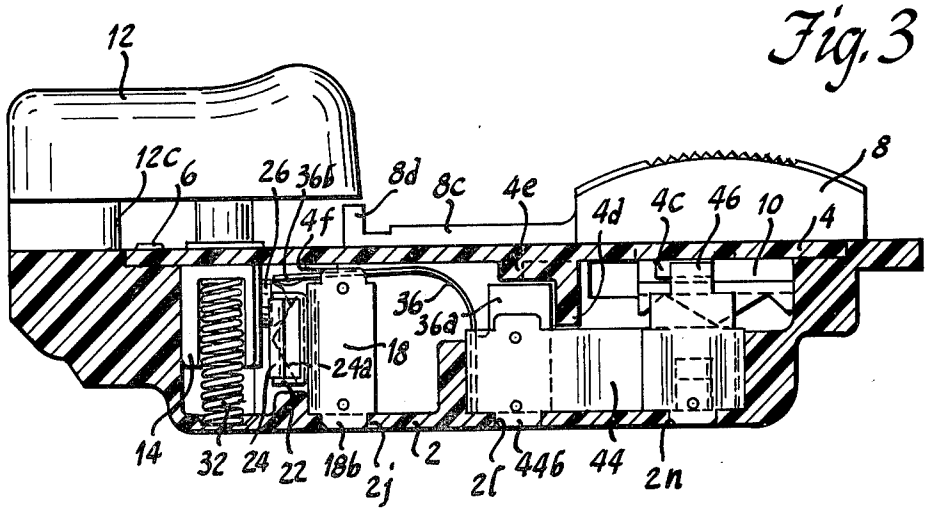


Fig. 4

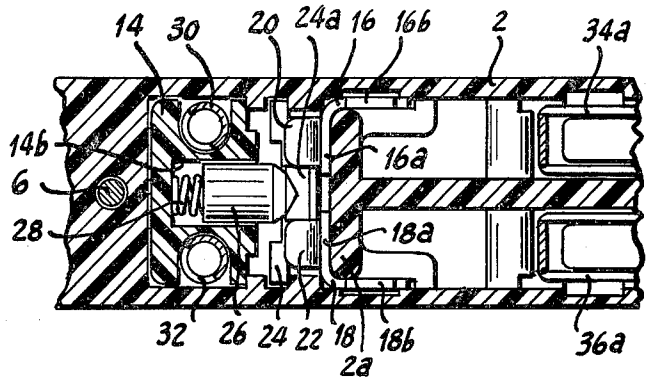


Fig. 5

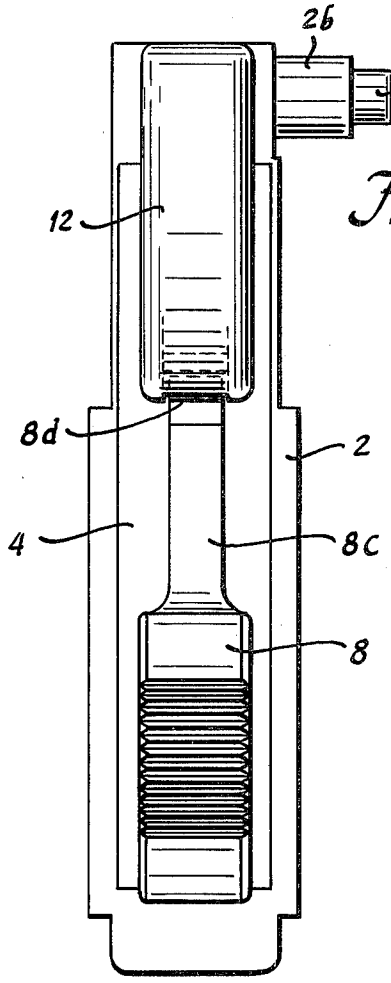


Fig. 6

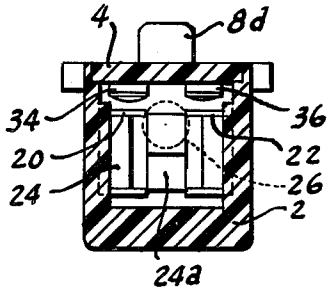


Fig. 7

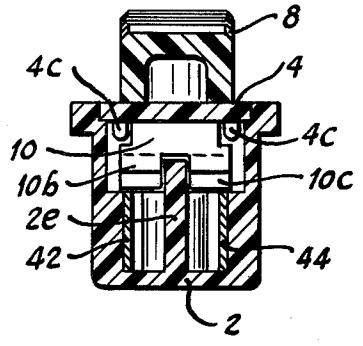


Fig. 8

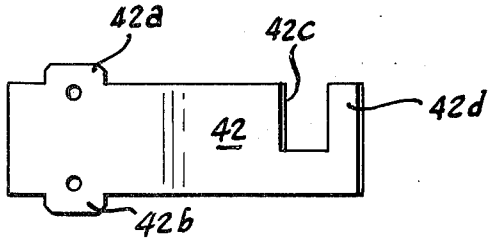


Fig. 9

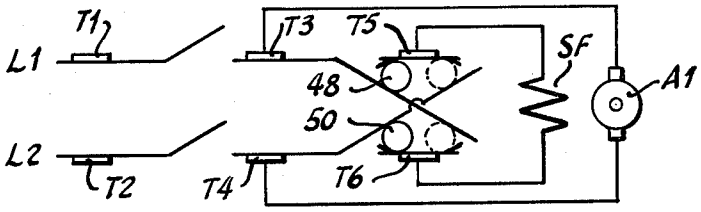


Fig. 10

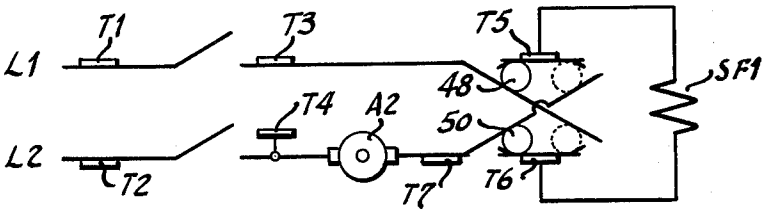


Fig. 11

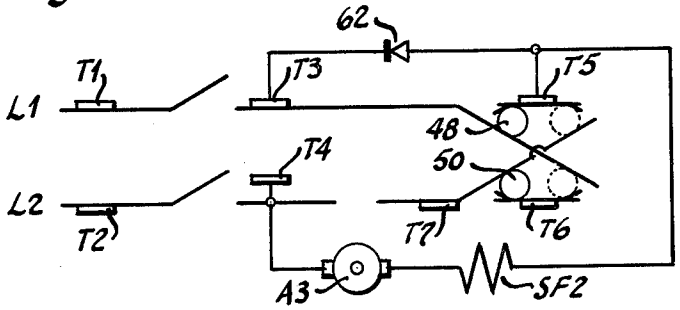


Fig. 12

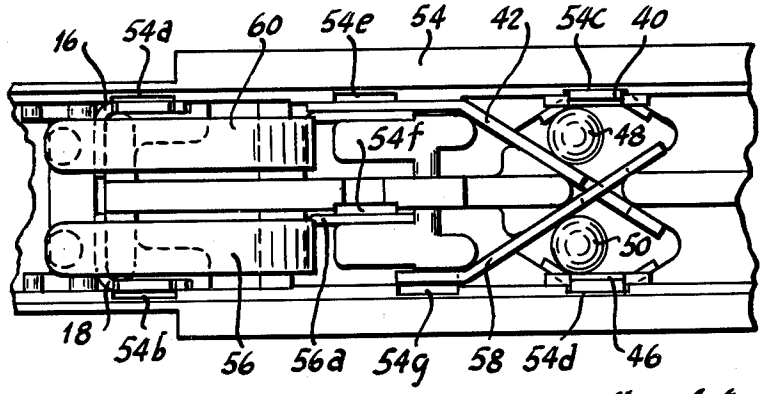


Fig. 13

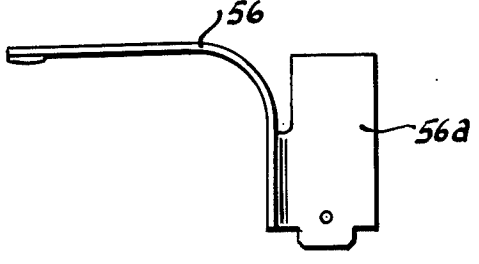
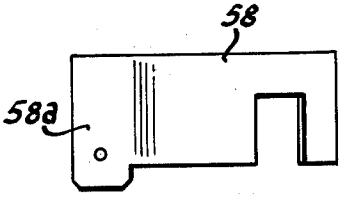


Fig. 14



TOOL HANDLE SWITCH WITH INTERLOCK

BACKGROUND OF THE INVENTION

Reversing tool handle switches with interlock have been known heretofore. However, these prior switches have been subject to one or more disadvantages that have limited their electrical capabilities such as sliding contacts subject to excessive wear that limits the life of the switch, contacts that close on corners or edges at reduced contact area inherently subject to deterioration, contacts that are teasable and contact operating mechanisms that reduce contact pressures prior to opening thereby causing early deterioration, and short trigger movement between contact closed and open positions that are subject to frequent or accidental operation and might create dangerous conditions particularly when used in portable electric circular saws. While these prior switches have been useful for their intended purpose, this invention relates to improvements thereover.

SUMMARY OF THE INVENTION

This invention relates to tool handle switches with interlock between the on-off and reversing actuators and more particularly to switches of the trigger actuated type.

An object of the invention is to provide an improved reversing switch.

A more specific object of the invention is to provide an improved butt contact switch having a controllable amount of wipe.

Another specific object of the invention is to provide an improved switch of the aforementioned type having low contact bounce.

Another specific object of the invention is to provide an improved switch of the aforementioned type maintaining maximum contact pressure until the point of trip open.

Another specific object of the invention is to provide an improved switch of the aforementioned type having substantial trigger movement between trip on and trip off positions to prevent repeated or accidental switch operation.

Another specific object of the invention is to provide an improved non-teasable switch.

Another specific object of the invention is to provide an economical and reliable contact mechanism for a tool handle switch.

Another specific object of the invention is to provide an improved interlock between the pushbutton trigger of the on-off switch and the slide button of the reversing switch of a reversing tool handle switch which interlock is external of the housing to avoid sealing problems.

Other objects and advantages of the invention will hereinafter appear.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is an enlarged, vertical cross-sectional view of the reversing tool handle switch with interlock taken along line **1—1** of FIG. **2**;

FIG. **2** is a horizontal cross-sectional view taken along line **2—2** of the switch of FIG. **1**;

FIG. **3** is a vertical cross-sectional view taken along line **3—3** of the switch of FIG. **2**;

FIG. **4** is a fragmentary, horizontal cross-sectional view taken along line **4—4** of the switch of FIG. **1**;

FIG. **5** is a top view of the switch of FIGS. **1–4**;

FIG. **6** is a vertical cross-sectional view taken along line **6—6** of the switch of FIG. **1**;

FIG. **7** is a vertical cross-sectional view taken along line **7—7** of the switch of FIG. **1**;

FIG. **8** is a front elevational view of one of the contacts of the reversing slide button switch of FIGS. **1** and **3**;

FIG. **9** is a circuit diagram showing the switch of FIGS. **1–8** connecting an electrical power supply to a shunt motor for reversing;

FIG. **10** is a circuit diagram showing the modified switch of FIGS. **12–14** connecting an electrical power supply to a series motor for reversing;

FIG. **11** is a circuit diagram showing the modified switch of FIGS. **12–14** connecting an electrical power supply through a rectifying diode to a series motor for two-speed operation;

FIG. **12** is an enlarged fragmentary horizontal cross-sectional view of a modified reversing tool handle switch;

FIG. **13** is a front elevational view of one of the contacts of the on-off switch of FIG. **12**; and

FIG. **14** is a front elevational view of one of the contacts of the reversing slide button switch of FIGS. **12** and **13**.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings, there is shown a tool handle switch with interlock constructed in accordance with the invention.

As shown in the drawings, this switch is provided with an insulating base **2** gnerally rectangular in shape and open at the top for housing the double-pole contacts of both the trigger on-off switch and the slide button reversing switch, the former being shown at the left end in FIG. **1** and the latter being shown at the right end therein.

The top of this base is closed by an insulating cover **4** that is set into and secured within and generally flush with the top of the base by two or more rivets **6** or the like. This cover has a suitable oblong aperture at its right end beneath slide button **8** to provide clearance for reciprocal movement of the shank **10***a* of overcenter cam actuator **10** that extends up through the cover and is secured by a snap fit into bushing **8***a* of the slide button. This cover also has a round hole at its left end surrounded by a raised collar **4***a* beneath pushbutton trigger lever **12** for guiding shank **14***a* of plunger actuator **14** as shown in FIG. **1** that extends up through the cover and is secured by a snap fit into bushing **12***a* of trigger lever **12.**

This cover is also provided with means for limiting reciprocal movement of and guiding slide button **8.** This means comprises an upstanding lug **4***b* near the middle of the cover that projects into an elongated groove **8***b* on the underside of extension **8***c* of the slide button. Opposite ends of this groove stop against this lug to limit movement of the slide button in opposite directions, and this lug guides extension **8***c* in its sliding movement.

The interlock between the trigger lever **12** and the slide button **8** comprises an upstanding lug **8***d* on the end of extension **8***c* of the slide button and a pair of notches in the underside of the trigger lever separatd by a dividing wall **12***b*. As will be apparent, when the slide

button is in the right-hand position shown in FIG. 1, lug 8*d* will enter the right-hand notch when the trigger lever is depressed and dividing wall 12*b* will prevent actuation of the slide button toward the left. On the other hand, when the slide button is moved to its left-hand position and the trigger lever is then depressed, lug 8*d* will enter the left-hand notch and dividing wall 12*b* will prevent actuation of the slide button toward the right. This interlock prevents application of reverse power to the motor while it remains connected to the power supply, that is, it prevents "plugging" the tool motor. The motor must be disconnected from the power supply by restoring the trigger lever before the reversing switch can be operated. This gives the motor time to stop or slow down almost to a stop before reverse energy can be applied thereto.

The on-off switch is provided with snap-action doublepole butt contacts having a predetermined or controlled amount of wipe. For this purpose, there are provided a pair of angular terminals **16** and **18** arranged vertically in retaining grooves in the base as shown in FIGS. **2** and **4.** Each such terminal is bent at a right angle along its longitudinal center to provide a contacting portion, **16***a* and **18***a*, and a terminal portion, **16***b* and **18***b*, as shown in FIG. **4.** As shown in FIG. **3,** the opposite ends of terminal portion **18***b* are provided with connector lugs. While only the lower connector lug is used to connect to an external circuit, the connector portion is made symmetrical so that one design can be used for both connectors. The other connector is turned around and inserted in the base so that contacting portions **16***a* and **18***a* are in a common plane as shown in FIG. **4** for sliding engagement by the movable contacts hereinafter described. As shown in FIG. **3,** the lower lug of terminal portion **18***b* is exposed in an opening in the bottom corner of the base to provide a terminal T2 shown in FIG. **9** for engagement by a wire connector. Similarly the lower lug of terminal portion **16***b* of the other connector is exposed on the opposite bottom corner of the base as terminal T1 shown in FIG. **9.**

A pair of U-shaped movable contacts **20** and **22** shown in FIGS. **3, 4** and **6** are carried by opposite ends of a generally rectangular movable contact block **24.** These U-shaped movable contacts embrace the ends of the movable contact block and are slid thereby along contacting portions **16***a* and **18***a*, respectively, of the terminals and remain in constant contact with the latter.

The center portion of the movable contact block is provided with an over-center cam **24***a* shown in FIG. **1** and in dotted line profile in FIG. **3** whereby the movable contacts are given a snap-action movement. For this purpose, a plunger **26** is biased laterally against this over-center cam by a helical compression spring **28** retained in a lateral well **14***b* of plunger actuator **14** as shown in FIGS. **1** and **4.** This plunger actuator **14** is slidably guided in the base and is biased upwardly by a pair of helical compression springs **30** and **32** that bear at their lower ends against the bottom of the base. As shown in FIG. **3,** plunger actuator **14** is provided with recesses for the upper ends of these springs and the bottom of the base is provided with shallow recesses for the lower ends of these springs to hold them in place.

As shown in FIGS. **1–4,** the movable contacts serve to connect terminals **16** and **18** to respective stationary contacts **34** and **36.** Each such stationary contact is provided with a generally U-shaped connector portion **34***a*, **36***a* as shown in FIG. **2** and an arm **34***b*, **36***b* extending therefrom up and toward the left to a point overlying the respective movable contact as shown in FIG. **3.** The contacting end of each such arm **34***b*, **36***b* is biased down from a horizontal plane toward the movable contact and it is this bias that determines the amount of wipe when the contacts close and open. This wipe is set at an amount sufficient to keep the contacts clean for good conductivity but not so much as to cause excessive wear. As will be apparent in FIG. **1,** arms **34***b* and **36***b* are biased down tight against the top of wall **2***a* in the base to fix the distance therefrom to the two movable contacts when open.

When the trigger lever is depressed, the tip of plunger **26** slides down along the upper incline of cam **24***a* of the movable contact block until it passes the center high point on this cam. During this time plunger actuator springs **30** and **32** are compressed and plunger spring **28** is also compressed. Upon passing the high point of the cam, plunger **26** causes the movable contact block to snap up while the plunger rides along the lower incline of the cam. The movable contact block carries the movable contacts with it so that the upper arms thereof engage stationary contacts **34** and **36,** respectively. The upward force on the movable contact block causes arms **34***b* and **36***b* to move up and straighten out against the lower surface of cover **4** effecting wiping action between the movable and stationary contacts.

This trigger on-off switch may be locked in its on position. For this purpose, there is provided a horizontal bushing **2***b* molded integrally on the base as shown in FIGS. **2** and **5.** This bushing retains a spring-biased lock pin **38.** The adjacent end of the base is provided with a vertical slot **2***c* into which the inner end of the lock pin may be laterally depressed. Trigger lever **12** is provided with a downwardly extending tab **12***c* formed integrally therewith that fits into slot **2***c*. This tab has a hole **12***d* in it for receiving the lock pin after the trigger lever has been depressed thereby to hold the switch on after the trigger is released. A slight depression of the trigger lever allows the bias spring to snap the lock pin out of the way so that the trigger can return to its extended position.

Upon return of the trigger under spring force, the tip of plunger **26** slides up the lower incline of cam surface **24***a* while maintaining maximum contact pressure between the movable and stationary contacts. When it reaches the high point of the cam at maximum contact pressure, and passes thereover, the force of bias spring **28** causes the movable contacts to snap open while plunger **26** slides along the upper incline of cam surface **24***a*. Thus, teasing of the contacts is prevented because maximum contact pressure is maintained until the contacts are suddenly separated.

A small amount of contact wiping takes place on initial opening movement of the contacts. At this point, stationary contact arms **34***b* and **36***b* move down with and wipe the movable contacts a small amount until these arms abut dividing wall **2***a* of the base. This serves to keep the contacting surfaces clean of any dust, dirt or oxides for a good electrical connection whenever the contacts close.

The slide button reversing switch is provided with two pairs of stationary contacts with the inner contacts of the pairs being crossed at notch **2***e* in dividing wall **2***f* of the base so as to provide reversing double-pole

connections from stationary contacts **34** and **36** of the on-off switch to external terminals T5 and T6 shown in FIG. **9.** For this purpose, there are provided a first pair of contacts including an outer contact **40** and an inner contact **42,** and a second pair of contacts including an inner contact **44** and an outer contact **46** as shown in FIG. **2.** Outer contacts **40** and **46** are alike and each has a pair of slightly inwardly turned wings, inwardly referring to the interior of the switch housing as opposed to outwardly or the exterior of the housing. Inner contacts **42** and **44** are alike and each is constructed as shown by stationary contact **42** in FIG. **8.** As shown therein, the contact is provided with a terminal portion at its left end having symmetrically arranged upper and lower terminal lugs **42***a* and **42***b* and an angular contact portion at its right end having a notch **42***c* cut out to leave an upstanding leg **42***d* at the extreme right end thereof. As shown in FIG. **2,** this angular portion extends inwardly at an obtuse angle with the terminal portion. This stationary contact is provided with two terminal lugs so that one such contact can be used for contact **42** and another such contact, turned over, can be used for contact **44** in FIG. **2.** When so arranged, a connector lug of each such stationary contact will be exposed at the bottom corner of the base, as shown in FIG. **3,** and terminals T3 and T4 in FIG. **9,** to which a suitable wire connector may be attached if desired. Also, when so arranged, the portion below notch **42***c* in contact **42** will pass through the notch in contact **44** with clearance so that these inner contacts can be crossed but do not touch. In this manner, a first spherical ball bearing movable contact **48** when moved to the left will bridge the converging parts of contacts **40** and **42** while at the same time a second spherical ball bearing movable contact **50** when simultaneously moved to the left will bridge the converging parts of contcts **44** and **46.** These converging parts are the inner flat surface of the left wing of outer contact **40** and the corresponding flat surface of inner contact **42,** and the inner flat surface of the left wing of outer contact **46** and the corresponding flat surface of inner contact **44.**

When the two ball bearing movable contacts are snapped to the right, one of them will wedge between the inner flat surface of the right wing of outer contact **40** and the corresponding flat surface of inner contact **44,** and the other one will wedge between the inner flat surface of the right wing of outer contact **46** and the corresponding flat surface of inner contact **42.**

Movable contacts **48** and **50** are biased upwardly by a pair of helical compression springs **52** against like, spaced, respective over-center cams **10***b* and **10***c* of actuator **10.** Conical projections **2***d* are molded in the bottom of the base and extend into the lower ends of springs **52** to hold them in place.

As shown in FIG. **7,** actuator **10** is provided with a pair of cams **10***b* and **10***c* having a groove therebetween into which dividing wall **2***e* of the base extends. These cams are alike and each is provided with a high point at its center as shown in FIG. **1.** Thus, as the slide button is moved, this high point passes over the spherical movable contact, in the meantime compressing springs **52,** and the movable contact then snaps along the opposite incline of the cam to reverse the connection. With the spherical movable contacts wedging between the vertical flat surfaces of the stationary contacts, a good contact of substantial contacting area is made, and the wedging action tends to keep the contact surfaces clean.

The terminal portions of inner contacts **42** and **44** are retained in electrical connection with U-shaped portions **34***a* and **36***a* of stationary contacts **34** and **36,** respectively, of the on-off trigger switch. This is done by pressing these terminal portions into the narrow slots between contacts **34** and **36** and the opposite walls of the base.

The parts are retained in place by suitable integrally molded portions on the lower surface of the cover. Thus, lugs **4***c* shown in FIG. **7** keep outer stationary contacts **40** and **46** of the slide button switch up against the inner walls of the base and prevent them from falling into the interior cavity. Two downward projections **4***d*, one of which is shown in FIG. **3,** press down on stationary contacts **42** and **44** to retain them in place. U-shaped ridge **4***e* between projections **4***d* overlies U-shaped terminal portions **34***a* and **36***a* of stationary contacts **34** and **36** of the on-off trigger switch to keep them in place in the base. Dividing wall **2***f* within the base has a suitable notch **2***g* for this ridge to pass across as shown in FIG. **2.** A pair of very short lugs **4***f* on the lower surface of the cover press down on terminals **16** and **18** to hold them in place, one of these lugs being shown in FIG. **3.**

The switch provides three pairs of terminals for connections to external circuits as shown in FIG. **9.** A first pair of connections can be made to the exposed lower lugs of terminals **16** and **18,** these lugs being marked as terminals T1 and T2 in FIG. **9.** For example, these terminals T1 and T2 can be connected to A.C. power supply lines L1 and L2.

A second pair of connections can be made to the exposed lower lugs of stationary contacts **42** and **44,** these lugs being marked as terminals T3 and T4 in FIG. **9.** For example, the armature winding A1 of the shunt motor can be connected across terminals T3 and T4 as shown in FIG. **9.**

A third pair of connections can be made to the exposed lower lugs of stationary contacts **40** and **46,** these lugs being marked as terminals T5 and T6 in FIG. **9.** For example, the shunt field winding SF of the shunt motor can be connected across terminals T5 and T6.

With the above connections as shown in FIG. **9,** the armature winding can be energized by the on-off switch and the shunt field winding can be reversely energized through the on-off and reversing switches to run the motor selectively in either the forward or reverse direction.

The openings in the bottom of the base through which the lugs are exposed for making wire connections are shown in FIG. **2** at **2***h* and **2***j*, **2***k* and **21,** and **2***m* and **2***n*.

A modification of the switch, enabling use thereof for reversing a series motor or for controlling a two-speed motor is shown in FIGS. **10–14.** As will readily be apparent in FIG. **10,** this modification involves disconnecting contact **44** in FIG. **3** from contact **36** and providing contact **36** with its own terminal.

The structure for accomplishing this is shown in FIGS. **12–14,** wherein reference characters like those in FIG. **2** are used for like parts. As shown in FIG. **12,** there is provided a modified base **54** having a first pair of holes **54***a* and **54***b* at its bottom corners for making connections to the lugs of terminals **16** and **18,** the

same as in FIG. 2. These correspond to terminals T1 and T2 in FIGS. 10 and 11.

This base is also provided with another pair of holes 54*c* and 54*d* at its bottom corners for making connections to the lugs of outer contacts 40 and 46, respectively, the same as in FIG. 2. These correspond to terminals T5 andd T6 in FIGS. 10 and 11.

This base is also provided with another hole 54*e* at its bottom corner for making a connection to the lower lug of inner contact 42, the same as in FIG. 2. This corresponds to terminal T3 in FIGS. 10 and 11.

This base is provided with a pair of relocated holes 54*f* and 54*g* for making connections to lugs on modified stationary contacts 56 and 58, respectively. These correspond to terminals T4 and T7 in FIGS. 10 and 11.

In order to disconnect one of the stationary contacts of the on-off switch from the correspondidng contact of the reversing switch as aforesaid, one arm has been omitted from the U-shaped portion to provide a stationary contact 56 for the on-off switch as shown in FIG. 13. In addition, a connector lug has been provided at the lower edge of terminal portion 56*a* of this stationary contact. As a result, when this stationary contact is pressed into its slot in the base, this lug is exposed within hole 54*f* for making a connection to an external circuit.

For this purpose also, inner contact 58 is shortened at its terminal portion 58*a* and is provided with a lug at its lower edge to be exposed within hole 54*g* in FIG. 12.

For uniformity of production, stationary contact 60 is made the same shape as stationary contact 56.

Otherwise, this modification of the switch is similar to that shown in FIGS. 1–9.

As shown in FIG. 10, this modified switch can be connected to an A.C. power supply source at conductors L1 and L2 and to a series motor in a reversing relation. For this purpose, armature winding A2 is connected across terminals T4 and T7 and series field winding SF1 is connected across terminals T5 and T6. Thus, when the slide button reversing switch is operated to shift the position of movable contacts 48 and 50, the energization of the series field winding is reversed to reverse the direction of rotation of the motor.

As shown in FIG. 11, this modified switch can be used for controlling a two-speed motor. In this circuit, armature winding A3 is connected in series with field winding SF2 of the series motor across terminals T4 and T5, and a rectifying diode 62 is connected from terminal T5 to terminal T3. Thus, when the slide button switch is in its dotted line position as shown in FIG. 11, the current will flow through diode 62 for half-wave energization of the motor for slow speed operation. When the slide button switch is operated to its full line position, the diode is shunted for full-speed operation of the motor.

An alternative way of connecting the motor and diode in FIG. 11 would be to connect armature A3 and series field SF2 in series from terminal T4 to terminal T6, and to connect diode 62 from terminal T5 to terminal T6. Then, when the slide button switch is in its full line position, current will flow through the motor and the diode for slow speed operation. When the slide button switch is in its dotted line position, current will flow through the motor for full speed operation, and the diode will be disconnected. With this connection, terminal T3 is not required as it is not required in FIG. 10.

While the apparatus hereinbefore described is effectively adapted to fulfill the objects stated, it is to be understood that this invention is not intended to be limited to the particular preferred embodiment of higher rated tool handle switch with interlock disclosed, inasmuch as it is susceptible of various modifications without departing from the scope of the appended claims.

I claim:

1. A double-pole tool handle switch comprising:
an insulating housing;
a return spring biased switch actuator mounted to said housing for reciprocal movement;
a plunger extending from said switch actuator within said housing;
a spring biasing said plunger and said plunger being resiliently depressible against the force of said bias spring;
a pair of connector members mounted in said housing and having exposed terminal lugs adapted to be connected to an external circuit;
a movable contact actuator block having a double-incline camming surface comprising opposite inclines meeting at a high point arranged for engagement by said plunger;
double-pole on-off butt contacts having a controlled amount of wipe comprising a pair of movable contacts carried by said actuator block and being pressed against the respective connector members and sliding therealong and remaining in contact therewith throughout the movement of said actuator block, and a pair of stationary contacts mounted in said housing and having flexible cantilever portions extending into overlapping relation to the respective movable contacts and biased to a small inclination toward said movable contacts from a plane substantially perpendicular to the path of movement thereof;
and actuation of said switch actuator causing said plunger to slide up one incline of said camming surface and, after passing over said high point, to cause snap-action movement of said actuator block while said plunger acts on the other incline and said movable contacts remain in sliding contact with said connector members thereby to cause said movable contacts to contact said stationary contacts and to move a small distance further, flexing said stationary contacts against the bias therein to cause a controlled amount of wipe therebetween.

2. The apparatus defined in claim 1, together with:
a reversing switch mounted in said housing;
a slide button mounted on said housing for actuating said reversing switch;
an extension on said slide button having a lug at the exterior of said housing;
and a depressible trigger connected to said switch actuator of said on-off switch and having a pair of notches separated by a dividing wall for interlocking said slide button lug to said trigger to prevent movement of said slide button when said trigger is depressed.

3. The apparatus defined in claim 1, wherein:
said switch actuator is mounted for linear sliding movement;
and said plunger is recessed in said switch actuator to extend perpendicular to the line of said linear sliding movement.

4. The apparatus defined in claim 1, whereini:
said movable contacts are U-shaped and embrace the opposite end portions of said actuator block on opposite sides of said double-incline camming surface.

5. The apparatus defined in claim 1, wherein:
said switch actuator is a trigger adapted for operation by the forefinger of the user.

6. The apparatus defined in claim 1, wherein:
the angle between said inclines of said movable contact actuator block is a large obtuse angle affording substantial switch actuator travel between trip on and trip off positions thereby to avoid accidental turn-on of said switch.

7. The apparatus defined in claim 1, wherein:
said housing is provided with a wall limiting said small inclination to which said flexible cantilever portions of said stationary contacts are biased.

8. The apparatus defined in claim 1, wherein:
said housing comprises slots for said connector members and said stationary contacts and a cover having projections for retaining the same in place in said slots.

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